THE STATE OF NEW HAMPSHIRE
BEFORE THE
PUBLIC UTILITIES COMMISSION

Unitil Energy Systems, Inc.

RELIABILITY ENHANCEMENT PROGRAM AND VEGETATION MANAGEMENT PROGRAM ANNUAL REPORT 2015

1. Introduction

Pursuant to the Settlement Agreement approved by the New Hampshire Public Utilities Commission ("Commission") in Docket No. DE 10-055[1] , Unitil Energy Systems, Inc. ("UES" or "Company") is submitting the results of the Reliability Enhancement Plan ("REP") and Vegetation Management Plan ("VMP") for Fiscal Year 2014 ("FY 2015"), representing the period, January 1, 2015 – December 31, 2015.

The Settlement Agreement provides that on or before the last day of February of each year following approval, Unitil will provide an annual report to the Commission, Staff and OCA showing actual REP and VMP activities and costs for the previous calendar year, and its planned activities and costs for the current calendar year. Actual and planned REP and VMP costs shown in the report will be reconciled along with the revenue requirements associated with the actual and planned capital additions and expenses. This report includes the following information:

(A) A description of Unitil's VMP;
(B) A comparison of FY2015 actual to budgeted spending on O&M activities related to the VMP
(C) Detail on the O&M spending related to the FY2016 VMP estimated expenditures and work to be completed;
(D) A summary of the reliability performance tracking for pruning, hazard tree and storm pilot program components;
(E) A summary of the Vegetation Management Storm Hardening Pilot Program results;
(F) Detail on the O&M spending related to Exacter Inspection survey;
(G) Detail on the O&M spending related to Enhanced Tree Trimming;

[1] Order 25,214 dated April 26, 2011

(H) Detail on the REP capital spending for 2015 and 2016 budget; and

(I) Reliability performance of the UES Capital and UES Seacoast systems.

2. Vegetation Management Plan

The Settlement Agreement provides that Unitil will implement an augmented Vegetation Management Program (VMP). The VMP shall be based upon the recommended program provided in the report of Unitil's consultant Environmental Consultants, Inc. ("ECI")[2], modified to incorporate a 5-year multi-phase and 5-year single phase trim cycle with 10-foot side and 15-foot top trim zones. In addition, the VMP will be conducted in a manner that addresses fast growing species, and will provide that deadwood will be removed above the primary, and that deadwood outside the trim zone will be removed if service could be impacted. The VMP shall also comply with the requirements of NESC Rule 218.B regarding overhanging vegetation at railroad and limited access highway crossings[3].

2.1. Plan Description

Unitil's Vegetation Management Program ("VMP") is comprised of six components; 1) circuit pruning; 2) hazard tree mitigation; 3) mid-cycle review; 4) forestry reliability assessment; 5) brush removal; and 6) storm resiliency work. This program is designed to support favorable reliability performance, reduce damage to lines and equipment, as well as provide a measure of public safety. The main benefits and risks addressed by these programs are reliability, regulatory, efficiency, safety and customer satisfaction.

2.1.1. Circuit Pruning

Vegetation maintenance pruning is done on a cyclical schedule by circuit. The optimal cycle length was calculated by balancing five important aspects: 1) clearance to be created at time of pruning; 2) growth rates of predominant species; 3) risk to system performance; 4) aesthetics / public acceptance of pruning; and 5) cost to implement. For New Hampshire, this optimal cycle length was calculated as 5 years for all lines.

[2] A copy of the ECI report, originally provided in response to data request Staff 1-29 (Confidential), was made part of the record in DE 10-055 as a Confidential Exhibit, accompanied by a public redacted version, during the hearing before the Commission.

[3] Reference Settlement Agreement Section 7.3 Page 14 of 26

2.1.2. Hazard Tree Mitigation

The Hazard Tree Mitigation program ("HTM") consolidates tree removal activities into a formalized program with risk tree assessment. This program is aimed at developing a more resistant electrical system that is more resilient under the impacts of typical wind, rain and snow events. The intention is to accomplish this through minimizing the incidence and resulting damage of large tree and limb failures from above and alongside the conductors through removal of biologically unhealthy or structurally unstable trees and limbs.

HTM circuits are identified and prioritized through reliability assessment risk ranking, identification as a worst performing circuit, field problem identification, and time since last worked. Once circuits are identified they are scheduled in two ways: 1) while the circuit is undergoing cycle pruning; or 2) scheduled independently of cycle pruning. In New Hampshire, HTM circuit selection corresponds closely with cycle pruning, as both pruning and HTM are on a 5 year cycle.

In order to produce the greatest reliability impact quickly and cost effectively, HTM circuit hazard tree assessment and removal is focused primarily on the three phase only, with most emphasis on the portion of the circuit from the substation to the first protection device. In circuits that have undergone storm resiliency work, the HTM focus also includes single phase circuitry.

2.1.3. Mid-Cycle Review

The mid-cycle review program targets circuits for inspection and pruning based on time since last circuit pruning and forecasted next circuit pruning. The aim of this program is to address the fastest growing tree species that will grow into the conductors prior to the next cyclic pruning, potentially causing reliability, restoration and safety issues. As the first full circuit pruning cycle is underway, mid-cycle review will be used to address only 13.8kV and above, three-phase portions of selected circuits. Circuit selection is based on number of years since last prune and field assessment.

2.1.4. Forestry Reliability Assessment

The Forestry Reliability Assessment program targets circuits for inspection, pruning, and hazard tree removal based on recent historic reliability performance. The goal of this program is to allow reactive flexibly to address immediate reliability issues not addressed by the scheduled maintenance programs. Using recent historic interruption data, poor performing circuits are selected for analysis of tree related

interruptions. Circuits or portions of circuits showing a high number of tree related events per mile, customers interrupted per event, and/or customer minutes interrupted per event are selected for field assessment. After field assessment, suitable circuits are scheduled and a forestry work prescription is written for selected circuits or areas.

2.1.5. Brush Removal

The Brush Removal program targets removal of healthy trees growing under or directly adjacent to conductors to realize benefits of avoided cost of future pruning and future hazard limb or tree removal. Tree removal will be paired with a selective stump treatment program to inhibit sprouting and re-growth and provide short and long-term benefits. The program targets small diameter trees to maximize cost effectiveness.

Due to program prioritization in relation to the VMP ramp up of funding, this program was not selected for implementation in 2015.

2.1.6. Storm Resiliency Work

The Storm Resiliency program targets critical sections of circuits for tree exposure reduction by removing all overhanging vegetation or pruning "ground to sky", as well as performing intensive hazard tree review and removal along these critical sections and the remaining three phase of the circuit. The goal of this program is to reduce tree related incidents and resulting customers interrupted along these portions in minor and major weather events. In turn, the aim is to reduce the overall cost of storm preparation and response, and improve restoration.

2.2. 2015 Actual Expenditures and Work Completed

Table 1 depicts the 2015 VMP expenditures by activity in relation to the anticipated budget expenditures. As the program progressed in 2015 there were some deviations in the anticipated expenditures. In the VMP spending, the Hazard Tree, the Mid-Cycle Review, and the Police/Flagging work activity required the most deviation in spending relative to anticipated costs. Mid-Cycle work cost was slightly above the anticipated level, however all 2015 Mid-Cycle was completed. An additional cost for VMP Planning was also incurred for updates to software which more efficiently and effectively schedules, manages, implements and monitors the VM program components and the SRP work. Due to these unanticipated costs, Hazard Tree Mitigation work spending was below the level anticipated. Sub-

Transmission work spending was slightly below anticipated as the Company was able to do work along inactive railroad sections without a railroad flagger. As shown in the table below, the program total was 18,985 over budget. The work spending for the Storm Resiliency Program was below the anticipated level. The Company anticipated this underspending after bid pricing was received and elected to add an additional circuit to the SRP work. Even with this additional 3.3 mile circuit, storm resiliency work cost was below anticipated. As shown in the table below, total spending for all VMP and SRP component was below the budget by $384,726

Table 1

2015 VMP O&M Activities		
VM Activity	**2015 Cost Proposal**	**2015 Actual Cost**
Cycle Prune	$ 1,156,000	$ 1,182,992
Hazard Tree Mitigation	$ 800,000	$ 685,040
Forestry Reliability Work	$ 32,751	$ 34,477
Mid-Cycle Review	$ 112,000	$ 156,305
Police / Flagger	$ 525,188	$ 620,323
Core Work	$ 150,000	$ 159,139
VMP Planning	$ -	$ 18,500
Distribution Total	**$ 2,775,939**	**$ 2,856,777**
Sub-T	$ 362,221	$ 348,454
VM Staff	$ 319,577	$ 271,492
Program Total	**$ 3,457,737**	**$ 3,476,722**
Storm Resiliency Program	$ 1,423,000	$ 1,019,289
Grand Total	**$ 4,880,737**	**$ 4,496,011**

The following tables detail the 2015 VMP work completed by activity. Table 2 details the cycle pruning work. One circuit had ten (10) miles that was not completed in 2015, noted with an asterisk, and is a planned carry-over into 2016. A total of 235.2 miles of cycle pruning was completed in 2015.

Table 2

2015 VMP Completed Cycle Pruning Details				
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**	**Completed Miles**
Capital	C13W1	33.5	4.3	4.3
Capital	C15W1	16.8	16.8	16.8
Capital	C15W2	5.9	5.9	5.9
Capital	C14H1	1.0	1.0	1.0
Capital	C14H2	3.9	3.9	3.9
Capital	C14X3	0.3	0.3	0.3
Capital	C1H1	0.8	0.8	0.8
Capital	C1H2	0.6	0.6	0.6
Capital	C1H3	2.3	2.3	2.3
Capital	C1H4	1.6	1.6	1.6
Capital	C1H5	0.9	0.9	0.9
Capital	C1H6	1.6	1.6	1.6
Capital	C3H1	2.7	2.7	2.7
Capital	C3H2	2.3	2.3	2.3
Capital	C3H3	1.0	1.0	1.0
Capital	C7X1	2.6	2.6	2.6
Capital	C22W3	39.8	39.8	39.8
Capital	C7W3	23.2	23.2	23.2
Seacoast	E21W1	28.5	14.2	14.2
Seacoast	E1H3	1.8	1.8	1.8
Seacoast	E1H4	3.3	3.3	3.3
Seacoast	E23X1	23.8	23.8	23.8
Seacoast	E6W1	27.0	27.0	27.0
Seacoast	E22X1	44.3	44.3	34.3*
Seacoast	E6W2	19.2	19.2	19.2
Total			**245.2**	**235.2**

Table 3 details the hazard tree mitigation work. A total of 180.6 miles of line across 20 circuits were mitigated for hazard tree risk. Unitil had estimated approximately 1,942 hazard tree removals in the budget. The actual results indicate 1,936 total hazard trees were removed on these circuits and various other circuits as found through the course of work over the year.

Table 3

2015 VMP Completed Hazard Tree Mitigation Details					
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**	**Completed Miles**	**# of Removals**
Capital	C14H2	3.9	3.9	3.9	9
Capital	C8X3	104.9	23.4	23.4	451
Capital	C15W1	16.8	5.0	5.0	49
Capital	C22W3	39.8	11.3	11.3	144
Capital	C7W3	23.2	14.8	14.8	56
Capital	C13W2	17.9	3.7	3.7	43
Capital	C13W1	33.5	0	27.3	95
Capital	C4X1	34.4	0	7.6	97
Capital	Various				122
Seacoast	E6W2	18.9	4.9	4.9	87
Seacoast	E21W1	28.5	8.9	8.9	36
Seacoast	E47X1	15.4	6.2	6.2	54
Seacoast	E19H1	4.7	3.3	3.3	50
Seacoast	E27X1	16.1	3.5	3.5	5
Seacoast	E23X1	23.8	10.0	10.0	102
Seacoast	E6W1	27.0	5.8	5.8	83
Seacoast	E22X1	44.3	11.4	11.4	9*
Seacoast	E59X1	15.5	7.3	7.3	2
Seacoast	E54X1	30.1	7.8	7.8	63
Seacoast	E56X1	16.8	3.7	3.7	74
Seacoast	E21W2	21.3	0	13.1	158
Seacoast	Various				147
Total			**132.6**	**180.6**	**1936**

* All hazard trees identified, marked, and approved for removal but not yet completed in the field – removals to carry over to 2016

Tables 4 and 5 detail the forestry reliability work and mid-cycle work respectively. A total of 3.5 miles of line underwent forestry reliability work and 67.8 miles of line were completed for mid-cycle work.

Table 4

2015 VMP Completed Reliability Analysis Details				
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**	**Completed Miles**
Seacoast	E27X1	16.1	3.5	3.5
Total			**3.5**	**3.5**

Table 5

2015 VMP Completed Mid-Cycle Review Details				
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**	**Completed Miles**
Capital	C13W2	17.9	3.7	3.7
Seacoast	E27X2	8.7	3.4	3.4
Seacoast	E59X1	15.5	7.3	7.3
Seacoast	E2X3	13.2	7.2	7.2
Seacoast	E28X1	10.2	5.1	5.1
Seacoast	E2X2	20.1	12.9	12.9
Seacoast	E46X1	3.8	1.9	1.9
Seacoast	E20H1	4.5	2.2	2.2
Seacoast	E19X2	2.8	1.7	1.7
Seacoast	E11X2	11.8	6.6	6.6
Seacoast	E11X1	11.8	4.3	4.3
Seacoast	E54X1	30.1	7.8	7.8
Seacoast	E56X1	16.8	3.7	3.7
Total			**67.8**	**67.8**

Table 6 details the sub-transmission right-of-way clearing work. A total of 13.7 linear miles of right-of-way floor were cleared.

Table 6

2015 Sub Transmission Clearing Details			
District	**Feeder**	**Scheduled Miles**	**Completed Miles**
Capital	34	1.7	1.7
Capital	374	2.7	2.7
Capital	375	1.5	1.5
Seacoast	3342/3353	3.7	3.7
Seacoast	3346	2	2
Seacoast	3341/3352	2.1	2.1
Total		**13.7**	**13.7**

Additionally the sub-transmission right-of-way that was cleared in both Capital and Seacoast in 2014 underwent the integrated vegetation management (IVM) program's low-volume foliar herbicide application work in 2015. A total of approximately 111 acres were managed with IVM chemical control.

2.3. 2016 VMP Estimated Expenditures and Work To Be Completed

Table 7 depicts the 2016 VMP expenditures by activity and the proposed VMP activity details. Unitil proposes to spend $3,495,351 on VMP activities and another $1,423,000 on vegetation storm resiliency, explained in more detail below, for a total of $4,918,351.

Table 7

2016 VMP O&M Activities Cost Proposal		
VM Activity		**2016 Cost Proposal**
Cycle Prune	$	1,163,000
Hazard Tree Mitigation	$	800,000
Forestry Reliability Work	$	24,857
Mid-Cycle Review	$	112,000
Brush Control	$	-
Police / Flagger	$	616,852
Core Work	$	150,000
Distribution Total	**$**	**2,867,603**
Sub-T	$	362,221
VM Staff	$	256,527
Program Total	**$**	**3,495,351**
Storm Resiliency Work	$	1,423,000
Grand Total	**$**	**4,918,351**

Tables 8 through 12 provide more detail on each of the VMP activities planned for 2016. The activities include 242.7 miles of cycle pruning (Table 8), 198.1 miles of hazard tree mitigation (Table 9) which estimates 1,975 hazard tree removals, 3.0 miles of forestry reliability work (Table 10), 70.5 miles of mid-cycle pruning (Table 11), and 18.1 miles of sub-transmission clearing.

Table 8

2016 VMP Planned Cycle Pruning Details			
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**
Capital	C4W3	18.6	14.8
Capital	C13X4	1.7	1.7
Capital	C37X1	6.8	6.8
Capital	C16H1	3.2	3.2
Capital	C16H3	1.4	1.4
Capital	C16X4	6.7	6.7
Capital	C16X5	0.5	0.5
Capital	C16X6	0.1	0.1
Capital	C375X1	0.1	0.1
Capital	C15H3	1.3	1.3
Capital	C35X1	0.5	0.5
Capital	C35X2	0.03	0.0
Capital	C35X3	0.03	0.0
Capital	C35X4	0.04	0.0
Capital	C374X1	0.5	0.5
Capital	C6X3	15.1	13.3
Capital	C21W1P	1.8	1.8
Capital	C2H1	3.3	3.3
Capital	C2H2	8.7	8.7
Capital	C2H4	1.8	1.8
Capital	C34X1	0.2	0.2
Capital	C34X2	0.4	0.4
Capital	C34X3	0.04	0.04
Capital	C18W2	33.7	33.7
Seacoast	E22X1	44.3	10.0*
Seacoast	E19X3	37.9	37.9
Seacoast	E43X1	30.7	30.7
Seacoast	E51X1	29.9	29.9
Seacoast	E3H1	2.0	2.0
Seacoast	E3H2	1.5	1.5
Seacoast	E3H3	1.6	1.6
Seacoast	E3W4	5.6	5.6
Seacoast	E7W1	7.4	7.4
Seacoast	E59X1	15.4	15.4
Total			**242.7**

*carry-over

Table 9

2016 VMP Planned Hazard Tree Mitigation Details			
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**
Capital	C13W3	82.7	17.9
Capital	C4W3	18.6	11.0
Capital	C37X1	6.8	1.2
Capital	C6X3	15.1	16.0
Capital	C18W2	33.7	28.7
Seacoast	E22X1	53.5	10.0*
Seacoast	E13W2	29.0	10.7
Seacoast	E15X1	9.8	6.3
Seacoast	E27X1	16.1	5.1
Seacoast	E58X1	31.1	17.9
Seacoast	E19X3	37.9	22.5
Seacoast	E43X1	30.7	22.9
Seacoast	E51X1	29.9	19.74
Seacoast	E59X1	15.4	8.2
Total			**198.1**

*carry-over

Table 10

2016 VMP Planned Reliability Analysis Details			
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**
Capital	C15W1	16.8	0.9
Seacoast	E6W1	26.9	2.1
Total			**3.0**

Table 11

2016 VMP Planned Mid-Cycle Review Details			
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**
Capital	C13W3	82.7	17.9
Capital	C24H1	2.0	0.8
Capital	C24H2	1.9	1.5
Capital	C33X4	2.0	0.1
Capital	C34X4	0.2	0.2
Seacoast	E13W2	29.0	10.7
Seacoast	E13X3	3.8	2.5
Seacoast	E15X1	9.8	6.3
Seacoast	E17W2	4.8	2.0
Seacoast	E27X1	16.1	5.1
Seacoast	E27X2	8.7	1.4
Seacoast	E2H1	2.4	1.4
Seacoast	E56X2	2.4	2.1
Seacoast	E58X1	31.1	13.2
Seacoast	E5H1	4.5	3.2
Seacoast	E5H2	4.8	2.2
Total			**70.5**

Table 12

2016 Sub Transmission Planned Clearing Details		
District	**Feeder**	**Scheduled Miles**
Capital	33	8.1
Seacoast	3341/3352	3.2
Seacoast	3347	2.5
Seacoast	3351/3362	4.3
Total		**18.1**

2.4. Vegetation Management Storm Resiliency Program Results

In 2015, Unitil continued the Storm Resiliency Program targeting the resiliency efforts in communities in the Capital area. As in previous pilot program years, the 2015 circuits were selected through analysis of tree related reliability performance. The 2015 circuits are shown below in Table 13. In 2015, 37.7 miles of critical three phase line were mitigated and 1,834 hazard trees were removed along this portion of line.

Table 13

2015 Storm Program Work Details			
Circuit	**Scheduled Miles**	**Completed Miles**	**# of Removals**
C8X3	26.8	26.8	684
C4W4	7.6	7.6	875
C6X3	0	3.3	275
Total	**34.4**	**37.7**	**1,834**

This program was met with success, again in its fourth year. All program work in 2015 was completed below the estimated budget, with final expenditures totaling $1,019,289, which is $403,711 under the $1,423,000 budget estimate. The reason for the underspending was due to the lesser number of identified hazard trees on the C8X3 circuit. In previous years, the average number of removals per mile was approximately 82 trees per mile, ranging from 115 trees per mile down to 60 trees per mile. With the C8X3 only having 684 removals identified over 26.8 miles, the number of removals identified was low at 25.5 trees per mile. This anomaly, perhaps due to the circuit location along Route 4, was noticed during the work planning phase. The Company added an additional 3.3 mile circuit, C6X3, midway through the project to harden additional miles and provide maximum benefit for the cost since budget was still available. Even with the reduced time frame and additional work planning needs, the Company and was able to complete this additional circuit.

Due to the varying nature of storm resiliency work and traffic control, the Company expects costs may continue to experience minor variances, with final annual costs being slightly above or below the estimated budget.. The Company believes that the annual program funding level of $1,423,000 remains an appropriate and reasonable estimate of the Company's targeted spending for its Storm Resiliency Program.

Although the Company did not experience any major storms in 2015, it is evident from the 2014 Thanksgiving storm experience and favorable results of the 2012 and 2013 storm resiliency pilot circuits over the last four years, that the Storm Resiliency work has the ability to and was successful at preventing tree related failures and subsequent electric incidents. This reduction in incidents reduces damage to the electric infrastructure and the need for crews to respond, in turn reduces the overall storm costs and expedites the restoration.

2.5. Vegetation Management Storm Resiliency Program Recommendation

For 2016, storm resiliency work on 33.8 miles of line in the Seacoast service area is proposed, at a total cost of $1,423,000. These circuits, shown in Table 14, were chosen for their recent historic reliability performance, number of customers served, field conditions, and location.

Table 14

2016 Storm Pilot Planned Work Details		
Circuit	**Overhead Miles**	**Scheduled Miles**
E51X1	29.9	10.2
E47X1	14.8	6.2
E54X1	30.1	7.8
E56X1	17.0	4.8
E13W1	18.6	4.8
Total		**33.8**

2.6. Vegetation Management Reliability Performance Tracking

As the Vegetation Management Program progresses through its first five year prune and hazard tree cycles, the effects of these programs on reliability have begun to emerge. Overall New Hampshire system tree related reliability performance was reviewed. Chart 1, shown below, displays the number of tree related incidents per year as well as the number of customers interrupted from tree related incidents from 2011 to 2015 against the 5 year average of tree related incidents during the same time period. The data used for this comparison excludes all major storm events identified by the NH PUC definition of a major storm in effect prior to 2015. The data for 2015 uses IEEE 1366 methodology for identifying major event days. However there were no major event days during 2015 that excluded tree related interruptions.

Chart 1 shows a steady declining trend in tree related incidents as well as in customers interrupted from 2011 through 2015. The number of tree related incidents and the number of customers interrupted were at their lowest point in 2015 over this five year period. The number of interruptions was below the five year average for the third year in a row while the number of customer interruptions was below the five year average for two years. These results clearly indicate that the VM program is producing positive results. To further this, Table 15 shows the 10 worst performing circuits of 2015 relative to tree related outages. This table shows that all of these circuits had some type of VM completed in 2015 or that is planned for 2016. This is expected and a testament to a well-managed VM program and it is fully anticipated that the performance of these circuits will markedly improve in 2016 & 2017.

Chart 1

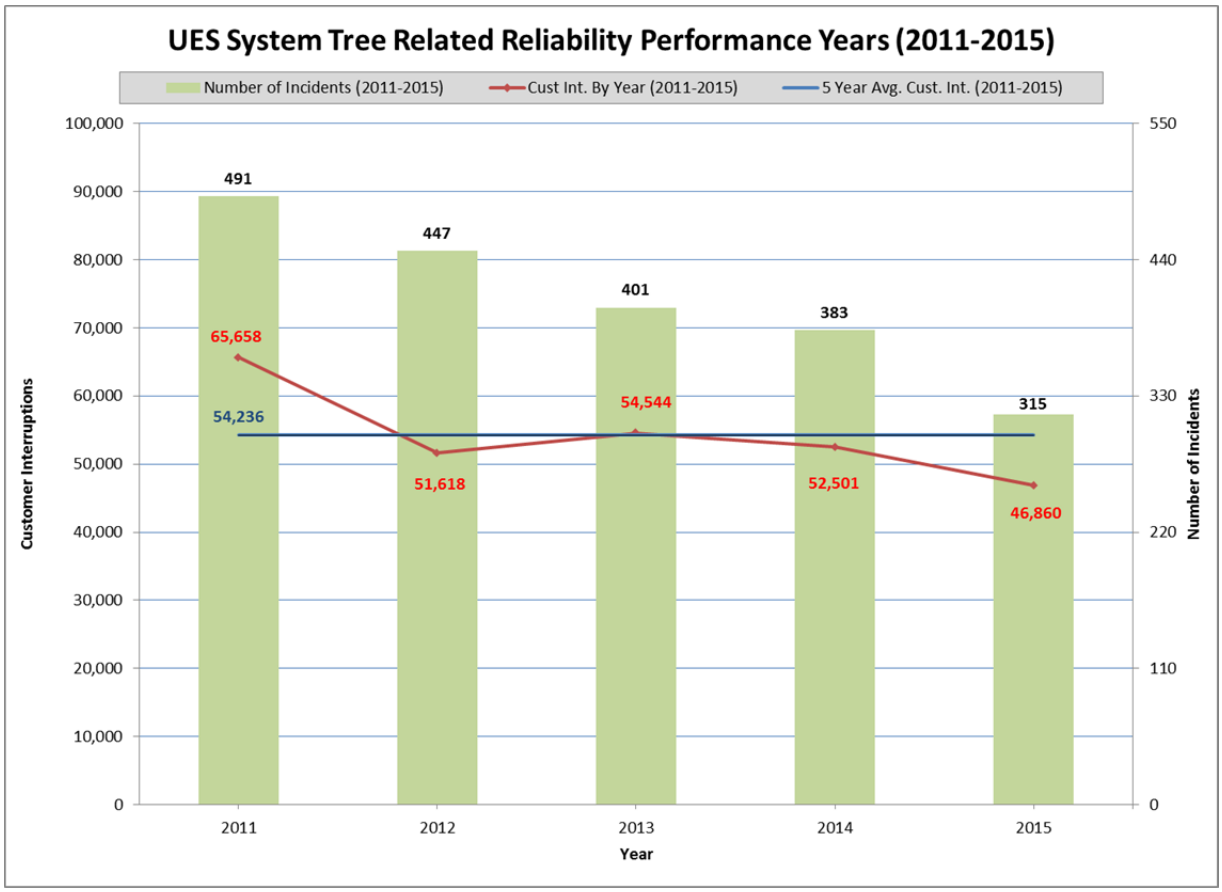

UES System Tree Related Reliability Performance Years (2011-2015)
Number of Incidents (2011-2015)
Cust Int. By Year (2011-2015)
5 Year Avg. Cust. Int. (2011-2015)
Customer Interruptions
Number of Incidents
Year
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
550
440
330
220
110
0
2011
2012
2013
2014
2015
491
447
401
383
315
65,658
51,618
54,544
52,501
46,860
54,236

Table 15

Worst Performing Circuits				
Circuit	**# of Interruptions**	**Customer Interruptions**	**Customer Minutes of Interruption**	**VM Completed or Planned**
C13W3	34	2,859	202,507	mid cycle review & hazard tree planned for 2016
C8X3	29	1,095	69,212	SRP & hazard tree completed 2015
C22W3	19	1,973	210,257	cycle prune & hazard tree completed 2015
E22X1	16	1,293	163,295	cycle prune completed 2015 (some carryover in 2016)
E58X1	14	897	126,536	mid cycle review & hazard tree planned for 2016
C15W1	12	1,529	95,585	hazard tree completed 2015
C18W2	11	551	63,419	cycle prune planned for 2016
C13W1	11	588	37,816	some cycle prune & hazard tree completed 2015
E43X1	10	1,093	96,899	cycle prune & hazard tree planned for 2016
E51X1	9	3,234	216,313	SRP & cycle prune & hazard tree planned for 2016

3. Reliability Enhancement Plan

The Settlement Agreement provides that Unitil should implement a Reliability Enhancement Program (REP). Pursuant to the Agreement and beginning in 2011, the Company has planned to spend a target amount of $1,750,000 annually and is subject to a cap of $2,000,000 in REP capital expenditures in a given year and $300,000 in operation and maintenance expense effective May 1, 2012.[4]

The Reliability Enhancement Program covers capital and O&M activities and projects intended to maintain or improve the reliability of the electric system including: (1) system hardening measures, i.e., equipment upgrades; installation of additional fuses, sectionalizers and reclosers; SCADA and automation

[4] Reference Settlement Agreement Section 7.1 Page 14 of 26

projects; improvements to lightning protection; installation of animal guards; and other activities to mitigate the specific causes of outages; (2) enhanced tree trimming, i.e., aggressive trimming and clearing involving an expanded trim zone or more aggressive removal beyond what is normally included in maintenance trimming, typically in localized areas of poor reliability; (3) asset replacement, which targets aging electrical components at increased risk of failure, including porcelain cutouts and insulators, transformers, circuit breakers, underground cable, wood poles and other equipment, and includes conductor replacement and reconductoring of select mainlines with spacer cable; and (4) reliability-based inspections and maintenance, which will include enhanced inspection methods to detect and mitigate outage causes before they occur, including surveys using new or improved technology such as thermography (IR) and radiofrequency (RF) sensor technology to identify and mitigate failing electrical equipment, as well as software applications to better manage inspection, maintenance, and reliability programs and data.

3.1. Annual Studies

Each year the Company completes an annual distribution planning study and reliability study in each of the operation areas. Both of these studies incorporate analysis to improved system reliability.

3.1.1. Distribution Planning Study

The Company conducts distribution planning studies on an annual basis. The purpose of this study is to identify when system load growth is likely to cause main elements of the distribution system to reach their operating limits, and to prepare plans for the most cost-effective system improvements.

Circuit analysis provides the basis for the distribution planning study. Circuit analysis is completed on a three year rotating cycle with the objective to review one-third of the entire system each year. The Milsoft WindMil software application is used to perform circuit analysis to identify potential problem areas and to evaluate available alternatives for system improvements. Circuit analysis includes the following: 1) update of circuit model from GIS; 2) circuit diagnostics; 3) load allocation and overload analysis; 4) voltage drop analysis; 5) fault current and protection device coordination analysis. Engineering work requests are initiated for any apparent miscoordination identified during this analysis. Protection device coordination analysis is an automated function within the WindMil application. This function is included each year as part of the circuit analysis performed on the circuits evaluated.

In addition to the fuse coordination completed as part of circuit analysis, the Company reviews trouble interruption reports on a daily basis. Any outage in which the fuse did not appear to operate correctly is further analyzed to determine the cause. Engineering Work Requests are issued to implement upgrades or changes on the system identified by the circuit analysis or an evaluation of an outage. In 2015, fifteen Engineering Work Requests were initiated specific to fuse installation or fuse size changes, at twenty-six locations, due to the coordination analysis performed.

3.1.2. Reliability Studies

Each year, Unitil completes annual reliability studies for each of its operating areas. The purpose of these studies is to report on the overall reliability performance of the electric systems from January 1 through December 31 of the previous year (12 months total). The scope of this report also evaluates substation, subtransmission (34.5kV system generally off road and serving one or more substations or circuit taps) and individual circuit reliability performance over the same time period. The analysis also identifies common trends or themes based upon type of outage (i.e. tree, equipment failure, etc.). The Annual Reliability Analysis and Recommendations report for the UES Capital Operating Area and UES Seacoast Operating Area are attached to this report as Attachment 1 and Attachment 2 respectively.

The recommendations provided in the study are focused on improving the worst performing circuits as well as the overall system reliability. These recommendations are provided for budget consideration and will be further developed with the intention of incorporation into the capital budget development process.

There are several common solutions which can improve reliability depending upon the circumstance: 1) installation of reclosers or sectionalizers; 2) addition of fusing locations; 3) tree trimming; and 4) installation of tree wire or spacer cable. These solutions are recommended most commonly; however, other solutions are also recommended for specific situations.

3.2. REP O&M Expenditures

The Company has allocated $80,000 Operation and Maintenance expenditures on enhanced tree trimming in areas recommended by the Distribution Engineering Department and Reliability Inspections and Maintenance. The Enhanced Tree Trimming funding is intended to target “problem” areas identified through engineering analysis.

Table 16 below lists the amount of operation and maintenance expenditures budgeted for 2016 and past four years on Enhanced Tree Trimming and reliability centered inspection and maintenance programs.

Table 16

REP O&M Category	Budgeted Spending Amounts				
	2012	2013	2014	2015	2016
Enhanced Tree Trimming	$133,333	$200,000	$200,000	$80,000	$80,000
Reliability Inspection and Maintenance	$ 66,667	$100,000	$100,000	$220,000	$220,000
Totals	$200,000	$300,000	$300,000	$300,000	$300,000

3.2.1. Enhanced Tree Trimming

Each year, the Company completes reliability analysis on the distribution and subtransmission system. The reliability analysis (as shown in Attachments 1 and 2) identifies areas of the system which have experienced an abnormal or increasing amount of tree related outages in the previous year. Distribution Engineering provides the System Arborist a prioritized list of recommended subtransmission lines and/or distribution circuits which would benefit the most from enhanced tree trimming.

In 2015, Distribution Engineering recommended the sub-transmission 33 Line in the UES Capital area to receive enhanced tree trimming. In total, $48,895 was spent on Enhanced Tree Trimming on this line. The 33 line underwent enhanced risk tree assessment, and 96 hazard tree removals were completed along with sideline clearing on selected portions.

For 2016, Distribution Engineering is recommending enhanced tree trimming/ hazard tree removal be performed on the 375 line in the UES Capital area in an effort to widen the narrow right-of-way. The work on this line will be prioritized and is budgeted not to exceed $80,000 in 2016.

3.2.2. Reliability Inspection and Maintenance

In 2015, Unitil continued to inspect our distribution facilities utilizing Exacter® technology as described in the Unitil Energy Systems, Inc. Reliability Enhancement Program and Vegetation Management Report 2013. The scope of the 2015 program included Davey Resource Group performing field survey work and analysis, and providing the company with a report of their findings. In 2015, the

Company spent $220,000 in O&M expenditure and $57,223 in capital, to replace equipment that the 2014 survey indicated as possibly failing in the near future.

Unitil has budgeted $220,000 again in 2016 for Reliability Inspection and maintenance. The specific plan of the program will be determined after we receive the analysis of the 2015 results.

3.2.2.1. Exacter Overview

As explained in our previous 2013 report, Exacter® technology is deployed by electric utilities to locate overhead distribution equipment showing signs of degradation and possible failure, thereby increasing overall system reliability by preventing failures before they occur. As a result of the successful pilot, Unitil continued the program in 2015.

3.2.2.2. Project Overview and Results

Unitil continued the inspection and survey program and completed a third survey of all our overhead, three-phase circuitry, or a total of 419 pole miles of line. We believe this methodology provides the greatest impact to customers as a failure of equipment along these circuits would affect the greatest amount of customers and therefore have the greatest impact on system reliability, i.e. SAIDI.

The circuit survey performed in 2015 identified 28 pieces of equipment that displayed the immanent failure signature and required repair or replacement. As was the case in 2013 and 2014, the types of facilities identified included transformers, insulators, lightning arrestors, bushings, and cutouts.

Utilizing Unitil's Outage Management System (OMS) which details customer counts and protective devices, we are able to develop potential system reliability impacts. The 2015 program identified a repair every 15.0 miles, and an average of 720 customers impacted by each failure event if it occurred. The estimated number of customers impacted by potential failures of all identified locations is 20,165. The estimated customer minutes of interruption would be 1,586,221, calculated using 2015 customer counts. . The total opportunity for avoided system SAIDI would be 20.9 minutes, which represents 13.3% of UES' most recent 10-year average annual SAIDI of 157.6 minutes.

This data compliments our findings in 2014, which estimated 27.6 SAIDI minutes of savings. We continue to believe the program has significant benefits to our customers.

3.2.2.3. 2016 Plan Proposal

Unitil is continuing the Exacter® preventative maintenance program in 2016. This is the last year of our three year contract with the vendor. We will continue to perform an annual survey of all three-phase circuit miles of the UES distribution system, as failures of this equipment has the greatest impact on customer interruptions. The estimated cost to perform the annual survey and provide the analytics is $220,000, and the cost to replace the identified equipment is expected to be approximately $50,000 annually. Given the potential impact on system SAIDI, the company believes these expenditures are prudent and beneficial to customers.

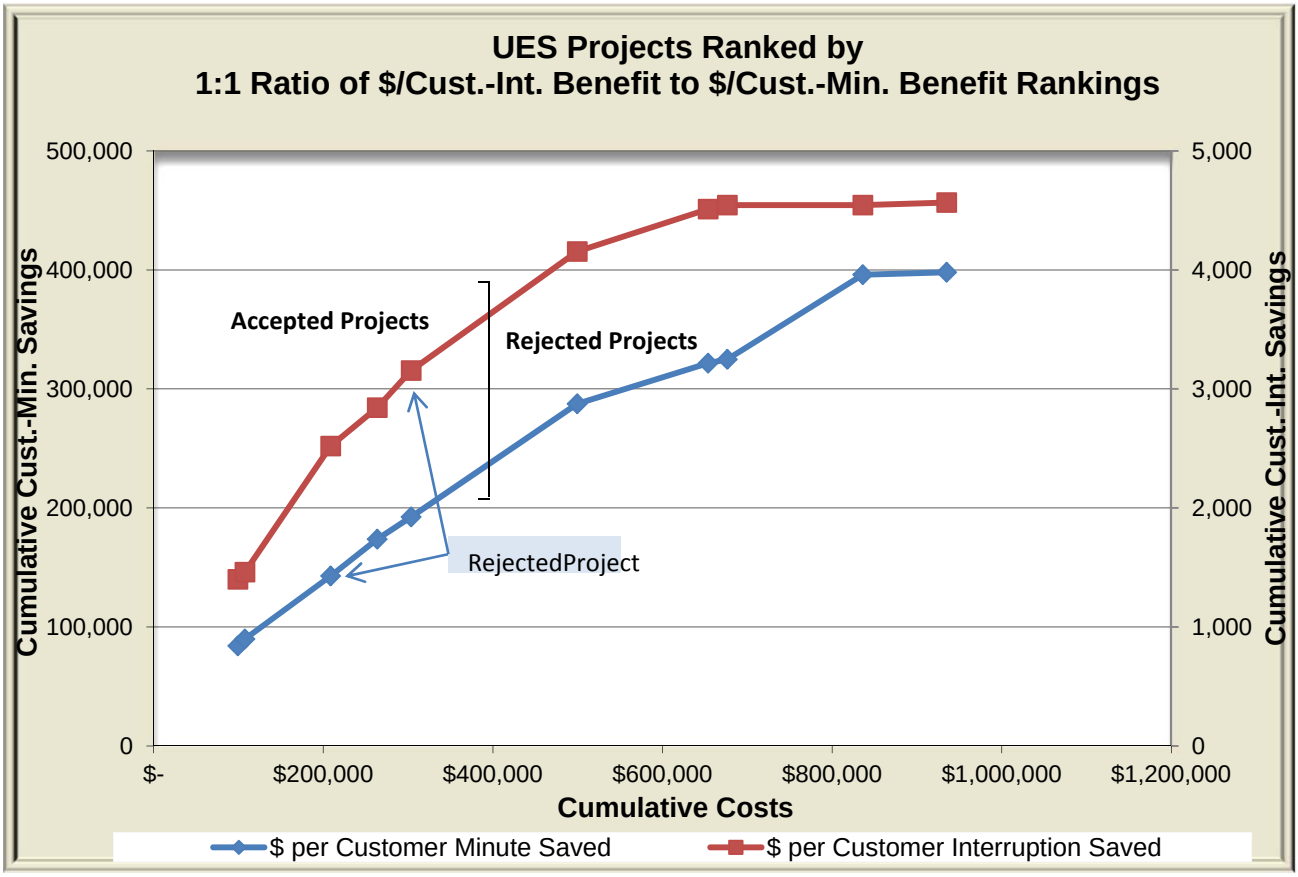
3.3. REP Capital Expenditures

As described in section 3.1.2 above, in addition to the annual pole inspection and replacement program, each year Unitil completes annual reliability studies for each of its operating areas. The recommendations provided in the study are focused on improving the worst performing circuits as well as the overall system reliability. These REP projects count for the majority or all of the "System Hardening/Reliability" spending for each year.

The REP projects recommended for the budget include a project scope, construction cost estimate and estimated reliability improvements (annualized saved customer minutes and saved customer interruptions). All of the recommended projects are ranked against each other based upon two cost benefit comparisons (cost per saved customer minute and cost per saved customer interruption).

An overall project rank is derived from the sum of these two cost benefit rankings. In general, projects with low construction cost and high saved customer minutes or high saved customer interruptions are ranked highest on the list while those projects with high construction cost and low saved customer minutes or saved customer interruptions are ranked low on the list. Another way these projects are analyzed by Distribution Engineering is shown in Chart 2 below. This chart displays the cumulative project cost compared to the anticipated reliability benefits of all projects. Each data point pair represents a specific project and its associated reliability benefits (saved customer minutes and saved customer interruptions). This chart is used to compare the relative return of reliability benefits associated with project cost between all projects. The projects to the left of the cutoff line are those that are entered into the annual Capital Budget for approval. Those to the right have been rejected.

Chart 2



The REP projects for 2016 presented in Table 17 below provide an illustration of the process used to identify REP projects. Table 17 is a listing of REP projects recommended by Distribution Engineering as part of the 2015 annual reliability studies for the UES system which have been accepted into the 2016 Capital Budget. This project-listing details the overall project ranking, scope, cost, and anticipated reliability benefits.

Table 17

Recommended 2016 REP projects

Project Ranking	DOC / Budget No.	Description	Project Cost	Cumulative Cost	Customer Interruptions Saved Annually	Customer Minutes Saved Annually
1	DRBC04	Bow Jct Auto Transfer	$99,349	$99,349	1,400	84,000
2	DRBC01	15W1 - Install Recloser Shaker Rd	$8,229	$107,579	61	5,800
3	DRBC06	375 Line Automatic Sectionalizing at Terrill Park	$101,137	$208,716	1,059	53,000
4 *	DRBE03	18X1 - Install Recloser Mary Batchelder	$54,879	$263,595	323	30,994
5	DRBC05	374 Line Auto sectionalizing	$40,000	$303,595	312	18,700
PROPOSED NH REP PROJECTS			$303,594	$982,834		192,494

*Although this project ranked higher in estimated customer-minute savings/cost, the project was rejected because of a conflict with a plan for a potential new customer project

Note the project list above has been sorted by project rank in ascending order beginning with the project having the best composite cost benefit ranking. This list is used by Distribution Engineering as a guide for recommending projects to be included in the Capital Budget as REP projects. The projects listed above are those projects that were accepted into the 2016 capital budget. However, it should be noted other projects were identified in the annual reliability analysis and were not accepted in the Capital Budget as providing adequate reliability compared to the cost.

3.3.1. 2015 Actual REP Expenditures

The capital expenditures of project construction for the Company in 2015, totaled $1,919,323[5]. This total includes the annual pole replacement project in addition to the projects recommended as part of the 2014 annual reliability analysis. . The actual spending was below the budgeted amount due to multiple projects that were not completed in 2015 and are planned to be completed in 2016.

3.3.2. 2016 REP Estimated Capital Expenditures and Work To Be Completed

[5] Reference Attachment 3 for schedule of 2015 REP project spending

The 2016 REP capital spending plan was developed from the recommendations identified in the annual reliability studies. The projects shown below provide the best cost benefit ratio based upon project cost and estimated reliability improvement. The proposed 2016 REP capital spending for Asset Replacement and System Hardening/Reliability is $1,827,303. The proposed projects are identified below.

The Asset Replacement projects identified for 2016 include distribution pole replacement of $1,217,080. Distribution pole replacements are based upon field inspections and are defined as poles that are not expected to last until the next inspection cycle. Distribution pole replacements are prioritized based upon their condition. Other smaller projects may be identified throughout the year such as insulator or cutout replacements identified during normal inspections. At this time, the cost of those replacements is unknown.

The 2016 System Hardening/Reliability projects are shown below in order of the ranking described in section 3.3. The total estimated cost of these projects, including the cost to complete the projects started in 2015 is $610,223. Other System Hardening/Reliability projects may be identified throughout the year which may provide a better cost benefit than the projects presently identified. If such projects are identified, the Company generally attempts to maintain flexibility and complete the project with the better cost benefit ratio.

(1) *Bow Jct Auto Transfer* – This project consists of installing an automation scheme that will open the 374J3 switch and close the 374J4 switch during an up line 374 Line outage. This action would transfer the Bow Junction substation load to the Bridge St. portion of the 374 Line.

(2) *15W1 – Install Recloser on Shaker Rd.* – This project will install a V4L hydraulic recloser with a 70A trip coil

(3) *375 Line Automatic Sectionalizing at Terrill Park* –This project will install automatic sectionalizing capability on the 375J3 switch. This would automatically restore Terrill Park Substation and 375X1for a fault on the 375 line between Garvin's and Terrill Park, leaving no customers without power.

(4) *374 Line Auto-sectionalizing scheme*– This project consists of installing an auto-sectionalizing scheme at an existing line switch, to open the switch during the 396/0374 breakers reclosing cycle. The faulted section of line will remain open and allow the unfaulted section to close and restore customers.

4. 2015 Reliability Performance

4.1. Historical Performance (2011-2015)

The historical reliability performance for the UES system for the time period from 2011-2015 is outlined in Charts 3-5 below. These charts display annual SAIDI and SAIFI for the combined UES systems as well as separate charts for each of the UES-Capital and UES-Seacoast service territories.

Chart 3

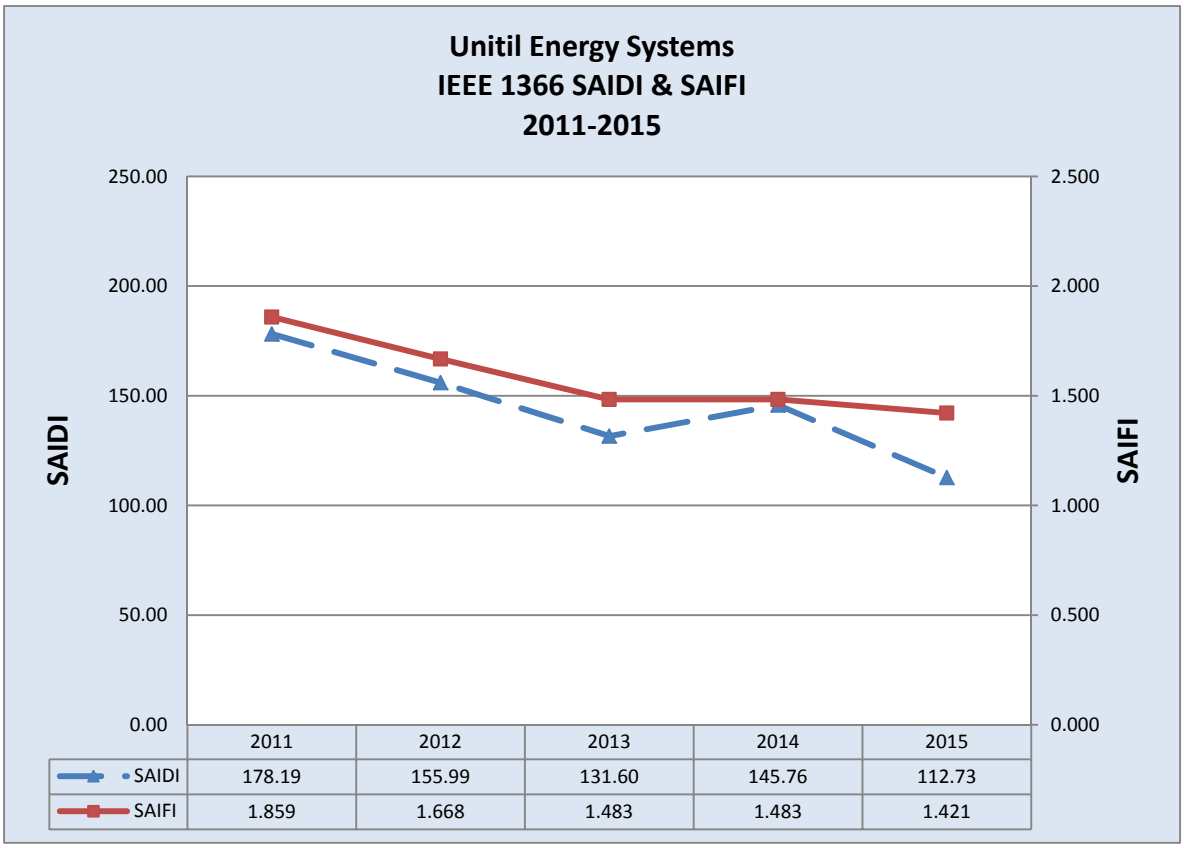


Chart 4

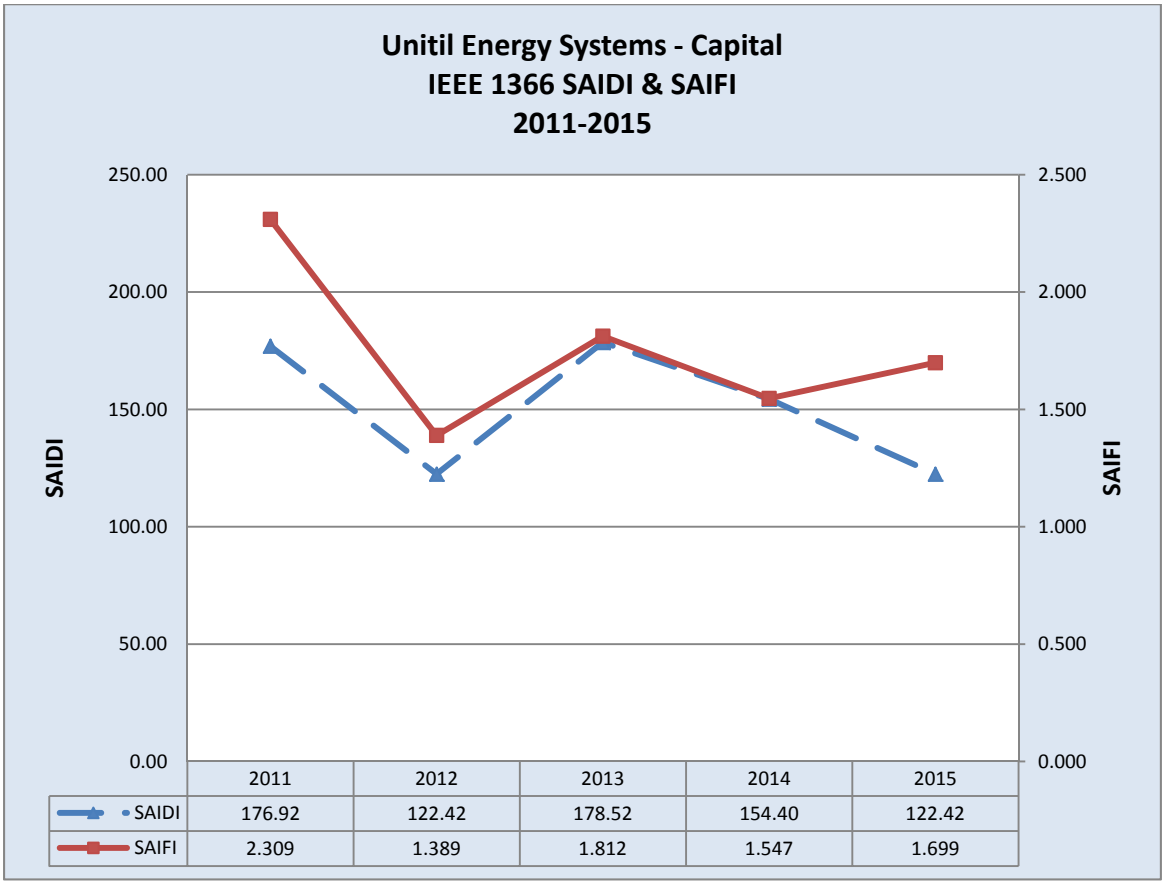
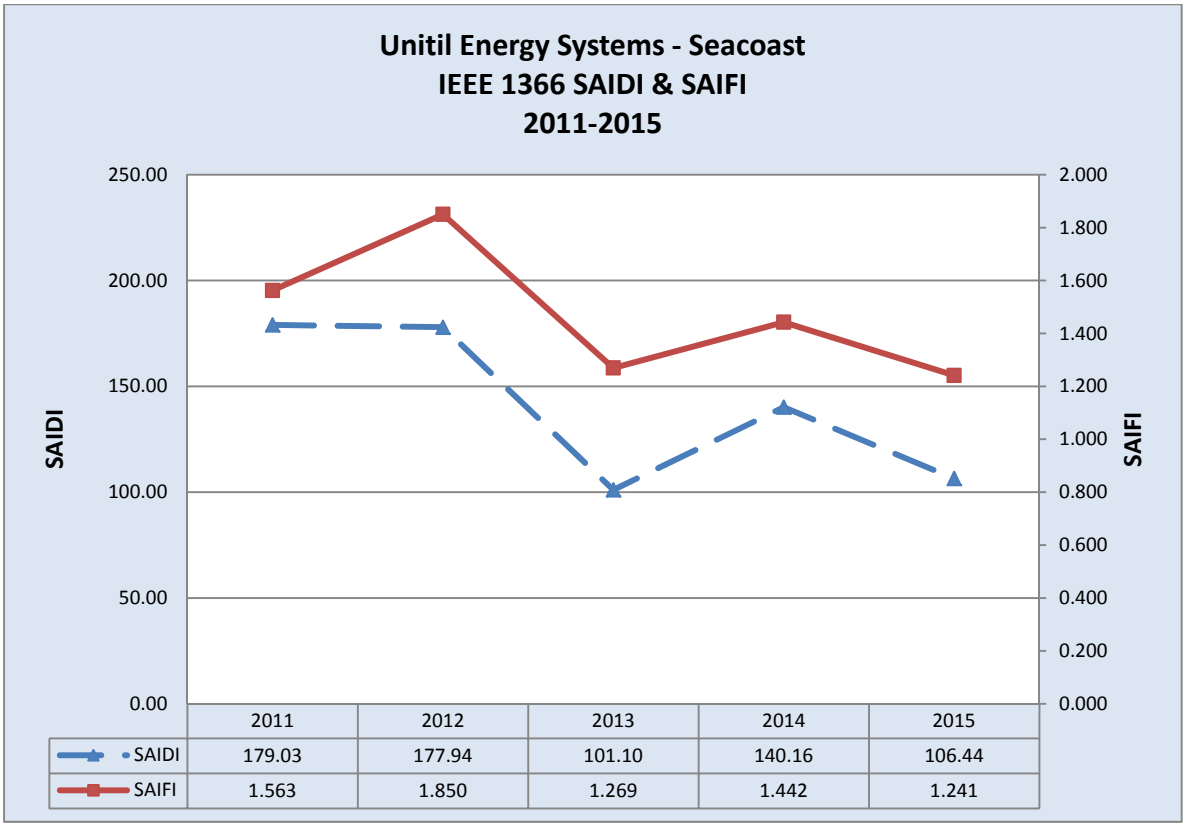

Unitil Energy Systems - Capital
IEEE 1366 SAIDI & SAIFI
2011-2015
SAIDI
SAIFI
250.00
200.00
150.00
100.00
50.00
0.00
2.500
2.000
1.500
1.000
0.500
0.000
2011 2012 2013 2014 2015
SAIDI 176.92 122.42 178.52 154.40 122.42
SAIFI 2.309 1.389 1.812 1.547 1.699

Chart 5



NOTE: Only those events causing an outage to 1 or more customers and lasting more than 5 minutes in duration are included in the calculation of these indices. In addition, events meeting any of the following criteria have also been excluded from these calculations:

- PUC Major Storm: All outages occurring in any day classified as an IEEE-1366 Major Event Day
- Interruptions/outages involving the failure of customer owned equipment
- Off system power supply interruptions

4.2. Summary of 2015 Performance

The reported reliability performance of the UES systems in 2015 (based on IEEE-1366) was the best performance in the last five years in terms of SAIDI and the number of interruption events experienced. The combined UES system SAIDI of 112.73 minutes is roughly 26% lower than the 5 year average of 152.89 minutes. The UES combined system SAIFI for 2015 was 1.421 interruptions which was the best performance in the last five years. The system SAIFI was approximately 12% lower than the

5 year average of 1.623. The total number of interruption events recorded in 2015 was 1,029. In 2015, there were no Major Event Days as defined by IEEE -1366 criteria.

Table 18 below shows a breakdown of the reliability performance of the UES system by individual cause codes.

Table 18

Cause of Outage	No of Troubles	Cust Int	Cust Hrs	SAIDI	% Total	SAIFI	% Total
Action by Others	24	240	390.66	0.31	0.8%	0.003	0.7%
Animal - Other	3	1	0.62	0.00	0.0%	0.000	0.0%
Bird	22	190	239.07	0.19	0.5%	0.002	0.5%
Civil Emergency (fire,flood,etc.)	3	138	83.90	0.07	0.2%	0.002	0.4%
Corrosion/Contamination/Decay	2	7	15.65	0.01	0.0%	0.000	0.0%
Equipment Failure Company	141	5,486	11,544.19	9.10	23.1%	0.072	15.2%
Equipment Failure Customer	1	1	1.02	0.00	0.0%	0.000	0.0%
Lightning Strike	14	183	397.76	0.31	0.8%	0.002	0.5%
Loose/Failed Connection	20	485	470.71	0.37	0.9%	0.006	1.3%
Operator Error/System Malfunction	1	-	-	0.00	0.0%	0.000	0.0%
Other	8	67	109.61	0.09	0.2%	0.001	0.2%
Overload	5	1	1.42	0.00	0.0%	0.000	0.0%
Patrolled, Nothing Found	134	3,787	4,130.27	3.26	8.3%	0.050	10.5%
Scheduled, Planned Work	87	2,818	1,467.60	1.16	2.9%	0.037	7.8%
Squirrel	134	2,052	2,160.53	1.70	4.3%	0.027	5.7%
Tree/Limb Contact - Broken Limb	204	6,836	10,032.07	7.91	20.0%	0.090	19.0%
Tree/Limb Contact - Broken Trunk	63	4,989	7,945.49	6.27	15.9%	0.066	13.9%
Tree/Limb Contact - Growth into Line	28	199	370.89	0.29	0.7%	0.003	0.6%
Tree/Limb Contact - Uprooted Tree	15	3,594	3,776.03	2.98	7.5%	0.047	10.0%
Tree/Limb Contact - Vines	5	10	13.94	0.01	0.0%	0.000	0.0%
Vehicle Accident	40	4,932	6,897.44	5.44	13.8%	0.065	13.7%
Totals	**954**	**36,016**	**50,049**	**39.47**	**100.0%**	**0.473**	**100.0%**

As observed from the preceding table, tree related outages and equipment failures had the greatest impact on the UES system reliability in terms of both SAIDI and SAIFI performance in 2015. Table 19 below shows how the top three causes during 2015 have trended over the last three years[6].

Table 19

	SAIDI (% Total)				SAIFI (% Total)		
Cause	**2015**	**2014**	**2013**		**2015**	**2014**	**2013**
Tree Related	44%	55%	56%		43%	51%	51%
Equipment Failure	23%	18%	16%		15%	24%	20%
Vehicle Accident	14%	8%	4%		14%	5%	5%

[6] Percentages based on reliability data after removing exclusionary events based on the PUC exclusionary criteria in effect for the respective year.