2018 Electric Service Reliability Report

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Avista's Electric Service Reliability Report for 2018

Introduction

Background

Avista's Electric Service Reliability Report documents the annual reliability performance of our electric system for the prior reporting year, which is filed each year with the Washington Utilities and Transportation Commission ("WUTC" or "Commission").[1] This report is for the results of the Company's electric operations in 2018.

For this annual report our definition of "electric system" has always referred to our overall network[2] of transmission lines, substations, and the distribution lines, or "feeders," that carry electricity to every home and business in our Washington and Idaho service area. "Service reliability" refers to the various measures of the number of times during the year that our customers experience an electric service outage (number of outages or service interruptions) and the average length of time of these outages (outage duration). In accordance with the Commission's rules,[3] the Company established a baseline year (2005) for each of its reliability measures and then annually compares the results for each reporting year with these baseline statistics in addition to including results for the current seven-year period, as required by the rule. In addition to reporting reliability statistics, Avista must also report any changes to the methods used to collect and report the results, identify the geographic areas of greatest reliability concern on the Company's electric system, and explain our plans to improve reliability performance in those areas. Finally, Avista reports the number of complaints from its customers related to power quality and service reliability. The detailed reporting requirements are listed under definitions and electric system reliability reporting requirements, provided in Appendix A. Avista files its annual electric service reliability report with the Commission by April 30th each year.

[1] Pursuant to WAC 480-100-398.
[2] Entire electric system, irrespective of state jurisdiction.
[3] Washington Administrative Code (*WAC) 480-100-393.*

Providing Our Customers Reliable Electric Service

Avista is focused on maintaining a high degree of reliability as an important aspect of the quality of our service, particularly as our society becomes ever more reliant upon electronic technologies. The Company's objective has been to generally uphold our current level of reliability, which we believe has been acceptable to our customers. Providing a level of system reliability that is adequate for our customers represents a complex balance of customer expectations, cost, and performance. Because it is expensive to achieve every new increment of system reliability, and because these investments must be sustained over a period of many years before the benefit is realized, it is important to ensure that we are investing only the amount of money it takes to achieve an acceptable level of performance. Avista believes the current reliability performance of our system effectively achieves this balance, and because of this, it represents a cost-effective value for our customers. This assessment is evidenced by our high level of customer satisfaction with their overall service from Avista (which includes aspects such as electric reliability), our customers' satisfaction with their power quality and reliability,[4] by the low number of complaints we receive each year that are related to reliability issues, by our performance being in a reasonable range for the electric utility industry, and our results generally aligning with results for Avista in the Commission's Reliability Benchmarking Study.

Purpose of this Report

This report describes results of the Company's annual monitoring of several key reliability indices (or metrics, or measures). Primary indices are industry standard measures developed by the Institute of Electrical and Electronics Engineers (IEEE), and which are important in promoting standardized and comparable reporting across the utility industry. In addition to these IEEE indices the Company also monitors and uses in its analyses several other reliability measures, all of which are briefly described below.

- ✓ **System Average Interruption Frequency Index** – often referred to by its acronym "SAIFI," is the average number of sustained interruptions (or outages) per customer for the year. This <u>index value</u>, developed by the IEEE, is calculated by dividing the total number of outages on the system each year by the average total number of customers on the system for that year. Dividing the value by the total number of customers "normalizes" the number of outages for comparison with other utilities.
- ✓ **System Average Interruption Duration Index** – often referred to by its acronym "SAIDI," is the average duration (or length) of sustained interruptions per customer

[4] As measured in the annual customer satisfaction survey conducted by J.D. Power.

for the year. This index value, developed by the IEEE, is calculated by dividing the total number of customer outage hours (number of customers experiencing an outage multiplied by the duration of the outage) experienced on the system for the year by the average total number of customers on the system for that year. Dividing the value by the total number of customers "normalizes" the number of outages for comparison with other utilities.

- ✓ **Customer Average Interruption Duration index** – often referred to by its acronym "CAIDI," is the average duration of sustained interruptions for those customers who actually experienced a service outage that year. This index value, developed by the IEEE, is calculated by dividing the total number of customer outage hours experienced on the system for the year by the total number of customers who experienced an outage that year. Since this measure reflects the duration of outages for customers experiencing those outages, it is often used to represent the utility's average outage restoration time.

- ✓ **Average Outage Duration** – this measure is used by Avista to describe the average duration of outages on the system. Since this average number of hours per outage is not divided by any number of customers or any other value, it is not an index value.
- ✓ **Average Number of Customers per Outage Event** – this measure is used by Avista to describe the average number of customers that were impacted by all of the outages on the system for the year. This value is calculated by adding all of the customers impacted by outage events for the year, divided by the number of outage events for the year. Since this average number of customers is not divided by any other value it is not an index value. This measures the effectiveness of our efforts to minimize the impact of individual outage events on our customers.
- ✓ **Number of Outage Events** – this measure is simply the number of outage events on our system each year that result in a sustained outage for our customers. Since the number of outage events is not divided by any other number it is not an index value.
- ✓ **Total Customer Outage Hours** – this measure is simply the total number of customer outage hours that were experienced by the customers on our system for the year. For each event, the number of customers experiencing the sustained outage is multiplied by the duration of the outage to yield the customer outage hours for each event. Summing all of the individual event's customer outage hours over a year yields the total customer outage hours. Since this total number of customer hours is not divided by any other number it is not an index value.

In addition to these primary reliability metrics, Avista also tracks the following measures:

- ✓ **Momentary Average Interruption Frequency Index** – often referred to by its acronym "MAIFI" is the average number of momentary interruptions (outages) per customer for the year. It is calculated the same way as SAIFI but uses the number of momentary outages instead of the number of sustained outages.
- ✓ **Customer Experiencing Multiple Interruptions** – often referred to by its acronym "CEMI" is the number of customers who experience greater than an identified or set number of interruptions for the year.

The standard reliability statistics and the methods of their calculation are discussed in Appendix B of this report.

The Company is also required to report on any changes it has made in the prior year in the manner of collecting reliability data or in calculating values for each reliability index. A brief record of such changes the Company has made historically is provided in Appendix C of this report. As part of this reporting, Avista must also compare its annual reliability performance to a set of baseline reliability statistics, which were established in 2005.[5] The Company's performance for each year since 2005 is presented in each annual report. All of the data included in this report is based on "system data," and represents our entire electric service territory in Washington and Idaho.

Results for Avista's Electric System Reliability in 2018

System Results

Results for several of these reliability measures for 2018 are provided in the table below. In addition to the current-year results we have also listed the prior year result, the five-year average for each measure, and the 2005 baseline value. In the future, Avista plans on having a Strategic Reliability Plan that outlines our intended actions.

*Table 1. Avista Reliability Results for Key Measures in 2018.**

Reliability Measure	2017 Result	2018 Results	Previous 5-Year Average (2013-2017)	5-Year Average (2014-2018)	2005 Baseline*
System Average Interruption Frequency Index (SAIFI)	1.20	0.81	1.05	1.01	0.97
System Average Interruption Duration Index (SAIDI - Minutes)	183	126	151	149	108
Customer Average Interruption Duration Index (CAIDI - Hours)	153	145	144	149	112

[5] WAC 480-100-393(3)(b).

*Excludes outage results for qualifying major event days.

Major Event Days

Avista tracks and reports reliability issues associated with major events,[6] and in the table, below, lists the major event days on its system in 2018.

Table 2. Major Events[7] and Major Event Days[8] Experienced on Avista's Electric System in 2018.

Major Event Day(s)	SAIDI (hours)	Event Cause
2018 Major Event Day Threshold	10.47	
January 24, 2018	12.08	Weather – Snow and Ice
November 24, 2018	13.30	Weather – Snow and Ice

Avista reported one major event day on its system in 2017, and a record of our major event days is provided in Appendix E of this report.

[6] Major Events and Major Event Days (MED) as used in this report are defined by the IEEE Guide for Electric Power Distribution Reliability Indices, IEEE P1366-2012. Avista's definition and use of the terms 'major events,' 'major event days' are taken from this IEEE Guide. The Company will use the process defined in IEEE P1366 to calculate the threshold value of T_{MED} and to determine MED's. All indices will be reported both including and excluding MED's. The comparisons of service reliability to the baseline statistics in subsequent years will be made using the indices calculated without MED's.

[7] Major Event – Designates an event that exceeds reasonable design and or operation limits of the electric power system. A Major Event includes at least one MED.

[8] Major Event Day – A day in which the daily system SAIDI exceeds a threshold value, T_{MED}. For the purposes of calculating daily system SAIDI, any interruption that spans multiple calendar days is accrued to the day on which the interruption began. Statistically, days having a daily system SAIDI greater than T_{MED} are days on which the energy delivery system experienced stresses beyond what is normally expected (such as severe weather). Activities that occur on major event days should be separately analyzed and reported.

System Average Interruption Frequency Index (SAIFI)

Historic Performance – The figure below shows the system average interruption frequency index on the Company's system for the seven-year period 2012 – 2018, including the linear trend.[9] Overall, the trend in average interruption frequency is improving somewhat even with the significant deviation upward in 2017. The number of outages for 2017 was well above the prior-year result and was in the highest quartile of results measured on the Company's system since 2005. By contrast, the number of outages on our system in 2016 was the lowest number recorded since we began reporting results in 2005. These "swings" in performance results clearly make the point that randomly-varying factors beyond the control of the Company are the predominant drivers of our annual service reliability.

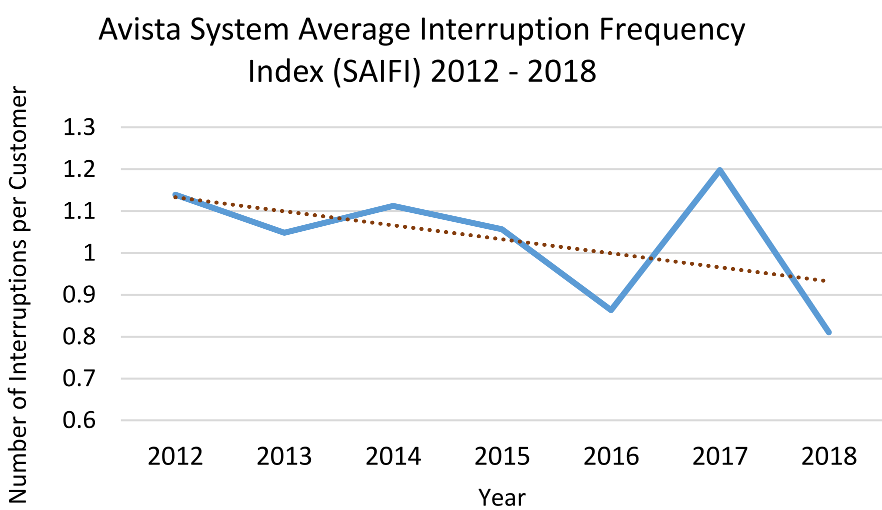

Figure 1. System Average Interruption Frequency Index (SAIFI) on Avista's Electric System 2012 – 2018

[9] Excluding outages associated with Major Event Days.

System Average Interruption Duration Index (SAIDI)

Historic Performance – The figure below shows the system average interruption duration index on the Company's electric system for the seven-year period from 2012 – 2018, including the linear trend.[10] The average duration of outages for all customers in 2017 was well above the prior-year result, and was the second-highest value measured on the Company's system since 2005. While the average duration for all customers in 2018 was well below the prior year value, and the lowest in this seven-year period, the linear trend is still increasing slightly, reflecting a slight trend in reduction in reliability performance, as measured at the system level.

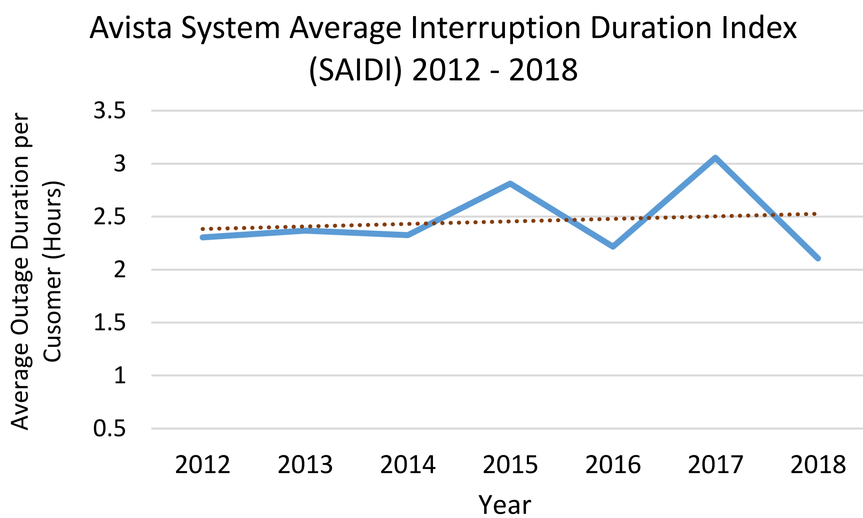

Figure 2. System Average Interruption Duration Index (SAIDI) on Avista's Electric System 2012 – 2018

[10] Excluding Major Event Days.

Customer Average Interruption Duration Index (CAIDI)

Historic Performance – The figure below shows the customer average outage restoration time on the Company's system for the seven-year period from 2012 – 2018, including the linear trend.[11] Like SAIDI, the overall trend reflects an increase in the system average restoration time, or deterioration in reliability performance.

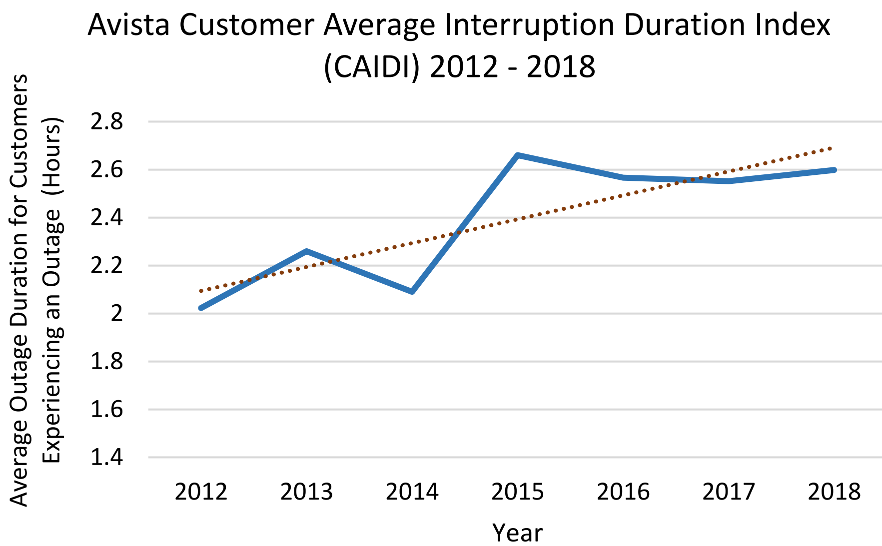

Figure 3. Customer Average Interruption Duration Index (CAIDI) on Avista's Electric System 2012 – 2018

The average restoration time for 2018 was slightly higher than the preceding two years and was the second highest value recorded since 2005. This increasing value for customer restoration time generally corresponds with the increasing value for our overall system outage duration (SAIDI) briefly mentioned above.

[11] Excluding Major Event Days.

Average Outage Duration

Results for 2018 –The figure below shows the average outage duration on Avista's system for the seven-year period 2012 – 2018, including the linear trend.[12]

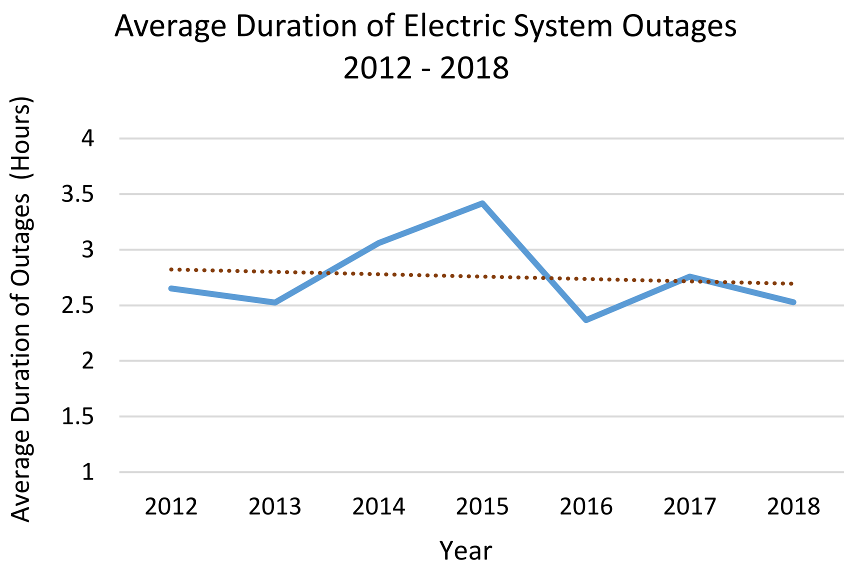

Figure 4. Average Outage Duration on Avista's Electric System 2012 – 2018

The trend reflects a modest decrease in the annual average duration of outage events on our system, and at first glance, appears to conflict with the trends for system outage duration and customer average restoration time, previously discussed. This measure differs from those in that it measures only the average of outage duration times and does not include the total number of customers or number of customers associated with the outages, and therefore is not an index value.

[12] Excluding Major Event Days.

Average Number of Affected Customers per Outage Event

Results for 2018 –The figure below shows the average number of affected customers per outage event on Avista's electric system for the seven-year period 2012 – 2018, including the linear trend.[13] The trend shows a marked decrease in the average number of customers affected per outage event on our system. This reduction is the result of the Company's efforts to improve fuse coordination on feeders and laterals, install midline reclosers on feeders of all types, and implement feeder automation and communications with Fault Detection Isolation and Restoration (FDIR) and other Distribution Management System capabilities.

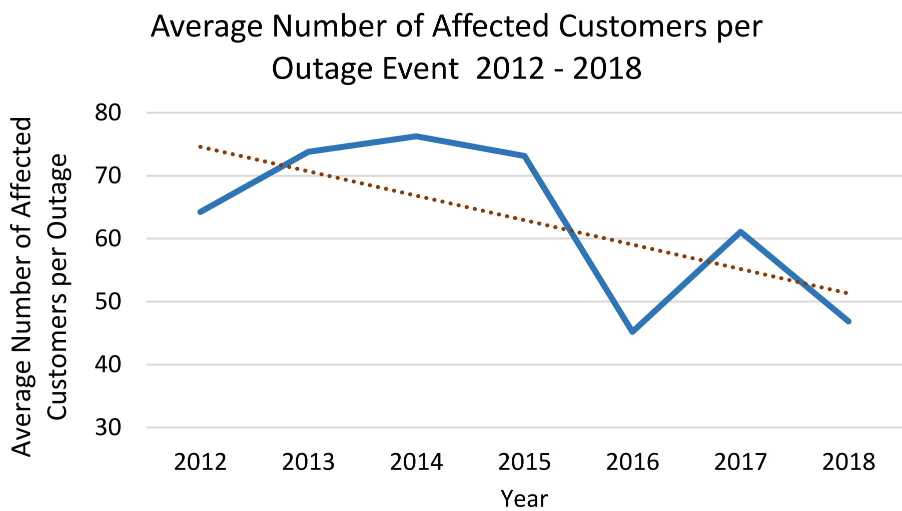

Figure 5. Average Number of Customers Affected per Outage Event on Avista's Electric System 2012 - 2018

[13] Excluding Major Event Days.

Number of Outage Events

Results for 2018 –The figure below shows the number of outage events on Avista's system for the seven-year period 2012 – 2018, including the linear trend.[14] Even though the result for 2018 was the first decline in recent years for this period, the linear trend is a consistent and modest increase in the annual number of outage events occurring on our electric system.

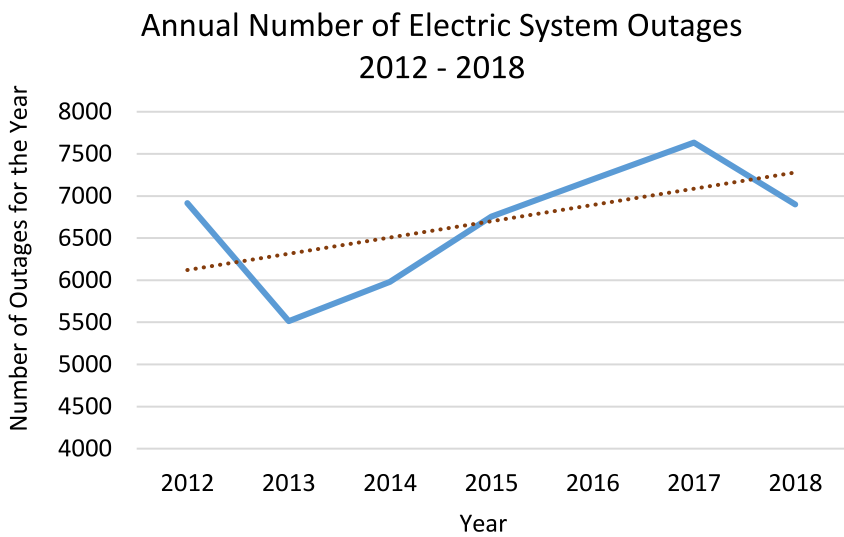

Figure 6. Number of Outage Events on Avista's Electric System 2012 - 2018

[14] Excluding Major Event Days.

Customer Outage Hours

Results for 2018 – The figure below shows the number of outage hours on Avista's system for the seven-year period 2012 – 2018, including the linear trend.[15] Even though the result for 2018 was the lowest value for this period, the linear trend shows a slight overall increase in total customer outage hours.

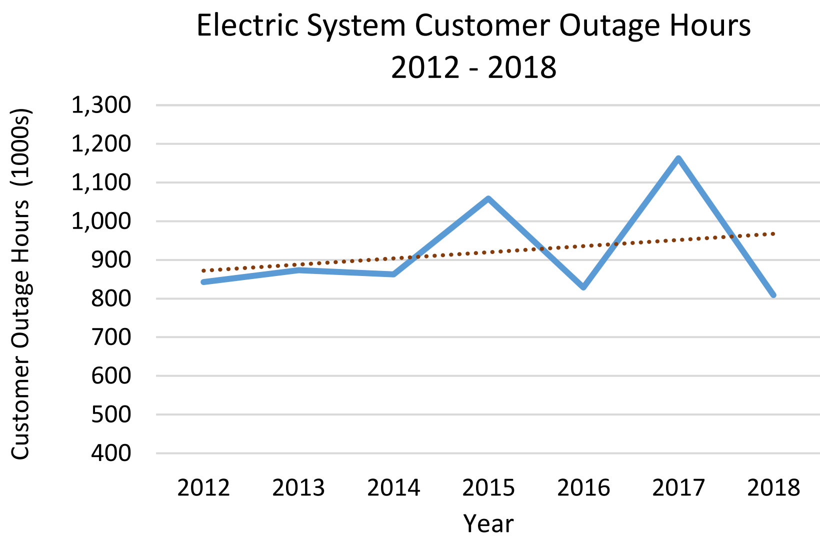

Figure 7. Total Customer Outage Hours on Avista's Electric System 2012 - 2018

The formulas for calculation of the number of outages (SAIDI) and outage restoration time (CAIDI) share the same numerator, which is the number of customer outage hours. The similarity in the trends for both of these indices reflect the underlying increase in the number of customer outage hours. Two factors affect the customer outage hours, the number of outages and the duration of these outages. Both of these factors are discussed briefly in the sections below.

[15] Excluding Major Event Days.

Analysis of System Reliability Measures by Feeder Classification

Classification of Feeders by Customer Density

Results for 2018 – In further evaluating the reliability measures discussed above, Avista compared the statistics for feeders based on the classification of "urban," "suburban" and "rural," as shown in the table below.[16]

Table 3. High Level Comparison of Avista's Urban, Suburban and Rural Feeders and Contribution to Outage Events and Customer Outage Hours. [17]

Feeder Classification	Percentage of Total Customers	Total Power Consumption (%)	Contribution to Customer Outage Hours (%)	Contribution to Number of Outage Events (%)
Urban	12.0	7.4	3.0	6.0
Suburban	52.0	47.6	24.0	37.0
Rural	36.0	44.9	73.0	57.0

In this comparison, we see that suburban customers dominate by number, but that rural customers stand out from those served on urban and suburban feeders in some important ways:

- ✓ Consumption of electricity on a per customer basis is highest on rural feeders.
- ✓ Customer outage hours on rural feeders accounts for nearly three quarters of the system total.
- ✓ The number of outage events on rural feeders is disproportionately greater than for urban and suburban feeders.

In the sections above, we present several reliability statistics measured at the system level, which are now reported by feeder classification in the discussion below.

[16] Avista's classification of feeder is based on customer density per feeder mile: Urban – > 150 customers per mile; Suburban – 50 to 150 customers per mile, and Rural – < 50 customers per mile.

[17] Results for this table are based on number of customers and electricity consumption in 2017, and their contribution to customer outage hours and number of outage events for the prior seven-year period.

System Average Outage Frequency Index (SAIFI) by Feeder Type

The system-level trend for this reliability measure, as shown above in Figure 1, reflects a modest improvement in reliability performance over the seven-year period. The figure below shows the strongest improving trend for rural feeders, followed by a similar trend for suburban feeders, and generally stable performance for urban feeders.

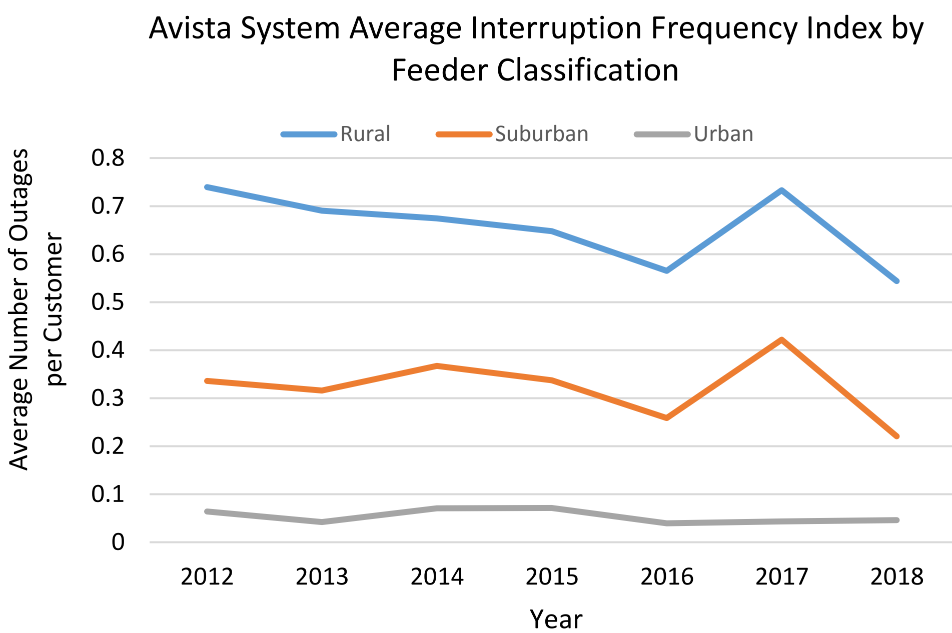

Figure 8. System Average Outage Frequency Index (SAIFI) by Feeder Classification, 2012 - 2018

System Average Outage Duration Index (SAIDI) by Feeder Type

The system-level trend for this reliability measure, as shown above in Figure 2, reflects a slight reduction in reliability performance over the seven-year period. The results by feeder type as shown in the figure below reveals that the overall system trend is being driven by results on Avista's rural feeders. Rural feeders reflect a substantial increasing trend in outage duration, while the trend for suburban feeders is improving slightly, and is generally stable for urban feeders. The disproportionate contribution of outage events on rural feeders, however, is driving the overall system performance.

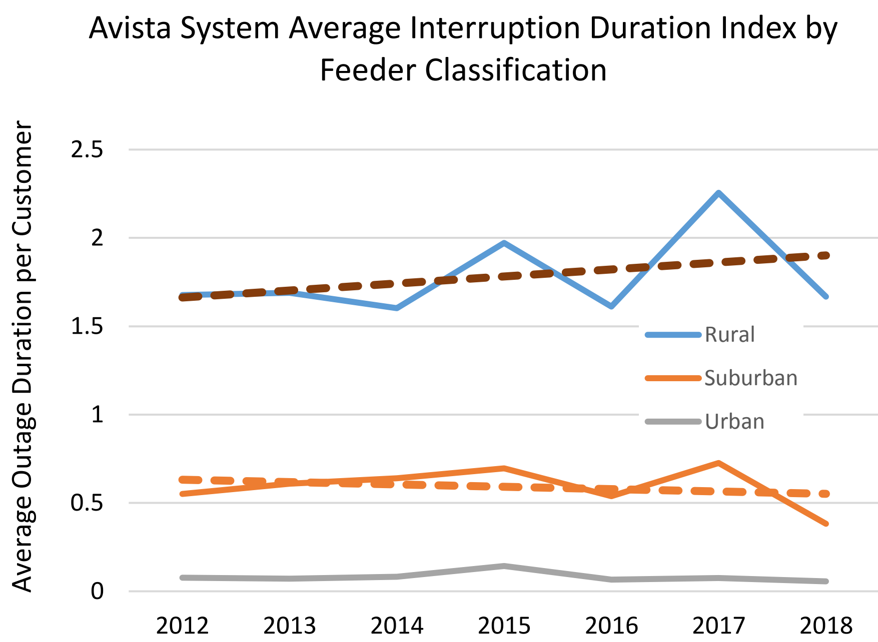

Figure 9. System Average Interruption Duration Index (SAIDI) by Feeder Classification, 2012 - 2018

Customer Average Interruption Duration Index (CAIDI) by Feeder Type

The system-level trend for this reliability measure, as shown above in Figure 3, reflects a fairly strong increase outage restoration time for our customers who experience an outage. These results, broken down by feeder type in the figure below, show a very slightly increasing trend for urban and suburban feeders, and a strongly-increasing trend for rural feeders. As with the results for system average outage duration, Figure 9, the disproportionate contribution of outage events on rural feeders is driving the overall system performance toward a modest deterioration in reliability performance.

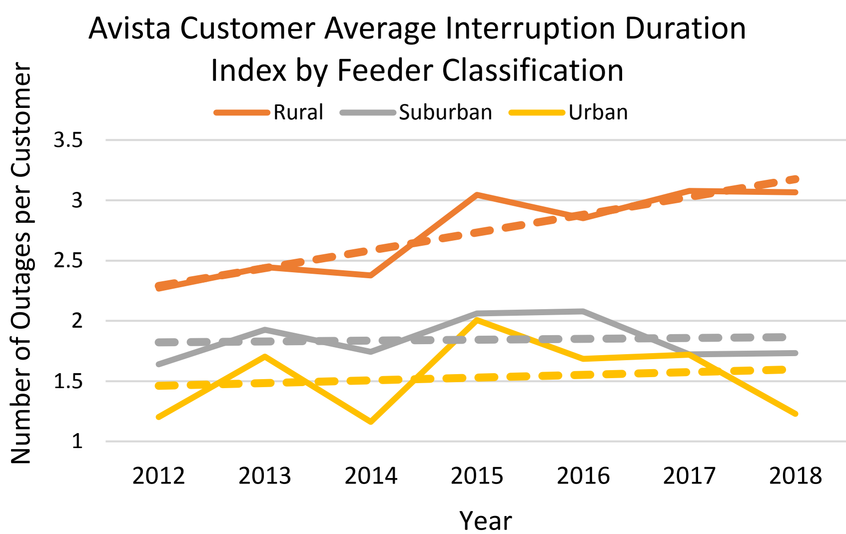

Figure 10. Customer Average Interruption Duration Index (CAIDI) by Feeder Classification, 2012 - 2018

Average Outage Duration Time by Feeder Type

While the system average annual outage duration is trending downward overall, the figure below shows that the system trend is being driven by results for our rural feeders. The average outage duration is trending upward for customers served on urban and suburban feeders as shown in the figure. The downward trend for rural feeders, however, as weighted by the greater number of outage hours associated with those feeders, is driving the overall system-level trend downward, as shown in Figure 4, above.

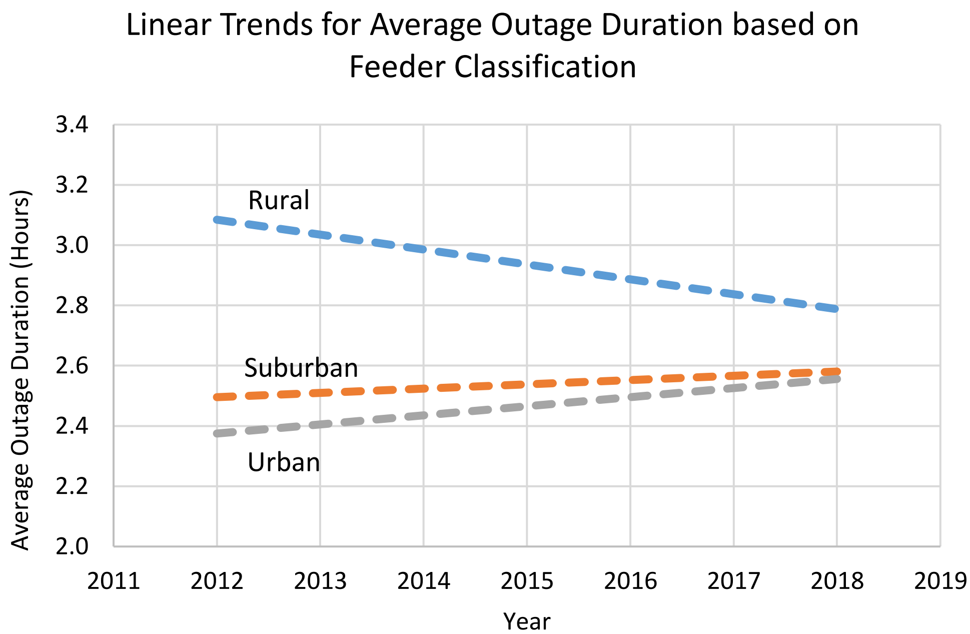

Figure 11. Linear Trend for Average Outage Duration by Feeder Classification on Avista's Electric System, 2012 - 2018

Average Number of Affected Customers per Outage Event by Feeder Type

The system average number of affected customers is trending downward overall, as shown in Figure 5, and the Figure 12 below shows that this trend is consistent for urban, suburban and rural feeds on the Company's system. This pattern, as noted above, reflects the Company's efforts to reduce the impact of sustained outage events on customers across its system.

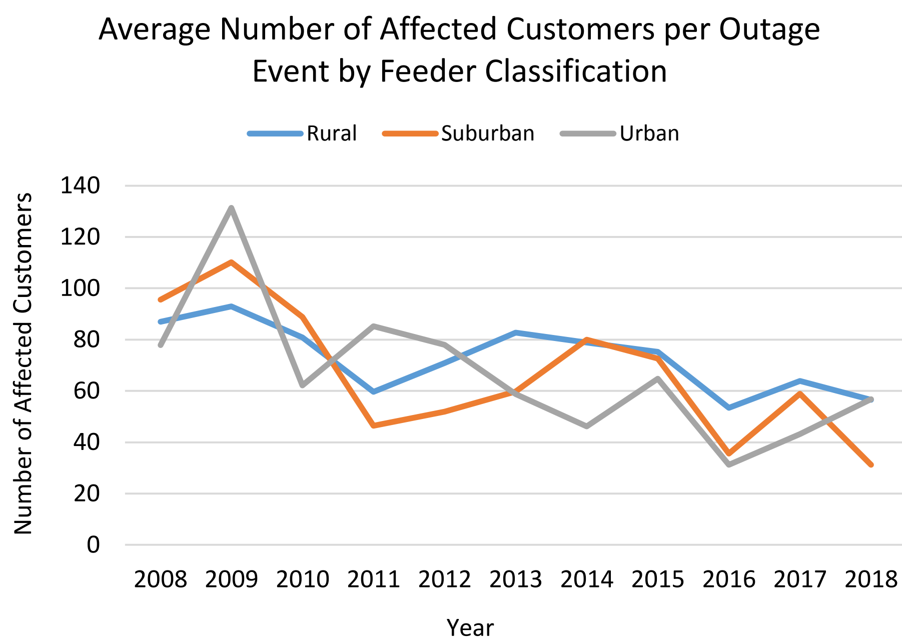

Figure 12. Average Number of Affected Customers per Outage Event by Feeder Classification, 2012 - 2018

Number of Outage Events by Feeder Type

In Figure 6, above, for number of outage events on the Company's electric system, the results showed a slight increase in the linear trend over the seven-year period. However, breaking down these events by feeder classification shows a pronounced disparity between feeder types. The number of outage events on our urban feeders is essentially flat over the period, while the upward trends for suburban and rural feeders is similar in slope. The results also show the much greater contribution of outage events associated with our rural feeders, which accounts for approximately half of all events.

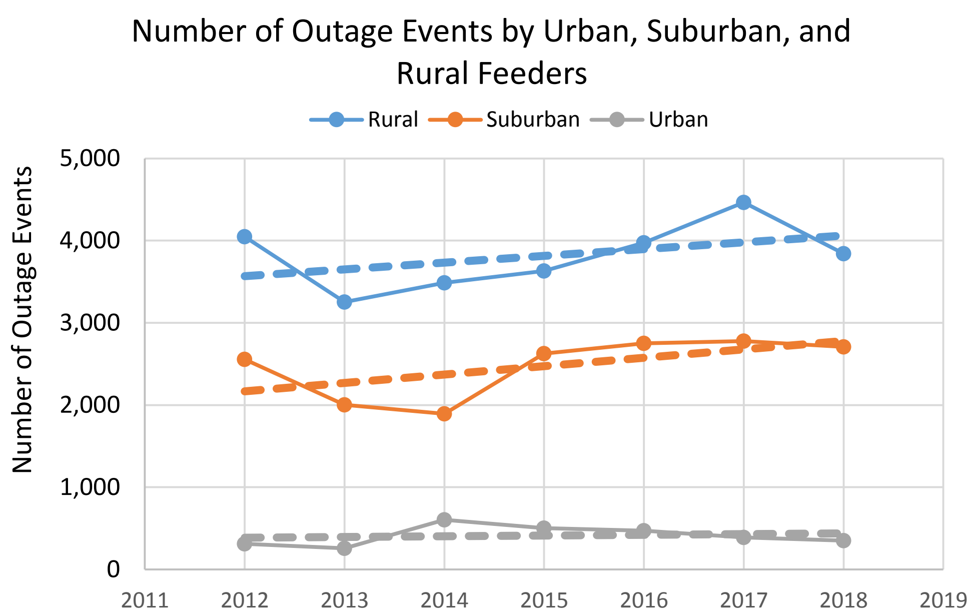

Figure 13. Number of Outage Events on Avista's Electric System by Feeder Classification, 2012 - 2018

Customer Outage Hours by Feeder Type

Figure 7, above, shows the total number of customer outage hours trending upward slightly on the Company's electric system over the seven-year period. However, breaking down the contribution of outage hours by feeder classification shows a substantial disparity between feeder types.

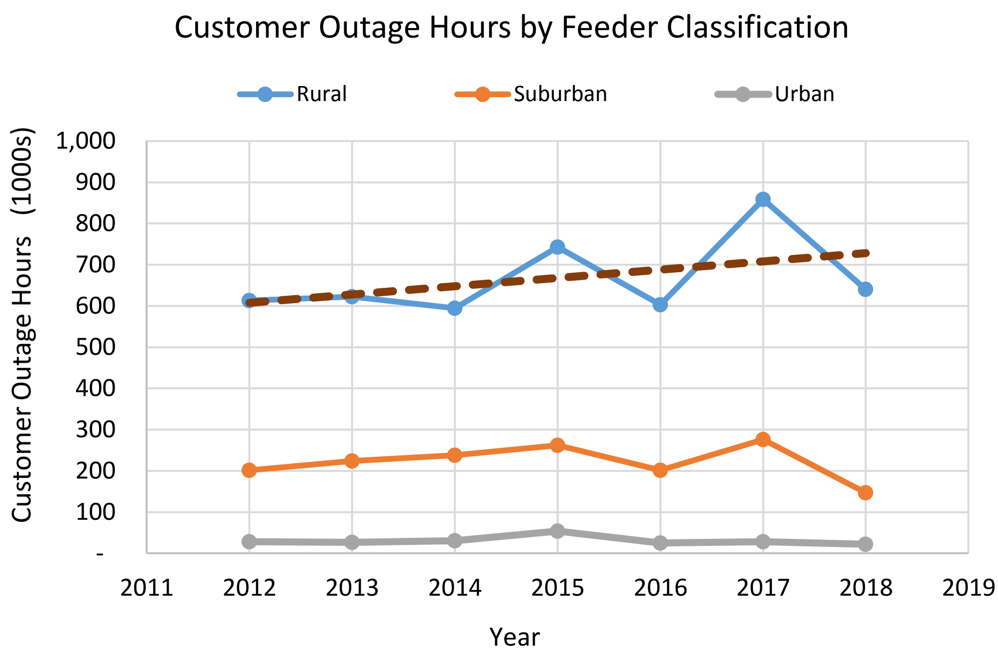

Figure 14. Customer Outage Hours on Avista's Electric System by Feeder Classification, 2012 - 2018

The number of outage hours on our urban feeders is essentially flat and the trend on suburban feeders is declining slightly. The trend for rural feeders, however, shows a moderate increase over the same period. The figure also reflects the magnitude of the contribution of outage hours for rural feeders, which accounted for almost three quarters of total outage hours in 2018. The results also show the growing difference between urban and suburban (as a group) and the rural feeders over time.

These differences in outage hours between feeder types, as well as the increasing trend in outage hours on rural feeders, reveal that service reliability performance on our rural system is ultimately driving the overall upward trend in system values for number of outages (SAIDI) and outage restoration time (CAIDI).

Overall Service Reliability by Feeder Type

Service Reliability on Urban Feeders

The Company's urban feeders serve approximately 12% of our electric customers and generally provide very high levels of service reliability, having only 3% of the total customer outage hours and 6% of total outage events. Of the seven key measures tracked in this report, five are stable or improving (green shading), and two are trending somewhat negatively (orange shading).

Table 4. Key Reliability Trends for Avista's Urban Feeders, 2012 - 2018

System Average Interruption Frequency Index (SAIFI)	Stable
System Average Interruption Duration Index (SAIDI)	Stable
Customer Average Interruption Duration Index (CAIDI)	Slight Increase
Average Duration of Outages (average outage time)	Moderate Increase
Average Number of Affected Customers per Outage	Decreasing
Number of Outage Events per Year	Stable
Total Customer Outage Hours	Stable

The one key measure that is trending negatively for urban feeders is the average duration of outages, which is moderately increasing in the current seven-year period. This trend is having a slight impact on the customer average interruption duration index (CAIDI), which is a measure of outage restoration time. At the same time, however, the average number of customers impacted per outage event has been steadily decreasing, with the net result that the overall number of customer outage hours has been stable over time.

Service Reliability on Suburban Feeders

The Company's suburban feeders serve approximately 52% of our electric customers and, like our urban feeders, generally provide very high levels of service reliability. Suburban feeders experience approximately 37% of total outage events, but account for only 24% of the total customer outage hours.

Table 5. Key Reliability Trends for Avista's Suburban Feeders, 2012 - 2018

System Average Interruption Frequency Index (SAIFI)	Moderate Decrease
System Average Interruption Duration Index (SAIDI)	Slight Decrease
Customer Average Interruption Duration Index (CAIDI)	Stable

Average Duration of Outages (average outage time)	Slight Increase
Average Number of Affected Customers per Outage	Decreasing
Number of Outage Events per Year	Slight Increase
Total Customer Outage Hours	Stable

Of the seven key measures in Table 5, five are stable or improving and two are trending slightly negatively. The average duration of outages on these feeders has increased slightly over the seven-year period, but that trend is having only a slight impact on the customer average interruption duration index (CAIDI), which trended nearly flat. While the number of outage events per year has continued to trend up slightly, the total customer outage hours are stable, because (like with urban and rural feeders) the average number of customers per outage has continued to trend downward.

Service Reliability on Rural Feeders

Avista's rural feeders serve approximately 36% of our electric customers, however, they experience 57% of the total outage events, and 73% of the total customer outage hours. Reliability performance on these rural feeders, *while very reliable for the conditions served*, is trending toward decline in four of the key areas discussed. And, the magnitude of the difference between urban and suburban feeders (as a group) and the rural feeders is driving Avista's system-level results for outage events, average outage duration, and customer average interruption frequency index (CAIDI), as discussed below.

Table 6. Key Reliability Trends for Avista's Urban Feeders, 2012 - 2018

System Average Interruption Frequency Index (SAIFI)	Decreasing
System Average Interruption Duration Index (SAIDI)	Increasing
Customer Average Interruption Duration Index (CAIDI)	Increasing
Average Duration of Outages (average outage time)	Decreasing
Average Number of Affected Customers per Outage	Decreasing
Number of Outage Events per Year	Increasing
Total Customer Outage Hours	Increasing

While three of the key measures for rural feeders are improving, four are trending toward reduced service reliability. These include system average interruption duration index (SAIDI), the customer average interruption duration index (CAIDI), the number of outage events experienced on the system each year, and the total number of customer outage hours. Though the average duration of outages is decreasing on our rural feeders, the system and customer average interruption duration indices are increasing due to the increasing number of outage events experienced on these feeders. Likewise, the total customer outage hours are trending upward because the increase in the number of outage events is outpacing the downward trending number of customers impacted per outage event.

Initial Evaluation of Rural Feeder Performance

Customer Outage Hours

Over the period 2012 – 2018, the Company's rural feeders have added an average of just over 20,000 customer outage hours each year to our system total (or 140,000 additional hours for the seven-year period). Table 7 shows the average rates of change for the top 12 factors, the net of which has contributed to this annual average increase in customer outage hours.

Table 7. Average Annual Change in Customer Outage Hours by Reason and Sub-Reason for Avista's Rural Feeders, 2012 - 2018

Outage Cause Category	Average Annual Rate of Change (Hours/Year)
Company Maintenance / Upgrade	9,281
Public Caused	6,295
Tree Caused	5,982
Undetermined Cause	5,135
Pole Fire	2,048
Animal Caused	635
Underground Equipment Failure	478
Miscellaneous Caused	163
Company Operations	126
Overhead Equipment Failure	-398
Substation Equipment Failure	-1,091
Weather Caused	-8,581

The reasonably good news from this assessment is that the leading cause of increased outage events and customer outage hours is Avista's own work to improve the condition of these feeders. In this same vein, investments made in the system are having the effect of slightly reducing the customer outage hours associated with overhead and substation equipment failures. Fortuitously, customer outage hours associated with weather caused outage events were also reduced by a significant measure, likely due in some part to the maintenance / upgrade work being performed by the Company on its rural feeders.

Beyond Company maintenance / upgrade activities, other leading causes of the increase in total customer outage hours included public caused, such as "car hit pole" incidents, tree caused outages, outages of undetermined cause, and pole fires. The top ten contributing reasons (and sub-reasons) to customer outage hours on our rural feeders are shown in Figure 15 below.

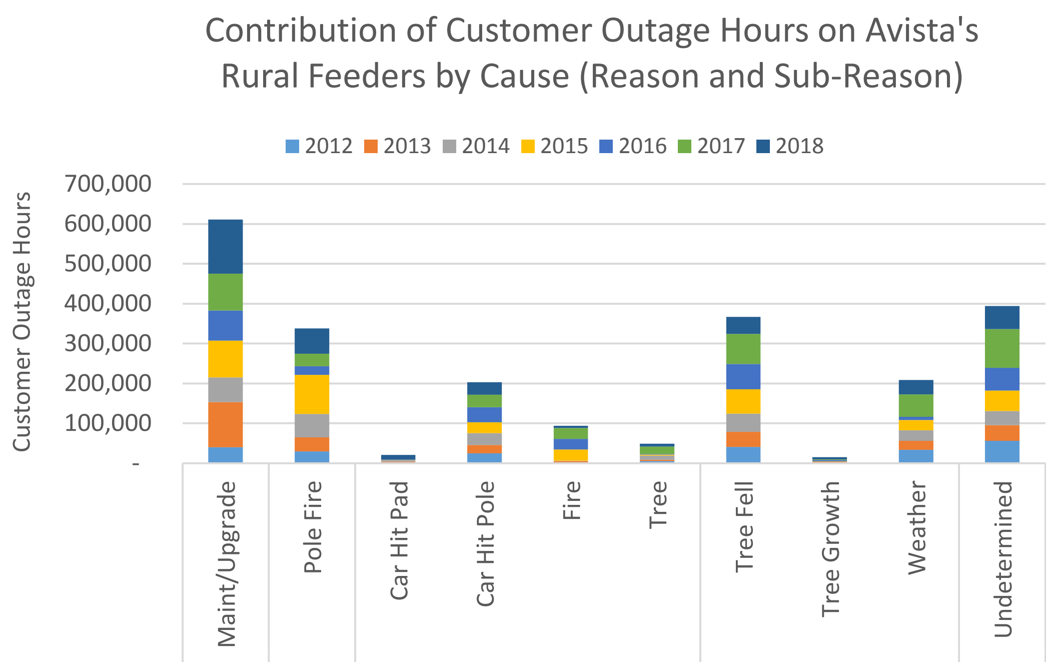

Figure 15. Contribution to Customer Outage Hours by Reason and Sub-Reason on Avista's Rural Feeders, 2012 – 2018

As with the rates of change discussion, above, the leading contributor or customer outage hours for the seven-year period is Avista's maintenance / upgrade activities, which contributed just over 600,000 outage hours. In order of contribution, outages of undetermined cause, tree fell, pole fire, weather, and car hit pole added between 200,000 and 400,000 customer outage hours over this period.

Worst Performing Feeders

For the purposes of this limited discussion, we identified the worst performing feeders on our system based on five of the reliability measures discussed above, plus the category of five year trend in outage events. The individual feeders are listed by the code abbreviations Avista uses as a naming convention for feeders in its system (e.g. STM633 refers to the feeder named St. Maries 633).

Table 8. Worst Performing Feeders by Reliability Measure[18]

System Average Interruption Frequency Index (SAIFI)	System Average Interruption Duration Index (SAIDI)	Customer Average Interruption Duration Index (CAIDI)	Total Customer Outage Hours	Annual Number of Outage Events	Five-Year Trend in Outage Events
STM633	STM633	STM633	STM633	3HT12F4	CLV34F1
CLV34F1	GIF34F1	GIF34F1	GIF34F1	ARD12F2	KET12F2
GIF34F1	CLV34F1	CLV34F1	CLV34F1	BLU321	SOT523
GRV1273	GRV1273	GRV1273	GRV1273	CHW12F3	DER651
SPI12F1	GIF34F2	GIF34F2	GIF34F2	CLV34F1	GRV1273
GIF34F2	ORI12F3	ORI12F3	ORI12F3	COB12F2	ORO1281
STM631	SPI12F1	SPI12F1	SPI12F1	DEP12F1	EFM12F1
BLU321	VAL12F1	VAL12F1	VAL12F1	F&C12F4	LIB12F3
ORI12F3	STM631	STM631	STM631	GIF34F1	SAG741
M15514	BLU321	BLU321	BLU321	GIF34F2	OLD721

The pattern immediately evident is the relative consistency of the individual feeders on the list for the first four measures (SAIFI, SAIDI, CAIDI, and Customer Outage Hours). Since the increase in outage events on rural feeders has been a key contributor to customer outage hours, we also listed the worst performing feeders for that reliability measure. Evaluating feeders by this measure resulted in the addition of six new feeders to list compared with the four prior measures. Sorting the rural feeders by the five-year trend in outage events introduces eight new feeders to the list (feeders that were not previously listed for any of the other reliability measures in the table).

In a similar analysis, Avista also ranked the performance of its rural feeders based on outage cause reason and sub-reason using the criteria in Figure 6, as well as outage trends on a per mile basis for each feeder. Each of these assessments produced a different listing of individual feeders – sometimes substantially so – which could be used to develop different target lists of feeders for investment, based on what objectives are trying to be achieved. A total of 69 feeders were identified as “top ten worst performing” based on the listing of reliability measures that were used to rank performance.

[18] The description of each feeder is provided in Appendix D

Looking specifically at the measure for customer outage hours, Avista calculated the cumulative outage hours (2012 – 2018) for the top ten worst feeders by outage reason and sub-reason, as shown in Figure 16 below.

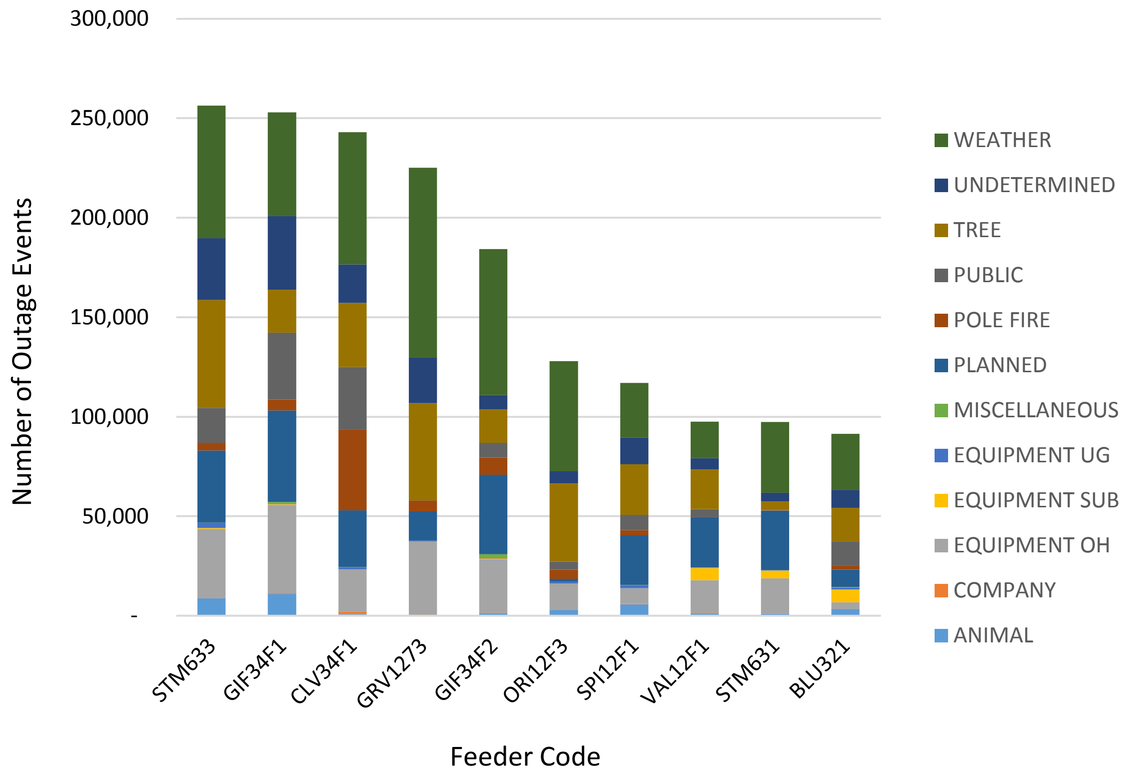

Figure 16. Cumulative Outage Events by Feeder and Reason, 2012 – 2018

Depending on the reliability objectives being pursued, and the reliability measure determined to be important, this type of analysis could be useful for identifying what types of measures could be implemented in order to improve targeted performance.

In a further analysis, the Company performed additional work to assess how reliability performance could be used to develop work plans for targeted rural feeders in the future. As an example, Table 9 below lists the top ten worst performing feeders based on the rate of change for ten outage causes (reasons and sub-reasons).

Table 9. Contributions by Percentage to Feeders Outage Events by Reason and Sub-Reason[19]

Feeder	ANIMAL	Avista	Overhead Equipment	Underground Equipment	Mainten / Upgrade	POLE FIRE	PUBLIC	TREE	Not Determined	WEATHER
CLV34F1	4.5%	0.0%	11.3%	2.6%	17.63%	1.7%	5.6%	10.2%	25.9%	20.4%
DER651	2.5%	0.8%	9.2%	0.0%	5.00%	3.3%	5.0%	21.7%	11.7%	40.0%
EFM12F1	22.0%	1.2%	7.9%	4.3%	21.34%	1.8%	8.5%	3.0%	6.1%	23.8%

[19] The description of each feeder is provided in Appendix D

Feeder	ANIMAL	Avista	Overhead Equipment	Underground Equipment	Mainten / Upgrade	POLE FIRE	PUBLIC	TREE	Not Determined	WEATHER
GRV1273	3.1%	0.8%	20.9%	3.1%	11.63%	1.6%	3.9%	16.3%	16.3%	22.5%
KET12F2	4.0%	0.8%	7.3%	2.8%	12.50%	0.8%	13.3%	8.5%	20.6%	28.6%
LIB12F3	6.8%	0.8%	9.0%	6.0%	21.05%	0.8%	8.3%	10.5%	9.8%	27.1%
OLD721	10.4%	0.7%	8.1%	3.7%	6.67%	0.0%	9.6%	12.6%	14.8%	33.3%
ORO1281	10.6%	0.0%	13.0%	2.4%	21.95%	4.1%	2.4%	17.1%	7.3%	21.1%
SAG741	2.4%	0.3%	3.7%	1.0%	14.24%	0.3%	6.8%	18.6%	3.1%	49.5%
SAG742	10.0%	0.0%	4.3%	4.3%	12.92%	0.0%	2.9%	8.1%	3.3%	54.1%
SOT523	16.9%	0.4%	8.7%	2.4%	38.19%	4.3%	6.3%	2.4%	15.0%	5.5%
Grand Total	**7.6%**	**0.4%**	**9.1%**	**2.8%**	**17.5%**	**1.6%**	**6.6%**	**10.9%**	**15.0%**	**28.2%**

For ease of review the rates of change are color coded to highlight what outage reasons and sub-reasons are of importance to the individual feeders. In the future, Avista expects to evaluate the need for investment in its electric distribution system, based first on the development of specific reliability objectives for feeders of different types, and on the predominant reasons and sub-reasons that are impacting the performance of individual feeders.

Appendices

Appendix A - Definitions

"Baseline reliability statistic" – Avista will compare its reliability statistics to the year 2005.

"Commission Complaint" – When a customer is not satisfied with the Company as it relates to Electric Reliability and files a complaint directly with the Commission.

"*Customer Complaint"* - When a customer is not satisfied with the Company as it relates to Electric Reliability and makes a complaint directly to a Company representative.

"Electric Service Reliability" - The continuity of electric service experienced by retail customers.

"*Electric System Reliability Reporting Requirements*" – The minimum reporting requirements are as follows:

> *(1) The report must be consistent with the electric service reliability monitoring and reporting plan filed under WAC 480-100-393. As set forth in the plan, in an identified year, baseline reliability statistics must be established and reported. In subsequent years, new reliability statistics must be compared to the baseline reliability statistics and to reliability statistics from all intervening years. The utility must maintain historical reliability information necessary to show trends for a minimum of seven years.*
>
> *(2) The report must address any changes that the utility may make in the collection of data and calculation of reliability information after initial baselines are set. The utility must explain why the changes occurred and explain how the change is expected to affect comparisons of the newer and older information. Additionally, to the extent practical, the utility must quantify the effect of such changes on the comparability of new reliability statistics to baseline reliability statistics.*
>
> *(3) The report must identify the utility's geographic areas of greatest reliability concern, explain their causes, and explain how the utility plans to address them.*
>
> *(4) The report must identify the total number of customer complaints about reliability and power quality made to the utility during the year, and must distinguish between complaints about sustained interruptions and power quality. The report must also identify complaints that were made about major events.*

"Full-system" - All equipment and lines necessary to serve retail customers whether for the purpose of generation, transmission, distribution or individual service.

"Interruption Cause Code" – Used to describe the cause of an interruption (i.e., animal, tree, public, etc…).

"Major Event" – Designates an event that exceeds reasonable design and or operation limits of the electric power system. A Major Event includes at least one Major Event Day (MED).

"Major Event Day" – A day in which the daily system SAIDI exceeds a threshold value, T_{MED}. For the purposes of calculating daily system SAIDI, any interruption that spans multiple calendar days is accrued to the day on which the interruption began. Statistically, days having a daily system SAIDI greater than T_{MED} are days on which the energy delivery system experienced stresses beyond that normally expected (such as severe weather). Activities that occur on major event days should be separately analyzed and reported.

"Momentary Event Interruption" – An interruption(s) of duration 5 minutes or less. Each event consists of one trip and one reclose operation that occur within 5 minutes. For example, if an interrupting device operates three times and then holds, this would be counted as three events with the number of customers affected as three times the Ni.

"Power Quality" – Characteristics of electricity, primarily voltage and frequency, that must meet certain specifications for safe, adequate and efficient operations.

"*Reliability Statistic"* – Standard Statistics measures and calculation methods are per the IEEE Standard 1366-2003 (or latest version) Titled "IEEE Guide for Electric Power Distribution Reliability Indices". Same as Reliability Indices.

"Sustained Interruption" - An interruption lasting longer than 5 minutes.

Appendix B - Index Calculations

SAIFI – System Average Interruption Frequency Index

- The average number of sustained interruptions per customer
- = The number of customers which had ***sustained interruptions*** / Total number of customers served
- $$= \frac{\sum N_i}{N_T}$$

$MAIFI_E$ – Momentary Average Interruption Event Frequency Index

- The average number of momentary interruption events per customer
- = The number of customers which had ***momentary interruption events*** / Total number of customers served
- $$= \frac{\sum ID_E N_i}{N_T}$$
- MAIFI can be calculated by one of two methods. Using the number of momentary interruptions or the number momentary events. This report calculates $MAIFI_E$ using momentary events. The event includes all momentary interruptions occurring within 5 minutes of the first interruption. For example, when an automatic interrupting device opens and then recloses two, or three times before it remains closed, it is considered a single event.

SAIDI – System Average Interruption Duration Index

- ✓ Average sustained outage time per customer
- = Outage duration multiplied by the customers effected for all ***sustained interruptions*** / Total number of customers served
- $$= \frac{\sum r_i N_i}{N_T}$$

CAIDI – Customer Average Interruption Duration Index

- Average restoration time
- = Outage duration multiplied by the customers effected for all ***sustained interruptions*** / The number of customers which had ***sustained interruptions***
- $$= \frac{\sum r_i N_i}{\sum N_i}$$

Quantities

i = An interruption event;

r_i = Restoration time for each interruption event;
T = Total;
ID_E = Number of interrupting device events;
N_i = Number of interrupted customers for each interruption event during the reporting period;
N_T = Total number of customers served for the area being indexed;

$CEMI_n$ – Customers Experiencing Multiple Sustained Interruptions more than n.

- $CEMI_n$
- = Total Number of Customers that experience more than *n* **sustained interruptions** / Total Number of Customers Served
- $= \frac{CN_{(k>n)}}{N_T}$

$CEMSMI_n$ – Customers experiencing multiple sustained interruption and momentary interruption events.

- CEMSMIn
- = Total Number of Customers experiencing more than *n* **interruptions** / Total Number of Customers Served
- $= \frac{CNT_{(k>n)}}{N_T}$

MED - Major Event Day
A major event day is a day in which the daily system SAIDI exceeds a threshold value. Its purpose is to allow major events to be studied separately from daily operation, and in the process, to better reveal trends in daily operation that would be hidden by the large statistical effect of major events.

T_{MED} is calculated (taken from the IEEE 1366-2003 Standard)
The major event day identification threshold value, T_{MED}, is calculated at the end of each reporting period (typically one year) for use during the next reporting period as follows:

a) Collect values of daily SAIDI for five sequential years ending on the last day of the last complete reporting period. If fewer than five years of historical data are available, use all available historical data until five years of historical data are available.
b) Only those days that have a SAIDI/Day value will be used to calculate the T_{MED} (do not include days that did not have any interruptions).
c) Take the natural logarithm (ln) of each daily SAIDI value in the data set.
d) Find a(Alpha), the average of the logarithms (also known as the log-average) of the data set.
e) Find b(Beta), the standard deviation of the logarithms (also known as the log-standard deviation) of the data set.
f) Compute the major event day threshold, TMED, using equation (25).

$$T_{MED} = e^{(\alpha + 2.5\,\beta)}$$

g) Any day with daily SAIDI greater than the threshold value TMED that occurs during the subsequent reporting period is classified as a major event day. Activities that occur on days classified as major event days should be separately analyzed and reported.

When an event has reached the threshold to constitute a MED described in subpart (f) above, all outage incidents associated with the MED will be flagged in the Company's Outage Management Tool. As the Company further assesses damage in the field while making repairs, new subsequent outage incidents that were a result of the MED may be created as more accurate information is made available. The subsequent incidents will be flagged and included as part of original outage event and MED.

Avista's Methodology for Calculating CEMI

The IEEE Standard 1366P-2003 provides for two methods to analyze data associated with customers experiencing multiple momentary interruptions and/or sustained interruptions. Avista's Outage Management Tool (OMT) and Geographical Information System (GIS) provide the ability to geospatially associate an outage to individual customer service points. This association allows for graphically showing Customers Experiencing Multiple sustained Interruptions ($CEMI_n$) with Major Event Day data included onto GIS produced areas. Data can be exported to MS Excel to also create graphs representing different values of n. The calculation for $CEMI_n$ and Customers Experiencing Multiple Sustained and Momentary Interruptions $CEMSMI_n$ is provided in Attachment B.

Avista has used the data from the OMT system integrated with the GIS system to geospatially display reliability data for specific conditions. The specific conditions imply looking at the number of sustained interruptions for each service point (meter point). This would be similar to the SAIFI index, but would be related to a certain number of sustained interruptions. Avista includes all sustained interruptions including those classified under Major Event Days. This provides a view of what each customer on a specific feeder experiences on an annual basis. Momentary Interruptions are not included in the $CEMI_n$ index because by IEEE definition only applies to sustained outages. Other Momentary Indices are not included because of the lack of indication at many rural substations and line locations.

Appendix C - Methods and Measures

WAC 480-100-398 (2) requires the Company to report changes made in data collection or calculation of reliability information after initial baselines are set. This section addresses changes that the Company has made to data collection.

Data Collection

Since Avista's Electric Service Reliability Monitoring and Reporting Plan was filed in 2001 (UE-011428), there have been several improvements in the methods used to collect outage data. In late 2001, centralizing the distribution trouble dispatch and data collection function for Avista's entire service territory began. The distribution dispatch office is located in the Spokane main complex. At the end of September 2005, 100% of the Company's feeders, accounting for 100% of the customers, are served from offices that employ central dispatching.

The data collected for 2016 represents the tenth full year of outage data collected through the Outage Management Tool (OMT). For 2016, all data was collected using the "Outage Management Tool" (OMT) based on the Company's Geographic Information System (GIS). The OMT system automates the logging of restoration times and customer counts.

Avista discovered a software coding error that has been within the OMT system since 2002 that caused a small increase in the SAIDI and CAIDI for 2008. Previous years were also evaluated to determine the overall impact to the Avista baseline statistics and at this time Avista is not proposing a change to the baseline numbers. The software error only occurred during very specific outage conditions when a group of customers with an initial outage starting time were "rolled" up into another group of customers that were determined to be part of the first group outage. The second group may have had a later outage starting time. When the first group of customer outage information was rolled up, the original outage starting time was lost and the second group outage starting time was used for both groups of customers instead of using the first outage starting time. The number of customers was counted correctly.

Even as good as the OMT system is at quantifying the number of customers and duration of the outage duration, there still are areas where the data collection is not precise. Determining the exact starting time of an outage is dependent on when a customer calls in, how well the Avista Distribution Dispatcher determines where the outage is and defines the device that has opened to remove the faulted section.

As AMR/AMI metering is implemented in the future and the customer meter provides outage information to the OMT system through an interface, the SAIDI and CAIDI numbers are expected to increase. This is similar to the above discussion.

Use of the OMT system and GIS data has improved the tracking of the numbers of customers without power, allowed for better prioritization of the restoration of service, and the improved dispatching of crews.

Appendix D - Areas of Greatest Concern

Please see Table 8, above, for the Company's current listing of worst performing feeders based on current service reliability results. Figure 15 and Table 9 also provide feeder specific information related to outage causes by reason and sub-reason, as well as total outage events. As Avista notes in the discussion above, because there are a number of approaches for determining "worst" performance, the designation of worst performing feeders should be informed by the reliability objectives the Company is intending to achieve. Avista is currently in the process of developing a new set of electric system reliability performance measures and strategic supporting plan. Accordingly, we anticipate that our report on 2019 service reliability performance will provide new information, analysis and recommendations on worst feeder performance based on these new objectives.

Feeder Details for Select Feeders

Feeder	Feeder Type	Substation Description	Sub ID	Feeder Identifies	City	State
3HT12F3	Urban	Third & Hatch 115kV	3HT	12F3	Spokane	WA
3HT12F4	Suburban	Third & Hatch 115kV	3HT	12F4	Spokane	WA
9CE12F1	Suburban	Ninth & Central 115kV	9CE	12F1	Spokane Valley	WA
9CE12F2	Suburban	Ninth & Central 115kV	9CE	12F2	Spokane Valley	WA
ARD12F1	Rural	Arden 115kV	ARD	12F1	Colville	WA
ARD12F2	Rural	Arden 115kV	ARD	12F2	Colville	WA
BEA12F5	Suburban	Beacon 230kV	BEA	12F5	Spokane	WA
BEA13T09	Rural	Beacon 230kV	BEA	13T09	Spokane	WA
BLU321	Rural	Blue Creek 115kV	BLU	321	Coeur d'Alene	ID
C&W12F1	Urban	College & Walnut 115kV	C&W	12F1	Spokane	WA
C&W12F2	Urban	College & Walnut 115kV	C&W	12F2	Spokane	WA
C&W12F4	Urban	College & Walnut 115kV	C&W	12F4	Spokane	WA
CFD1210	Suburban	Critchfield 115kV	CFD	1210	Clarkston	WA
CFD1211	Rural	Critchfield 115kV	CFD	1211	Clarkston	WA
CHW12F3	Rural	Chewelah 115kV	CHW	12F3	Chewelah	WA
CKF711	Rural	Clark Fork 115 kV	CKF	711	Clark Fork	ID
CLV12F2	Rural	Colville 115kV	CLV	12F2	Colville	WA
CLV34F1	Rural	Colville 115kV	CLV	34F1	Colville	WA
COB12F1	Rural	Colbert 115kV	COB	12F1	Colbert	WA
COB12F2	Rural	Colbert 115kV	COB	12F2	Colbert	WA
CRG1260	Suburban	Craigmont 115kV	CRG	1260	Craigmont	ID
DEP12F1	Rural	Deer Park 115kV	DEP	12F1	Deer Park	WA
DER651	Rural	Deary 115kV	DER	651	Deary	ID
DIA231	Rural	Diamond 115kV	DIA	231	Colfax	WA
ECL222	Suburban	East Colfax 115kV	ECL	222	Colfax	WA
EFM12F1	Rural	East Farms 115kV	EFM	12F1	Newman Lake	WA
F&C12F4	Suburban	Francis & Cedar 115kV	F&C	12F4	Spokane	WA
FWT12F2	Suburban	Ft Wright 115kV	FWT	12F2	Spokane	WA
GIF34F1	Rural	Gifford 115kV	GIF	34F1	Gifford	WA
GIF34F2	Rural	Gifford 115kV	GIF	34F2	Gifford	WA
GRV1273	Rural	Grangeville 115kV	GRV	1273	Grangeville	ID
HOL1205	Urban	Holbrook 115kV	HOL	1205	Lewiston	ID
KAM1291	Rural	Kamiah 115kV	KAM	1291	Kamiah	ID
KAM1293	Rural	Kamiah 115kV	KAM	1293	Kamiah	ID
KET12F2	Rural	Kettle Falls 115kV	KET	12F2	Kettle Falls	WA
L&S12F2	Urban	Lyons & Standard 115kV	L&S	12F2	Spokane	WA
LF34F1	Rural	Little Falls HED	LF	34F1	Reardan	WA

LIB12F3	Rural	Liberty Lake 115kV	LIB	12F3	Liberty Lake	WA
LMR1530	Suburban	Lewiston Mill Road 115kV	LMR	1530	Lewiston	ID
LOL1359	Suburban	Lolo 230kV	LOL	1359	Lewiston	ID
M15511	Suburban	Moscow City 115kV	M15	511	Moscow	ID
M15512	Suburban	Moscow City 115kV	M15	512	Moscow	ID
M15514	Suburban	Moscow City 115kV	M15	514	Moscow	ID
OGA611	Rural	O'Gara 115kV	OGA	611	St. Maries	ID
OLD721	Rural	Oldtown 115kV	OLD	721	Old Town	ID
ORI12F3	Rural	Orin 115kV	ORI	12F3	Colville	WA
ORO1281	Rural	Orofino 115kV	ORO	1281	Orofino	ID
ORO1282	Rural	Orofino 115kV	ORO	1282	Orofino	ID
OTH503	Rural	Othello 115kV	OTH	503	Othello	WA
OTH505	Rural	Othello 115kV	OTH	505	Othello	WA
PDL1201	Suburban	Pound Lane 115kV	PDL	1201	Clarkston	WA
POT321	Rural	Potlatch 115kV	POT	321	Potlatch	ID
ROS12F5	Urban	Ross Park 115kV	ROS	12F5	Spokane	WA
ROS12F6	Urban	Ross Park 115kV	ROS	12F6	Spokane	WA
SAG741	Rural	Sagle 115kV	SAG	741	Sagle	ID
SLW1348	Rural	South Lewiston 115kV	SLW	1348	Lewiston	ID
SOT523	Rural	South Othello 115kV	SOT	523	Othello	WA
SPI12F1	Rural	Spirit 115kV	SPI	12F1	Colville	WA
SPT4S30	Suburban	Sandpoint 115kV	SPT	4S30	Sandpoint	ID
STM631	Rural	St. Maries 115kV	STM	631	St. Maries	ID
STM633	Rural	St. Maries 115kV	STM	633	St. Maries	ID
SUN12F3	Suburban	Sunset 115kV	SUN	12F3	Spokane	WA
SWT2403	Rural	Sweetwater 115kV	SWT	2403	Culdesac	ID
TUR113	Urban	Turner 115kV	TUR	113	Pullman	WA
TUR116	Suburban	Turner 115kV	TUR	116	Pullman	WA
VAL12F1	Rural	Valley 115kV	VAL	12F1	Valley	WA
WEI1289	Rural	Weippe 115kV	WEI	1289	Weippe	ID
WOR471	Suburban	Worley 115 kV	WOR	471	Worley	ID
SAG742	Rural	Sagle 115kV	SAG	742	Sagle	ID

Appendix E - Historic Major Event Days on Avista's System

The following table is provided as an initial review of Major Event Day information. The main premise of the IEEE Major Event Day calculation is that using the 2.5b method should classify 2.3 days each year as MED's. The following table shows the previous major event days, the daily SAIDI value and the relationship of the yearly T_{MED}.

Year	Date	SAIDI	T_{MED}
2004	05-21-2004	7.11	6.35
	08-02-2004	7.36	
	12-08-2004	31.00	
2005	06-21-2005	39.53	4.916
	06-22-2005	9.03	
	08-12-2005	19.60	
2006	01-11-2006	12.10	7.058
	03-09-2006	8.58	
	11-13-2006	30.79	
	12-14-2006	29.26	
	12-15-2006	158.31	
2007	01-06-2007	9.98	8.017
	06-29-2007	32.64	
	07-13-2007	12.79	
	08-31-2007	21.30	
2008	01-27-2008	17.57	9.224
	07-10-2008	36.74	
	08-18-2008	9.49	
2009	None		9.925
2010	5/3/2010	21.04	11.110
	11/16/2010	68.67	
2011	None		10.848
2012	1/19/2012	9.93	9.489
	12/17/2012	14.35	
2013	8/25/2013	24.97	8.956
	8/26/2013	11.78	
	9/15/2013	14.01	
	11/16/2013	11.09	
2014	7/23/14	92.95	8.719
	7/24/14	35.66	
	8/25/14	121.05	
	8/3/14	38.52	
	8/12/14	9.84	
2015	8/29/15	13.42	8.219

	9/30/15	9.99	
	11/17/15	2093.19	
	11/18/15	399.34	
	11/19/15	147.97	
	11/20/15	66.96	
	11/21/15	47.30	
	11/22/15	32.61	
	11/23/15	15.38	
	11/24/15	12.19	
	12/23/15	29.35	
	12/24/15	19.24	
2016	None		10.171
2017			10.189
2018	1/24/18	12.08	10.47
	11/24/18	13.30	

Appendix F - Interruption Cause Codes

Cause code information is provided in this report to give readers a better understanding of outage sources. Further, the Company uses cause information to analyze past outages and, if possible, reduce the frequency and duration of future outages.

Since 2011, Avista has stopped using the subcategory "protected" under the "Animal" category. Almost all birds are considered protected, so there is little differentiation between the "Bird" and "Protected" subcategories. Avista will include additional information in the Remarks section as reported from the field personnel. .

MAIN CATEGORY	SUB CATEGORY	Definition
ANIMAL	Bird Squirrel Underground Other	Outages caused by animal contacts. Specific animal called out in sub category.
PUBLIC COMPANY	Car Hit Pad Car Hit Pole Dig In Fire Tree Other Dig in Other	Underground outage due to car, truck, construction equipment etc. contact with pad transformer, junction enclosure etc... Overhead outage due to car, truck, construction equipment etc. contact with pole, guy, neutral etc. Dig in by a customer, a customer's contractor, or another utility. Outages caused by or required for a house/structure or field/forest fire. Homeowner, tree service, logger etc. fells a tree into the line. Other public caused outages Dig in by company or contract crew. Other company caused outages
EQUIPMENT OH	Arrestors Capacitor Conductor - Pri Conductor - Sec Connector - Pri Connector - Sec Crossarm- rotten Cutout / Fuse Insulator Insulator Pin Other Pole - Rotten Recloser Regulator Switch / Disconnect	Outages caused by equipment failure. Specific equipment called out in sub category. Wildlife guard failed or caused an outage

	Transformer - OH Wildlife Guard	
EQUIPMENT UG	URD Cable - Pri URD Cable- Sec Connector - Sec Elbow Junctions Primary Splice Termination Transformer - UG Other	Outages caused by equipment failure. Specific equipment called out in sub category.
EQUIPMENT SUB	High side fuse Bus Insulator High side PCB High side Swt / Disc Lowside OCB/Recloser Low side Swt / Disc Relay Misoperation Regulator Transformer Other	
MISCELLANEOUS		For causes not specifically listed elsewhere
NOT OUR PROBLEM (*Outages in this category are not included in reported statistics*)	Customer Equipment Other Utility	Customer equipment causing an outage to their service. If a customer causes an outage to another customer this is covered under Public. Outages when another utility's facilities cause an outage on our system.
POLE FIRE		Used when water and contamination causes insulator leakage current and fire. If insulator is leaking due to material failure list under equipment failure. If cracked due to gunfire use customer caused other.

PLANNED TREE UNDETERMINED	Maintenance / Upgrade Forced Tree fell Tree growth Service Weather	Outage, normally prearranged, needed for normal construction work. Outage scheduled to repair outage damage. For outages when a tree falls into distribution primary/secondary or transmission during normal weather. Tree growth causes a tree to contact distribution primary/secondary or transmission during normal weather. For outages when a tree falls or grows into a service. When snow and wind storms causes a tree or branch to fall into, or contact the line. Includes snow loading and unloading. Use when the cause cannot be determined.
WEATHER	Snow / Ice Lightning Wind	Outages caused by snow or ice loading or unloading on a structure or conductor. Use weather tree for snow and ice loading on a tree. Lightning flashovers without equipment damage. Equipment failures reported under the equipment type. Outages when wind causes conductors to blow into each other, another structure, building etc.