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**Edward L. Reinhardt**  
*President*

June 27, 2011

PUBLIC UTILITIES  
COMMISSION

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The Honorable Chair and Members of the  
Hawaii Public Utilities Commission  
Kekuanaoa Building  
465 South King Street, First Floor  
Honolulu, Hawaii 96813

Dear Commissioners:

Subject: MECO Annual Service Reliability Report for 2010

Maui Electric Company, Limited respectfully submits a copy of its Annual Service Reliability Report for the year 2010.

Sincerely,

*Edward L. Reinhardt*

Attachment

c: Division of Consumer Advocacy (with Attachment)



MAUI ELECTRIC COMPANY, LIMITED

## **ANNUAL SERVICE RELIABILITY REPORT**

**2010**

Prepared By

Transmission and Distribution Department  
Operations Division

## **Introduction**

This is the 2010 service reliability report for Maui Electric Company, Limited (MECO). The average number of electric customers increased from 67,126 in 2009 to 67,405 in 2010 (an increase of 0.42%). The peak 2010 demand for the system was 203.8 MW (gross) that occurred on December 28, 2010. The peak 2010 demand was lower than the 2009 peak demand of 204.3 MW (gross) on October 21, 2009 (a decrease of -0.24%).

The system interruption summary for the past year and the system reliability indices for the five prior years are presented to depict the quality of service to the electrical energy consumer.

The definitions of terms, the explanation and equations of reliability indices are contained on Attachments B-1 through B-3.

The Average Service Availability Index (ASA), the System Average Interruption Frequency Index (SAIFI), the Customer Average Interruption Duration Index (CAIDI), and the System Average Interruption Duration Index (SAIDI) are indicators of service reliability. These indices measure reliability in terms of the overall availability of electrical service (ASA), the frequency or number of times MECO's customers experience an outage during the year (SAIFI), and the average length of time an interrupted customer is out of power (CAIDI). SAIDI is an indication of overall system reliability because it is the product of SAIFI and CAIDI and incorporates the impact of frequency and duration of outages on MECO's total customer base (in this case, 67,405 customers).

## **Analysis**

This analysis of the system reliability for MECO is for the year 2010. To determine the relative level of reliability, the statistics for five prior years, 2005 through 2009, are used for comparison.

The reliability indices are calculated using the data from all sustained<sup>1</sup> system outages, except customer maintenance outages. The data used for the 2005 reliability indices was not normalized due to the lack of system events that would qualify certain data to be normalized. The data used for calculating the reliability indices for 2006, 2007, 2008 and 2009 was normalized.

There were 764 outages in 2006. The data used for the 2006 reliability indices for MECO was normalized to exclude the following event:

- October 15 - Earthquake

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<sup>1</sup> An interruption of electrical service of 1 minute or longer.

There were 693 outages in 2007. The data used for the 2007 reliability indices for MECO was normalized to exclude the following events:

- January 29 – Kona Storm
- December 5 - Kona Storm

There were 707 outages in 2008. The data used for the 2008 reliability indices for MECO was normalized to exclude the following events:

- Storms on Maui, Molokai and Lanai
- Various equipment failures and faults

There were 880 outages in 2009. The data used for the 2009 reliability indices for MECO was normalized to exclude the following events:

- January 16 – High Winds
- June 19 – High Winds
- Various equipment failures and faults

The data used in calculating the reliability indices was normalized in accordance with the guidelines specified in the report on reliability that was prepared for the Public Utilities Commission, titled "Methodology for Determining Reliability Indices for HECO Utilities," dated December 1990. That report indicates that normalization is allowed for "abnormal" situations such as hurricanes, tsunamis, earthquakes, floods, catastrophic equipment failures, and a single outage that cascades into a loss of load that is greater than 10% of the system peak load. These normalizations are made in calculating the reliability indices, because good engineering design takes into account safety, reliability, utility industry standards, and economics, and cannot always plan for catastrophic events.

Graphs of the ASA (Figure 1), SAIFI (Figure 2), CAIDI (Figure 3), and SAIDI (Figure 4) for the six years are included.

## **2010 Normalized Results**

The 2010 service reliability results were normalized to exclude the effects of various catastrophic equipment failures and large storms on Maui, Molokai and Lanai. There were 868 outages in 2010 and 81 of these outages in 2010 were classified as "abnormal" situations (i.e. catastrophic equipment failures and major storms) that cascaded into a loss of load greater than 10% of the system peak load.

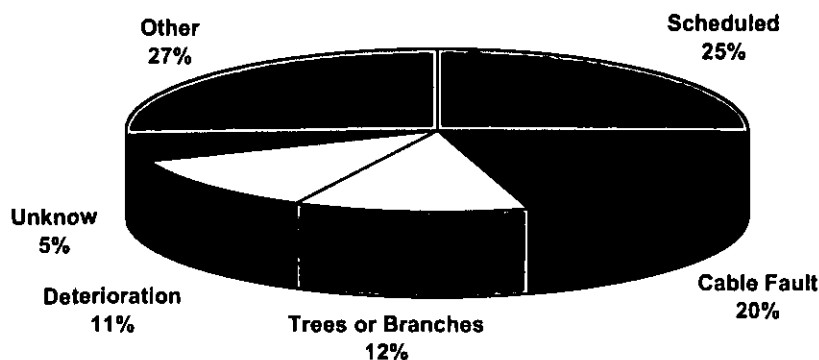
The data used for the 2010 reliability indices for MECO was normalized to exclude the following events:

- March 28, 29, 30 & 31 – High Winds
- April 1 & 4 – High Winds
- December 9 & 10 – Kona Storm
- Various equipment failures and faults

The 2010 service reliability results (normalized) indicate that MECO did make improvements in the ASA, SAIFI, CAIDI and SAIDI indices compared to 2009.

- The ASA index of 99.9898% is an increase from 2009 and is ranked the highest ASA index of the last six years. (Higher is better.)
- The SAIFI index of 1.001 is a decrease from 2009 and is ranked the lowest SAIFI index of the last six years. (Lower is better.)
- The CAIDI index of 53.35 minutes is a decrease from 2009 and is ranked the second lowest CAIDI index of the last six years. (Lower is better.)
- The 2009 SAIDI index of 53.41 minutes is a decrease from 2009 and is ranked the lowest SAIDI index of the last six years. (Lower is better.)

### **2010 Outage Causes**



Scheduled outages were the leading cause of outages in 2010, with 170 outages, which accounted for 25.22% of all outages. This was an increase of 9.68% from 2009. Outages caused by cable faults were the second leading cause of outages in 2010, with 136 outages and accounted for 20.18% of all outages. This was a decrease of 4.23% from 2009.

MECO experienced 24 load shed events in 2010. Maui experienced 8 load shed events, Molokai experienced 8 load shed events and Lanai experienced 8 load shed events in 2010.

### **Annual Service Reliability Indices**

The normalized results for 2010, the previous un-normalized indices for 2005 and the normalized indices for 2006, 2007, 2008 and 2009 are shown in the table "Annual Service Reliability Indices". Figures 1 through 4 contain the same data shown in graphical form as well as the 2009 outages listed by cause and associated reliability indices shown on Attachments A1 and A2, (normalized results).

**MECO**  
**Table of Annual Service Reliability Indices**

<b>SYSTEM TOTALS</b>	<b>2005</b>	<b>2006<sup>2</sup></b>	<b>2007<sup>2</sup></b>	<b>2008<sup>2</sup></b>	<b>2009<sup>2</sup></b>	<b>2010<sup>2</sup></b>
Number of Customers	63,103	64,405	65,728	66,810	67,126	67,405
Customer Hrs. Interrupted	126,010	235,186	186,022	114,001	173,602	60,006.6
Customer-Interruptions	162,827	249,485	170,299	75,764	108,368	67,481.0
ASA (Percent)	99.9772	99.9583	99.9692	99.9805	99.9705	99.9898
SAIFI (Occurrence)	2.580	3.874	2.593	1.134	1.614	1.001
CAIDI (Minutes)	46.43	56.56	62.52	90.28	96.12	53.35
SAIDI (Minutes)	119.81	219.10	162.13	102.38	155.17	53.41

**Figure 1**

**MECO AVERAGE SERVICE AVAILABILITY  
(ASA)**

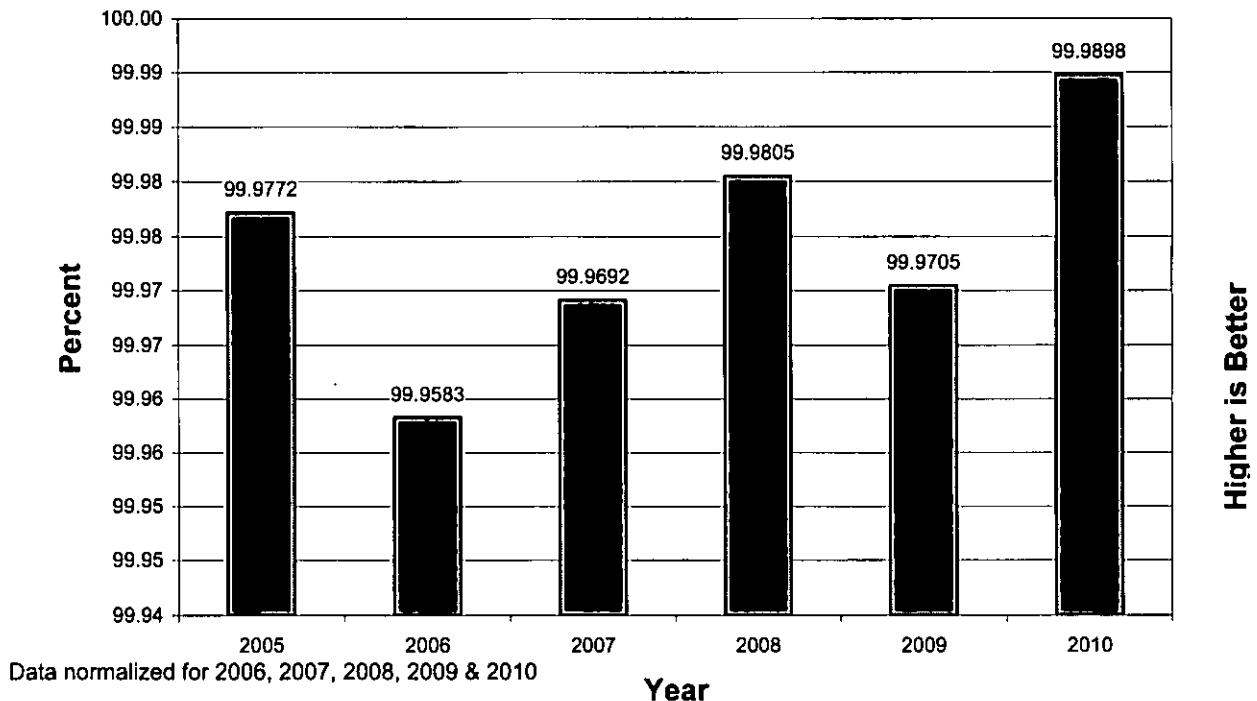


Figure 1 shows that the 2010 Average Service Availability (ASA) index has increased from the 2009 results of 99.9705% to 99.9898% during 2010. This was an increase of 0.0193% in the 2010 Average Service Availability compared to the previous year. The 2010 service reliability results (normalized) showed that MECO did make improvements in the SAIFI, CAIDI or SAIDI indices compared to 2009.

<sup>2</sup> Data normalized per guidelines specified in the report on reliability that was prepared for the Public Utilities Commission, titled "Methodology for Determining Reliability Indices for HECO Utilities," dated December 1990.

**Figure 2**

**MECO SYSTEM AVERAGE INTERRUPTION  
FREQUENCY  
(SAIFI)**

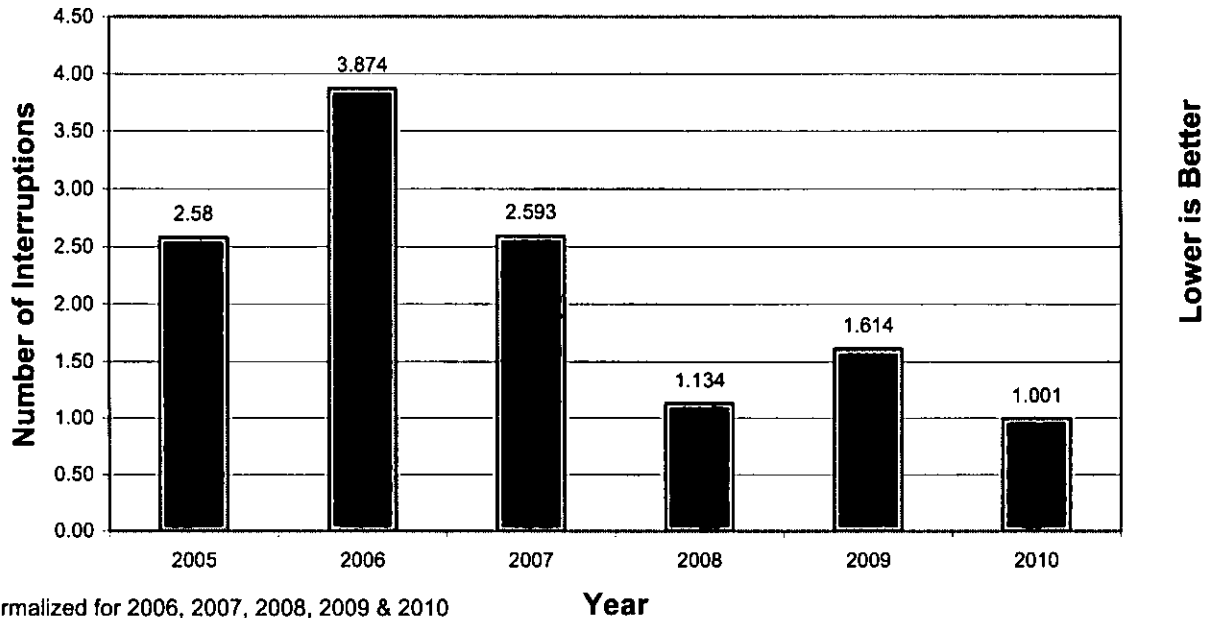


Figure 2 shows the System Average Interruption Frequency Index (SAIFI) for the past six years. It shows that in 2010, the recorded SAIFI index was 1.001 and it had decreased from 2009 by 37.98%.

A decrease in interruptions caused by cable faults, transformer overloads and trees or branches in lines contributed to a lower SAIFI for 2010.

**Figure 3**  
**MECO CUSTOMER AVERAGE INTERRUPTION**  
**DURATION**  
**(CAIDI)**

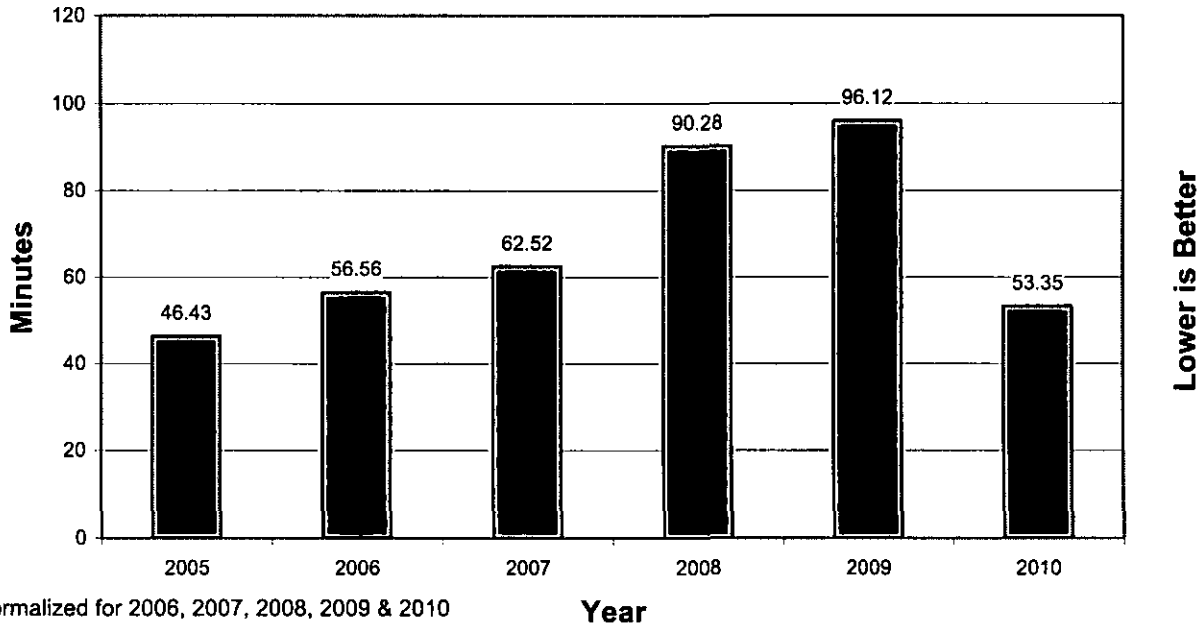


Figure 3 shows the Customer Average Interruption Duration index (CAIDI) for the past six years. The average electrical outage duration of 53.35 minutes per customer for 2010 is a decrease of 44.5% from the previous year.

The contributing factors to the decrease of the CAIDI index from 2009 were reductions of outage durations related to trees or branches in lines, cable faults and weather related outages (high wind, flooding and lightning). Outages due to trees or branches in lines decreased in 2010, which incurred 14,385.4 customer interruption hours, as compared to 38,834.8 customer interruption hours in 2009. Outages due to trees or branches in lines accounted for 24.0% of all customer interruption hours in 2010. Outages due to cable faults decreased in 2010, which incurred 5221.6 customer interruption hours, as compared to 10,164.3 customer interruption hours in 2009. Outages due to cable faults accounted for 8.7% of all customer interruption hours in 2010. Outages due to weather also decreased in 2010, which incurred 1,558.0 customer interruption hours, as compared to 31,364.4 customer interruption hours in 2009. Outages due to weather accounted for 2.6% of all customer interruption hours in 2010.



**Figure 4**

**MECO SYSTEM AVERAGE INTERRUPTION DURATION  
(SAIDI)**

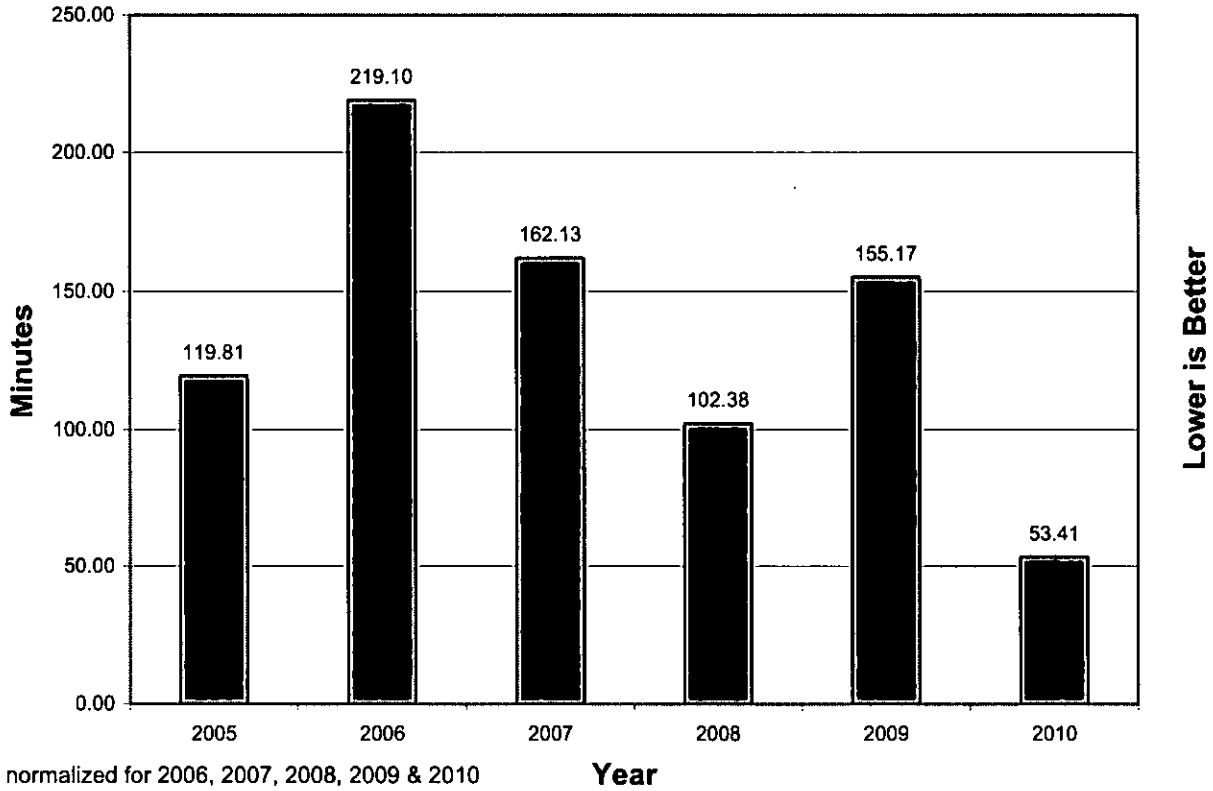


Figure 4 shows the System Average Interruption Duration Index (SAIDI) for the past six years. It shows that in 2010, the recorded SAIDI index was 53.41 and it had decreased from 2009 by 65.58%.

The SAIDI is the composite of both the SAIFI and CAIDI indices and produces a broader benchmark of system reliability by combining both the duration and the number of customer interruptions during a given period of time. The lower SAIDI result was due to a decrease in the SAIFI and CAIDI statistics as noted previously.

**Maui Electric Company System Interruption  
Service Reliability - System Total  
From: January 1, 2010 To: December 31, 2010**

<u>Cause</u>	<u>Cust-Hr</u>	<u>Cust-Int</u>	<u>SAIFI</u>	<u>SAIDI</u>	<u>CAIDI</u>	<u>SAIDI Rank</u>
17. Equipment failure	8112.8	26699.0	0.396	7.22	18.23	2
12. Flashover	7698.4	10078.0	0.150	6.85	45.83	3
07. Trees or branches in lines	14385.4	7867.0	0.117	12.81	109.71	1
13. Cable fault	5221.6	6064.0	0.090	4.65	51.66	5
04. Fire	6618.7	4615.0	0.068	5.89	86.05	4
02. Man or animals in lines or equipment	2979.6	2298.0	0.034	2.65	77.80	8
08. Deterioration, rot, corrosion, termites	3737.4	2290.0	0.034	3.33	97.92	6
25. Maintenance - scheduled	1403.0	1498.0	0.022	1.25	56.20	10
10. High wind	1270.7	1284.0	0.019	1.13	59.38	12
26. Maintenance - forced	747.0	989.0	0.015	0.66	45.32	13
29. Unknown failure	2106.3	975.0	0.014	1.87	129.62	9
01. Automobile Accident	3047.1	929.0	0.014	2.71	196.80	7
19. Faulty operation of equipment	142.7	571.0	0.008	0.13	15.00	18
14. Transformer failure other than overload	1309.4	411.0	0.006	1.17	191.15	11
20. Operator or switching error	128.2	203.0	0.003	0.11	37.88	19
30. Other company personnel error	177.0	199.0	0.003	0.16	53.38	16
16. Equipment overload	271.0	163.0	0.002	0.24	99.74	15
05. Contact by moving equipment	128.0	127.0	0.002	0.11	60.45	20
11. Loose connection	148.2	93.0	0.001	0.13	95.59	17
09. Lightning	287.3	79.0	0.001	0.26	218.20	14
06. Excavation and construction	23.8	16.0	0.000	0.02	89.13	22
03. Foreign objects in lines or equipment	34.3	12.0	0.000	0.03	171.67	21
15. Transformer overload	21.2	10.0	0.000	0.02	127.00	23
24. Nec. Int. to balance load or system conversion	5.0	5.0	0.000	0.00	60.00	24
23. Nec. Int. to transfer load (out of phase)	0.1	4.0	0.000	0.00	1.00	26
21. Failure of customer's electrical equipment	2.7	2.0	0.000	0.00	79.50	25
31. Mylar Balloon	0.0	0.0	0.000	0.00	0.00	30
27. System additions or removals	0.0	0.0	0.000	0.00	0.00	29
22. Tsunami, earthquake, or flooding	0.0	0.0	0.000	0.00	0.00	28
18. Vandalism	0.0	0.0	0.000	0.00	0.00	27
<b>Total</b>	60006.6	67481.0	1.001	53.41	53.35	

**Average System Availability Index (ASA) = 99.9898%**

**Number of Customers for the Period = 67405**

**SAIFI = System Average Interruption Frequency Index**

**SAIDI = System Average Interruption Duration Index (Minutes)**

**CAIDI = Customer Average Interruption Duration Index (Minutes)**

**The Outage Causes are Listed in Order of its SAIFI Index**

## Maui Electric Company System Interruption System Total

From: January 1, 2010 To: December 31, 2010

<u>Cause</u>	<u>Interruptions</u>		<u>Customer Hours</u>	
	<u>Number</u>	<u>% of Total</u>	<u>Hours</u>	<u>% of Total</u>
<u>Non-Connected System Emergency</u>	116	17.21%	27219.5	45.4%
Foreign	2	0.30%	34.3	0.1%
Contact by Moving	2	0.30%	128.0	0.2%
Excavation and Construction	2	0.30%	23.8	0.0%
Fire	10	1.48%	6618.7	11.0%
Auto	12	1.78%	3047.1	5.1%
Man or Animal in Lines or Equipment	4	0.59%	2979.6	5.0%
Trees or Branches	82	12.17%	14385.4	24.0%
Vandalism	0	0.00%	0.0	0.0%
Customer Equip. Failure	2	0.30%	2.7	0.0%
Mylar	0	0.00%	0.0	0.0%
<u>Error</u>	11	1.63%	305.2	0.5%
Operator or Switching	8	1.19%	128.2	0.2%
Other Company Personnel	3	0.45%	177.0	0.3%
<u>Weather</u>	32	4.75%	1558.0	2.6%
Lightning	14	2.08%	287.3	0.5%
High Wind	18	2.67%	1270.7	2.1%
Tsunami, Earthquake or Flooding	0	0.00%	0.0	0.0%
<u>Non-Transformer Equipment</u>	252	37.39%	25332.1	42.2%
Loose Connection	5	0.74%	148.2	0.2%
Flashover	12	1.78%	7698.4	12.8%
Equipment Failure	13	1.93%	8112.8	13.5%
Cable Fault	136	20.18%	5221.6	8.7%
Equipment Overload	8	1.19%	271.0	0.5%
Deterioration, Rot, Corrosion or Termites	77	11.42%	3737.4	6.2%
Faulty Operation of Equipment	1	0.15%	142.7	0.2%
<u>Transformer</u>	23	3.41%	1330.6	2.2%
Transformer	1	0.15%	21.2	0.0%
Transformer Failure Other Than Overload	22	3.26%	1309.4	2.2%
<u>Switching</u>	2	0.30%	5.1	0.0%
Necessary Inter. to Transfer Load (Out of Phase)	1	0.15%	0.1	0.0%
Necessary Inter. to Balance Load or Conversion	1	0.15%	5.0	0.0%
<u>Unknown After Tests and Inspections</u>	34	5.04%	2106.3	3.5%
<u>Maintenance</u>	204	30.27%	2150.0	3.6%
Scheduled	170	25.22%	1403.0	2.3%
Forced	34	5.04%	747.0	1.2%
<u>System Additions or Removals</u>	0	0.00%	0.0	0.0%
<u>TOTALS</u>	674		60006.6	

## **DEFINITION OF TERMS**

### **OUTAGE**

The state of a component when it is not available to perform its intended function due to some event directly associated with that component. An outage may or may not cause an interruption of service to consumers depending on system configuration.

### **INTERRUPTION**

The loss of service to one or more customers and is a result of one or more component outages.

### **INTERRUPTION DURATION**

The period from the initiation of an interruption to a customer until service has been restored to that customer.

### **MOMENTARY INTERRUPTION**

An interruption that has a duration limited to the period required to restore service by automatic or supervisory-controlled switching operations or by manual switching at locations where an operator is immediately available. Such switching operations must be completed in a specific time not to exceed one minute. Previous issues of this report indicated that a momentary interruption has a duration not to exceed five minutes. A December 1990 report, "Methodology for Determining Reliability Indices for HECO Utilities," indicated that momentary interruptions will have a duration less than one minute.

### **SUSTAINED INTERRUPTION**

Any interruption not classified as a momentary interruption. Only this type of interruption is included in the reliability indices which follow: In conformance with the guidelines established in the report, "Methodology for Determining Reliability Indices for HECO Utilities," dated December 1990, a sustained interruption has a duration of one minute or longer.

**CUSTOMER INTERRUPTION**

One interruption of one customer.

**NOTE:** Interruption to customers at their request (e.g., customer maintenance) are not considered.

**RELIABILITY INDICES**

Reliability indices used in this report conform to standards proposed by both the Edison Electric Institute (EEI) and the Institute of Electrical and Electronics Engineers (IEEE) unless otherwise indicated in the above definitions. Four reliability indices that convey a meaningful representation of the level of reliability were selected and are presented in this report. These reliability indices are as follows:

**AVERAGE SERVICE AVAILABILITY (ASA)**

Total customer hours actually served as a percentage of total customer hours possible during the year. This indicates the extent to which electrical service was available to all customers. This index has been commonly referred to as the "Index of Reliability." A customer-hour is calculated by multiplying the number of customers by the number of hours in the period being analyzed.

$$ASA = \frac{\sum \text{No. of Customer Hours Actually Served during the year}}{\sum \text{No. of Customer Hours Possible during the year}} \times 100\%$$

**SYSTEM AVERAGE INTERRUPTION FREQUENCY INDEX (SAIFI)**

The number of customer interruptions per customer served during the year. This index indicates the average number of sustained interruptions experienced by all customers serviced on the system.

$$SAIFI = \frac{\sum \text{No. of Customer Interruptions Experienced during the year}}{\text{Average No. of Customers served during the year}}$$

**CUSTOMER AVERAGE INTERRUPTION DURATION INDEX (CAIDI)**

The interruption duration per customer interrupted during the year. This index indicates the average duration of an interruption for those customers affected by a sustained interruption.

$$CAIDI = \frac{\sum \text{Duration of Interruptions} \times \text{No. of Customers affected}}{\sum \text{No. of Customer Interruptions Experienced for the year}}$$

**SYSTEM AVERAGE INTERRUPTION DURATION INDEX (SAIDI)**

The interruption duration per customer served during the year. This index indicates the average interruption time experienced by all customers serviced on the system.

$$SAIDI = \frac{\sum \text{Duration of Interruption} \times \text{No. of Customers affected}}{\text{Average No. of Customers Served during the year}}$$