NorthWestern Energy
Delivering a Bright Future

March 1, 2018

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

RE: 2017 Annual Electric Reliability Report

Dear Mr. Rosquist:

With this letter, NorthWestern Energy submits the 2017 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 six 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: 2017 Annual Electric Reliability Report

CERTIFICATE OF SERVICE

I hereby certify that NorthWestern Energy's 2017 Annual Electric Reliability Report has been hand delivered to the Montana Public Service Commission and the Montana Consumer Counsel this date. It has also been e-filed on the MPSC website.

Date: March 1, 2018

Connie Moran
Administrative Assistant
Regulatory Affairs

NorthWestern® Energy

2017
-Montana-
Electric Distribution/Transmission
Annual Reliability Report

March 2018

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EXECUTIVE SUMMARY

This report provides information and insights into NorthWestern Energy's (NWE) 2017 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, 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.

MEDs are identified through a daily 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 2017, there were four Major Event Days**.** By comparison, there were no MEDs in 2011, two in 2012, two in 2013, none in 2014, five in 2015, and three in 2016. Please see table below listed in descending SAIDI Minutes. For the Montana region, it took 6.08 SAIDI minutes in 2017 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
10/2/2017 3:44	30	A severe snow/ice storm hit the Havre area.
10/3/2017 3:47	25	A severe snow/ice storm hit the Havre area.
6/7/2017 19:00	10	A broken conductor occurred while the feed to Trident was out for maintenance. This affected mainly the Belgrade and Bozeman areas.
5/17/2017 9:38	7	Snow storm that affected mainly the Bozeman, Butte, and Livingston areas.

Table 1: Major Event Days (2017)

Due to the very large SAIDI contribution by the MEDs on October 2 and October 3 and the Non-MED outages on October 4, they have been determined to be a "Catastrophic Event." NorthWestern has defined a "Catastrophic Event" as a sequential series of days, that begins with an MED, that have a combined SAIDI that is seven times the MED threshold, or 42.57 SAIDI minutes in 2017. Catastrophic events are not included in any reliability metric.

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 layman'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.

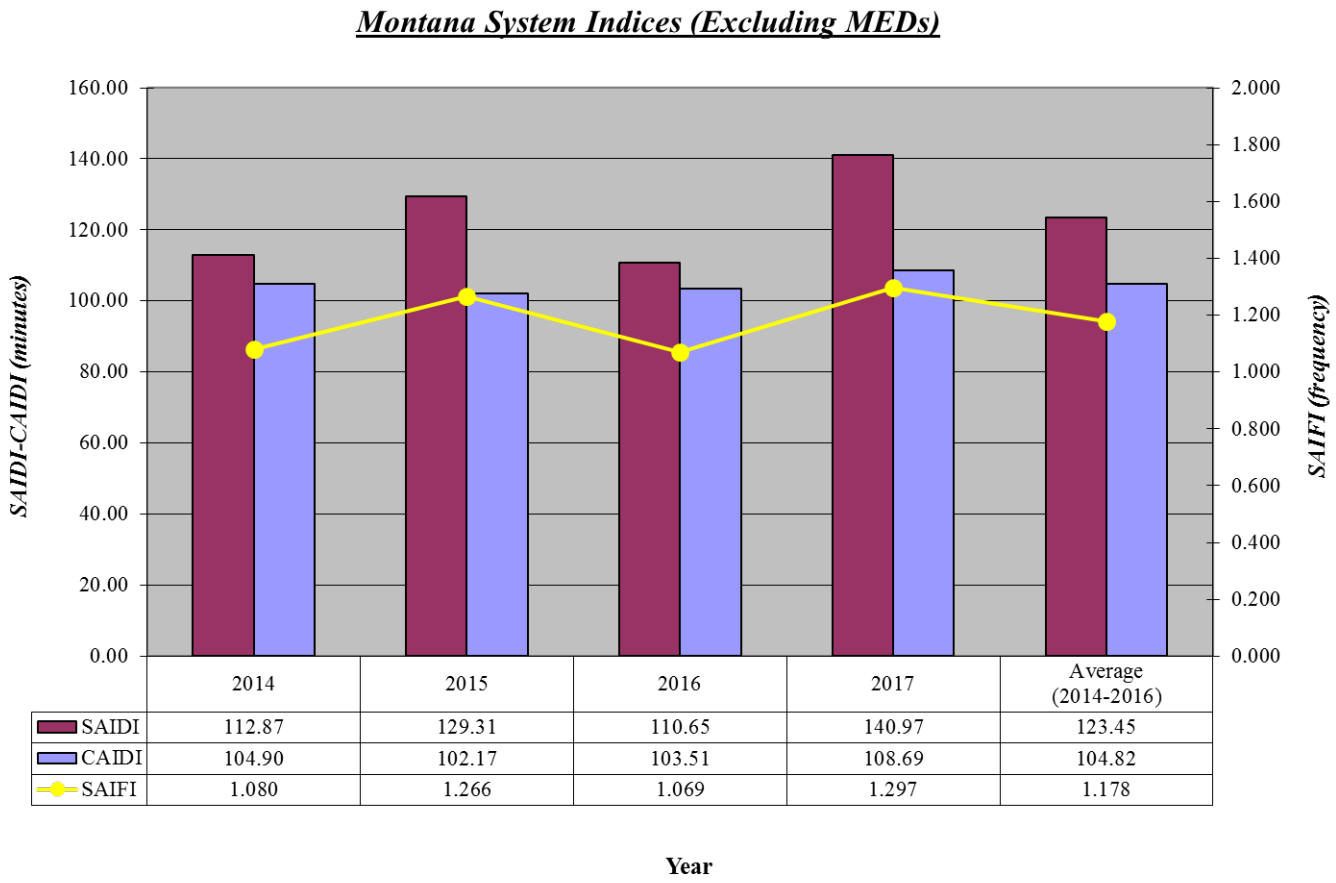
1.2 Additional Notable Events

There were four days with a "Customer-Minutes Interrupted" (CMI) number greater than one million (an MED for 2017 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 2017. For comparison, there were three days in 2016 with over a million CMI.

Date	CMI	Divisions Impacted	Majority Causes
9/14/17	1,403,874	Bozeman, Great Falls	Trees in line and broken insulator
4/25/17	1,173,890	Butte	Major planned outage for work at the Anaconda city substation
6/2/17	1,116,333	Great Falls. Lewistown, Havre	A fault in the Glengarry Substation, a broken cutout, car hit pole
12/30/17	1,007,184	Missoula, Hamilton, Helena	Winter storm with strong winds, snow and ice loading and trees in line

Table 2: Additional Notable Events (2017)

2. MONTANA SYSTEM RELIABILITY



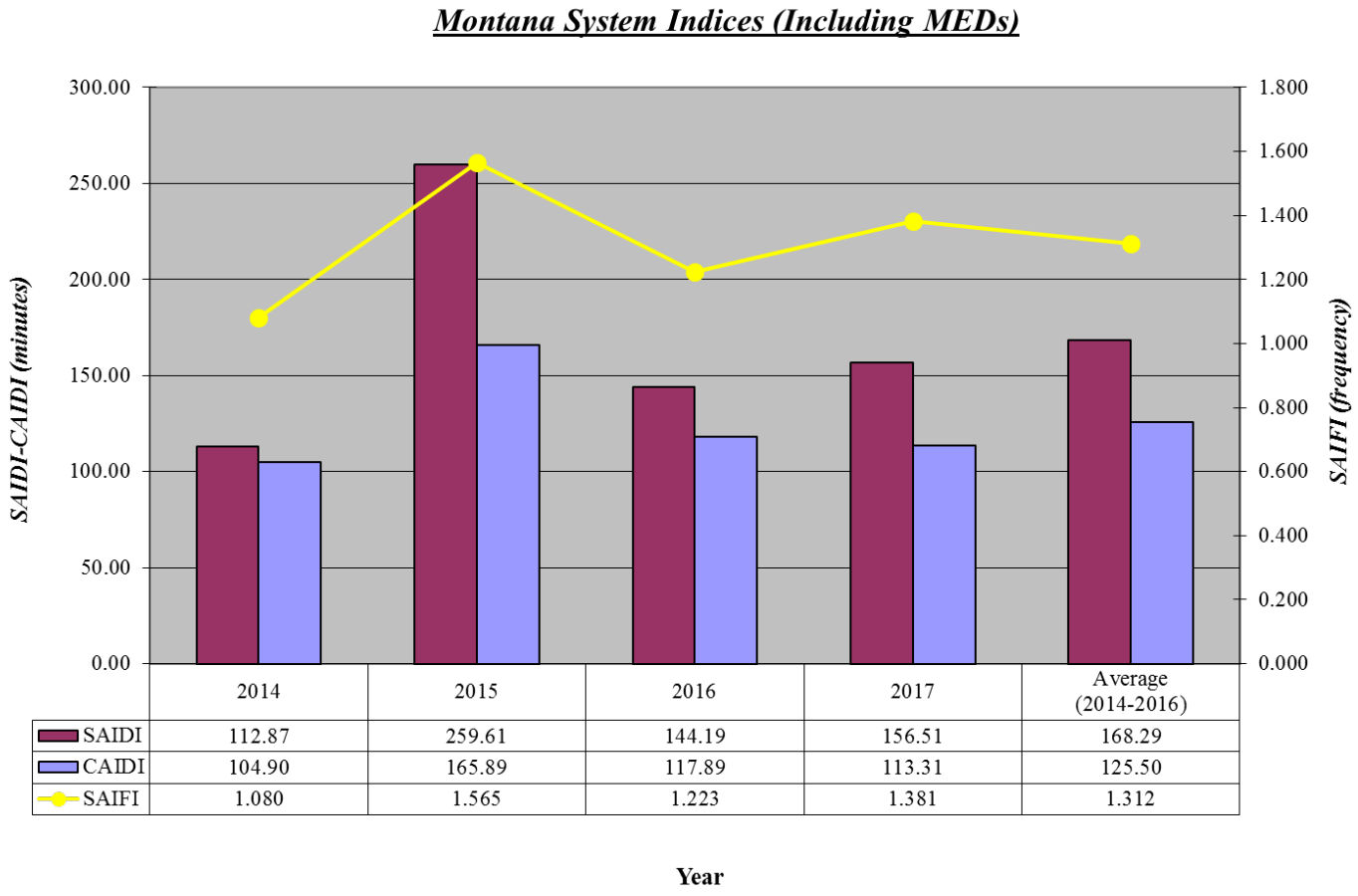
	2014	2015	2016	2017	Average (2014-2016)
SAIDI	112.87	129.31	110.65	140.97	123.45
CAIDI	104.90	102.17	103.51	108.69	104.82
SAIFI	1.080	1.266	1.069	1.297	1.178

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 2014-2017. Region indices shown for 2014 to 2017 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**, SAIDI, SAIFI, and CAIDI increased compared to 2016. Also, all three indices in 2017 were higher than the previous three-year averages. In 2017, NWE saw a large increase in the number and duration of weather related outages throughout the Montana region.

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.

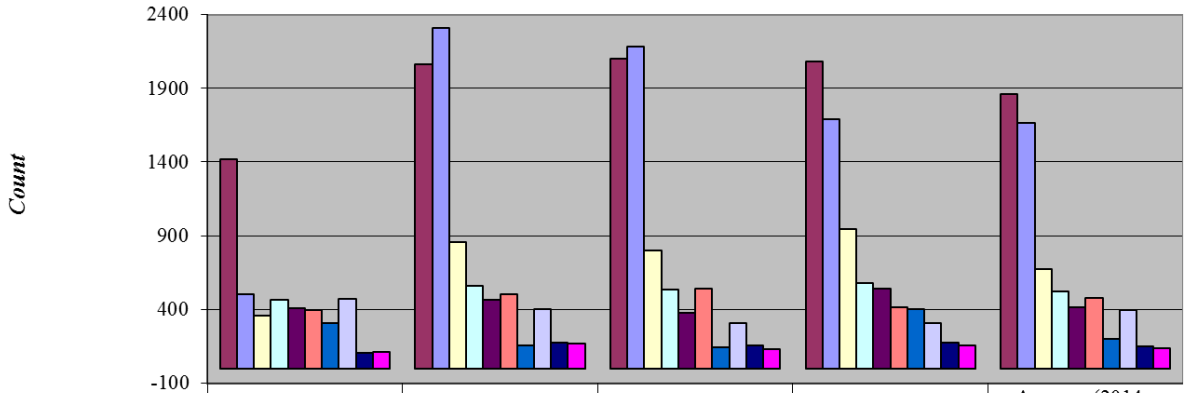


	2014	2015	2016	2017	Average (2014-2016)
SAIDI	112.87	259.61	144.19	156.51	168.29
CAIDI	104.90	165.89	117.89	113.31	125.50
SAIFI	1.080	1.565	1.223	1.381	1.312

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

SAIDI increases 16 minutes as shown in 2017 when the MEDs are included in the reliability index. Also, CAIDI and SAIFI increase noticeably.

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

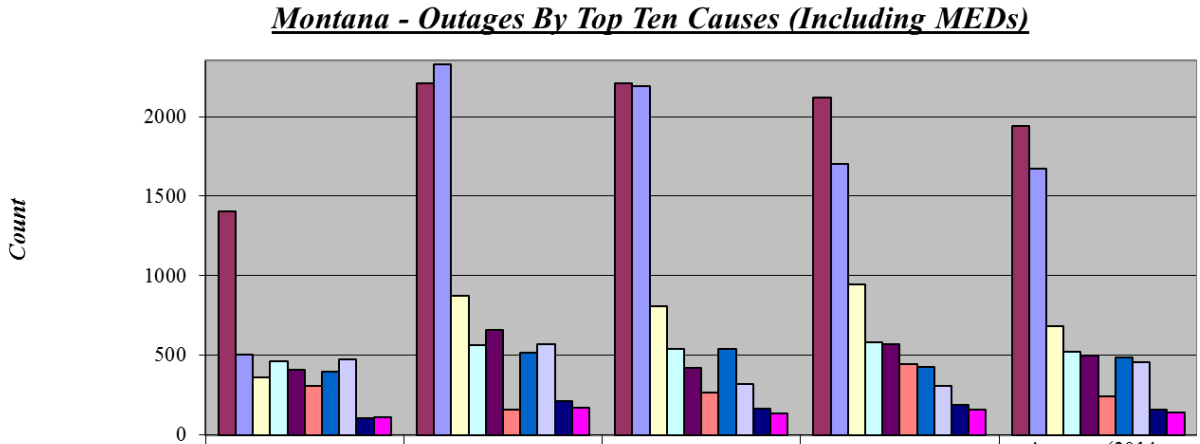


	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	1419	2061	2100	2081	1860
System - Scheduled Maintenance	502	2306	2181	1688	1663
Animal - Other Bird	358	857	800	943	672
Animal - Squirrel	465	557	536	580	519
Nature - Tree In Line	411	467	374	540	417
Nature - Lightning	394	505	539	415	479
Nature - Snow/Ice	305	159	141	402	202
Nature - Wind	472	400	310	309	394
Nature - Limb In Line	107	175	158	177	147
Public - Vehicle Hit	112	169	131	157	137
MT REGION TOTAL	6105	8758	8230	8337	7696

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 increased 1.3% to 8337. 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 increased from 7270 in 2016 to 7292 in 2017. Nature related outages such as wind, lightning and snow/ice increased by 136 outages or 13.7%. Overall Equipment Failure outages decreased slightly by 19. 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. Scheduled Maintenance decreased by 493 outages.



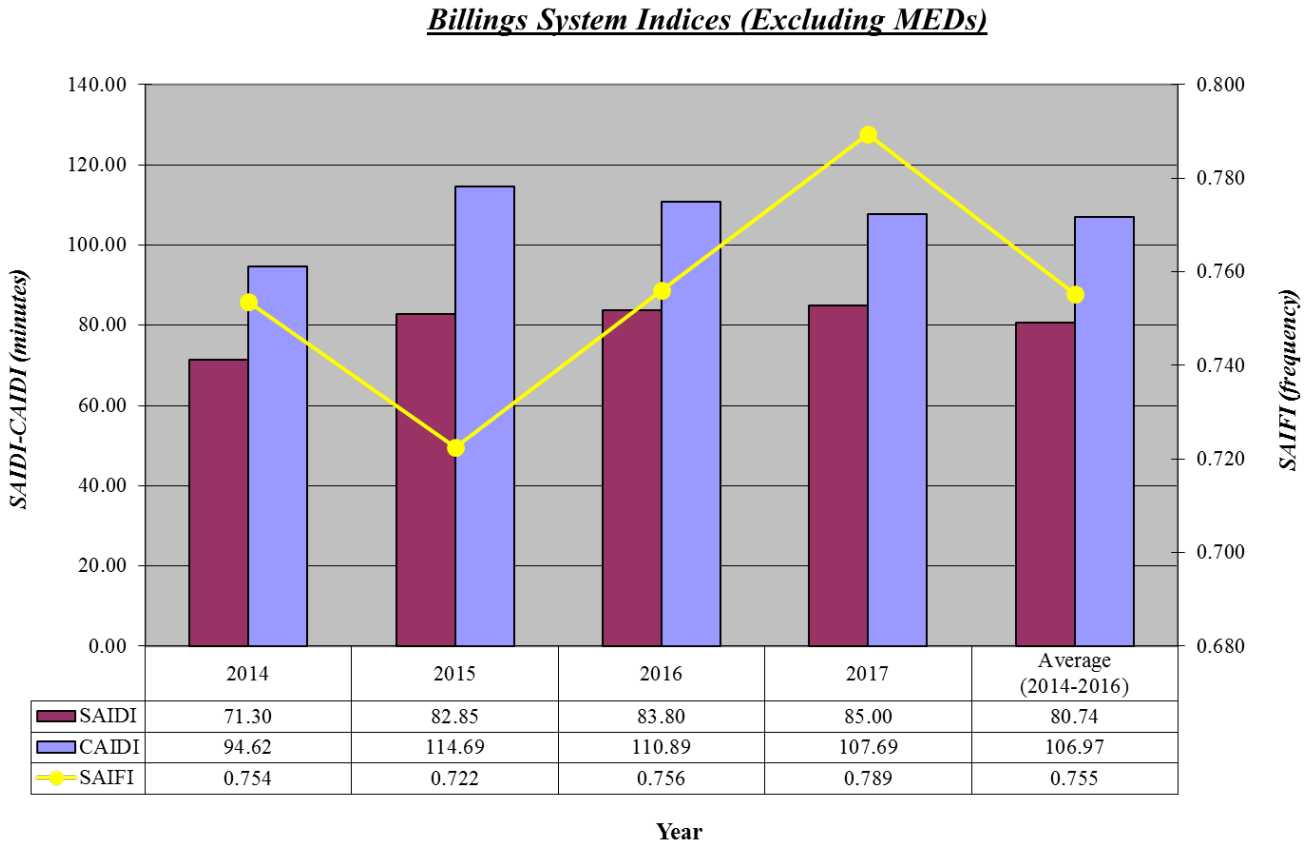
	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	1402	2210	2212	2122	1941
System - Scheduled Maintenance	502	2330	2192	1705	1675
Animal - Other Bird	358	875	809	948	681
Animal - Squirrel	465	561	538	582	521
Nature - Tree In Line	411	658	418	570	496
Nature - Snow/Ice	305	159	265	443	243
Nature - Lightning	394	517	541	425	484
Nature - Wind	472	571	317	309	453
Nature - Limb In Line	107	210	164	185	160
Public - Vehicle Hit	112	172	132	157	139
MT REGION TOTAL	7503	9384	8566	8501	8013

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 2017 have increased when comparing them to 2016 numbers. Snow/ice outages increased 178 outages or 67%.

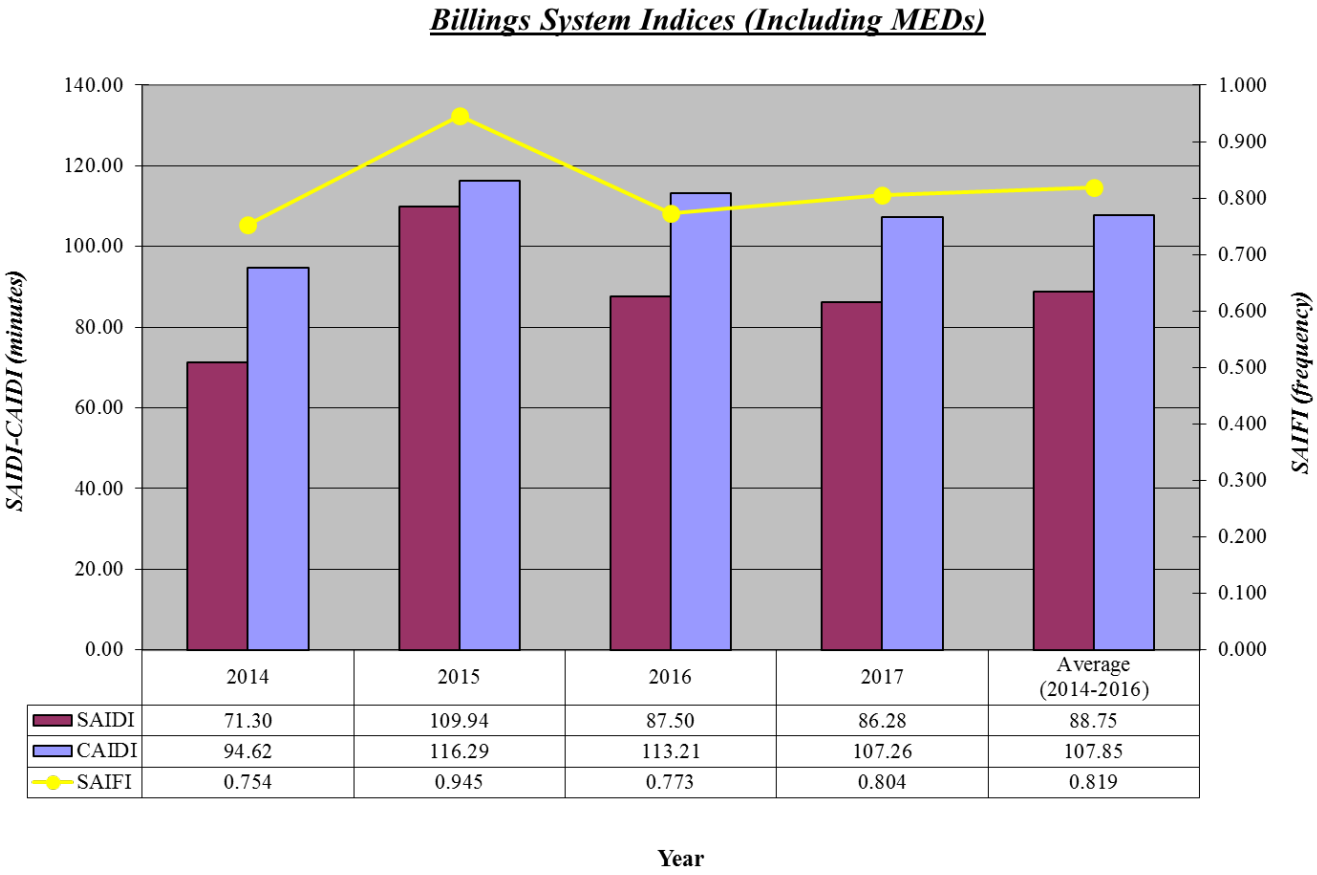
3. BILLINGS SYSTEM RELIABILITY

For Billings, SAIFI increased in 2017. SAIDI increased slightly while CAIDI decreased slightly. The increase in SAIDI and CAIDI in 2015 was expected due to the OMS implementation. All three indices are greater than their three-year averages. Storm problems are up from 2016 and equipment failure outage counts were down. A fault at the Glengarry Substation affected the Lewistown area. Larger outages for the year were equipment failures caused by insulators and a jumper. Three large outages were caused by vehicle hits. Squirrels and Other Birds still cause a large number of outages. Tree problem outages are up slightly.



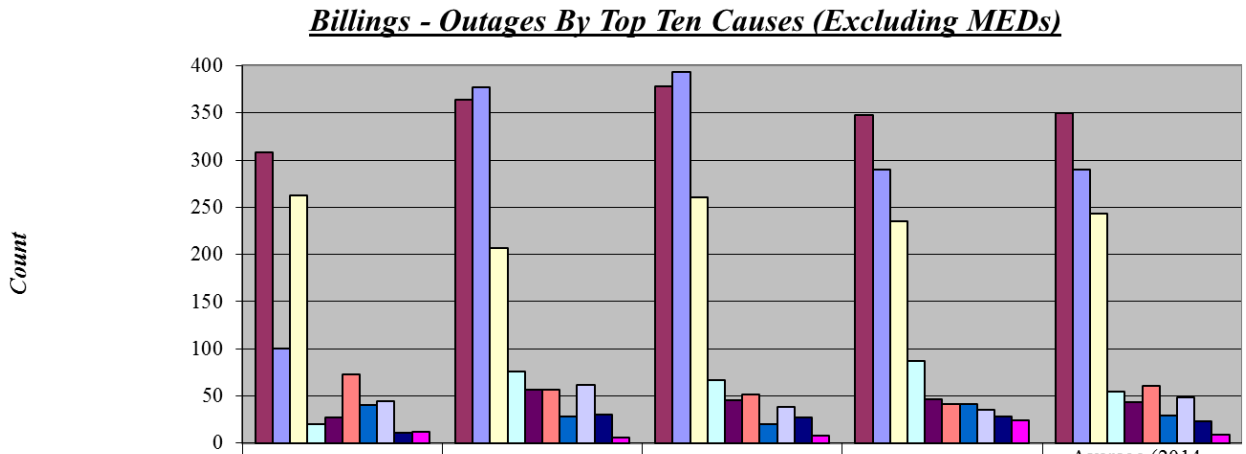
	2014	2015	2016	2017	Average (2014-2016)
SAIDI	71.30	82.85	83.80	85.00	80.74
CAIDI	94.62	114.69	110.89	107.69	106.97
SAIFI	0.754	0.722	0.756	0.789	0.755

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



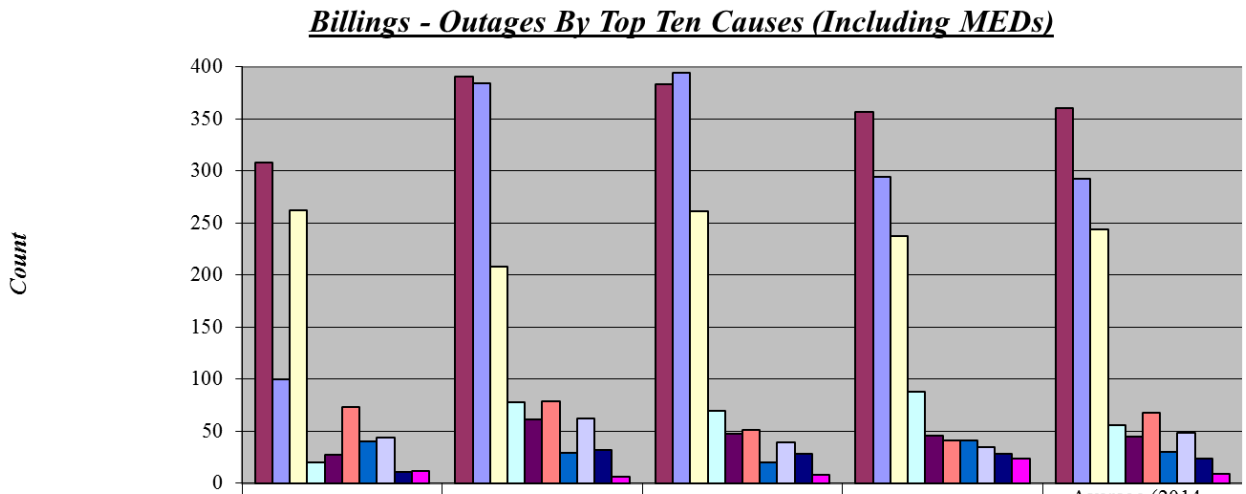
	2014	2015	2016	2017	Average (2014-2016)
SAIDI	71.30	109.94	87.50	86.28	88.75
CAIDI	94.62	116.29	113.21	107.26	107.85
SAIFI	0.754	0.945	0.773	0.804	0.819

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



	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	308	364	378	348	350
System - Scheduled Maintenance	100	377	393	290	290
Animal - Squirrel	262	207	260	235	243
Animal - Other Bird	20	76	67	87	54
Nature - Tree In Line	27	57	45	46	43
Nature - Wind	73	57	51	41	60
Public - Vehicle Hit	40	28	20	41	29
Nature - Lightning	44	62	38	35	48
Nature - Limb In Line	11	30	27	28	23
Nature - Snow/Ice	12	6	8	24	9
DIVISION TOTAL	1,167	1,384	1,439	1,276	1,330

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

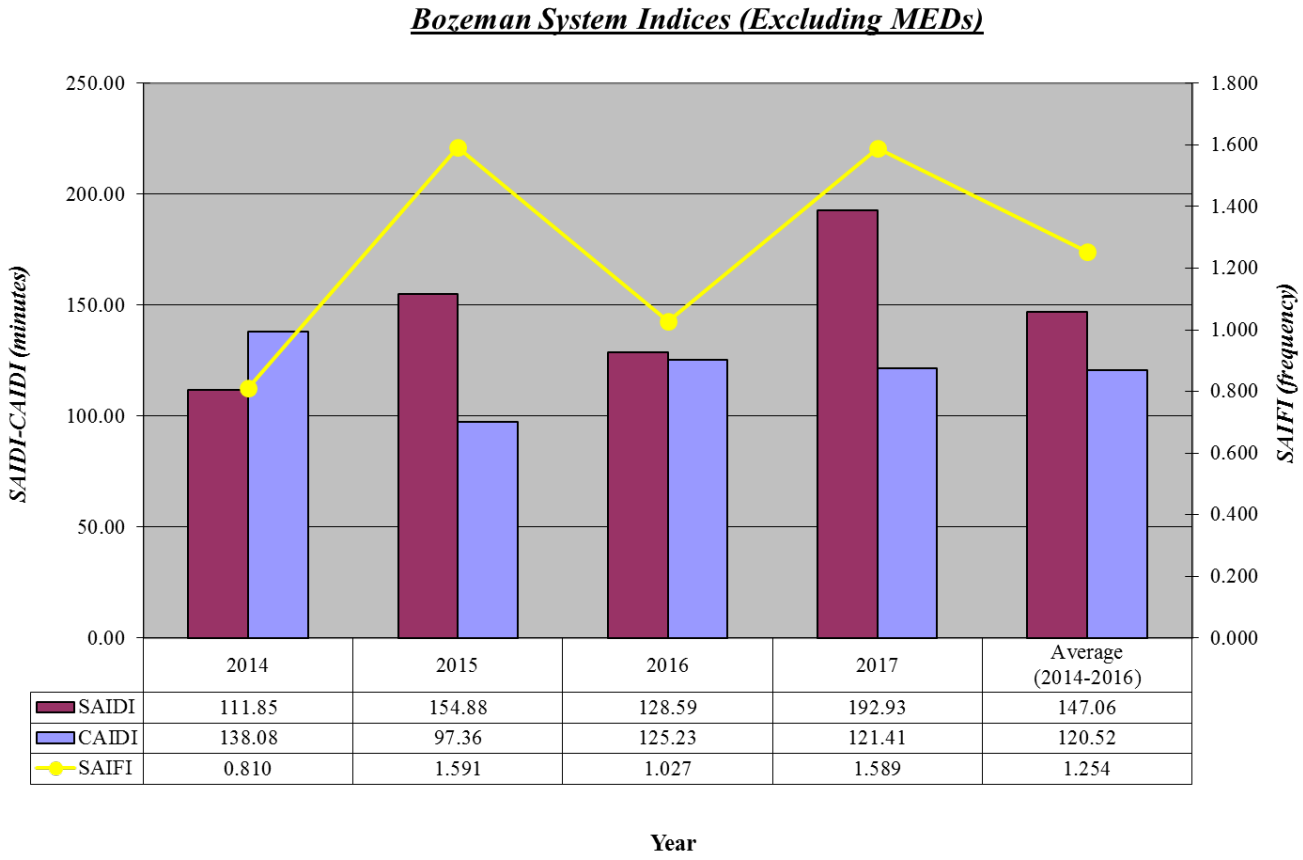


	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	308	390	383	356	360
System - Scheduled Maintenance	100	384	394	294	293
Animal - Squirrel	262	208	261	237	244
Animal - Other Bird	20	78	69	88	56
Nature - Tree In Line	27	61	47	46	45
Nature - Wind	73	79	51	41	68
Public - Vehicle Hit	40	29	20	41	30
Nature - Lightning	44	62	39	35	48
Nature - Limb In Line	11	32	28	28	24
Nature - Snow/Ice	12	6	8	24	9
DIVISION TOTAL	1,167	1,449	1,452	1,291	1,356

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

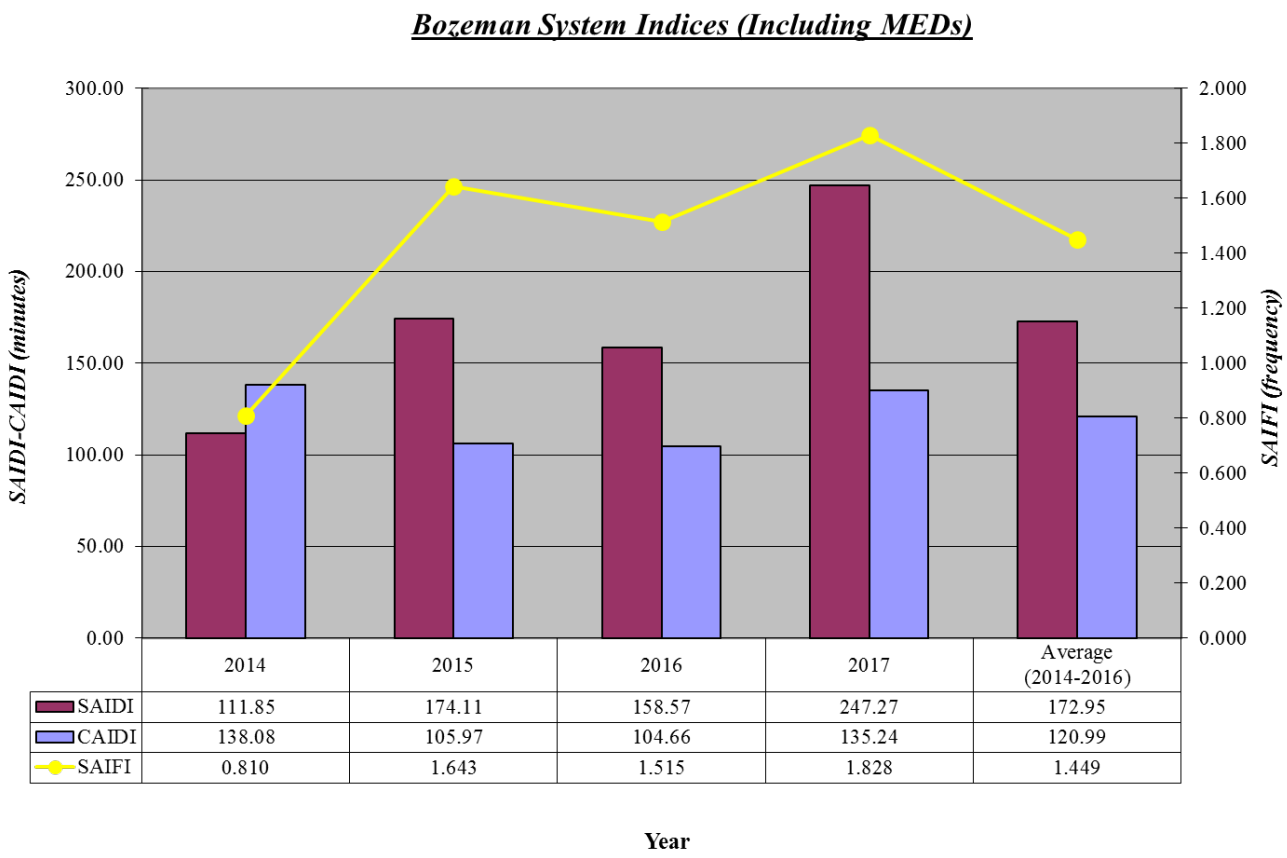
4. BOZEMAN SYSTEM RELIABILITY

Bozeman division indices for 2017 saw a significant increase in SAIDI and SAIFI from 2016. However, there was a slight decrease in CAIDI. Larger events in the area include a MED, on 5/17, due to a late spring snow storm. On 6/7, a conductor broke while the feed to Trident was out for maintenance. This caused a flashover on the feed from Jackrabbit. This also resulted in a MED. Another storm caused tree problems and a broken insulator. Also, a metering wire in the Ennis City substation caused an outage of all circuits fed from that substation. Equipment failure outage counts were essentially unchanged. However, nature caused outages, except for water fowl, and vehicle hit counts increased. Planned outages decreased.



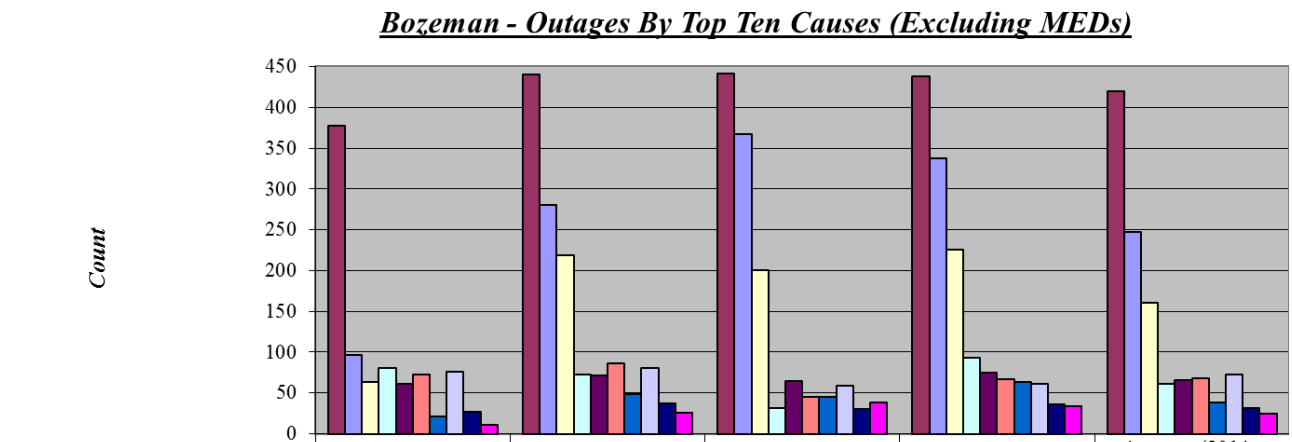
	2014	2015	2016	2017	Average (2014-2016)
SAIDI	111.85	154.88	128.59	192.93	147.06
CAIDI	138.08	97.36	125.23	121.41	120.52
SAIFI	0.810	1.591	1.027	1.589	1.254

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



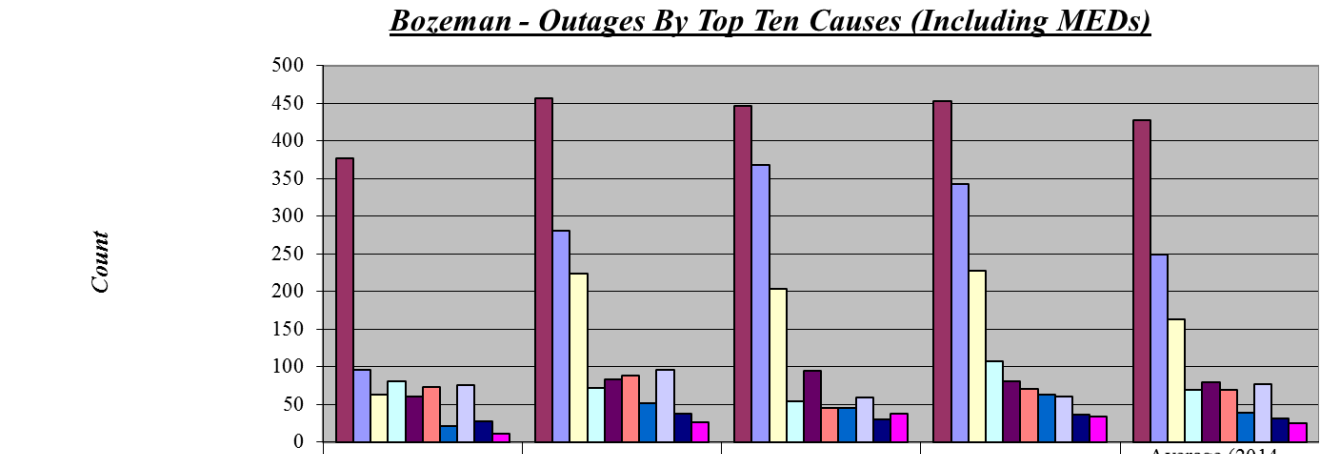
	2014	2015	2016	2017	Average (2014-2016)
SAIDI	111.85	174.11	158.57	247.27	172.95
CAIDI	138.08	105.97	104.66	135.24	120.99
SAIFI	0.810	1.643	1.515	1.828	1.449

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



	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	377	440	441	438	419
System - Scheduled Maintenance	96	280	367	338	248
Animal - Other Bird	63	219	200	226	161
Nature - Snow/Ice	81	72	31	93	61
Nature - Tree In Line	61	71	64	75	65
Nature - Lightning	73	86	45	67	68
Animal - Squirrel	21	49	45	63	38
Nature - Wind	76	81	59	61	72
Public - Vehicle Hit	27	37	30	36	31
Animal - Waterfowl	11	26	38	34	25
DIVISION TOTAL	1,353	1,609	1,581	1,690	1,519

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

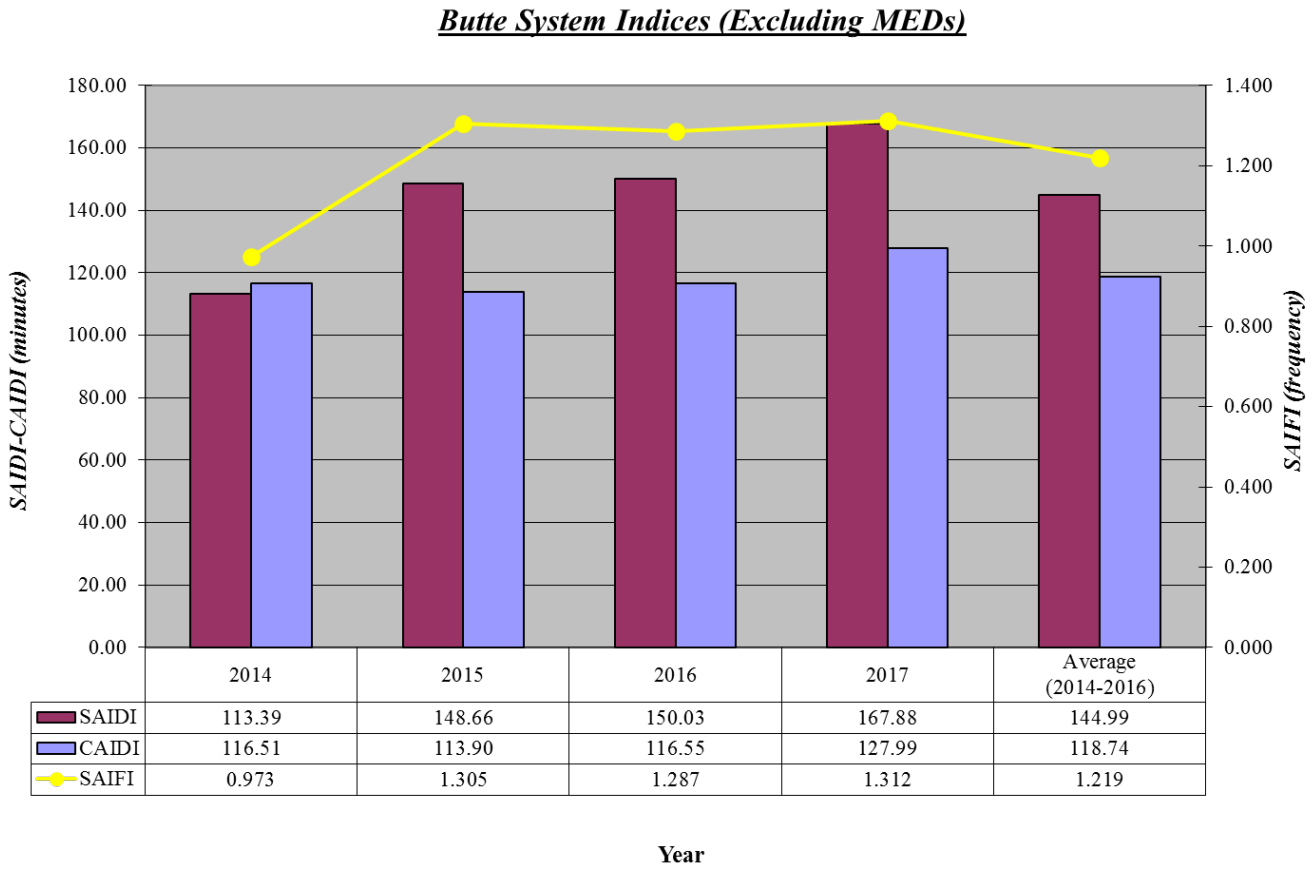


	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	377	457	446	452	427
System - Scheduled Maintenance	96	281	368	342	248
Animal - Other Bird	63	223	203	228	163
Nature - Snow/Ice	81	72	54	107	69
Nature - Tree In Line	61	83	94	81	79
Nature - Lightning	73	88	45	70	69
Animal - Squirrel	21	51	45	63	39
Nature - Wind	76	96	59	61	77
Public - Vehicle Hit	27	37	30	36	31
Animal - Waterfowl	11	26	38	34	25
DIVISION TOTAL	1,353	1,668	1,649	1,735	1,557

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

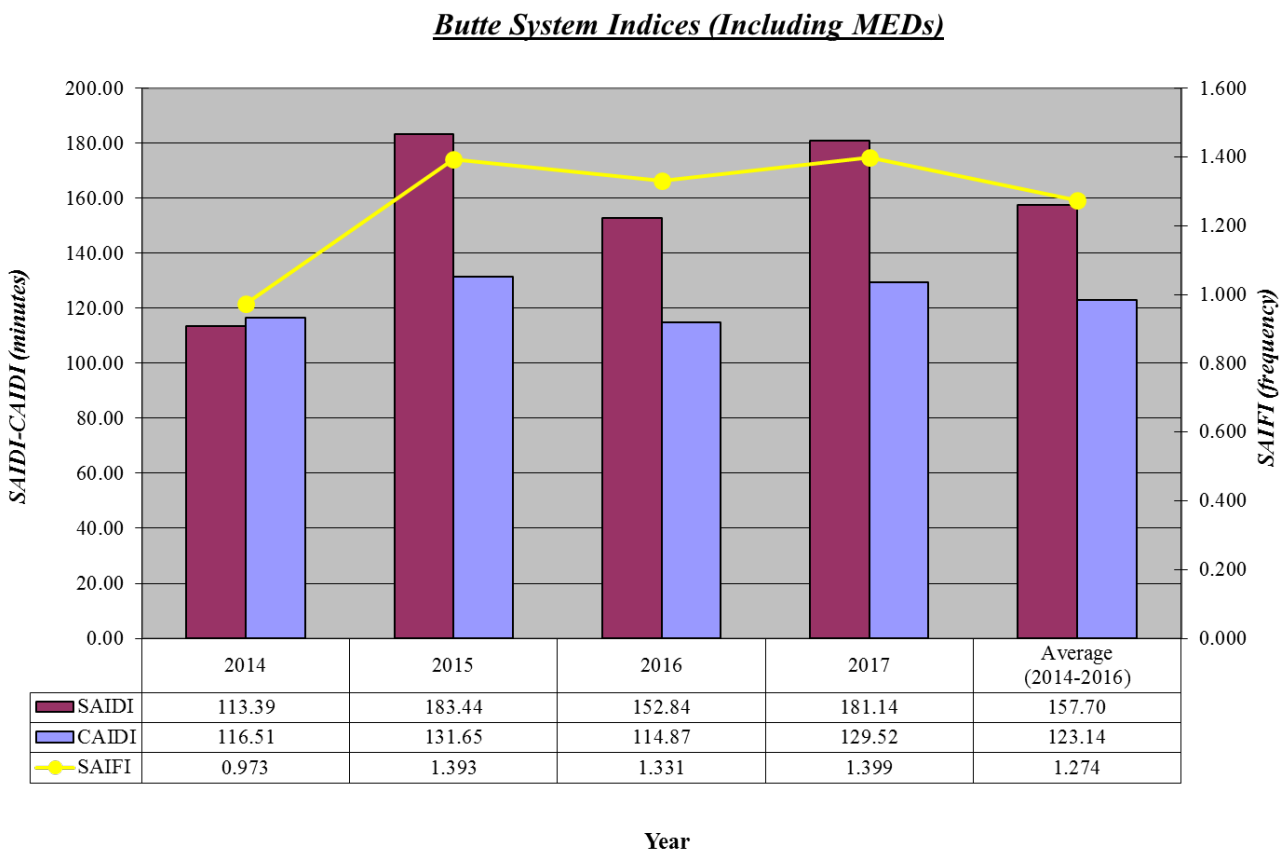
5. BUTTE SYSTEM RELIABILITY

For 2017, SAIDI and CAIFI increased and SAIFI held about the same for the Butte Division. A snow storm, on 5/17, affected the Butte Division and resulted in a MED. Extensive construction and maintenance at the Anaconda City Substation and a relay setting causing an outage at the Philipsburg City Substation were the two largest single events for the division. Equipment outages remained about the same for Butte. There was a large increase in animal related outages, in particular birds other than raptors. Tree outages also increased.



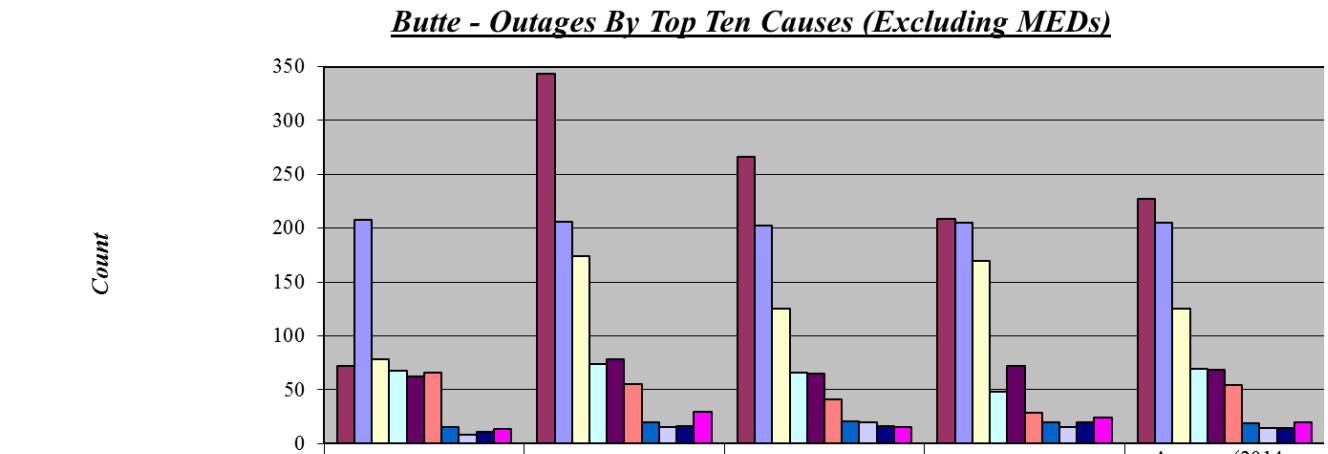
	2014	2015	2016	2017	Average (2014-2016)
SAIDI	113.39	148.66	150.03	167.88	144.99
CAIDI	116.51	113.90	116.55	127.99	118.74
SAIFI	0.973	1.305	1.287	1.312	1.219

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



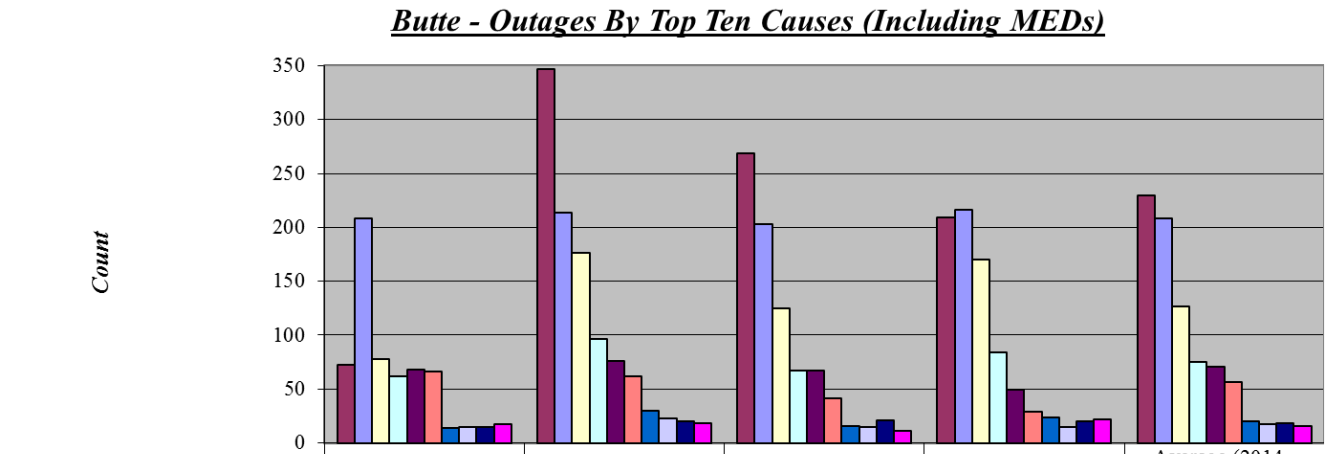
	2014	2015	2016	2017	Average (2014-2016)
SAIDI	113.39	183.44	152.84	181.14	157.70
CAIDI	116.51	131.65	114.87	129.52	123.14
SAIFI	0.973	1.393	1.331	1.399	1.274

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



	2014	2015	2016	2017	Average (2014 - 2016)
System - Scheduled Maintenance	72	343	266	209	227
System - Equipment Failure	208	206	202	205	205
Animal - Other Bird	78	174	125	170	126
Nature - Lightning	68	74	66	48	69
Nature - Tree In Line	62	78	65	72	68
Nature - Wind	66	55	41	29	54
Animal - Squirrel	15	20	21	20	19
Animal - Raptor	8	15	20	15	14
Animal - Other	11	16	16	20	14
Animal - Waterfowl	14	30	15	24	20
DIVISION TOTAL	837	1,153	942	982	977

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

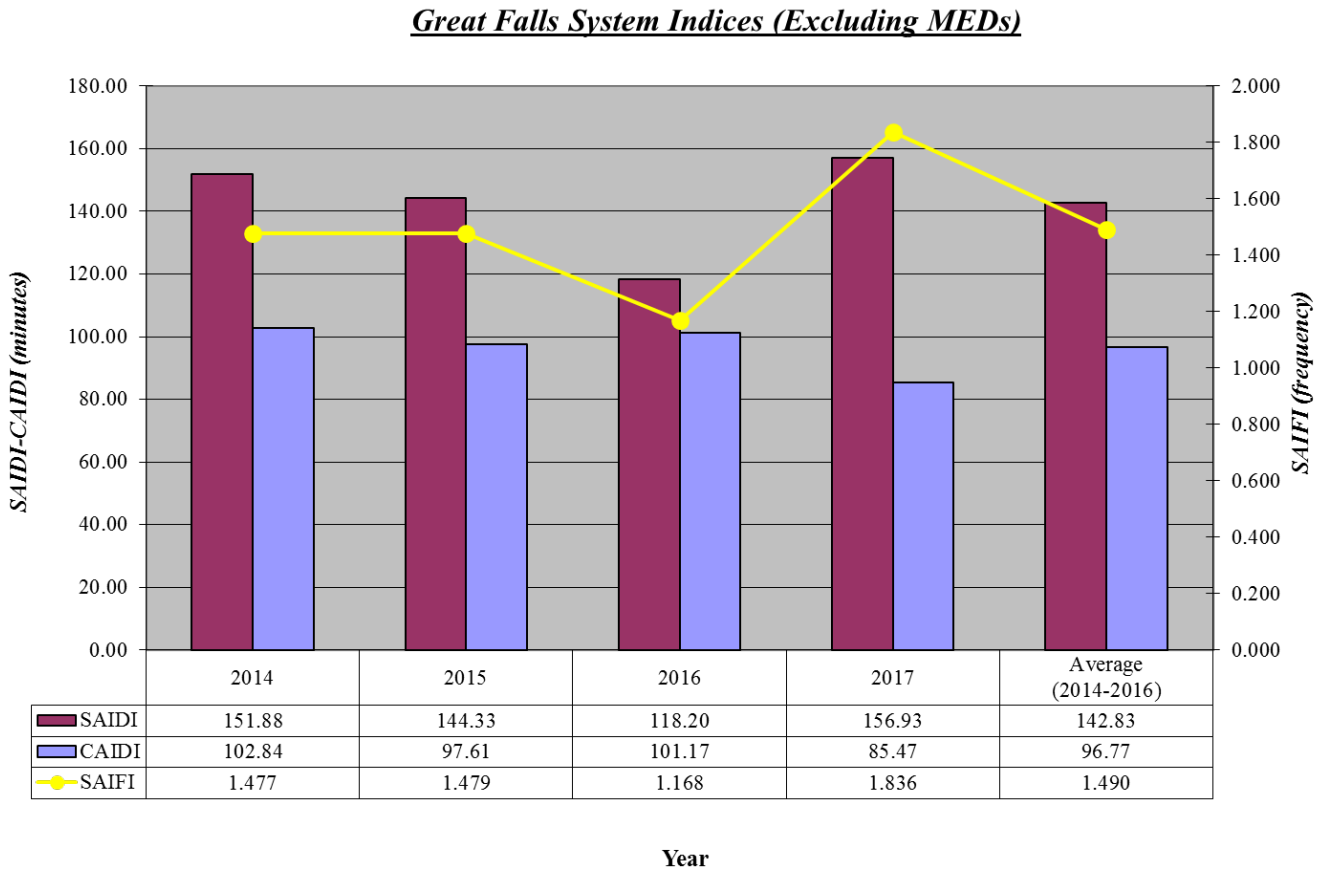


	2014	2015	2016	2017	Average (2014 - 2016)
System - Scheduled Maintenance	72	347	269	209	229
System - Equipment Failure	208	214	203	216	208
Animal - Other Bird	78	176	125	170	126
Nature - Tree In Line	62	96	67	84	75
Nature - Lightning	68	76	67	49	70
Nature - Wind	66	62	41	29	56
Animal - Waterfowl	14	30	16	24	20
Nature - Limb In Line	15	23	15	15	18
Animal - Squirrel	15	20	21	20	19
System - Scheduled Construction	17	18	11	22	15
DIVISION TOTAL	837	1,200	956	1,024	998

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

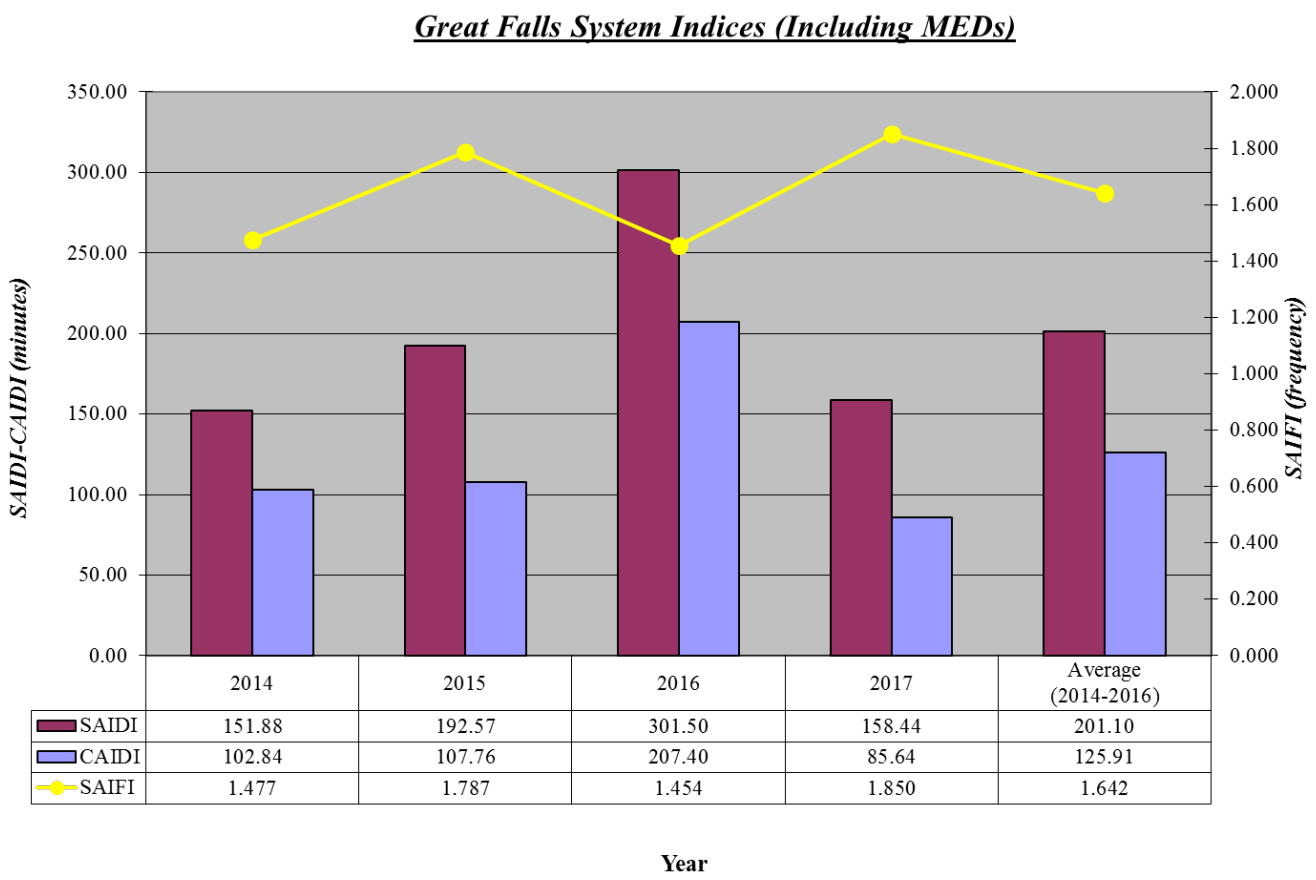
6. GREAT FALLS SYSTEM RELIABILTY

Great Falls Division saw an increase in SAIDI and SAIFI for 2017. CAIDI decreased. Animal related and lightning caused outages greatly increased. The number of equipment failures planned outages decreased and squirrel caused outages increased. The largest outages in the division were caused by a tree in the line and a floater (when a conductor has worked its way off an insulator) and conductor on a crossarm caused by a broken insulator in the rain. Also, a fault in the Glengarry Substation greatly affected the Great Falls Division.



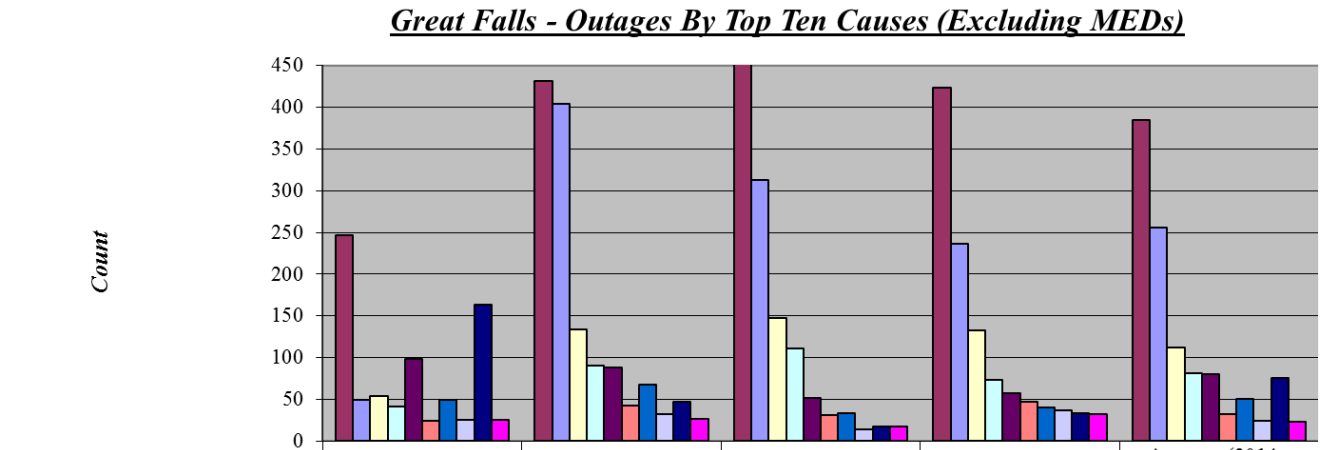
	2014	2015	2016	2017	Average (2014-2016)
SAIDI	151.88	144.33	118.20	156.93	142.83
CAIDI	102.84	97.61	101.17	85.47	96.77
SAIFI	1.477	1.479	1.168	1.836	1.490

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



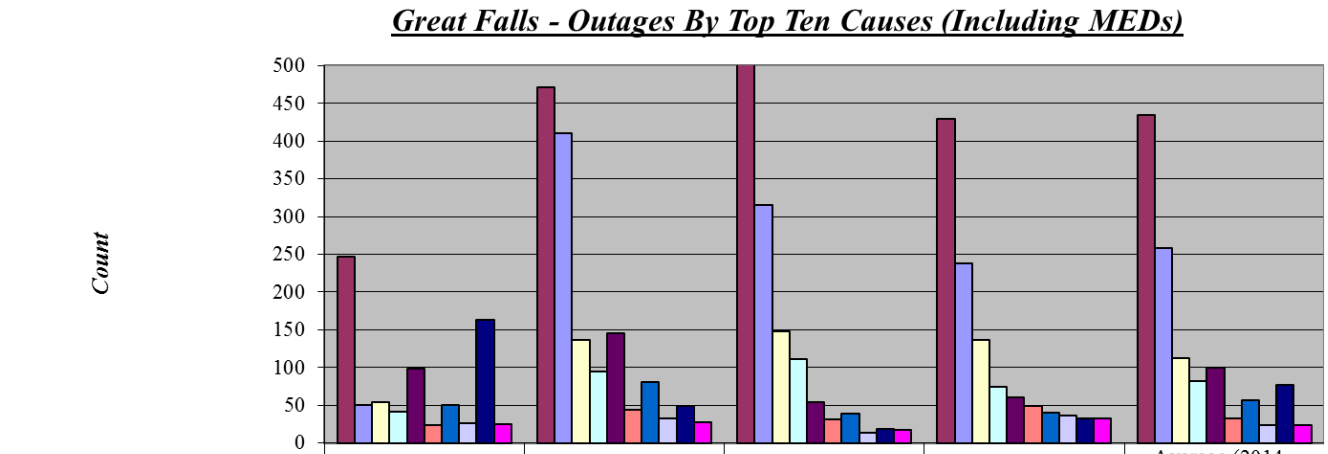
	2014	2015	2016	2017	Average (2014-2016)
SAIDI	151.88	192.57	301.50	158.44	201.10
CAIDI	102.84	107.76	207.40	85.64	125.91
SAIFI	1.477	1.787	1.454	1.850	1.642

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



	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	247	431	475	423	384
System - Scheduled Maintenance	50	404	313	236	256
Animal - Other Bird	54	134	147	133	112
Nature - Lightning	42	91	111	73	81
Nature - Wind	99	88	52	58	80
Animal - Waterfowl	24	43	31	47	33
Nature - Tree In Line	50	68	33	40	50
Animal - Squirrel	26	32	14	37	24
Unknown	163	47	17	33	76
System - Scheduled Construction	25	27	18	32	23
DIVISION TOTAL	921	1,519	1,366	1,277	1,269

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



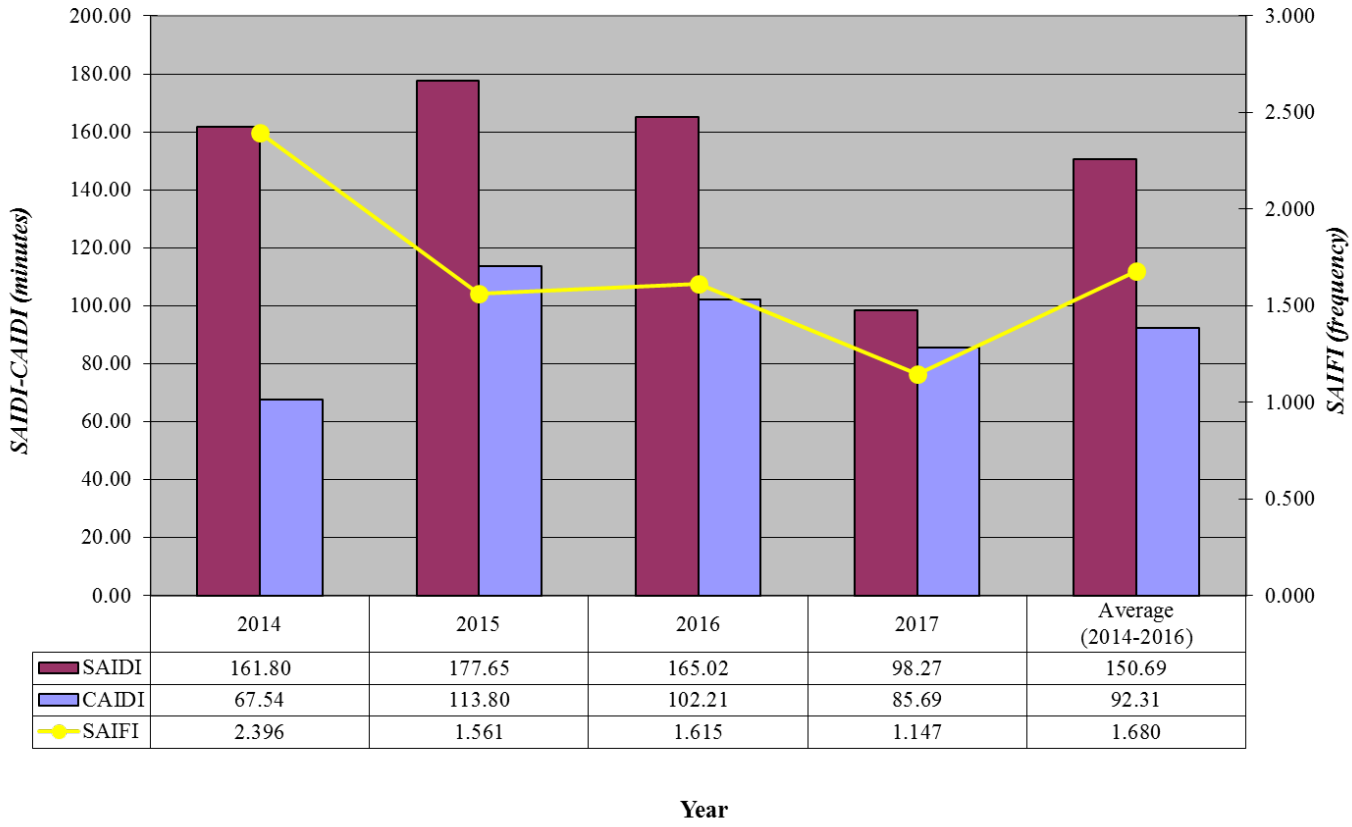
	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	247	472	585	429	435
System - Scheduled Maintenance	50	411	315	238	259
Animal - Other Bird	54	137	148	136	113
Nature - Lightning	42	95	111	74	83
Nature - Wind	99	145	54	60	99
Animal - Waterfowl	24	44	31	49	33
Nature - Tree In Line	50	81	39	40	57
Animal - Squirrel	26	33	14	37	24
Unknown	163	49	19	33	77
System - Scheduled Construction	25	27	18	32	23
DIVISION TOTAL	921	1,653	1,556	1,295	1,377

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

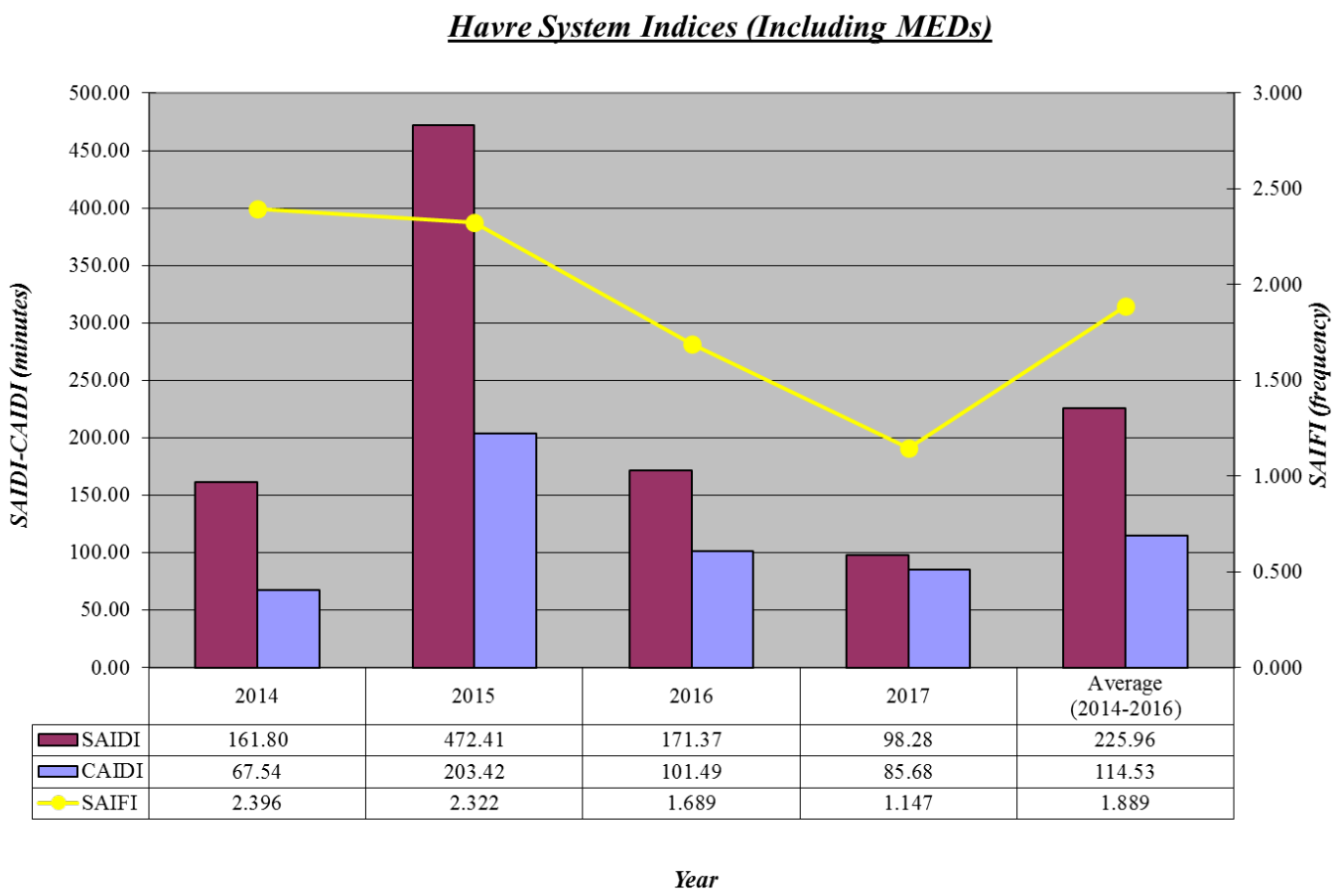
Havre saw a significant decrease in SAIDI and SAIFI and a smaller decrease in CAIDI. This probably due to the Catastrohic Event that occurred in October. SAIDI, SAIFI, and CAIDI were lower than the three year averages. Storm caused MEDs had a large impact on the Havre area. These MEDs are part of the Catastrophic Event. A fault in the Glengarry Substation on June 2, had an impact on the Havre area. Larger events were a relay issue between Havre City and Havre Eastside Substations and a strong wind caused outage on the Fort Belknap S 2 feeder. Non-MED outages were notably down including lightning and scheduled maintenance.

Havre System Indices (Excluding MEDs)



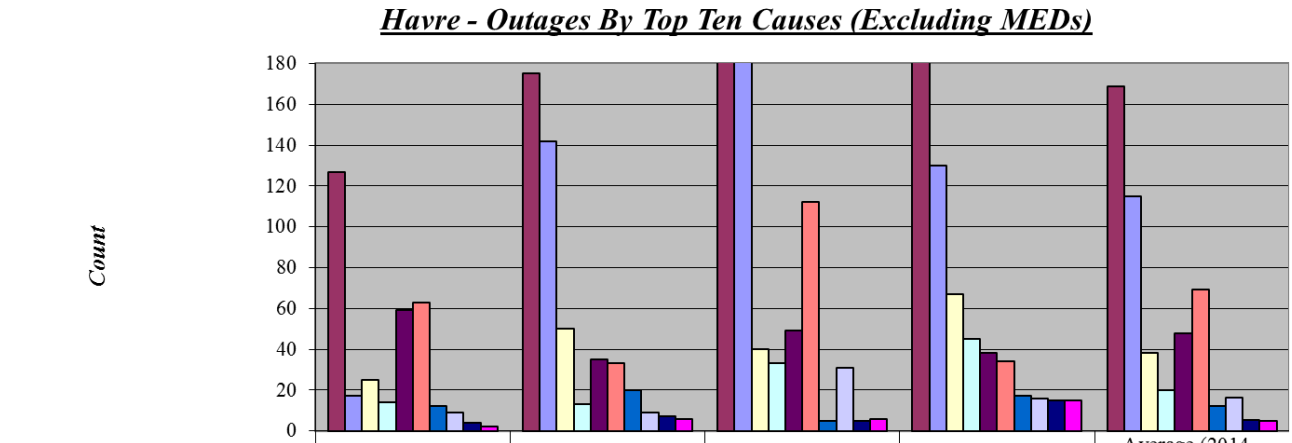
	2014	2015	2016	2017	Average (2014-2016)
SAIDI	161.80	177.65	165.02	98.27	150.69
CAIDI	67.54	113.80	102.21	85.69	92.31
SAIFI	2.396	1.561	1.615	1.147	1.680

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



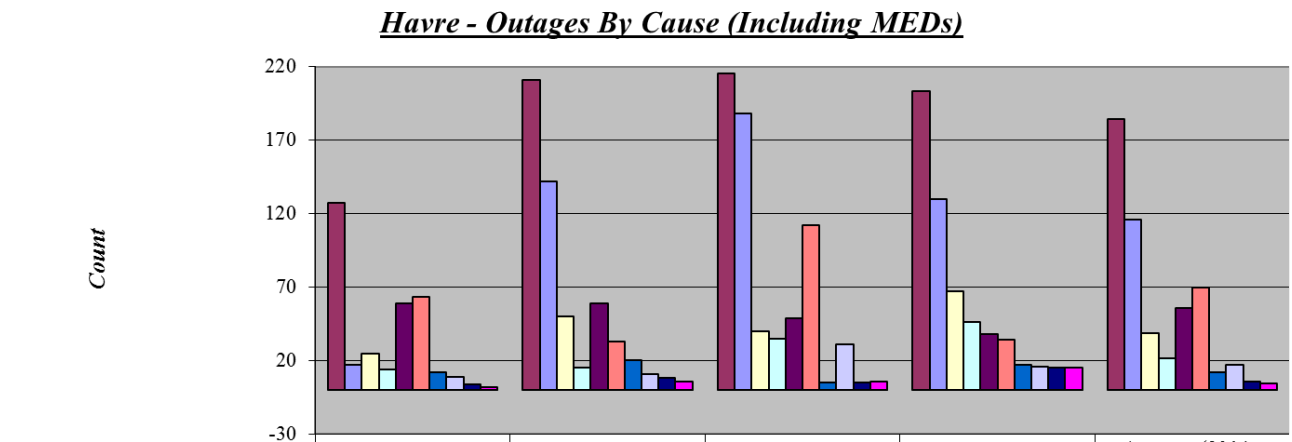
	2014	2015	2016	2017	Average (2014-2016)
SAIDI	161.80	472.41	171.37	98.28	225.96
CAIDI	67.54	203.42	101.49	85.68	114.53
SAIFI	2.396	2.322	1.689	1.147	1.889

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



	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	127	175	205	203	169
System - Scheduled Maintenance	17	142	186	130	115
Animal - Other Bird	25	50	40	67	38
Nature - Tree In Line	14	13	33	45	20
Nature - Wind	59	35	49	38	48
Nature - Lightning	63	33	112	34	69
Animal - Raccoon	12	20	5	17	12
Nature - Limb In Line	9	9	31	16	16
System - Scheduled Construction	4	7	5	15	5
Animal - Other	2	6	6	15	5
DIVISION TOTAL	427	590	778	651	598

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

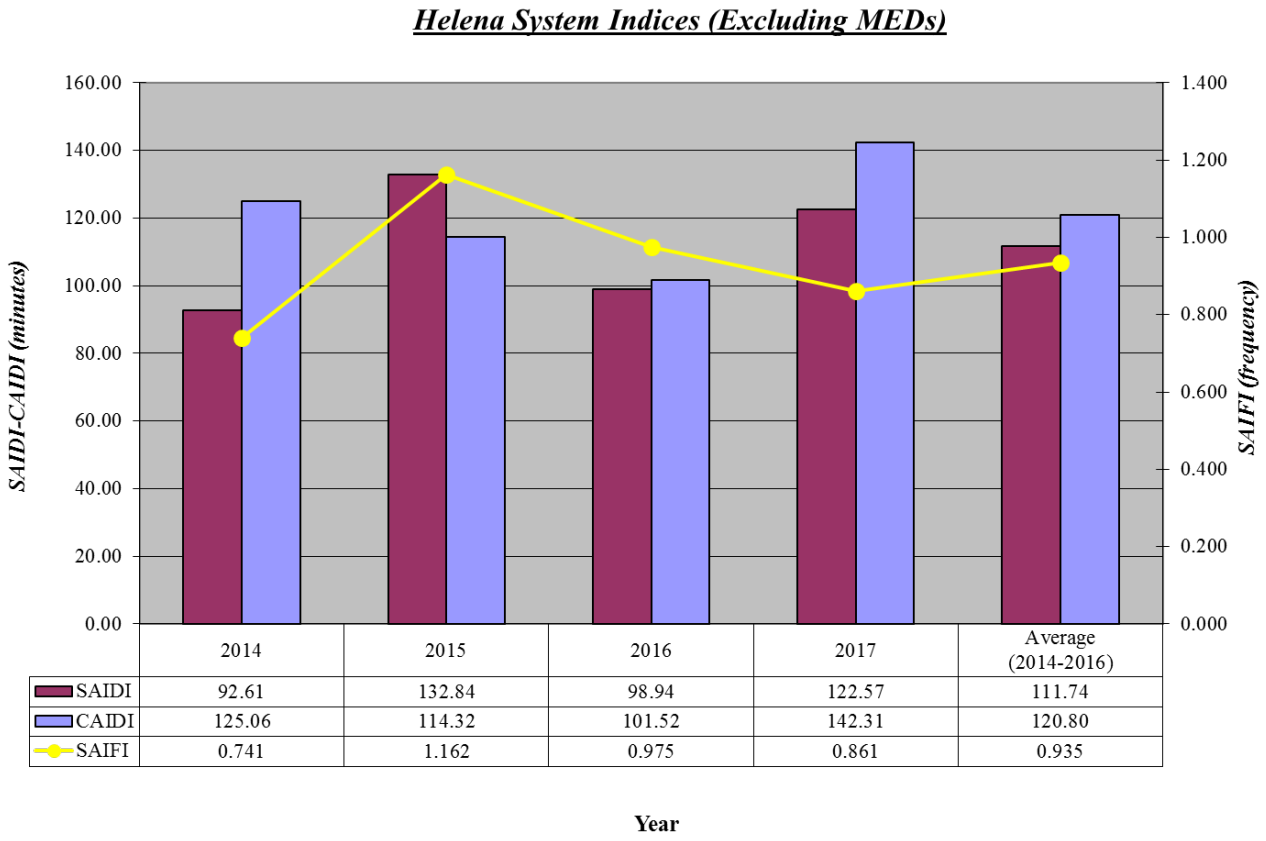


	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	127	211	215	203	184
System - Scheduled Maintenance	17	142	188	130	116
Animal - Other Bird	25	50	40	67	38
Nature - Tree In Line	14	15	35	46	21
Nature - Wind	59	59	49	38	56
Nature - Lightning	63	33	112	34	69
Animal - Raccoon	12	20	5	17	12
Nature - Limb In Line	9	11	31	16	17
System - Scheduled Construction	4	8	5	15	6
Animal - Other	2	6	6	15	5
DIVISION TOTAL	427	655	800	652	627

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 an increase in SAIDI and CAIDI and a decrease in SAIFI in 2017. SAIFI was also below the three year average. A strong winter storm on Dec. 30, caused ice loading and trees in the line. The Lincoln Road East Fdr #2 had a major outage caused by a bird. Snow load caused an extensive outage on the Wolf Creek Feeder. Trees in the line and a burnt jumper caused a significant outage on the York/C.F. Feeder. Snow/ice outages were up significantly as were tree caused outages.



	2014	2015	2016	2017	Average (2014-2016)
SAIDI	92.61	132.84	98.94	122.57	111.74
CAIDI	125.06	114.32	101.52	142.31	120.80
SAIFI	0.741	1.162	0.975	0.861	0.935

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

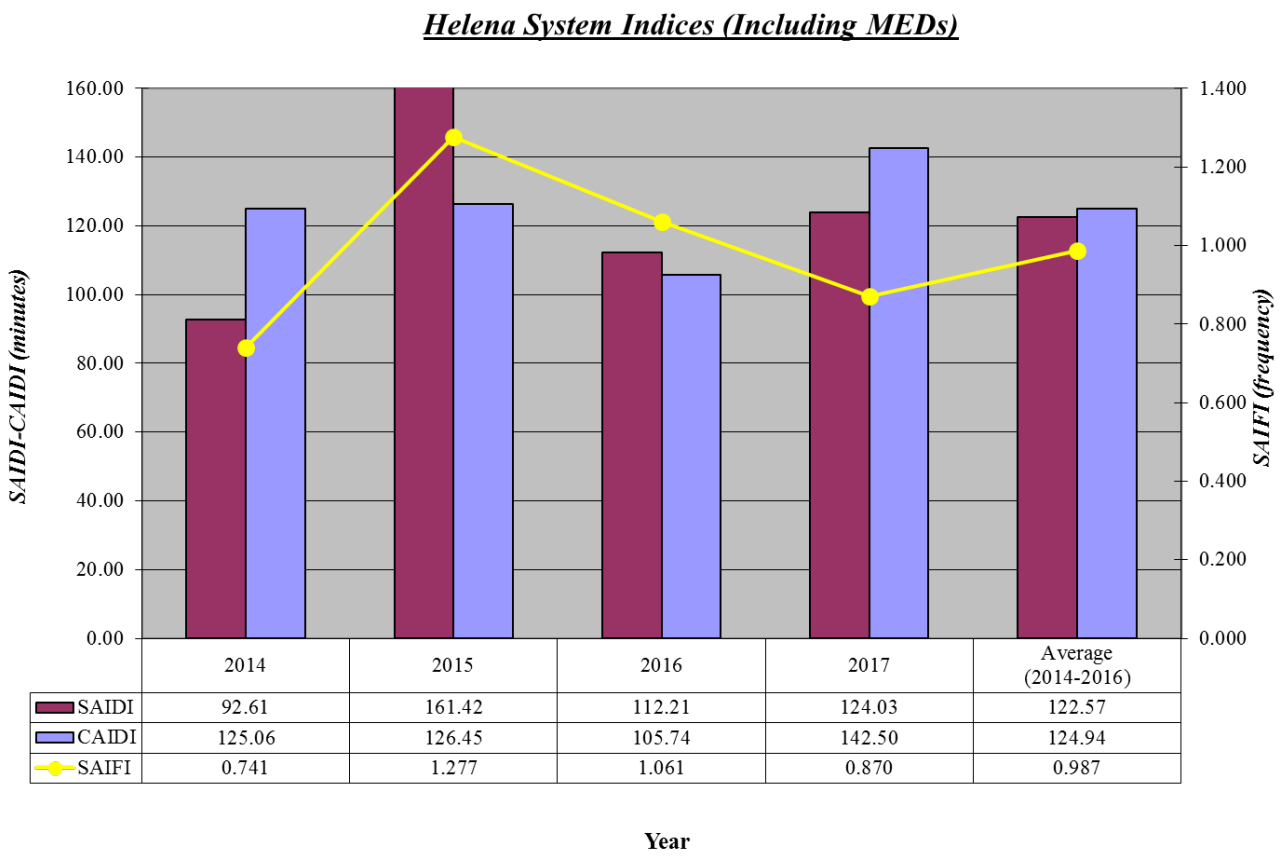
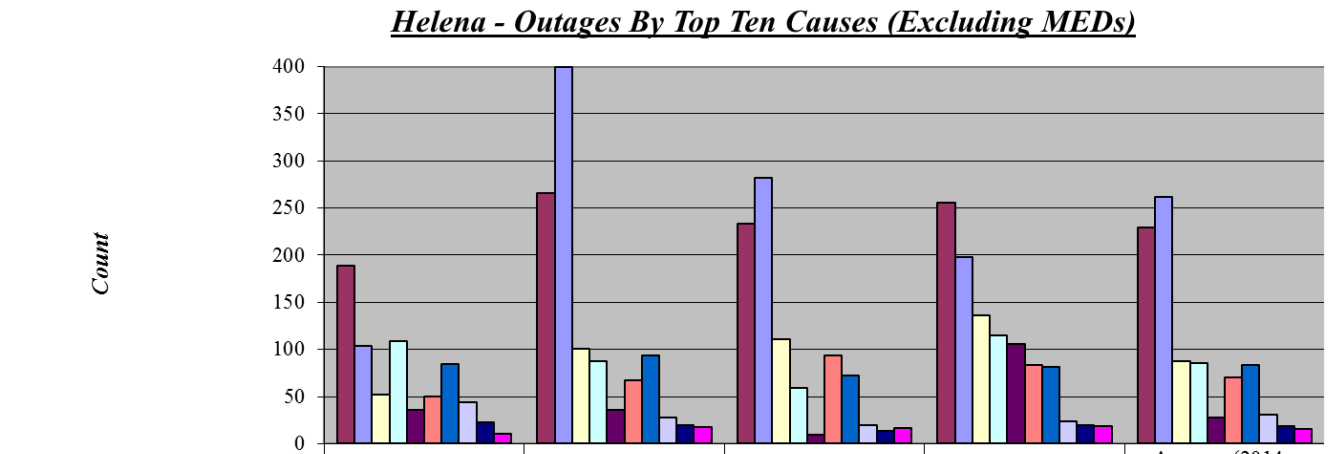
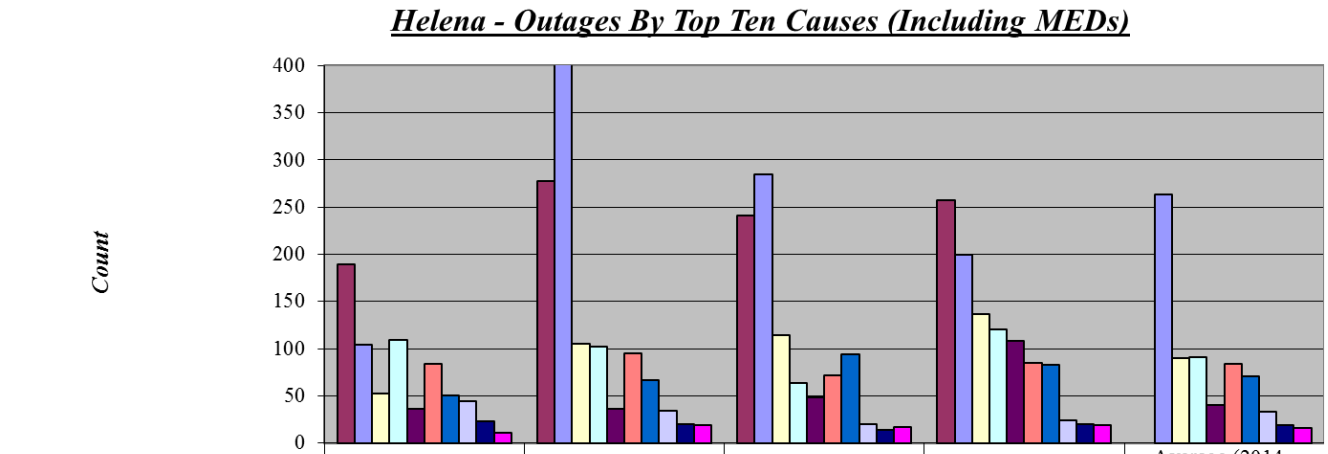


Figure 8.2 Helena system indices including major event days (MEDs) as defined in IEEE Standard 1366-2012.



	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	189	266	233	256	229
System - Scheduled Maintenance	104	399	282	198	262
Animal - Other Bird	52	101	111	136	88
Nature - Tree In Line	109	88	59	115	85
Nature - Snow/Ice	36	36	10	106	27
Animal - Squirrel	50	67	94	83	70
Nature - Lightning	84	94	72	81	83
Nature - Wind	44	28	20	24	31
System - Scheduled Construction	23	20	14	20	19
Public - Vehicle Hit	11	18	17	19	15
DIVISION TOTAL	847	1,217	992	1,133	1,019

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

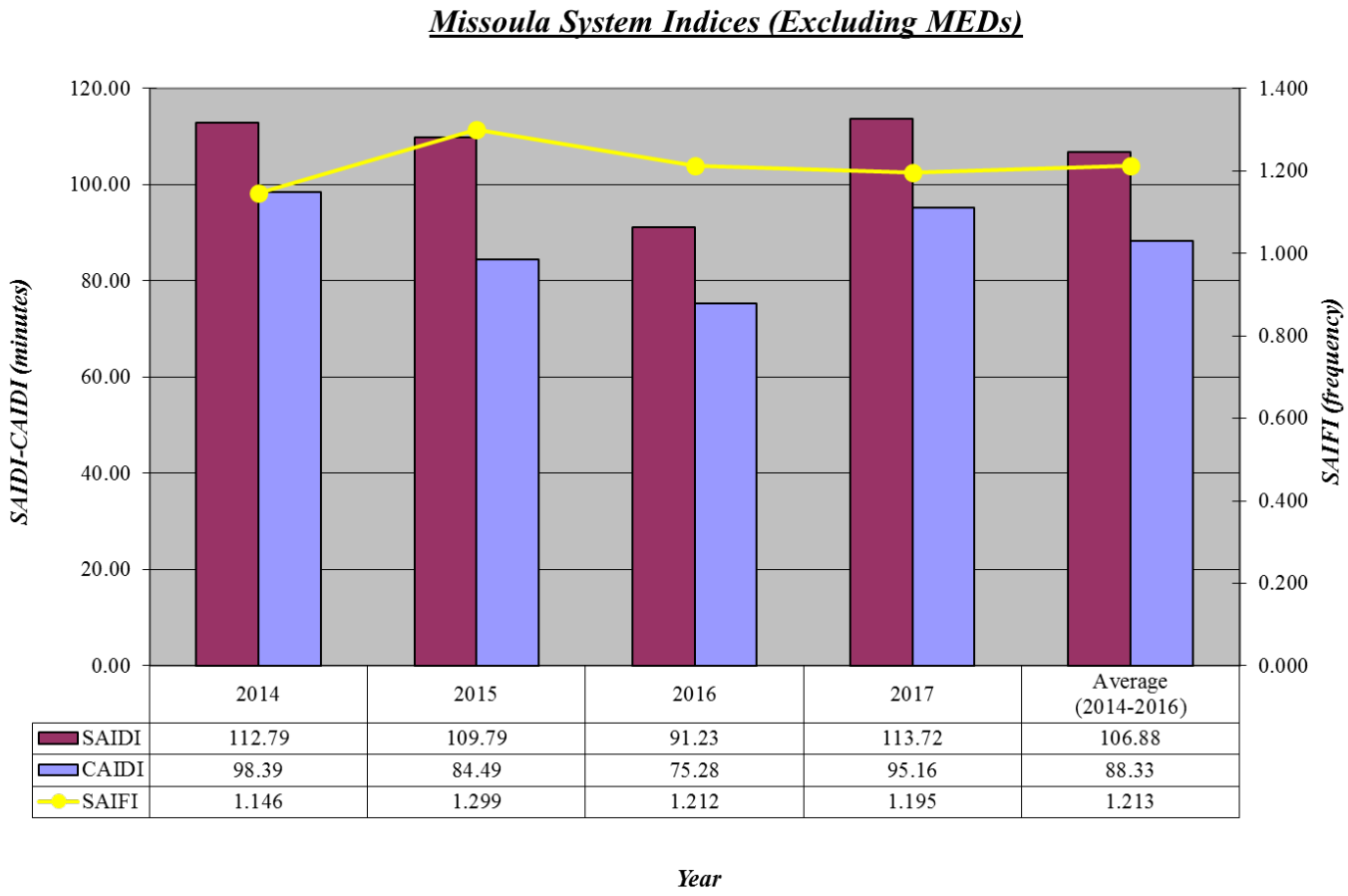


	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	189	278	241	257	
System - Scheduled Maintenance	104	401	285	199	263
Animal - Other Bird	52	105	114	137	90
Nature - Tree In Line	109	102	63	120	91
Nature - Snow/Ice	36	36	48	108	40
Nature - Lightning	84	95	72	85	84
Animal - Squirrel	50	67	94	83	70
Nature - Wind	44	34	20	24	33
System - Scheduled Construction	23	20	14	20	19
Public - Vehicle Hit	11	19	17	19	16
DIVISION TOTAL	847	1,259	1,050	1,148	1,079

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

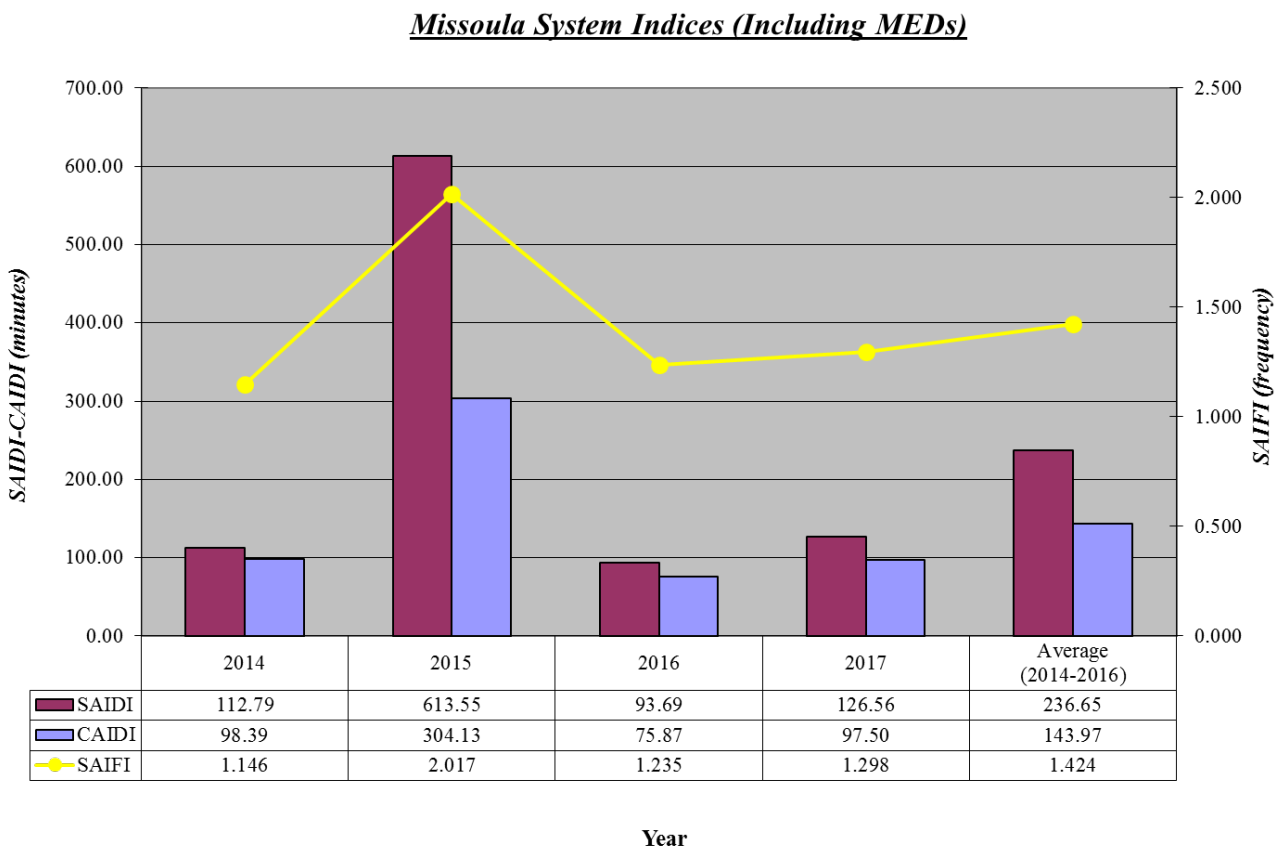
9. MISSOULA SYSTEM RELIABILITY

The Missoula Division improved SAIFI so that it is below the three year average. However, SAIDI and CAIDI indices both increased in 2017. The largest non-MED event was caused by a limb in Plains Fdr1 in October. In July, lightning burned off a hot line clamp causing a phase to go down on Feeder 62 fed from the Bonner Substation. A winter storm causing problems due to snow and ice loading and trees in the line occurred on 12/30. Weather, in particular snow, caused a transmission outage that took out the Haugan Substation. All top ten outage causes increased except for scheduled construction which was down slightly.



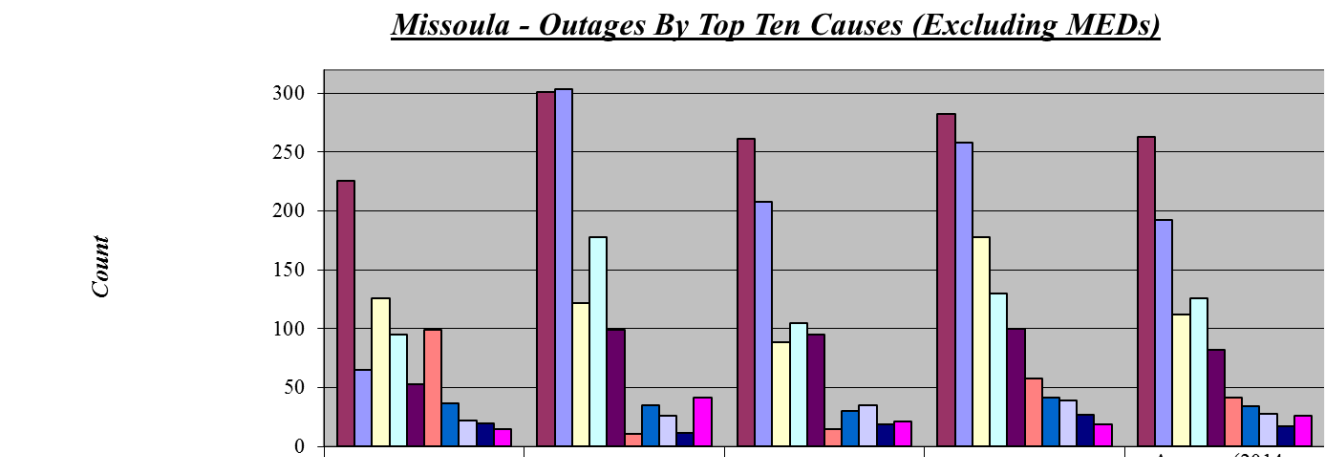
	2014	2015	2016	2017	Average (2014-2016)
SAIDI	112.79	109.79	91.23	113.72	106.88
CAIDI	98.39	84.49	75.28	95.16	88.33
SAIFI	1.146	1.299	1.212	1.195	1.213

Figure 9.1 Missoula system indices excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.



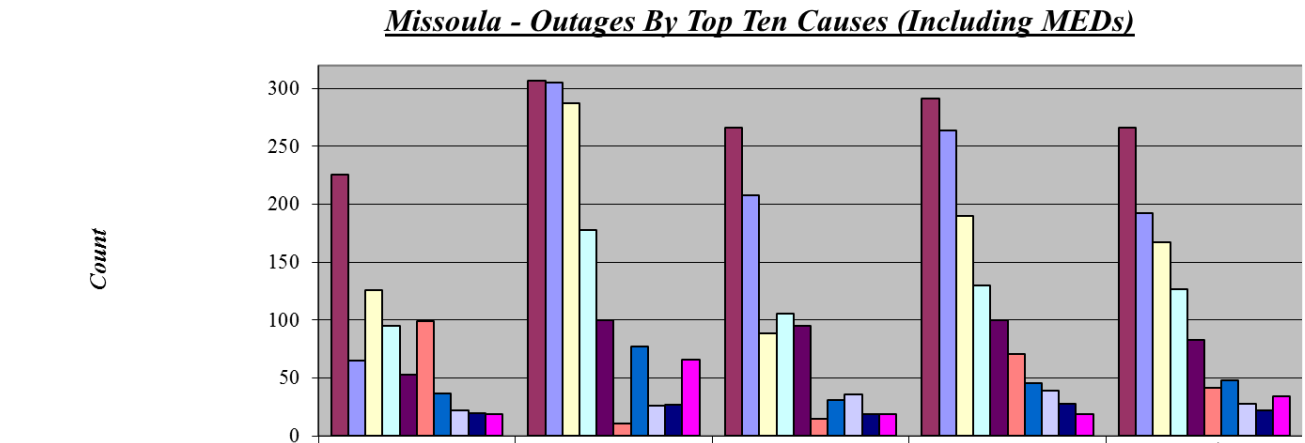
	2014	2015	2016	2017	Average (2014-2016)
SAIDI	112.79	613.55	93.69	126.56	236.65
CAIDI	98.39	304.13	75.87	97.50	143.97
SAIFI	1.146	2.017	1.235	1.298	1.424

Figure 9.2 Missoula system indices including major event days (MEDs) as defined in IEEE Standard 1366-2012.



	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	226	301	261	282	263
System - Scheduled Maintenance	65	303	208	258	192
Nature - Tree In Line	126	122	89	178	112
Animal - Squirrel	95	178	105	130	126
Animal - Other Bird	53	99	95	100	82
Nature - Snow/Ice	99	11	15	58	42
Nature - Limb In Line	37	35	30	42	34
Public - Vehicle Hit	22	26	35	39	28
Nature - Lightning	20	12	19	27	17
System - Scheduled Construction	15	42	21	19	26
DIVISION TOTAL	877	1,312	1,004	1,288	1,064

Figure 9.3 Missoula system outages by top ten causes excluding major event days (MEDs) as defined in IEEE Standard 1366-2012.



	2014	2015	2016	2017	Average (2014 - 2016)
System - Equipment Failure	226	307	266	291	266
System - Scheduled Maintenance	65	305	208	264	193
Nature - Tree In Line	126	287	89	190	167
Animal - Squirrel	95	178	106	130	126
Animal - Other Bird	53	100	95	100	83
Nature - Snow/Ice	99	11	15	71	42
Nature - Limb In Line	37	77	31	46	48
Public - Vehicle Hit	22	26	36	39	28
Nature - Lightning	20	27	19	28	22
Nature - Wind	19	66	19	19	35
DIVISION TOTAL	899	1,556	1,014	1,339	1,156

Figure 9.4 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 very well with SAIDI below the three year average until March. Unfortunately, SAIDI was above the three year average every other month except for August and November. The MED on May 5th, was caused by a snow storm in the Bozeman, Livingston, and Butte areas. This drove May's SAIDI over 12 minutes, compared to an earlier three-year April average of 9 minutes. Then the MED on June 8 occurred in the Bozeman and Belgrade areas that added 10 minutes to Montana SAIDI. With unusually large interruptions from June through December, SAIDI remained higher than average. The result was a year-end SAIDI, without MEDs, of 141 compared to the three year average of 123. The year-end SAIDI, with MEDs, was 157 compared to the 168 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 2017. 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.

As 2017 illustrates, the impacts of storms are a major contributor to reduced reliability and complicate any analysis. Substation and other asset improvements increased scheduled outages, but 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 2017 is given for each metric. Also a graph showing data from 2002 to 2017 is given for ASAI and SAIFI. Graphs showing the 2014-2016 average and 2017 year end are provided. Also included are graphs showing the outage cause duration and frequency by year from 2013 through 2017.

The 2017 outage duration is approximately **704.1 hours (49.3%) more** than the 2014-2016 average. The 2017 outage frequency (count) is approximately **43 outages (6.1%) less** than the 2014-2016 average. These numbers reflect a 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 2017.

Outage Duration - Hours													
Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	Monthly	147.18	253.37	244.38	201.79	294.35	117.24	156.39	69.54	49.91	432.94	54.08	112.57
2014-2016	Monthly	96.77	131.40	93.87	130.41	79.41	122.58	224.86	143.79	44.93	78.45	189.27	93.89
2017	Cumulative	147.18	400.55	644.93	846.72	1141.07	1258.31	1414.70	1484.24	1534.15	1967.08	2021.17	2133.73
2014-2016	Cumulative	96.77	228.17	322.04	452.45	531.86	654.44	879.30	1023.09	1068.01	1146.46	1335.73	1429.63

Outage Frequency - Count													
Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	Monthly	24.0	41.0	36.0	86.0	71.0	87.0	67.0	59.0	37.0	76.0	33.0	45.0
2014-2016	Monthly	37.0	56.7	42.7	62.0	68.7	77.7	86.7	91.7	46.3	54.7	42.0	39.3
2017	Cumulative	24.0	65.0	101.0	187.0	258.0	345.0	412.0	471.0	508.0	584.0	617.0	662.0
2014-2016	Cumulative	37.0	93.7	136.3	198.3	267.0	344.7	431.3	523.0	569.3	624.0	666.0	705.3

ASAI (Average Service Availability Index) - % Larger is Better													
Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	Monthly	99.931	99.869	99.886	99.903	99.864	99.944	99.928	99.968	99.976	99.802	99.975	99.949
2014-2016	Monthly	99.956	99.934	99.957	99.938	99.964	99.942	99.897	99.934	99.979	99.964	99.911	99.957
2017	Cumulative	99.931	99.902	99.896	99.898	99.891	99.900	99.904	99.912	99.919	99.907	99.913	99.916
2014-2016	Cumulative	99.956	99.945	99.949	99.947	99.950	99.949	99.941	99.940	99.945	99.947	99.943	99.945

SAIFI (System Average Interruption Frequency) – Smaller is Better													
Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	Monthly	0.981	1.856	1.472	3.633	2.883	3.648	2.705	2.379	1.537	3.044	1.363	1.796
2014-2016	Monthly	1.485	2.488	1.712	2.574	2.754	3.214	3.470	3.670	1.915	2.185	1.732	1.570
2017	Cumulative	0.981	1.396	1.422	1.975	2.162	2.410	2.454	2.444	2.343	2.416	2.320	2.275
2014-2016	Cumulative	1.485	1.964	1.878	2.051	2.195	2.364	2.526	2.672	2.588	2.547	2.474	2.397

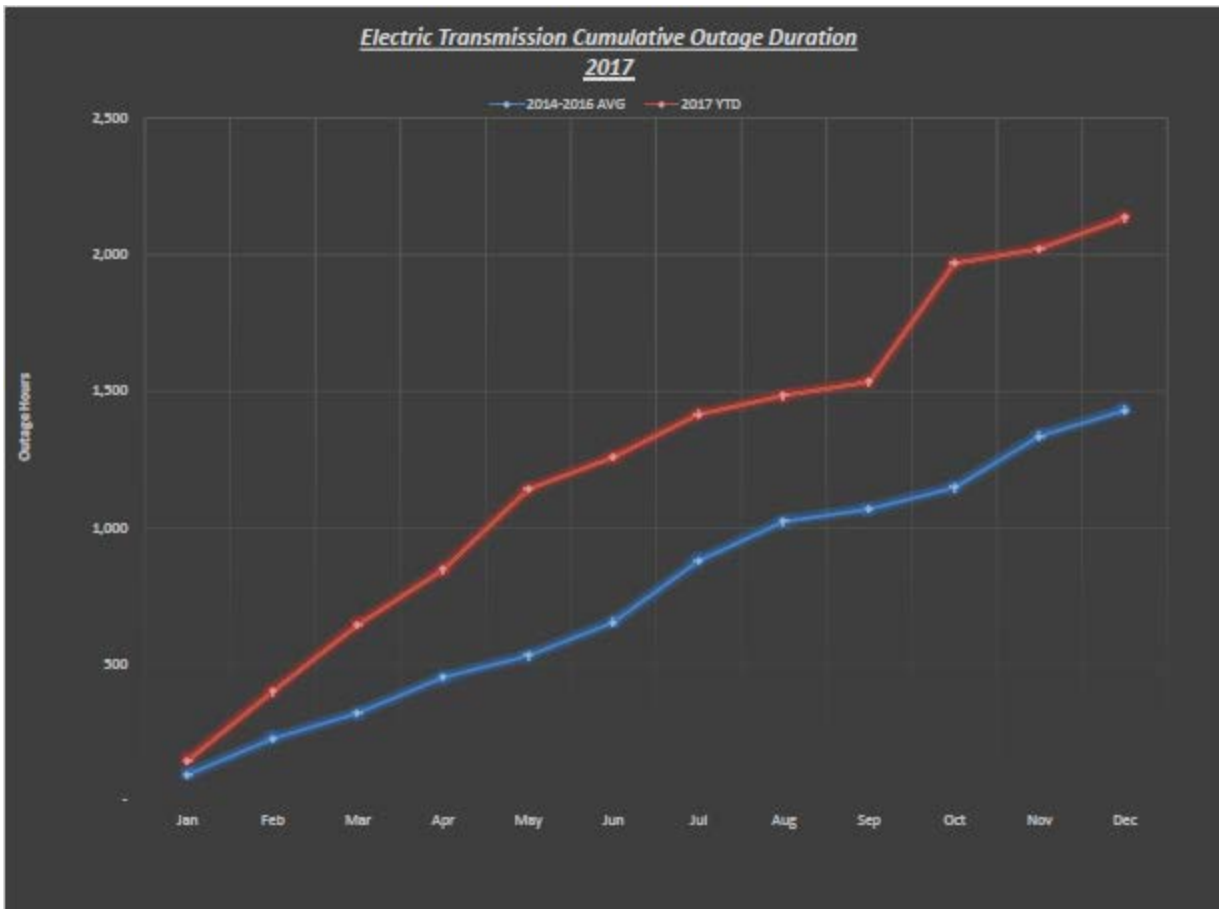


Figure A.1 Electric transmission cumulative outage duration - 2017

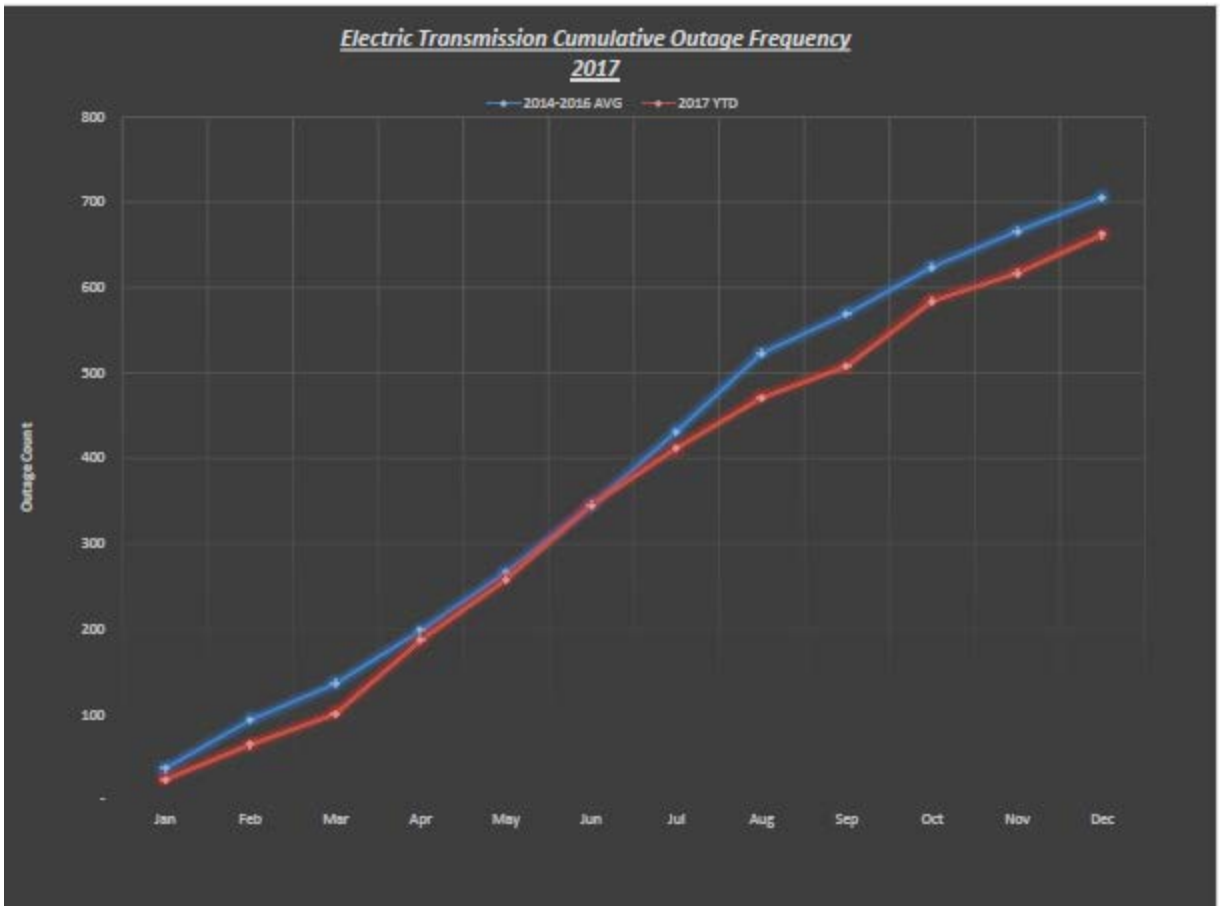


Figure A.2 Electric transmission cumulative outage frequency - 2017

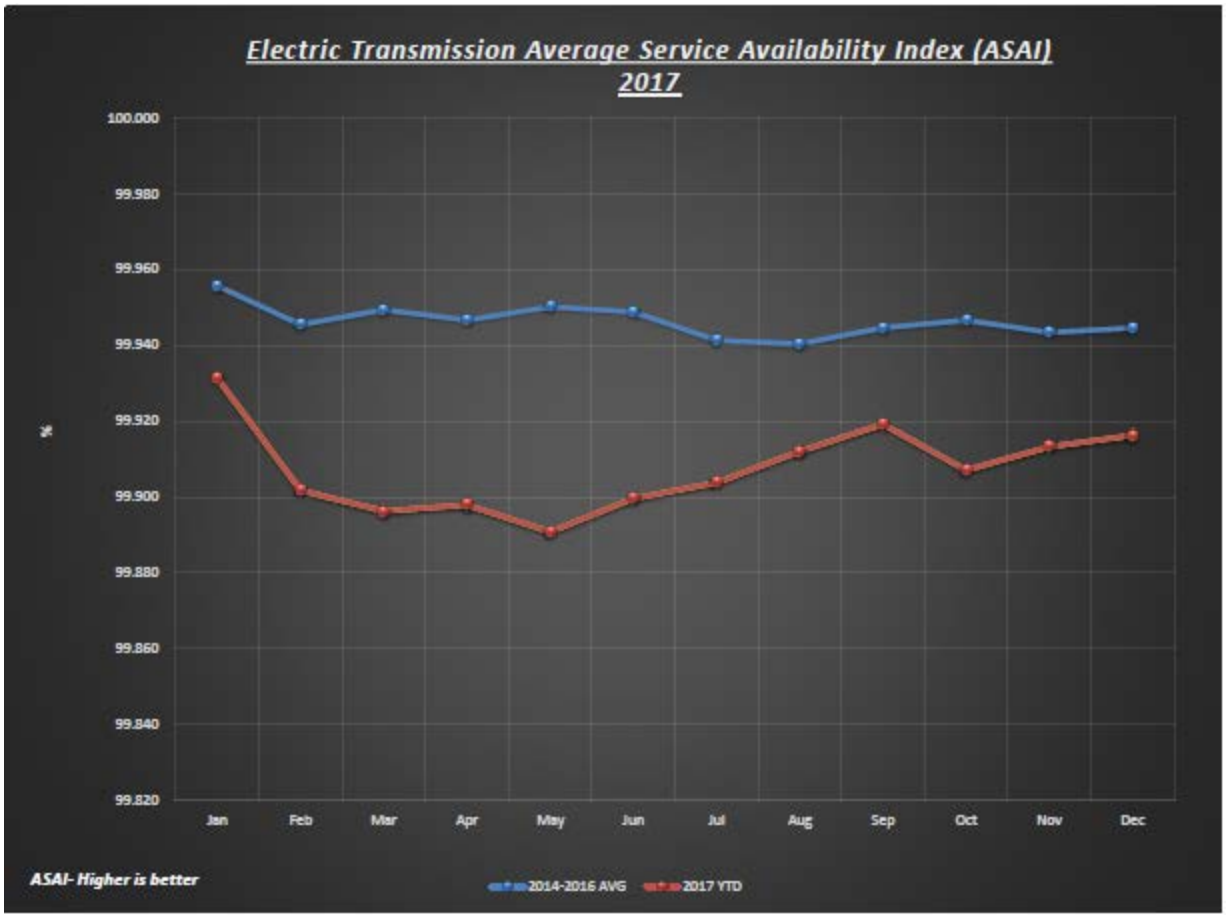


Figure A.3 Electric transmission Average Service Availability Index (ASAI) - 2017

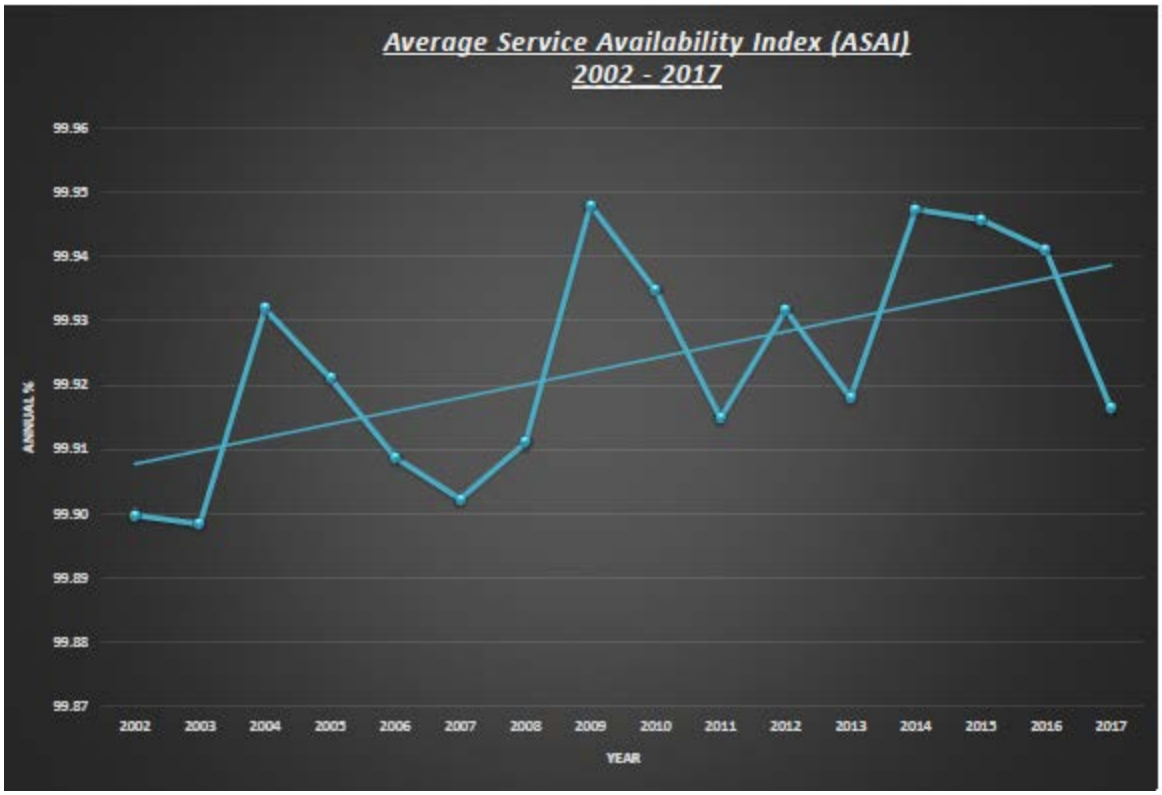


Figure A.4 Electric transmission Average Service Availability Index (ASAI) 2002-2017

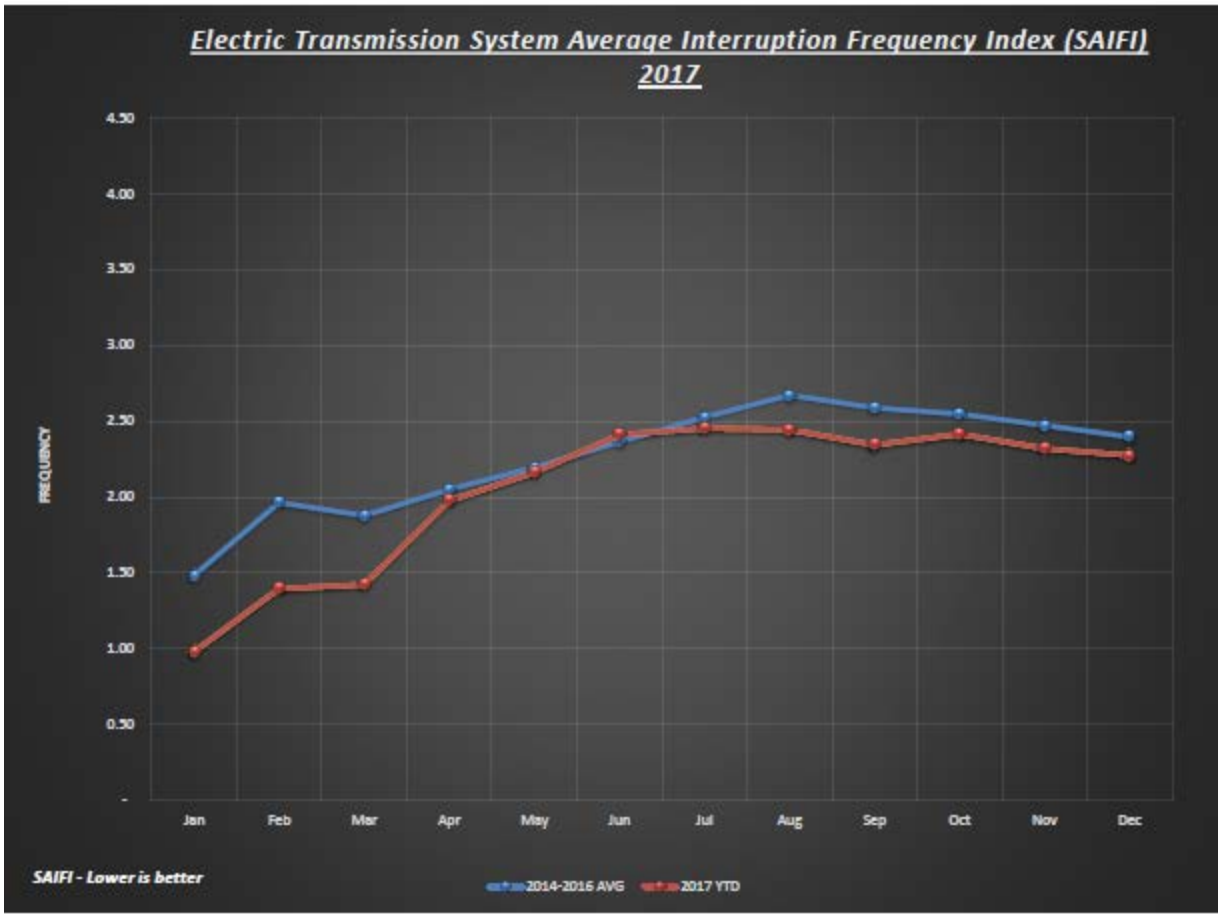


Figure A.5 Elect. Transmission System Average Interruption Frequency Index (SAIFI) - 2017

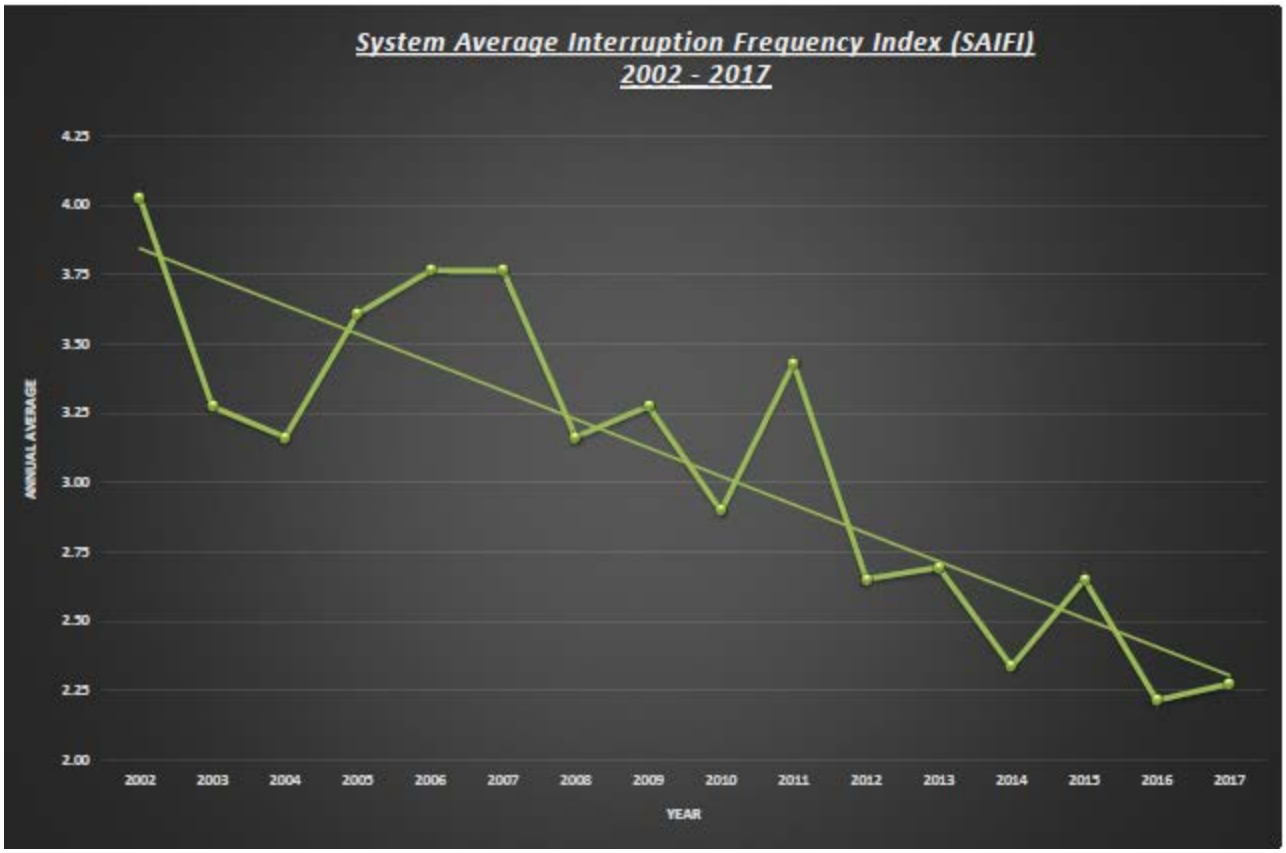


Figure A.6 Elect. Trans. System Average Interruption Frequency Index (SAIFI) 2002 - 2017

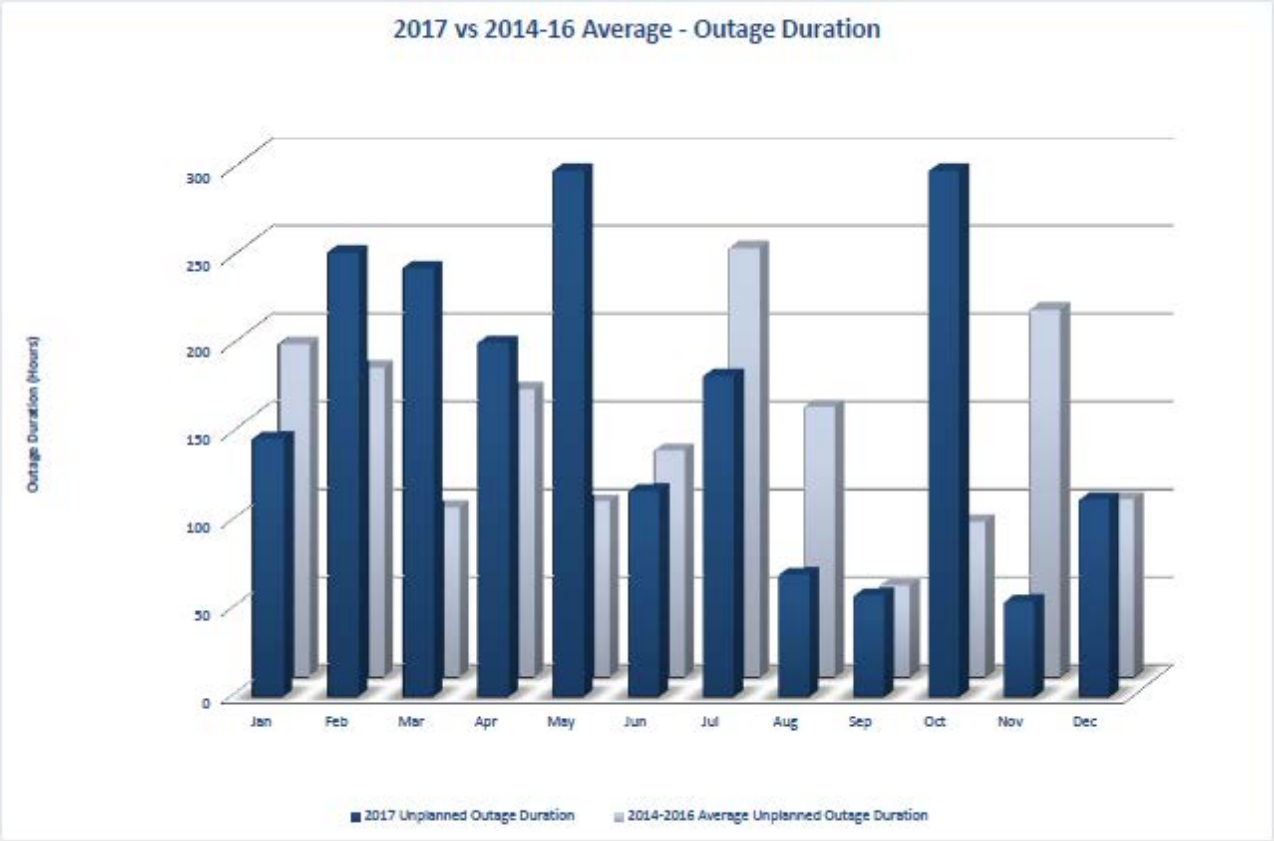


Figure A.7 Comparison of 2017 outage duration to previous three-year average

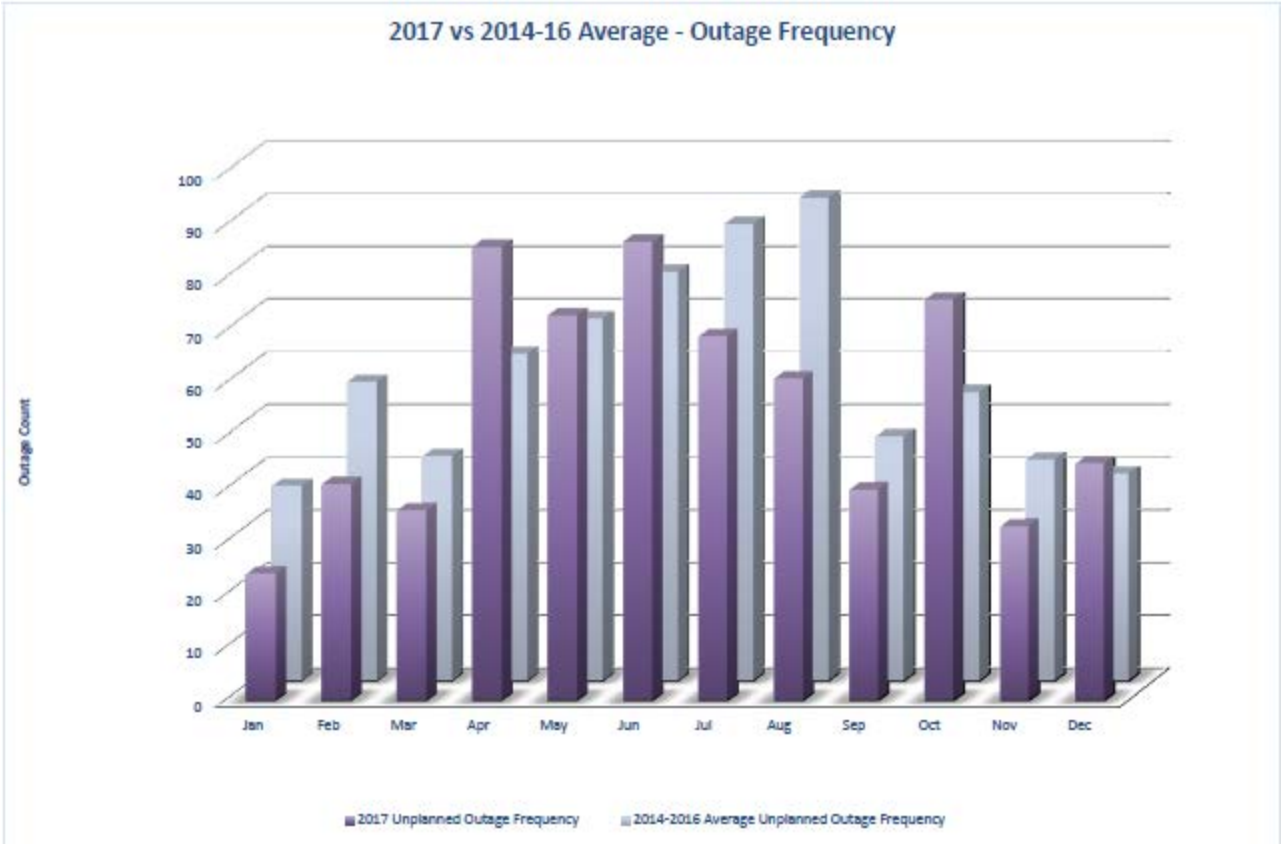


Figure A.8 Comparison of 2017 outage frequency to previous three-year average

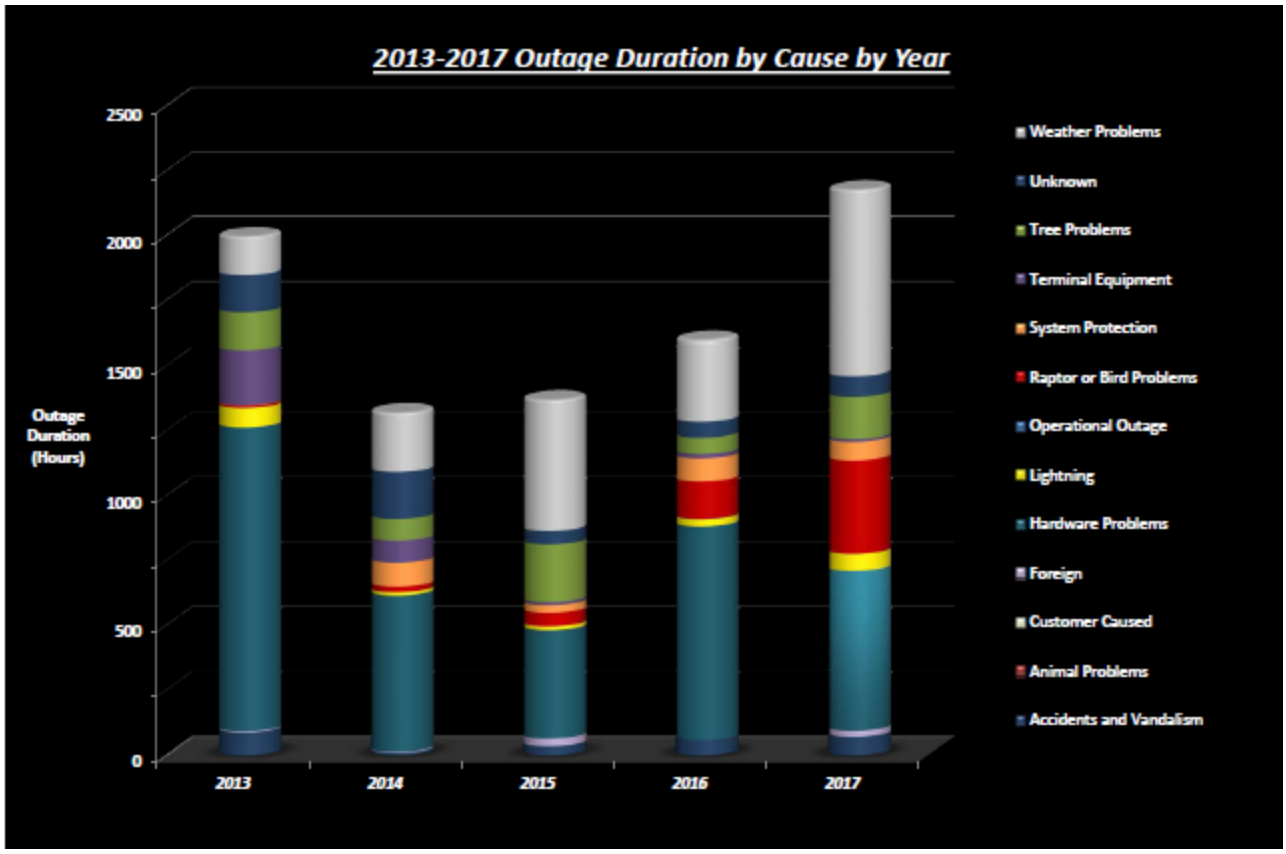


Figure A.9 Outage duration by cause by year for 2013-2017

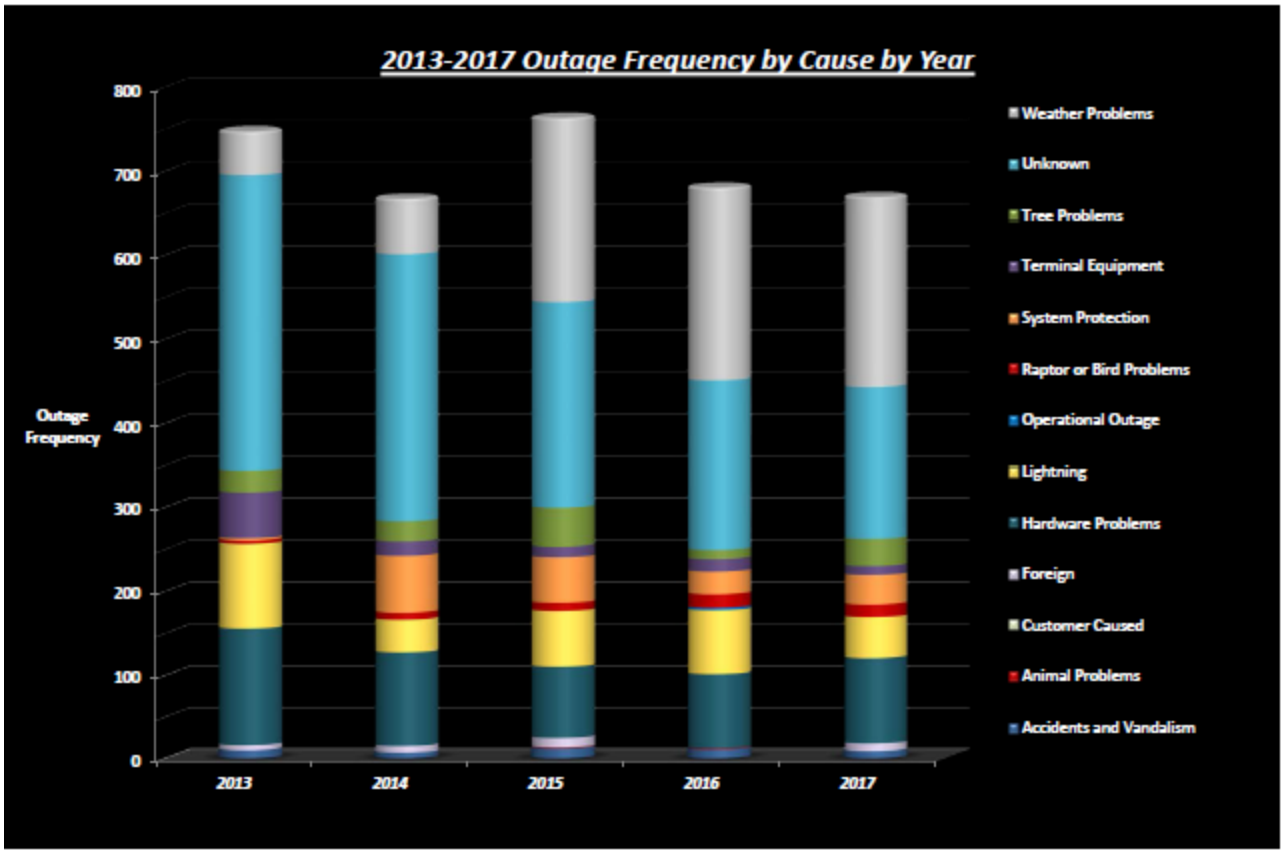


Figure A.10 Outage frequency by cause by year for 2013-2017