NorthWestern Energy
Delivering a Bright Future

March 1, 2017

Will Rosquist
Administrator, Regulatory Division
Montana Public Service Commission
1701 Prospect Avenue
PO Box 202601
Helena, MT 59620-2601

RE: 2016 Annual Electric Reliability Report

Dear Mr. Rosquist:

With this letter, NorthWestern Energy submits the 2016 Reliability Report in compliance with Administrative Rules of Montana 38.5.8619 Annual Electric Reliability Report, effective on July 29, 2005. The data provided in this report includes the information requested in ARM 38.5.8619 and utilizes the *IEEE Guide for Electric Power Distribution Reliability Indices (IEEE Std. 1366-2012)* for definition of major events and the appropriate reliability indices. Similar to the previous five years, additional transmission line reliability information is attached to the report.

Please contact me to answer any questions concerning this report. My contact information is as follows:

Bill Bowden
Technical Advisor, Senior
NorthWestern Energy
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William.bowden@northwestern.com

Sincerely,

Bill Bowden

Bill Bowden, P.E.
Technical Advisor, Senior

Enclosure: 2016 Annual Electric Reliability Report

CERTIFICATE OF SERVICE

I hereby certify that NorthWestern Energy's 2016 Annual Electric Reliability Report has been hand delivered to the Montana Public Service Commission this date. It has also been e-filed on the MPSC website.

Date: March 1, 2017

Connie Moran
Administrative Assistant
Regulatory Affairs

NorthWestern® Energy

2016
-Montana-
Electric Distribution/Transmission
Annual Reliability Report

March 2017

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EXECUTIVE SUMMARY

This report provides information and insights into NorthWestern Energy's (NWE) 2016 Electric Distribution and Transmission System reliability indices for the Montana region, in accordance with the guidelines outlined by the Administrative Rules of Montana (Rule 38.5.8619). The indices included are **SAIDI** (**S**ystem **A**verage **I**nterruption **D**uration **I**ndex – in minutes), **CAIDI** (**C**ustomer **A**verage **I**nterruption **D**uration **I**ndex – in minutes), **SAIFI** (**S**ystem **A**verage **I**nterruption **F**requency **I**ndex – in frequency) and **Outage Counts**. By the IEEE standard definitions, these indices are for "sustained interruptions" meaning they lasted longer than five minutes.

System indices are given for the NWE Montana operating region and are also broken down into the eight operating areas of the state: Billings, Bozeman, Butte, Great Falls, Havre, Helena, Lewistown, and Missoula. As with the previous years' annual reports, the Institute of Electrical and Electronics Engineers (IEEE) Standard 1366-2012 will again be followed. This standard is directly related to the use of a statistically based definition for classification of Major Event Days (MEDs) – also commonly referred to as the 2.5 Beta Method. Major Event Days are days in which the regional SAIDI exceeds a statistically derived threshold value and represent days in which the electric system experienced stresses beyond normal operating conditions (such as a severe weather storm) and often requiring additional crews be brought into the area for repairs.

The InService mobile work force and outage management system was implemented by NWE during the fall of 2014. This provides more accurate and timely outage reporting. Outage customer counts and times are derived from the GIS, call logging, and automated systems, eliminating the earlier manual outage reporting system and its inherent approximations. Both IEEE and the Department of Energy reports indicate that SAIDI numbers normally increase with this improved accuracy, but with the whims of nature, this may be difficult to determine for some time. The IEEE reliability standard (1366-2012) does not define the 24 hour day and many of the utilities involved in the IEEE benchmark survey have gone to something other than midnight-to-midnight. Some will "roll" the 24 hours to more accurately capture the full impact of a storm day (and possible MED). This option was implemented by NWE in 2015.

NorthWestern Energy has an active relationship with the IEEE Power and Energy Society Reliability Working Group to ensure a consistent and accurate portrayal of our utility's ability to report and benchmark reliability indices. MEDs are identified through a monthly process for each region and can be included or excluded per the data requested. This report will provide all information, including and excluding MEDs, for all three indices to better demonstrate and analyze normal versus emergency conditions. In 2016, there were three Major Event Days**.** By comparison, there was one MED in 2010, none in 2011, two in 2012, two in 2013, none in 2014, and five in 2015. Please see table below listed in descending SAIDI Minutes. For the Montana region, it took 6.25 SAIDI minutes in 2016 to declare an MED. Historically in Montana, a larger MED event could be 20 SAIDI minutes or more.

Date/Time MED Started	SAIDI Minutes	Cause
4/14/2016 15:12	14	Extreme wind with snow and ice in the Great Falls area.
4/15/2016 15:16	12	Extreme wind with snow and ice in the Great Falls and Helena areas.
5/9/2016 14:43	7	Equipment overload caused by a line being out of service and a breaker failure during a fault on another line in the Bozeman area.

Table 1: Major Event Days (2016)

NorthWestern has also defined a "Catastrophic Day." It takes seven times the MED threshold, or 43.75 SAIDI minutes to declare a "Catastrophic Day." NorthWestern did not experience a Catastrophic Day in 2016.

Transmission related reliability data and graphs have been added as an annex to the report again this year.

1. GENERAL

1.1 Reliability indices calculation

The calculation of SAIDI and CAIDI, (in minutes) and SAIFI (in outages per customer) are based on the following IEEE formulas:

$$SAIDI = \frac{sum\ of\ all\ customer\ outage\ durations(minutes)}{total\ number\ of\ customers\ served}$$

$$SAIFI = \frac{total\ number\ of\ customers\ experiencing\ outages}{total\ number\ of\ customers\ served}$$

$$CAIDI = \frac{sum\ of\ all\ customer\ outage\ duration(minutes)}{total\ number\ of\ customers\ experiencing\ outages} = \frac{SAIDI}{SAIFI}$$

In laymen's terms, SAIDI represents the average outage in minutes for each customer served. SAIFI is the average number of interruptions that a customer would typically experience in a year. CAIDI is the average outage duration any given customer would experience. CAIDI is also typically thought of as the average restoration time.

1.2 Additional Notable Events

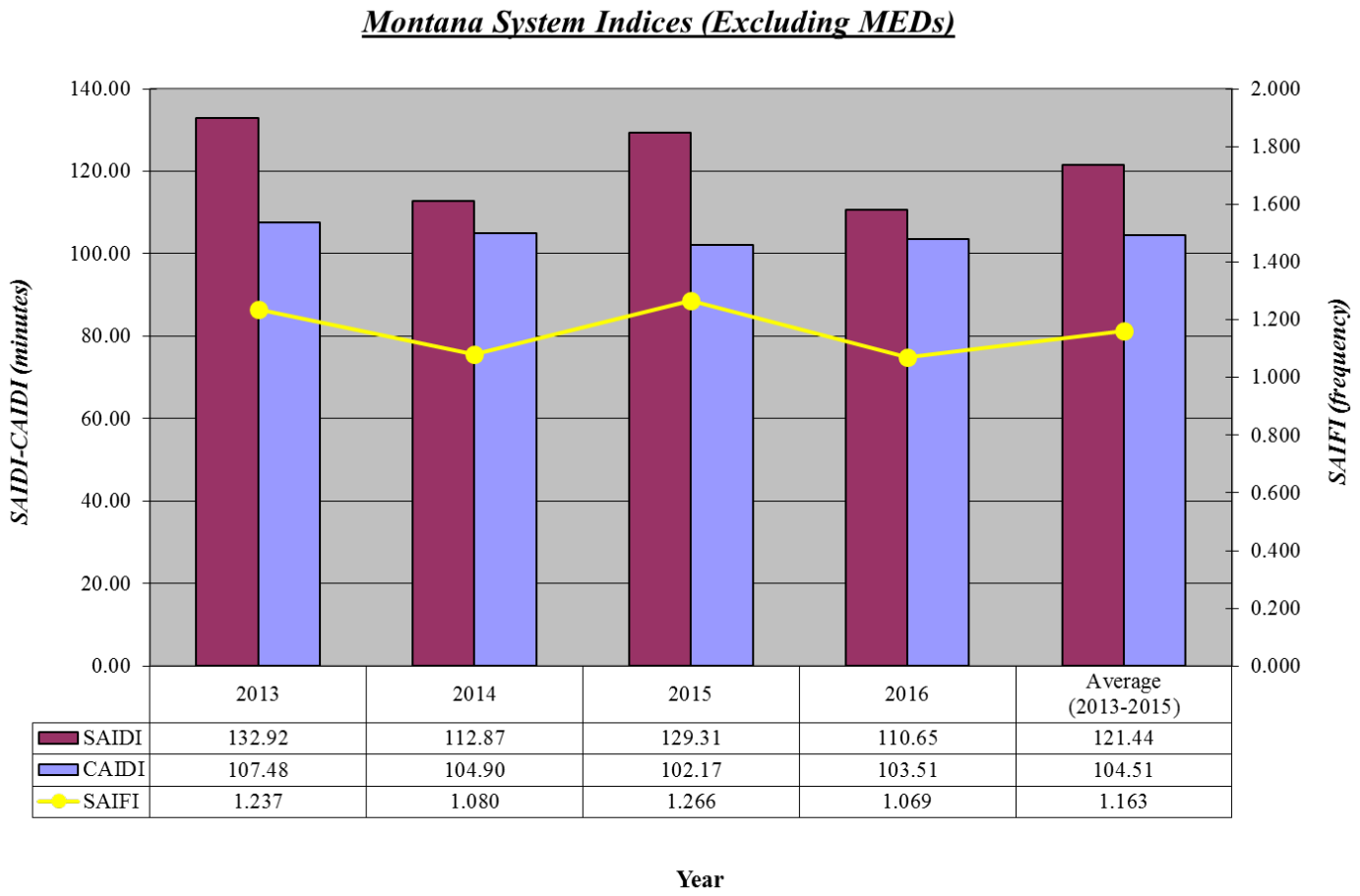
There were three days with a "Customer-Minutes Interrupted" (CMI) number greater than one million (an MED for 2016 required 2.34 million CMI). Please see table below, listed in descending CMI. These storm events, while not being MEDs, added significantly to the SAIDI minutes for 2016. For comparison, there were three days in 2015 with over a million CMI.

Date	CMI	Divisions impacted	Majority Causes
4/5/2016	1,423,238	Billings, Bozeman, and Lewistown District	Wind, Equipment Failure, Tree In Line
10/1/2016	1,096,597	Great Falls	A bird caused a fault in the Great Falls Southside Substation
8/19/2016	1,012,219	Bozeman and Missoula	Thunderstorm, strong winds, Trees in Line

Table 2: Additional Notable Events (2016)

Further details on these events are provided in the operating area discussions below.

2. MONTANA SYSTEM RELIABILITY



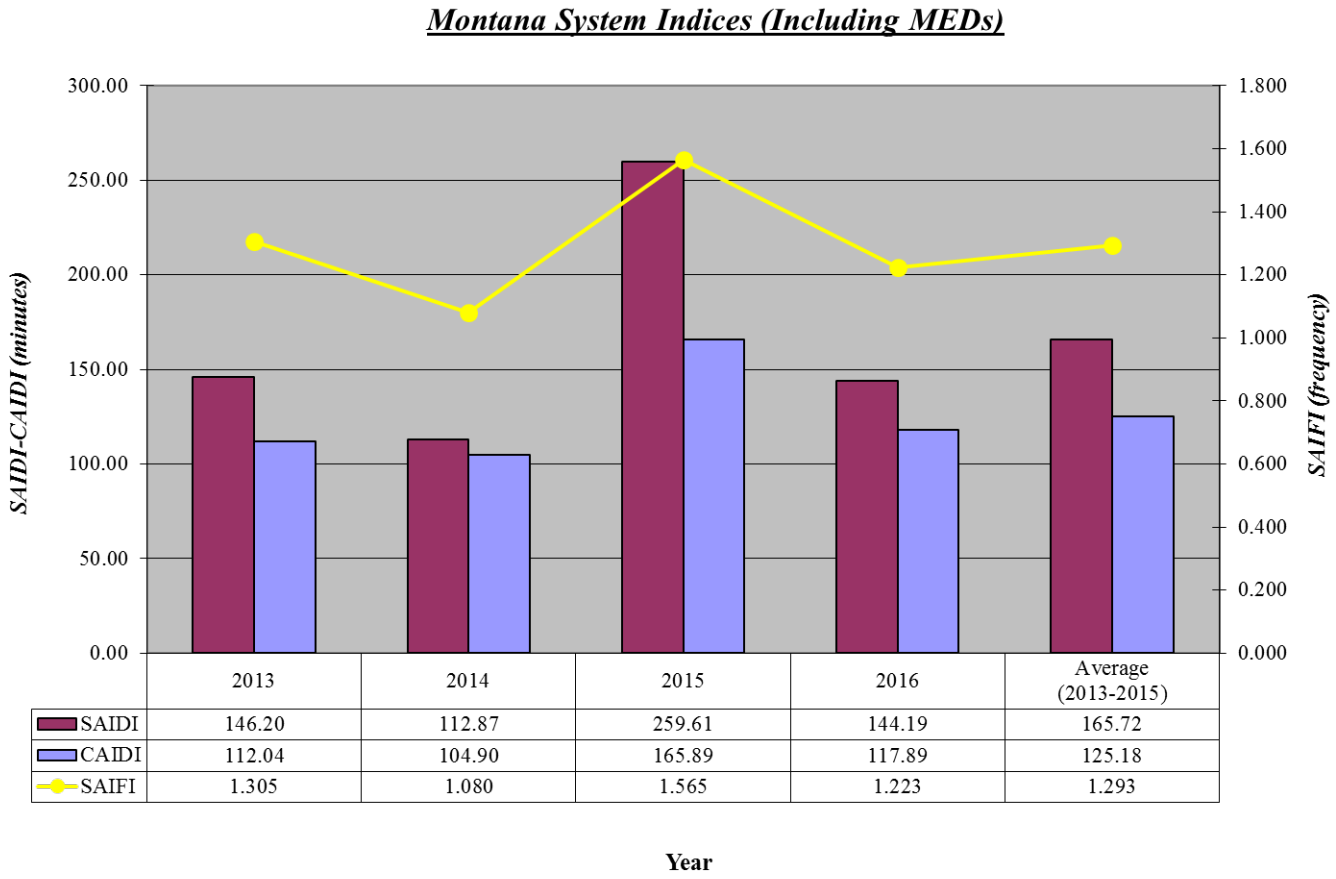
	2013	2014	2015	2016	Average (2013-2015)
SAIDI	132.92	112.87	129.31	110.65	121.44
CAIDI	107.48	104.90	102.17	103.51	104.51
SAIFI	1.237	1.080	1.266	1.069	1.163

Figure 2.1 Montana system indices excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.

The figure above displays NorthWestern Energy's Montana region indices for the years 2013-2016. Region indices shown for 2013 to 2016 data (excluding MEDs) are from year-end audited data (excluding MEDs). Please note that SAIDI and CAIDI are given in minutes and SAIFI is given in the frequency of occurrence.

As can be seen by **Figure 2.1**, 2016 SAIDI and SAIFI improved from 2015, while CAIDI decreased slightly. Also, all three indices in 2016 were lower than the previous three-year averages. In 2016, NWE saw a number of wind storms mainly in the Great Falls and Havre areas.

Contributing factors to system reliability will be discussed as each of the operating divisions of the Montana region are examined and in the report conclusion. Data and figures are presented that characterize the system reliability both including and excluding MEDs to demonstrate the effect MEDs had on the system reliability in previous years.

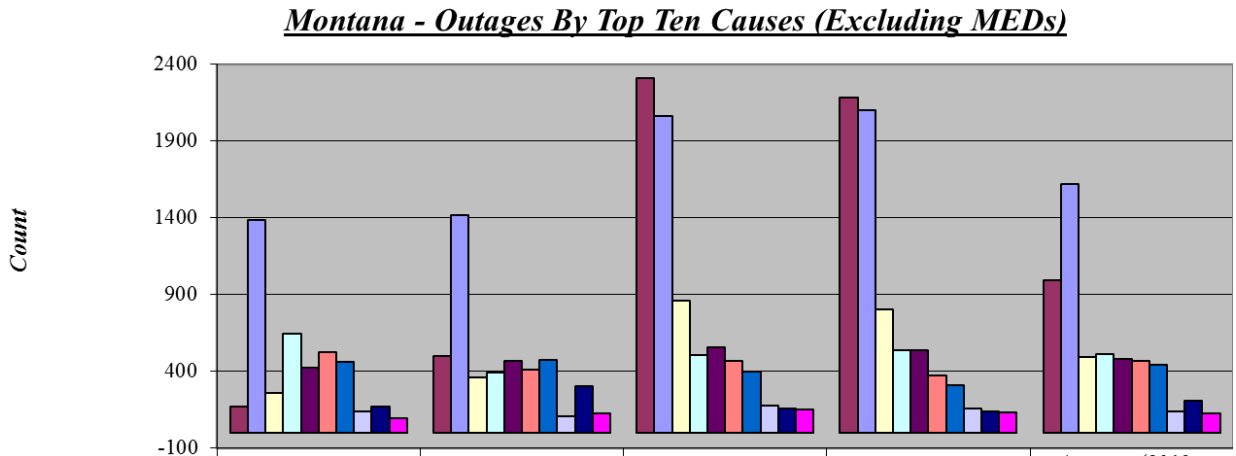


	2013	2014	2015	2016	Average (2013-2015)
SAIDI	146.20	112.87	259.61	144.19	165.72
CAIDI	112.04	104.90	165.89	117.89	125.18
SAIFI	1.305	1.080	1.565	1.223	1.293

Figure 2.2 Montana system indices including major event days (MEDs) as defined in IEEE Standard 1366-2012.

SAIDI increases 33 minutes as shown in 2016 when the three MEDs are included in the reliability index. Also, CAIDI and SAIFI increase noticeably.

Outages by cause (excluding MEDs) are shown in **Figure 2.3**.

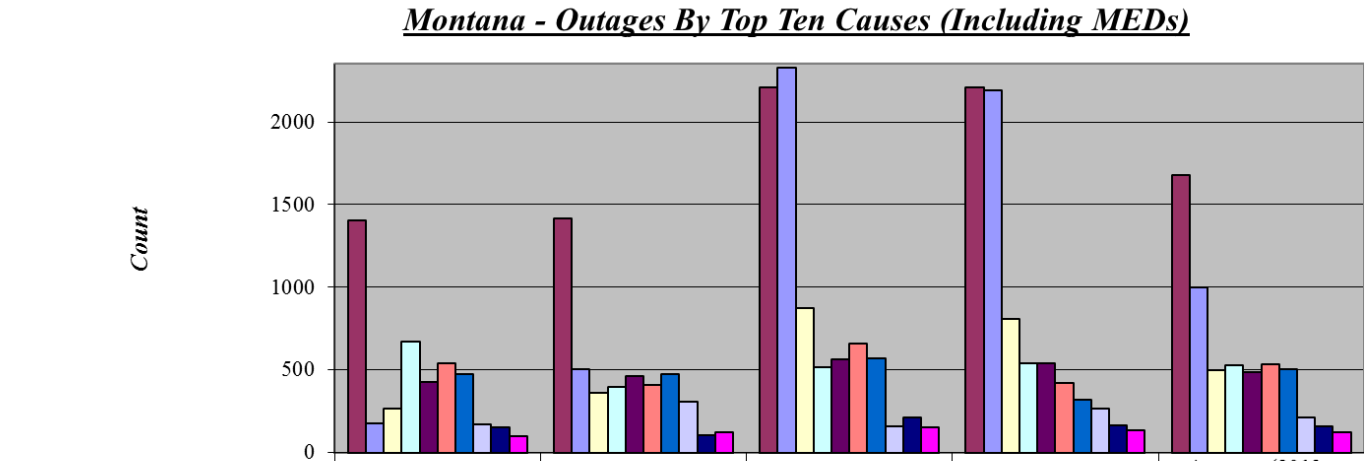


	2013	2014	2015	2016	Average (2013 - 2015)
System - Scheduled Maintenance	171	502	2306	2181	993
System - Equipment Failure	1386	1419	2061	2100	1622
Animal - Other Bird	260	358	857	800	492
Nature - Lightning	644	394	505	539	514
Animal - Squirrel	422	465	557	536	481
Nature - Tree In Line	527	411	467	374	468
Nature - Wind	460	472	400	310	444
Nature - Limb In Line	141	107	175	158	141
Nature - Snow/Ice	168	305	159	141	211
System - Scheduled Construction	97	123	149	133	123
MT REGION TOTAL	5859	6105	8758	8230	6906

Figure 2.3 Montana system outages by top ten causes excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.

The outage causes represented in this table are the top ten major contributors for customer outages on the NorthWestern Energy Electric Distribution and Transmission system. Overall outages reported decreased 6% to 8230. A significant increase in 2015 was expected due to the more accurate data collected by the Outage Management System (OMS) that entered service in the fourth quarter of 2014. For example, outage counts for scheduled maintenance increased noticeably. In the past, small planned outages, where the crew notified the customers of the pending outage were not well documented but they are now. As a result, Scheduled Maintenance greatly increased. This increase is due to the previously mentioned OMS and the increased work as part of the DSIP program. This had a significant impact of 11.6 minutes or 8.1% of Montana Region SAIDI. It is now one of the top ten outages causes in each division/district in Montana.

The top ten outage counts decreased from 7656 in 2015 to 7272 in 2016. Nature related outages such as wind, lightning and snow/ice went down by 174 outages. Overall Equipment Failure outages increased slightly by 39. Equipment Failure is the most common of the unscheduled outage causes due to its broad and all-inclusive category nature. Outages can be related back to Equipment Failure in many different ways and it is the responsibility of the operations personnel to correctly identify the cause.



	2013	2014	2015	2016	Average (2013 - 2015)
System - Equipment Failure	1402	1419	2210	2212	1677
System - Scheduled Maintenance	173	502	2330	2192	1002
Animal - Other Bird	263	358	875	809	499
Nature - Lightning	670	394	517	541	527
Animal - Squirrel	425	465	561	538	484
Nature - Tree In Line	540	411	658	418	536
Nature - Wind	475	472	571	317	506
Nature - Snow/Ice	168	305	159	265	211
Nature - Limb In Line	154	107	210	164	157
System - Scheduled Construction	98	123	152	133	124
MT REGION TOTAL	5966	6105	9384	8566	7152

Figure 2.4 Montana system outages by top ten causes including major event days (MEDs) as defined in IEEE Standard 1366-2012.

The graph and table above show outage causes with MEDs. Most of the outage categories in 2016 have decreased when comparing them to 2015 numbers. A portion of this increase was due to the DSIP program.

3. BILLINGS SYSTEM RELIABILITY

For Billings, SAIDI and SAIFI increased in 2016. CAIDI decreased slightly. The increase in SAIDI and CAIDI in 2015 was expected due to the OMS implementation. SAIDI is less than the three-year average. Storm problems were down from 2015 and although equipment outage counts were up, the SAIDI impact was lower. Larger outages for the year were equipment failures caused by broken cutouts, insulators and a crossarm. Squirrels and Other Birds still cause a large number of outages. Tree problem outages are down, most likely due to increased trimming efforts.

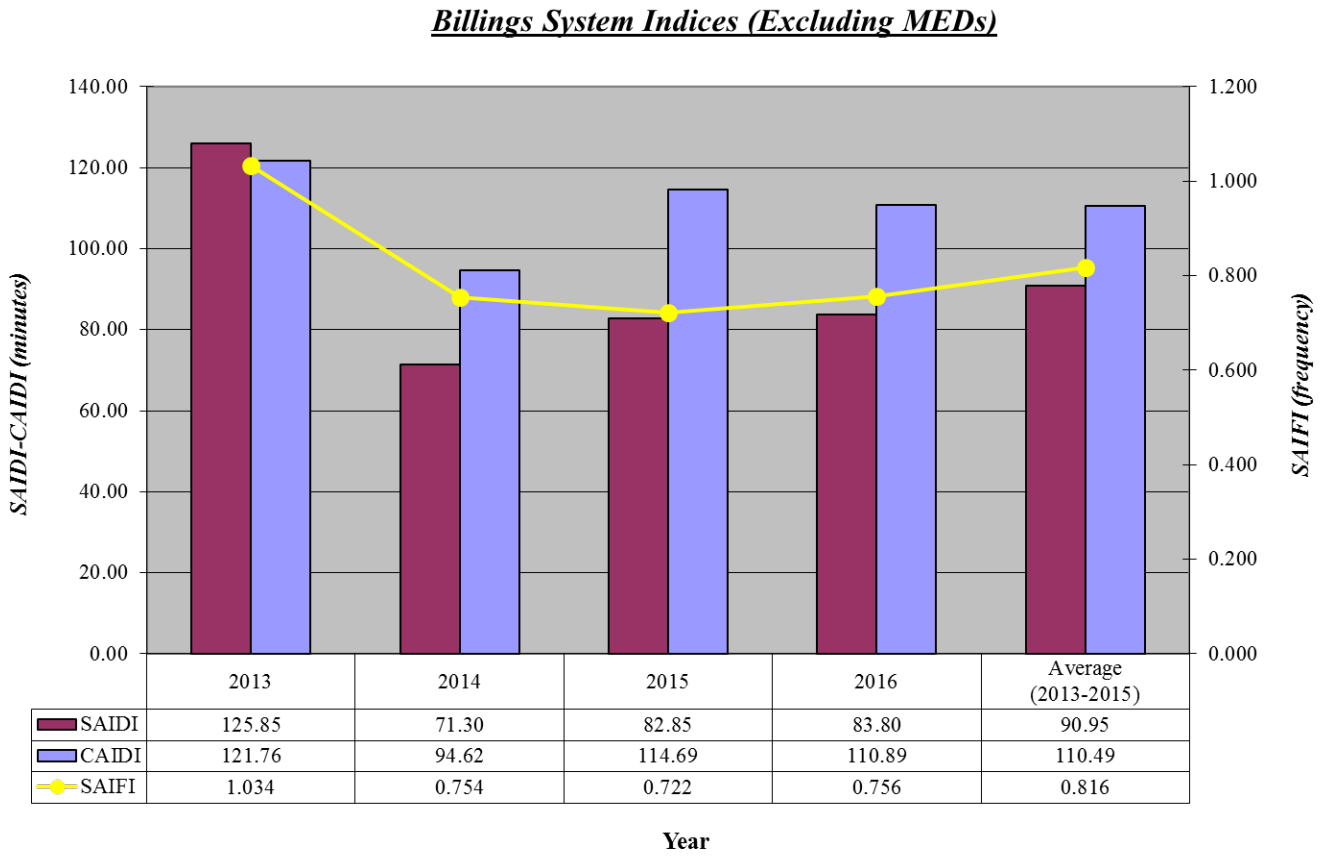
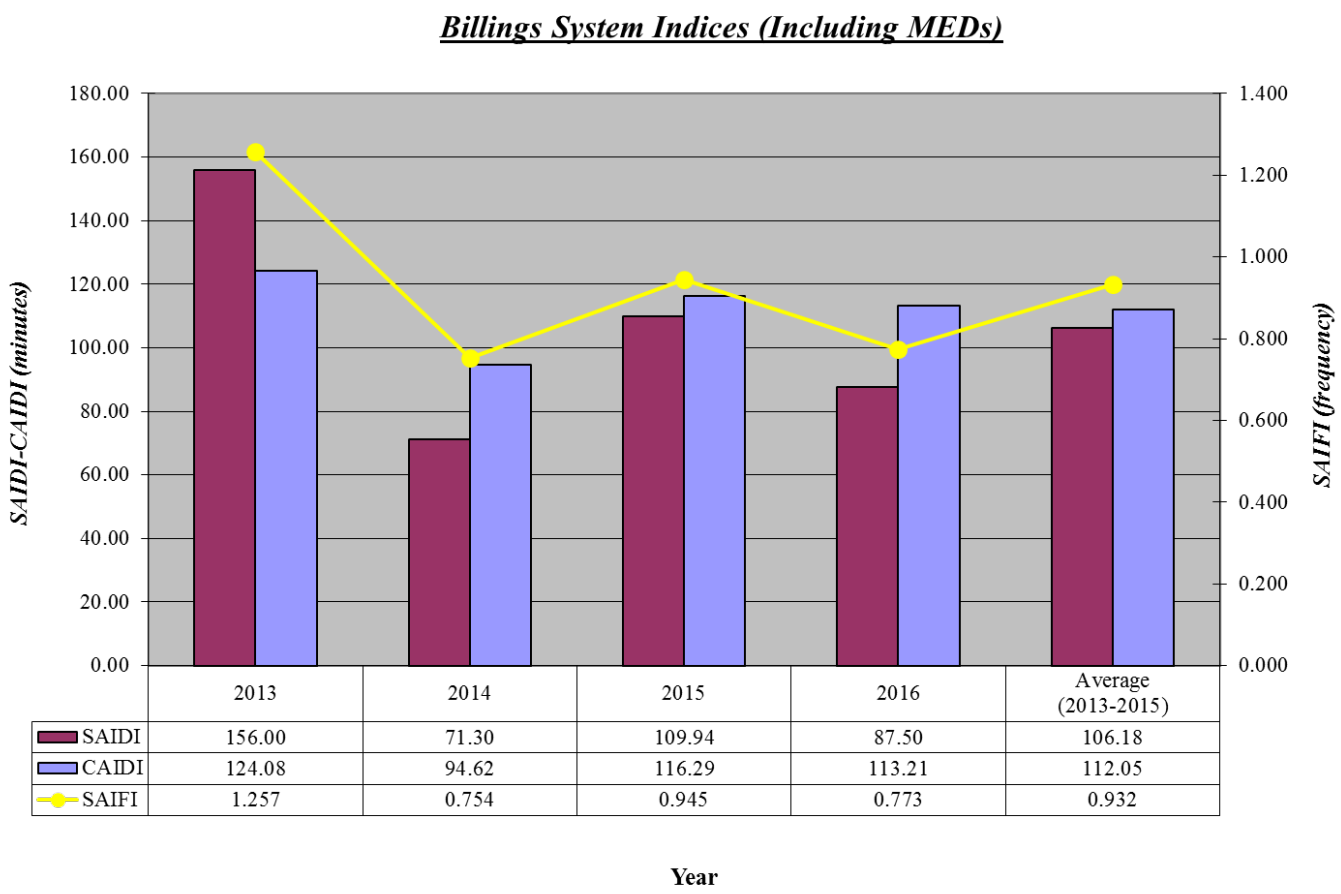
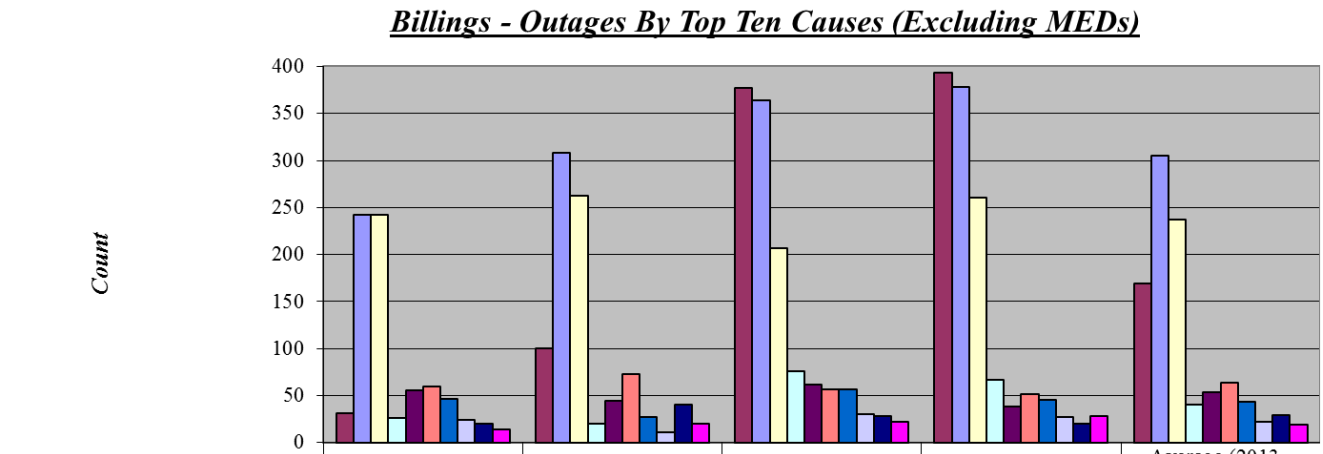


Figure 3.1 Billings system indices excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.



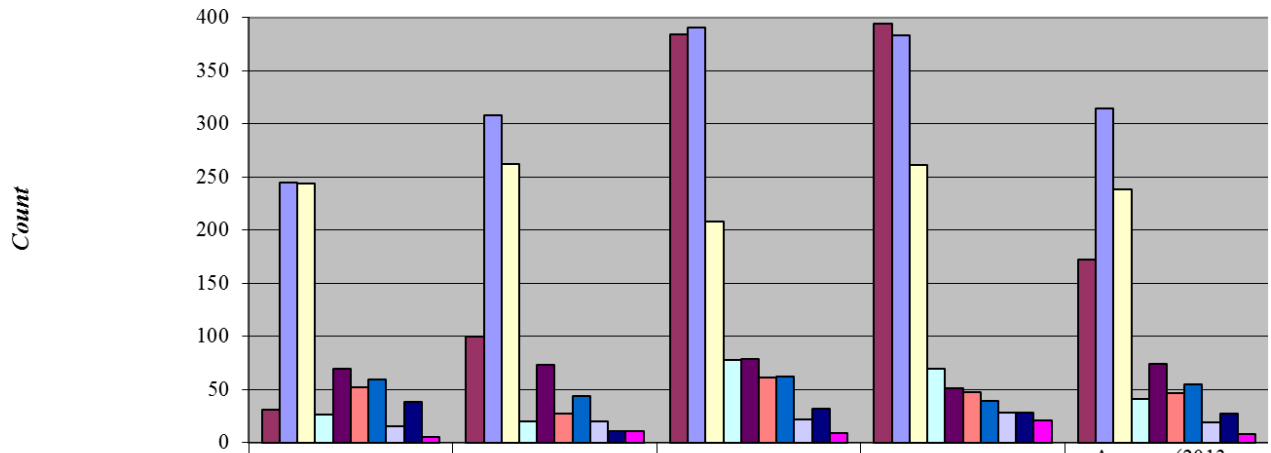
	2013	2014	2015	2016	Average (2013-2015)
SAIDI	156.00	71.30	109.94	87.50	106.18
CAIDI	124.08	94.62	116.29	113.21	112.05
SAIFI	1.257	0.754	0.945	0.773	0.932

Figure 3.2 Billings system indices including major event days (MEDs) as defined in IEEE Standard 1366-2012.



	2013	2014	2015	2016	Average (2013 - 2015)
System - Scheduled Maintenance	31	100	377	393	169
System - Equipment Failure	242	308	364	378	305
Animal - Squirrel	242	262	207	260	237
Animal - Other Bird	26	20	76	67	41
Nature - Lightning	55	44	62	38	54
Nature - Wind	60	73	57	51	63
Nature - Tree In Line	46	27	57	45	43
Nature - Limb In Line	24	11	30	27	22
Public - Vehicle Hit	20	40	28	20	29
System - Human Error/Accident	14	20	22	28	19
DIVISION TOTAL	1,024	1,167	1,384	1,439	1,192

Figure 3.3 Billings system outages by top ten causes excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.

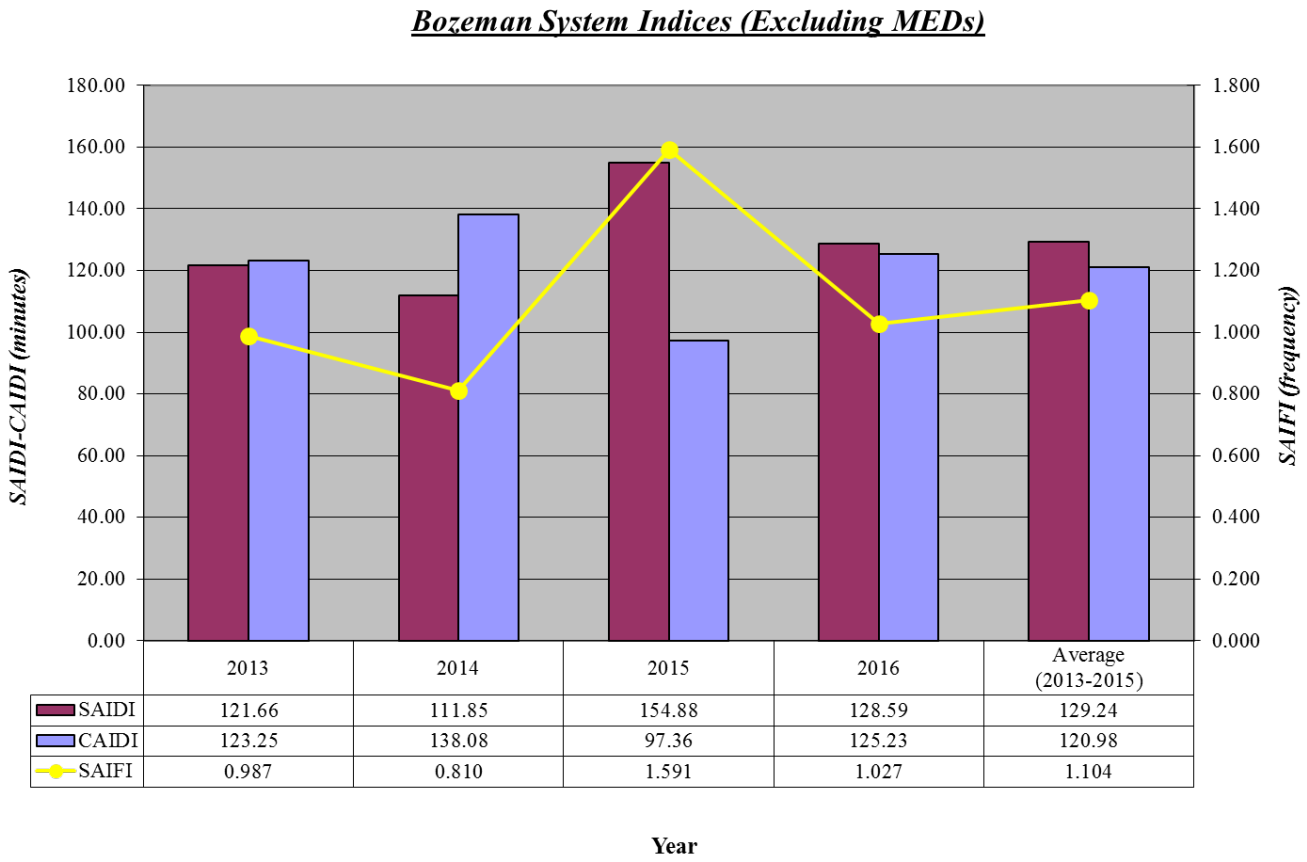


	2013	2014	2015	2016	Average (2013 - 2015)
System - Scheduled Maintenance	31	100	384	394	172
System - Equipment Failure	245	308	390	383	314
Animal - Squirrel	244	262	208	261	238
Animal - Other Bird	26	20	78	69	41
Nature - Wind	69	73	79	51	74
Nature - Tree In Line	52	27	61	47	47
Nature - Lightning	59	44	62	39	55
System - Human Error/Accident	15	20	22	28	19
Nature - Limb In Line	38	11	32	28	27
Public - Digging	5	11	9	21	8
DIVISION TOTAL	1,068	1,167	1,449	1,452	1,228

Figure 3.4 Billings system outages by top ten causes including major event days (MEDs) as defined in IEEE Standard 1366-2012.

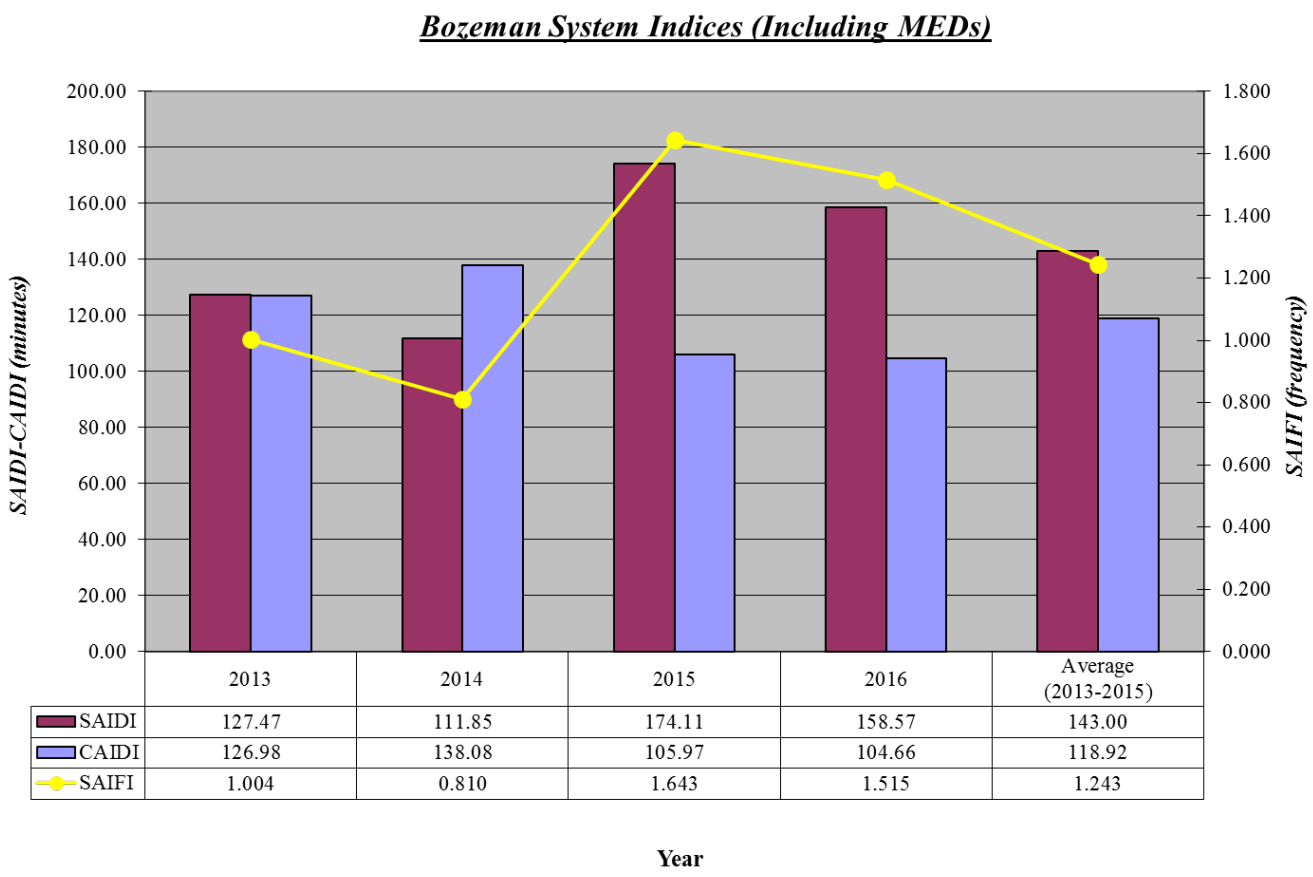
4. BOZEMAN SYSTEM RELIABILITY

Bozeman division indices for 2016 saw a significant decrease in SAIDI and SAIFI from 2015. However, there was a significant increase in CAIDI. Larger events in the area were tree falling into Livingston Westside Ckt 4-2 and a bird nest, during an MED, causing the Jackrabbit Ckt. 72 to trip. Equipment failure outage counts were essentially unchanged, but water fowl and public digging outage counts increased. Probably due to the OMS implementation planned outages greatly increased.



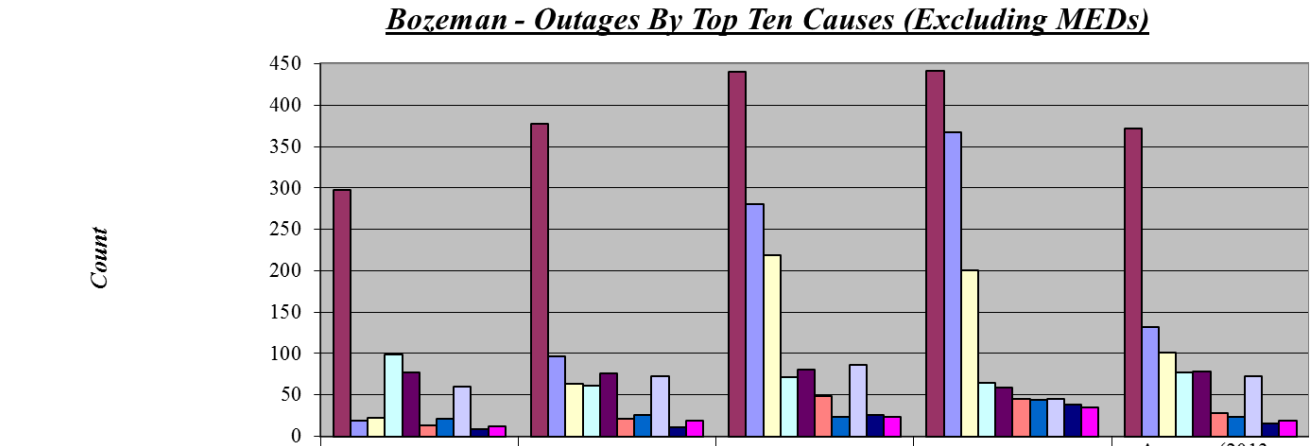
	2013	2014	2015	2016	Average (2013-2015)
SAIDI	121.66	111.85	154.88	128.59	129.24
CAIDI	123.25	138.08	97.36	125.23	120.98
SAIFI	0.987	0.810	1.591	1.027	1.104

Figure 4.1 Bozeman system indices excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.



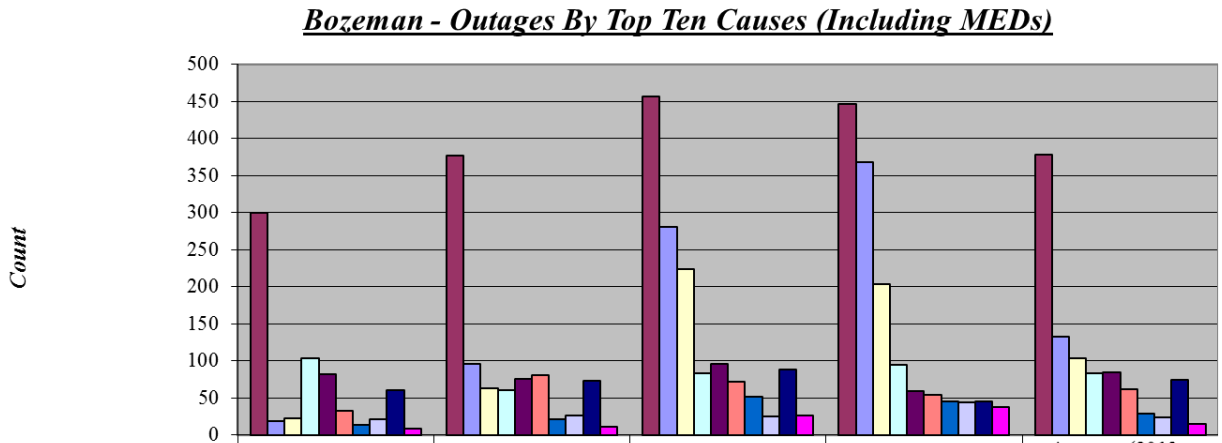
	2013	2014	2015	2016	Average (2013-2015)
SAIDI	127.47	111.85	174.11	158.57	143.00
CAIDI	126.98	138.08	105.97	104.66	118.92
SAIFI	1.004	0.810	1.643	1.515	1.243

Figure 4.2 Bozeman system indices including major event days (MEDs) as defined in IEEE Standard 1366-2012.



	2013	2014	2015	2016	Average (2013 - 2015)
System - Equipment Failure	297	377	440	441	371
System - Scheduled Maintenance	19	96	280	367	132
Animal - Other Bird	22	63	219	200	101
Nature - Tree In Line	99	61	71	64	77
Nature - Wind	77	76	81	59	78
Animal - Squirrel	13	21	49	45	28
System - Scheduled Construction	21	26	24	44	24
Nature - Lightning	60	73	86	45	73
Animal - Waterfowl	9	11	26	38	15
Public - Digging	12	19	24	35	18
DIVISION TOTAL	1,046	1,353	1,609	1,581	1,340

Figure 4.3 Bozeman system outages by top ten causes excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.

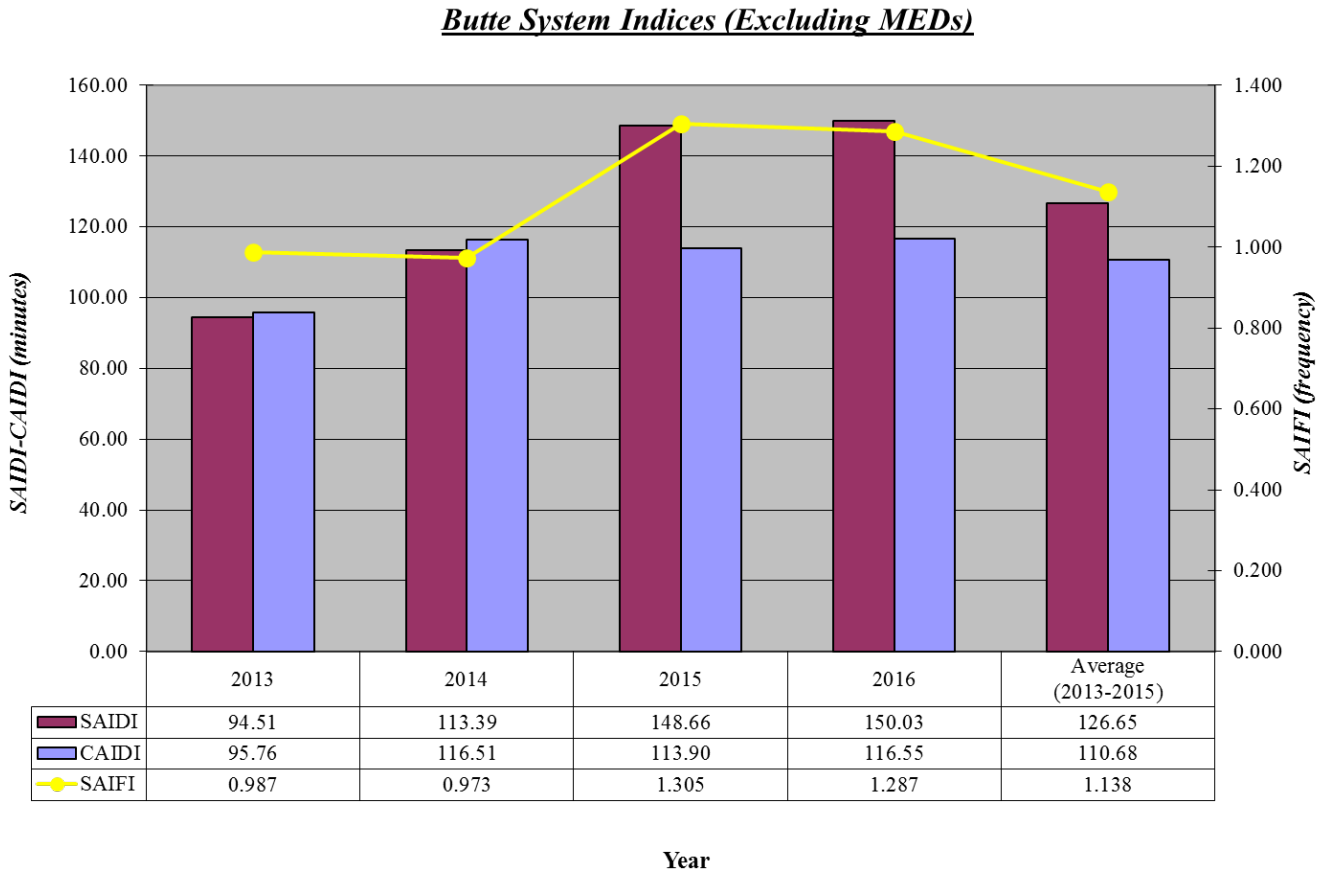


	2013	2014	2015	2016	Average (2013 - 2015)
System - Equipment Failure	300	377	457	446	378
System - Scheduled Maintenance	19	96	281	368	132
Animal - Other Bird	23	63	223	203	103
Nature - Tree In Line	104	61	83	94	83
Nature - Wind	82	76	96	59	85
Nature - Snow/Ice	32	81	72	54	62
Animal - Squirrel	13	21	51	45	28
System - Scheduled Construction	21	26	25	44	24
Nature - Lightning	61	73	88	45	74
Animal - Waterfowl	9	11	26	38	15
DIVISION TOTAL	1,064	1,353	1,668	1,649	1,362

Figure 4.4 Bozeman system outages by top ten causes including major event days (MEDs) as defined in IEEE Standard 1366-2012.

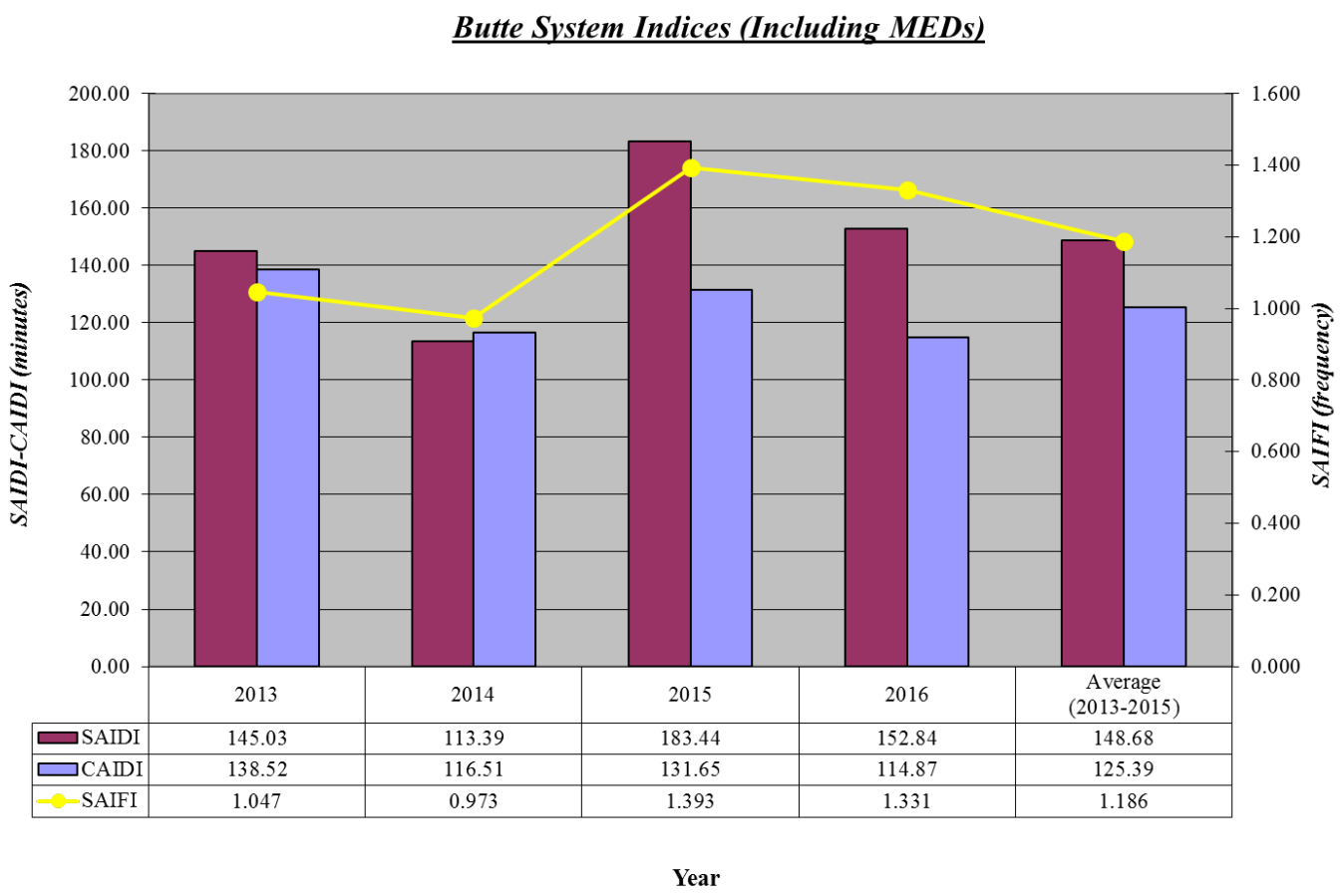
5. BUTTE SYSTEM RELIABILITY

For 2016, SAIDI and CAIFI slightly increased and SAIFI held about the same for the Butte Division. A tree falling into a feeder out of the Continental Drive Substation and a burnt cross-arm in the Laurin Sundowner Ruby Circuit were the two largest single events for the division. Equipment outages decreased slightly for Butte. There was a large decrease in animal related outages. Tree outages also decreased.



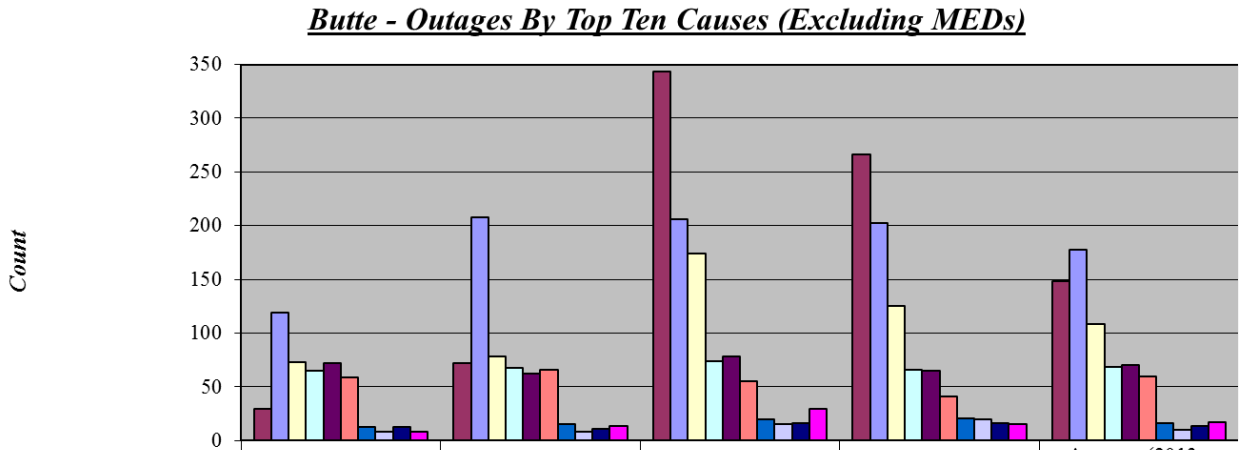
	2013	2014	2015	2016	Average (2013-2015)
SAIDI	94.51	113.39	148.66	150.03	126.65
CAIDI	95.76	116.51	113.90	116.55	110.68
SAIFI	0.987	0.973	1.305	1.287	1.138

Figure 5.1 Butte system indices excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.



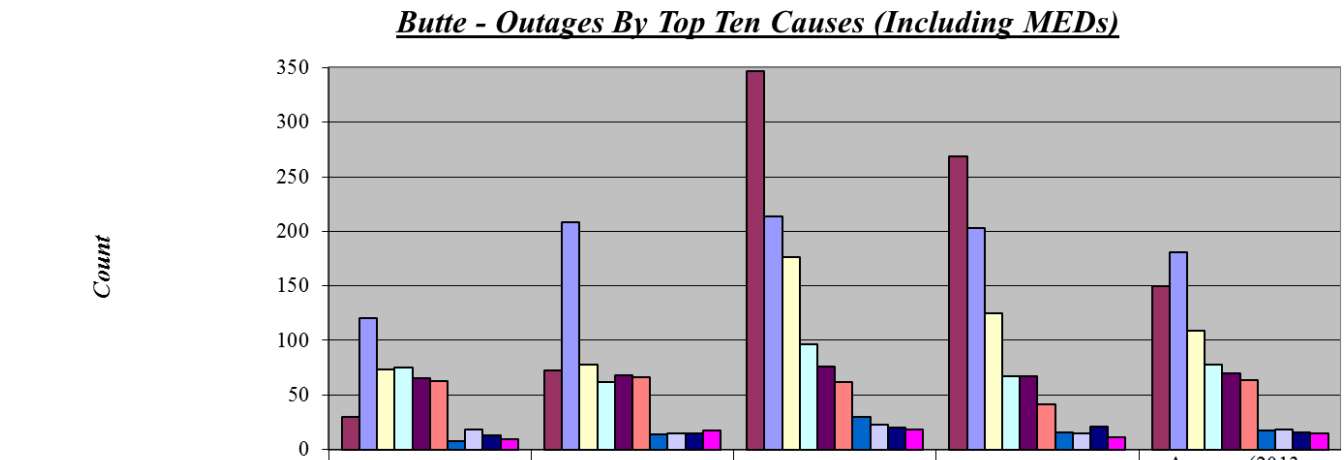
	2013	2014	2015	2016	Average (2013-2015)
SAIDI	145.03	113.39	183.44	152.84	148.68
CAIDI	138.52	116.51	131.65	114.87	125.39
SAIFI	1.047	0.973	1.393	1.331	1.186

Figure 5.2 Butte system indices including major event days (MEDs) as defined in IEEE Standard 1366-2012.



	2013	2014	2015	2016	Average (2013 - 2015)
System - Scheduled Maintenance	30	72	343	266	148
System - Equipment Failure	119	208	206	202	178
Animal - Other Bird	73	78	174	125	108
Nature - Lightning	65	68	74	66	69
Nature - Tree In Line	72	62	78	65	71
Nature - Wind	59	66	55	41	60
Animal - Squirrel	13	15	20	21	16
Animal - Raptor	8	8	15	20	10
Animal - Other	13	11	16	16	13
Animal - Waterfowl	8	14	30	15	17
DIVISION TOTAL	691	837	1,153	942	889

Figure 5.3 Butte system outages by top ten causes excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.

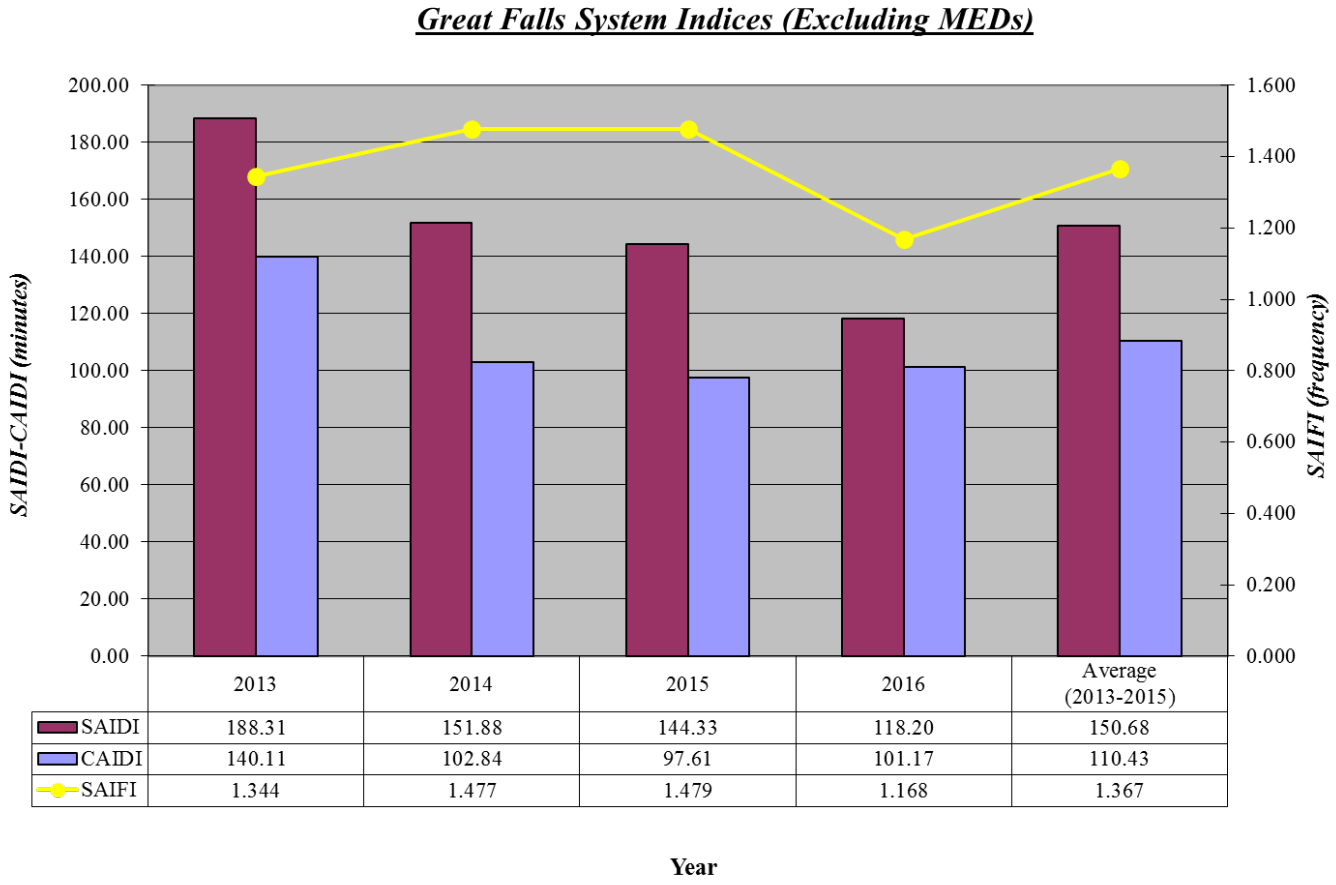


	2013	2014	2015	2016	Average (2013 - 2015)
System - Scheduled Maintenance	30	72	347	269	150
System - Equipment Failure	120	208	214	203	181
Animal - Other Bird	73	78	176	125	109
Nature - Tree In Line	75	62	96	67	78
Nature - Lightning	65	68	76	67	70
Nature - Wind	63	66	62	41	64
Animal - Waterfowl	8	14	30	16	17
Nature - Limb In Line	18	15	23	15	19
Animal - Squirrel	13	15	20	21	16
System - Scheduled Construction	9	17	18	11	15
DIVISION TOTAL	703	837	1,200	956	913

Figure 5.4 Butte system outages by top ten causes including major event days (MEDs) as defined in IEEE Standard 1366-2012.

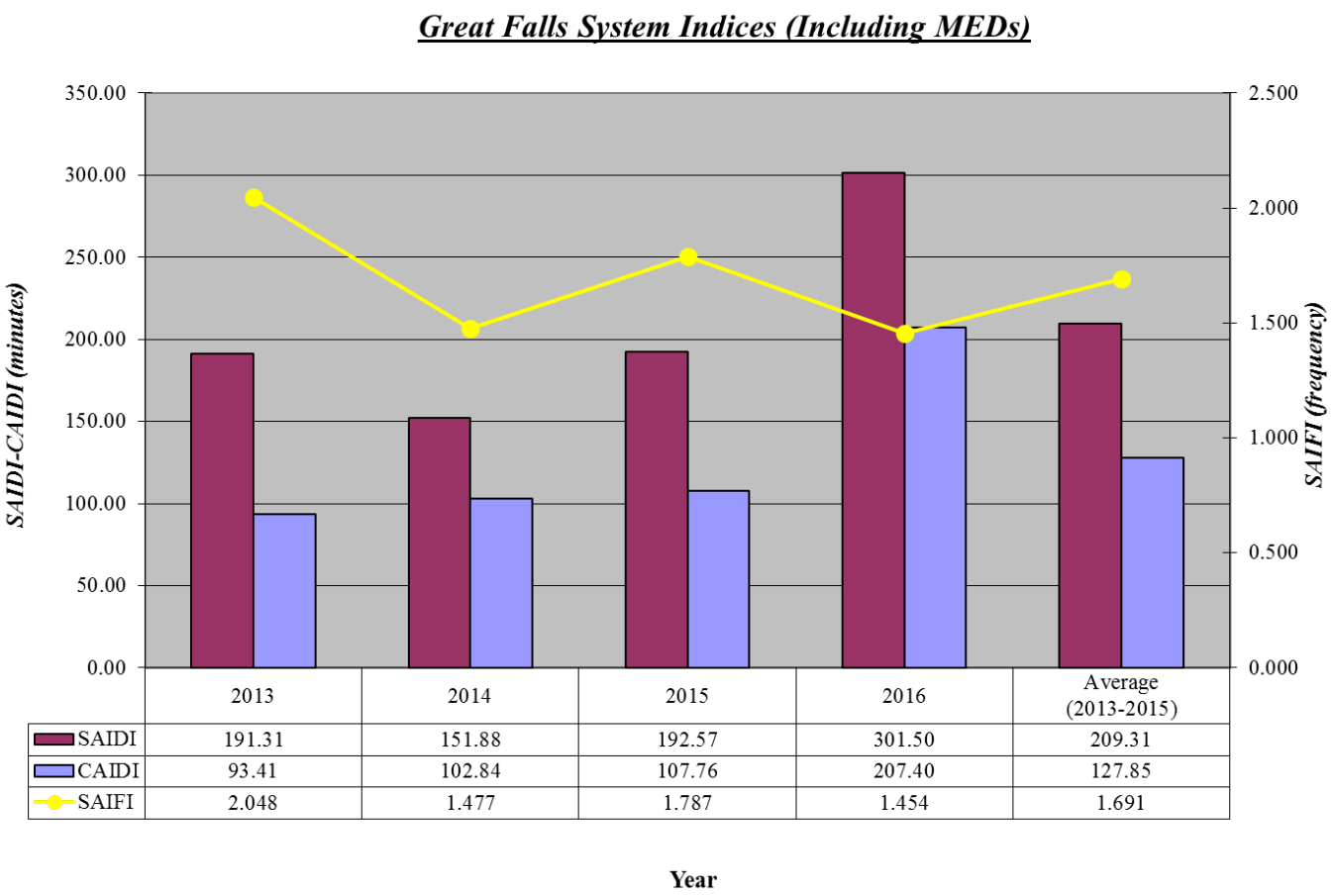
6. GREAT FALLS SYSTEM RELIABILTY

Great Falls Division saw a decrease in SAIDI, CAIDI, and SAIFI for 2016. Animal related and lightning caused outages greatly increased. The number of equipment failures also increased. Lightning, wind, and snow/ice contributed to many of the failures. This reflects the large impact of weather in 2016. Great Falls was greatly affected by two MEDs in 2016. The number of Vehicle Hit outages decreased. The larger outages for the division were a caused by a broken wire and a floater caused a WAPA transmission line to trip.



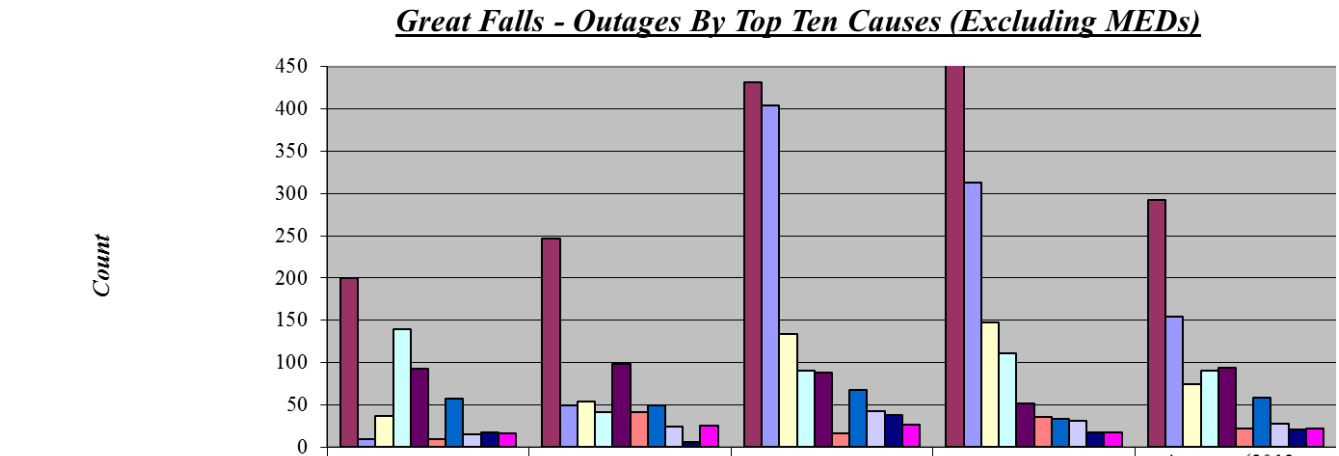
	2013	2014	2015	2016	Average (2013-2015)
SAIDI	188.31	151.88	144.33	118.20	150.68
CAIDI	140.11	102.84	97.61	101.17	110.43
SAIFI	1.344	1.477	1.479	1.168	1.367

Figure 6.1 Great Falls system indices excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.



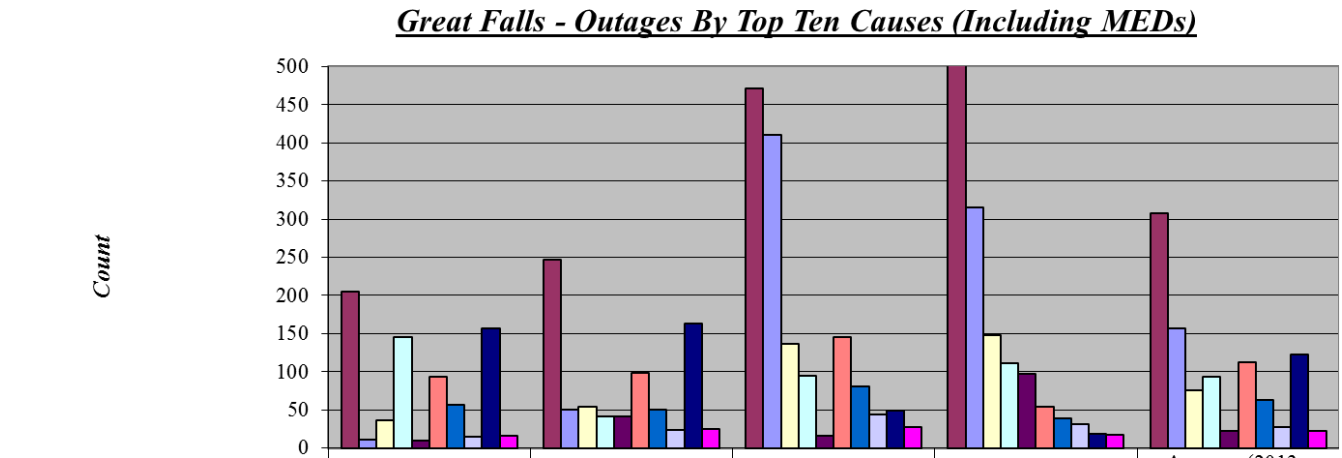
	2013	2014	2015	2016	Average (2013-2015)
SAIDI	191.31	151.88	192.57	301.50	209.31
CAIDI	93.41	102.84	107.76	207.40	127.85
SAIFI	2.048	1.477	1.787	1.454	1.691

Figure 6.2 Great Falls system indices including major event days (MEDs) as defined in IEEE Standard 1366-2012.



	2013	2014	2015	2016	Average (2013 - 2015)
System - Equipment Failure	200	247	431	475	293
System - Scheduled Maintenance	10	50	404	313	155
Animal - Other Bird	37	54	134	147	75
Nature - Lightning	139	42	91	111	91
Nature - Wind	93	99	88	52	93
Nature - Snow/Ice	10	41	16	36	22
Nature - Tree In Line	57	50	68	33	58
Animal - Waterfowl	15	24	43	31	27
Public - Vehicle Hit	18	6	38	18	21
System - Scheduled Construction	16	25	27	18	23
DIVISION TOTAL	853	921	1,519	1,366	1,098

Figure 6.3 Great Falls system outages by top ten causes excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.

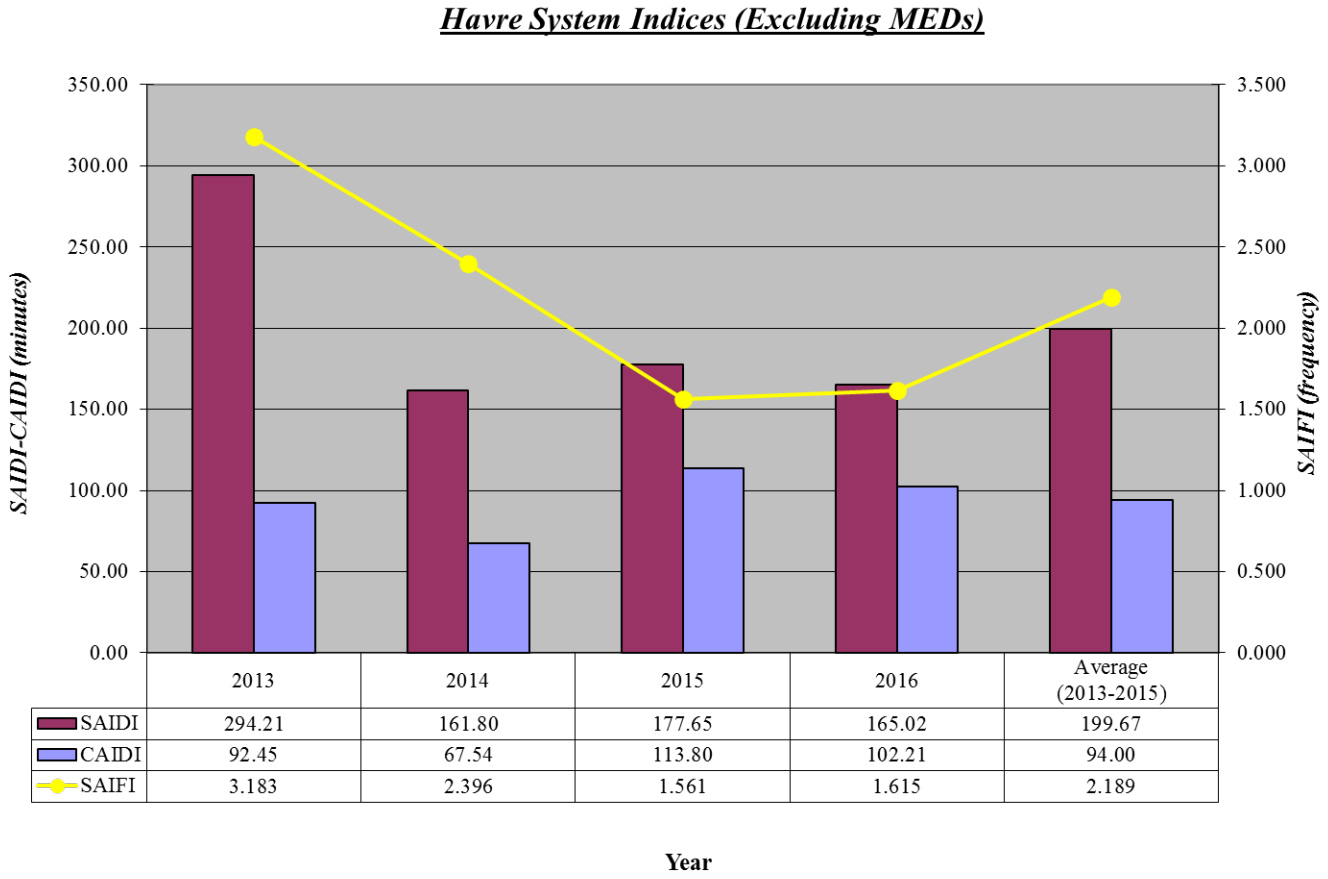


	2013	2014	2015	2016	Average (2013 - 2015)
System - Equipment Failure	205	247	472	585	308
System - Scheduled Maintenance	11	50	411	315	157
Animal - Other Bird	37	54	137	148	76
Nature - Lightning	145	42	95	111	94
Nature - Snow/Ice	10	41	16	97	22
Nature - Wind	93	99	145	54	112
Nature - Tree In Line	57	50	81	39	63
Animal - Waterfowl	15	24	44	31	28
Unknown	157	163	49	19	123
System - Scheduled Construction	16	25	27	18	23
DIVISION TOTAL	870	921	1,653	1,556	1,148

Figure 6.4 Great Falls system outages by top ten causes including major event days (MEDs) as defined in IEEE Standard 1366-2012.

7. HAVRE SYSTEM RELIABILITY

Havre saw a significant decrease in SAIDI and SAIFI and a small increase in CAIDI. SAIDI and SAIFI were lower than the three year averages. Larger events were a planned outage to maintain the power transformer at the Harlem Substation and a wind caused outage on the Harlem Town circuit. Non-MED outages were notably down including animal and equipment failure. Storm caused MEDs had a large impact on the Havre area.



	2013	2014	2015	2016	Average (2013-2015)
SAIDI	294.21	161.80	177.65	165.02	199.67
CAIDI	92.45	67.54	113.80	102.21	94.00
SAIFI	3.183	2.396	1.561	1.615	2.189

Figure 7.1 Havre system indices excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.

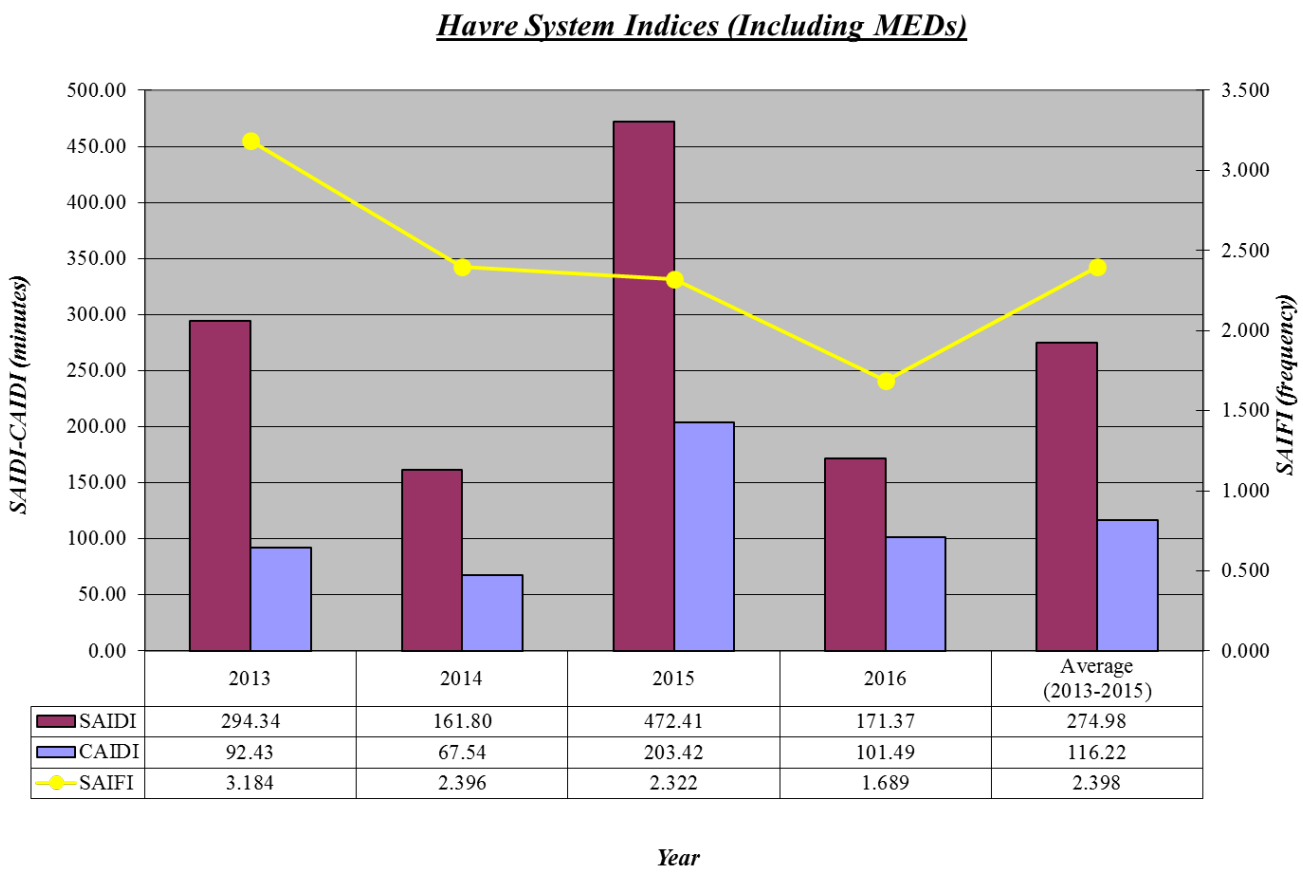
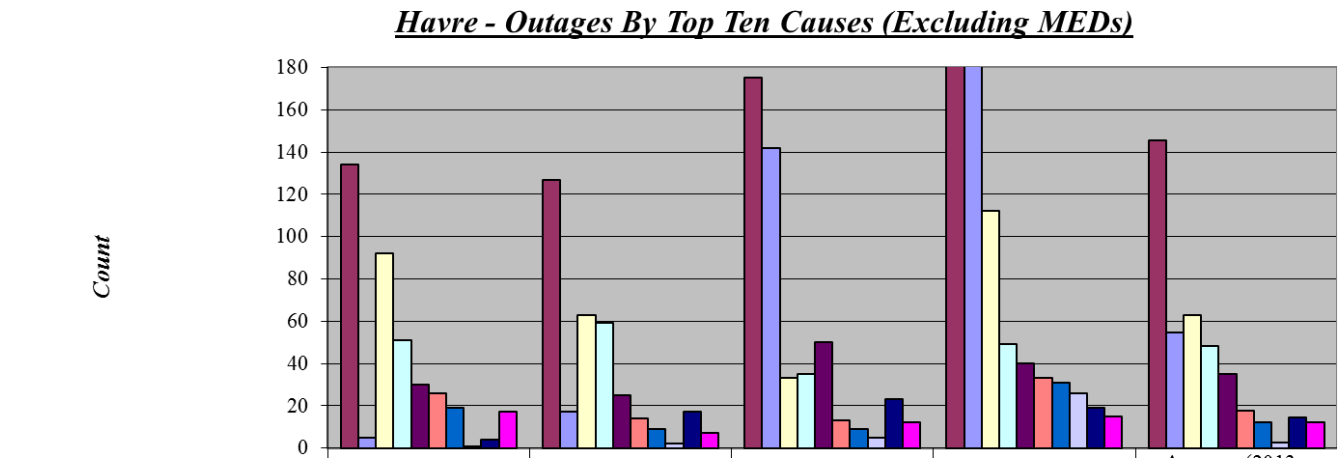
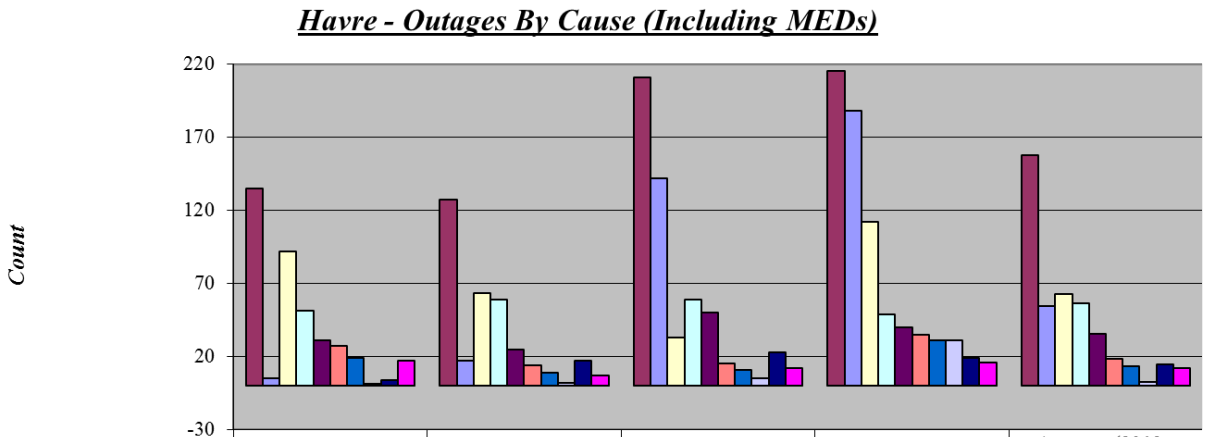


Figure 7.2 Havre system indices including major event days (MEDs) as defined in IEEE Standard 1366-2012.



	2013	2014	2015	2016	Average (2013 - 2015)
System - Equipment Failure	134	127	175	205	145
System - Scheduled Maintenance	5	17	142	186	55
Nature - Lightning	92	63	33	112	63
Nature - Wind	51	59	35	49	48
Animal - Other Bird	30	25	50	40	35
Nature - Tree In Line	26	14	13	33	18
Nature - Limb In Line	19	9	9	31	12
Nature - Snow/Ice	1	2	5	26	3
Public - Vehicle Hit	4	17	23	19	15
Animal - Waterfowl	17	7	12	15	12
DIVISION TOTAL	486	427	590	778	501

Figure 7.3 Havre system outages by top ten causes excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.

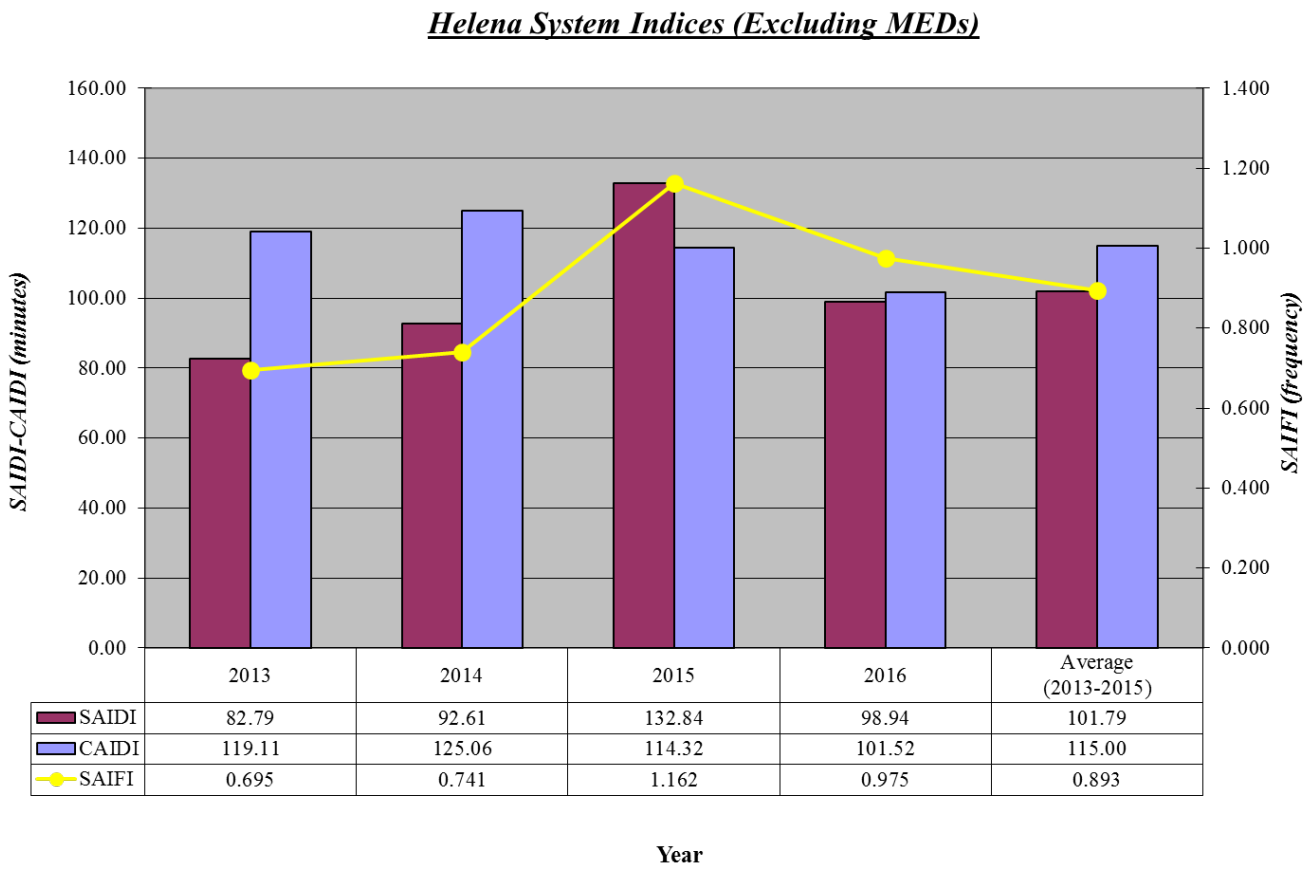


	2013	2014	2015	2016	Average (2013 - 2015)
System - Equipment Failure	135	127	211	215	158
System - Scheduled Maintenance	5	17	142	188	55
Nature - Lightning	92	63	33	112	63
Nature - Wind	51	59	59	49	56
Animal - Other Bird	31	25	50	40	35
Nature - Tree In Line	27	14	15	35	19
Nature - Limb In Line	19	9	11	31	13
Nature - Snow/Ice	1	2	5	31	3
Public - Vehicle Hit	4	17	23	19	15
Animal - Waterfowl	17	7	12	16	12
DIVISION TOTAL	491	427	655	800	524

Figure 7.4 Havre system outages by top ten causes including major event days (MEDs) as defined in IEEE Standard 1366-2012.

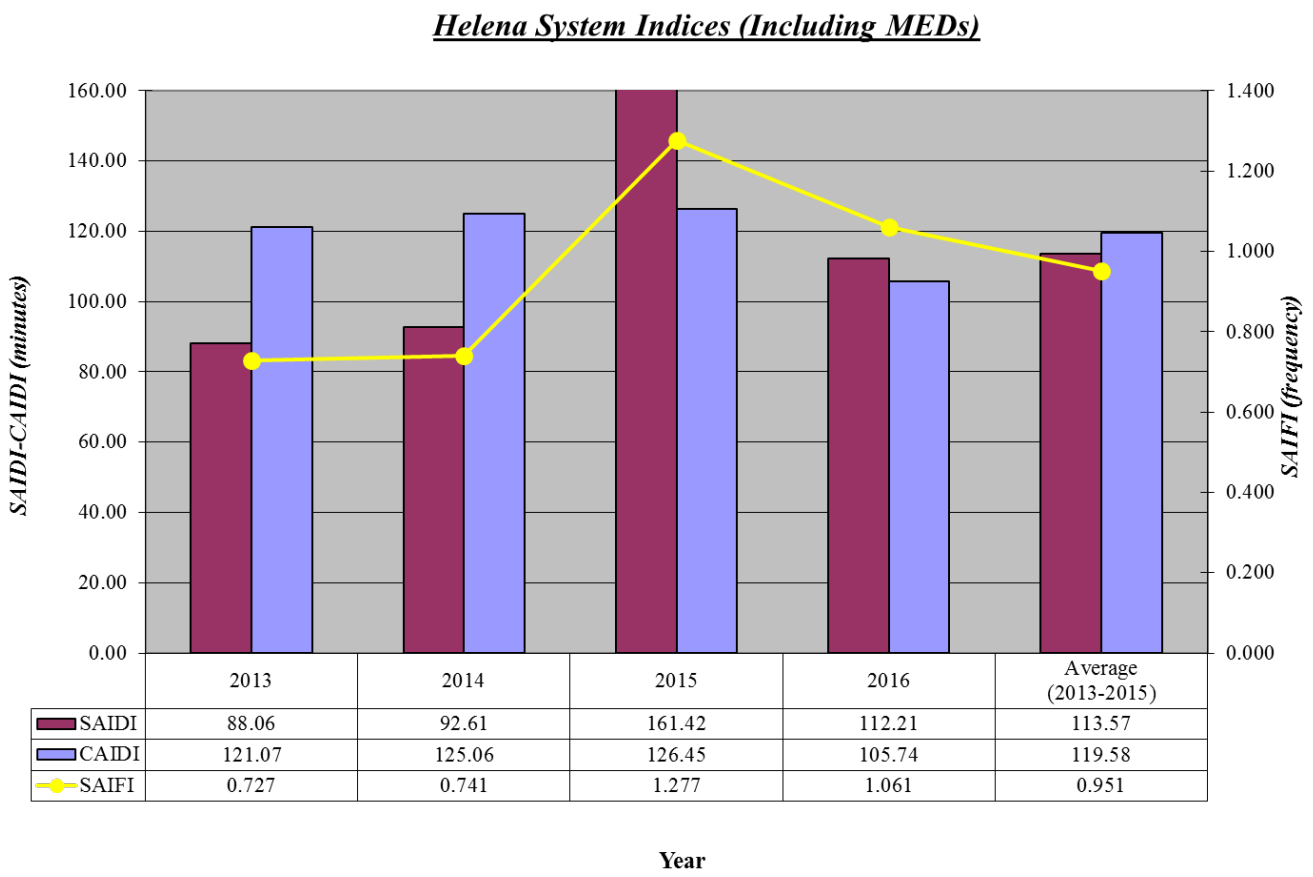
8. HELENA SYSTEM RELIABILITY

Helena Division saw a decrease of all three indices for 2016 over 2015 values. The Mont. Ave. South Fdr. 2 had a major outage caused by a tree falling into the line and breaking a crossarm. Snow load caused an extensive outage on the Wolf Creek Feeder. A problem at the Great Falls 230 substation caused the 230KV line feeds the Landers Fork Substation to trip causing an outage to these customers. Tree and wind caused outages were higher.



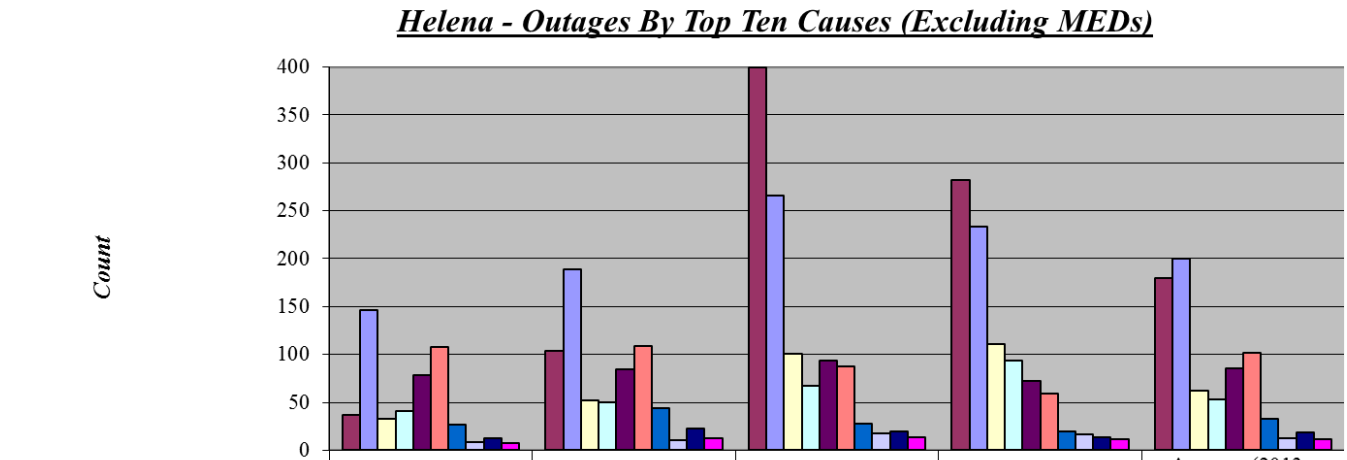
	2013	2014	2015	2016	Average (2013-2015)
SAIDI	82.79	92.61	132.84	98.94	101.79
CAIDI	119.11	125.06	114.32	101.52	115.00
SAIFI	0.695	0.741	1.162	0.975	0.893

Figure 8.1 Helena system indices excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.



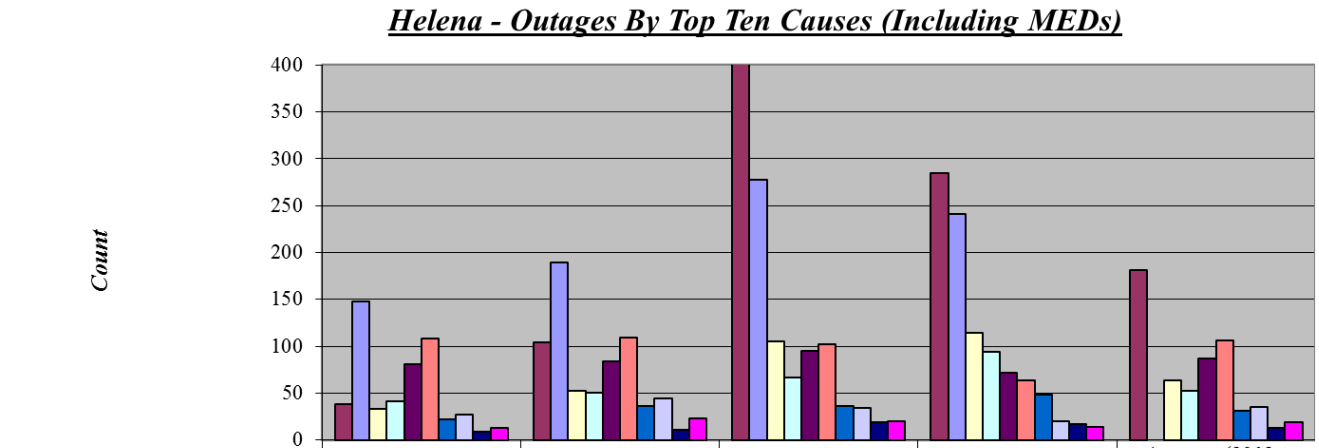
	2013	2014	2015	2016	Average (2013-2015)
SAIDI	88.06	92.61	161.42	112.21	113.57
CAIDI	121.07	125.06	126.45	105.74	119.58
SAIFI	0.727	0.741	1.277	1.061	0.951

Figure 8.2 Helena system indices including major event days (MEDs) as defined in IEEE Standard 1366-2012.



	2013	2014	2015	2016	Average (2013 - 2015)
System - Scheduled Maintenance	37	104	399	282	180
System - Equipment Failure	146	189	266	233	200
Animal - Other Bird	33	52	101	111	62
Animal - Squirrel	41	50	67	94	53
Nature - Lightning	78	84	94	72	85
Nature - Tree In Line	108	109	88	59	102
Nature - Wind	27	44	28	20	33
Public - Vehicle Hit	9	11	18	17	13
System - Scheduled Construction	13	23	20	14	19
System - Human Error/Accident	8	13	14	12	12
DIVISION TOTAL	636	847	1,217	992	900

Figure 8.3 Helena system outages by top ten causes excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.

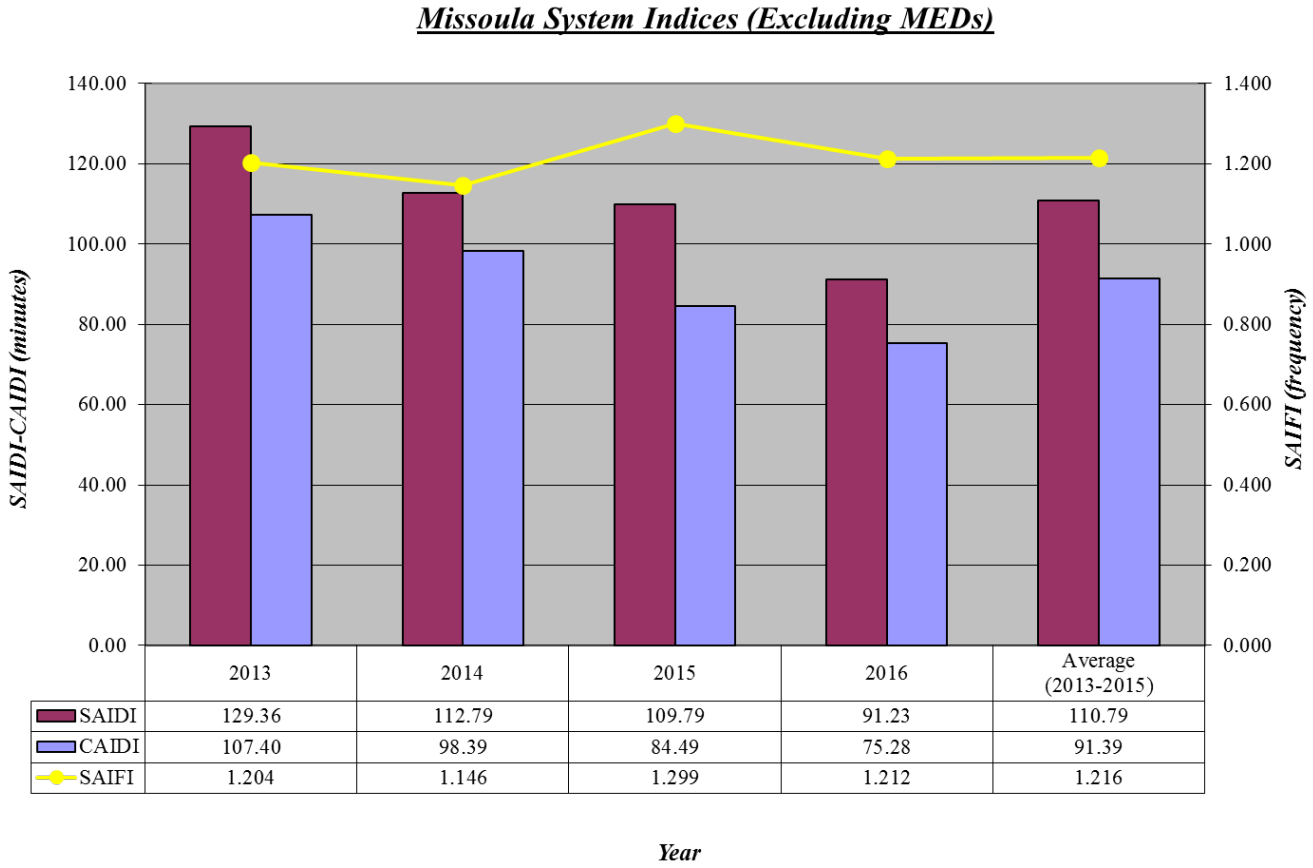


	2013	2014	2015	2016	Average (2013 - 2015)
System - Scheduled Maintenance	38	104	401	285	181
System - Equipment Failure	148	189	278	241	
Animal - Other Bird	33	52	105	114	63
Animal - Squirrel	41	50	67	94	53
Nature - Lightning	81	84	95	72	87
Nature - Tree In Line	108	109	102	63	106
Nature - Snow/Ice	22	36	36	48	31
Nature - Wind	27	44	34	20	35
Public - Vehicle Hit	9	11	19	17	13
System - Scheduled Construction	13	23	20	14	19
DIVISION TOTAL	638	847	1,259	1,050	891

Figure 8.4 Helena system outages by top ten causes including major event days (MEDs) as defined in IEEE Standard 1366-2012.

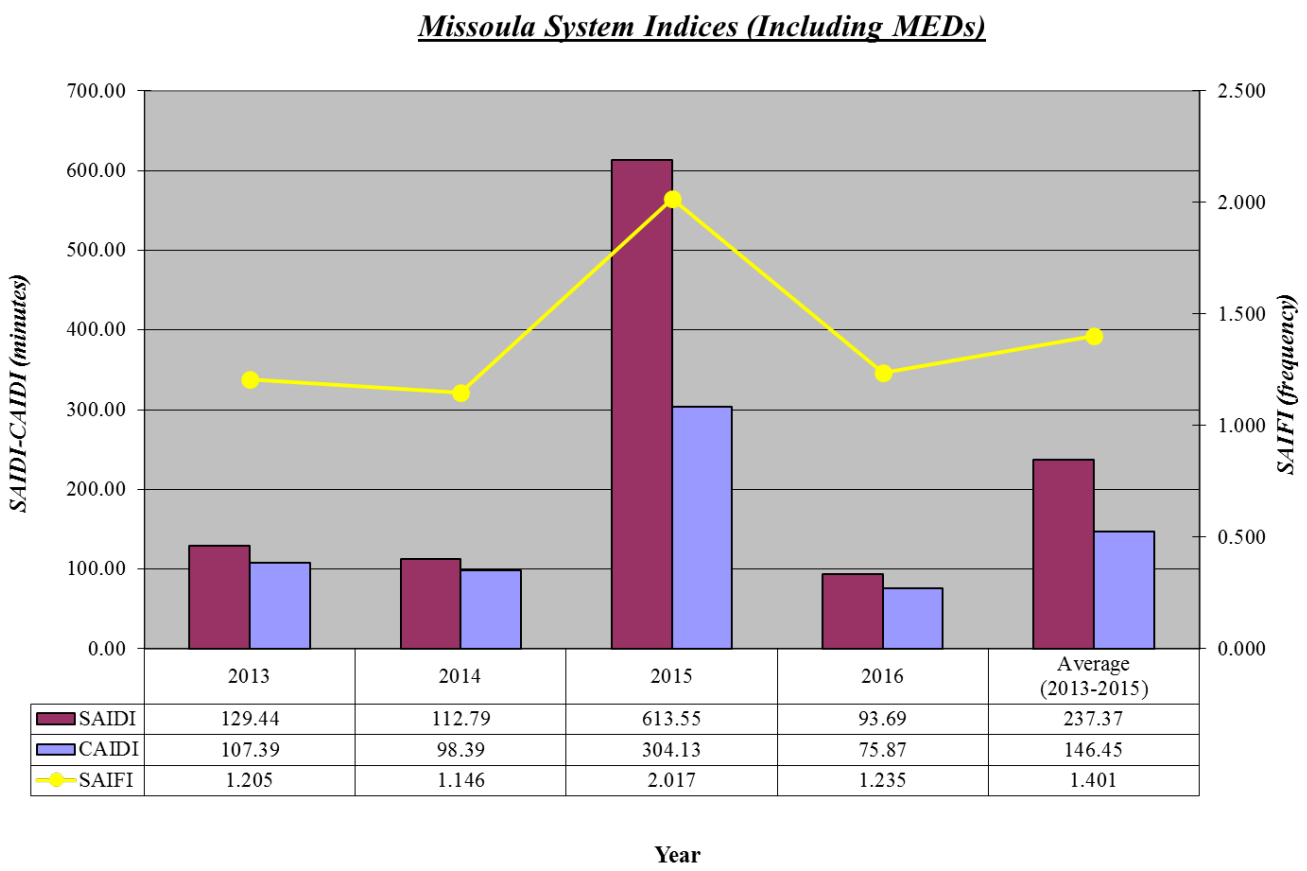
9. MISSOULA SYSTEM RELIABILITY

Excluding MEDs, the Missoula Division continues to improve SAIDI and CAIDI indices in 2016. There was decrease in SAIFI. Note that the Catastrophic Day in 2015 is still having a large impact on the three year averages including MED's. All three indecies are below their three year averages. The largest non-MED event was a squirrel on Russell St. Fdr. 31 in September. In August, a transformer problem in the Missoula Industrial sub also caused a large outage. Trees took out Industrial Sub Fdr. 42 in March. Most outages were down, while lightning and vehicle hit outages were up.



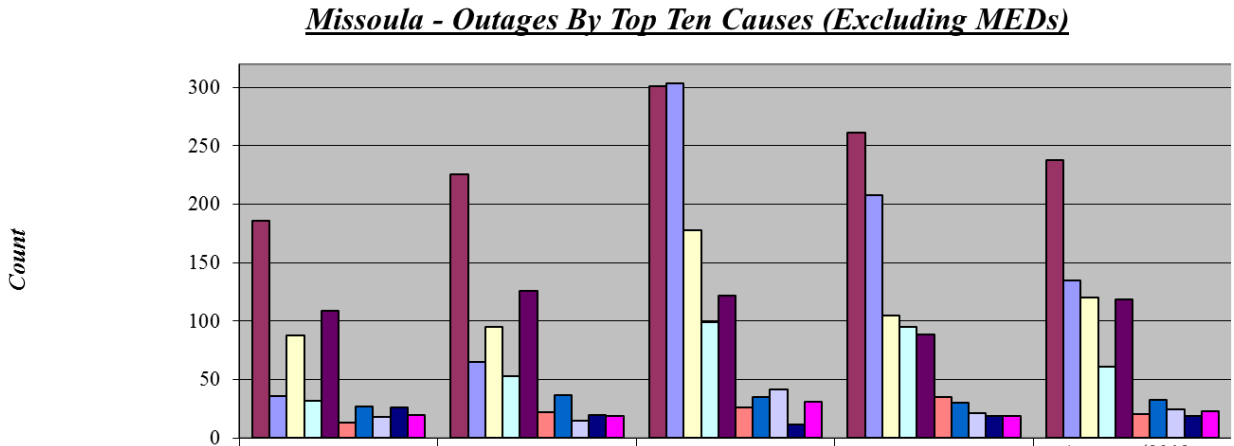
	2013	2014	2015	2016	Average (2013-2015)
SAIDI	129.36	112.79	109.79	91.23	110.79
CAIDI	107.40	98.39	84.49	75.28	91.39
SAIFI	1.204	1.146	1.299	1.212	1.216

Figure 10.1 Missoula system indices excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.



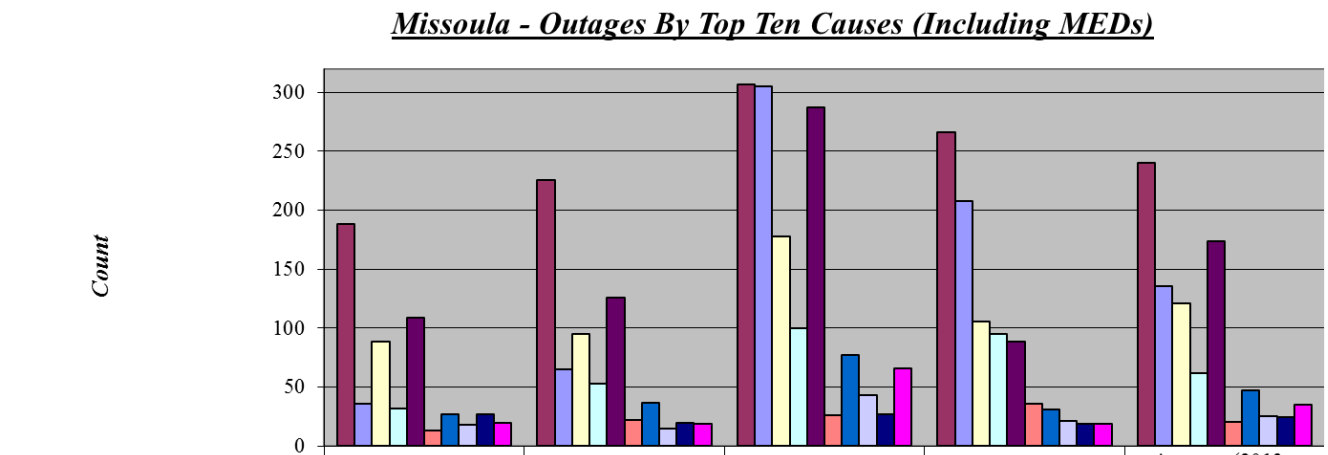
	2013	2014	2015	2016	Average (2013-2015)
SAIDI	129.44	112.79	613.55	93.69	237.37
CAIDI	107.39	98.39	304.13	75.87	146.45
SAIFI	1.205	1.146	2.017	1.235	1.401

Figure 10.2 Missoula system indices including major event days (MEDs) as defined in IEEE Standard 1366-2012.



	2013	2014	2015	2016	Average (2013 - 2015)
System - Equipment Failure	186	226	301	261	238
System - Scheduled Maintenance	36	65	303	208	135
Animal - Squirrel	88	95	178	105	120
Animal - Other Bird	32	53	99	95	61
Nature - Tree In Line	109	126	122	89	119
Public - Vehicle Hit	13	22	26	35	20
Nature - Limb In Line	27	37	35	30	33
System - Scheduled Construction	18	15	42	21	25
Nature - Lightning	26	20	12	19	19
Nature - Wind	20	19	31	19	23
DIVISION TOTAL	751	877	1,312	1,004	980

Figure 10.3 Missoula system outages by top ten causes excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.



	2013	2014	2015	2016	Average (2013 - 2015)
System - Equipment Failure	188	226	307	266	240
System - Scheduled Maintenance	36	65	305	208	135
Animal - Squirrel	89	95	178	106	121
Animal - Other Bird	32	53	100	95	62
Nature - Tree In Line	109	126	287	89	174
Public - Vehicle Hit	13	22	26	36	20
Nature - Limb In Line	27	37	77	31	47
System - Scheduled Construction	18	15	43	21	25
Nature - Lightning	27	20	27	19	25
Nature - Wind	20	19	66	19	35
DIVISION TOTAL	757	899	1,556	1,014	1,071

Figure 10.4 Missoula system outages by top ten causes including major event days (MEDs) as defined in IEEE Standard 1366-2012.

10. CONCLUSION

Last year started off well with SAIDI being below the three year average until the MED on April 15th. This was caused by a strong wind and snow/icen storm in the Great Falls and Havre areas. This drove that month's SAIDI over 44 minutes, compared to an earlier three-year April average of 31 minutes. With fairly average interruptions from April 15th to May 9th, SAIDI remained higher than average. Then the MED on May 9 occurred that added seven minutes to Montana SAIDI. The remaining months were generally at their corresponding three year average. This continued until August 10th when the SAIDI dropped significantly below the three year average due to the large effect of the Missoula MED's in 2015. The result was a year-end SAIDI, without MEDs, of 111 compared to the three year average of 121. The year-end SAIDI, with MEDs, was 144 compared to the 166 three year average.

The InService mobile work force and outage management system was implemented by NWE during the fall of 2014. This provided more accurate and timely outage reporting for 2016. Outage customer counts and times are derived from the GIS, call logging, and automated systems, eliminating the earlier manual outage reporting system and its inherent approximations. This was well illustrated in 2015 and 2016 with the large increase in Scheduled Construction and Maintenance outages. In the past, many of these outages were not reported. Both IEEE and the Department of Energy reports indicate that SAIDI numbers normally increase with this improved accuracy, but with the whims of nature, this may be difficult to determine for some time. The conversion to The IEEE reliability standard (1366-2012) does not define the 24 hour day and many of the utilities involved in the IEEE benchmark survey have gone to something other than midnight-to-midnight. Some will even "roll" the 24 hours to more accurately capture the full impact of a storm day (and possible MED). This option was implemented by NWE in 2015.

Increased efforts in line patrol and repairs as well as vegetation work may have improved reliability in 2016, as well as reduced the impacts from larger storms. Additionally, with the implementation of reliability projects under the Distribution System Infrastructure Project (DSIP), stability and hopefully improvement in electric system reliability should be realized. Of course the impacts of storms are a major contributor to reduced reliability and complicate any analysis. Substation and other asset improvements increased scheduled outages, but careful planning kept these outages to a minimum and this work helps avoid equipment failures and provides facilities to serve future loads. With continued upgrades and planning, diligent work, and sincere effort, NorthWestern Energy strives to provide safe, reliable electric service to our customers and a safe working environment for our employees, now and into the future.

ANNEX A: TRANSMISSION DATA AND GRAPHS

Attached below are graphs showing the electric transmission cumulative outage duration, cumulative outage frequency, ASAI and SAIFI. A graph for 2016 is given for each metric. Also a graph showing data from 2002 to 2016 is given for ASAI and SAIFI. Graphs showing the 2013-2015 average and 2016 year end are provided. Also included are graphs showing the outage cause duration and frequency by year from 2011 through 2016.

The 2016 outage duration is approximately **33.4 hours (2.1%) more** than the 2013-2015 average. The 2016 outage frequency (count) is approximately **46 outages (6.3%) less** than the 2013-2016 average. These numbers reflect a very reliable year at the transmission level. Tree Problems, System Protection, and Unknown outage numbers were all down from 2015, with Hardware, Raptor or Bird Problems, and Lightning outages increasing in 2016.

Outage Duration - Hours													
Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	Monthly	133.28	59.88	117.60	131.66	150.74	128.69	316.93	217.55	68.68	85.70	86.22	99.11
2013-2015	Monthly	86.80	121.45	76.14	145.15	143.66	132.92	241.93	143.31	108.44	115.17	174.04	73.68
2016	Cumulativ	133.28	193.16	310.76	442.42	593.16	721.86	1038.79	1256.34	1325.02	1410.73	1496.94	1596.06
2013-2015	Cumulativ	86.80	208.25	284.39	429.53	573.20	706.12	948.05	1091.37	1199.81	1314.97	1489.01	1562.69

Outage Frequency - Count													
Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	Monthly	28.0	60.0	35.0	65.0	96.0	80.0	90.0	73.0	41.0	59.0	24.0	31.0
2013-2015	Monthly	36.3	44.0	45.3	62.7	68.0	90.3	100.3	89.0	65.3	47.7	39.0	39.7
2016	Cumulativ	28.0	88.0	123.0	188.0	284.0	364.0	454.0	527.0	568.0	627.0	651.0	682.0
2013-2015	Cumulativ	36.3	80.3	125.7	188.3	256.3	346.7	447.0	536.0	601.3	649.0	688.0	727.7

ASAI (Average Service Availability Index) - % Larger is Better													
Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	Monthly	99.942	99.972	99.949	99.940	99.934	99.942	99.862	99.905	99.969	99.963	99.961	99.957
2013-2015	Monthly	99.959	99.936	99.964	99.929	99.932	99.935	99.886	99.932	99.947	99.946	99.915	99.965
2016	Cumulativ	99.942	99.956	99.954	99.950	99.947	99.946	99.934	99.930	99.935	99.937	99.940	99.941
2013-2015	Cumulativ	99.959	99.948	99.954	99.947	99.944	99.943	99.934	99.934	99.936	99.937	99.935	99.937

SAIFI (System Average Interruption Frequency) – Smaller is Better													
Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	Monthly	1.077	2.467	1.346	2.583	3.680	3.169	3.450	2.798	1.619	2.262	0.948	1.184
2013-2015	Monthly	1.506	2.020	1.879	2.688	2.820	3.866	4.155	3.685	2.796	1.971	1.665	1.639
2016	Cumulativ	1.077	1.749	1.611	1.852	2.226	2.382	2.538	2.571	2.466	2.445	2.311	2.215
2013-2015	Cumulativ	1.506	1.750	1.795	2.018	2.182	2.462	2.710	2.834	2.830	2.742	2.645	2.559

Figure A.1 Electric transmission cumulative outage duration - 2016

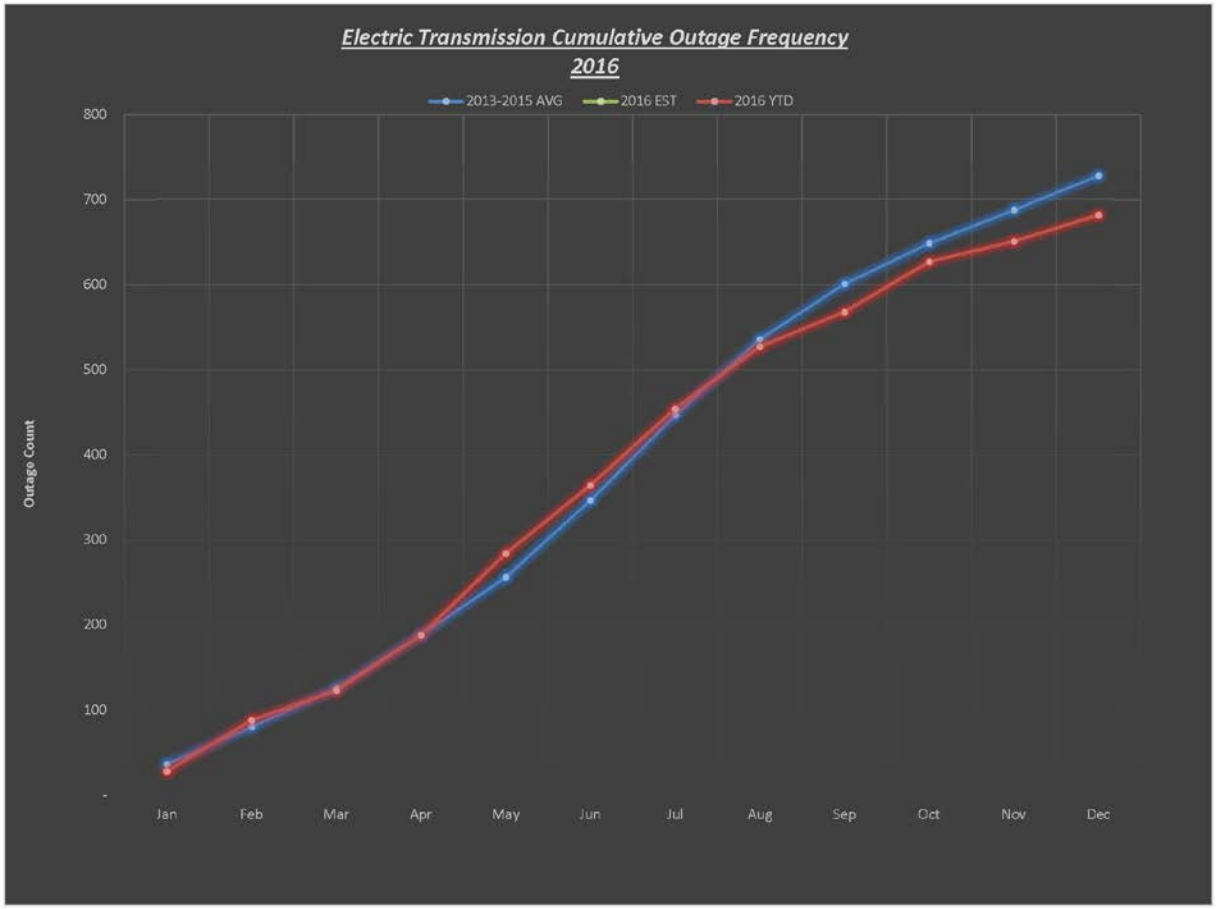


Figure A.2 Electric transmission cumulative outage frequency - 2016

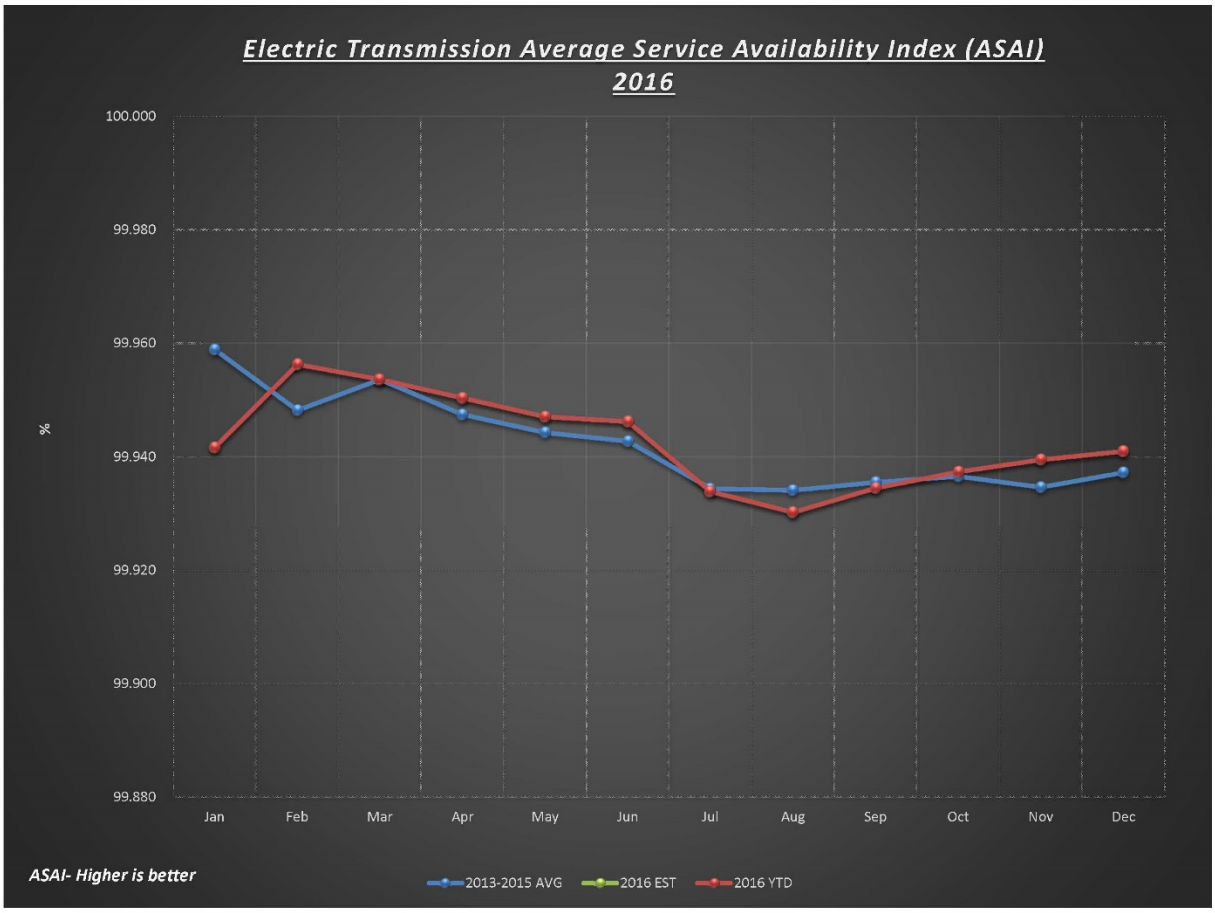
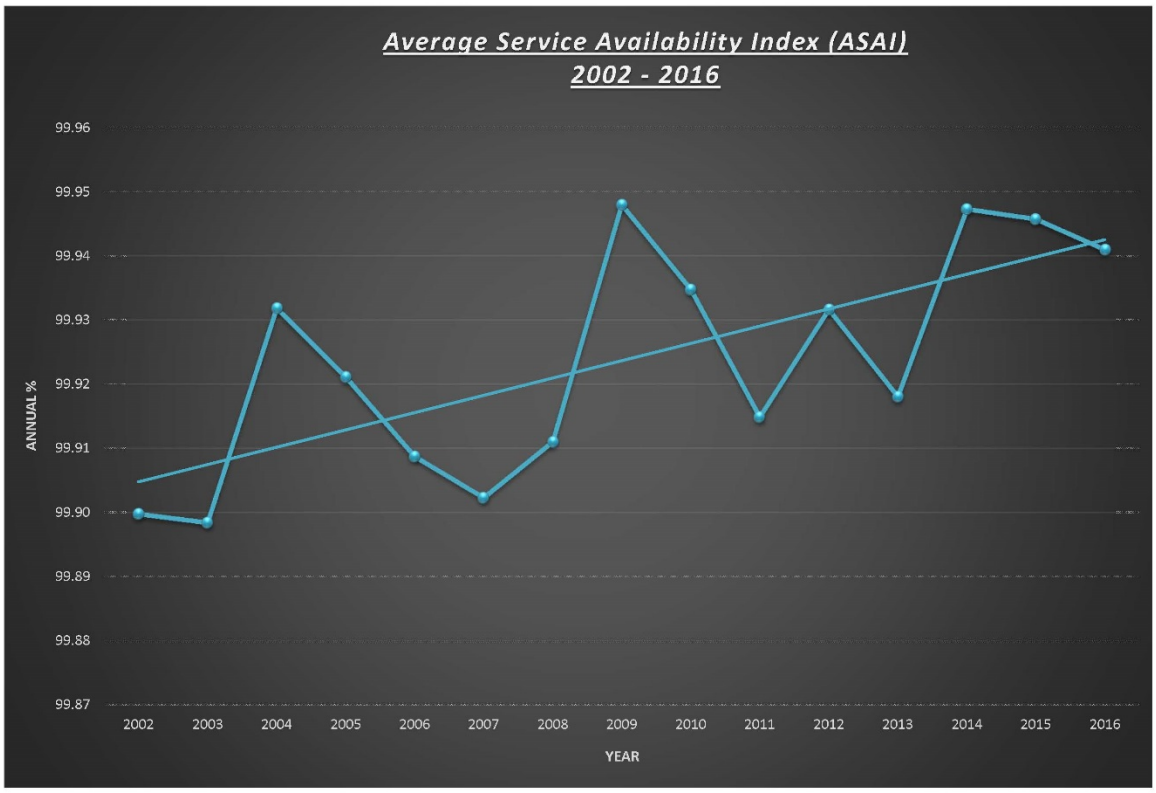


Figure A.3 Electric transmission Average Service Availability Index (ASAI) - 2016



ASAI - Higher is Better

Figure A.4 Electric transmission Average Service Availability Index (ASAI) 2002-2016

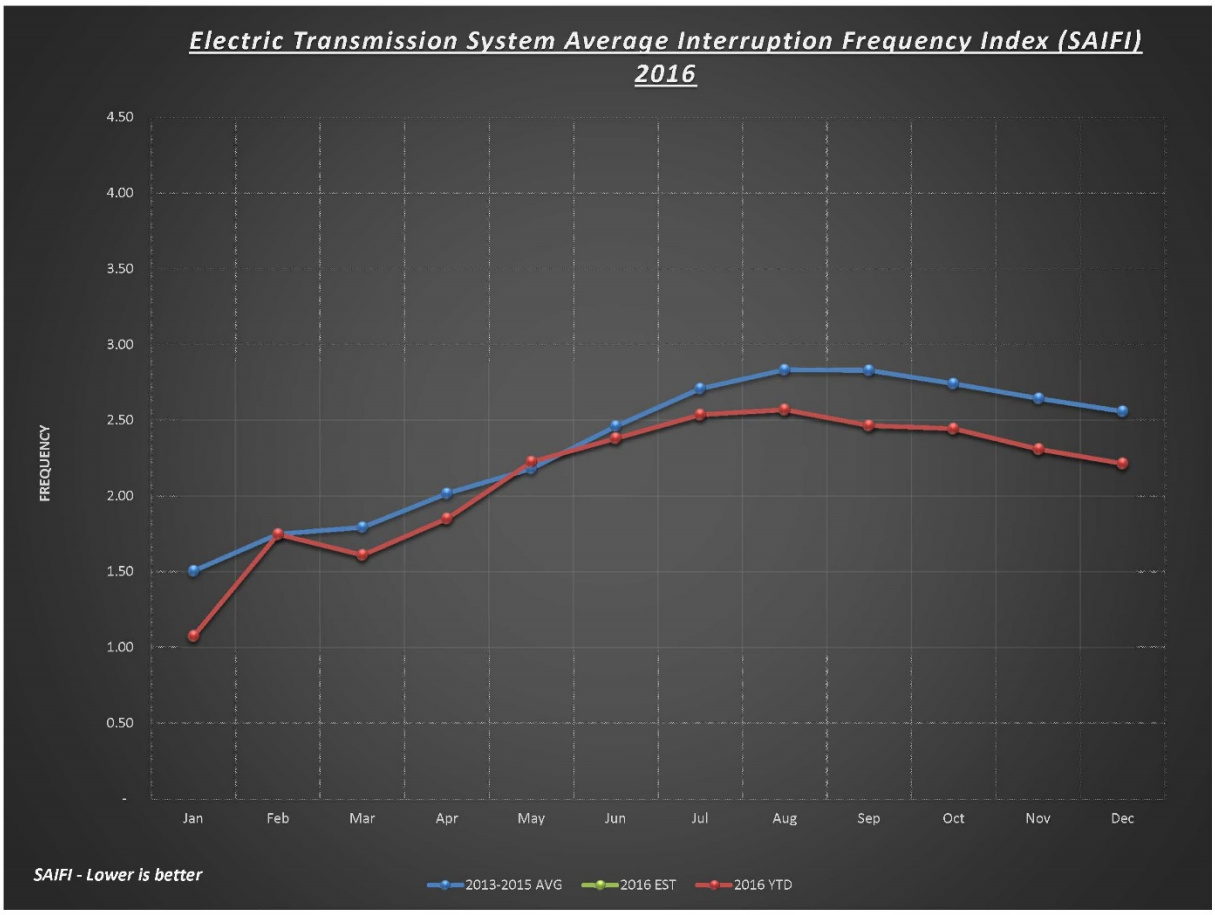
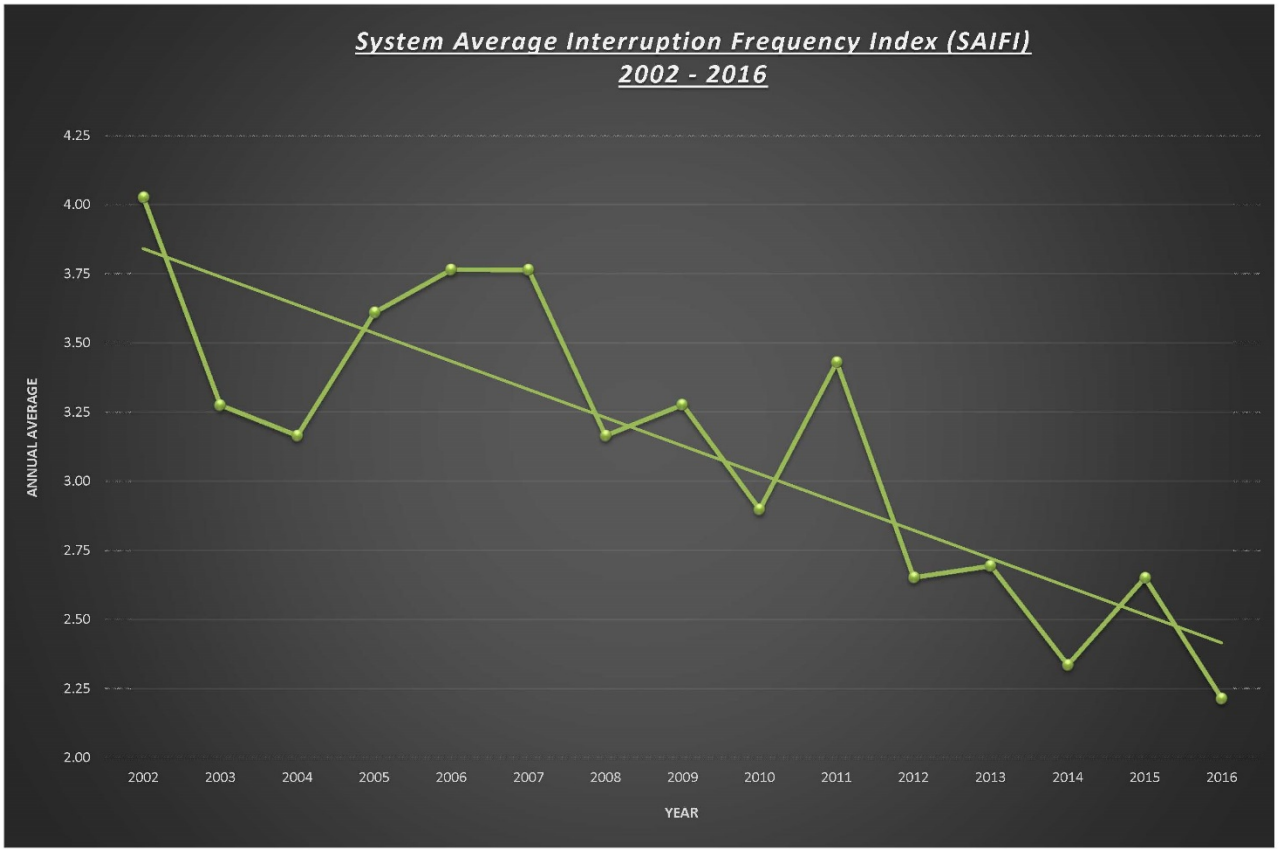


Figure A.5 Elect. Transmission System Average Interruption Frequency Index (SAIFI) - 2016



SAIFI - Lower is Better

Figure A.6 Elect. Trans. System Average Interruption Frequency Index (SAIFI) 2002 - 2016

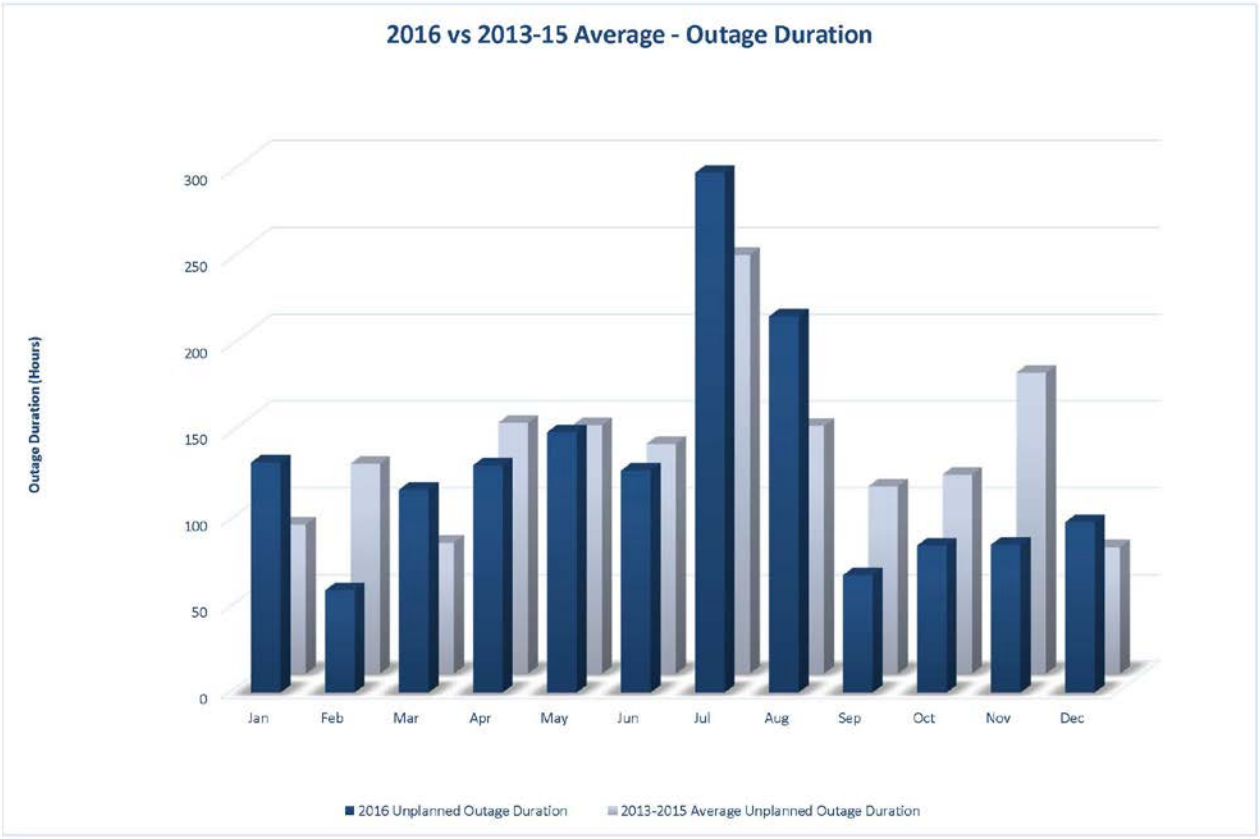


Figure A.7 Comparison of 2016 outage duration to previous three-year average

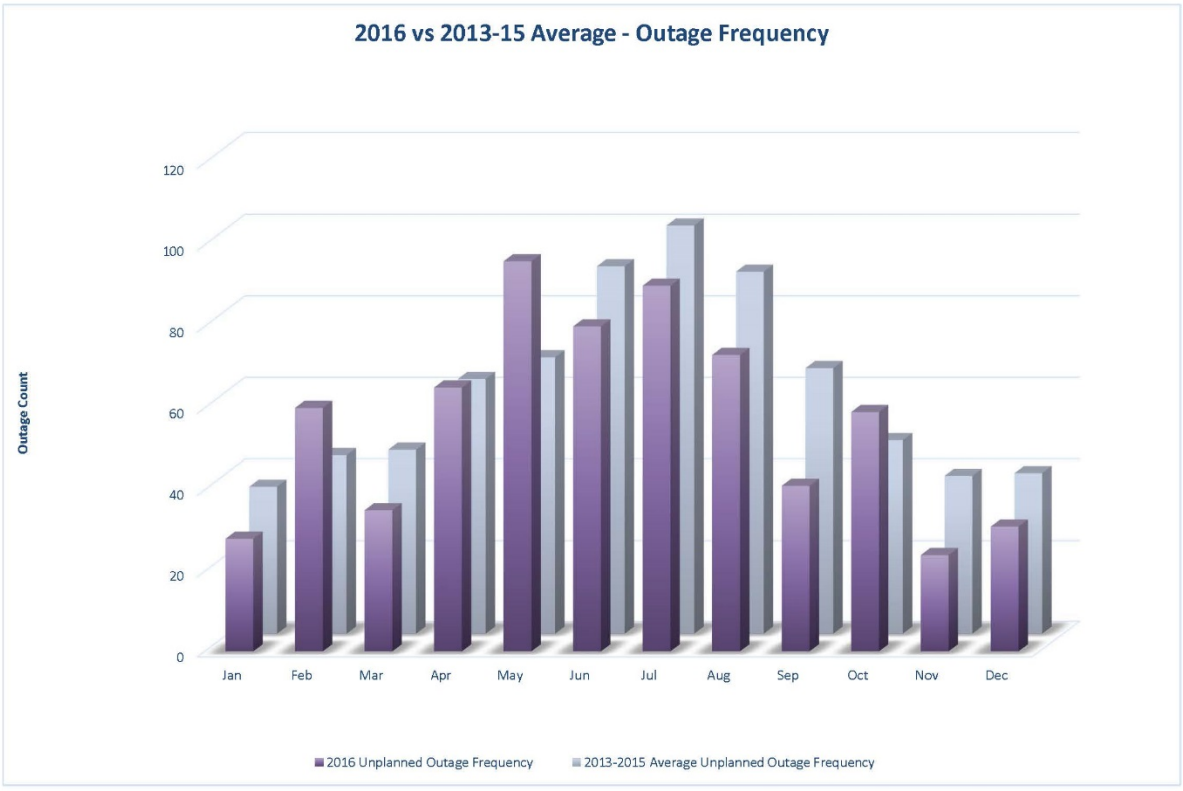


Figure A.8 Comparison of 2016 outage frequency to previous three-year average

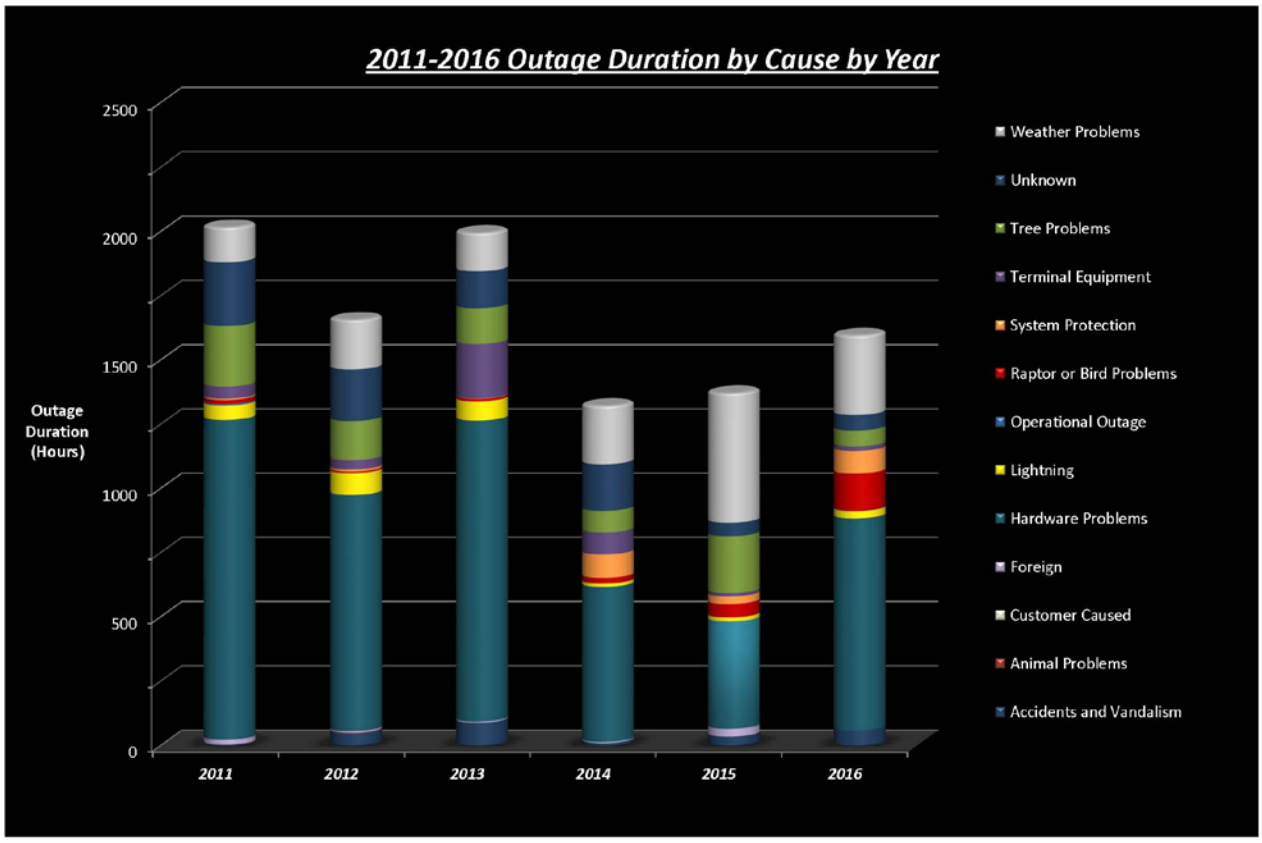


Figure A.9 Outage duration by cause by year for 2011-2016

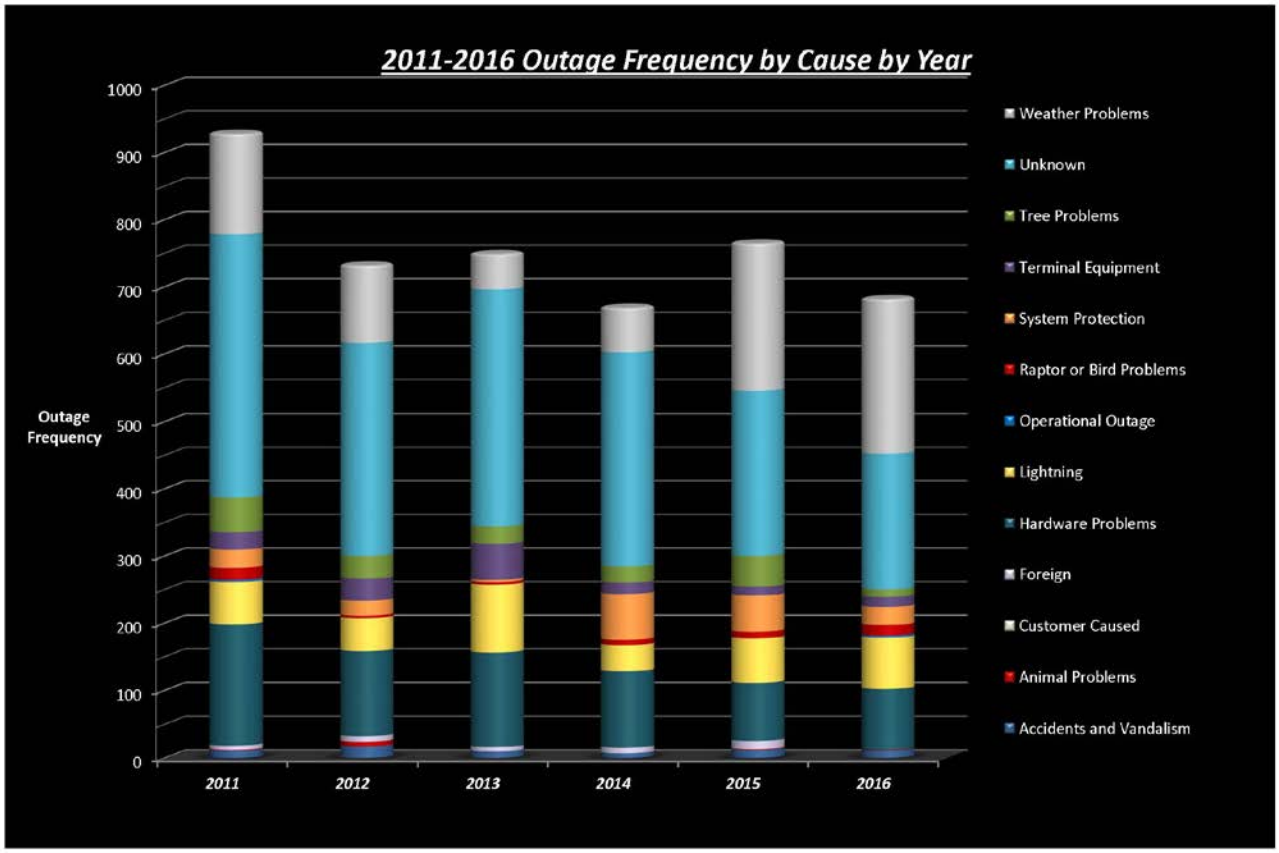


Figure A.10 Outage frequency by cause by year for 2011-2016