
IOWA UTILITIES BOARD
Policy Section

Docket No.: EDR Dockets
Utility: MidAmerican and Interstate
Power and Light
File Date/Due Date: N.A
Memo Date: November 19, 2015

TO: The Board

FROM: Parveen Baig

SUBJECT: MidAmerican and IPL Reliability Indices for the period 2002 through 2014
(Board Order is not required at this time)

I. Background

199 IAC 20.18 outlines service reliability requirements for Iowa utilities. 199 IAC 20.18(7) requires annual reliability and service quality report for utilities with more than 50,000 Iowa retail customers. Each electric utility is required to submit to the Board and Consumer Advocate on or before May 1 of each year an annual reliability report for the previous calendar year. The annual reliability reports are filed by two Iowa investor owned utilities, MidAmerican Energy Company (MidAmerican) and Interstate Power and Light (IPL), as well as thirty-eight rural electric cooperatives operating in Iowa.

II. Legal Standards

Iowa Administrative Code IAC 20.18(7) states:

20.18(7) *Annual reliability and service quality report for utilities with more than 50,000 Iowa retail customers.* Each electric utility with over 50,000 Iowa retail customers shall submit to the board and consumer advocate on or before May 1 of each year an annual reliability report for the previous calendar year for the Iowa jurisdiction.

III. Analysis

This requirement began in 2003 to cover reliability reporting for the 2002 calendar year. The attached document analyses annual reliability metrics submitted by MidAmerican and IPL from 2002 to 2014.

Staff is aware that ITC Midwest also collects reliability indices for its transmission system. Staff believes that a meeting with ITC Midwest to discuss its reliability indices data would be beneficial in understanding ITC Midwest's approach to its transmission operations.

IV. Major Conclusions

1. Reported reliability metrics have been stable during the past eleven years for MidAmerican and IPL.
2. Reliability reports contain data discrepancies that may lead to contradictory conclusions. Staff plans to schedule follow-up meetings between Board staff, IPL, MidAmerican, and ITC Midwest utilities to gain better understanding of how the data is being collected and used.

**2002-2014 RELIABILITY REPORT FILINGS BY MIDAMERICAN
ENERGY COMPANY AND INTERSTATE POWER AND LIGHT
COMPANY**
November 2015

Introduction

199 IAC 20.18 covers service reliability requirements for Iowa electric utilities. Specifically, section 20.18(7) requires filing of annual reliability and service quality report by utilities with more than 50,000 Iowa retail customers. Beginning in 2003, each electric utility is required to submit to the Utilities Board (Board) and the Consumer Advocate Division of the Iowa Department of Justice (Consumer Advocate) on or before May 1 of each year an annual reliability report for the previous calendar year. The report shall include a description of the service area, system reliability performance indices, reports on customer outages, a major events summary, information on transmission and distribution facilities, plans for reliability improvements, capital expenditures, and maintenance activities.

The annual reliability reports are filed by two Iowa investor owned utilities, MidAmerican Energy Company (MidAmerican) and Interstate Power and Light Company (IPL), as well as thirty-eight rural electric cooperatives operating in Iowa. This requirement began in 2003 to cover reliability reporting for the 2002 calendar year. These annual reliability reports are a separate requirement from the notification of outages required by 199 IAC 20.19.

This document summarizes the annual reliability metrics submitted by MidAmerican and IPL from 2002 to 2014 under annual EDR docket filings.

Major Findings and Recommendations

1. Reported reliability metrics have been stable during the past eleven years for MidAmerican and IPL.
2. Reliability reports contain data discrepancies that lead to contradictory conclusions. Staff recommends follow-up meetings with the utilities to gain better understanding of how the data is being collected, reported, and used.
3. ITC Midwest also collects reliability metrics, but does not file the metrics information with the Board. Meeting with ITC Midwest to its metrics data is also recommended.

Reliability Reports (2002 to 2014) Filed by MidAmerican and IPL

This document summarizes annual reliability metrics submitted by MidAmerican and IPL from 2002 to 2014 under annual EDR docket filings. This report does not seek to provide a comparison between the two companies. Comparisons

between the two companies are not appropriate since their service territories have different customer load characteristics and load profiles. MidAmerican serves mainly urban customers with nearly 660 thousand customers while IPL primarily serves rural customers with about 480 thousand customers. The objective of this document is to summarize information included in these reports and report on trends in reliability indicators taken from the reliability reports filed by MidAmerican and IPL.

Four reliability indices are reported in these annual filings along with additional information. 199 IAC 20.18(4) defines the four reliability indices as:

- System Average Interruption Frequency Index (SAIFI) – average number of interruptions per customer during the year
- System Average Interruption Duration Index (SAIDI) – average interruption duration per customer served during the year
- Customer Average Interruption Duration Index (CAIDI) – average interruption duration for those customers who experience interruptions during the year
- Momentary Average Interruption Frequency Index (MAIFI) – average number of momentary electric service interruptions for each customer during the year

As required by 199 IAC 20.18(4), values for SAIDI, SAIFI, CAIDI are presented with and without the inclusion of major events. Board rules define a major event as:

“Major event” will be declared whenever extensive physical damage to transmission and distribution facilities has occurred within an electric utility’s operating area due to unusually severe and abnormal weather or event and:

1. Wind speed exceeds 90 mph for the affected area, or
2. One-half inch of ice is present and wind speed exceeds 40 mph for the affected area, or
3. Ten percent of the affected area total customer count is incurring a loss of service for a length of time to exceed five hours, or
4. 20,000 customers in a metropolitan area are incurring a loss of service for a length of time to exceed five hours.

This document assumes that MidAmerican and IPL use the above definition to determine what constitutes a major event, but the utility filings do not confirm this.

199 IAC 20.19 requires utilities to notify the Board when it is projected that an outage may result in a loss of service for more than six hours or the outage meets certain other criteria (e.g., loss of service for more than six hours). The

notices are for the timely collection of electric outage information that may be useful to emergency management agencies in providing for the welfare of individual Iowa citizens. This notification must identify the cause of the outage, including identification of the major event as defined in 199 IAC 20.18(4).

Reliability Metrics Data Reporting

The annual reliability reports submitted to the Board include the following information required by 199 IAC 20.18(7):

- Total number of customer served broken down by rural and urban
- Annual values of SAIDI, SAIFI, and CAIDI for the past five years
 - Reported separately for urban and rural customers
 - Reported with and without the inclusion of major events
- Reliability metrics for the most recent year
- Annual MAIFI values for the past five years
 - MidAmerican provides MAIFI values for the combined urban and rural customer base
 - IPL was granted a waiver in 2007 (Docket No. WRU-07-3-150) and does not provide MAIFI values
- Annual budgeted amounts and expenditures for transmission and distribution system capital improvements
- Annual budgeted amounts and expenditures for transmission and distribution system maintenance
- Annual budgeted amounts and expenditures for tree trimming
- Annual projected and actual miles of trees trimmed (may also be expressed in man-hours)
- Tables showing outage data by cause of outage
 - MidAmerican provided frequency data for each type of outage
 - IPL provided data on total hours of outage duration for each type of outage
- Tables and graphs indicating the number of customers with a set number of outages
- Tables and graphs indicating the number of customers with a set range of total amount of outage duration

Data Tables Required by 199 IAC 20.18(7)c

199 IAC 20.18(7)c(1) requires that the reporting electric utility shall provide tables and graphical representations showing, in ascending order, the total number of customers that experienced set numbers of sustained interruptions during the year (i.e., the number of customers who experienced zero interruptions, the number of customers who experienced one interruption, two interruptions, three interruptions, and so on). The utility shall provide this for each of the following:

1. All Iowa customers, excluding major events.
2. All Iowa customers, including major events.

Additionally 199 IAC 20.18(7)c(2) requires that the reporting electric utility shall provide tables and graphical representations showing, in ascending order, the total number of customers that experienced a set range of total annual sustained interruption duration during the year (i.e., the number of customers who experienced zero hours total duration, the number of customers who experienced greater than 0.0833 but less than 0.5 hour total duration, the number of customers who experienced greater than 0.5 but less than 1.0 hour total duration, and so on, reflecting half-hour increments of duration). The utility shall provide this for each of the following:

1. All Iowa customers, excluding major events.
2. All Iowa customers, including major events.

Staff notes that each of the tables required in 199 IAC 20.18(7)c should have customer values that sum to give the total number of customers served by the utility. When the customer counts do not sum to equal the total number of customers served, then the data has errors. Differences in the values likely arise from errors in the reports or in the data entry from utility reports. All data entered by staff from the reports were double checked, but that does not mean it was all entered correctly. Requiring utilities to submit reliability data in excel format would remove the potential for staff data entry errors since the customer tables are large and cumbersome to recreate in excel.

MidAmerican

Numbers reported by MidAmerican, with few exceptions, equal total number of customers, as shown in table 1. The summed customer counts from the sustained outage tables in 2007 and 2008 were lower than expected by more than 100 when major events were excluded (indicated with shaded rows).

Table 1: Comparison of total customers reported by MidAmerican with summed values from outage frequency and outage duration tables

MidAmerican					
Year	Reported number of customers	Customer counts from outage frequency tables		Customer counts from sustained outage duration tables	
		With major events	Without major events	With major events	Without major events
2014	658,021	658,021	658,021	658,021	658,021
2013	651,444	651,444	651,444	651,444	651,444
2012	645,732	645,732	645,732	645,732	645,732
2011	640,837	640,837	640,837	640,837	640,837
2010	638,115	638,115	638,115	638,115	638,115
2009	634,699	634,699	634,699	634,699	634,699
2008	636,455	636,455	636,455	636,338	636,455
2007	632,830	632,830	632,830	632,659	632,830
2006	628,704	628,704	628,704	628,704	628,704
2005	621,125	621,125	621,125	621,125	621,125
2004	613,063	613,063	613,063	613,057	613,057
2003	604,114	604,114	604,114	604,114	604,114
2002	596,797	596,797	596,797	596,797	596,797

The first row of data in the outage frequency and sustained outage duration tables should be the same each year. In other words, the number of customers who had no outages in the first table should be equal to the number of customers with zero sustained outage duration in the second table. MidAmerican reports had consistent numbers, except for 2014 (shaded), as shown in Table 2.

Table 2: MidAmerican - customers with zero outages and customers with zero outage duration

MidAmerican				
Year	Customer counts <i>with</i> major events		Customer counts <i>without</i> major events	
	No outages	Zero outage Duration	No outages	Zero outage Duration
2014	240,200	240,200	240,200	274,705
2013	283,047	283,047	318,914	318,914
2012	249,947	249,947	293,967	293,967
2011	246,619	246,619	278,931	278,931
2010	212,867	212,867	289,223	289,223
2009	264,648	264,648	293,659	293,659
2008	197,611	197,729	251,982	251,982
2007	229,449	229,449	292,260	292,260
2006	333,959	333,959	333,996	333,996
2005	340,629	340,629	340,629	340,629
2004	279,215	279,215	279,215	279,215
2003	277,910	277,910	277,910	277,910
2002	262,241	262,241	286,926	286,926

IPL

The IPL data shows inconsistencies. The results are shown in Table 3. There are large discrepancies in 2007, 2008, 2009, 2011 and 2012 data between the reported number of customers and the summed customer values from the outage duration tables (indicated as shaded rows in Table 3). Additionally, in the 2008 report, the outage frequency table values did not agree with the reported number of customers served.

Table 3: IPL - Comparison of total customers with summed values from outage frequency and outage duration tables

IPL					
Year	Reported number of customers	Customer counts from <i>outage frequency</i> tables		Customer counts from <i>sustained outage duration</i> tables	
		With major events	Without major events	With major events	Without major events
2014	473,834	473,834	473,834	726,380	551,227
2013	478,961	478,991	478,991	612,184	530,430
2012	479,695	479,695	479,747	628,810	515,171
2011	480,447	480,447	480,447	1,011,638	892,030
2010	487,354	487,355	487,355	487,359	487,358
2009	475,061	475,059	475,061	474,991	473,155
2008	478,366	316,269	316,063	454,840	454,998
2007	482,422	482,382	482,422	481,954	324,399
2006	478,165	478,166	478,166	479,212	479,215
2005	478,366	478,367	478,367	478,367	478,367
2004	475,940	475,940	475,940	475,940	475,931
2003	472,579	472,579	472,579	472,668	472,672
2002	480,194	480,194	480,194	480,194	480,194

In the case of IPL there were issues with the sustained outage duration table. In some years, IPL provided customer counts for zero outage duration and also for outage durations between 0 and 30 minutes (2002 – 2007). In other years, these two values seemed to be combined into one category (2010-2014). Sometimes, IPL seemed to leave out the count for zero sustained minutes of outage out of the table altogether (2008 and 2009). Table 4 shows the counts reported by IPL. Years 2007 and 2012 as shaded because they have major problems. In the 2007 report, the number of customers with no outages, counting major events, equaled 89,144 while the number of customers listed as having zero outage duration equaled 4 and the number of customers with less than 30 minutes of total sustained outage duration equaled 14,079 (still much less than 89,144). In 2013, the number of customers reported to have no outages when major events are not counted equaled 178,929 while the number of customers with less than 30 minutes of sustained outage duration equaled 154,172. There was no explanation given for these apparent data discrepancies.

Table 4: IPL - Customers with zero outages and customers with zero outage duration

IPL						
	Customer counts with major events			Customer counts without major events		
Year	No outages	Zero Duration	0-30 min. Duration	No outages	Zero Duration	0-30 min. Duration
2014	63,390	N/A	184,688	174,529	N/A	148,793
2013	115,331	N/A	168,262	178,929	N/A	154,172
2012	132,638	N/A	149,976	212,039	N/A	128,260
2011	54,919	N/A	344,667	166,319	N/A	362,621
2010	278,087	N/A	289,218	297,621	N/A	333,080
2009	161,212	N/A	16,072	182,357	N/A	14,951
2008	138,569	N/A	10,074	138,933	N/A	10,075
2007	89,144	4	14,079	166,439	391	24,989
2006	206,055	206,055	31,487	206,057	206,057	31,487
2005	162,098	162,098	30,442	162,304	162,304	30,443
2004	185,608	185,608	27,706	191,961	191,961	28,443
2003	166,951	166,951	37,471	172,511	172,511	37,732
2002	140,101	140,101	27,236	142,768	142,768	27,970

In 2011 and 2010, IPL seemed to include the zero outage group with the group of outage duration under 30 minutes. However, it is not clear whether this is the case with the 2012, 2013, and 2014 data. Given that the cumulative customer count from the outage duration table in the last three years is well above the number of customers served in IPL territory, there is an obvious error here.

SAIFI

Tables showing customer counts by number of outages allow recalculation of the SAIFI values for comparison with the reported values. If all values are reported correctly, then the calculated SAIFI should match exactly with the reported SAIFI.

MidAmerican

SAIFI values calculated by staff from customer counts are compared with reported SAIFI values from MidAmerican reports in table 5. In recent years the reported SAIFI values match the calculated values closely. Some discrepancies occur in 2014 and in earlier years.

Table 5: Comparison of reported SAIFI values in MidAmerican with SAIFI values derived from detailed outage information

MidAmerican				
	SAIFI <i>with</i> major events		SAIFI <i>without</i> major events	
Year	Reported SAIFI	Calculated SAIFI	Reported SAIFI	Calculated SAIFI
2014	1.40	1.40	1.03	1.23
2013	1.06	1.06	0.89	0.88
2012	1.19	1.19	0.93	0.93
2011	1.21	1.21	1.04	1.04
2010	1.76	1.76	1.14	1.14
2009	1.18	1.18	0.96	0.96
2008	1.58	1.58	1.18	1.18
2007	1.78	1.62	1.15	1.00
2006	0.93	0.79	0.92	0.77
2005	0.95	0.77	0.95	0.77
2004	1.10	1.00	1.10	1.00
2003	1.19	1.08	1.19	1.08
2002	1.36	1.04	1.17	0.90

IPL

IPL data, with the exception of years 2008 – 2010, match pretty well as shown in Table 6 below. The summed customer values from the outage frequency tables were generally consistent with the reported number of customers with the exception of year 2008 (see table 2). Therefore, it is not clear why there is a large discrepancy in data for years 2008, 2009 and 2010.

Table 6: Comparison of reported SAIFI values in IPL with SAIFI values derived from detailed outage information

IPL				
	SAIFI <i>with</i> major events		SAIFI <i>without</i> major events	
Year	Reported SAIFI	Calculated SAIFI	Reported SAIFI	Calculated SAIFI
2014	1.48	1.51	1.13	1.15
2013	1.28	1.26	1.10	1.09
2012	1.31	1.29	1.08	1.07
2011	1.67	1.64	1.35	1.32
2010	1.63	0.76	1.36	0.65
2009	1.28	1.52	1.13	1.23
2008	1.92	1.02	1.46	1.02
2007	2.44	2.45	1.40	1.40
2006	1.07	1.08	1.07	1.08
2005	1.34	1.33	1.33	1.33
2004	1.19	1.19	1.12	1.12
2003	1.43	1.43	1.38	1.38
2002	1.47	1.45	1.44	1.42

SAIDI

Tables specifying customer counts for sustained outage duration were used to estimate annual SAIDI indices. The tables displayed outage durations in discrete increments of 30 minutes which prevents an actual recalculation of the SAIDI.

IPL tables often deviated from the 30 minute time increments specified in 199 IAC 20.18(7)c(2) and increased the time increments from 30 minutes to 4 hours towards the end of the table. In order to estimate SAIDI values, all customers within a duration interval were assumed to have total outages equal to the midpoint of the duration period (e.g. if 1000 customers had total outage duration from 4 to 4.5 hours, all customers were assumed to have outages for 4.25 hours). Tables 7 and 8 show the reported and estimated values of SAIDI for MidAmerican and IPL respectively. For analytical purposes Staff made one correction to the IPL data in the 2004 report where it was apparent that a value was entered with too few digits. The incorrect value was changed from 6,667 to 26,667 which resulted in a value that looked correct and made the summed customer count equal the reported number of customers.

Table 7: MidAmerican - Comparison of reported SAIDI values with SAIDI values estimated from detailed outage information

MidAmerican				
	SAIDI <i>with</i> major events		SAIDI <i>without</i> major events	
Year	Reported SAIDI	Estimated SAIDI	Reported SAIDI	Estimated SAIDI
2014	156.29	156.20	98.09	98.04
2013	143.54	143.44	84.72	84.59
2012	208.19	208.61	84.39	84.79
2011	158.84	159.15	101.92	102.26
2010	402.35	402.58	111.61	112.05
2009	163.59	163.75	101.02	101.08
2008	262.21	262.24	124.80	125.03
2007	474.69	443.51	111.18	95.91
2006	86.39	88.19	77.42	70.49
2005	90.39	73.87	90.39	73.87
2004	108.02	106.35	108.02	106.35
2003	105.21	111.76	105.21	111.76
2002	201.06	183.92	102.58	105.26

Table 8: IPL - Comparison of reported SAIDI values in IPL with SAIDI values estimated from detailed outage information

IPL				
Year	SAIDI <i>with</i> major events		SAIDI <i>without</i> major events	
	Reported SAIDI	Estimated SAIDI	Reported SAIDI	Estimated SAIDI
2014	194.42	155.21	108.87	91.12
2013	140.29	106.11	90.89	81.90
2012	174.47	137.36	105.77	99.71
2011	262.80	104.60	118.97	68.11
2010	218.82	118.03	134.63	127.85
2009	126.86	87.85	99.00	78.56
2008	616.30	135.16	133.19	134.54
2007	1444.48	1460.68	128.59	70.30
2006	89.46	92.51	89.07	92.15
2005	120.09	118.72	119.51	118.18
2004	142.00	137.46	104.20	99.75
2003	157.69	157.24	115.29	114.92
2002	127.24	144.65	114.84	133.30

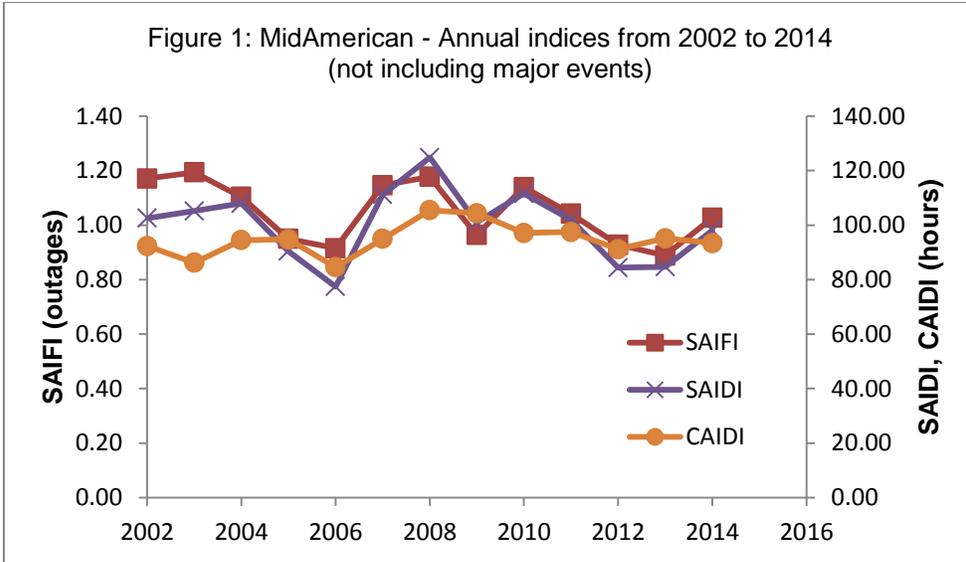
Aggregated Reliability Indices

All reliability indices were reported separately for urban and rural customers. The aggregated SAIDI, SAIFI and CAIDI indices are shown here.

This section focuses on results excluding major weather events. MidAmerican reported no major events during the three year stretch from 2003 – 2005. As a result, indices do not change during these years when major events are included in the calculations. IPL had no years of major events. Both utilities reported minimal major events in 2005 and 2006.

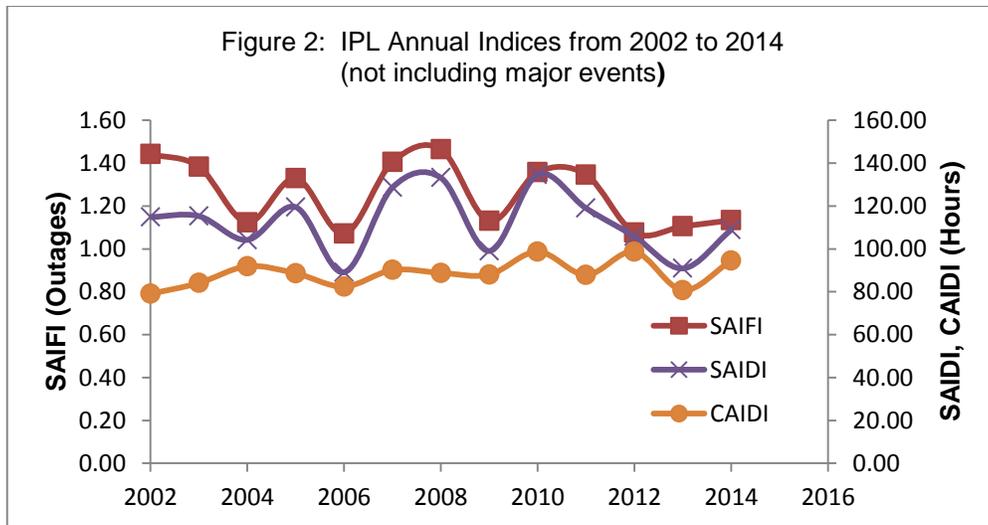
MidAmerican

MidAmerican indices over the period 2002 to 2014 are shown in Figure 1. SAIDI and CAIDI values are shown in hours to allow easier viewing of the three time series on one plot. The graph shows that reliability in MidAmerican’s service territory has remained stable. Recent years seem to indicate a slight improvement, possibly due to an increase in spending during the same time period (see Figure 2), but more data and analysis are needed to confirm this.



IPL

Due to IPL's data quality concerns discussed earlier in this document, reliability trends for IPL cannot be completely verified. The following analysis is provided based on IPL data. Figure 2 shows the SAIDI, SAIFI and CAIDI values for 2002 to 2013. IPL reliability indices also do not exhibit a statistical trend over the period 2002 through 2014.

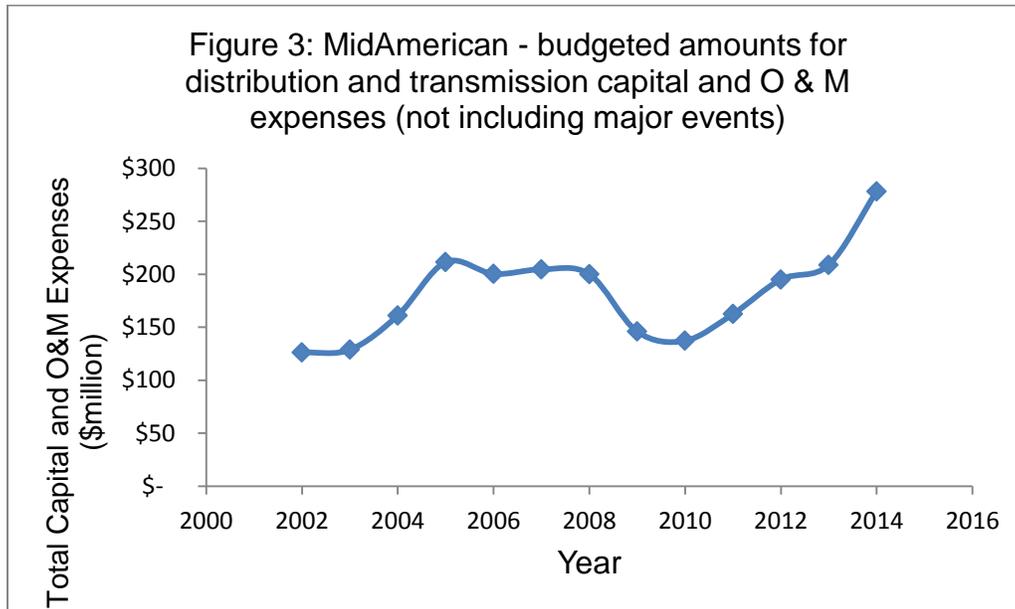


Annual Capital and Operation and Maintenance (O&M) Expenditures

Budgets for reliability and outage information by customer numbers were aggregated for all customers.

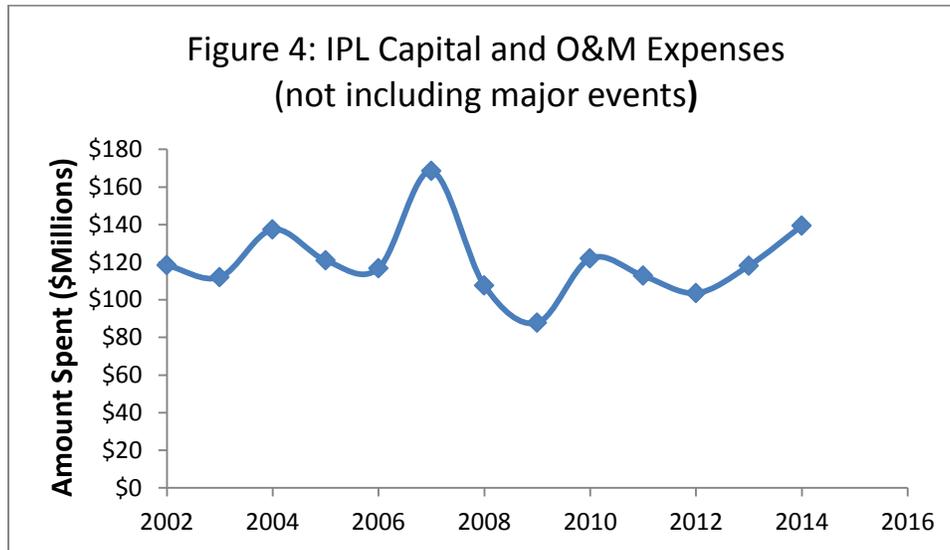
MidAmerican

MidAmerican's annual expenditures on transmission and distribution (capital expenses plus O&M expenses) for the years 2002 through 2014 are shown in Figure 3. These expenses have increased every year over the last five years.



IPL

IPL's expenditures on the transmission and distribution infrastructure for the years 2002 to 2014 are shown in Figure 4. IPL divested its transmission assets in 2008 which may account for the drop in spending at that time. Similar to MidAmerican, IPL's expenses have increased every year over the last five years.

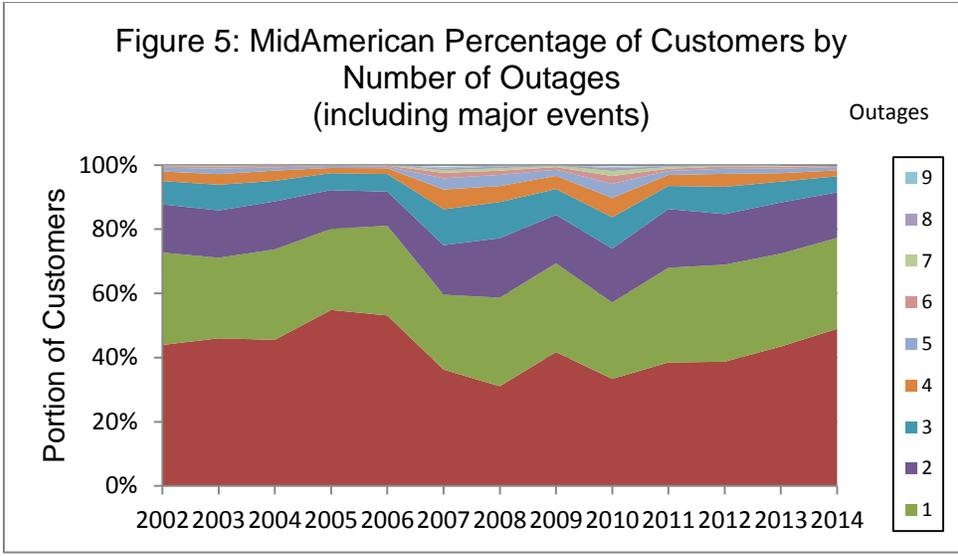


Number of Outaged Customers

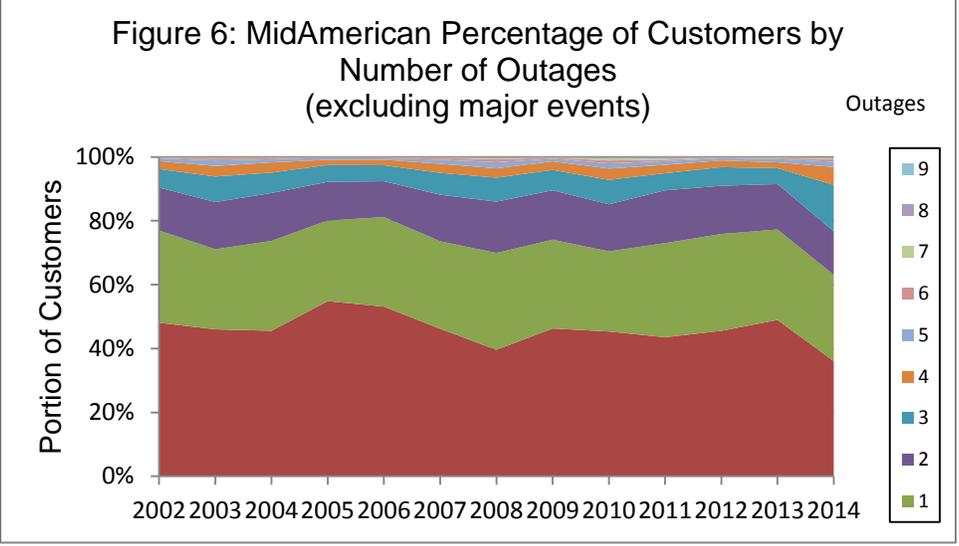
The three main reliability indices, SAIDI, SAIFI and CAIDI, provide a small picture of overall system reliability. Percentage of customers with no outages, one outage, two outages, etc. over the thirteen year period gives another look at system reliability.

MidAmerican

Figure 5 shows percentage of customer that experienced outages. Every year 40-50 percent of the customers had no outages and over 70 percent of customers had one or zero interruptions (excluding major events). This compares with the average SAIFI for MidAmerican of around 1.1 during this time indicating the average customer had more than one outage. In general, the data showed little change from year to year.

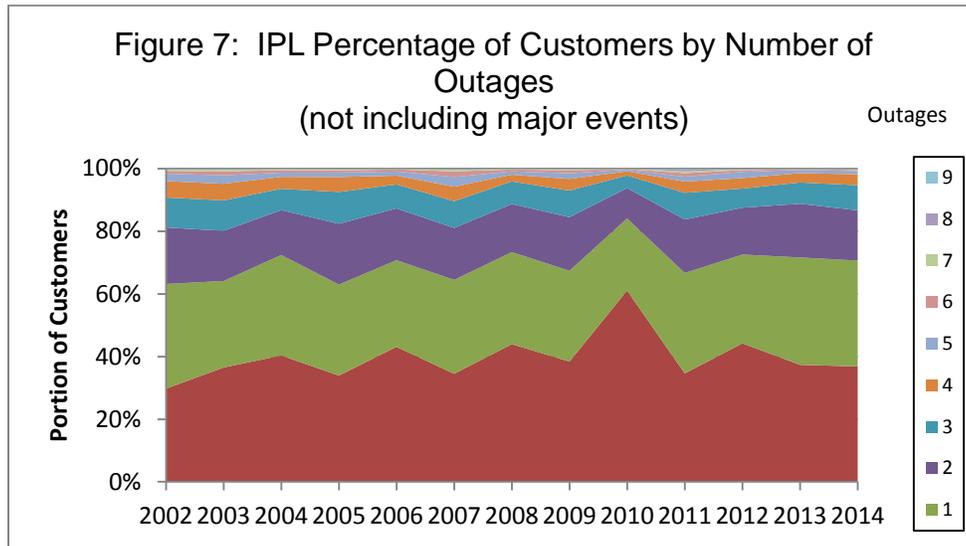


In Figure 6, the percentage of customers with different lengths of cumulative outage duration is shown. The data seems stable with no major changes from one year to another. The average SAIDI value for the time period shown is 102 minutes (1.7 hours). Figure 6 shows that 60 percent of customers experience one hour or less of total outage while 75 percent of customers had two or less hours of outage duration. Figure 6 also shows that roughly 10 percent of customers annually had more than five hours of total electricity outage. There is not sufficient data available to determine whether the same customers experienced outages each year. This information for customers who are connected to circuits that show consistent poor performance needs to be explored and analyzed.

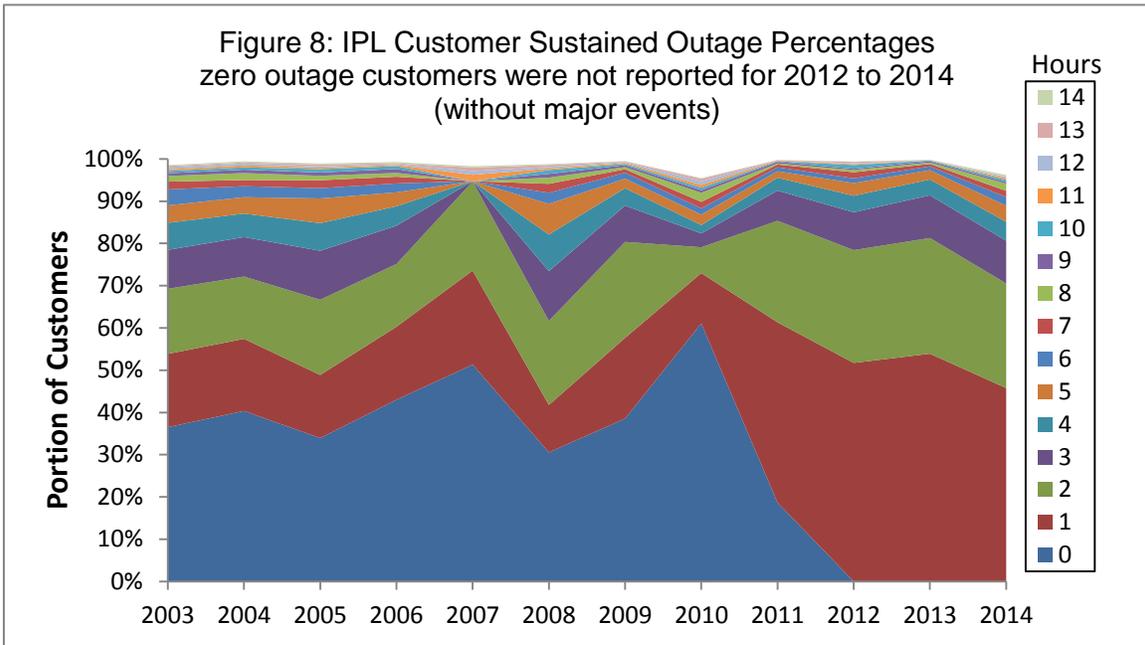


IPL

Figure 7 shows customer counts by outage frequency. Between 30 to 40 percent of IPL's customers experienced no outages in a year with the exception of 2010. Note that year 2008 to 2010 data may not be accurate as the implied SAIFI values from the outage tables differ from the reported values as discussed earlier (see Table 6). Over 60 percent of IPL customers experienced one or fewer outages every year compared with the SAIFI values of IPL which averaged 1.28 without major events included. In general, customer counts by frequency of outages were stable over the reported time period.



Customer counts of sustained outage durations for IPL are shown in Figure 8. Note that this data is not reliable for years 2007 to 2014. The graph shows that customer counts varied widely and no meaningful conclusion could be drawn from the data. Similar to MidAmerican, over 10 percent of IPL customers had five hours or more outages annually.



Outage Causes

The reports indicate number of outages attributed to different types of causes. The categories of outages reported by MidAmerican and IPL do not match completely. Board rule 199 IAC 20.18(7)b(1) states that these reliability reports must contain “tabular and graphical presentations of ... the trends of major causes of interruptions.”

Utilities are required to maintain records of causes of interruptions with the minimum set of causes specified in 199 IAC 20.18(5)a(4). However, there is no requirement to use the same set of causes in the annual reliability report. Table 9 shows the set of causes listed in 199 IAC 20.18(5)a(4) along with the cause labels used by MidAmerican and IPL in their annual reliability report filings. MidAmerican is lacking categories for “earthquake”, “major event”, and “overload”. IPL is lacking an “other” category. It is unclear why MidAmerican has a “weather/other” category as well as an “other” category.

**Table 9: MidAmerican and IPL - Interruption cause labels
(199 IAC 20.18(5)a(4) specifies Minimum categories)**

199 IAC 20.18(5)a(4)	MidAmerican	IPL
Animals	Animals	Wildlife
Lightning	Lightning	Lightning
Scheduled	Scheduled	Scheduled
Trees	Trees	Trees
Error	Error	Error
Supply	Supply	Supply
Unknown	Unknown	Unknown
Earthquake		Earthquake
Other	Other	
Major Event		Major Event
Overload		Overload
Equipment	Equipment-OH	Equipment
	Equipment-UG	
	Weather-Other	Weather
	Public	Public

Also, MidAmerican reports the *number of interruptions* associated with each cause while IPL reports the *percentage of customer minutes of outage* attributed to each cause. Lastly, MidAmerican reports the causes of interruptions separately for urban and rural customers while IPL presents this information without separating the customer types.

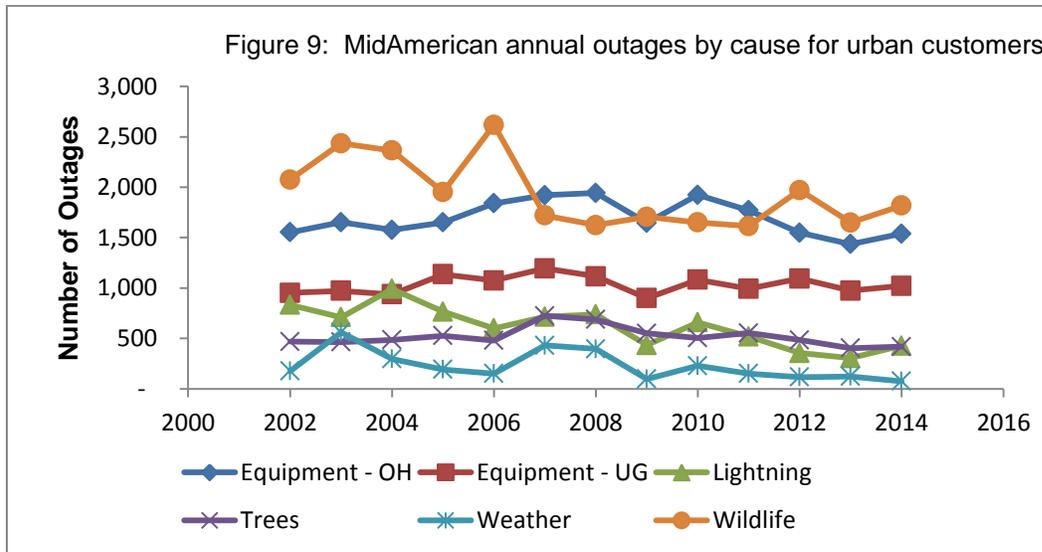
MidAmerican

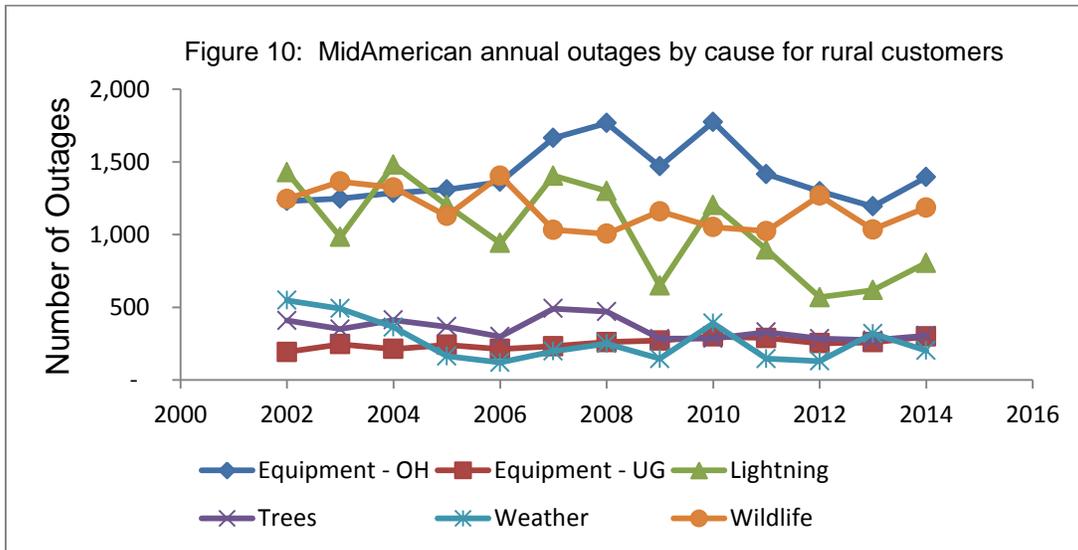
The magnitude of outages caused by each type of event varies greatly. Table 10 shows the average number of annual outages reported by MidAmerican from 2002 to 2013 for each type of cause without recognizing major events. Equipment failures (overhead and underground) account for the vast majority of outages. Most of the causes did not change a great deal from year to year. Some had slight statistical declines over the time period (lightning, weather, wildlife, unknown, public), others increased over the eleven years (scheduled, other), and the remaining causes were stable (overhead equipment, underground equipment, trees, supply, error). Figure 10 shows a sampling of the trends for the causes of the greatest number of outages. No description of the different cause categories was found in the reports (e.g. what constitutes a supply outage or public outage). It should be noted that outage numbers for urban and rural customers were not combined since this could potentially lead to double counting of events that affected both urban and rural customers.

Table 10: MidAmerican - Average annual number of outages for twelve causes (Without major events)

Cause	Average Annual Number of Outages for <u>Urban</u> Customers 2002 – 2014	Average Annual Number of Outages for <u>Rural</u> Customers 2002 – 2014
Equipment - OH	1692	1,417
Equipment - UG	1,034	252
Lightning	619	1,037
Trees	519	351
Weather/Other	230	267
Animals	1,938	1,172
Unknown	355	435
Public	324	203
Scheduled	444	220
Supply	28	72
Error	50	15
Other	122	73

Figure 9 shows number of outages for six different causes for urban customers. Figure 10 shows number of outages for six different causes for rural customers.



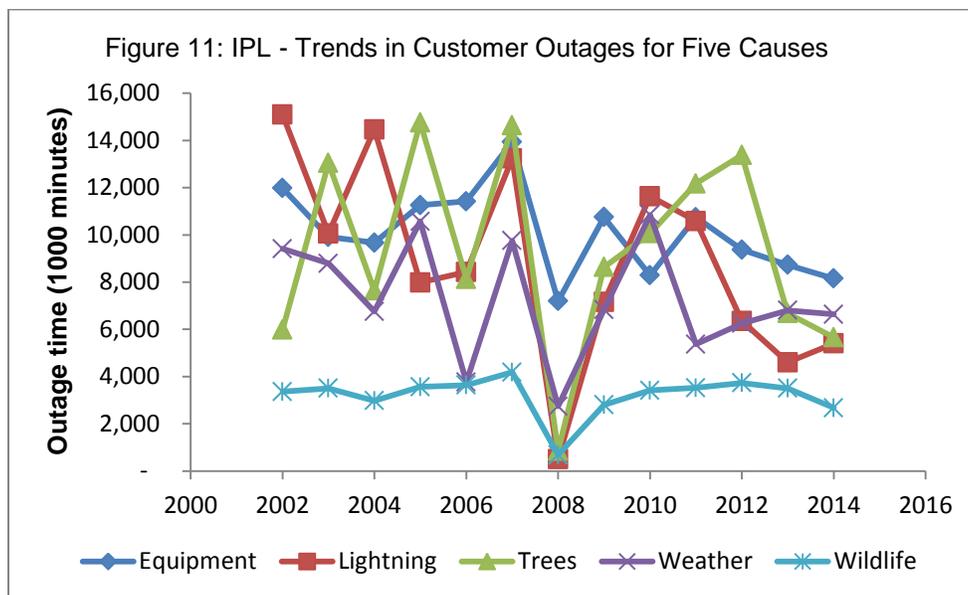


IPL

IPL reports the causes of outages using slightly different categories as compared to MidAmerican. For each outage cause, IPL reports the percentage of customer minutes attributed to the outage cause for each year. Customer minutes were calculated by multiplying these customer percentages by the SAIDI and number of customers. Given the data quality issues previously identified it is possible that this conversion could have introduced errors. Table 11 shows the average number of customer hours attributed to each cause of outage from 2002 to 2014. Aside from major events, which dwarfed all other types of causes, equipment failure was responsible for the majority of outage duration. This is similar to the results shown for MidAmerican although the metric used in the MidAmerican results was frequency of outages rather than duration. Annual values are shown in Figure 10 for five causes. It shows that there is not a set of common outage cause during the past thirteen years. It is worth noting that in 2008, outage durations from all causes seem to drop considerably. The reason for this is that in 2008 major floods caused most of the outages in the IPL grid. Therefore, most of the outages were labeled as “major events” which reduced the values for all other causes.

Table 11: IPL - Average annual outage duration for thirteen different classes of causes

Cause	Average Annual Outage Duration 2002 - 2014 (thousands of customer minutes)
Equipment	10,108
Lightning	8,884
Trees	9,357
Weather	7,271
Wildlife	3,195
Unknown	2,184
Public	2,548
Scheduled	2,490
Supply	4,355
Error	445
Overload	309
Major Event	89,674
Earthquake	-



Conclusions

This report analyses reliability metrics submitted by MidAmerican and IPL for the years 2002 to 2014. An analysis of the data indicated minor issues with the reported values from MidAmerican and relatively more issues with the IPL data. Staff recommends that staff schedule follow-up meetings with the utilities in order to fix the data problems and to ensure future reliability report filings are useful. Also, the data could be more readily analyzed if submitted in Excel format.

Time series of SAIDI, SAIFI and CAIDI in both MidAmerican and IPL show that reliability is fairly constant over the reported time period. It is possible that technological improvements in measurement equipment countered improved reliability, leaving a stable trend. In other words, better situational awareness of outages may increase the visibility of reliability problems, and show stable trends even if reliability is actually improving.

Major events were not included in this analysis because they cause large swings in reliability indices that are difficult to avoid, and the company would have little, if any, control over the outages caused by natural disasters. Although it is assumed that MidAmerican and IPL are defining major events as per the definitions outlined in the Iowa Administrative Code, this is not explicitly stated in their reports.

MidAmerican reports zero major events in 2003, 2004, and 2005. IPL is not showing any years of zero major events. Years 2005 and 2006 appear to show minimal activity. Again, clarification of definition of a major event would make the data more meaningful.

Detailed information on customer outages showed that roughly 10 percent of IPL and MidAmerican customers experienced 5 hours or more time without electricity each year without including the effect of major events. It may be useful in the future to attempt to track which customers have electrical outages. Engineering staff is interested in finding out whether same customers are experiencing long outages year after year. Such information would help determine which circuits are worst performing circuits that need maintenance and/or upgrades.

The reports also do not state how the data is collected nor provide any indication of the level of uncertainty associated with the numbers. Staff believes inquiring and knowing more details about the data collection process may help the Board in understanding how reliable the numbers are in terms of assessing changes in reliability.

Staff plans to schedule meetings with MidAmerican and IPL to discuss reliability report filings and findings.

Staff is aware that ITC Midwest, an independent transmission company that owns transmission in Iowa also collects reliability metrics. Staff also plans to schedule a meeting with ITC Midwest to discuss its reliability metrics and data collection processes.

Appendix

The following tables show the reported MAIFI, SAIFI, SAIDI, and CAIDI values by customer type with and without major events included. MAIFI is only reported by MidAmerican

Table 12: MidAmerican reported MAIFI values by year.

MidAmerican	
Year	MAIFI
2014	2.26
2013	2.01
2012	2.17
2011	2.09
2010	2.77
2009	1.53
2008	2.04
2007	1.96
2006	1.55
2005	1.78
2004	2.01
2003	1.60
2002	2.20

Table 13: MidAmerican - SAIFI values by year.

MidAmerican				
Year	SAIFI without major events		SAIFI with major events	
	Urban	Rural	Urban	Rural
2014	0.88	1.38	1.08	1.62
2013	0.85	0.98	1.01	1.17
2012	0.94	0.90	1.23	1.10
2011	1.03	1.07	1.16	1.33
2010	1.08	1.28	1.55	2.27
2009	0.94	1.02	1.12	1.32
2008	1.10	1.36	1.57	1.59
2007	1.03	1.42	1.54	2.33
2006	0.90	0.95	0.92	0.95
2005	0.91	1.04	0.91	1.04
2004	0.97	1.41	0.97	1.41
2003	1.08	1.45	1.08	1.45
2002	1.10	1.33	1.36	1.37

Table 14: MidAmerican - SAIDI values by year.

MidAmerican				
Year	SAIDI without major events		SAIDI with major events	
	Urban	Rural	Urban	Rural
2014	77.97	146.45	131.84	215.06
2013	75.22	107.39	139.71	152.69
2012	81.37	91.57	216.19	189.21
2011	97.05	113.46	135.91	213.25
2010	97.86	143.97	266.35	722.43
2009	92.40	121.18	137.22	225.24
2008	112.08	154.69	264.75	256.24
2007	89.39	162.39	295.76	895.09
2006	74.55	84.03	87.3	84.29
2005	81.20	111.46	81.2	111.46
2004	81.59	168.65	81.59	168.65
2003	85.56	149.32	85.56	149.32
2002	82.76	146.94	210.74	179.4

Table 15: MidAmerican - CAIDI values by year.

MidAmerican				
Year	CAIDI without major events		CAIDI with major events	
	Urban	Rural	Urban	Rural
2014	88.23	105.84	122.53	133.14
2013	88.89	109.81	138.42	130.98
2012	86.88	101.35	175.61	172.47
2011	94.09	105.59	117.12	159.93
2010	90.71	112.28	172.30	318.20
2009	98.39	118.37	123.02	170.49
2008	101.94	113.78	168.43	160.80
2007	86.82	114.20	191.64	383.94
2006	82.88	88.50	95.18	88.74
2005	89.49	106.99	89.49	106.99
2004	83.74	119.25	83.74	119.25
2003	78.89	102.64	78.89	102.64
2002	75.08	131.03	148.32	131.03

Table 16: IPL - SAIFI values by year.

IPL				
Year	SAIFI without major events		SAIFI with major events	
	Urban	Rural	Urban	Rural
2014	1.12	1.14	1.45	1.50
2013	0.88	1.22	1.09	1.37
2012	0.79	1.22	1.15	1.39
2011	1.24	1.40	1.51	1.75
2010	0.90	1.59	0.92	1.99
2009	1.13	1.13	1.13	1.34
2008	1.40	1.50	1.60	2.10
2007	1.06	1.59	1.92	2.72
2006	0.74	1.25	0.74	1.25
2005	1.05	1.48	1.05	1.49
2004	0.80	1.30	0.89	1.35
2003	1.18	1.49	1.29	1.51
2002	1.17	1.59	1.17	1.63

Table 17: IPL - SAIDI values by year.

IPL				
Year	SAIDI without major events		SAIDI with major events	
	Urban	Rural	Urban	Rural
2014	105.8	110.4	290.0	219.8
2013	58.80	107.30	130.30	145.40
2012	79.10	119.30	195.30	163.90
2011	94.80	131.20	270.70	258.80
2010	82.90	161.00	87.80	285.60
2009	99.00	99.00	99.30	137.50
2008	112.80	144.20	933.70	444.90
2007	84.00	152.60	1269.00	1539.00
2006	58.80	105.50	58.80	106.10
2005	83.60	138.90	83.60	139.80
2004	65.40	125.30	137.60	144.40
2003	106.30	120.00	219.40	125.40
2002	84.93	131.19	84.93	150.38

Table 18: IPL - CAIDI values by year.

IPL				
Year	CAIDI without major events		CAIDI with major events	
	Urban	Rural	Urban	Rural
2014	94.60	96.40	200.50	146.90
2013	67.00	87.80	120.00	105.70
2012	100.10	97.90	169.80	117.80
2011	76.50	93.60	179.50	148.10
2010	92.50	101.90	95.00	143.20
2009	88.00	88.00	88.10	102.30
2008	78.80	94.20	586.60	214.80
2007	78.90	96.20	662.30	565.00
2006	79.10	84.20	79.10	84.50
2005	79.40	93.60	79.40	94.00
2004	83.60	96.40	154.50	107.20
2003	90.30	80.80	170.50	83.20
2002	72.66	82.50	72.66	92.46

