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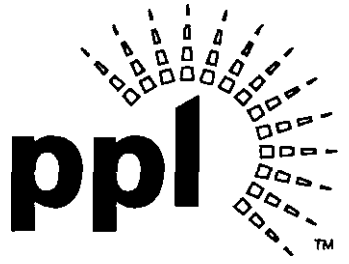

PPL Electric Utilities

PPL Electric Utilities Corporation

Quarterly Reliability Report

to the

Pennsylvania Public Utility Commission

November 2019

1) ***A description of each major event that occurred during the preceding quarter, including the time and duration of the event, the number of customers affected, the cause of the event and any modified procedures adopted in order to avoid or minimize the impact of similar events in the future.***

No major events occurred during the third quarter of 2019.

2) ***Rolling 12-month reliability index values (SAIFI, CAIDI, SAIDI, and if available, MAIFI) for the EDC's service territory for the preceding quarter. The report shall include the data used in calculating the indices, namely the average number of customers served, the number of sustained customer interruptions, the number of customers affected, and the customer minutes of interruption. If MAIFI values are provided, the report shall also include the number of customer momentary interruptions.***

The following table provides data for the 12 months ending September 30, 2019.

SAIFI (Benchmark = 0.98; Rolling 12-month Std. = 1.18)	0.79
CAIDI (Benchmark = 145; Rolling 12-month Std. = 174)	155
SAIDI (Benchmark = 142; Rolling 12-month Std. = 205)	123
MAIFI	5.1
Average Number of Customers Served[1]	1,426,424
Number of Sustained Customer Interruptions (Trouble Cases)	19,514
Number of Customers Affected[2]	1,228,975
Customer Minutes of Interruptions (CMI)	174,785,959
Number of Customer Momentary Interruptions	7,322,293

During the third quarter, there were no (0) PUC major events, one (1) PUC reportable event, and nine (9) other storms that required the opening of one or more area emergency centers to manage restoration efforts.

[1] PPL Electric calculates the annual indices using customers served at the end of period. This is consistent with the method used to calculate PPL Electric's benchmarks.

[2] The data reflects the number of customers interrupted for each interruption event summed for all events, also known as customer interruptions. If a customer is affected by three separate cases of trouble, that customer represents three customer interruptions, but only one customer interrupted.

Rolling 12-month reliability index values (SAIFI, CAIDI, SAIDI, CMI, and if available, MAIFI) and other pertinent information such as customers served, number of interruptions, customer minutes interrupted, number of lockouts, and so forth, for the worst performing 5% of the circuits in the system. An explanation of how the EDC defines its worst performing circuits shall be included.

The following table provides reliability index values for the worst performing 5% of the circuits in the system for the 12 months ended at the current quarter. An explanation of how PPL Electric defines its worst performing circuits is included in Appendix A.

WPC Rank	Feeder ID	SAIDI	CAIDI	SAIFI	MAIFI	Customers	Cases of Trouble	Customer Minutes Interrupted (CMI)
1	55001	2473	191	12.9	74.7	1,288	219	3,184,703
2	43401	2732	797	3.4	11.0	975	37	2,664,075
3	46301	2361	760	3.1	6.2	1,051	49	2,481,020
4	45501	1615	1266	1.3	13.5	1,418	33	2,289,443
5	40201	1298	330	3.9	16.0	1,660	99	2,154,776
6	43402	2012	889	2.3	3.4	1,040	55	2,092,148
7	44301	1021	304	3.4	5.8	2,034	102	2,076,670
8	28602	934	363	2.6	1.6	1,937	48	1,809,385
9	43202	1334	362	3.7	11.5	1,150	66	1,533,547
10	43201	1387	508	2.7	9.3	957	47	1,327,057
11	42701	819	352	2.3	3.5	1,465	81	1,199,912
12	45302	980	317	3.1	6.2	1,208	50	1,183,805
13	46302	1056	385	2.7	4.8	1,083	75	1,143,518
14	46001	488	221	2.2	4.4	2,334	62	1,138,111
15	20103	654	194	3.4	5.8	1,736	11	1,135,067
16	47704	809	195	4.1	8.6	1,379	62	1,116,061
17	18502	595	280	2.1	9.1	1,833	84	1,091,201
18	46206	595	470	1.3	1.9	1,823	50	1,084,700
19	45002	544	258	2.1	13.2	1,945	67	1,058,977
20	59002	455	157	2.9	6.4	2,236	75	1,018,014
21	40602	413	137	3.0	5.3	2,296	59	947,467
22	59202	554	209	2.7	20.7	1,704	69	943,859
23	11804	789	633	1.2	4.7	1,131	28	892,366
24	56802	582	114	5.1	10.6	1,532	75	891,898

WPC Rank	Feeder ID	SAIDI	CAIDI	SAIFI	MAIFI	Customers	Cases of Trouble	Customer Minutes Interrupted (CMI)
25	40101	416	83	5.0	8.9	2,124	52	883,223
26	41602	1050	257	4.1	11.3	839	69	880,546
27	26601	656	161	4.1	10.6	1,326	37	870,130
28	56803	682	417	1.6	3.8	1,256	52	856,563
29	54701	772	164	4.7	26.7	1,099	51	848,755
30	26703	447	244	1.8	4.2	1,893	54	847,081
31	21705	304	447	0.7	4.5	2,764	30	839,811
32	41802	1560	269	5.8	12.8	524	40	817,421
33	46004	395	283	1.4	4.4	2,054	48	810,891
34	21502	214	297	0.7	17.9	3,680	15	788,236
35	52402	475	153	3.1	7.7	1,659	75	787,517
36	18501	541	126	4.3	11.3	1,440	38	779,018
37	53901	570	326	1.7	44.6	1,339	61	763,337
38	48302	450	256	1.8	6.8	1,654	42	744,009
39	59101	428	94	4.6	24.4	1,698	63	726,532
40	45001	408	153	2.7	11.7	1,772	63	722,403
41	45402	435	486	0.9	12.2	1,632	79	709,562
42	56501	295	169	1.7	18.0	2,394	49	705,910
43	45502	1149	474	2.4	17.6	614	28	705,759
44	45602	417	254	1.6	10.2	1,624	37	677,433
45	22404	599	143	4.2	1.0	1,096	17	656,984
46	40601	769	247	3.1	6.8	852	33	655,363
47	12402	1189	421	2.8	10.9	542	30	644,407
48	67801	297	122	2.4	6.9	2,149	38	637,646
49	42802	539	468	1.2	10.2	1,176	22	634,094
50	26001	440	202	2.2	10.2	1,433	65	630,477
51	52401	486	268	1.8	7.4	1,281	84	622,141
52	61101	479	171	2.8	3.2	1,298	25	622,109
53	25801	342	130	2.6	2.6	1,816	45	621,879
54	21206	247	188	1.3	6.1	2,476	19	610,673
55	66401	541	286	1.9	18.0	1,086	21	587,506
56	59401	331	204	1.6	8.0	1,773	72	586,831
57	67502	290	142	2.0	23.7	2,025	35	586,348
58	44502	670	231	2.9	10.4	870	61	582,975
59	28301	254	173	1.5	8.9	2,284	100	581,199
60	44802	391	374	1.0	4.4	1,479	34	578,483
61	58402	373	153	2.4	9.1	1,535	41	572,311
62	14103	262	216	1.2	5.7	2,170	55	569,602
63	56504	285	151	1.9	14.5	1,976	62	563,700

3) ***Specific remedial efforts taken and planned for the worst performing 5% of the circuits identified in paragraph (3).***

01 Circuit 55001 -- NEWPORT 50-01

Performance Analysis

The NEWPORT 50-01 circuit experienced nine outages of over 100,000 CMI between October 2018 and September 2019.

On November 16, 2018, during a period of ice/sleet/snow, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 324 customers for up to 1,474 minutes resulting in 228,901 CMI.

On February 25, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 211 customers for up to 968 minutes resulting in 142,146 CMI.

On March 3, 2019, during a period of ice/sleet/snow, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 325 customers for up to 427 minutes resulting in 122,821 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing an interruption. This outage affected 258 customers for up to 633 minutes resulting in 137,520 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a temporary open point to be interrupted. This outage affected 449 customers for up to 227 minutes resulting in 101,104 CMI.

On May 29, 2019, during a period of strong wind, a tree contacted an overhead splice causing a temporary open point to be interrupted. This outage affected 126 customers for up to 1,214 minutes resulting in 149,985 CMI.

On May 30, 2019, during a period of heavy rain, a tree contacted an overhead conductor causing a temporary open point to be interrupted. This outage affected 403 customers for up to 839 minutes resulting in 337,573 CMI.

On June 26, 2019, during a period of strong wind, a tree contacted an overhead conductor causing an interruption. This outage affected 1,224 customers for up to 536 minutes resulting in 390,324 CMI.

On July 31, 2019, during a period of strong wind, an equipment failure occurred on an overhead splice causing a temporary open point to be interrupted. This outage affected 446 customers for up to 317 minutes resulting in 122,937 CMI.

In total, the NEWPORT 50-01 circuit had 219 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (126); equipment failure (63); animal contacts (11); nothing found (7); other (7); vehicles (5).

Remedial Actions

- In 2019, a Smart Grid device was installed.
- In 2019, a battery demonstration energy storage system was installed to study reliability benefits and voltage control.
- In 2019, three single-phase reclosers were installed, along with related fusing.
- In 2019, a substation conversion will be completed.
- In 2019, protection coordination will be evaluated.
- In 2019, single-phase sectionalizing will be installed.
- In 2020, single-phase sectionalizing devices will be installed at four locations
- In 2020, full circuit tree trimming will be performed.

02 Circuit 43401 -- BENTON 34-01

Performance Analysis

The BENTON 34-01 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 972 customers for up to 5,114 minutes resulting in 2,407,429 CMI.

In total, the BENTON 34-01 circuit had 37 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (25); equipment failure (7); animal contacts (3); nothing found (2).

Remedial Actions

- In 2019, an additional single-phase recloser was installed.
- In 2019, an additional Smart Grid device was installed.
- In 2019, a Proactive Circuit Analysis will be performed.
- In 2020, additional single-phase fusing will be installed.
- In 2020, full circuit trimming will be performed.

03 Circuit 46301 -- ROHRSBURG 63-01

Performance Analysis

The ROHRSBURG 63-01 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On April 14, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 1,052 customers for up to 4,937 minutes resulting in 2,242,417 CMI.

In total, the ROHRSBURG 63-01 circuit had 49 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (27); equipment failure (13); animal contacts (3); nothing found (3); vehicles (2); other (1).

Remedial Actions

- In 2019, multiple porcelain cutouts will be replaced.
- In 2019, full circuit trimming will be performed.
- In 2019, multiple poles will be replaced.
- In 2020, two additional single-phase reclosers will be installed.

04 Circuit 45501 -- DERRY 55-01

Performance Analysis

The DERRY 55-01 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 1,415 customers for up to 3,799 minutes resulting in 2,174,287 CMI.

In total, the DERRY 55-01 circuit had 33 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (22); equipment failure (5); animal contacts (4); nothing found (2).

Remedial Actions

- In 2019, multiple porcelain cutouts will be replaced.
- In 2020, a section of difficult to access conductor will be relocated and reconfigured.
- In 2021, additional single-phase fusing will be installed.
- In 2021, a section of difficult-to-access conductor will be relocated.
- In 2021, a single-phase recloser will be installed.

05 Circuit 40201 -- BEAR GAP 02-01

Performance Analysis

The BEAR GAP 02-01 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On February 24, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a load break fuse to operate. This outage affected 109 customers for up to 2,499 minutes resulting in 204,668 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a sectionalizing device to be interrupted. This outage affected 1,337 customers for up to 3,997 minutes resulting in 1,263,476 CMI.

In total, the BEAR GAP 02-01 circuit had 99 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (67); equipment failure (18); animal contacts (9); nothing found (5).

Remedial Actions

- In 2019, additional fusing will be installed at eight locations.
- In 2019, additional single-phase reclosers will be evaluated.
- In 2019, several sections of difficult-to-access conductor will be evaluated for relocation.
- In 2019, a section of conductor will be evaluated for undergrounding.
- In 2019, a section of conductor will be evaluated for re-sourcing.
- In 2020, full circuit trimming will be performed.
- In 2020, a section of existing conductor will be relocated and reconductored.

06 Circuit 43402 -- BENTON 34-02

Performance Analysis

The BENTON 34-02 circuit experienced four outages of over 100,000 CMI between October 2018 and September 2019.

On October 2, 2018, during a period of strong wind, an equipment failure occurred on a pole or pole arm causing a recloser to trip to lockout. This outage affected 180 customers for up to 617 minutes resulting in 107,477 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 1,041 customers for up to 30 minutes resulting in 1,096,131 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 146 customers for up to 1,080 minutes resulting in 157,680 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 83 customers for up to 3,496 minutes resulting in 163,157 CMI.

In total, the BENTON 34-02 circuit had 55 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (41); equipment failure (8); animal contacts (2); nothing found (2); other (2).

Remedial Actions

- In 2019, a section of difficult-to-access single-phase conductor was relocated.
- In 2019, multiple porcelain cutouts will be replaced.
- In 2020, full circuit trimming will be performed.

07 Circuit 44301 -- BEAVERTOWN 43-01

Performance Analysis

The BEAVERTOWN 43-01 circuit experienced four outages of over 100,000 CMI between October 2018 and September 2019.

On February 24, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 2,034 customers for up to 407 minutes resulting in 827,838 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 474 customers for up to 2,416 minutes resulting in 468,909 CMI.

On May 3, 2019, a tree contacted an overhead transmission component causing a circuit breaker to trip to lockout. This outage affected 2,021 customers for up to 67 minutes resulting in 135,407 CMI.

On May 23, 2019, during a period of heavy rain, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 470 customers for up to 321 minutes resulting in 143,535 CMI.

In total, the BEAVERTOWN 43-01 circuit had 102 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (60); equipment failure (24); nothing found (8); animal contacts (6); other (2); vehicles (2).

Remedial Actions

- In 2019, a section of difficult-to-access single-phase was relocated.
- In 2019, additional fusing was installed on this circuit.
- In 2019, 40 or more poles will be replaced.
- In 2021, a section of three-phase conductor will be relocated.
- In 2021, two additional Smart Grid devices will be installed.
- In 2021, full circuit trimming will be performed.
- In 2021, a new tie line will be constructed.

08 Circuit 28602 -- BLYTHEBURN 86-02

Performance Analysis

The BLYTHEBURN 86-02 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 769 customers for up to 2,201 minutes resulting in 860,351 CMI.

On September 11, 2019, during a period of strong wind, a tree contacted a pole or pole arm causing a recloser to trip to lockout. This outage affected 349 customers for up to 584 minutes resulting in 162,681 CMI.

In total, the BLYTHEBURN 86-02 circuit had 48 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (32); equipment failure (5); other (5); animal contacts (3); nothing found (2); vehicles (1).

Remedial Actions

- In 2019, an additional single-phase recloser was installed.
- In 2019, a section of difficult-to-access single-phase was relocated.
- In 2019, two additional switches will be installed.
- In 2019, a substation conversion will be evaluated.
- In 2019, a single-phase tie line will be evaluated.
- In 2019, an Expanded Operational Review will be performed.
- In 2019, an additional Smart Grid device will be evaluated.
- In 2019, Hendrix tree cable will be evaluated for a heavily wooded section of this circuit.
- In 2019, reconductoring will be evaluated for a three-phase section of this circuit.

09 Circuit 43202 -- MILLVILLE 32-02

Performance Analysis

The MILLVILLE 32-02 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted a pole or pole arm causing a circuit breaker to trip to lockout. This outage affected 1,149 customers for up to 4,425 minutes resulting in 1,055,792 CMI.

On April 20, 2019, during a period of strong wind, a tree contacted a pole or pole arm causing a circuit breaker to trip to lockout. This outage affected 1,148 customers for up to 407 minutes resulting in 107,392 CMI.

In total, the MILLVILLE 32-02 circuit had 66 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (46); equipment failure (12); nothing found (4); animal contacts (2); vehicles (2).

Remedial Actions

- In 2019, two single-phase reclosers were installed.
- In 2019, additional fusing was added at multiple locations.
- In 2019, multiple porcelain cutouts will be replaced.
- In 2020, a section of difficult-to-access three-phase will be relocated.
- In 2020, additional single phase reclosers will be installed.

10 Circuit 43201 -- MILLVILLE 32-01

Performance Analysis

The MILLVILLE 32-01 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 44 customers for up to 2,467 minutes resulting in 102,788 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 696 customers for up to 2,619 minutes resulting in 798,882 CMI.

In total, the MILLVILLE 32-01 circuit had 47 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (30); equipment failure (9); animal contacts (3); nothing found (3); other (1); vehicles (1).

Remedial Actions

- In 2019, multiple porcelain cutouts were replaced.
- In 2019, a section of difficult to access single phase conductor was relocated.
- In 2020, additional single-phase reclosers will be installed.
- In 2021, a section of difficult-to-access single-phase conductor will be relocated.

11 Circuit 42701 -- AUGUSTAVILLE 27-01

Performance Analysis

The AUGUSTAVILLE 27-01 circuit experienced three outages of over 100,000 CMI between October 2018 and September 2019.

On April 14, 2019, during a period of strong wind, a tree contacted a pole or pole arm causing a recloser to trip to lockout. This outage affected 56 customers for up to 2,327 minutes resulting in 109,762 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 191 customers for up to 2,484 minutes resulting in 402,902 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 143 customers for up to 2,504 minutes resulting in 148,007 CMI.

In total, the AUGUSTAVILLE 27-01 circuit had 81 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (60); equipment failure (11); animal contacts (7); nothing found (1); other (1); vehicles (1).

Remedial Actions

- In 2018, an Expanded Operational Review was performed. Additional fusing was installed as a result.
- In 2019, two additional single-phase reclosers were installed.
- In 2019, a section of multi-phase conductor was replaced.
- In 2019, an additional Smart Grid device was installed.
- In 2020, full circuit trimming will be performed.
- In 2020, a section of difficult-to-access conductor will be relocated.
- In 2020, an additional Smart Grid device will be installed.

12 Circuit 45302 -- WEST BERWICK 53-02

Performance Analysis

The WEST BERWICK 53-02 circuit experienced three outages of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 589 customers for up to 783 minutes resulting in 318,387 CMI.

On May 7, 2019, a tree contacted an overhead conductor causing a temporary open point to be interrupted. This outage affected 1,211 customers for up to 352 minutes resulting in 161,433 CMI.

On May 29, 2019, during a period of heavy rain, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 118 customers for up to 884 minutes resulting in 104,271 CMI.

In total, the WEST BERWICK 53-02 circuit had 50 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (32); equipment failure (10); animal contacts (6); nothing found (2).

Remedial Actions

- In 2019, a recloser was replaced with a telemetric triple-single recloser.
- In 2019, several sections of single-phase will be evaluated for reconductoring.
- In 2020, a section of difficult-to-access conductor will be relocated.
- In 2021, a section of difficult-to-access conductor will be relocated.

13 Circuit 46302 -- ROHRSBURG 63-02

Performance Analysis

The ROHRSBURG 63-02 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted a pole or pole arm causing a recloser to trip to lockout. This outage affected 316 customers for up to 28 minutes resulting in 426,891 CMI.

On August 6, 2019, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 292 customers for up to 70 minutes resulting in 153,600 CMI.

In total, the ROHRSBURG 63-02 circuit had 75 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (43); equipment failure (19); nothing found (9); animal contacts (3); vehicles (1).

Remedial Actions

- In 2018, an existing three-phase recloser was converted to single-phase operation.
- In 2018, an Expanded Operation Review was performed with 35 minor remediations performed.
- In 2018, hot spot trimming was performed.
- In 2019, an additional single-phase recloser was installed.
- In 2019, an additional Smart Grid device was installed.
- In 2019, full circuit trimming will be performed.
- In 2019, the trim cycle length will be re-evaluated for this circuit.
- In 2020, additional fusing will be installed.

14 Circuit 46001 -- BERWICK 60-01

Performance Analysis

The BERWICK 60-01 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 176 customers for up to 3,631 minutes resulting in 354,287 CMI.

On August 15, 2019, during a period of lightning, an equipment failure occurred on an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 2,330 customers for up to 273 minutes resulting in 281,135 CMI.

In total, the BERWICK 60-01 circuit had 62 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (36); equipment failure (16); nothing found (7); vehicles (2); animal contacts (1).

Remedial Actions

- In 2019, multiple porcelain cutouts will be replaced.
- In 2019, a section of single-phase conductor will be evaluated for re-sourcing.
- In 2022, a section of three-phase conductor will be extended.
- In 2022, a new tie line will be constructed.

15 Circuit 20103 -- AVOCA 01-03

Performance Analysis

The AVOCA 01-03 circuit experienced three outages of over 100,000 CMI between October 2018 and September 2019.

On July 6, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 1,736 customers for up to 197 minutes resulting in 226,617 CMI.

On July 30, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 1,889 customers for up to 311 minutes resulting in 529,854 CMI.

On August 2, 2019, a vehicle contact occurred causing a circuit breaker to trip to lockout. This outage affected 1,886 customers for up to 400 minutes resulting in 289,301 CMI.

In total, the AVOCA 01-03 circuit had 11 outages between October 2018 and September 2019, with the causes breaking down as follows: equipment failure (5); tree related (5); vehicles (1).

Remedial Actions

- In 2019, additional three-phase sectionalizing will be evaluated at two locations.
- In 2019, a tie to the AVOCA 01-06 will be evaluated.
- In 2019, additional fusing will be evaluated at four locations.
- In 2019, additional single-phase reclosers will be evaluated.

16 Circuit 47704 -- BLOOMSBURG 77-04

Performance Analysis

The BLOOMSBURG 77-04 circuit experienced five outages of over 100,000 CMI between October 2018 and September 2019.

On February 25, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 93 customers for up to 1,693 minutes resulting in 123,351 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted a pole or pole arm causing a recloser to trip to lockout. This outage affected 156 customers for up to 2,524 minutes resulting in 268,364 CMI.

On April 15, 2019, during a period of strong wind, an unidentified issue occurred with an overhead conductor causing a recloser to trip to lockout. This outage affected 404 customers for up to 448 minutes resulting in 180,874 CMI.

On June 29, 2019, during a period of heavy rain, an equipment failure occurred on an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 1,518 customers for up to 377 minutes resulting in 119,490 CMI.

On July 19, 2019, a tree contacted an overhead conductor causing an interruption. This outage affected 271 customers for up to 498 minutes resulting in 134,958 CMI.

In total, the BLOOMSBURG 77-04 circuit had 62 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (34); equipment failure (16); nothing found (6); animal contacts (4); contact or dig in (1); vehicles (1).

Remedial Actions

- In 2018, the circuit breaker was replaced.
- In 2019, line reconfiguration was performed on a section of single-phase line.
- In 2020, full circuit trimming will be performed.

17 Circuit 18502 -- CANADENSIS 85-02

Performance Analysis

The CANADENSIS 85-02 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On July 21, 2019, during a period of strong wind, a tree contacted an overhead transmission component causing a circuit breaker to trip to lockout. This outage affected 1,841 customers for up to 672 minutes resulting in 726,808 CMI.

In total, the CANADENSIS 85-02 circuit had 84 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (51); equipment failure (16); animal contacts (11); vehicles (5); nothing found (1).

Remedial Actions

- In 2019, several transmission poles and conductors were replaced.
- In 2020, hot spot trimming will be performed.
- In 2020, Hendrix tree cable will be installed at four locations on the line.
- In 2020, a three-phase recloser will be installed.
- In 2020, two single-phase reclosers will be installed.
- In 2020, additional animal guarding will be installed.
- In 2020, a three-phase recloser will be replaced.

18 Circuit 46206 -- DANVILLE 62-06

Performance Analysis

The DANVILLE 62-06 circuit experienced three outages of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted a pole or pole arm causing a recloser to trip to lockout. This outage affected 90 customers for up to 1,551 minutes resulting in 126,853 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 83 customers for up to 2,665 minutes resulting in 179,905 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 74 customers for up to 3,775 minutes resulting in 196,434 CMI.

In total, the DANVILLE 62-06 circuit had 50 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (36); equipment failure (8); animal contacts (4); nothing found (2).

Remedial Actions

- In 2019, two additional single-phase reclosers were installed.
- In 2019, a section of single-phase conductor was rebuilt to underground.
- In 2019, a section of single-phase conductor will be re-sourced.
- In 2019, multiple porcelain cutouts were replaced.
- In 2019, the trim cycle for this circuit will be re-evaluated.
- In 2019, a new distribution river crossing will be evaluated.
- In 2020, a tie to the DANVILLE 62-04 will be constructed.

19 Circuit 45002 -- LIMESTONE 50-02

Performance Analysis

The LIMESTONE 50-02 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 1,519 customers for up to 2,706 minutes resulting in 360,644 CMI.

On May 29, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 146 customers for up to 2,830 minutes resulting in 113,275 CMI.

In total, the LIMESTONE 50-02 circuit had 67 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (48); equipment failure (9); nothing found (5); animal contacts (2); vehicles (2); contact or dig in (1).

Remedial Actions

- In 2019, a section of difficult-to-access conductor was relocated.
- In 2019, additional fusing was installed.
- In 2019, a new Smart Grid device was installed.
- In 2019 and 2020, ten poles will be replaced.
- In 2019, a Proactive Circuit Analysis will be performed.
- In 2019, a new tie line for this circuit will be evaluated.
- In 2020, multiple porcelain cutouts will be replaced.
- In 2021, a section of difficult-to-access conductor will be relocated.

20 Circuit 59002 -- MIFFLINTOWN 90-02

Performance Analysis

The MIFFLINTOWN 90-02 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On June 12, 2019, a member of the public felled a tree onto an overhead transmission line causing a circuit breaker to trip to lockout. This outage affected 2,246 customers for up to 409 minutes resulting in 516,381 CMI.

On August 18, 2019, during a period of lightning, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 1,075 customers for up to 243 minutes resulting in 179,232 CMI.

In total, the MIFFLINTOWN 90-02 circuit had 75 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (43); equipment failure (24); animal contacts (4); nothing found (2); other (1); vehicles (1).

Remedial Actions

- In 2018, single-phase sectionalizing was installed.
- In 2019, two single-phase sectionalizing devices were installed.
- In 2019, additional single-phase fusing will be installed at two locations.
- In 2019, upgrading an existing recloser to triple-single operation will be evaluated.
- In 2020, a new line and terminal at MIFFLINTOWN substation will be installed.

21 Circuit 40602 -- PINE GROVE 06-02

Performance Analysis

The PINE GROVE 06-02 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On October 17, 2018, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 416 customers for up to 318 minutes resulting in 103,421 CMI.

On December 21, 2018, a vehicle contacted a pole causing a motor operated switch to be interrupted. This outage affected 1,875 customers for up to 413 minutes resulting in 192,541 CMI.

In total, the PINE GROVE 06-02 circuit had 59 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (30); equipment failure (15); nothing found (6); vehicles (6); animal contacts (1); other (1).

Remedial Actions

- In 2019, an additional Smart Grid device was installed.
- In 2019, two single-phase reclosers will be installed.
- In 2019, two poles will be replaced.
- In 2019, ten additional locations will receive fusing.
- In 2020, a section of single-phase line will be reconductored to three-phase, and the protection scheme will be upgraded.
- In 2021, a section of conductor in a heavily wooded area will be undergrounded.
- In 2021, full circuit trimming will be performed.

22 Circuit 59202 -- THOMPSONTOWN 92-02

Performance Analysis

The THOMPSONTOWN 92-02 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On February 25, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a sectionalizing device to be interrupted. This outage affected 888 customers for up to 239 minutes resulting in 212,232 CMI.

On April 27, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a sectionalizing device to be interrupted. This outage affected 922 customers for up to 1,587 minutes resulting in 171,928 CMI.

In total, the THOMPSONTOWN 92-02 circuit had 69 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (51); equipment failure (12); vehicles (3); animal contacts (2); nothing found (1).

Remedial Actions

- In 2019 a section of line was storm hardened with new conductor, upgraded poles, and static tree wire.
- In 2019, a Smart Grid device was installed.
- In 2019, single-phase sectionalizing will be installed.
- In 2020, a sectionalizing single-phase device will be installed.
- In 2019, a section of inaccessible conductor will be relocated.
- In 2019, additional fusing will be installed at three locations.
- In 2020, full circuit trimming will be performed.
- In 2020, a three-phase protective device will be upgraded to a Smart Grid device.
- In 2022, an additional Smart Grid device will be installed.

23 Circuit 11804 -- FRANCONIA 18-04

Performance Analysis

The FRANCONIA 18-04 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On May 29, 2019, during a period of strong wind, an equipment failure occurred on an overhead conductor. This outage affected 963 customers for up to 1,297 minutes resulting in 812,710 CMI.

In total, the FRANCONIA 18-04 circuit had 28 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (9); equipment failure (8); animal contacts (4); nothing found (4); vehicles (2); contact or dig in (1).

Remedial Actions

- In 2019, hazard tree removal will be evaluated.
- In 2020, two additional single-phase reclosers will be installed.
- In 2020, additional fusing will be installed.
- In 2021, full circuit trimming will be performed.

24 Circuit 56802 -- BENVENUE 68-02

Performance Analysis

The BENVENUE 68-02 circuit experienced no outages of over 100,000 CMI between October 2018 and September 2019.

In total, the BENVENUE 68-02 circuit had 75 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (55); equipment failure (12); animal contacts (4); nothing found (4).

Remedial Actions

- In 2018 and 2019, single-phase sectionalizing was installed.
- In 2019, four additional single-phase sectionalizing devices were installed.
- In 2019, the protection settings on this circuit were optimized.
- In 2019, additional single-phase fuses will be installed.
- In 2019, an additional single-phase recloser will be evaluated.
- In 2019, several additional locations will be evaluated for fusing.
- In 2019, a section of single-phase line will be evaluated for re-sourcing.

25 Circuit 40101 -- HUNTER 01-01

Performance Analysis

The HUNTER 01-01 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On November 10, 2018, during a period of strong wind, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 2,113 customers for up to 220 minutes resulting in 212,073 CMI.

In total, the HUNTER 01-01 circuit had 52 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (35); equipment failure (9); animal contacts (5); nothing found (2); contact or dig in (1).

Remedial Actions

- In 2019, an additional single-phase recloser was installed.
- In 2019, additional fusing will be installed at four locations.
- In 2019, several porcelain cutouts will be replaced.
- In 2019, full circuit trimming will be performed.
- In 2019, additional Smart Grid devices will be evaluated.
- In 2019, a substation rebuild will be evaluated.
- In 2021, a section of single-phase will be reconductored.
- In 2021, a section of three-phase will be reconductored.

- In 2021, Hendrix tree cable will be installed on a heavily wooded section of conductor.

26 Circuit 41602 -- CLEVELAND 16-02

Performance Analysis

The CLEVELAND 16-02 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 87 customers for up to 3,561 minutes resulting in 124,961 CMI.

On April 15, 2019, during a period of strong wind, an equipment failure occurred on a pole or pole arm causing a recloser to trip to lockout. This outage affected 189 customers for up to 1,080 minutes resulting in 203,976 CMI.

In total, the CLEVELAND 16-02 circuit had 69 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (45); equipment failure (13); animal contacts (7); nothing found (3); contact or dig in (1).

Remedial Actions

- In 2018 and 2019, hazard tree removal was performed.
- In 2019, an existing recloser was upgraded to a Smart Grid device.
- In 2019, an additional Smart Grid device was installed.
- In 2019, a new single-phase recloser was installed.
- In 2019, additional single-phase reclosers will be evaluated.
- In 2019, aerial and Hendrix cable will be evaluated for sections of this circuit.
- In 2019, re-conductoring will be evaluated for a section of heavily wooded conductor.
- In 2020, an Expanded Operational Review will be performed.
- In 2020, the CLEVELAND substation will be rebuilt.

27 Circuit 26601 -- BROOKSIDE 66-01

Performance Analysis

The BROOKSIDE 66-01 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On May 19, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 1,765 customers for up to 240 minutes resulting in 369,758 CMI.

On May 19, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 573 customers for up to 682 minutes resulting in 122,101 CMI.

In total, the BROOKSIDE 66-01 circuit had 37 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (22); equipment failure (8); animal contacts (2); nothing found (2); other (2); vehicles (1).

Remedial Actions

- In 2018, fusing was installed at five locations.
- In 2018, 21 poles were replaced.
- In 2018, addition animal guarding was installed.
- In 2019, a single-phase recloser will be installed.
- In 2019, several porcelain cutouts will be replaced with polymer.
- In 2020, full circuit trimming will be performed.
- In 2020, an additional single-phase recloser will be installed.

28 Circuit 56803 -- BENVENUE 68-03

Performance Analysis

The BENVENUE 68-03 circuit experienced three outages of over 100,000 CMI between October 2018 and September 2019.

On February 24, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 651 customers for up to 2,302 minutes resulting in 232,455 CMI.

On May 29, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 143 customers for up to 1,740 minutes resulting in 205,539 CMI.

On May 29, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 124 customers for up to 994 minutes resulting in 123,288 CMI.

In total, the BENVENUE 68-03 circuit had 52 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (32); equipment failure (14); animal contacts (4); nothing found (1); other (1).

Remedial Actions

- In 2019, an additional single-phase recloser was installed.
- In 2019, additional fusing was installed at four locations.
- In 2019, additional fusing will be evaluated.
- In 2020, full circuit trimming will be performed.

29 Circuit 54701 -- NEW BLOOMFIELD 47-01

Performance Analysis

The NEW BLOOMFIELD 47-01 circuit experienced three outages of over 100,000 CMI between October 2018 and September 2019.

On November 16, 2018, during a period of ice/sleet/snow, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 479 customers for up to 529 minutes resulting in 207,206 CMI.

On April 27, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 1,091 customers for up to 448 minutes resulting in 141,099 CMI.

On May 29, 2019, during a period of heavy rain, a tree contacted a pole or pole arm causing a recloser to trip to lockout. This outage affected 473 customers for up to 228 minutes resulting in 107,962 CMI.

In total, the NEW BLOOMFIELD 47-01 circuit had 51 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (35); equipment failure (9); animal contacts (4); vehicles (3).

Remedial Actions

- In 2019, a protection coordination study was conducted, as a result several changes will be applied.
- In 2019, additional single-phase sectionalizing devices will be evaluated.
- In 2020, three single-phase sectionalizing devices will be installed.
- In 2020, full circuit trimming will be performed.
- In 2021, a new Smart Grid device will be installed.
- In 2021, an additional Smart Grid device will be evaluated.

30 Circuit 26703 -- HEMLOCK FARMS 67-03

Performance Analysis

The HEMLOCK FARMS 67-03 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On February 24, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 823 customers for up to 2,602 minutes resulting in 436,304 CMI.

On February 25, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 1,796 customers for up to 141 minutes resulting in 253,236 CMI.

In total, the HEMLOCK FARMS 67-03 circuit had 54 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (24); animal contacts (13); equipment failure (13); nothing found (4).

Remedial Actions

- In 2019, nine single-phase reclosers were installed.
- In 2019, a new three-phase recloser was installed.
- In 2019, 27 overhead transformers were replaced.
- In 2019, three additional fuses will be evaluated.
- In 2020, 80 porcelain cutouts will be replaced.
- In 2020, full circuit trimming will be performed.

31 Circuit 21705 -- SUBURBAN YARD#2 17-05

Performance Analysis

The SUBURBAN YARD#2 17-05 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 599 customers for up to 876 minutes resulting in 361,903 CMI.

On April 15, 2019, during a period of strong wind, a tree contacted a pole or pole arm causing a recloser to trip to lockout. This outage affected 716 customers for up to 646 minutes resulting in 377,293 CMI.

In total, the SUBURBAN YARD#2 17-05 circuit had 30 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (15); equipment failure (7); animal contacts (6); nothing found (1); vehicles (1).

Remedial Actions

- In 2020, 3 sectionalizing devices will be installed.
- In 2020, full circuit trimming will be performed.

32 Circuit 41802 -- GOWEN CITY 18-02

Performance Analysis

The GOWEN CITY 18-02 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On October 8, 2018, an animal interfered with an overhead switch causing a circuit breaker to trip to lockout. This outage affected 523 customers for up to 385 minutes resulting in 193,721 CMI.

On August 18, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 520 customers for up to 539 minutes resulting in 273,638 CMI.

In total, the GOWEN CITY 18-02 circuit had 40 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (29); animal contacts (4); equipment failure (3); nothing found (2); other (2).

Remedial Actions

- In 2018, the circuit breaker for this circuit was replaced.
- In 2019, numerous hazard trees were removed.
- In 2019, relocation or reconductoring will be evaluated for a section of this circuit.
- In 2021, full circuit trimming will be performed.

33 Circuit 46004 -- BERWICK 60-04

Performance Analysis

The BERWICK 60-04 circuit experienced three outages of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a load break fuse to operate. This outage affected 60 customers for up to 2,313 minutes resulting in 136,656 CMI.

On April 15, 2019, during a period of strong wind, an equipment failure occurred on an overhead lightning protector causing a recloser to trip to lockout. This outage affected 116 customers for up to 3,822 minutes resulting in 139,121 CMI.

On May 31, 2019, during a period of heavy rain, a tree contacted an overhead conductor causing an interruption. This outage affected 361 customers for up to 805 minutes resulting in 260,346 CMI.

In total, the BERWICK 60-04 circuit had 48 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (23); equipment failure (14); nothing found (7); animal contacts (3); vehicles (1).

Remedial Actions

- In 2019, an additional single-phase recloser was installed.
- In 2019, full circuit trimming will be performed.
- In 2019, multiple porcelain cutouts were replaced.

34 Circuit 21502 -- CEDAR AVENUE 15-02

Performance Analysis

The CEDAR AVENUE 15-02 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 895 customers for up to 866 minutes resulting in 591,386 CMI.

In total, the CEDAR AVENUE 15-02 circuit had 15 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (6); equipment failure (5); other (3); nothing found (1).

Remedial Actions

- In 2019, an additional fuse was installed.
- In 2019, the protection scheme for this circuit was reviewed and optimized.
- In 2019, additional fusing will be installed.
- In 2020, additional fusing will be installed.

35 Circuit 52402 -- GREEN PARK 24-02

Performance Analysis

The GREEN PARK 24-02 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On February 24, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 253 customers for up to 917 minutes resulting in 180,194 CMI.

In total, the GREEN PARK 24-02 circuit had 75 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (45); equipment failure (19); animal contacts (4); nothing found (4); contact or dig in (2); other (1).

Remedial Actions

- In 2019, a single-phase sectionalizing device was installed.
- In 2019, additional animal guarding was installed.
- In 2019, a section of difficult-to-access single-phase was relocated.
- In 2019, multiple sections of conductor will be relocated.
- In 2019, a second transmission source to the distribution substation will be constructed.
- In 2019, an additional sectionalizing device will be installed.
- In 2019, two additional single-phase sectionalizing devices will be evaluated.
- In 2019, a battery energy storage system will be evaluated.
- In 2020, additional single-phase sectionalizing will be installed at 2 locations.
- In 2020, two sections of difficult-to-access conductor will be relocated.

36 Circuit 18501 -- CANADENSIS 85-01

Performance Analysis

The CANADENSIS 85-01 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On May 16, 2019, an equipment failure occurred on an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 1,410 customers for up to 280 minutes resulting in 118,347 CMI.

On July 21, 2019, during a period of strong wind, a tree contacted an overhead transmission component causing a circuit breaker to trip to lockout. This outage affected 1,428 customers for up to 532 minutes resulting in 336,533 CMI.

In total, the CANADENSIS 85-01 circuit had 38 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (25); equipment failure (9); animal contacts (2); nothing found (2).

Remedial Actions

- In 2019, several transmission poles and conductors were replaced.
- In 2019, hot spot circuit trimming will be performed.
- In 2019, additional smart grid devices will be evaluated.
- In 2020, full circuit trimming will be performed.
- In 2020, additional animal guarding will be installed.

37 Circuit 53901 -- HALIFAX 39-01

Performance Analysis

The HALIFAX 39-01 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On February 25, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 574 customers for up to 924 minutes resulting in 328,968 CMI.

In total, the HALIFAX 39-01 circuit had 61 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (45); equipment failure (11); animal contacts (3); nothing found (2).

Remedial Actions

- In 2019, animal guarding was installed at five locations. Six more locations will receive animal guarding in 2019.
- In 2019, an additional single-phase sectionalizing device was installed.
- In 2019, additional single-phase fusing will be installed.
- In 2019, hazard tree removal will be evaluated.
- In 2019, multiple sections of single phase will be evaluated for relocation.
- In 2019, replacing a section of underground cable will be evaluated.
- In 2020, a single-phase sectionalizing device will be installed.
- In 2020, an additional Smart Grid device will be installed.

38 Circuit 48302 -- ORWIGSBURG 83-02

Performance Analysis

The ORWIGSBURG 83-02 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On February 21, 2019, during a period of ice/sleet/snow, a tree contacted a pole or pole arm causing a recloser to trip to lockout. This outage affected 772 customers for up to 233 minutes resulting in 273,335 CMI.

On February 24, 2019, during a period of strong wind, a tree contacted an overhead splice causing a load break fuse to operate. This outage affected 105 customers for up to 1,827 minutes resulting in 132,137 CMI.

In total, the ORWIGSBURG 83-02 circuit had 42 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (19); equipment failure (13); animal contacts (4); nothing found (3); vehicles (2); other (1).

Remedial Actions

- In 2019, two additional single-phase reclosers were installed.
- In 2019, additional fusing will be installed.
- In 2019, aerial or Hendrix tree cable will be evaluated for a heavily wooded section of single-phase conductor.
- In 2019, reconductoring a section of single-phase conductor will be evaluated.
- In 2020, additional fusing will be installed.
- In 2020, an additional single-phase reclosers will be installed.
- In 2020, full circuit trimming will be performed.

39 Circuit 59101 -- WALKER 91-01

Performance Analysis

The WALKER 91-01 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On December 16, 2018, during a period of heavy rain, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 1,900 customers for up to 453 minutes resulting in 157,984 CMI.

On April 15, 2019, during a period of heavy rain, a tree contacted an overhead conductor. This outage affected 661 customers for up to 221 minutes resulting in 146,213 CMI.

In total, the WALKER 91-01 circuit had 63 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (33); equipment failure (22); animal contacts (3); nothing found (2); other (2); vehicles (1).

Remedial Actions

- In 2019, four additional single-phase sectionalizing devices were installed.
- In 2019, four single-phase fuses were installed.
- In 2019 a section of single-phase line will be re-sourced.
- In 2019, full circuit tree trimming will be performed.
- In 2019, an additional single-phase recloser will be evaluated.
- In 2020, three single-phase sectionalizing devices will be installed.

40 Circuit 45001 -- LIMESTONE 50-01

Performance Analysis

The LIMESTONE 50-01 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On July 16, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 436 customers for up to 24 minutes resulting in 151,610 CMI.

In total, the LIMESTONE 50-01 circuit had 63 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (44); equipment failure (8); animal contacts (7); other (2); nothing found (1); vehicles (1).

Remedial Actions

- In 2019, additional series fusing was installed.
- In 2019, a section of difficult to access single-phase will be evaluated to be relocated.
- In 2019, additional single-phase fusing will be evaluated.
- In 2020, full circuit tree trimming will be performed.

41 Circuit 45402 -- WEST BLOOMSBURG 54-02

Performance Analysis

The WEST BLOOMSBURG 54-02 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of lightning, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 137 customers for up to 3,899 minutes resulting in 157,902 CMI.

In total, the WEST BLOOMSBURG 54-02 circuit had 79 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (53); equipment failure (16); nothing found (7); animal contacts (3).

Remedial Actions

- In 2018, hot spot trimming was performed.
- In 2019, numerous porcelain cutouts were replaced with polymer cutouts.
- In 2019, several additional locations received animal guarding.
- In 2019, relocation of difficult to access single-phase will be evaluated.
- In 2019, installation of a Smart Grid device will be evaluated.

42 Circuit 56501 -- ROCKVILLE 65-01

Performance Analysis

The ROCKVILLE 65-01 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On May 29, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 1,029 customers for up to 301 minutes resulting in 305,766 CMI.

In total, the ROCKVILLE 65-01 circuit had 49 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (30); equipment failure (10); animal contacts (7); nothing found (1); other (1).

Remedial Actions

- In 2019, full circuit tree trimming was performed.
- In 2019, voltage support devices were installed to increase tie capability.
- In 2019, a new substation will be evaluated.
- In 2019, an existing recloser was upgraded to a Smart Grid device.
- In 2019, additional animal guarding will be evaluated.
- In 2020, a section of line will be re-sourced.
- In 2020, an additional Smart Grid device will be installed.
- In 2020, an additional tie line will be installed.

43 Circuit 45502 -- DERRY 55-02

Performance Analysis

The DERRY 55-02 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead transmission component causing a circuit breaker to trip to lockout. This outage affected 615 customers for up to 2,696 minutes resulting in 458,286 CMI.

In total, the DERRY 55-02 circuit had 28 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (16); animal contacts (6); equipment failure (3); nothing found (3).

Remedial Actions

- In 2020, a section of single-phase conductor will be re-sourced.
- In 2020, a Proactive Circuit Analysis will be performed.
- In 2020, multiple porcelain cutouts will be replaced.
- In 2020, full circuit tree trimming will be performed.

44 Circuit 45602 -- WOOLRICH 56-02

Performance Analysis

The WOOLRICH 56-02 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On February 24, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 983 customers for up to 1,474 minutes resulting in 372,932 CMI.

In total, the WOOLRICH 56-02 circuit had 37 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (20); animal contacts (7); equipment failure (7); nothing found (3).

Remedial Actions

- In 2019, an additional Smart Grid device was installed.
- In 2019, additional animal guarding was installed.
- In 2019, a Proactive Circuit Analysis will be performed.
- In 2019, a tie to the WOOLRICH 56-01 will be evaluated.
- In 2020, an additional single-phase sectionalizing device will be installed.

45 Circuit 22404 -- MORGAN 24-04

Performance Analysis

The MORGAN 24-04 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On May 19, 2019, during a period of heavy rain, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 2,081 customers for up to 83 minutes resulting in 503,518 CMI.

In total, the MORGAN 24-04 circuit had 17 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (9); animal contacts (4); equipment failure (3); other (1).

Remedial Actions

- In 2018, full circuit trimming was performed.
- In 2019, a section of single-phase line was relocated.
- In 2019, three fuses will be installed.
- In 2020, a tie line will be constructed.
- In 2021, a single-phase extension will be completed with additional fusing.

46 Circuit 40601 -- PINE GROVE 06-01

Performance Analysis

The PINE GROVE 06-01 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On February 25, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 56 customers for up to 2,036 minutes resulting in 113,994 CMI.

On May 13, 2019, during a period of heavy rain, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 642 customers for up to 497 minutes resulting in 288,674 CMI.

In total, the PINE GROVE 06-01 circuit had 33 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (20); equipment failure (7); nothing found (4); animal contacts (2).

Remedial Actions

- In 2019, reconductoring will be evaluated for a section of single-phase.
- In 2020, a group of customers at the far end of this circuit will be transferred to another circuit.
- In 2020, full circuit trimming will be performed.

47 Circuit 12402 -- MILFORD 24-02

Performance Analysis

The MILFORD 24-02 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On May 29, 2019, during a period of strong wind, a tree contacted an underground conductor causing a recloser to trip to lockout. This outage affected 545 customers for up to 1,377 minutes resulting in 530,065 CMI.

In total, the MILFORD 24-02 circuit had 30 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (20); equipment failure (5); animal contacts (2); nothing found (1); other (1); vehicles (1).

Remedial Actions

- In 2019, full circuit tree trimming was performed.
- In 2019, additional single-phase reclosers will be evaluated.
- In 2019, additional fusing will be evaluated.
- In 2019, a new tie line will be evaluated.

48 Circuit 67801 -- WEST LANCASTER 78-01

Performance Analysis

The WEST LANCASTER 78-01 circuit experienced three outages of over 100,000 CMI between October 2018 and September 2019.

On February 25, 2019, during a period of strong wind, an unidentified issue occurred with an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 2,132 customers for up to 211 minutes resulting in 163,459 CMI.

On April 27, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 1,292 customers for up to 169 minutes resulting in 128,432 CMI.

On May 5, 2019, an equipment failure occurred on underground switching gear causing a load break fuse to operate. This outage affected 233 customers for up to 574 minutes resulting in 133,415 CMI.

In total, the WEST LANCASTER 78-01 circuit had 38 outages between October 2018 and September 2019, with the causes breaking down as follows: equipment failure (18); tree related (13); nothing found (4); animal contacts (1); other (1); vehicles (1).

Remedial Actions

- In 2019 and 2020, additional fusing will be installed at multiple locations.
- In 2019, an additional sectionalizing device will be evaluated.
- In 2019, an automated tie line will be evaluated.
- In 2019, addition Smart Grid devices will be evaluated.
- In 2021, a new tie line will be constructed.
- In 2021, two new reclosers will be installed.

49 Circuit 42802 -- SELINSGROVE 28-02

Performance Analysis

The SELINSGROVE 28-02 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On June 29, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 974 customers for up to 2,546 minutes resulting in 542,458 CMI.

In total, the SELINSGROVE 28-02 circuit had 22 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (11); equipment failure (5); animal contacts (3); nothing found (3).

Remedial Actions

- In 2018, full circuit trimming was performed.
- In 2019, additional fusing will be evaluated.
- In 2019, relocating a section of difficult-to-access single-phase conductor will be evaluated.

50 Circuit 26001 -- WEST DAMASCUS 60-01

Performance Analysis

The WEST DAMASCUS 60-01 circuit experienced no outages of over 100,000 CMI between October 2018 and September 2019.

In total, the WEST DAMASCUS 60-01 circuit had 65 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (32); equipment failure (16); nothing found (9); animal contacts (7); vehicles (1).

Remedial Actions

- In 2018, animal guarding was installed at several locations.
- In 2019, 10 single-phase reclosers were installed.
- In 2019, 40 cross arms were replaced.
- In 2019, additional animal guarding will be installed.
- In 2019, an additional Smart Grid device will be installed.
- In 2019, a new substation will be evaluated.
- In 2020, several sections of single-phase conductor will be reconductored and relocated.
- In 2020, additional single-phase reclosers will be installed.
- In 2020, an additional three-phase recloser will be installed.
- In 2020, a recloser will be replaced.

51 Circuit 52401 -- GREEN PARK 24-01

Performance Analysis

The GREEN PARK 24-01 circuit experienced no outages of over 100,000 CMI between October 2018 and September 2019.

In total, the GREEN PARK 24-01 circuit had 84 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (60); equipment failure (11); animal contacts (7); nothing found (4); other (1); vehicles (1).

Remedial Actions

- In 2019, two single-phase sectionalizing devices were installed.
- In 2019, installing additional single phase reclosers will be evaluated.
- In 2019, additional fusing will be evaluated.
- In 2019, hazard tree removal will be evaluated.
- In 2019, a single-phase tie will be evaluated.
- In 2020, three additional single-phase sectionalizing devices will be installed.
- In 2020, multiple devices will be evaluated for protection improvements.

52 Circuit 61101 -- BERKS 11-01

Performance Analysis

The BERKS 11-01 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On November 24, 2018, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 199 customers for up to 611 minutes resulting in 102,478 CMI.

On May 19, 2019, during a period of lightning, an unidentified issue occurred with an overhead transmission component causing a circuit breaker to trip to lockout. This outage affected 1,293 customers for up to 440 minutes resulting in 211,801 CMI.

In total, the BERKS 11-01 circuit had 25 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (13); equipment failure (7); vehicles (3); nothing found (1); other (1).

Remedial Actions

- In 2019, additional fusing was installed.
- In 2019, a single-phase recloser was installed.
- In 2019, a three-phase sectionalizing device was upgraded.
- In 2019, four additional single-phase sectionalizing devices will be installed.
- In 2020, a transmission line rebuild will be evaluated.
- In 2020, a single-phase recloser will be installed.

53 Circuit 25801 -- SULLIVAN TRAIL 58-01

Performance Analysis

The SULLIVAN TRAIL 58-01 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On July 21, 2019, during a period of strong wind, a tree contacted an overhead conductor causing an interruption. This outage affected 248 customers for up to 568 minutes resulting in 140,392 CMI.

In total, the SULLIVAN TRAIL 58-01 circuit had 45 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (27); equipment failure (11); nothing found (3); other (2); animal contacts (1); vehicles (1).

Remedial Actions

- In 2018, an Expanded Operational Review was performed. As a result, six cross arms were replaced, and three additional minor repairs were completed.
- In 2019, additional fusing will be evaluated for this circuit.
- In 2019, undergrounding will be evaluated for a section of single-phase conductor.
- In 2019, additional single-phase reclosers will be evaluated for this circuit.
- In 2019, two Smart Grid devices will be upgraded to improve communication capability.

54 Circuit 21206 -- EAST CARBONDALE 12-06

Performance Analysis

The EAST CARBONDALE 12-06 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On July 30, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 3,052 customers for up to 275 minutes resulting in 591,341 CMI.

In total, the EAST CARBONDALE 12-06 circuit had 19 outages between October 2018 and September 2019, with the causes breaking down as follows: equipment failure (7); tree related (5); animal contacts (3); other (2); nothing found (1); vehicles (1).

Remedial Actions

- In 2019, the protection settings for this circuit will be reviewed.
- In 2020, a fuse will be replaced with a single-phase recloser and additional downstream fusing will be installed.
- In 2020, a single-phase recloser will be installed with additional downstream fusing.
- In 2020, a load break disconnect will be replaced with a recloser.

- In 2020, a section of this circuit will be re-sourced, and additional sectionalizing will be installed.
- In 2020, full circuit trimming will be performed.

55 Circuit 66401 -- ROBESONIA 64-01

Performance Analysis

The ROBESONIA 64-01 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On February 25, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a temporary open point to be interrupted. This outage affected 281 customers for up to 955 minutes resulting in 264,020 CMI.

On May 19, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 288 customers for up to 562 minutes resulting in 161,818 CMI.

In total, the ROBESONIA 64-01 circuit had 21 outages between October 2018 and September 2019, with the causes breaking down as follows: equipment failure (8); tree related (8); animal contacts (3); contact or dig in (1); vehicles (1).

Remedial Actions

- In 2019, two additional single-phase sectionalizing devices were installed.
- In 2019, an additional sectioning device will be installed.
- In 2019, additional fusing will be installed.
- In 2019, additional single-phase reclosers will be evaluated at several locations.
- In 2019, a section of single-phase will be evaluated for re-sourcing.
- In 2019, additional fusing will be evaluated at several locations.

56 Circuit 59401 -- RICHFIELD 94-01

Performance Analysis

The RICHFIELD 94-01 circuit experienced no outages of over 100,000 CMI between October 2018 and September 2019.

In total, the RICHFIELD 94-01 circuit had 72 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (37); equipment failure (18); animal contacts (7); vehicles (5); nothing found (4); other (1).

Remedial Actions

- In 2019, a single-phase sectionalizing device was installed.
- In 2019, circuit coordination will be evaluated.
- In 2019, additional single-phase sectionalizing will be evaluated.
- In 2019, multiple single-phase ties will be evaluated.
- In 2020, full circuit trimming will be performed.

57 Circuit 67502 -- WEST WILLOW 75-02

Performance Analysis

The WEST WILLOW 75-02 circuit experienced two outages of over 100,000 CMI between October 2018 and September 2019.

On November 13, 2018, during a period of heavy rain, a vehicle contacted a pole causing a recloser to trip to lockout. This outage affected 876 customers for up to 520 minutes resulting in 103,982 CMI.

On December 20, 2018, during a period of heavy rain, an equipment failure occurred on an overhead lightning protector causing a recloser to trip to lockout. This outage affected 880 customers for up to 306 minutes resulting in 268,901 CMI.

In total, the WEST WILLOW 75-02 circuit had 35 outages between October 2018 and September 2019, with the causes breaking down as follows: equipment failure (14); tree related (14); nothing found (3); animal contacts (2); vehicles (2).

Remedial Actions

- In 2019, multiple single-phase sectionalizing devices were installed.
- In 2019, additional single-phase sectionalizing devices will be installed.
- In 2019, multiple porcelain cutouts will be replaced with polymer cutouts.
- In 2019, a section of difficult-to-access single-phase conductor will be relocated.
- In 2019, a single-phase tie will be evaluated.
- In 2019, resourcing a section of single-phase conductor will be investigated.
- In 2020, three additional sectionalizing devices will be installed.

58 Circuit 44502 -- HAMILTON 45-02

Performance Analysis

The HAMILTON 45-02 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 154 customers for up to 2,531 minutes resulting in 154,661 CMI.

In total, the HAMILTON 45-02 circuit had 61 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (42); equipment failure (13); nothing found (4); animal contacts (2).

Remedial Actions

- In 2018, an Expanded Operational Review was performed with several cross-arms and cutouts replaced as a result.
- In 2019, hazard tree removal was performed.
- In 2019, additional animal guarding was installed.
- In 2019, multiple porcelain cutouts were replaced.
- In 2019, an existing pole was relocated.
- In 2019, additional single-phase fusing will be installed.
- In 2021, full circuit trimming will be performed.

59 Circuit 28301 -- NEWFOUNDLAND 83-01

Performance Analysis

The NEWFOUNDLAND 83-01 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On February 25, 2019, during a period of strong wind, a tree contacted a pole or pole arm causing a recloser to trip to lockout. This outage affected 358 customers for up to 365 minutes resulting in 130,637 CMI.

In total, the NEWFOUNDLAND 83-01 circuit had 100 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (61); equipment failure (24); animal contacts (7); nothing found (7); other (1).

Remedial Actions

- In 2019, the protection settings for this circuit were reviewed and optimized.
- In 2019, additional fusing was installed.
- In 2019, hot spot trimming will be performed.
- In 2019, 20 porcelain cutouts will be replaced.
- In 2019, ten transformers will be replaced.
- In 2019, additional animal guarding will be installed.
- In 2019, a section of single-phase will be reconductored.
- In 2019, a three-phase recloser was converted to single-phase operation.
- In 2019, a section of three-phase line will be reconductored.
- In 2019, a new line and terminal will be constructed.
- In 2019, two single-phase reclosers will be installed.
- In 2019, a recloser will be replaced.
- In 2020, additional fusing will be installed.
- In 2020, additional Smart Grid devices will be installed.
- In 2020, three single-phase reclosers will be installed.
- In 2020, 15 porcelain cutouts will be replaced.
- In 2020, additional animal guarding will be installed.

60 Circuit 44802 -- EAST DANVILLE 48-02

Performance Analysis

The EAST DANVILLE 48-02 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On April 15, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 446 customers for up to 1,176 minutes resulting in 452,822 CMI.

In total, the EAST DANVILLE 48-02 circuit had 34 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (19); equipment failure (9); nothing found (4); animal contacts (2).

Remedial Actions

- In 2019, multiple porcelain cutouts were replaced.
- In 2019, a Proactive Circuit Analysis will be performed.
- In 2019, a section of difficult-to-access conductor will be evaluated for relocation.
- In 2020, a new single-phase recloser will be installed.

61 Circuit 58402 -- MOUNT ROCK 84-02

Performance Analysis

The MOUNT ROCK 84-02 circuit experienced no outages of over 100,000 CMI between October 2018 and September 2019.

In total, the MOUNT ROCK 84-02 circuit had 41 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (25); equipment failure (7); animal contacts (4); other (3); nothing found (1); vehicles (1).

Remedial Actions

- In 2019, five single-phase fuses will be installed
- In 2019, additional single-phase sectionalizing devices will be evaluated
- In 2020, five devices will be reconfigured to improve coordination.

62 Circuit 14103 -- TRUMBAUERSVILLE 41-03

Performance Analysis

The TRUMBAUERSVILLE 41-03 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On May 29, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a recloser to trip to lockout. This outage affected 290 customers for up to 1,227 minutes resulting in 332,712 CMI.

In total, the TRUMBAUERSVILLE 41-03 circuit had 55 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (37); equipment failure (8); animal contacts (5); vehicles (3); nothing found (2).

Remedial Actions

- In 2019, additional single-phase reclosers will be evaluated.
- In 2019, additional fusing will be evaluated.
- In 2020, full circuit trimming will be performed.

63 Circuit 56504 -- ROCKVILLE 65-04

Performance Analysis

The ROCKVILLE 65-04 circuit experienced one outage of over 100,000 CMI between October 2018 and September 2019.

On July 6, 2019, during a period of strong wind, a tree contacted an overhead conductor causing a circuit breaker to trip to lockout. This outage affected 1,993 customers for up to 423 minutes resulting in 193,977 CMI.

In total, the ROCKVILLE 65-04 circuit had 62 outages between October 2018 and September 2019, with the causes breaking down as follows: tree related (38); equipment failure (11); animal contacts (9); other (2); contact or dig in (1); nothing found (1).

Remedial Actions

- In 2018, several single-phase sectionalizing devices were installed.
- In 2018, a section of single-phase covered conductor was installed.
- In 2019, an additional single-phase sectionalizing device was installed.
- In 2019, additional fusing was installed at five locations.
- In 2019, reconductoring will be evaluated for a section of three-phase conductor.
- In 2019, a section of single phase will be evaluated for covered conductor.

5) A rolling 12-month breakdown and analysis of outage causes during the preceding quarter, including the number and percentage of service outages, the number of customers interrupted, and customer interruption minutes categorized by outage cause such as equipment failure, animal contact, tree related, and so forth. Proposed solutions to identified service problems shall be reported.

The following table shows a breakdown of service interruption causes for the 12 months ended at the current quarter.

Cause Description	Trouble Cases	Percent of Trouble Cases	Customer Interruptions	Percent of Customer Interruptions	Customer Minutes	Percent of Customer Minutes
Animals	2,499	12.8%	39,287	3.5%	2,593,183	1.5%
Contact / Dig-In	160	0.8%	9,836	0.9%	752,060	0.4%
Directed by Non-PPL Authority	78	0.4%	16,483	1.5%	910,158	0.5%
Equipment Failures	5,977	30.6%	338,392	30.0%	32,079,482	18.4%
Improper Design	1	0.0%	31	0.0%	295	0.0%
Improper Installation	4	0.0%	624	0.1%	76,657	0.0%
Improper Operation	7	0.0%	8,731	0.8%	112,330	0.1%
Nothing Found	969	5.0%	64,255	5.7%	4,297,717	2.5%
Other Controllable	84	0.4%	9,714	0.9%	544,529	0.3%
Other Non Control	225	1.2%	10,157	0.9%	1,102,480	0.6%
Other Public	40	0.2%	5,911	0.5%	678,471	0.4%
Tree Related	8,685	44.5%	509,946	45.2%	120,810,468	69.1%
Unknown	-	0.0%	-	0.0%	-	0.0%
Vehicles	737	3.8%	94,124	8.3%	9,529,045	5.5%
Forced Due To UGI Gas	48	0.2%	21,484	1.9%	1,299,083	0.7%
Total	**19,514**	**100.0%**	**1,128,975**	**100.0%**	**174,785,958**	**100.0%**

Analysis of causes contributing to the majority of service interruptions:

Weather Conditions: PPL Electric records weather conditions, such as wind or lightning, as contributing factors to service interruptions, but does not code them as direct interruption causes. Therefore, some fluctuations in cause categories, especially tree- and equipment-related causes, are attributable to weather variations. For the current reporting period, weather was considered a significant contributing cause in 55% of cases, 60% of customer interruptions, and 79% of CMI.

Tree Related: Vegetation is one of the largest single contributors to the number of cases of trouble, customer interruptions and customer minutes. For the current reporting period, approximately 83% of the cases of trouble, 87% of the customer interruptions and 93% of the customer minutes attributed to tree related outages were weather-related.

Animals: Animals accounted for approximately 13% of PPL Electric's cases of trouble. Although this represents a significant number of cases, the effect on SAIFI and CAIDI is small because approximately 75% of the number of cases of trouble was associated with individual distribution transformers. However, when animal contacts affect substation equipment, the effect may be widespread and potentially can interrupt thousands of customers on multiple circuits. In addition to guarding new distribution transformers and substations, in 2009, PPL Electric initiated distribution and substation animal guarding programs to focus systematically on protecting existing facilities most at risk of incurring animal-caused interruptions. All PPL Electric substations have received animal guarding.

Vehicles: Although vehicles cause a small percentage of the number of cases of trouble, they accounted for a large percentage of customer interruptions and customer minutes, because main distribution lines generally are located along major thoroughfares with higher traffic densities. In addition, vehicle-related cases often result in extended repair times to replace broken poles. PPL Electric has a program to identify and relocate poles that are subject to multiple vehicle hits.

Equipment Failure: Equipment failure is one of the largest single contributors to the number of cases of trouble, customer interruptions and customer minutes. However, approximately 42% of the cases of trouble, 48% of the customer interruptions and 58% of the customer minutes attributed to equipment failure were weather-related and, as such, are not considered to be strong indicators of equipment condition or performance.

Nothing Found: This description is recorded when the responding crew can find no cause for the interruption. That is, when there is no evidence of equipment failure, damage, or contact after a line patrol is completed. For example, during heavy thunderstorms, when a line fuse blows or a single-phase OCR locks open and when closed for test, the fuse holds, or the OCR remains closed, and a patrol reveals nothing.

6) *Quarterly and year-to-date information on progress toward meeting transmission and distribution inspection and maintenance goals/objectives. (For first, second and third quarter reports only.)*

Inspection & Maintenance Goals/Objectives	Annual Budget	3rd Quarter		Year-to-date	
		Budget	Actual	Budget	Actual
Transmission					
Transmission C-tag poles (# of structures)	661	257	257	610	610
Transmission arm replacements (# of arms)	20	19	19	48	48
Transmission air break switch inspections (# of switches)	N/A	1	1	5	5
Transmission surge arrester installations (# of sets)	N/A	13	13	241	241
Transmission structure inspections (# of activities)	37,069	85	85	37,154	37,154
Transmission tree side trim-Bulk Power (linear feet)	N/A				
Transmission herbicide-Bulk Power (# of acres)	N/A				
Transmission reclearing (# of miles) BES Only	627	295	141	530	541
Transmission reclearing (# of miles) 69 kV	1,544	867	445	1,389	1,059
Transmission reclearing (# of miles) 138 kV	171	68	39	140	153
Transmission danger tree removals-Bulk Power (# of trees)	NA				
Substation					
Substation batteries (# of activities)	456	71	153	71	658
Circuit breakers (# of activities)	95	107	181	113	422
Substation inspections (# of activities)	775	215	379	216	1,443
Transformer maintenance (# of activities)	41	27	36	47	134

Inspection & Maintenance Goals/Objectives	Annual Budget	3rd Quarter		Year-to-date	
		Budget	Actual	Budget	Actual
Distribution					
Distribution C-tag poles replaced (# of poles)	3,418	1,262	800	3,366	2,367
C-truss distribution poles (# of poles)	1,182	428	428	1,224	1,224
Capacitor (MVAR added)	0	0	3	0	14
OCR Replacements (# of)	31	0	0	31	31
Distribution pole inspections (# of poles)	90,000	0	0	12,017	12,017
Distribution line inspections (hours)	10,459	800	796	3,513	3,190
Group re-lamping (# of lamps)	13,434	5,091	5,091	8,331	8,331
Test sections of underground distribution cable	N/A	209	209	781	781
Distribution tree trimming (# of miles)	5,967	1,467	1,265	4,358	4,165
Distribution herbicide (# of acres)	N/A				
Distribution >18" removals within R/W (# of trees)	N/A				
Distribution hazard tree removals outside R/W (# of trees)	N/A				
LTN manhole inspections (# of)	448	34	61	39	416
LTN vault inspections (# of)	345	41	87	43	469
LTN network protector overhauls (# of)	92	17	15	18	44
LTN reverse power trip testing (# of)	33	5	8	5	21

7) ***Quarterly and year-to-date information on budgeted versus actual transmission and distribution operation and maintenance expenditures in total and detailed by the EDC's own functional account code or FERC account code as available.***

The following table provides the operation and maintenance (O&M) expenses for PPL Electric, as a whole, which includes the work identified in response to Item (6).

Activity	3rd Quarter		Year-to-date	
	Budget ($000)	Actual ($000)	Budget ($000)	Actual ($000)
Provide Electric Service	1,840	1,551	4,969	4,819
Vegetation Management	10,210	12,330	32,940	31,965
Customer Response	16,497	16,774	43,196	55,170
Reliability Maintenance	11,810	8,084	31,555	22,683
System Upgrade	2,812	1,560	8,732	5,501
Customer Service/Accounts	30,004	28,947	81,090	72,576
Others	7,859	11,288	22,544	41,834
Total O&M Expenses	**81,033**	**80,535**	**225,026**	**234,547**

*8) **Quarterly and year-to-date information on budgeted versus actual transmission and distribution capital expenditures in total and detailed by the EDC's own functional account code or FERC account code as available.***

The following table provides the capital expenditures for PPL Electric, as a whole, which includes transmission and distribution ("T&D") activities.

Activity	3rd Quarter		Year-to-date	
	Budget ($000)	Actual ($000)	Budget ($000)	Actual ($000)
New Service/Revenue	23,601	24,534	64,117	65,385
System Upgrade	89,935	117,391	375,063	353,885
Reliability & Maintenance	157,917	137,494	387,814	349,766
Customer Response	5,139	4,587	13,025	25,079
Other	5,216	4,756	13,568	11,340
Total	**281,808**	**288,761**	**853,587**	**805,455**

9) Quarterly and year-to-date information on distribution substation inspections and reliability metrics.

(a) The Number of Corrective Work Orders by Type (Low-Priority, Mid-Priority, Urgent)

During the third quarter of 2019, 152 corrective work orders were created with the following breakdown by priority.

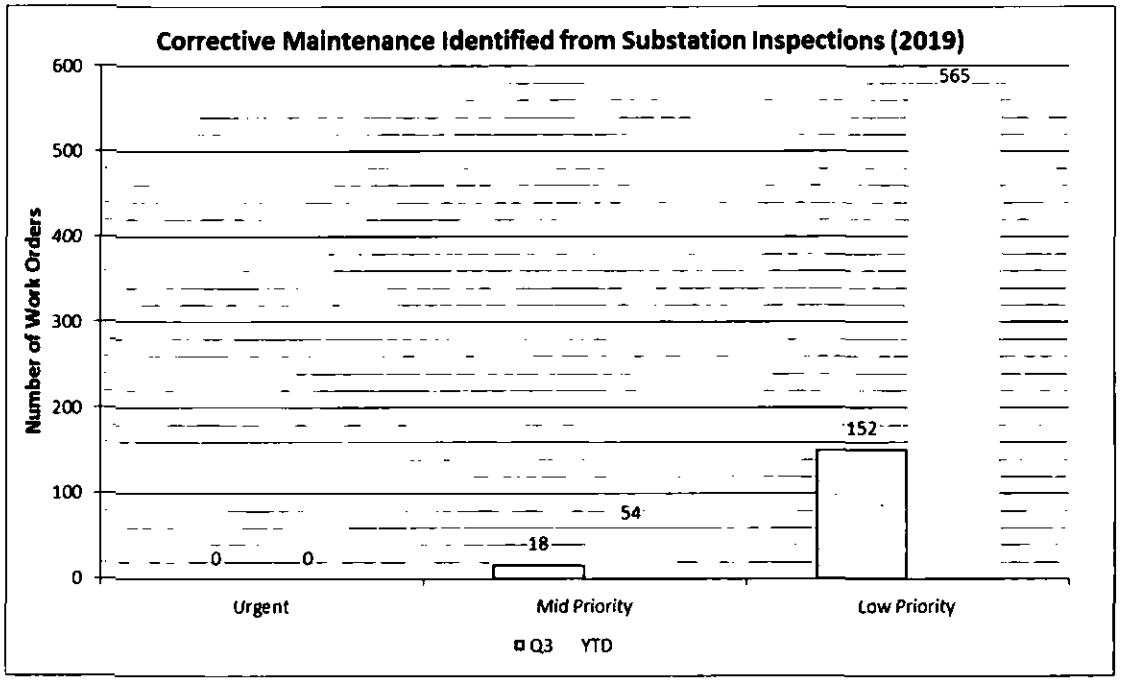

Figure 1: Corrective Maintenance Work Orders by Priority Level for third quarter and year-to-date 2019

(b) The Amount Spent on Substation Inspections

During the third quarter of 2019, PPL Electric spent approximately $122,000 on substation inspections.

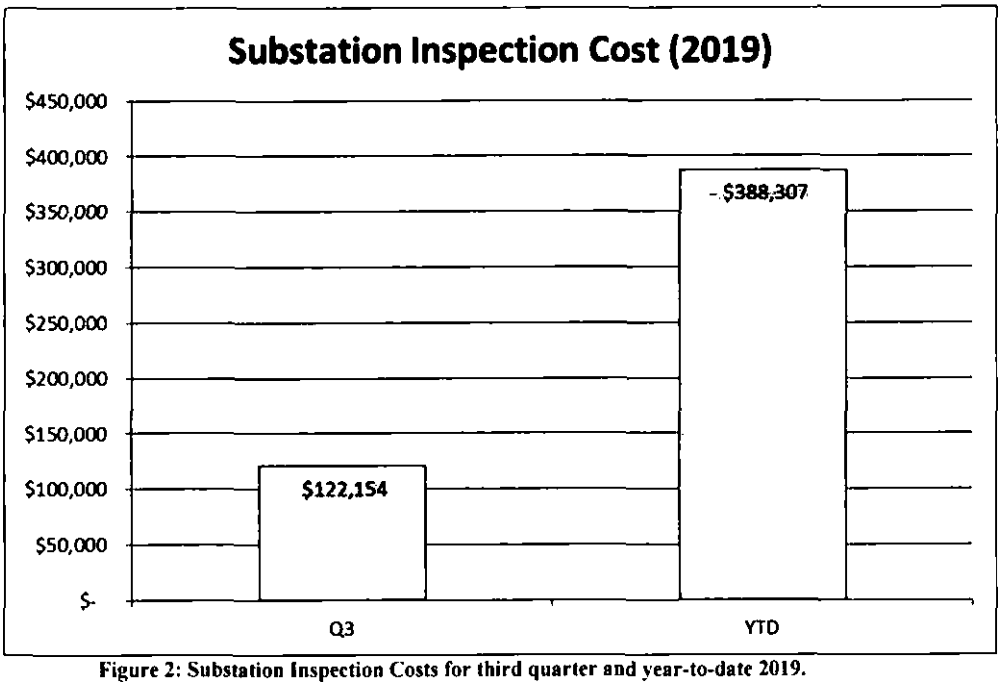

Figure 2: Substation Inspection Costs for third quarter and year-to-date 2019.

(c) The Amount Spent on Vegetation Management

Please refer to Section 7 for vegetation management expenses, for the fourth quarter and year-to-date.

(d) The Projected CMI Avoidance Due to Substation Inspections

The figure below shows the amount of CMI avoidance that PPL Electric has estimated for the third quarter and year-to-date. During third quarter of 2019, PPL Electric avoided a projected 474,000 CMI.

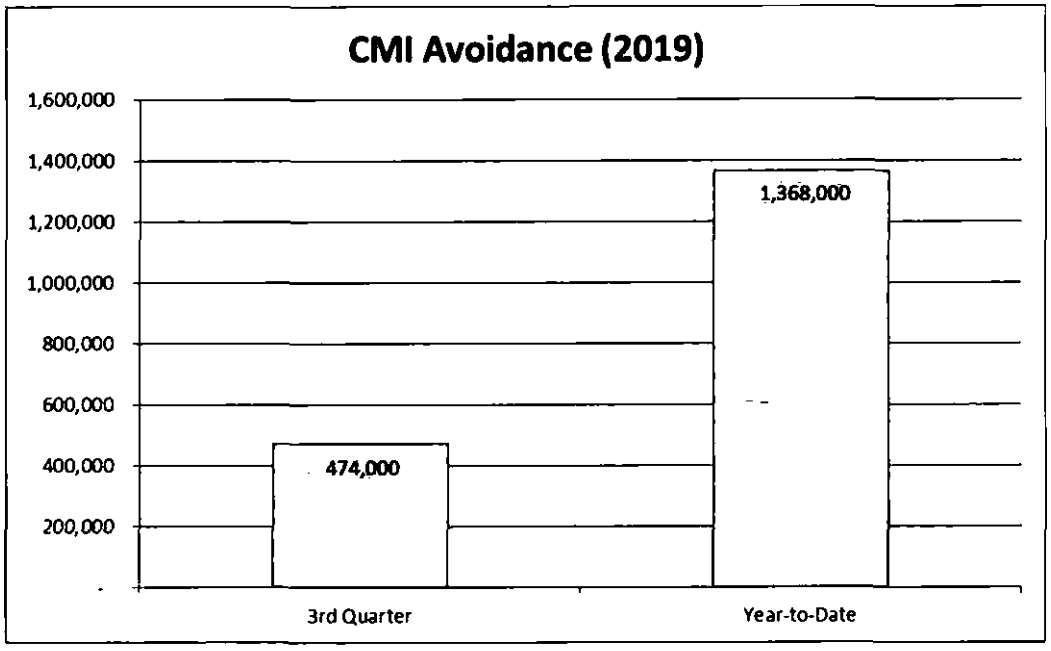

Figure 3: CMI Avoidance Due to Inspections for third quarter and year-to-date 2019

(e) Customer Minutes and Number of Customers Affected Due to Substation Sustained Outages

In the past three years, distribution substations have contributed a small amount toward the reliability metrics. During the third quarter of 2019, the Company interrupted about 28,000 customers for a total of approximately 412,000 CMI. The figures below show these results for the number of customers interrupted and CMI experienced, respectively.

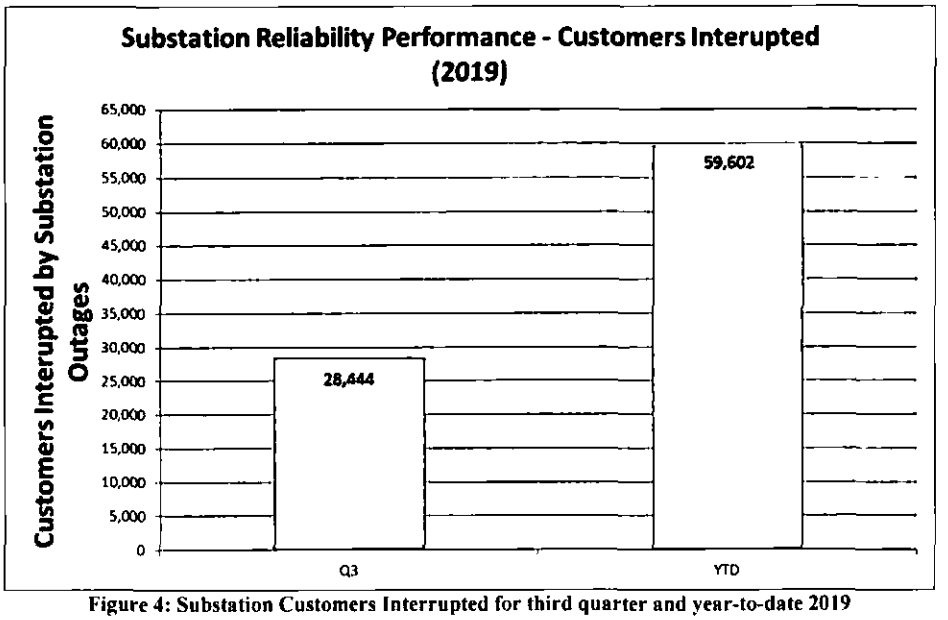

Figure 4: Substation Customers Interrupted for third quarter and year-to-date 2019

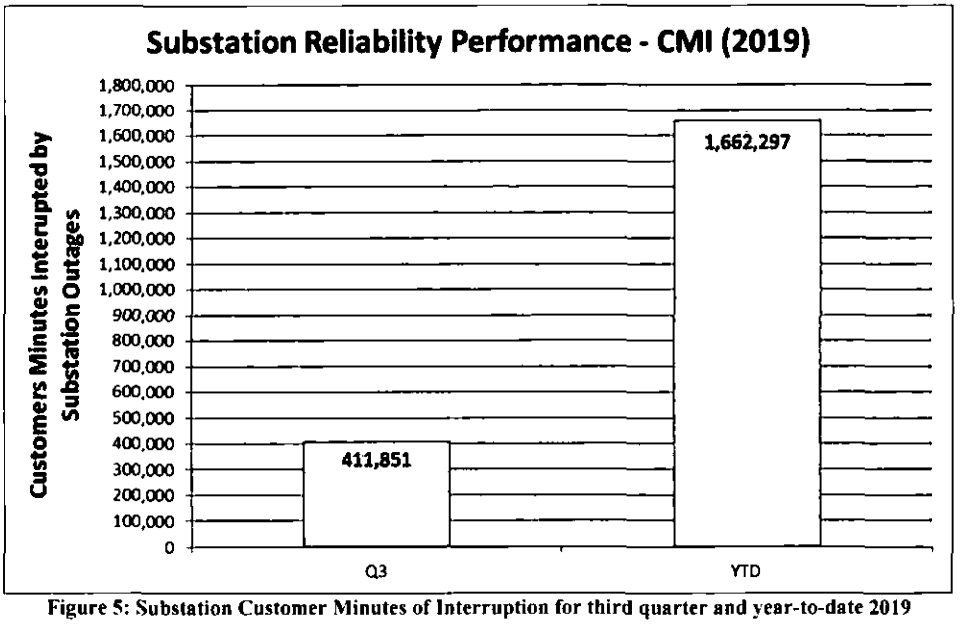

Figure 5: Substation Customer Minutes of Interruption for third quarter and year-to-date 2019

(f) Substation SAIFI Contribution

Overall, substation outages contributed approximately 10% of the total SAIFI experienced by PPL Electric customers in the third quarter of 2019. Historically, PPL Electric has ranked in the first quartile for Substation SAIFI performance on the Southeastern Electric Exchange (SEE) Survey, and is on-track to maintain its ranking among other electric utilities.

(g) Number of Substations with Remote Monitoring and Communication Technologies

PPL Electric has the capability of remotely monitoring its distribution substations through SCADA installations and through other telemetered equipment. This equipment allows PPL Electric to closely track the performance of its substation assets and respond to any trouble that is experienced on the distribution system. The table below shows the number of distribution substations that have this functionality.

	3rd Quarter	Year-to-Date
Substations with Remote Monitoring	354	354
Total Number of Substations	356	356

PPL Electric has launched a project to install smart relaying onto all 12kV circuit breakers at its distribution substations. These relays will allow the Company to quickly perform automated switching for lesser system impact during an outage event, and better-estimate fault locations for quicker system restoration. By 2022, the Company expects all 12kV circuit breakers to have these functionalities in order to enhance reliability performance.

10) ***Dedicated staffing levels for transmission and distribution operation and maintenance at the end of the quarter, in total and by specific category (for example, linemen, technician and electrician).***

The following table shows the dedicated staffing levels as of the end of the quarter. Job descriptions are provided in Appendix B.

Transmission and Distribution(T&D)	
Lineman Leader	58
Journeyman Lineman	193
Journeyman Lineman-Trainee	23
Helper	18
Groundhand	2
Troubleman	49
T&D Total	**343**
Electrical	
Elect Leaders-UG	2
Elect Leaders-Net	10
Elect Leaders-Sub	21
Journeyman Elect-UG	9
Journeyman Elect-Net	30
Journeyman Elect-Sub	64
Journeyman Elect Trainee-UG	0
Journeyman Elect Trainee-Net	0
Journeyman Elect Trainee-Sub	0
Helper	0
Laborer-Network	0
Laborer-Substation	0
Electrical Total	**136**
Overall Total	**479**

11) Quarterly and year-to-date information on contractor hours and dollars for transmission and distribution operation and maintenance.

Proprietary and Confidential

12) Monthly call-out acceptance rate for transmission and distribution maintenance workers presented in terms of both the percentage of accepted call-outs and the amount of time it takes the EDC to obtain the necessary personnel. A brief description of the EDC's call-out procedure should be included where appropriate.

Proprietary and Confidential

13) 52 Pa. Code 57.198(l) – EDC Updates

Pursuant to 52 Pa. Code § 57.198(l), PPL Electric hereby submits, as an Addendum to this Quarterly Reliability Report, a redline copy of its Commission-approved 2020-2021 Biennial Inspection, Maintenance, Repair and Replacement Plan ("I&M Plan"), which contains proposed revisions to PPL Electric's pole inspection interval. The redline copy of the I&M Plan shows the prospective and past revisions to the I&M Plan and provides the reasons for the proposed revisions.

Appendix A

PPL Electric Utilities Corporation

Worst Performing Circuit Definition / Comparison under old and new Circuit Performance Index (CPI) formulas.

PPL Electric uses total Customer Minutes Interrupted (CMI) during the previous four quarters to define the worst performing circuits on its system. Major events and pre-arranged outages are excluded. This ranking system was put in place as of the second quarter of 2013, for the following reasons:

- It focuses remediation efforts where they will have the greatest customer impact. Small pockets of customers with multiple interruptions are addressed under the CEMI (Customers Experiencing Multiple Interruptions) program, which is adequately funded to remediate these smaller customer groups.
- It identifies the circuits contributing the most to system SAIDI.
- It is simple and transparent, therefore allowing WPCs to be identified and remediated on a short timetable.

Appendix B

PPL Electric Utilities Corporation

Job Descriptions

Transmission and Distribution

Groundhand	• Performs manual labor and assists employees in higher job classifications.
Helper	• Performs semi-skilled labor at any work location on de-energized overhead and underground transmission, and distribution facilities to prepare the employee for entrance into the Journeyman Lineman Apprenticeship Program.
Journeyman Lineman	• Works alone or as part of a crew on the maintenance, operation, and construction activities of the transmission and distribution systems associated with, but not limited to, PPL Electric facilities.
Journeyman Lineman-Trainee	• Works alone or as part of a crew on the maintenance, operation, and construction activities of the transmission and distribution systems associated with, but not limited to, PPL Electric facilities.
Lineman Leader	• Responsible for completing assigned work by directing one or multiple groups of employees involved in the maintenance, operation, and construction activities of the transmission and distribution systems associated with, but not limited to, PPL Electric facilities. • Engage in and perform work along with providing the necessary leadership, all-around knowledge, program, judgment, and experience to produce a quality job. • Performs all the direct duties of the Journeyman Lineman when not acting as a Lineman Leader.
Troubleman	• Investigates and resolves trouble calls, voltage abnormalities on transmission and distribution systems associated with, but not limited to, PPL Electric facilities.

Electrical

Electrician Leader - Substation - Network - Underground	• Responsible for completing assigned work by directing one or multiple groups of employees involved in the construction and maintenance activities of the transmission and distribution systems associated with, but not limited to, PPL Electric facilities. • Engage in and perform work along with providing the necessary leadership, all-around knowledge, program, judgment, and experience to produce a quality job. • Performs all direct duties of the Journeyman Electrician when not acting as a leader.
Helper - Substation - Network - Underground	• Performs manual labor at any work location including those areas containing non-exposed energized electrical equipment, and to prepare the employee for entrance into the Apprenticeship Program.
Laborer - Substation - Network - Underground	• Performs manual labor and assists employees in higher job classifications.
Journeyman Electrician - Substation - Network - Underground	• Normally under limited supervision performs and is responsible for work associated with, but not limited to, PPL Electric facilities involving the highest degree of skill in construction and maintenance work associated with substations, LTN or underground distribution and transmission. • Uses microprocessor based equipment for troubleshooting and revising relay logic and its control systems related to the field services electrical discipline.

Journeyman Electrician - Trainee - Substation - Network - Underground	• Normally under limited supervision performs and is responsible for work associated with, but not limited to, PPL Electric facilities involving the highest degree of skill in construction and maintenance work associated with substations, LTN or underground distribution and transmission. • Uses microprocessor based equipment for troubleshooting and revising relay logic and its control systems related to the field services electrical discipline.

Addendum

PPL Electric Utilities Corporation

Biennial Inspection, Maintenance, Repair and Replacement Plan of PPL Electric Utilities Corporation

For the Period of January 1, 2020 – December 31, 2021

Submitted by:

~~Salim Salet~~
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Dated: ~~October 1, 2018~~November 1, 2019

PPL Electric Utilities Corporation

Table of Contents

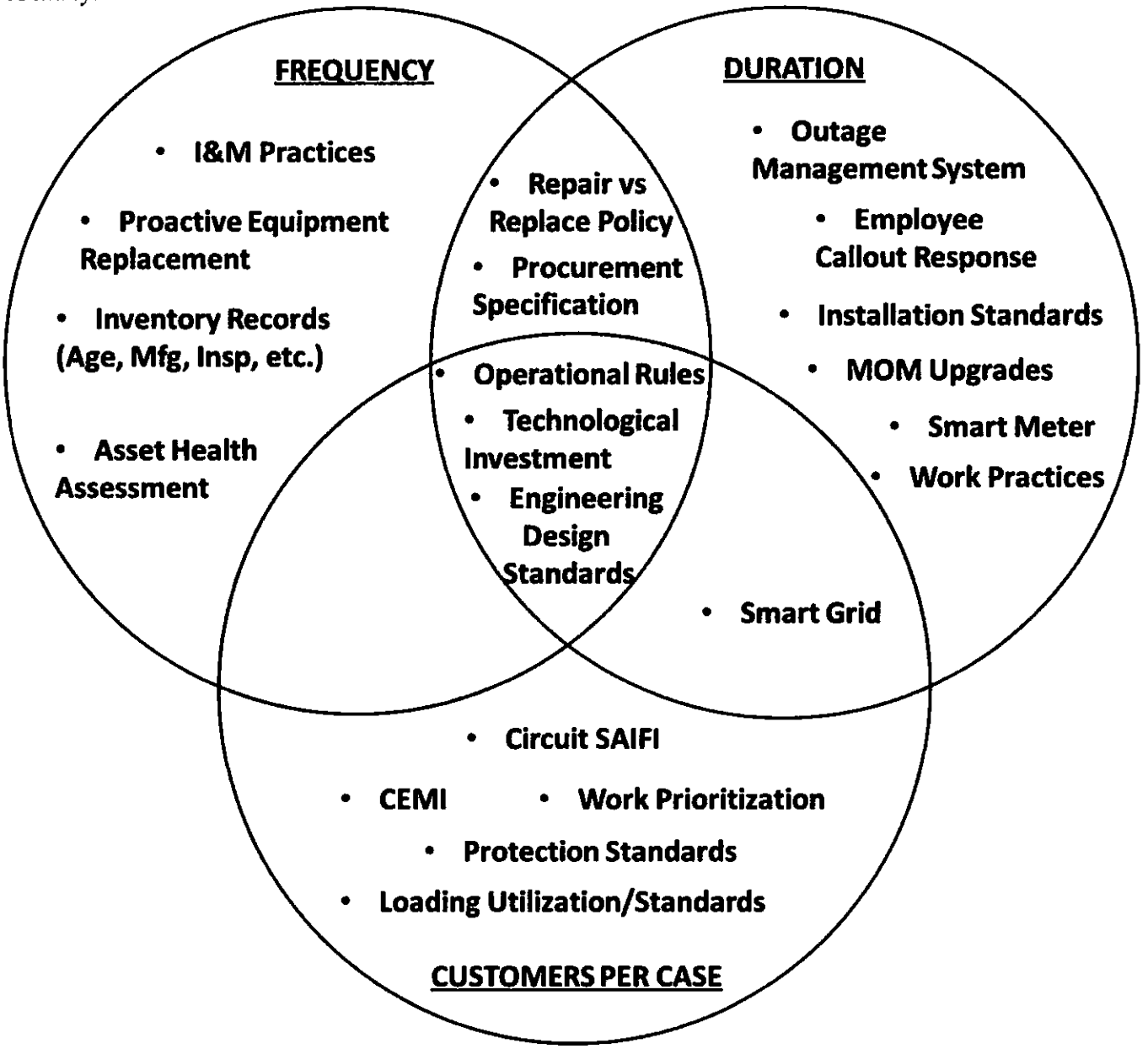
Introduction

PPL Electric Utilities Corporation ("PPL Electric" or "Company") is firmly committed to maintaining high levels of customer satisfaction. Customer surveys demonstrate that high levels of customer satisfaction depend upon providing reliable performance coupled with reasonable cost. PPL Electric has established a strong, long-term record of customer satisfaction and electric reliability. PPL Electric has earned 26 J. D. Power customer satisfaction awards – more than any other investor-owned utility in the country – since J. D. Power began studying customer satisfaction among electric utility customers. PPL Electric has ranked highest among large electric utilities in the eastern United States in J. D. Power annual study of residential customer satisfaction 15 times: in 1999 and from 2001-2007 and 2012-2018.

Ultimately, all of the costs of maintaining reliability are borne by the ratepayers. Therefore, managing finite resources to produce optimal results is essential in order to deliver excellence in customer satisfaction. The criteria for program inclusion is not whether any given activity produces a positive reliability result, but, rather, what portfolio of activities produces the best result for a given expenditure of resources given the specific reliability challenges faced by PPL Electric at this point in time, and for the foreseeable future. PPL Electric's goal is focused on results (i.e., the reliability experienced by customers), not the rote execution of particular tasks.

Reliability performance is driven by a mixture of manageable and unmanageable factors. The most impactful of the unmanageable factors is the frequency and severity of weather events, which can vary

dramatically over time and geography. The manageable factors have an effect on service interruption frequency, duration, or number of customers affected, or a combination of all three. The figure below depicts a portfolio of manageable factors with inspection and maintenance ("I&M") practices being one of many.



Reliability Programs and Policies

PPL Electric's philosophy is that the first step in improving reliability is to prevent outages altogether. The primary focus is, therefore, on the manageable factors that reduce the frequency (number) of cases. Efforts that typically overlap are those designed to minimize the number of customers affected should an outage occur. Realizing that not all outages are preventable, PPL Electric also directs rigorous efforts

designed to reduce the duration of the outages that do occur. Examples of PPL Electric initiatives addressing each of the three reliability sectors, frequency (number of cases), customers affected per case, and duration are addressed below.

Frequency (number of cases)

- **Inspection and maintenance practices and programs:** PPL Electric remains focused on equipment performance and service interruption avoidance through the application of effective inspection and maintenance practice and programs. A comprehensive discussion has been provided to the Pennsylvania Public Utility Commission ("PUC" or "Commission") via PPL Electric's I&M filing on a biennial basis since the initial report in 2010. The scope of these programs, procedures and activities covers all areas of the electrical infrastructure to include transmission, substations, distribution, and vegetation.

  Transmission
  Transmission inspection programs include aerial patrols and structure inspections, treatments and replacements. The patrols focus on comprehensive inspections, routine inspections, stop-go inspections, and identification of emergency work. The inspections encompass all equipment, including poles, arms, line switches, interrupters, arresters, grounding, guying, anchors and other key transmission components.

  Substation
  Substation maintenance programs include inspections, condition testing, and preventative maintenance of equipment, such as power transformers, circuit breakers, disconnects, power cables, and security equipment. Some equipment is maintained on a time basis; other equipment is condition monitored. These two methods help ensure that maintenance work is performed in a timely manner. In addition to time and condition-based maintenance, thermographic inspections help to ensure that substation equipment does not operate at elevated temperature levels, which could lead to premature failures.

  Distribution
  Distribution encompasses many maintenance aspects similar to transmission and substations, and also includes load surveys that assist in determining peak load requirements, and circuit analyses that help identify lines requiring maintenance work, voltage relief, or other capital improvements. Overhead line inspections identify the weak links in the system so that damaged or deteriorated equipment can be repaired or replaced. In addition, distribution maintenance includes inspections of poles, voltage regulators, line switches, capacitors, and other key distribution equipment. PPL Electric also tests underground cable for integrity to determine if the cable needs to be replaced, repaired or cured to prevent future failures.

  Vegetation
  The vegetation on PPL Electric's transmission and distribution rights-of-way is maintained using a combination of several management techniques. These include

reclearing, ground-to-sky trimming, hazard tree removal, tree pruning, and herbicide application. The work is prioritized based on the conditions observed and past performance.

Each of these programs is more fully described in Appendices A through D.

- **Asset Optimization Strategy ("AOS"):** PPL Electric conducted a major condition assessment and maintenance study of its distribution system in 2009. This project was initiated to identify and address the challenges created by the Company's aging infrastructure. The objectives were to assess equipment health in seventeen distribution asset classes comprising approximately 30,000,000 units of equipment, and generate a strategy for capital replacements and maintenance improvements to address these challenges. PPL Electric conducts effectiveness reviews of the various programs comprising this strategy to ensure that aging infrastructure continues to be appropriately addressed.

- **Asset Health Assessment:** In 2015, asset health and criticality scores for substation and LTN ("Low Tension Network") vital equipment were captured and evaluated. As a result, AOS replacement programs for these asset classes were further refined based on the score ranking to achieve the most effective reliability impact per dollar invested. Additionally, Low Tension Network ("LTN") inspections and replacement programs are being adjusted to optimize cost and reliability based on the health and criticality scoring. PPL Electric continuously monitors the accuracy and effectiveness of these asset health and criticality scores, and in early 2018, as more data records were captured, began an initiative to develop predictive failure models of these vital assets with the intention of continuously improving the health and criticality scores. These continued health calculation efforts enable PPL Electric to more effectively mitigate risk and optimize reliability.

- **Long Term Infrastructure Improvement Plan:** In January 2018 the Commission approved PPL Electric's second Long Term Infrastructure Improvement Plan ("LTIIP") This Plan was submitted pursuant to the requirements of Subchapter B, Distribution Systems, of the Public Utility Code, 66 Pa.C.S. §§ 1350-1360, and the PUC's Implementation Order for Establishment of a Distribution System Improvement Charge ("DSIC"). The Plan is a continuation of AOS infrastructure replacements in addition to prudent capital investments such as the proactive installation of animal guards, new sectionalizing devices, distribution automation, asset life extension methods, replacement of deteriorated equipment, and capital projects aimed at addressing worst performing circuits ("WPCs").

- **Customers Experiencing Multiple Interruptions ("CEMI") Program:** The goal of the CEMI Program is to reduce the number of interruptions experienced by customers such that no customer has an excessive number of outages in any rolling 12 month period, and to communicate in an effective and timely manner with customers when multiple service interruptions do occur. CEMI performance is monitored closely by regional distribution planners and reliability supervisors to identify cost-effective solutions which are submitted to the CEMI Task Force for evaluation and consideration.

The CEMI program is structured around three key attributes:

- Anticipate – monitor, forecast, and attempt to prevent multiple service interruptions from occurring.
- Mitigate – when multiple service interruptions occur, determine root causes, develop solutions, and ultimately implement corrective actions to reduce the risk of future interruptions.
- Communicate – following multiple service interruptions, contact customers to inform them that PPL Electric is aware that a service interruption has occurred, provide the cause of the service interruption, and the Company's plans to prevent future service interruptions, among other pertinent details. In addition, when solutions are implemented, contact customers and advise them of the improvements.

- **Distribution and substation animal guarding:** Two programs were established in 2009 to limit service interruptions caused by animals. The first was to install animal guards on distribution overhead transformers and switches in locations with a high density of animal-related service outages, and the second was to install animal guard materials at all distribution substations by 2019. This has proven effective. Since the program's rollout, animal outages have decreased by 34%.

Customers affected per case

- **Expanded Operational Reviews ("EOR"):** EORs are performed on each circuit on a four-year cycle. The review analyzes and addresses both operational and reliability characteristics of each circuit. Voltage support, phase balancing, protection coordination, power factor maintenance and loading issues are addressed from an operational perspective. Service outage analysis, exposure analysis and field checks address reliability and power quality.

- **Reliability Principles and Practices ("P&P") Revisions:** The P&P sets forth a set of principles that PPL Electric follows to plan, protect and operate the Electrical Distribution System ("EDS"). These principles are implemented through a set of standard practices that are used as guidelines in designing the EDS. These practices are reviewed regularly to ensure they remain reasonable and acceptable, and align well in accordance with good utility practices. Additional revisions to PPL Electric's P&P are underway to reduce the overall impact to our customers as the Company implements smart grid strategies.

- **Circuit SAIFI:** In 2013, PPL Electric launched a system wide initiative to install approximately 1,000 new fuses on single phase taps to limit the number of customers exposed to an outage on a given circuit. The Company continues to evaluate areas where fuse installation may reduce customer exposure to outages. As of 2018, over 2,600 locations have been fused, with more installations planned.

- **MAIFI**: In 2016, PPL Electric became one of the first electric utility companies in the nation to launch a concentrated effort to reduce momentary interruptions (defined as any power interruption less than five minutes) that customers experience. Through tracking momentary

interruptions and concentrating on circuits that experience higher than average momentary interruptions per customer, PPL Electric is reducing the number of momentary power outages on the system.

Duration (minutes/case)

- **Restore App / Storm Event Management** ("STEM"): As of 2017, two mobile applications are available that significantly improve storm response efficiency and situational awareness. The Restore App is an application that enables non-PPL crews to receive information about outages directly to their smart devices or PCs. Previously this information was provided via phone calls or hand-delivered documents. The Restore App also enables field personnel to send photographs of damaged equipment to PPL Electric support staff. To support command center situational awareness and strategy development, an application known as Storm Event Management ("STEM") now makes outage information, resource allocation, and estimated restoration times available on smart devices and PCs.

- **Automated Callout:** As of 2013, an automated system has been employed to call employees into work for after-hours emergencies. This system performs callouts simultaneously, whereas the previous system performed callouts sequentially, which shortens response time under storm conditions when large numbers of employees must be called out to restore service to customers.

- **Outage Management System ("OMS") enhancements:** In 2015, PPL Electric completed an upgrade of its OMS system. Numerous improvements were made to the software, including a stronger model of the network grid, improved system response time, and improved outage scenario modeling.

- **Storm Central:** Storm Central is a user friendly tool that allows personnel to quickly find the information and tools, developed under PPL Electric's Emergency Response Plan, needed to support the restoration of service to our customers after an emergency event.

- **Distribution Automation:** In 2010, PPL Electric launched a "smart grid" pilot project that enables the Company to react rapidly to changes on the delivery system, and automatically re-route power around problems that occur. The project initially focused on the Harrisburg, Pa. area, but has since been rapidly expanded to cover all of our service territory. The project included the implementation of an advanced Distribution Management Systems ("DMS"), which is a breakthrough technology that enables our operators to see the status of our distribution network in real-time. In 2016, PPL Electric completed a system wide rollout of FISR (Fault Isolation and Service Restoration) technology. FISR identifies faulted sections and quickly develops an optimized restoration plan, then automatically executes that plan. Customers typically can be restored within five minutes from the start of the outage. This milestone is an industry first and looks to significantly reduce overall outage durations. Over 7,500 automated smart devices have been installed to date. Such installations allow for remote operation and monitoring of circuit sectionalizing equipment, and advanced fault location technology. The goals of these improvements are threefold:

    - Reduce the number of upstream customers affected by a service outage.

- Reduce the time necessary to restore customers by transferring circuit sections to alternate sources and limiting long-duration service outages to smaller circuit sections involving fewer customers.
- Facilitate fault location and reduce the time necessary for repair and restoration.

The end-result will be a delivery system that operates more efficiently, recognizes problems immediately, and responds in seconds to restore the service for many customers who otherwise need to wait for crews to physically respond to an outage.

- **Smart Meter Technology**: PPL Electric is a national leader in the use of advanced metering technology for the benefit of customers, having installed an advanced metering system for all customers between 2002 and 2004. The Company has used the technology to improve the efficiency of responding to service outages – especially during storm emergencies – and as a tool for reliability planning. PPL Electric began exchanging its power line carrier meters with radio frequency ("RF") based meters, in December 2016. The RF meters will allow for even more improvements in outage detection and restoration as well as proactive reliability planning and customer service. As of August 31, the Company has installed 950,659 RF meters with deployment to be completed by the end of 2019.

PPL Electric Reliability Results

The reliability planning and investment process employed by PPL Electric have been very effective, as evidenced by its reliability performance. This has been accomplished while preserving a reasonable cost of providing service.

PPL Electric Reliability Planning Process

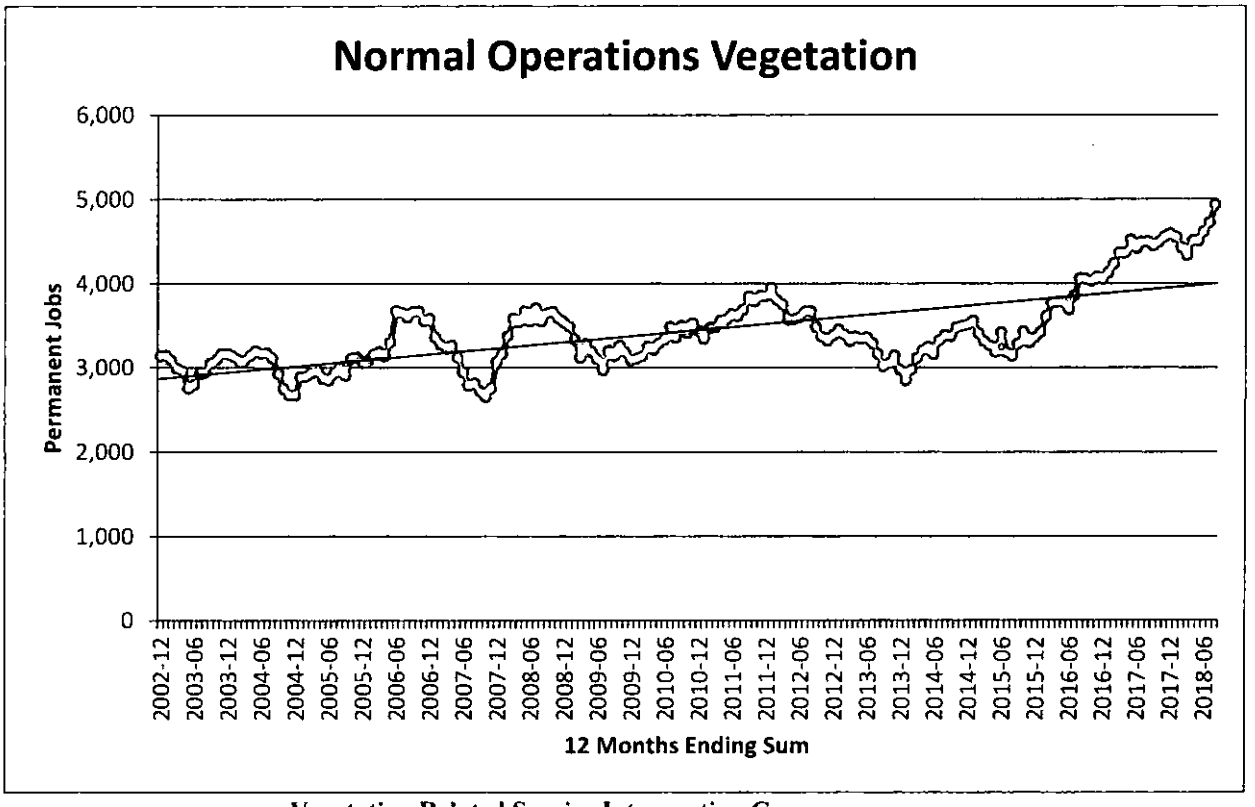
PPL Electric's process is forward-looking and proactive. It consists of the following:

- Analyze the historical trends of causes of service outages and other power service problems.
- Identify the drivers of those trends.
- Forecast future reliability metrics (SAIDI, SAIFI, CAIDI, and MAIFI) given existing mitigation programs' effect on the identified drivers.
- Identify new programs, policies and activities to add to or substitute for existing mitigation programs to avoid any forecasted gaps between future reliability and the desired levels.
- Identify, evaluate and implement new technologies that enhance its condition monitoring strategy
- Continually evaluate and adjust programs, policies and activities to produce the desired future results.
- The resulting portfolio of existing and new programs, policies and activities are incorporated in to PPL Electric's I&M plan.

PPL Electric Utilities Corporation

PPL Electric Reliability Analysis

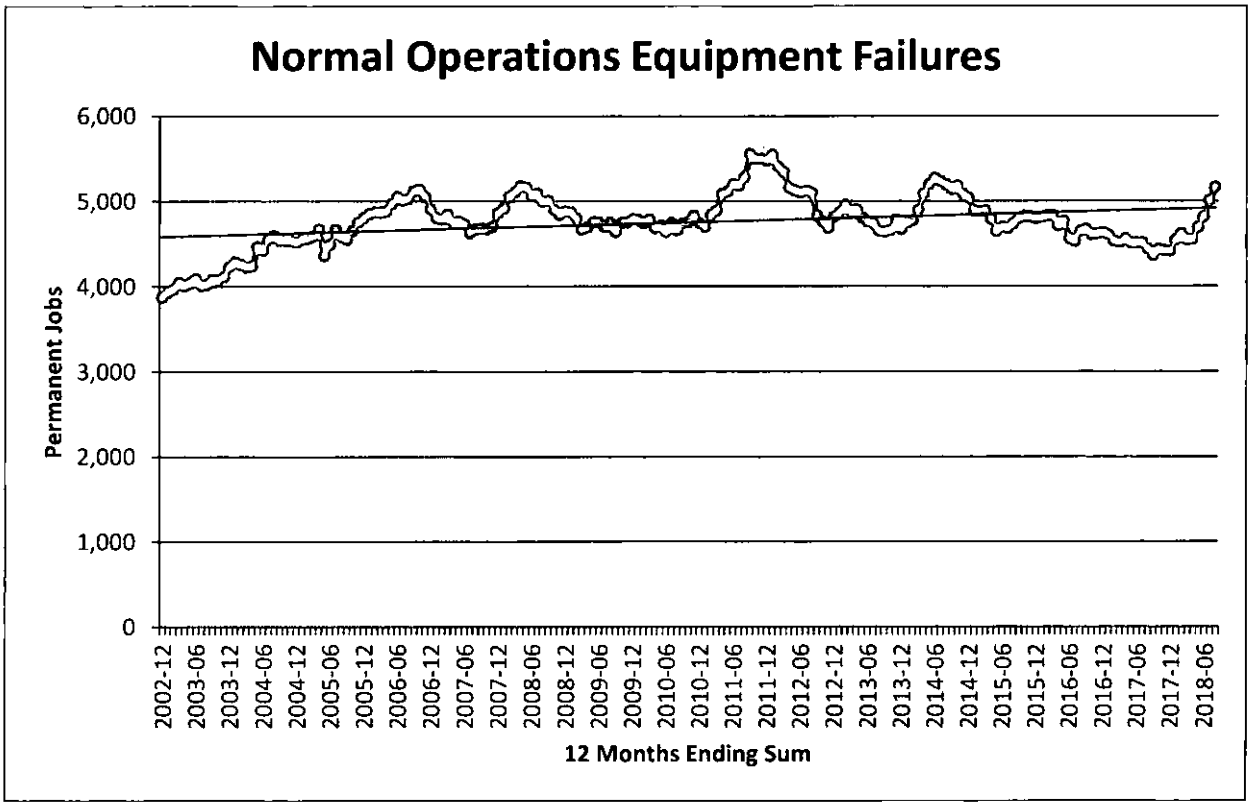
Identification and understanding of trends creates the opportunity to plan programs to mitigate undesirable trends. Most of the year-to-year variation in service interruptions is explained by differences in storm experience. Therefore, PPL Electric generally removes all declared-storm caused service outages (though not all weather related outages) for internal analysis to identify other causal trends affecting reliability. Each data point in the following charts represents a 12-month ending value to eliminate the effect of seasonal variation.



Vegetation Related Service Interruption Cases

PPL Electric is committed to continuing an aggressive tree trimming program to address the threat of tree related outages. It is worth noting that even when excluding major and PUC reportable storm events, 75% of vegetation related outages occur during adverse weather conditions. The saturated ground conditions prevalent in 2018 have resulted in higher than normal occurrences of healthy trees toppling into overhead conductor. Also of note is the ongoing infestation of the emerald ash borer in Pennsylvania, which is having a negative impact on vegetation related interruptions.

A significant risk to PPL Electric's ability to meet reliability benchmarks is the large portion of distribution facilities, which were installed in the 1960's and 1970's, that are now beyond or nearing the end of their design lifetime. The resultant effect on non-storm-related equipment failure is illustrated by the chart below.



Equipment Failure Service Interruption Cases

The annual number of outages due to equipment failure rose steadily through mid-2011 and has generally stabilized or declined since then. The recent spike in equipment failures is partially a result of the addition of thousands of additional fuse locations: currently a fuse operation where no clear cause can be found is coded into outage data as an equipment failure. However, if the fault was caused by a transient contact that is no longer apparent, the fuse operated as intended and no equipment failed. This practice is being reviewed.

Other initiatives contributing to this stabilization are equipment replacements identified through Expanded Operational Reviews of 25% of circuits annually, aggressive worst performing circuit remediation, implementation of PPL Electric's Asset Optimization Strategy, enhanced pole inspection and treatment, distribution automation including a new Distribution Management System, and infrared inspections.

Although these programs have successfully slowed equipment failure growth rates in the short-term, PPL Electric faces a long-term challenge regarding aging infrastructure. PPL Electric is committed to mitigating the aging infrastructure challenge through effective use of proactive replacement programs. Scheduled replacement of that infrastructure is necessary to avoid accelerating failure rates due to end of life fatigue.

Reliability is the largest contributor to overall customer satisfaction. Satisfaction levels vary depending upon the amount of information provided to the customer regarding their outage. Providing customers with accurate information about their outage is increasingly important. Customers are more understanding of storm and weather-related service outage impacts than they are of other outage causes, such as utility equipment failures.

If it is more cost-effective to offset an increase in equipment failure cases with a program to reduce vegetation-related cases, the ratepayer is better served by this cost-effective choice. Similarly, if a program that reduces the average number of customers affected by each service outage is more cost-effective than a program to reduce the gross number of service outages, the more cost-effective program should be chosen. The management challenge is to maintain reliability within acceptable parameters in the most cost-effective manner, while keeping customer satisfaction levels high.

52. Pa. Code § 57.198 (b) Plan Consistency. *The plan must be consistent with the National Electrical Safety Code, Codes and Practices of the Institute of Electrical and Electronic Engineers, Federal Energy Regulatory Commission Regulations and the provisions of the American National Standards Institute, Inc.*

PPL Electric's I&M Plan is consistent with the National Electric Safety Code ("NESC"), Codes and Practices of the Institute of Electrical and Electronic Engineers ("IEEE"), Federal Energy Regulatory Commission Regulations ("FERC") and the provisions of the American National Standards Institute, Inc. ("ANSI").

52. Pa. Code § 57.198 (c) Requested Deviations *The plan must comply with the inspection and maintenance standards in subsection (n). A justification for the inspection and maintenance time frames selected shall be provided, even if the time frame falls within the intervals prescribed in subsection (n). However, an EDC may propose a plan that, for a given standard, uses intervals outside the Commission standard, provided that the deviation can be justified by the EDC's unique circumstances or a cost/benefit analysis to support an alternative approach that will still support the level of reliability required by law.*

PPL Electric is again requesting acceptance of the following deviations from the intervals in the Commission standard as were included in the four previous I&M reports (2012-2013, 2014-2015, 2016-2017, and 2018-2019):

- Section 57.198 (n)(2). Pole Inspections. (vi) A load calculation.
- Section 57.198 (n)(4). Distribution overhead line inspections.
- Section 57.198 (n)(6). Distribution transformer inspections.

PPL Electric is again requesting acceptance of the following deviations from the intervals in the Commission standard as were included in the two previous I&M reports (2016-2017, 2018-2019):

- Section 57.198 (n)(7). Recloser inspections.

PPL Electric is again requesting acceptance of the following deviation from the intervals in the Commission standard as were included in the previous I&M report (2018-2019):

- Section 57.198(n)(8). Substation inspections.

52. Pa. Code § 57.198 (m) Recordkeeping(m) *An EDC shall maintain records of its inspection and maintenance activities sufficient to demonstrate compliance with its distribution facilities inspection, maintenance, repair and replacement programs as required by subsection (n). The records shall be made available to the Commission upon request within 30 days. Examples of sufficient records include: (1) Date-stamped records signed by EDC staff who performed the tasks related to inspection. (2) Maintenance, repair and replacement receipts from independent contractors showing when and what type of inspection, maintenance, repair or replacement work was done.*

Inspection and maintenance activities performed by PPL Electric employees are tracked by electronic work requests in the Company's Work & Asset Management System (WAM) software application which date-stamps transactions and captures an electronic signature of the employee certifying completion.

Inspection and maintenance activities performed by PPL Electric contractors are documented with itemized records, which identify when and what type of work was performed, before invoices for the work are paid.

52. Pa. Code § 57.198 (n)(1). Vegetation Management. *The Statewide minimum inspection and treatment cycle for vegetation management is between 4-8 years for distribution facilities. An EDC shall submit a condition-based plan for vegetation management for its distribution system facilities explaining its treatment cycle.*

Program Description

PPL Electric employs four-year and five-year inspection and trim cycles for its distribution circuits in its southern and northern territories respectively. The demarcation line for the northern and southern areas is the ridgeline of the Blue Mountains, which does not follow the borders of PPL Electric's regions. Based on conditions the cycle schedule may be modified, but not beyond established regulations. Additionally, a three-year inspection and trim cycle is currently applied to transmission lines in all of PPL Electric service territories.

PPL Electric rights-of-way will be maintained to the originally established clearances or the limits as defined in the right-of-way agreement, whichever is greater.

- Purpose

To safeguard the reliability of its electric distribution system, PPL Electric has developed a comprehensive program to manage vegetation around power lines. Keeping trees and other

vegetation away from high-voltage lines is important. Tree contacts can result in short-circuits and subsequent service outages.

Taller species of trees that are permitted to grow under power lines eventually will contact the wires, causing service interruptions and unsafe conditions. It is necessary for PPL Electric to trim or remove these trees to continue safe and reliable electric service.

- Process

Distribution

Multi-phase lines will be pruned to the full extent of the established tree line, not to exceed 25' from centerline and ground to sky pruning will be utilized.

Single-phase lines will be pruned to the full extent of the established tree line, not to exceed 15' from centerline and to a distance of 15' above the line. All dead or structurally weak limbs which could fall or blow into the conductor are removed regardless of their distance above the conductor.

Exceptions: Trees on the opposite side of any thoroughfare, where normal line construction exists (not alley arms), should be considered for proper lateral pruning using the centerline of the thoroughfare as a guideline. Fast growing tree species may need more aggressive pruning.

Another enhancement is hazard tree removal. "Hazard trees" are those trees outside the right of way that may be leaning, diseased, or otherwise pose a threat of falling on a distribution line. PPL Electric bears all costs of removing hazard trees and conducts the removal either based on right of way agreements or with property owner permission.

PPL Electric Utilities Corporation

Transmission

PPL Electric Utilities operates thousands of miles of high-voltage transmission lines. The Company's vegetation management program is designed to promote the safe and reliable operation of the electric grid, while taking into account the concerns of property owners and our obligations to electric customers. Low-growing grasses and other compatible species are permitted within the wire zone. In the remainder of the right-of-way, certain compatible trees and shrubs are allowed if they do not pose a reliability risk.

Inspection Plan

Distribution Vegetation Management			
	Area *(Line Miles)*	**Scheduled Trimming** *(Line Miles)*	
		2020	**2021**
PPL Electric Utilities Corporation *Total Line Miles (28,094)*	Lehigh (3,469)	788	795
	Northeast (5,190)	928	925
	Central (4,535)	900	903
	Susquehanna (5,769)	999	984
	Harrisburg (4,822)	1202	1004
	Lancaster (4,309)	964	972
	Totals	**5,781**	**5,583**

PPL Electric Utilities Corporation

52. Pa. Code § 57.198 (n)(2). Pole Inspections. *Distribution poles shall be inspected at least as often as every 10-12 years except for the new southern yellow pine creosoted utility poles which shall be initially inspected within 25 years, then within 12 years annually after the initial inspection. Pole inspections must include:*

(i) Drill tests at and below ground level.
(ii) A shell test.
(iii) Visual inspection for holes or evidence of insect infestation.
(iv) Visual inspection for evidence of unauthorized backfilling or excavation near the pole.
(v) Visual inspection for signs of lightning strikes.
(vi) A load calculation.

Program Description

- Cycle

~~Every ten years.~~
PPL Electric is proposing to change the pole inspection cycle from every 10 years (as provided for in its original 2020-2021 Plan) to every 12 years. This change in inspection cycle is consistent with the inspection frequency requirement set forth in Section 57.198(n)(2) of the Commission's regulations.

PPL Electric's proposed change will increase efficiency in pole inspections and treatments, without adversely affecting reliability. PPL Electric recently completed its first full pole inspection cycle and will start a second cycle in 2020. During the first inspection cycle, fewer than 5% of the remediated poles were less than 25 years old (see Figure 1). Notably, none of the pole failures causing an outage in the last 10 years was less than 25 years old. In fact, the average age of poles experiencing failures in the last 10 years was 51 years old.

Additionally, PPL Electric is confident the proposed change will have minimal or no impact to reliability. As shown in Figure 2 below, during the first cycle of pole inspections, PPL Electric only saw on average seven to eight failures annually that caused an outage: this equates to a 0.001% failure rate observed. These trends are projected to continue through the second cycle of pole inspections.

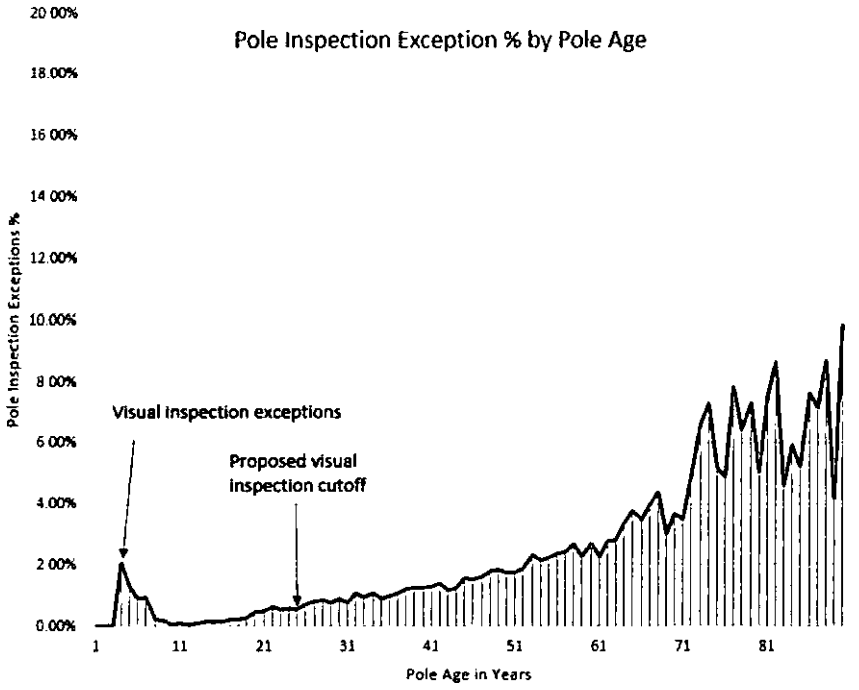


Figure 1 - Pole Inspection Exception % by Pole Age

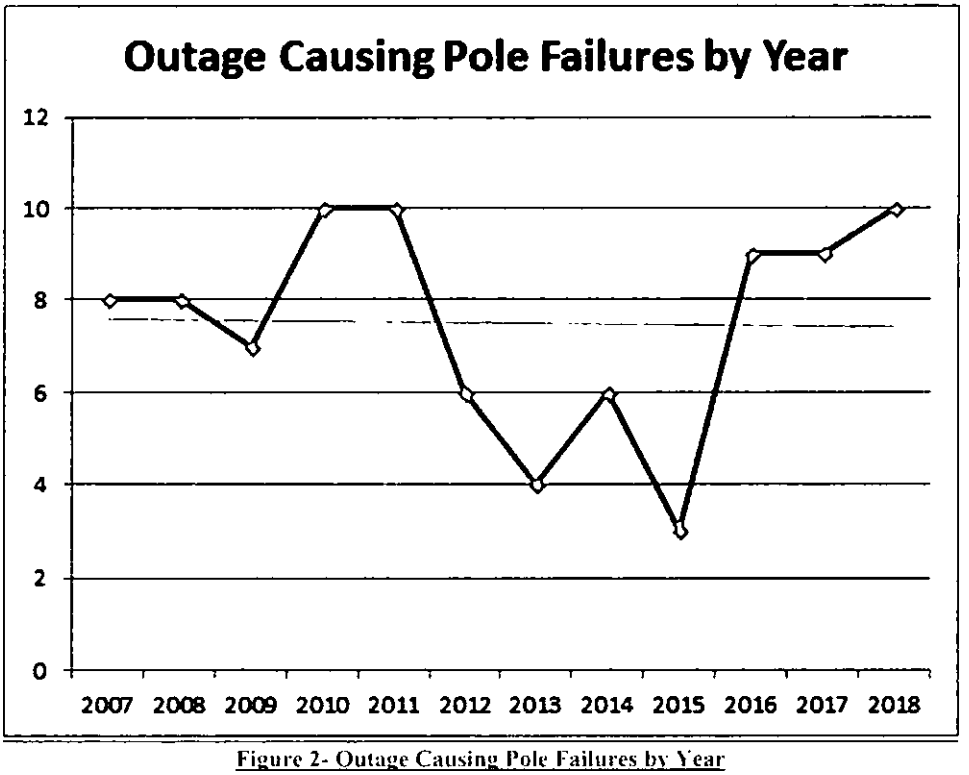


Figure 2- Outage Causing Pole Failures by Year

To optimize our pole inspection program while maintaining a high level public safety and reliability, PPL Electric is proposing to change the frequency of inspections to 12 years and full excavation inspections to poles older than 25 years.

This proposed change is based on the Company's data analytics review of the current pole inspection program. This data review indicated that pole exception rate (i.e., pole not passing the acceptance criteria) is very low before 25 years of age (2% less than 25 years), and only gradually increases afterward. The majority of pre-25 pole inspection exceptions are visual inspection exceptions (versus excavation and decay exceptions), which would still be caught under the proposed change.

- Purpose

  Distribution poles are inspected to identify and measure the extent of decay and defects that may adversely affect safety or service reliability.

- Process

  ~~Beginning in 2016, PPL Electric enhanced its pole inspection program from a partial excavation inspection program to a full excavation program. In a partial excavation program, each pole over the age of ten years that can be is excavated on two sides to a depth of 12 inches. In the current full excavation program, each pole over the age of ten years that is not set in concrete, asphalt or with a riser is fully excavated to a depth of 18 inches. The pole is inspected visually, sounded and bored above ground in addition to the full excavation. All measurable decay is entered into the contractor's engineering-based software program to determine the percentage of remaining strength, taking into consideration ANSI and NESC standards. If the percentage of remaining strength is below established parameters, a load calculation is performed to determine the pole's capacity to support the load in accordance with NESC standards. Poles younger than ten years are visually inspected only.~~

  ~~Based upon the inspection and testing results, the pole is treated with a preservative, reinforced (by truss or fiber wrap) or replaced.~~Beginning in 2020, each pole will be inspected on a 12-year cycle. Poles younger than 25 years are visually inspected only. Pole inspection program includes a visual inspection looking for holes or evidence of insect infestation, evidence of unauthorized backfilling or excavation near the pole, and signs of lightning strikes. Based on inspection results subsequent treatment, reinforcement, or replacement of Distribution poles is identified as defined in Appendix C. All poles greater than or equal 25 years of age are examined for deterioration, and the degree of decay is measured along with a treatment process applied to extend pole life.

- Justification for waiver

PPL Electric's pole inspection program generally complies with the intervals set forth in 52. Pa. Code § 57.198-(n)(2), NESC rules and is consistent with industry practices. PPL Electric proposes a continuance of the deviation from the requirement in 52 Pa. Code § 57.198(n)(2)(vi) for a load calculation to be performed for each pole inspected. The design of PPL Electric's lines is based on its Distribution Engineering Instructions which are based upon NESC heavy loading conditions. These instructions provide adequate safety factors such that the allowable percentage of strength reduction does not compromise the ability of the pole to support the load. PPL Electric requires entities attaching facilities to its poles to perform their own load calculations before making the attachment. Load calculations are performed on every pole where new attachments are requested by third parties.

~~PPL Electric does not track service outages caused by pole equipment failure as a discrete category. Poles are contained within a category that includes poles arms, brackets, guys, push braces, pole top extensions and any other mounting hardware. In 2017, equipment failures requiring replacement in this category amounted to 374 (7.6% of total cases), of which only a small fraction are poles. Excluding pole fires, only 9 cases (0.3% of total cases) suggest broken PPL Electric owned poles. (Nine poles represent 1/1000 of one percent of PPL Electric's 885,000 wood distribution pole inventory.) Most of the limited numbers of pole failures are aggravated by weather conditions such as trees being blown into lines, so the potential risk reduction through a load calculation is insignificant.~~

~~Beginning in 2010, the Company's wood pole maintenance program was enhanced from an inspection only process to an inspection and treat program, whereby all poles passing the inspection are chemically treated to arrest decay at the same visit. The preservative treatment permits the next inspection to be at a uniform ten years, rather than the former one to nine year cycle after original inspection applied to individual poles. Changing to a uniform ten year cycle will enable more economic geographic based inspections where all poles in a defined area are inspected, rather than the current method of inspecting scattered poles with individually specified intervals which maximizes the employee travel involved.~~

PPL Electric Utilities Corporation

Inspection Plan

Distribution Wood Pole Inspections			
	Area *(Poles)*	**Inspections Planned** *(Poles)*	
		2020	**2021**
PPL Electric Utilities Corporation *Total Poles (885,040)*	Lehigh (118,218)	~~12,022~~9,851	~~12,022~~9,851
	Northeast (175,862)	~~17,883~~14,655	~~17,883~~14,655
	Central (158,243)	~~16,092~~13,186	~~16,092~~13,186
	Susquehanna (160,991)	~~16,371~~13,415	~~16,371~~13,415
	Harrisburg (140,595)	~~14,297~~11,716	~~14,297~~11,716
	Lancaster (131,131)	~~13,335~~10,927	~~13,335~~10,927
	Totals	**~~90,000~~73,750**	**~~90,000~~73,750**

52. Pa. Code § 57.198 (n)(3). Pole inspection failure. *If a pole fails the groundline inspection and shows dangerous conditions that are an immediate risk to public or employee safety or conditions affecting the integrity of the circuit, the pole shall be replaced within 30 days of the date of inspection.*

Corrective Maintenance

- PPL Electric obtains pole replacement data weekly. Critical poles, those that pose an immediate safety concern, are reinforced or replaced as soon as possible, and not later than 30 days after notification. Other non-restorable rejected poles generally are replaced within one year of identification. Pole strength and loading calculations are provided for each rejected pole to assist in reinforce versus replace decisions and schedule prioritization.

- Reinforcement by steel C-Truss, a galvanized steel truss which is banded around the pole in order to regain the pole's original strength or fiber wrap, several layers of high-strength fiberglass wrapped onto the pole and saturated with resin is completed within 90 days of identification. The method of reinforcement is determined by the circumstances and/or location of the pole.

52. Pa. Code § 57.198 (n)(4). Distribution overhead line inspections. *Distribution lines shall be inspected by ground patrol a minimum of once every 1-2 years. A visual inspection must include checking for:*

(i) Broken insulators.
(ii) Conditions that may adversely affect operation of the overhead transformer.
(iii) Other conditions that may adversely affect operation of the overhead distribution line.

Program Description

- Cycle

  Infrared inspection: Multi-phase overhead lines adjacent to roadways every two years.

  Visual inspection: Condition based – selected line segments. Inspections are scheduled under various conditions to include CEMI and WPC circuits, if warranted based on EORs, and if power quality issues are experienced. Additional patrols are conducted to ensure continued reliability include those in support of distribution construction projects as well as summer and winter readiness patrols.

  Pole inspection: ~~Every ten years~~See section ***52. Pa. Code § 57.198 (n)(2). Pole Inspections.***

- Purpose

  The objective of an overhead line inspection is to identify and correct hardware or equipment defects that may lead to a future service interruption or pose a safety hazard. Defects are identified by inspection, ranked in order of priority and scheduled for repair.

- Process

  Infrared: Multi-phase distribution lines adjacent to roadways are scanned from vehicles. A roof-mounted infrared camera is employed to capture a thermal image of components carrying electrical current. Heat emission measurements are compared to reference temperatures. Probability of failure is estimated based upon the magnitude of temperature difference from reference. The method detects problems in current carrying components such as transformers, connections, splices, hot line clamps, disconnects, switches, lightning arresters, bridges disconnects, terminators, etc., whether or not there are visible

defects. A detailed report of findings is prepared and at-risk items are prioritized and mitigated by repair or replacement.
Visual: An analysis of actual service interruptions is conducted on selected circuits (e.g., poor performing circuits as measured by PPL Electric's WPC process, circuits with higher CEMI customers, and circuits undergoing expanded operational reviews.) If an analysis indicates a pattern of equipment failure exists, a visual line inspection is scheduled. In addition to looking for visible defects in current-carrying components, visual inspection looks for mechanical defects in anchors, guys, crossarms, insulators, offset brackets, grounding systems and poles.

Pole Inspection: As an integral part of the ten-year pole inspection process, the wood poles are observed, with at-risk conditions of all pole attachments, specifically crossarms, braces, conductors, transformers, fuse cutouts, lightning arresters, reclosers, regulators, capacitors, switches, wildlife protection, vegetation encroachment, guys, anchors, ground wires and rods noted and reported.

- Justification for waiver

PPL Electric hereby proposes a continued deviation from the 1-2 year inspection cycle on the basis of an effectiveness evaluation and cost benefit analysis in favor of the program described herein. Resources that would be applied to shorter visual cycles than this proposal would reduce the resources applied to other more cost-effective reliability programs described in this plan.

PPL Electric conducted a trial of infrared inspections of multi-phase lines in 2006. The trial inspections cost $122,500 and identified repairs costing $100,000, saving an estimated 1,460,000-2,600,000 Customer Minutes Interrupted ("CMI"), at a cost of $0.09 to $0.15 per CMI saved. PPL Electric restructured the infrared service contract gaining further efficiencies in 2014. The cost benefit as calculated by the 2018 program effectiveness review suggested that the two programs, at a yearly cost of $327,000, save an estimated 719,000 CMI, at a cost of $0.45 per CMI saved.

PPL Electric employs a $2.00 per CMI saved cost threshold[1] as a principal criteria for evaluating new projects for inclusion in the portfolio of reliability programs. Costs below that threshold are generally considered to be prudent investments, while those above typically provide less benefit for the cost. The cost threshold assists in applying finite

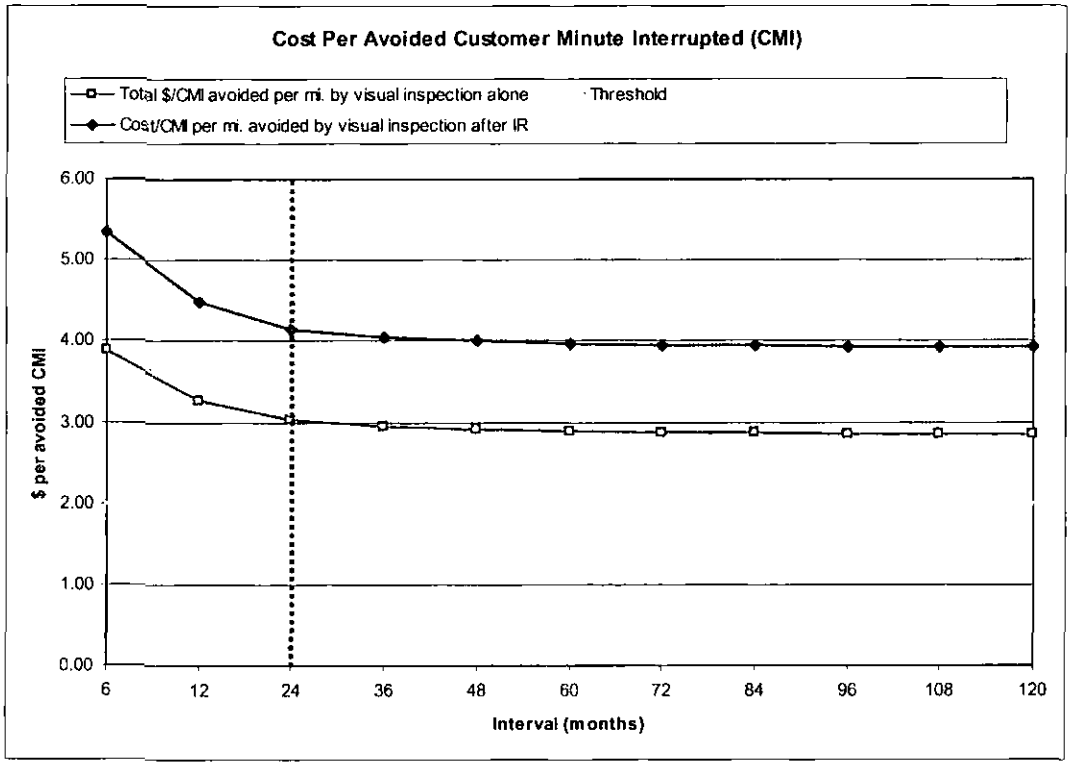
[1] Cost threshold recommended by Richard E. Brown, Sr. Vice President and co-founder of Quanta Technology, a firm specializing in technical and management consulting for utilities. Dr. Brown has provided consulting services to most major utilities in the U.S. Dr. Brown has published more than 90 technical papers related to asset management and is the author of Electric Power Distribution Reliability, CRC Press, 2009.

resources to programs producing better results, thus enabling the most effective portfolio of programs. Because infrared costs per CMI saved are well below the threshold, PPL Electric instituted a two-year infrared cycle for accessible multi-phase lines.

PPL Electric also conducted an overhead line visual inspection cost benefit study in 2010. The study calculated a reliability benefit as a probability that inspections and the associated repairs will reduce equipment failure service interruptions. The overall probability is the product of (a) the probability that an equipment failure service outage is preceded by a visible condition, (b) the probability that the visible condition exists at the time of inspection, (c) the probability that an existing condition is detected and (d) the probability that the condition is repaired before a service interruption occurs. For seven of the thirteen overhead distribution component codes, actual inspection data established little likelihood of visible conditions preceding failure. For the remaining six component codes, subject matter experts were surveyed. The resulting probability estimates were applied to actual service outage data to estimate avoided CMI per mile. The inspection and repair cost per mile divided by CMI avoided per mile yielded an estimate of cost per CMI avoided. The graph below shows these costs per CMI for various inspection intervals.

The study also estimated avoided CMI/mile for visual inspections that follow infrared inspections because there is significant overlap between the two methods: infrared identifies both visible and hidden defects in current carrying components, while visual inspection detects only visible defects in electrical and mechanical components. The second graph below shows these costs per CMI for various inspection intervals.

As the graphs below depict, given PPL Electric's reliability parameters, there is no interval for visual overhead inspections that meets the established cost threshold, particularly when performed in conjunction with infrared inspections. Visual inspections alone at two-year intervals are 50% above the threshold; two year visuals done in conjunction with infrared are 100% above the threshold.



Overhead Line Inspection Cost per Avoided CMI

Although universal overhead visual inspections are not cost-effective, targeted visual inspections have more value. In a typical year, less than 15% of the circuits are responsible for 80% of equipment failure CMI. For the period 2002 to 2009, 30% of the circuits were responsible for 80% of equipment failure CMI.

Consequently, PPL Electric employs the condition-based visual inspection approach described above, combined with Expanded Operational Review field checks and overhead inspections in conjunction with pole inspections.

PPL Electric Utilities Corporation

Inspection Plan

PPL Electric will inspect multi-phase drivable lines every other year, per the total mileage listed in the chart below.

Distribution Overhead Multi-phase Line Infrared Inspections			
Total Line Miles/Drivable Line Miles[2]	**Line Miles by Region**	**Infrared Inspections Planned** *(Line Miles)*	
		2020	**2021**
PPL Electric Utilities Corporation *(Total System Line Miles: 8,626/8,195)*	Lehigh (1,337/1,270)	635	635
	Northeast (1,446/1,374)	687	687
	Central (1,618/1,537)	768	769
	Susquehanna (1,264/1,201)	601	600
	Harrisburg (1,411/1,340)	670	670
	Lancaster (1,550/1,473)	737	736
	Annual totals	**4,098**	**4,097**

[2] For planning purposes, an assumption that 95% of multi-phase line miles are drivable is employed.

PPL Electric Utilities Corporation

Distribution Overhead Visual Inspections			
	Line Miles by Region	**Estimated Visual Inspections** *(Line Miles)*	
		2020	**2021**
PPL Electric Utilities Corporation *Total System Line Miles (28,094)*	Lehigh (3,469)	390	390
	Northeast (5,190)	540	540
	Central (4,535)	480	480
	Susquehanna (5,769)	600	600
	Harrisburg (4,822)	510	510
	Lancaster (4,309)	480	480
	Annual totals	**3,000**	**3,000**

52. Pa. Code § 57.198 (n)(5). Inspection failure. *If critical maintenance problems are found that affect the integrity of the circuits, they shall be repaired or replaced no later than 30 days from discovery.*

Corrective Maintenance Description

- Infrared

  Priorities for corrective maintenance are determined by the magnitude of the variance from normal operating temperature.

Distribution Overhead Infrared Inspections Corrective Maintenance		
	Variance from Normal Operating Temp.	**Days Allowed After Report Receipt for Service**
Secondaries	+20-60° C	8 weeks
	> +60° C	2 weeks
Disconnect Switches	+20-60° C	8 weeks
	> +60° C	2 weeks
All Other Facilities	+10-40° C	8 weeks
	> +40° C	2 weeks

- Visual

  The urgency for repairs is determined and an appropriate order of priority is assigned from four categories (Emergency, Priority, Unsatisfactory, and System Improvement) described below.

Distribution Overhead Visual Inspections Corrective Maintenance	
Definition	**I&M Standard**
Emergency; Defects which: (1) Threaten the safety of the public or employees; or (2) Will cause a service interruption at any moment Scheduling Priority: 1	Corrective Action taken Immediately
Priority; Defects with a high probability of causing a service interruption if not corrected promptly. Scheduling Priority: 2	Corrective Action must be taken within 30 days.
Unsatisfactory; Defects with a lower probability of causing a service interruption if not corrected promptly. Scheduling Priority: 3	Corrective action must be taken within 3 months.
System Improvement; Conditions which could be altered to improve service reliability, with no immediate reduction of risk of service interruption. Scheduling Priority: 5	Corrective action may or may not be taken.

PPL Electric Utilities Corporation

52. Pa. Code § 57.198 (n)(6). Distribution transformer inspections. *Overhead distribution transformers shall be visually inspected as part of the distribution line inspection every 1-2 years. Above-ground pad-mounted transformers shall be inspected at least as often as every 5 years and below-ground transformers shall be inspected at least as often as every 8 years. An inspection must include checking for:*

(i) Rust, dents or other evidence of contact.
(ii) Leaking oil.
(iii) Installation of fences or shrubbery that could adversely affect access to and operation of the transformer.
(iv) Unauthorized excavation or changes in grade near the transformer.

Program Description

- Cycle

  Overhead: Overhead transformers are inspected as part of overhead visual line inspections, infrared inspections, and pole inspections. Additionally, load profiles are analyzed to identify and remedy overhead transformer locations that have consistent load demands exceeding design parameters.

  Pad-mount and below-ground: Inspections are scheduled when indicated by circuit performance and confirmed by an analysis of actual service interruptions that identifies underground failures addressable by visual inspection.

  Pad-mount and below-ground transformers may be inspected as part of the underground residential development cable testing, replacement and curing program, which tests approximately 500-600 sections per year and cures approximately 600-800 sections per year.

  During 2012, PPL Electric performed a pilot of single phase pad-mounted transformer inspections of some of the older underground residential developments. The result was that, apart from some minor rusting, the conditions of the pad-mount transformers were in good working condition. These transformers were generally reliable so a formal inspection program would add little reliability benefit for excessive costs to the customer as outlined in the justification.

- Purpose

  The objective of a transformer inspection is to identify and correct hardware or equipment defects that may lead to a future service interruption or pose a safety hazard. Defects are identified by inspection, ranked in order of priority and scheduled for repair.

- Process

  Overhead and underground transformers are visually inspected for damage (rust, dents, cracks, locking devices, broken bushings, etc.), integrity of connections and leaks. In addition, pad-mounts and below-ground transformers have cables and elbows inspected for deterioration, foundations and covers inspected and animals, nests, cobwebs and vegetation removed.

- Justification for waiver

  PPL Electric hereby proposes a continued deviation from the fixed inspection cycle for transformers in favor of the condition-based inspection program described herein.

  The overhead line inspection cost benefit study described previously estimated that about 20,000 CMI annually could be saved via visual overhead transformer inspections. In 2016, the estimated cost to inspect those transformers every two years was $1.3 million or $65 per CMI avoided, well above the threshold employed by PPL Electric of $2.00 per CMI saved for identifying prudent reliability investments.

  Similarly pad-mount transformers only contribute 500,000 CMI on average to overall system reliability. An inspection and maintenance program for transformer condition would cost millions in expense for little improved reliability over other underground reliability improvement programs.

  Resources that would be applied to shorter cycles than this proposal would reduce the resources applied to other more cost-effective reliability programs described in this plan.

52. Pa. Code § 57.198 (n)(7). Recloser inspections. *Three-phase reclosers shall be inspected on a cycle of 8 years or less. Single-phase reclosers shall be inspected as part of the EDC's individual distribution line inspection plan.*

Program Description

- Cycle

  PPL Electric has initiated an upgrade program to replace all three phase oil circuit reclosers ("OCRs") with vacuum circuit reclosers ("VCRs") based upon a review of the dominant failure modes and causes. The newer technology replaces oil with a vacuum as the interrupting media. This eliminates the OCR maintenance issues of carbonized oil, contact deterioration and the timing issues that sometimes occur with OCRs. In addition, the communication capabilities of the devices allows for PPL Electric to track data pertaining to the asset health which will allow PPL Electric to do condition based

maintenance on these devices. PPL Electric received approval from the commission on January 3, 2014 to complete these replacements on a 10-year cycle starting in 2015.

Three-phase VCRs are subjected to infrared inspection on the same 2-year cycle as OCRs.

Three-phase OCR: 2-year infrared; 10-year replacement.

Single-phase OCRs: inspected as part of PPL Electric's distribution line inspection program.

- Purpose

  The purpose of the recloser replacement program is to ensure the reliable operation of reclosers by replacing deprecated equipment with new installations.

- Process

  Three-phase oil and vacuum reclosers are included in the two-year infrared line inspection program.

  Three-phase OCRs are replaced with new communicating VCR units based upon installation date and type.

- Justification for waiver

  PPL Electric hereby proposes a continued deviation for reclosers in favor of the program described herein.

  A recloser's function is to isolate faults while minimizing the number of customers affected by permanent service outages. Visual inspection of an OCR provides relatively little useful information about the unit's capability to perform its function compared to testing. Testing in place would require almost all of the same steps that are involved in replacement. Bench testing is preferable to testing in place and refurbishment requires the unit's removal from service. With the planned installation of these communicating vacuum units, the devices have a longer life expectancy, and inspections can be planned.

  As PPL Electric has been replacing older oil reclosing three phased units, reliability has improved from the decreasing number of failed units. In addition, PPL Electric experienced close to a 50% improvement in reliability within the initial smart grid pilot area.

PPL Electric Utilities Corporation

Replacement Plan

Actual scope is determined annually based upon the number of OCRs on the system, age, and model type of OCR. The projections below are tentative until replacement recommendations are provided.

Distribution Three Phase OCR Replacements			
	Area *(Number of Three Phase OCRs)*	**OCR Replacements Planned**	
		2020	**2021**
PPL Electric Utilities Corporation *Total Three Phase OCRs (473)*	Lehigh (94)	10	10
	Northeast (117)	12	12
	Central (101)	11	11
	Susquehanna (53)	6	6
	Harrisburg (51)	5	5
	Lancaster (57)	6	6
	Totals	**50**	**50**

52. Pa. Code § 57.198 (n)(8). Substation inspections. *Substation equipment, structures and hardware shall be inspected on a cycle of 5 weeks or less.*

Program Description

- Cycle

	Visual	Infrared
Distribution- Supervisory control and data acquisition ("SCADA") Controlled	Quarterly	Annual
Distribution-Non SCADA	Quarterly	Annual

- Purpose

  Periodic substation inspections verify the integrity of station physical security, record and correct any security breaches, verify the proper fluid levels and gas pressures, and identify any leaks, verify the proper operation of essential station equipment and initiate any necessary corrective actions.

- Process

  Inspection of substation equipment and recording abnormal conditions of the equipment. Equipment inspected includes, but is not limited to:

  - Power transformers
  - Circuit breakers
  - Auxiliary equipment
  - Batteries and chargers
  - Control house
  - Yard and perimeter

- Justification for waiver

In 2017, PPL Electric was granted a deviation from the five-week inspection cycle for substations in favor of the quarterly program described herein.

From 2016-2018, PPL Electric estimates that a yearly average of 826k CMI was avoided through repairs identified via the monthly substation inspection. The costs of inspection plus repair averaged $1.24 million per year, or $1.50 per CMI avoided, which is under the threshold employed by PPL Electric of $2.00 per CMI saved for identifying prudent reliability investments.

PPL Electric plans to have SCADA at every substation, which provides real-time telemetry of potential issues. As of August 2018, PPL Electric has SCADA installed in 352 of the 353 total substations. The relay packages provide advanced health information about the breakers and signal when maintenance is required, negating the need for visual inspections of these assets. PPL Electric implemented an upgrade to the data historian software which allows the Company to be automatically alerted when substation abnormalities are detected, and automatically calculate remaining life on smart assets when operations occur.

Over the last four years, none of the repairs scheduled due to the monthly inspections have been critical repairs due to imminent failure risk. The repairs have been minor, and could have waited 90 additional days to be identified.

Resources that would be applied to shorter cycles than this proposal would reduce the resources applied to other more cost-effective reliability programs described in this plan.

Inspection Plan

Distribution Substation Visual Inspections			
	Area *(# of Substations)*	**Inspections Planned**	
		2020	**2021**
PPL Electric Utilities Corporation *Total Substations 361*	Lehigh (63)	252	252
	Northeast (58)	232	232
	Central (69)	276	276
	Susquehanna (50)	200	200
	Harrisburg (60)	240	240
	Lancaster (61)	244	244
	Totals	**1,444**	**1,444**

Appendix A: Transmission Programs and Procedures

Program	Activity
Helicopter Inspections – Stop-go	Aerial linemen perform annual routine transmission line patrols from a helicopter. They identify damaged or deteriorated equipment and any apparent vegetation issues. Engineers review the findings and develop plans for repair, replacement or remediation.
Helicopter Inspections – Comprehensive	Aerial linemen perform an overhead comprehensive inspection of transmission line facilities on a four-year or eight-year cycle. Detailed condition reports with close-up digital photos are prepared for each specific component problem found along the transmission line and right-of-way. Engineers review the findings and schedule corrective maintenance as needed.
Helicopter Inspections – Emergency	Aerial linemen perform patrols of transmission lines that operate abnormally. This inspection focuses on identifying damage that may have been caused by lightning, inclement weather, equipment failure or vandalism. Because of the nature of this work, corrective actions generally are expedited.
Steel Structures – Inspection, Treatment, Replacement, Reinforcement/Repair	Steel transmission structures are examined and measured for the degree of decay and deterioration. Any issues identified by the inspection are then categorized with a priority rating and are scheduled for follow-up actions based on the criticality. Follow-up actions may include remediation or replacement of steel members or foundations to extend the life of the asset.
Equipment Maintenance	During helicopter and foot patrols, equipment and facilities are identified that require repairs. Based on need and criticality, repairs are either scheduled or completed as soon as possible. Repairs are either completed by line crews or aerial line crews to ensure efficient and effective repairs.
Line Switches – Maintenance and Inspection	Line personnel inspect, maintain and perform operational tests on 138kV and 69kV line air break switches on an as-needed basis to assure proper operation. Corrective action is taken as needed.
Line Switch Upgrades	Line personnel install lightning arresters on 138kV and 69kV line switches to increase system reliability. Existing parallel break air breaks and load sectionalizing air breaks are being upgraded to motor operated load break air breaks to improve switching capabilities, outage restoration times, and sectionalizing ability. Corrective action is taken as needed.

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Program	Activity
Circuit Analysis	Engineers analyze circuit loading and performance to identify areas needing increased line capacity or improved line reliability. Circuits are also reviewed based on operational performance and ranked yearly in a WPC list, with appropriate circuits identified for targeted reliability improvements.

Appendix B: Substation Programs and Procedures

Program	Activity
Load Survey	Automatic monitoring devices such as SCADA provide continuous, real-time loading information. Engineers review equipment loading and identify facilities and transfer capabilities approaching capacity limits. A portion of the load may be supplied from a different source, the existing facilities may be upgraded, new lines and equipment may be added, or a new substation may be built to address capacity deficiencies.
Substation Inspection/Repair	Electricians inspect substations for security and equipment reliability on a time-based maintenance cycle. They identify and correct potential equipment problems before a failure or service interruption occurs.
Equipment Service	Electricians perform operational tests on power transformers, load tap changers ("LTC"), voltage regulators, circuit breakers, circuit switchers, vacuum switches, air break switches and transformer protective switches on a time-based maintenance cycle to assure that equipment is operating within established parameters. Equipment serviced includes batteries, battery chargers, protective relays, high voltage fuses and high-speed automatic grounding switches. Depending on the type of equipment, "service" can include actions other than operational testing.
Inspection and Condition Assessment	Electricians inspect and perform condition assessments of circuit breakers, wave traps, ground switches, stick-operated disconnects, gang-operated disconnects and motor-operated disconnects on a time-based maintenance cycle to assure proper operation. Corrective action is taken as needed.
Insulation Testing	Technicians perform power factor testing on power transformers, potential transformers, lightning arresters, current transformers, select circuit breakers and power cables on a time-based maintenance cycle. Testing also includes other instrument transformers (capacitance coupled voltage transformer, coupling capacitors, potential devices, etc.). They also perform high-potential testing on12kV oil, air and vacuum circuit breakers to assure proper operation.

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Program	Activity
Condition Monitoring of Station Equipment	Electricians/Technicians perform dissolved gas-in-oil analysis, dielectric, and physical properties oil tests for oil in power transformers, and impedance and select capacity tests on station batteries, to assure equipment is within normal parameters. Periodically, AC power factor tests, hi-potential tests, contact resistance tests and motion tests are performed on circuit breakers. Oil dielectric testing is conducted for oil circuit breakers.
Thermographic Inspections	Electricians perform infrared surveys of substation facilities to identify components operating at elevated temperature. Based on the findings, engineers develop plans to repair or replace the component(s) prior to failure.
Minor Improvements	Maintenance activities may identify conditions where additions or upgrades are needed to assure reliability. Engineers evaluate the need and develop action plans and schedules to complete the work.
DC Station Service Improvements	Repairmen and Testing identify deteriorated station batteries, battery chargers and battery components. Engineers schedule repair or replacement as necessary.
Capacitor Bank Protection	Engineers monitor the need for synchronous closing schemes on vacuum switches on 69kV capacitor banks. They plan and schedule installations as needed.
Area/Regional Supply	Engineers develop specific projects aimed at improving capacity shortfalls, or replacing deteriorated or substandard station equipment.
SCADA Replacement	Engineers identify deteriorating substation SCADA equipment and develop plans to repair or replace it.

Appendix C: Distribution Programs and Procedures

Program	Activity
Load Survey – of equipment that is not continuously monitored	Line personnel measure the loading of facilities during peak periods. Engineers use this data for system studies.
Load Survey – by automatic monitoring devices	Automatic monitoring devices such as SCADA provide continuous, real-time loading information. Operators use this data to assure that loads do not exceed design limits. Engineers use this data for system studies.
Circuit Analysis	Engineers analyze circuit voltage profiles to balance loads and to identify areas requiring voltage support to maintain required voltage at the customer's facility.
Capacitor – Inspection and Maintenance	Line personnel inspect and maintain associated electronic control equipment to assure proper operation. Line personnel repair or replace any defective equipment.
Voltage Regulator – Inspection and Maintenance	Line personnel inspect existing equipment for potential failure, and inspect and maintain controls and tap changers to assure proper operation. Line personnel repair or replace any defective equipment.
Overhead Line Switch – Inspection and Maintenance	Line personnel inspect switch installations to identify cracked or broken insulators / bushings, stuck or misaligned blades, insulation or gasket deterioration or other operational problems. Line personnel repair or replace any defective equipment.
Transformer Maintenance	Engineers analyze customer usage data to identify overloaded transformers. Transformers that are heavily loaded are replaced with higher capacity units or portions of the load are transferred to other nearby transformers.
Wood Pole – Inspection, Maintenance, Reinforcement, Replacement	Wood poles are examined for deterioration and the degree of decay is measured. Based on the results, the pole may be treated with preservative to extend its life, treated and reinforced for extended life or replaced.
Overhead Line Inspection	Line inspection personnel examine overhead facilities to identify damaged, deteriorated or substandard equipment. Line personnel repair or replace any defective equipment.

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Program	Activity
Circuit Performance Review	Engineers use PPL Electric's WPC score to ascertain the need for additional circuit reviews or inspections. The improved index looks at a circuit's overall impact to system SAIDI. Actual service interruption history is analyzed to identify causal or geographic patterns.
Underground Primary Cable – Testing, Maintenance, Replacement, Curing	Line personnel perform insulation and neutral tests on cable in residential developments with potential problems to identify deteriorated cable. Based on the results, the cable is placed back in service, repaired or replaced.
LTN Maintenance	Electricians inspect, service, maintain and overhaul LTN vaults, manholes, cables, transformers, low-voltage network protectors and primary transformer disconnect switches. Based on results, defective equipment is either repaired or replaced.
Public Damaged Facilities Review	A program aimed at identifying the locations of facilities that have been damaged by public contact more than once. Technicians evaluate those installations and, if relocation is deemed appropriate, schedule work to move the facilities.
Underground Service Cable	Engineers resolve customer service problems that are due to deteriorated underground service conductors.
Oil Circuit Reclosers	Line personnel replace in-service oil circuit reclosers on a time-based maintenance cycle. Removed units are tested, and may be refurbished and placed in inventory.
Line Protection Equipment	Line personnel replace in-service three phase oil circuit reclosers with communicating vacuum devices on a time-based maintenance cycle.
Capacitor and Voltage Regulator Installation	Engineers perform voltage profiles to determine the need, location and size of any new voltage support equipment required to maintain adequate service voltage levels at customer facilities and provide needed reactive support for system stability. Line personnel install the required equipment.

Appendix D: Vegetation Applications

Program	Activity
Tree Pruning	Tree pruning is scheduled based on field conditions observed and/or a system prioritization process. All pruning is done in accordance with American National Standard for Tree Care Operations-Tree, Shrub and Other Woody Plant Maintenance – Standard Practices (ANSI A300).
Hazard Tree Removal	Trees located outside the right-of-way that represent a threat to line performance/ safety are removed when it is feasible to do so.
Herbicide Application	Tall-growing, undesirable vegetation growing within the right-of-way corridors is selectively treated with herbicides. Low-growing vegetation that does not represent a hazard to the safe, reliable operation of PPL Electric's facilities is preserved wherever possible.
Reclearing	Tall-growing, undesirable vegetation growing within the right-of-way corridors is selectively removed in those situations where herbicides cannot be utilized. Low-growing vegetation that does not represent a hazard to the safe, reliable operation of PPL Electric's facilities is preserved wherever possible.

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