Unitil Energy Systems, Inc.
May 1, 2012 Step Adjustment

Explanation of Filing

REP and VMP Annual Report 2011

Pursuant to Section 7 of the Settlement Agreement, UES shall file an annual report 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 with the revenue requirements associated with the actual planned capital additions and expenses. UES' report for 2011 is attached hereto. The report also includes fuse and re-closer studies and reviews which the Company completed in accordance with the Settlement Agreement.

Changes in Non-REP Net Plant in Service

Pursuant to Section 6 of the Settlement Agreement, UES shall file financial documentation showing the actual changes to Net Plant in Service, which is included in the Step Adjustment as described below. Schedule 1 shows the calculation of the change in Non-REP Net Plant in Service. Page 1 shows the actual net book value by plant account at December 31, 2011 while page 2 provides the same information at December 31, 2010. Page 3 provides the change between periods, less the net book cost of 2011 REP projects. Page 4 provides additional supporting detail for the 2011 REP projects.

Step Adjustment Revenue Requirement

Pursuant to Section 6 of the Settlement Agreement, the Company has calculated a total revenue requirement of $1,469,304 for the May 1, 2012 Step Adjustment as shown in Schedule 2. The 2012 Step Adjustment reflects 75 percent of the actual changes to Non-REP net plant in service between December 31, 2010 and December 31, 2011, adjustments for the REP and VMP, removal of recoupment, and an adjustment for the amount of rate case expense pursuant to the final audit report. As discussed in the rate design section below, UES has also removed the rate case expense recovery in the amount of $406,031, or $0.00034 per kWh.

Non-REP Net Plant in Service: As provided for in Section 6 of the Settlement Agreement, the 2012 Step Adjustment reflects the revenue requirement associated with 75% of the actual change in non-REP net plant in service during 2011. The actual change in non-REP net plant in service during 2011 was $3,224,073, and 75% of that amount is $2,418,055. In Attachment 1 of the Settlement Agreement, the Company forecasted the change in non-REP net plant in service to be $6,430,668 during 2011. The difference between the forecasted and actual change in net plant in service primarily results from lower actual capital spending and a higher construction work in process balance at the end of 2011. The revenue requirement reflected in the 2012 Step Adjustment is $618,507 which was calculated based on 75% of the actual change in non-REP net plant in service of $2,418,055 during 2011. The amount $2,418,055, or 75% of the actual change in non-REP net plant in service during 2011, is below the recoverable limits established in Section 6.5 of the Settlement Agreement which specifies an annual maximum change for 75% of non-REP net plant in service of $8 million and a cumulative change of $20 million.

REP Net Plant in Service, REP Expense and VMP Spending: As provided for in Sections 2, 6 and 7 of the Settlement Agreement, the 2012 Step Adjustment also reflects a revenue requirement of $277,848 associated with $1,444,069 of REP net plant in service additions during 2011, $300,000 for REP O&M expense and $950,000 for VMP spending.

VMP Reconciliation: As required by Section 7 of the Settlement Agreement, UES has reconciled its VMP program costs. From July 1, 2010 through December 31, 2011, UES spent $2,477,184 on its VMP program. During this period, UES's rates reflected $2,236,942 of VMP recovery, for an under-collection of $240,242. Also during this period, UES collected $230,465 from Fairpoint related to the VMP program. This payment by Fairpoint for VMP partially offsets the under-collection from customers, reducing the under-collection to $9,776. This amount of $9,776 is reflected in the 2012 Step Adjustment and will be removed in the 2013 Step Adjustment.

VMP Storm Hardening Pilot Program: As explained in the REP and VMP Annual Report, Unitil requests funding to undertake a VMP storm hardening pilot program for a one-time cost of $535,000. This amount is reflected in the 2012 Step Adjustment and will be removed in the 2013 Step Adjustment.

Recoupment and Rate Case Expense: Lastly, the 2012 Step Adjustment reflects the removal of Recoupment of $1,210,494 and a reduction of $11,334 related to an adjustment to rate case expenses to reflect the difference between the amount included in rates and the final rate case expense reflected in the final audit report.

The total revenue requirement for all of the above components of the 2012 Step Adjustment is $1,469,304.

Rate Design

Schedule 3 shows the rate design from current rates to the rates proposed in this filing. Columns 1-3 demonstrate the current effective rates which include the rate case expense of $0.00034/kWh for all rate classes. Columns 4-6 show the removal of the rate case expense from rates, the resulting revenue and percent change in revenue. Columns 7-9 demonstrate the rate design for the Step Adjustment of $1,469,304 following the methodology approved in Section 9 of the Settlement Agreement. The overall percentage increase due to the Step Adjustment is 3.31%. Pursuant to the Settlement Agreement, the residential class will receive 115% of this increase, or 3.80% with residential customer charges to remain unchanged and the block difference remaining at $0.00500 per kWh. The remaining revenue requirement is to be collected from other rate classes on a uniform percentage basis through customer, kWh, demand, and luminaire charges as appropriate. This is a 2.80% increase for non-residential rate classes.

Bill Impacts

Bill impacts are computed and shown in Schedule 4. These reflect rates as proposed in this filing versus currently effective rates. The impact of any change in Default Service rates that normally occur on May 1 are not shown here. Those impacts are determined and considered in the semi-annual default service filing. UES has also proposed changes to its Storm Recovery Adjustment Factor for May 1, 2012 which are pending in a separate docket and are not reflected in this filing. As a result of this filing, a typical

600 kWh residential customer on default service will see a monthly bill increase of $0.86 or 1.0%. Impacts to other rate classes will be similar, but may vary based on size and consumption pattern.

Earnings Sharing

In accordance with Section 5 of the Settlement Agreement, UES has calculated its earned return on equity on Form F-1 for the calendar year ending December 31, 2011. Schedule 5 contains UES's Form F-1 for the year ending December 31, 2011 which shows an earned return on equity of 8.6%. Since its return on equity is not greater than 10 percent, UES is not subject to a sharing of earnings for the 2011 calendar year reporting period.

Exogenous Events

In accordance with Section 11 of the Settlement Agreement, UES certifies that no exogenous events occurred during calendar year 2011 which caused changes in excess of the Exogenous Events Rate Adjustment Threshold.

Report and Schedules:

REP and VMP Annual Report 2011
Schedule 1: Changes in Non-REP Net Plant in Service
Schedule 2: Step Adjustment Revenue Requirement
Schedule 3: Rate Design
Schedule 4: Bill Impacts
Schedule 5: Earnings Sharing Calculation

THE STATE OF NEW HAMPSHIRE
BEFORE THE
PUBLIC UTILITIES COMMISSION

Unitil Energy Systems, Inc.

RELIABILITY ENHANCEMENT PROGRAM AND VEGETATION MANAGEMENT PROGRAM ANNUAL REPORT 2011

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 2011 ("FY 2011"), representing the period, January 1, 2011 – December 31, 2011.

The Settlement Agreement provides that Unitil should implement a REP beginning in calendar year 2011 and allowed Unitil to spend $1,750,000 annually in REP capital expenditures. Unitil is also to increase its annual REP operation and maintenance expense by $300,000 effective May 1, 2012. The Settlement Agreement also provides that Unitil implement an augmented VMP. The revenue requirement for the permanent rates effective May 1, 2011 included $200,000 of augmented VMP spending above the test year amount and the Step Adjustment effective May 1, 2011 provided for an additional increase of $1,250,000 for annual VMP spending. The Step Adjustment effective May 1, 2012 provides for a further increase of $950,000.

The Settlement Agreement also 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 actual to budgeted spending on operating and maintenance ("O&M") activities related to the VMP beginning July 1, 2010 (the effective date of temporary rates);

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

(C) A comparison of FY2011 actual to budgeted spending on O&M activities related to the VMP and detail on the O&M spending related to the FY2012 VMP estimated expenditures and work to be completed;

(D) A proposal and recommendation for a Vegetation Management Storm Hardening Pilot Program;

(E) A summary of the reliability analysis undertaken by Unitil as defined by the Settlement Agreement;

(F) A description of the O&M spending related to the FY2012 REP plan;

(G) A comparison of FY2011 actual to budgeted spending on capital related activities related to REP project and detail on the capital spending related to the FY2012 proposed REP projects; and

(H) A summary of reliability performance from 2000 – 2011.

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 8-foot side and 10-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 five components; 1) circuit pruning; 2) hazard tree mitigation; 3) mid-cycle review; 4) forestry reliability assessment; and 5) brush removal. 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]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

2.1.1. 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.

2.1.2. 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.

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 2012.

2.2. 2010 Actual Expenditures and Work Completed

Prior to the formalized program in 2011, in anticipation of the vegetation management program ramp up, spending was increased for additional vegetation management work from July to December of 2010. This included the addition of reliability focused pruning and hazard tree removal. The total for the VM expenses for this time period was $745,373.

In Docket No. DE 10-055[4] the Company was allowed a temporary rate increase of $5.2 million annually effective July 1, 2010. Included in the temporary rate increase was $500,000 for the Company to begin expanding its reliability enhancement and tree trimming programs. Based on this rate Order, the Company increased its tree trimming program spending to better align costs with revenue received from ratepayers. For the period July 1, 2010 through December 31, 2010, the Company received $617,870[5] from ratepayers. For this period, spending was higher than revenue by $127,504 which reflected a ramp up in spending based on the temporary rate increase. When permanent rates were settled in Docket No. DE 10-055[6], the $500,000 was adjusted to $200,000 of augmented VMP spending above the test year amount.

2.3. 2011 Actual Expenditures and Work Completed

Table 1 depicts the 2011 VMP expenditures by activity in relation to the anticipated budget expenditures. As the new program progressed there were some deviations in the anticipated expenditures. The Cycle Pruning activity, Forestry Reliability activity and the Core Work activity required the most deviation in spending above anticipated costs. Cycle Pruning and Forestry Reliability costs were higher due primarily to traffic control costs. In order to track the effect of traffic control and police costs, this expenditure will be tracked as a separate category in 2012. Core work cost increases were driven by customer requests and emergency work. Due to these unanticipated costs, Hazard Tree Mitigation spending was below the level anticipated. As shown in the table below, total spending was above the budget by $112,738. However, because of payments received from FairPoint Communications for O&M related tree trimming in the amount of $230,465, the total spending for the period July 1, 2010 through December 31, 2011 is higher than total collections (revenue from ratepayers plus payments received from FairPoint Communications) by only $9,776.[7]

[4] Order 25,124 dated June 29, 2010
[5] 6/12 of $735,739 test year amount + 6/12 of $500,000 temporary rate increase
[6] Order 24,214 dated April 26, 2011
[7] The Settlement Agreement did not consider payments from FairPoint Communications for tree trimming. UES has credited these payments in its reconciliation calculation. The net amount of $9,776 is reflected in the Company's May 1, 2012 step adjustment.

Table 1

2011 VMP O&M Activities		
VM Activity	**2011 Cost Proposal**	**2011 Actual Cost**
Cycle Prune	$ 717,970	$ 839,180
Hazard Tree Mitigation	$ 452,507	$ 310,147
Forestry Reliability Work	$ 140,000	$ 157,709
Mid-Cycle Review	$ 50,596	$ 59,122
Brush Control	$ -	
Core Work	$ 50,000	$ 104,702
Distribution Total	**$ 1,411,073**	**$ 1,470,861**
Sub-T	$ 108,000	$ 102,878
VM Staff	$ 100,000	$ 158,071
Grand Total	**$ 1,619,073**[8]	**$ 1,731,810**

The following tables detail the 2011 VMP work completed by activity. Table 2 details the cycle pruning work. One circuit scheduled for cycle pruning, Seacoast E59X1, was carried over into the 2012 work plan. A total of 112.58 miles of cycle pruning was completed in 2011.

Table 2

2011 VMP Planned Cycle Pruning Details				
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**	**Completed Miles**
Capital	C18W2	33.55	10.00	10.00
Capital	C22W3	39.75	39.75	39.75
Capital	C8X3	104.62	8.50	8.5
Capital	C3H3	1.08	1.08	1.08
Seacoast	E43X1	31.29	31.29	31.29
Seacoast	E19X3	42.1	18.21	18.21
Seacoast	E59X1	15.75	15.75	3.75
Total			**129.58**	**112.58**

Table 3 details the hazard tree mitigation work. A total of 67.66 miles of line across 10 circuits was mitigated for hazard tree risk. Unitil had estimated approximately 600 hazard tree removals in the budget

[8] $735,739 test year amount + 8/12 of $1,250,000 included in May 1, 2011 step adjustment + $200,000 augmented VMP spending in permanent rates - $150,000 (adjustment for temporary rates to permanent rates for the period July 2010 through December 2010, 6/12 of $500,000-$200,000).

while the actual results indicate 530 total hazard trees were removed on these circuits and various other circuits as found through the course of work over the year.

Table 3

2011 VMP Planned Hazard Tree Mitigation Details					
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**	**Completed Miles**	**# of Removals**
Capital	C6X3	14.55	5.61	5.61	30
Capital	C22W2	5.22	4.79	4.79	13
Capital	C22W3	39.75	13.67	13.67	103
Capital	Various	-	0		112
Seacoast	E6W1	46.46	11.88	11.88	67
Seacoast	E19X3	42.1	6.81	6.81	7 *
Seacoast	E22X1	53.65	8.79	8.79	2 *
Seacoast	E43X1	31.29	8.90	8.90	64
Seacoast	E51X1	30.97	7.21	7.21	23
Seacoast	Various	-	0		118
Total			**67.66**	**67.66**	**530**

* more removals to carry over into 2012

Tables 4 and 5 detail the forestry reliability work and mid-cycle work respectively. A total of 11.9 miles of line underwent forestry reliability work and 7.76 miles of line were completed for mid-cycle work.

Table 4

2011 VMP Planned Reliability Analysis Details				
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**	**Completed Miles**
Capital	C15W1	16.48	3.0	3.0
Capital	C13W3	26.36	4.7	4.7
Seacoast	E23X1	27.97	4.2	4.2
Total			**11.9**	**11.9**

Table 5

2011 VMP Planned Mid-Cycle Review Details				
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**	**Completed Miles**
Capital	C38E	4.26	4.26	4.26
Seacoast	6W1	46.46	3.50	3.50
Total			**7.76**	**7.76**

Table 6 details the sub-transmission right-of-way clearing work. A total of 208.5 acres were cleared.

Table 6

2011 Subtransmission Planned Clearing Details				
District	**Feeder**	**Scheduled Miles**	**Scheduled Acres**	**Completed Acres**
Capital	33	6.53	84.5	84.5
Seacoast	3341	0.11	3.0	3.0
Seacoast	3352	0.10	3.0	3.0
Seacoast	3347	1.83	26.0	26.0
Seacoast	3362	3.59	46.0	46.0
Seacoast	3351	3.59	46.0	46.0
Total		**15.75**	**208.5**	**208.5**

2.4. 2012 VMP Estimated Expenditures and Work To Be Completed

Table 7 depicts the 2012 VMP expenditures by activity and the proposed VMP activity details. Unitil proposes to spend $2,819,072[9] on VMP activities and another $535,000 on a vegetation storm pilot program, explained in more detail below, for a total of $3,354,072.

Table 7

2012 VMP O&M Activities Cost Proposal		
VM Activity		**2012 Cost Proposal**
Cycle Prune	$	1,156,000
Hazard Tree Mitigation	$	630,400
Forestry Reliability Work	$	112,000
Mid-Cycle Review	$	77,645
Brush Control	$	-
Police / Flagger	$	483,227
Core Work	$	40,000
Distribution Total	**$**	**2,499,272**
Sub-T	$	100,000
VM Staff	$	219,800
Program Total	**$**	**2,819,072**
Storm Pilot Program	$	535,000
Grand Total	**$**	**3,354,072**

[9] Test year amount of $735,739 + $200,000 augmented VMP spending in permanent rates + $1,250,000 included in step adjustments + 8/12 of $950,000 increase to step adjustment effective May 1, 2012.

Tables 8 through 12 provide more detail on each of the VMP activities planned for 2012. The activities include 253.6 miles of cycle pruning (Table 8), 149.6 miles of hazard tree mitigation (Table 9) which estimates 1,050 hazard tree removals, 18 miles of forestry reliability work (Table 10), 40.9 miles of mid-cycle pruning (Table 11), and 171.5 acres of sub-transmission clearing.

Table 8

2012 VMP Planned Cycle Pruning Details			
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**
Capital	C8X3	104.62	96.1
Capital	C4W3	18.30	18.3
Seacoast	E59X1	15.75	1.2
Seacoast	E2X3	13.60	13.6
Seacoast	E28X1	10.30	10.3
Seacoast	E2X2	20.20	20.2
Seacoast	E46X1	3.90	3.9
Seacoast	E20H1	4.50	4.5
Seacoast	E19X2	2.80	2.8
Seacoast	E11X2	12.10	12.1
Seacoast	E11W1	12.10	12.1
Seacoast	E54X1	30.70	30.7
Seacoast	E56X1	17.00	17.0
Total			**253.6**

Table 9

2012 VMP Planned Hazard Tree Mitigation Details			
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**
Capital	C13W2	73.20	13.7
Capital	C7W3	23.30	14.2
Capital	C8X3	104.62	26.9
Capital	C4W3	18.30	7.5
Seacoast	E19X3	42.10	18.2
Seacoast	E22X1	53.70	14.9
Seacoast	E59X1	15.80	7.4
Seacoast	E2X3	13.60	7.3
Seacoast	E28X1	10.30	4.4
Seacoast	E2X2	20.20	13.0
Seacoast	E46X1	3.90	2.0
Seacoast	E19X2	2.80	1.7
Seacoast	E11X2	12.10	6.8
Seacoast	E54X1	30.70	7.9
Seacoast	E56X1	17.00	3.7
Total			**149.6**

Table 10

2012 VMP Planned Reliability Analysis Details			
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**
Capital	C4W4	14.2	4.0
Capital	C37X1	7.9	1.1
Seacoast	E15X1	10.1	6.4
Seacoast	E47X1	16.0	6.5
Total			**18.0**

Table 11

2012 VMP Planned Mid-Cycle Review Details			
District	**Feeder**	**Overhead Miles**	**Scheduled Miles**
Capital	C13W2	73.20	13.7
Capital	C7W3	23.30	14.2
Capital	C1H3	2.80	1.6
Seacoast	E13W1	18.60	4.7
Seacoast	E17W2	4.80	1.8
Seacoast	E46X1	3.91	2.0
Seacoast	E13X3	4.20	2.9
Total			**40.9**

Table 12

2012 Subtransmission Planned Clearing Details			
District	**Feeder**	**Scheduled Miles**	**Scheduled Acres**
Capital	396	4.35	29.0
Capital	375	4.12	29.5
Capital	374	4.04	18.0
Seacoast	3358	1.08	5.6
Seacoast	3345/3356	3.96	21.4
Seacoast	3343/3354	12.61	68.0
Total		**30.16**	**171.5**

2.5. VM Storm Hardening Pilot Program Recommendation

Unitil also proposes to implement a new VM Storm Hardening Pilot program. The recent catastrophic and severely damaging storms in 2011 provide a unique opportunity to consider the effects of implementing a vegetation centered storm hardening program. Program cost benefit analysis will be

assessed from this pilot program, critical to deciding if components should be incorporated in a full VM program. Cost to implement, reliability effects, and public acceptance will be studied in relation to the cost of storm preparation, restoration and response. This program will target specific circuits (shown in Table 13) in communities in the Seacoast area that have expressed desire for storm hardening and additional tree work. Each circuit was chosen for its recent historic reliability performance, number of customers served, field conditions, and location.

The critical sections of the circuit, from the substation out to the first protection device will have tree exposure reduced by removing all overhanging vegetation or pruning "ground to sky". Intensive hazard tree review and removal will also be conducted on these critical sections. In cases where the customer count is over 500 customers at the first protection device, overhang and hazard tree removal will continue to the second protection device. From that point, hazard tree inspection and removal will be conducted out to the third protection device or along remaining three phase lines.

Table 13

Circuit	Scheduled Miles
E13W2	4.65
E58X1	5.42
E21W2	4.66
Total	**14.73**

Cost for this pilot program was calculated using a weighted cost per mile estimate for pruning and tree removal including customer outreach and education materials, work planning, notification, and monitoring, plus an addition of traffic control costs. The pilot program will be put out to bid to Unitil's qualified line-clearance vendors to ensure lowest market price for specified work.

If successful in this program, Unitil would look to incorporate all or portions of the successful pilot into the Vegetation Management Program and seek recovery for the additional costs.

3. Reliability Enhancement Plan

The Settlement Agreement provides that Unitil should implement a Reliability Enhancement Program. Pursuant to the Agreement and beginning in 2011, the Company plans to spend $1,750,000

annually in REP capital expenditures and $300,000 in operation and maintenance expense effective May 1, 2012.[10]

As described in Mr. Meissner's Direct Testimony in Docket DE 10-055[11], the REP 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 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. Reliability Studies

The Settlement Agreement provides that the Company will complete the following fuse and recloser studies and reviews: 1) Un-fused Lateral Study; 2) Fuse Coordination Studies; and 3) Recloser Studies[12]. Each of these studies is described below.

3.1.1. Un-fused Lateral Study

The Settlement Agreement provides that the Company would complete a review of un-fused lateral on distribution circuits.

[10] Reference Settlement Agreement Section 7.1 Page 14 of 26
[11] Direct Testimony of Thomas P. Meissner, Jr. DE 10-055 filed 4-16-2010
[12] Reference Settlement Agreement Section 7.6.1 Page 15 of 26

The Company has completed a review of all distribution circuits in order to identify laterals tapped directly to the main line of distribution circuits without fusing or some other type of protective device. [13]The study is attached to this report as Attachment 1. For the purposes of this study, a distribution circuit main line is defined as all three phase sections of a distribution circuit that is currently protected by a substation recloser, breaker, or fuse.

This study was performed by identifying all unprotected laterals using GIS information and a confirmation using a field survey. In summary, this study identified 140 unprotected laterals (out of more than 7,300 fuse locations on the UES system) located on 56 different circuits. This total consists of 76 non-fused laterals on 32 circuits on the UES-Capital system and 64 non-fused laterals on 24 circuits on the UES-Seacoast system.

It should be noted that Distribution Engineering reviews all trouble reports on a daily basis. For any outage which occurs on an unprotected lateral, Distribution Engineering initiates an Engineering Work Request to install fusing. This is an attempt to reduce the probability of the same outage occurring in the future. The unprotected laterals identified in the report generally consist of one section of wire and have not experienced outages within the recent past

Distribution Engineering has developed a prioritized list of unprotected laterals based upon number of customers which could be affected by an outage event. Engineering Work Requests (EWRs) will be issued to address the identified locations prioritized based on customer impact (customers served) or completed as other work is performed on these circuits as part of planned system upgrades or modifications.

3.1.2.Fuse Coordination Studies

The Settlement Agreement provides that the Company would complete fuse coordination studies on distribution circuits where they are out of date and ensure that fuses are coordinated and of the proper size.

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.

[13] Reference Unitil Energy Systems Unprotected Lateral Study, November 29, 2011.

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 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 to circuit analysis or an evaluation of an outage. In 2011 there were thirteen Engineering Work Requests initiated specific to fuse installation or changes due to the coordination analysis performed.

3.1.3.Recloser Studies

The Settlement Agreement provides that the Company would complete a review of locations on distribution circuits where reclosers could be applied in an economic manner to improve reliability.

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 of the previous year through June 30 of the current year (18 months total). The scope of this report also evaluates substation, subtransmission 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 2 and Attachment 3 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 to be incorporated 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 quite regularly. For instance, in 2011, there were eight projects implemented to add reclosers to the UES system and in 2012 there are four projects approved which will add sectionalizers in place of fusing.

3.2. REP O&M Expenditures

The Settlement Agreement provides that Unitil will increase its annual REP O&M expense by $300,000 effective May 1, 2012.[14] The order does not specify, however, the allocation of the expense. The Company is allocating: 1) $200,000 for Enhanced Tree Trimming and 2) $100,000 for Reliability Inspections and Maintenance. The Enhanced Tree Trimming funding is intended to target "problem" areas identified through engineering analysis.

The annual budget year increases over the test year amounts for the Company are shown in Table 14 below:

Table 14

REP O&M Category	Spending Above Test Year Amounts		
	2011	2012[15]	2013
Enhanced Tree Trimming	-	$133,333	$200,000
Reliability Inspection and Maintenance	-	$ 66,667	$100,000
Totals	-	$200,000	$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 2 and 3) identifies areas of the system which have experienced an abnormal or increasing amount of tree related outages. 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. Distribution Engineering has recommended three subtransmission lines receive enhanced tree trimming in 2012: 1) Line 3346 in Hampton, 2) Line 37 in Boscawen, and 3) Line 3359 in Hampton, Hampton Falls and Seabrook. Tree

[14] Reference Settlement Agreement Section 7.1 Page 14 of 26
[15] Prorated annual amounts assuming May 1, 2012 increase

related outages on these three lines have accounted for 24% of the customer minutes of outage time and 18% of the customer interruptions for UES from January, 2010 through October 2011. The trimming on these three subtransmission lines will be prioritized as listed and are budgeted not to exceed $133,333 in 2012.

3.2.2. Reliability Inspection and Maintenance

The Company is planning a pilot study in 2012 focused around infrared survey of its distribution system. Infrared surveys are currently performed in substations and on 34.5 kV sub-transmission lines to identify potential failing connections, overloaded equipment, or any other hot spots before they result in an outage. Infrared surveys on distribution systems have recently become more successful at identifying potential problems. If the Company's pilot is successful, an infrared survey inspection program will be developed and implemented.

3.3. REP Capital Expenditures

As described above, beginning in 2011 the Company planned on spending $1,750,000 in REP capital projects annually. The breakdown of the spending by category is shown in Table 15 below:

Table 15

REP Capital Category	Spending Above Test Year Amounts		
	2011	2012	2013
System Hardening/Reliability	$ 750,000	$ 750,000	$ 750,000
Asset Replacement	$1,000,000	$1,000,000	$1,000,000
Totals	$1,750,000	$1,750,000	$1,750,000

As described above, 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 the 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.

The REP projects for 2012 are being presented in Table 16 below to describe provide an illustration of the process used to identify REP projects. The table below is a listing of REP projects recommended by Distribution Engineering as part of the 2011 annual reliability studies for the UES systems which have been accepted into the 2012 Capital Budget. This project listing details the overall project ranking, scope, cost, anticipated reliability benefits, as well as project status.

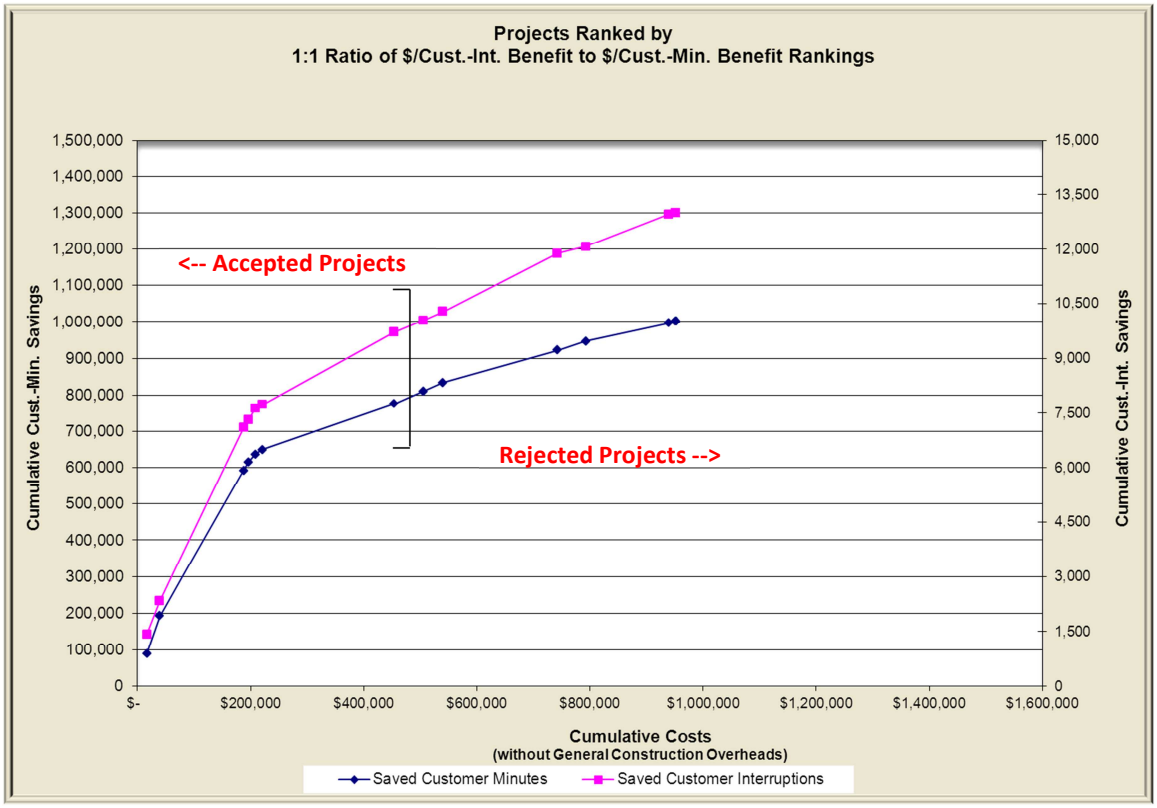
Table 16

Project Ranking	DOC / Budget No.	Description	Project Cost	Cumulative Cost	Customer Interruptions Saved Annually	Customer Minutes Saved Annually
1	SEA DRB05	Circuit 19X3 Install Cutout Mounted Sectionalizers	$30,890	$30,890	1,423	89,729
2	SEA DRB02	Circuit 3H2/3H3 Increase Phase Spacing	$41,570	$72,460	911	102,598
3	CAP DRB03	37 Line: Install Underground Cable	$266,567	$339,027	4,768	399,847
4	CAP DRB02	Circuit 13W2: Install Sectionalizers and Re-coordinate Salisbury Area	$15,167	$354,194	206	21,841
5	SEA DRB10	Circuit 51X1 Install Cutout Mounted Sectionalizers High Street	$22,658	$376,852	317	23,055
6	SEA DRB11	Circuit 58X1 Install Cutout Mounted Sectionalizers South Main Street	$22,658	$399,510	110	12,358
7	CAP DRB01	Circuits 13W2&3: Rebuild Substation Getaway	$425,222	$824,732	1,973	125,696
		PROPOSED NH REP PROJECTS		**$824,732**	**9,708**	**449,968**

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. However, it should be noted that not all projects identified in the annual reliability analysis are approved in the Capital Budget.

Another tool used by Distribution Engineering in selecting projects is shown in Figure 1 below. This chart displays the cumulative project cost versus 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 determine when there is a diminishing return of reliability benefits associated with project cost as indicated by the "knee" of the curve. Proposed projects to the left of the cutoff line are accepted in the 2012 Capital Budget and those to the right have been rejected.

Chart 1



3.3.1. 2011 Actual REP Expenditures

The 2011capital expenditures for the Company total $1,450,618 or $299,382 less than the approved $1,750,000 in REP spending[16].The under-spending is due to the fact that some projects were not completed as planned due to delays in material deliveries which delayed the project construction. The following projects were completed in the field and were closed to plant as of December 31, 2011.

(1) *Distribution Pole Replacement* – Replacement of distribution poles which were identified during pole inspections completed in 2010.

(2) *Circuit 4W3 Sewalls Falls Road Install (3) Reclosers* – Installation of single phase reclosers to allow for more downstream fusing locations.

(3) *Circuit 4X1 (North Main Street) Extension and Reliability Improvement* – This project consisted of replacing a long single phase open wire construction with three phase spacer cable construction.

(4) *Circuit 22X1 Install Recloser* – This project consisted of installing a three phase recloser with single phase tripping and lockout.

(5) *Circuit 23X1 Install Recloser* – This project consisted of installing a three phase recloser with single phase tripping and lockout.

(6) *Circuit 18X1 Install Recloser* – This project consisted of installing a three phase recloser with single phase tripping and lockout.

(7) *Circuit 5H2 Install Recloser* – This project consisted of installing a three phase recloser with single phase tripping and lockout.

(8) *Circuit 15X1 Install Recloser* – This project consisted of installing a three phase recloser with single phase tripping and lockout.

(9) *Circuit 2H1 (pole 27/18) Remove Cap Bank and Install Fusing* – This project consisted of removing a capacitor bank which was no longer needed and installing additional fusing locations. These fuse additions and cut-out replacements were based upon improvements found through reliability analysis and maintenance inspections.

(10) *Circuit 15X1 (pole 75/161) Installed Cutout* – This project consisted of installing a new fusing location. These fuse additions were based upon improvements found through reliability analysis and cutout replacements were found during inspections.

(11) *Circuit 13W2 Fusing Main Street/Highland Ave Newton* – This project consisted of installing additional fusing and replacing cut-outs at various locations. These fuse

[16] Reference Attachment 4 for schedule of 2011 REP project spending

additions and cut-out replacements were based upon improvements found through reliability analysis and maintenance inspections.

(12) *Circuit 13W2 Install Reclosers on Whittier Street* – This project consisted of installing single phase reclosers on Whittier Street.

(13) *Circuit 13W2 Pond St/Marcoux Road Newton* – This project consisted of installing additional fusing and replacing cut-outs at various locations. These fuse additions and cut-out replacements were based upon improvements found through reliability analysis and maintenance inspections.

(14) *4-1/4" Suspension Insulator and Porcelain Cutout Replacements* – This project consisted of replacing specific 4-1/4" suspension insulator and porcelain cutout which were identified through inspection.

(15) Circuit 13W2 Thornell Road Newton – This project consisted of replacing specific 4-1/4" suspension insulator and porcelain cutout which were identified through inspection.

3.3.2. 2012 REP Estimated Capital Expenditures and Work To Be Completed

As stated above, the 2012 REP capital spending plan was developed from the recommendations identified in the annual reliability planning studies. The projects shown below provide the best cost benefit ratio based upon project cost and estimated reliability improvement. The proposed 2012 REP capital spending is $ 1,754,812 which is $4,812 more than the approved $1,750,000. The proposed projects are identified below.

The Asset Replacement projects identified for 2012 include distribution pole replacement of $930,080. 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 2012 System Hardening/Reliability projects are shown below in order of the ranking described in section 3.3 and total $824,732. There might be other System Hardening/Reliability projects identified throughout the year which 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) *Circuit 19X3 Cutout Mounted Sectionalizers* – This project consists of installing three sectionalizers and the relocation of existing sectionalizers to an improved location. This project is estimated to save 89,729 customer minutes and 1,423 customer interruptions on an annual basis.

(2) *Circuit 3H2/3H3 Increase Phase Spacing* – These 4kV circuits are located directly on the seacoast and have experienced multiple outages due to phase galloping. This project will replace the 8 foot crossarms with 12 foot crossarms to achieve double pin phase spacing. This project is estimated to save 102,598 customer minutes and 911 customer interruptions on an annual basis.

(3) *37 Line Install Underground Cable* – This project consists of replacing overhead construction with underground construction for a short section of main line where trimming is not allowed. This project is estimated to save 399,847 customer minutes and 4,768 customer interruptions on an annual basis.

(4) *Circuit 13W2 Install Sectionalizers ad Re-coordinate Salisbury Area* – This project consists of replacing several fusing locations with sectionalizers, setting changes on existing distribution reclosers and other generalized fuse coordination to improve coordination, loadability and sensitivity. This project is estimated to save 21,841 customer minutes and 206 customer interruptions on an annual basis.

(5) *Circuit 51X1 Cutout Mounted Sectionalizers* – This project consists of installing three sectionalizers. This project is estimated to save 23,055 customer minutes and 317 customer interruptions on an annual basis.

(6) *Circuit 58X1 Cutout Mounted Sectionalizers* – This project consists of installing three sectionalizers. This project is estimated to save 12,358 customer minutes and 110 customer interruptions on an annual basis.

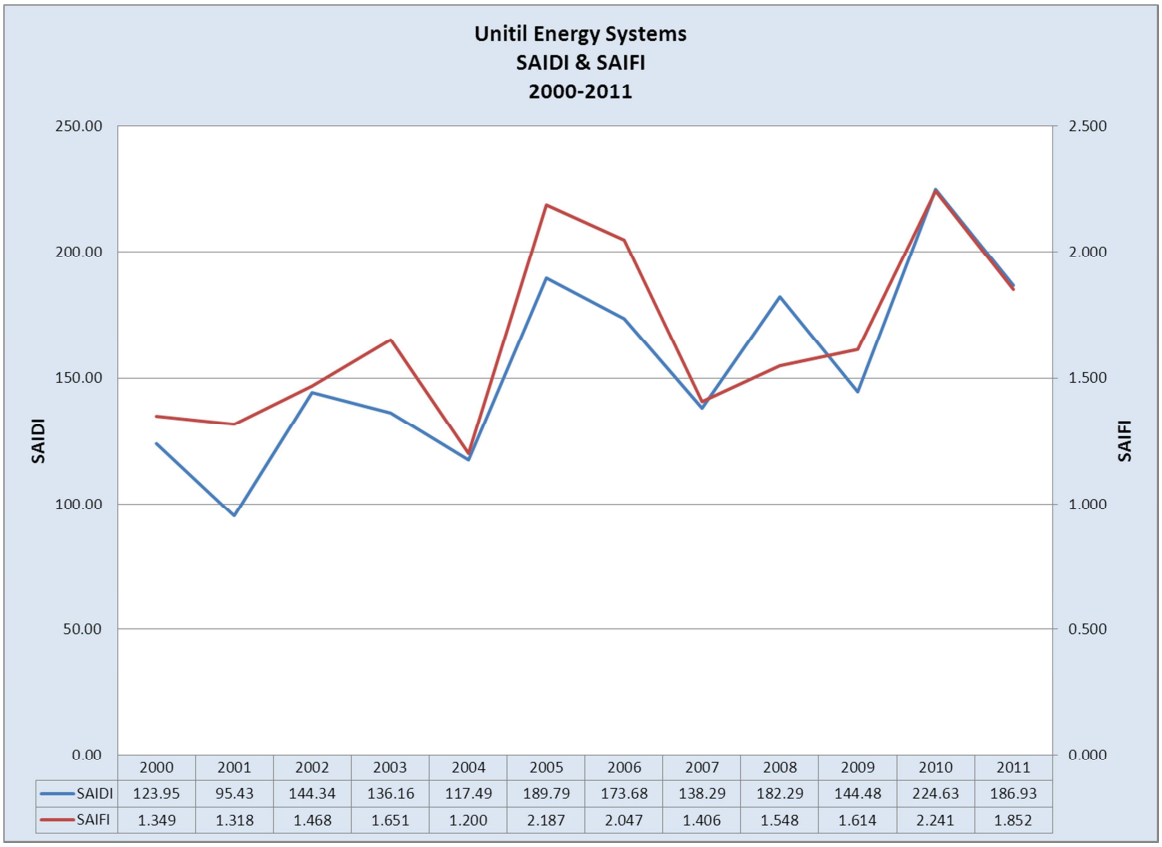
(7) *Circuits 13W2 and 13W3 Rebuild Substation Getaway* – The existing spacer cable on 13W2 and 13W3 is spacer cable from the early 1970's with gray insulation with infective UV inhibitor, has been recognized to have issues regarding its dielectric strength has recommended by the manufacturer that it be replaced as soon as it is feasible. Recently the Boscawen area has experienced an increase in the number of faults in the spacer cable due to the insulation break down. The circuit exit shall be reconfigured to replace the existing spacer cable with new spacer cable. This project is estimated to save 125,696 customer minutes and 1,973 customer interruptions on an annual basis.

4. 2011 Reliability Performance

4.1. Historical Performance (2000-2011)

The historical reliability performance for the UES system for the time period from 2000-2011 is outlined in Figure 2 below. This chart displays annual SAIDI and SAIFI for the combined UES systems consisting of the UES-Capital and UES-Seacoast service territories.

Figure 2



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
SAIDI	123.95	95.43	144.34	136.16	117.49	189.79	173.68	138.29	182.29	144.48	224.63	186.93
SAIFI	1.349	1.318	1.468	1.651	1.200	2.187	2.047	1.406	1.548	1.614	2.241	1.852

NOTE: Only those events affecting 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: Any event where the number of customers interrupted exceeds 15 % of customers served with 16 concurrent outage events or 22 concurrent outage events regardless of the number of customers interrupted.
- Scheduled Outages (beginning in year 2010)
- Off system power supply interruptions

4.2. Summary of 2011 Performance

The UES system was affected by several significant weather events in 2011. Four of these events were classified as a PUC Major Storm by meeting the criteria described in Section 4.1 and were excluded from the calculation of UES SAIDI and SAIFI. These Major Storm events are listed below:

- June 9th – Lightning Storm
- August 28th – Hurricane Irene
- October 29th – Nor'easter
- November 23rd – Snow Storm

In addition, several significant weather events were experienced during 2011 that did not meet the PUC Major Storm criteria and were therefore included in the reliability statistic calculations. Table 17 below is a breakdown of each of these storm events with the respective contribution of SAIDI and SAIFI.

Table 17

Event Description	SAIDI	% of Total	SAIFI	% of Total
February 25th – Snow Storm	6.20	3.3%	0.105	5.7%
April 1st – Snow Storm	2.32	1.2%	0.021	1.1%
September 5th – Microburst (UES-Capital)	11.14	6.0%	0.039	2.1%
October 27th – Snow Storm (UES-Seacoast)	7.85	4.2%	0.051	2.7%
December 8th – Rain/Snow and Wind Storm	5.92	3.2%	0.047	2.6%
Totals	**33.43**	**17.90**%	**0.263**	**14.20**%

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

Table 18

Cause	No of Troubles	Customer Hours	Customer Interruptions	SAIDI	% of Total	SAIFI	% of Total
Broken Tree/Limb	360	95,722.60	56,214	76.58	41.0%	0.750	40.5%
Equipment Failure - Company	133	49,685.75	31,666	39.75	21.3%	0.422	22.8%
Other	22	18,475.50	9,334	14.78	7.9%	0.124	6.7%
Tree/Limb Contact – Growth into Line	130	16,960.53	9,384	13.57	7.3%	0.125	6.8%
Squirrel	149	15,976.82	9,855	12.78	6.8%	0.131	7.1%
Vehicle Accident	39	15,453.60	6,810	12.36	6.6%	0.091	4.9%
Patrolled, Nothing Found	88	6,944.68	5,403	5.56	3.0%	0.072	3.9%
Lightning Strike	38	4,318.92	2,317	3.46	1.8%	0.031	1.7%
Loose/Failed Connection	22	3,979.65	3,212	3.18	1.7%	0.043	2.3%
Equipment Failure - Customer	4	2,612.95	1,030	2.09	1.1%	0.014	0.7%
Action by Others	22	1,854.97	1,121	1.48	0.8%	0.015	0.8%
Bird	29	1,162.52	2,264	0.93	0.5%	0.030	1.6%
Overload	20	444.10	261	0.36	0.2%	0.003	0.2%
Civil Emergency (fire, etc.)	4	42.50	22	0.03	0.0%	0.000	0.0%
Animal - Other	2	27.50	22	0.02	0.0%	0.000	0.0%
Corrosion/Contamination/Decay	3	6.58	7	0.01	0.0%	0.000	0.0%
Improper Installation	1	2.00	12	0.00	0.0%	0.000	0.0%
Totals	**1,066**	**233,671.16**	**138,934**	**186.93**	**100%**	**1.852**	**100%**

As observed from the preceding table, tree related outages had the greatest impact on UES system SAIDI and SAIFI performance in 2011. In addition, equipment failures also had a significant impact on system reliability. However, this does not appear to be a trend. Rather, only a small number of occurrences contributed to the majority of the resulting SAIDI and SAIFI contribution. In fact, only two insulator failures across the system contributed to more than 53% of the customer-hours of interruption and 26% of the customer-interruptions due to this cause. Also worth noting is that the majority of the customer-hour of interruption and customer-interruptions due to the cause “Other” were a direct result of a single outage event during the September 5th microburst in the UES-Capital territory (75% & 31% respectively).

Attachment 1

Unitil Energy Systems

Unprotected Lateral Study

Unitil Energy Systems
Unprotected Lateral Study

Prepared By:

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Unitil Service Corp.
November 17, 2011

1 Executive Summary

Unitil Energy Systems was mandated by the NH PUC to complete a review of all distribution circuits in order to identify laterals tapped directly to the main line without fusing or some other type of protective device. For the purposes of this study, a distribution circuit main line is defined as all three phase sections of a distribution circuit that is currently protected by a substation recloser, breaker, or fuse.

This study was performed by identifying all unprotected laterals using GIS followed by a field survey to confirm. In summary, this study identified 140 unprotected laterals on 56 different circuits; a total of 76 laterals on 32 circuits on the UES-Capital system and 64 laterals on 24 circuits on the UES-Seacoast system.

It should be noted that Distribution Engineering reviews all trouble reports on a daily basis. For any outage which occurs on an unprotected lateral, Distribution Engineering initiates an Engineering Work Request to install fusing. This is an attempt to reduce the probability of the same outage occurring in the future. The unprotected laterals identified in this report have not experienced outages within the recent past.

2 Findings

The tables below itemize the number of unprotected laterals by circuit for each company:

Table 1: UES-Capital Unprotected Laterals

DOC	Circuit	Customers Served	No. of Unprotected Laterals
Capital	3H1	599	10
Capital	1H2	255	7
Capital	1H6	335	6
Capital	16X4	527	4
Capital	2H2	1051	4
Capital	4X1	2374	4
Capital	24H2	430	3
Capital	2H1	451	3
Capital	8H1	661	3
Capital	16X6	15	2
Capital	1H4	60	2
Capital	3H3	111	2
Capital	7X1	158	2
Capital	37A	196	2
Capital	15W2	347	2
Capital	8X5	597	2
Capital	14H2	669	2
Capital	13W3	733	2
Capital	13X4	1	1

Capital	33X4	69	1
Capital	14H1	98	1
Capital	16H1	302	1
Capital	8H2	303	1
Capital	24H1	327	1
Capital	13W1	447	1
Capital	3H2	467	1
Capital	7W3	901	1
Capital	22W2	42	1
Capital	6X3	973	1
Capital	18W2	1054	1
Capital	4W4	2207	1
Capital	8X3	2765	1
Capital	16X5	8	0
Capital	1X7A	1	0
Capital	14X3	3	0
Capital	1X7P	12	0
Capital	1H5	12	0
Capital	15H3	16	0
Capital	2H4	94	0
Capital	211A	280	0
Capital	1H1	300	0
Capital	211P	412	0
Capital	22W1	494	0
Capital	16H3	664	0
Capital	1H3	737	0
Capital	15W1	977	0
Capital	13W2	1297	0
Capital	4W3	1326	0
Capital	22W3	1520	0
Total	**49**	**27,678**	**76**

Table 2: UES-Seacoast Unprotected Laterals

DOC	Circuit	Customers Served	No. of Unprotected Laterals
Seacoast	3H1	626	8
Seacoast	1H4	478	7
Seacoast	59X1	998	5
Seacoast	5H1	267	4
Seacoast	13W1	1082	4
Seacoast	11W1	593	3
Seacoast	21W1	1252	3
Seacoast	6W1	1725	3
Seacoast	2H1	144	2
Seacoast	19H1	162	2
Seacoast	3H2	260	2
Seacoast	3H3	459	2

Seacoast	27X1	528	2
Seacoast	19X2	523	2
Seacoast	15X1	950	2
Seacoast	46X1	1103	2
Seacoast	7W1	1220	2
Seacoast	3W4	1551	2
Seacoast	17W1	1780	2
Seacoast	5H2	610	1
Seacoast	20H1	439	1
Seacoast	13W2	1476	1
Seacoast	2X2	2500	1
Seacoast	18X1	1703	1
Seacoast	56X2	64	0
Seacoast	28X1	478	0
Seacoast	13X3	237	0
Seacoast	1H3	527	0
Seacoast	17W2	610	0
Seacoast	56X1	695	0
Seacoast	2X3	787	0
Seacoast	11X2	976	0
Seacoast	23X1	1101	0
Seacoast	21W2	1365	0
Seacoast	54X1	1406	0
Seacoast	47X1	1438	0
Seacoast	43X1	1825	0
Seacoast	7X2	1725	0
Seacoast	51X1	1861	0
Seacoast	22X1	2030	0
Seacoast	58X1	2141	0
Seacoast	19X3	3084	0
Total	**42**	**44,779**	**64**

3 Recommendations and Next Steps

Distribution Engineering has developed a prioritized list of unprotected laterals based upon the number of customers which could be affected by an outage event. Engineering Work Requests ("EWRs") will be issued to address the identified locations and will be prioritized based on customer impact (customers served) or completed as other work is performed on these circuits as part of planned system upgrades or modifications. The table below is a summary of all circuits with unprotected laterals sorted based on this priority. Also noted in this table are those circuits where EWRs have already been issued to install protection.

Table 2: UES Unprotected Lateral EWR Priority

DOC	Circuit	Customers Served	No. of Unprotected Laterals	EWR Issued
Capital	8X3	2765	1	
Seacoast	2X2	2500	1	
Capital	4X1	2374	4	
Capital	4W4	2207	1	
Seacoast	17W1	1780	2	
Seacoast	6W1	1725	3	
Seacoast	18X1	1703	1	
Seacoast	3W4	1551	2	
Seacoast	13W2	1476	1	
Seacoast	21W1	1252	3	
Seacoast	7W1	1220	2	
Seacoast	46X1	1103	2	
Seacoast	13W1	1082	4	
Capital	18W2	1054	1	
Capital	2H2	1051	4	
Seacoast	59X1	998	5	
Capital	6X3	973	1	
Seacoast	15X1	950	2	
Capital	7W3	901	1	EWR Issued
Capital	13W3	733	2	
Capital	14H2	669	2	
Capital	8H1	661	3	
Seacoast	3H1	626	8	
Seacoast	5H2	610	1	
Capital	3H1	599	10	
Capital	8X5	597	2	
Seacoast	11W1	593	3	
Seacoast	27X1	528	2	
Capital	16X4	527	4	
Seacoast	19X2	523	2	
Seacoast	1H4	478	7	
Capital	3H2	467	1	
Seacoast	3H3	459	2	
Capital	2H1	451	3	
Capital	13W1	447	1	
Seacoast	20H1	439	1	
Capital	24H2	430	3	

Capital	15W2	347	2	
Capital	1H6	335	6	
Capital	24H1	327	1	
Capital	8H2	303	1	
Capital	16H1	302	1	
Seacoast	5H1	267	4	
Seacoast	3H2	260	2	
Capital	1H2	255	7	
Capital	37A	196	2	
Seacoast	19H1	162	2	
Capital	7X1	158	2	EWR Issued
Seacoast	2H1	144	2	
Capital	3H3	111	2	
Capital	14H1	98	1	
Capital	33X4	69	1	
Capital	1H4	60	2	
Capital	22W2	42	1	
Capital	16X6	15	2	
Capital	13X4	1	1	
Total	**56**	**41,954**	**140**	

Attachment 2

UES – Capital

Reliability Analysis and Recommendations 2011

UES - Capital

Reliability Analysis and Recommendations 2011

Prepared By:
Robert Sandler & Cyrus Esmaeili
Unitil Service Corp.
November 14, 2011

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

1. Summary

The purpose of this document is to report on the overall reliability performance of the UES – Capital system during the past several months. The scope of this report will also evaluate individual circuit reliability performance from January, 2010 through June, 2011.

The ten worst events that occurred since January, 2010 are shown in *Table 1* of *Section 3* along with the associated impact to UES - Capital system SAIDI and SAIFI. *Table 2* in *Section 4* outlines the outage contributions due to subtransmission line outages during the study period. *Table 3* and *Table 4* included in *Section 5* of this report list the worst performing distribution circuits over the past 18 months ranked by customer minutes of interruption, as well as the major causes of sustained interruptions. In addition, *Table 5* and *Table 6* list the worst performing circuits ranked by annual SAIDI and SAIFI respectively.

A more detailed analysis of the performance issues on specific circuits as well as recommendations for improvement follows in *Section 6*. These recommendations are provided for consideration and will be further developed with the intention to be incorporated into the 2012 budget development process. *Section 7* and *Section 8* report on trends observed with equipment failures and tree related outages respectively. Recommendations to address these trends are provided if deemed necessary. All reliability data presented in this report is without exclusions taken.

2. Reliability Goals

The annual corporate system reliability goals for 2011 have been set at **191-156-121** SAIDI minutes. These were developed through benchmarking Unitil system performance with surrounding utilities.

Individual circuits are analyzed based upon circuit SAIDI, SAIFI, and CAIDI. This ultimately assists in identifying future capital improvement projects and/or operational enhancements which may be required in order to achieve and maintain these goals.

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

3. Top 10 Worst Outages (1/1/10 – 6/30/11)

The ten worst outages during the time period from January 1, 2010 through June 30, 2011 are summarized below. *Table 1* lists the ten worst outages ranked by the number of Customer Minutes.

Table 1
Worst Ten Outages (1/1/10 – 6/30/11)

Circuit	Description Date/Cause	No. of Customers Affected	No. of Customer Minutes	Effect on UES-Capital SAIDI	Effect on UES-Capital SAIFI
8X3	5/07/2010 Vehicle Accident	2,251	828,368	27.90	0.075
8X3	1/21/2010 Vehicle Accident	2,768	759,672	25.59	0.093
Hollis S/S	3/14/2010 Power Supply Interruption/Disturbance[1]	5,114	736,416	24.81	0.172
Boscawen S/S	11/26/2010 Broken Tree/Limb	2,907	437,800	14.75	0.097
W. Concord S/S	8/16/2010 Tree/Limb Contact – Growth into Line	1,595	389,673	13.12	0.053
8X3	12/21/2010 Loose/Failed Connection (Tap Wire)	2,698	385,095	12.97	0.090
034 Line	3/09/2011 Equipment Failure - Company	2,635	303,111	10.21	0.088
6X3	8/24/2010 Tree/Limb Contact – Growth into Line	2,565	243,720	8.21	0.086
13W3	3/20/2011 Other (Phase off Insulator)	1,791	179,965	6.06	0.060
13X4	12/11/2010 Equipment Failure – Company (Circuit Recloser)	3,170	174,350	5.87	0.106

[1] This event is considered exclusionary from Unitil reliability indices since the fault occurred on PSNH owned facilities.

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

Contribution of Subtransmission Line Outages (1/1/10 – 6/30/11)

This section is intended to illustrate the effect of subtransmission line outages on the overall reliability of the UES – Capital system by circuit in terms of Customer Minutes of interruption as well as circuit SAIDI. Please see *Table 2* below.

Table 2
Contribution of Subtransmission Outages (1/1/10 – 6/30/11)

Circuit	Subtransmission Line Outage	Number of Events	Customer-Minutes of Interruption	% of Total Circuit Outage Minutes	Circuit SAIDI Contribution
13W1	37 Line	2	41,423	8.24%	91.93
13W2	37 Line	2	119,805	15.58%	95.74
13W3	37 Line	2	115,358	12.95%	92.05
13X4	37 Line	2	93	36.75%	93.00
16H1	375 Line	1	15,132	63.34%	50.95
16H3	375 Line	1	33,124	33.10%	49.54
16X4	375 Line	1	28,600	40.38%	53.54
16X5	375 Line	1	1,300	51.83%	68.42
24H1	38 Line	2	40,016	93.22%	124.02
24H2	38 Line	2	44,164	80.40%	112.00
2H1	33 Line & 34 Line	2	39,694	39.25%	90.69
2H2	33 Line & 34 Line	2	92,916	22.72%	88.75
2H4	33 Line & 34 Line	2	9,434	12.26%	57.24
37X1	37 Line	2	18,190	12.93%	97.00
6X3	33 Line	1	101,430	52.24%	102.63
8H1	318 Line	1	84,528	100.00%	144.00
8H2	318 Line	1	41,904	88.34%	141.10
8X3	318 Line	1	398,160	213.51%	144.52
8X5	318 Line	1	79,632	99.32%	141.19
18W2	396X1	1	156,366	32.54%	152.67

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

4. Worst Performing Circuits

This section compares the reliability of the worst performing circuits using various performance measures.

4.1. Worst Performing Circuits in Past Eighteen Months (1/1/10 – 6/30/11)

A summary of the worst performing circuits during the time period between January 1, 2010 and June 30, 2011 is included in the tables below. *Table 3* shows the ten worst circuits ranked by the total number of Customer-Minutes of interruption. The SAIFI and CAIDI for each circuit are also listed in this table.

Table 4 provides detail on the major causes of the outages on each of these circuits. Customer-minutes of interruption are given for the six most prevalent causes: broken trees, tree growth into lines, animal, lightning, vehicle accidents and company equipment failures.

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

Table 3
Worst Performing Circuits by Customer-Minutes (1/1/10 – 6/30/11)

Circuit	No. of Customers Interruptions	Worst Event (% of Total Cust Int.)	Customer-Minutes of Interruption	Worst Event (% of Total Minutes)	Circuit SAIDI	Circuit SAIFI	Circuit CAIDI
8X3	17,027	13.22%	2,946,085	28.12%	1,069.34	6.180	173.02
13W3	13,695	13.08%	890,121	20.22%	710.86	10.937	65.00
13W2	9,415	13.01%	768,890	23.99%	614.52	7.525	81.67
22W3	7,810	10.71%	539,771	18.45%	318.36	4.606	69.11
13W1	4,454	9.96%	502,179	18.56%	1,114.54	9.885	112.75
18W2	3,902	26.26%	480,602	24.95%	469.24	3.810	123.17
2H2	3,190	32.10%	408,903	65.87%	390.27	3.045	128.18
4W4	7,452	28.93%	354,074	29.91%	169.61	3.570	47.51
3H2	2,202	8.81%	240,592	38.94%	513.35	4.698	109.26
22W2	3,626	20.35%	237,189	28.24%	325.89	4.982	65.41

Table 4
Circuit Interruption Analysis by Cause (1/1/10 – 6/30/11)

Circuit	Customer – Minutes of Interruption					
	Broken Tree/Limb	Animal	Loose/ Failed Connection	Vehicle Accident	Company Equipment Failure	Tree Growth into Line
8X3	314,100	35,802	385,185	1,619,490	36,467	71,090
13W3	337,626	35,707	0	0	198,920	97,475
13W2	443,785	168,324	9,250	4,529	91,789	27,014
22W3	312,121	62,397	31,822	120	502	71,087
13W1	354,830	32,358	0	240	94,647	19,319
18W2	252,516	27,675	11832	378	801	10,332
2H2	151	0	0	156	624	362,504
4W4	174,394	15,065	0	9,540	106,388	31,946
3H2	100,830	0	0	0	0	0
22W2	87,372	19,577	0	0	36,533	73,140
Total	2,377,725	396,905	438,089	1,634,453	566,671	763,907

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

4.2. Worst Performing Circuits of the Past Five Years (2006 – 2010)

The annual performance of the ten worst circuits for the past five years has been ranked in the tables below. *Table 5* lists the ten worst circuits ranked by SAIDI performance. *Table 6* lists the ten worst performing circuits ranked by SAIFI.

Table 5
Circuit SAIDI (1/1/06 – 12/31/10)

Circuit Ranking	2010		2009		2008		2007		2006	
	Circuit	SAIDI	Circuit	SAIDI	Circuit	SAIDI	Circuit	SAIDI	Circuit	SAIDI
1	8X3	1,037.0	13W1	797.86	211A	1,655.4	13W2	1,116.9	13W2	1,372.8
2	211A	650.29	13X4	444.00	13W2	1,071.9	13W1	1,108.9	16X5	1,279.0
3	13W1	648.23	13W2	443.03	13W1	575.6	13W3	988.0	7W3	556.7
4	13W2	487.15	18W2	369.36	22W3	434.3	15W2	949.0	22W3	528.6
5	13W3	417.67	13W3	349.28	4W3	396.1	22W3	777.4	4X1	508.6
6	2H4	414.01	211A	330.29	1H3	351.1	7W3	764.3	15W1	496.0
7	2H2	353.25	37A	269.61	22W2	291.3	4W3	744.3	13W1	476.4
8	37X1	304.57	22W3	246.30	15W1	288.9	22W1	674.9	8X3	464.1
9	3H2	298.00	4W3	245.64	13W3	233.1	15W1	642.4	14H1	426.7
10	18W2	293.13	15W1	210.10	1H4	194.0	13X4	572.0	4W3	392.0

Table 6
Circuit SAIFI (1/1/06 – 12/31/10)

Circuit Ranking	2010		2009		2008		2007		2006	
	Circuit	SAIFI	Circuit	SAIFI	Circuit	SAIFI	Circuit	SAIFI	Circuit	SAIFI
1	13W1	5.956	211A	8.614	13W2	9.98	7W3	7.38	16X5	11.00
2	8X3	5.847	13W1	6.091	211A	7.01	16X4	6.75	13W2	7.32
3	13W3	5.561	13W2	3.881	13W1	6.28	13W2	6.49	15W2	4.65
4	13W2	4.638	22W1	3.240	22W2	5.04	22W3	6.37	7W3	4.53
5	37X1	4.391	4W3	3.051	14X3	5.00	22W1	6.08	4X1	4.39
6	211A	4.365	13W3	2.748	22W3	4.58	13W1	4.90	15W1	4.04
7	1H5	4.235	22W2	2.720	15W1	3.08	1H4	4.83	4W4	3.60
8	1H3	4.135	15W1	2.277	1H3	3.00	2H2	4.51	13W1	3.57
9	1H4	4.127	18W2	2.004	4W3	2.88	6X3	4.50	8X3	3.48
10	3H2	4.000	37A	1.702	22W1	2.36	16H3	4.33	4W3	2.89

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

5. Circuit Level Reliability Analysis

This section discusses the major reliability performance problems associated with the circuits identified above and provides recommendations to improve their overall performance. The analysis performed as part of this study has identified unacceptable conditions as well as common themes on the circuit level. The recommendations listed below will be compared to the other proposed reliability projects on a system-wide basis. A cost benefit analysis focused on saved customer minutes and saved customer interruptions will determine which projects will be proposed for entry in the 2012-2016 capital budget. Saved customer minutes and saved customer interruptions calculated for each recommended project listed below are derived from a select number of historical Trouble Interruption Reports (TIR's) relevant to the circuit which will benefit from a specific project. The raw outage data from the outage database is reviewed, and based on the project scope, a certain percentage of the total minutes of interruption and customer interruptions can be saved by performing that specific modification to the distribution feeder. Please note that all project costs are shown without general construction overheads.

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

5.1. Circuits 13W2 & 13W3: Rebuild Spacer Cable on High Street & King Street

5.1.1. Identified Problems

One outage on King Street in Boscawen within the last 18 months has resulted in a total of 182,440 customer minutes and 1,291 customer interruptions on circuit 13W2. This represents 16.07% of circuit SAIDI & 9.35% of circuit SAIFI during the time period noted above.

5.1.2. Referenced Trouble Interruption Reports

Table 7

TIR #	Trouble Cause
C09766	Equipment Failure - Company

5.1.3. Recommendations

- ❖ Replace the existing spacer cable on King Street and High Street with new construction.

(Estimated 121,627 customer minutes and 861 customer interruptions saved annually)

- Reconductor from pole 135 to pole 169 on King Street and from pole 1 to pole 37 on High Street in Boscawen (approximately 8,000 feet) with 336 AAC spacer cable.
- Circuits 13W2 and 13W3 shall be combined in the vicinity of pole 169 King Street
- The existing spacer cable currently serving circuit 13W3 shall be removed from service and scraped.
- Use the 052 AWA messenger and 4/0 ACSR for the neutral conductor. These shall be bonded as per Unitil construction standards.
- Two three phase, electronically controlled 600 A reclosers shall be installed in the vicinity of pole 171 Valley of Industry and pole 2 High Street in Boscawen.

5.1.4. Additional Justification

The existing spacer cable on 13W2 and 13W3 is Hendrix cable from the early 1970's with gray insulation with infective UV inhibitor, has been recognized to have issues regarding its dielectric strength has recommended by the manufacturer that it be replaced as soon as it is feasible. Recently the Boscawen area has experienced a great number of faults in the spacer cable due to the insulation break down. Hendrix has recommended the replacement of all gray insulated cable manufactured prior to 1975.

Estimated Project Cost: $ 528,400

5.2. Circuits 13W2 & 13W3: Rebuild Substation Getaway

5.2.1. Identified Problems

Two outages on Depot Street in Boscawen within the 18 months has resulted in a total of 188,544 customer minutes and 2,959 customer interruptions on circuit 13W2. This represents 24.52% of circuit SAIDI & 31.43% of circuit SAIFI during the time period noted above.

5.2.2. Referenced Trouble Interruption Reports

Table 8

TIR #	Trouble Cause
C09047	Squirrel
C09302	Equipment Failure - Company

5.2.3. Recommendations

- ❖ Rebuild the Boscawen substation getaway and replace the existing spacer cable at the getaway and on Depot Road with new construction.

(Estimated 125,696 customer minutes and 1,973 customer interruptions saved annually)

- Circuits 13W2 and 13W3 shall be consolidated to the southwest side of the Boscawen substation getaway on common structures from the station steel to pole 4 Depot Street at which point a 600 A gang operated load break switch shall be installed and remain normally open.

- Circuits 13W1 and 13X4 shall be consolidated to the northeast side of the Boscawen substation getaway on common structures from the station steel to pole 5 Depot Street at which point 13W1 will continue east toward Chichester and 13X4 will continue down Depot Street toward King Street.

- From pole 4 Depot Street to the intersection of Depot Street and King Street, circuit 13W2 shall run on the south side of the road and serve the south load currently served from circuit 13W3 from the 13W2 breaker position. The portion of load which is currently served from the 13W2 breaker position and runs on the north side of Depot Street shall be combine with the north portion of 13W3 and shall be served from the 13W3 breaker position going forward.

- All new construction shall be 336 AAC spacer cable with a 052 AWA messenger and 4/0 ACSR for the neutral conductor. These shall be bonded as per Unitil construction standards.

5.2.4. Additional Justification

The existing spacer cable on 13W2 and 13W3 is Hendrix cable from the early 1970's with gray insulation with infective UV inhibitor, has been recognized to have issues regarding its dielectric strength has recommended by the manufacturer that it be replaced as soon as it is feasible. Recently the Boscawen area has experienced a great number of faults in the spacer cable due to the insulation break down. Hendrix has recommended the replacement of all gray insulated cable manufactured prior to 1975.

Estimated Project Cost: $ 232,521

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

5.3. Circuit 13W2: Install Sectionalizers and Re-coordinate Salisbury Area

5.3.1. Identified Problems

Twenty outages within the last 18 months has resulted in a total of 99,278 customer minutes and 927 customer interruptions on circuit 13W2. This represents 12.91% of circuit SAIDI & 9.85% of circuit SAIFI during the time period noted above.

5.3.2. Referenced Trouble Interruption Reports

Table 9

TIR #	Trouble Cause	TIR #	Trouble Cause
C09265	Broken Tree/Limb	C09622	Broken Tree/Limb
C09052	Broken Tree/Limb	C08735	Broken Tree/Limb
C8250	Broken Tree/Limb	C09678	Squirrel
C08862	Broken Tree/Limb	C08817	Broken Tree/Limb
C08739	Tree/Limb Contact - Growth into Line	C08817	Broken Tree/Limb
C08872	Broken Tree/Limb	C8357	Broken Tree/Limb
C09382	Broken Tree/Limb	C08801	Tree/Limb Contact - Growth into Line
C09537	Broken Tree/Limb	C08794	Broken Tree/Limb
C08772	Squirrel	C08823	Broken Tree/Limb
C08604	Broken Tree/Limb	C09477	Broken Tree/Limb

5.3.3. Recommendations

- ❖ Install sectionalizers in place of the existing fuses currently protecting various laterals in Salisbury. Additional minimal cost improvements as described below are also recommended as part of this project.

(Estimated 21,841 customer minutes and 206 customer interruptions saved annually by sectionalizers alone. Actual reliability savings are predicted to be greater as a result of the additional protection modifications proposed as part of this project.)

- Replace existing fuses at pole 75 Old Turnpike Road, pole 71 Old Turnpike Road, pole 1 Warner Road, and pole 2 Franklin Road all in Salisbury with a cutout mounted sectionalizers.
- Add a fast trip to the High Street Recloser in an effort to further allow for downline faults to be cleared before interrupting load.
- General fuse coordination is to be conducted in the Salisbury Area to provide adequate, coordination, loadability, and sensitivity as per Unitil guidelines.

Estimated Project Cost: $ 8,242

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

5.4. 37 Line: Install Underground Cable

5.4.1. Identified Problems

Three outages within the last two years have resulted in a total of 799,693 customer minutes and 9,536 customer interruptions on all customers served from the 37 Line on the Capital electric system. This represents 100% of circuit SAIDI & 100% of circuit SAIFI during the time period noted above.

5.4.2. Referenced Trouble Interruption Reports

Table 10

TIR #	Trouble Cause
C7788	Broken Tree/Limb
C09609	Broken Tree/Limb
C09747	Broken Tree/Limb

5.4.3. Recommendations

- ❖ Rebuild the portion of the 37 Line in Boscawen from structure 27 to structure 32 with 34.5 kV underground line construction.

(Estimated 399,847 customer minutes and 4,768 customer interruptions saved annually)

- Rebuild from structure 27 to structure 32 on the 37 Line Page St. (approximately 1,200 feet) with 34.5 kV 500 kcmil CU underground conductor.
- A backup run of 34.5 kV 500 kcmil CU underground cable shall also be installed in the same trench to serve the load in the event of a fault on the primary run. This run shall remain energized and fused until needed
- Two 900 Amp three-phase gang operated load break switches shall be installed at the source side riser poles.
- 27 kV cutouts shall be installed on the load side of riser poles.

Estimated Project Cost: $ 148,021

5.5. 8X3: New Circuit 8X4

5.5.1. Identified Problems

Six outages within the last five and a half years have resulted in a total of 1,167,666 customer minutes and 6,737 customer interruptions on the main line of 8X3. This represents 20.15% of circuit SAIDI & 17.26% of circuit SAIFI during the time period noted above.

5.5.2. Referenced Trouble Interruption Reports

Table 10

TIR #	Trouble Cause
C4767	Vehicle Accident
C08457	Vehicle Accident
C09133	Loose/Failed Connection
C8186	Vehicle Accident
C5291	Loose/Failed Connection
C08764	Broken Tree Limb

5.5.3. Recommendations

- ❖ Split 8X3 load by creating new circuit 8X4 served from an additional circuit position at Hollis substation.

(Estimated 212,303 customer minutes and 1,225 customer interruptions saved annually)

- Add a 600A breaker, associated relaying, and ancillary equipment to create a new circuit position for 8X4 at Hollis substation.
- From Hollis substation to the vicinity of pole 118 on Loudon Road (approximately 8,200 feet) circuit 8X4 and 8X3 shall be double circuited on the same structures.
- Re-conductor from pole 118 in Concord to pole 5 in Loudon, along Route 106 (approximately 7,000 feet). This new construction shall be fed from 8X4.
- Extend three phase construction from pole 1 on Staniels Road to the cross section of Ricker Road and King Road in Loudon (approximately 7700 feet). Most of this section will be through territory currently owned by PSNH.
- From pole 1 to pole 2 on King Road and from pole 2 on King Road to pole 180 on Main Street, along Canterbury Road, continue three phase construction (approximately 12000 feet).
- From pole 180 on Main Street to pole 90 on Dover Road in Chichester, continue three phase construction (approximately 2200 feet).
- Move the 500 kVA step downs on poles 164, 165, and 167 to the vicinity of pole 182 on Main Street in Chichester. Move C phase regulator on pole 175 to the vicinity of pole 183 on Main Street in Chichester.
- Install a 250 kVA step down in the vicinity of pole 33 on Center Road.

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

- All new conductor construction shall be built to 35kV using 35kV 336 AAC spacer cable with a 4/0 neutral and shall be fed from new circuit 8X4.

- Use a 052 AWA messenger for all spacer cable construction. The messenger and neutral shall be bonded as per Unitil construction standards.

- A 600 Amp three-phase gang operated load break switch shall be installed in the vicinity of pole 90 on Dover Road, and will facilitate switching during contingency scenarios.

  Estimated Project Cost: $ N/A

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

Table 11
Summarized Projects

Circuit	Number of Years in Worst 10 Circuits		Proposed Projects	Annual Savings		Cost	Cost/Min
	SAIDI	SAIFI		Customer Minutes	Customer Interruptions		
13W2/3	4	5	Rebuild Spacer Cable on High Street & King Street	121,627	861	$528,400	$4.34
13W2/3	4	5	Rebuild Station Getaway	125,696	1,973	$232,521	$1.85
13W2	4	5	Install Sectionalizers and Re-coordinate Salisbury Area	21,841	206	$8,242	$0.38
37 Line	N/A	N/A	Install Underground Cable	399,847	4,768	$148,021	$0.37
8X3	2	2	New Circuit 8X4	212,303	1,225	N/A	N/A
			Total:	889,770	8,853	$917,184	N/A

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

6. Failed Equipment

This section is intended to clearly show all equipment failures throughout the study period from January 2010 through June 2011. It is important to track these failures so that trends, if any exist, can be observed and corrected in an effort to reduce failures of a specific type of equipment in the future. *Figure 1*, shown below, shows all equipment failures throughout the study period. In addition *Figure 2* shows each equipment failure as a percentage of the total failures within this same study period. Finally *Table 11* and *Figure 3* show the top three types of failed equipment within the study period and the yearly count of top three failed equipment for the past five years respectively. Please note that a close look at failed pole mount transformers was conducted, and from this it seems as though the large number of failures is simply due to the fact that the capital system as a whole is aging. This situation will be monitored.

Figure 1
Circuit Interruption Analysis by Cause

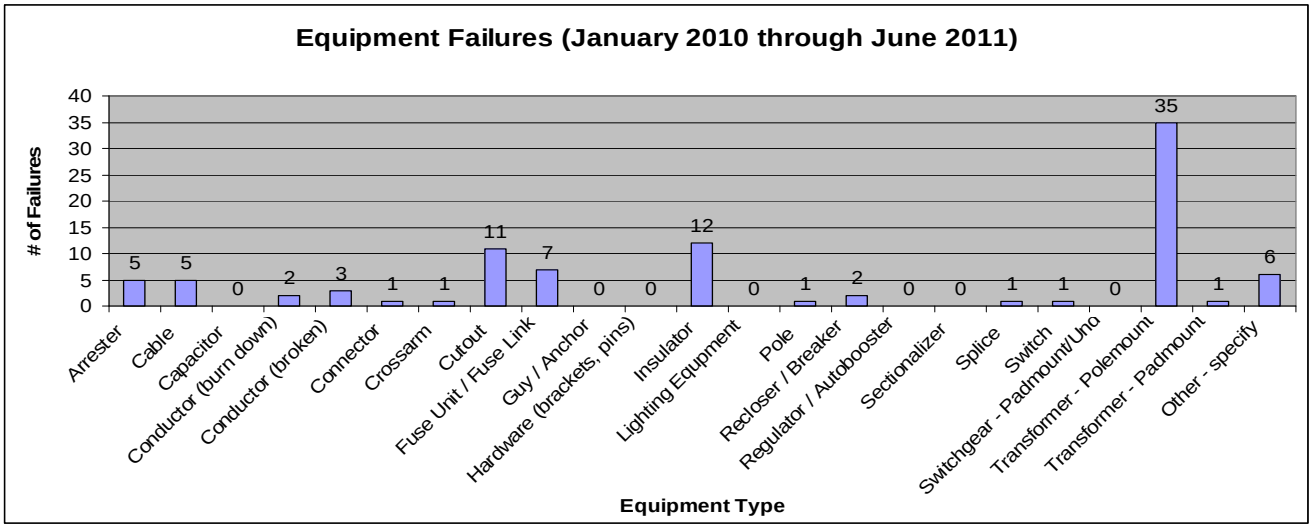
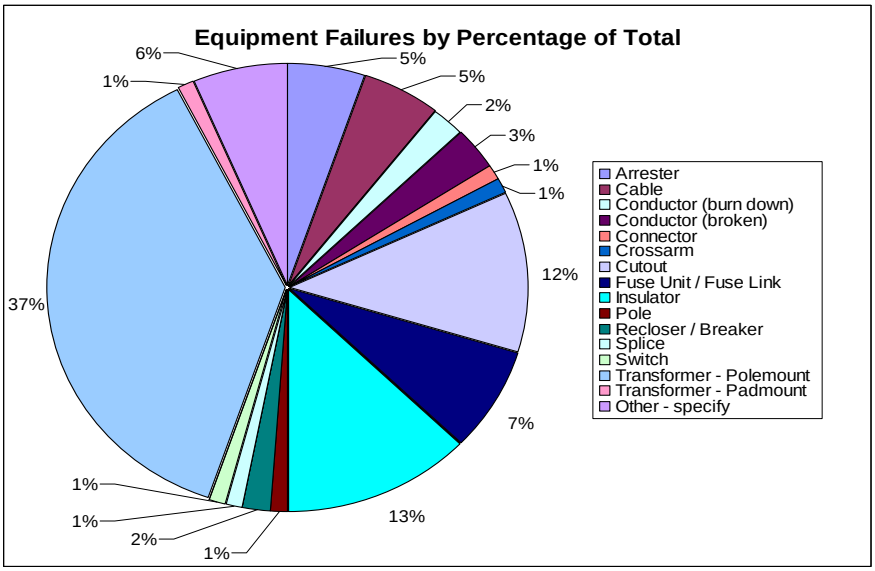


Figure 2
Circuit Interruption Analysis by Percentage of Total Failures



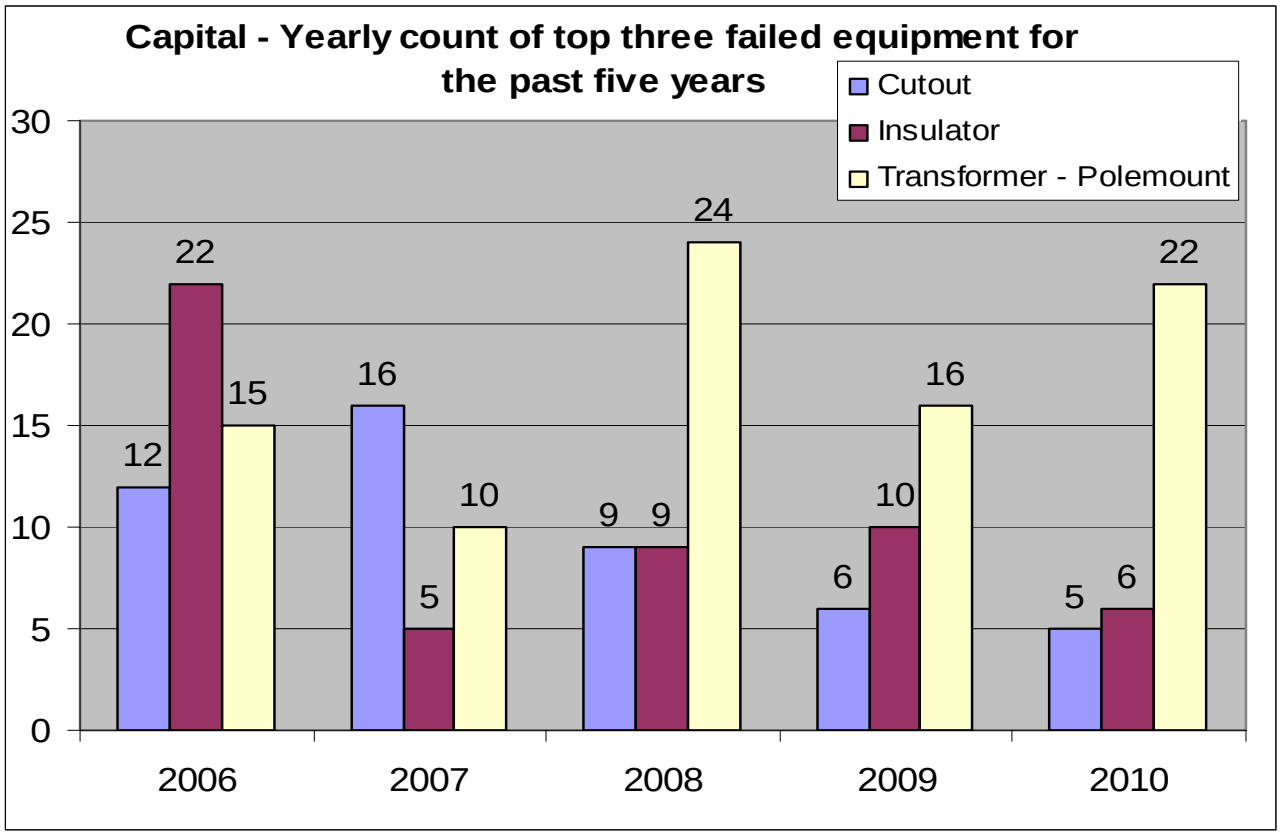
UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

Table 11
Top failed Equipment in the study period

Equipment	Equipment Failures
Cutout	11
Insulator	12
Transformer - Polemount	35

Figure 3
Yearly count of top three failed equipment for the past five years



UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

7. Tree Trimming Recommendations

Tree related outages continue to be a major reliability concern. An effective way of using the tree trimming budget to minimize customer minutes of interruption is to spend more of the trimming budget to trim circuit mainline as well as single phase laterals which are found to be problem areas. In an effort to accurately identify these areas of concern, all tree related outages on the UES Capital System within the past 18 months were sorted by circuit and street and reviewed in terms of each street's contribution to the overall customer interruptions and outages experienced on the system as a whole. To accomplish this, a composite ranking index was created to determine the priority of each street on the system. More specifically, the number of customers interrupted on each street was ranked and the number of outages on each street was ranked. These two ranks were then summed providing a composite rank for each street. *Table 12* and *Table 13* shown below, detail the 50 worst streets in terms of their overall contribution to tree related outages as compared to the entire UES -Capital System. The top 20 are shown graphically in *Figure 4*.

Table 12
Top 50 Streets in Terms of Tree Related Outages

Rank	Circuit	Street	# of Outages	Customer Interruptions
1	13W2	13W2 - Old Turnpike Rd	7	435
2	13W3	13W3 - Queen St	6	460
3	22W3	22W3 - Bow Center Rd	4	1446
4	13W1	13W1 - West Rd	4	971
5	8X3	8X3 - Lane Rd	6	280
6	18W2	18W2 - Bow Bog Rd	5	406
7	8X3	8X3 - Dover Rd	3	2256
8	4W3	4W3 - Sewalls Falls Rd	4	592
9	13W1	13W1 - Old Tilton Rd	6	239
10	13W2	13W2 - Battle St	6	190
11	13W2	13W2 - West Salisbury Rd	5	246
12	22W3	22W3 - Birchdale Rd	3	795
13	22W3	22W3 - Farrington's Corner Rd	4	344
14	4W3	4W3 - Mountain Rd	3	434
15	22W3	22W3 - Page Rd	5	179
16	13W2	13W2 - Franklin Rd	5	174
17	22W3	22W3 - Clinton St	3	263
18	18W2	18W2 - Allen Rd	4	182
19	6X3	6X3 - Pleasant St	2	3549
20	13W1	13W1 - Center Rd	2	3167
21	13W2	13W2 - Warner Rd	6	125
22	4W4	4W4 - North State St	2	2165
23	4W4	4W4 - Lakeview Dr	4	173
24	7W3	7W3 - River Rd	2	1308

Table 13

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

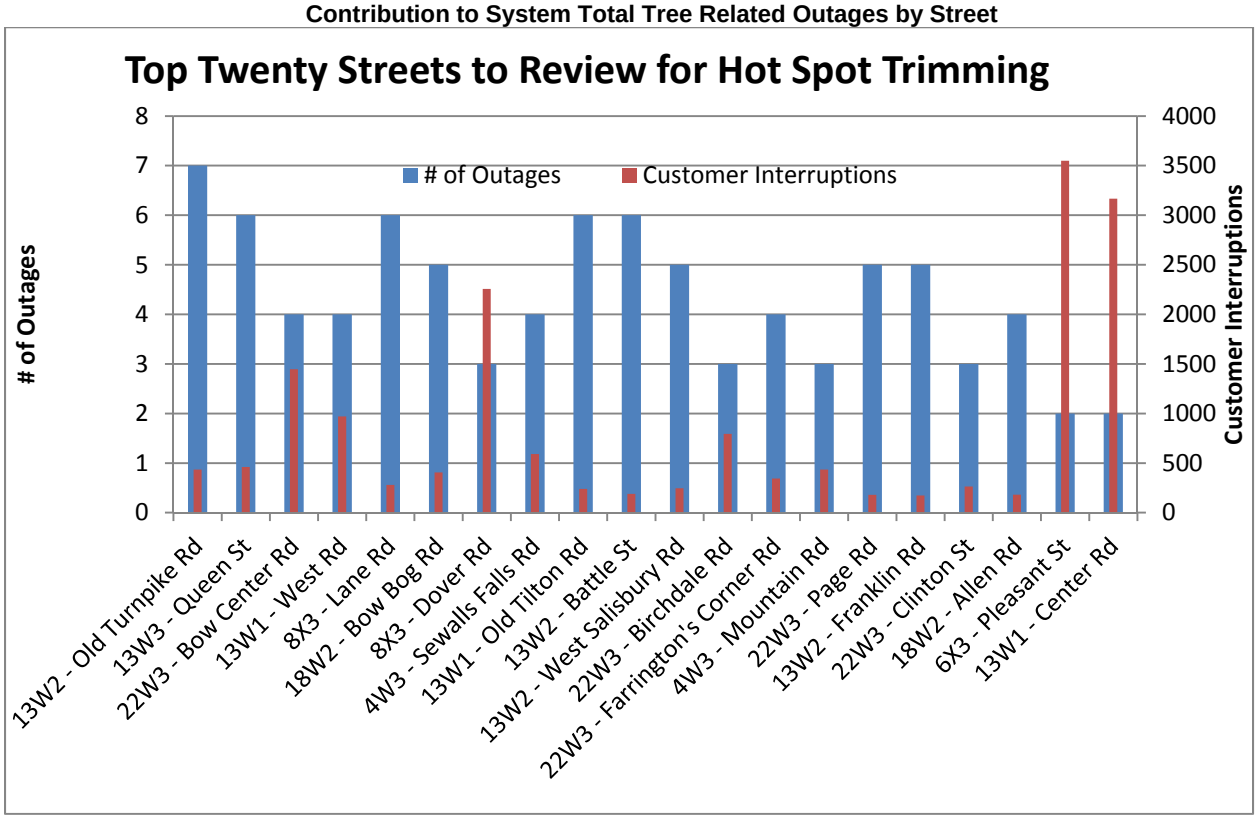
Top 50 Streets in Terms of Tree Related Outages (Continued)

Rank	Circuit	Street	# of Outages	Customer Interruptions
25	13W2	13W2 - Little Hill Rd	6	104
26	8X3	8X3 - New Rye Rd	4	171
27	22W2	22W2 - South St	3	181
28	13W2	13W2 - White Plains Rd	3	179
29	15W2	15W2 - Portsmouth St	2	671
30	8X3	8X3 - New Orchard Rd	3	178
31	37X1	37X1 - Boyce Rd	3	172
32	13W2	13W2 - North Water St	4	117
33	4W3	4W3 - Hoit Rd	3	155
34	37X1	37X1 - Old Boyce Rd	2	366
35	8X3	8X3 - Canterbury Rd	3	150
36	8X3	8X3 - Suncook Valley Hwy. - South	2	290
37	8X3	8X3 - Main St	2	289
38	37X1	37X1 - South West Rd	3	126
39	4W3	4W3 - Sanborn Rd	2	270
40	8X3	8X3 - Granny Howe Rd	6	57
41	13W1	13W1 - Pickard Rd	5	63
42	13W2	13W2 - Whittemore Rd	3	104
43	22W3	22W3 - Hooksett Tpke	2	228
44	22W3	22W3 - Knox Rd	2	184
45	15W1	15W1 - Snow Pond Rd	3	87
46	4W4	4W4 - Fisherville Rd	1	2125
47	4W4	4W4 - Hutchins St	2	180
48	15W1	15W1 - Mountain Rd	1	1051
49	8X3	8X3 - Mountain Rd	3	80
50	13W3	13W3 - King St	1	960

UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

Figure 4
Contribution to System Total Tree Related Outages by Street



UES - Capital Reliability Analysis and Recommendations 2011

November 14, 2011

8. Conclusion

During the past eighteen months, the Capital system has been greatly affected by interruptions involving trees. Out of the ten worst performing circuits covered in this study with regard to customer minutes, 51% of the total customer minutes for these circuits are due to tree related outages.

Projects developed from this study focus on areas of tree related outages as well as other types of outages and ways to prevent or minimize the reliability impact of these outages. Field work is in the process of being completed to analyze areas affected by broken tree limbs that fall from high above our trim zone. These areas provide ideal situations for the implementation of spacer cable to prevent outages due to falling tree limbs. In addition, new ideas and solutions to reliability problems are always being explored in an attempt to provide the most reliable service possible.

Attachment 3

UES - Seacoast

Reliability Analysis and Recommendations 2011

Unitil Energy Systems – Seacoast

Reliability Study
2011

Prepared By:

Nathan Sherwood
Unitil Service Corp.
December 6, 2011

1 Summary

The purpose of this document is to report on the overall reliability performance of the UES-Seacoast system January 1, 2010 through June 30, 2011. The scope of this report will also evaluate individual circuit reliability performance over the same time period.

The recommendations provided in this study are focused on improving the worst performing circuits as well as the overall UES-Seacoast system reliability. These recommendations are provided for consideration and will be further developed with the intention to be incorporated into the 2012 budget development process. All reliability data presented in this report is without exclusions taken.

2 Reliability Goals

The annual corporate system reliability goals for 2011 have been set at 191-156-121 SAIDI minutes. These were developed through benchmarking Unitil system performance with surrounding utilities.

Individual circuits will be analyzed based upon circuit SAIDI, SAIFI, and CAIDI. Analysis of individual circuits along with analysis of the entire Seacoast system is used to identify future capital improvement projects and/or operational enhancements which may be required in order to achieve and maintain these goals.

3 Top 10 Worst Outages

The ten worst outages ranked by customer-minutes of interruption during the time period from January 1, 2010 through June 30, 2011 are summarized in Table 1 below.

Table 1
Worst Ten Outages

Trouble Location	Description (Date/Cause)	No. of Customers Affected	No. of Customer Minutes	UES Seacoast SAIDI (min.)	UES Seacoast SAIFI
Line 3342	2/16/10 Broken Tree/ Limb	6,534	1,154,673	25.76	0.146
Line 3359	3/15/10 Broken Tree/ Limb	5,964	731,614	16.32	0.133
Timberlane S/S	5/16/11 Equipment Failure-Company (Insulator)	2,532	644,822	14.38	0.056
Guinea Sw/S	3/29/10 Equipment Failure-Company (Insulator)	8,352	609,696	13.60	0.186
Line 3351	3/15/10 Broken Tree/ Limb	5,575	373,740	8.34	0.124
7X2	6/16/11 Vehicle Accident	1,720	269,384	6.01	0.038
Line 3341	4/10/10 Broken Tree/ Limb	5,575	264,579	5.90	0.124
18X1	3/15/10 Broken Tree/ Limb	2,632	247,408	5.52	0.059
51X1	9/17/10 Broken Tree/ Limb	1,801	238,389	5.32	0.040
21W1	5/4/10 Tree/ Limb Contact- Growth into Line	1,155	231,955	5.17	0.026

4 Contribution of Sub-transmission Outages to Circuit SAIDI

This section describes the contribution of sub-transmission line to the individual circuit SAIDI from January 1, 2010 through June 30, 2011.

Table 2 shows the circuits that have been affected by sub-transmission line outages. The table lists the amount of customer minutes of interruption (CMI) caused by the sub-transmission line outage for each circuit and compares those CMI to the total CMI each circuit has experienced. By analyzing the contribution of sub-transmission line outages to the SAIDI performance of a circuit, it can be shown that either outages on the circuit or outages on the sub-transmission line serving the circuit are the major contributor to the circuit SAIDI. In aggregate, sub-transmission line outages accounted for 20% of the total customer-minutes for UES-Seacoast, excluding the February 25th wind storm.

Table 2
Contribution of Sub-transmission Outages

Circuit	Sub transmission Line Outage	Customer-Minutes of Interruption	% of Total Circuit Minutes	Circuit SAIDI Contribution	# of events experience by circuit
11W1	Line 3341 Line 3351	53,295	20.77%	93.68	2
11X2	Line 3341 Line 3351	93,100	74.99%	95.53	2
51X1	Line 3341 Line 3351	302,854	24.83%	163.23	2
20H1	Line 3341 Line 3351	49,420	36.97%	72.48	2
47X1	Line 3341 Line 3351	139,650	47.88%	95.67	2
46X1	Line 3342	261,648	88.64%	267.35	1
2X2	Line 3342	113,988	51.95%	69.86	1
3W4	Line 3342	141,201	64.13%	90.87	1
17W1	Line 3342	473,064	93.50%	271.34	1
17W2	Line 3342	164,772	76.06%	274.96	1
43X1	Line 3343	100,377	29.99%	57.37	1
27X1	Line 3343	29,463	38.74%	63.46	1
28X1	Line 3343	15,548	34.91%	69.95	1
23X1	Line 3359	75,375	15.69%	67.76	1
59X1	Line 3359	153,435	29.18%	157.69	1
15X1	Line 3359	95,142	24.73%	100.70	1
7X2	Line 3359	226,776	28.38%	131.92	1
7W1	Line 3359	180,886	34.85%	148.65	1
54X1	Line 3354	84,120	23.92%	60.27	1
6W1	Line 3354	104,920	24.67%	61.61	1

5 Worst Performing Circuits

This section compares the reliability of the worst performing circuits using various performance measures.

5.1 Worst Performing Circuits in Past Eighteen Months (1/1/10 – 6/30/11)

A summary of the worst performing circuits during the time period between January 1, 2010 and June 30, 2011 is included in the tables below.

Table 3 shows the ten worst circuits ranked by the total number of Customer-Minutes of interruption. The SAIFI and CAIDI for each circuit are also listed in this table.

Table 4 provides detail on the major causes of the outages on each of these circuits. Customer-minutes of interruption are given for the six most prevalent causes.

Table 3
Worst Performing Circuits Ranked by Customer-Minutes

Circuit	No. of Customers Interruptions	Worst Event (% of Total Cust. Int.)	Customer-Minutes of Interruption	Worst Event (% of Total Minutes)	Circuit SAIDI	Circuit SAIFI	Circuit CAIDI
22X1	19,579.00	10%	1,766,348	13%	878.40	9.74	90.22
51X1	13,547.00	13%	1,219,657	20%	657.37	7.30	90.03
13W2	7,081.00	21%	984,056	55%	681.23	4.90	138.97
18X1	10,328.00	25%	844,256	29%	322.22	3.94	81.74
7X2	6,903.00	25%	799,136	34%	464.87	4.02	115.77
58X1	6,034.00	9%	709,441	26%	330.41	2.81	117.57
19X3	8,872.00	10%	548,439	23%	163.87	2.65	61.82
59X1	3,877.00	25%	525,894	43%	540.47	3.98	135.64
7W1	3,876.00	32%	518,983	42%	426.49	3.19	133.90
17W1	2,087.00	82%	505,950	94%	290.20	1.20	242.43

Table 4
Circuit Interruption Analysis by Cause

Circuit	Customer – Minutes of Interruption					
	Broken Tree Limb	**Company Equipment Failure**	**Lightning Strike**	**Tree Growth into Line**	**Vehicle Accident**	**Animal**
22X1	1,302,440	162,516	38,090	1,023	225,062	0
51X1	846,531	177,812	9,309	112,368	1,950	38,875
13W2	361,190	541,540	27,549	8,845	0	3,464
18X1	279,450	202,467	176,276	6,558	0	810
7X2	257,978	202,948	0	1,829	285,184	0
58X1	269,264	64,276	18,114	65,638	186,833	26,892
19X3	170,526	148,138	0	7,951	70,010	4,756
59X1	393,199	70,628	0	21,275	888	0
7W1	180,886	308,762	0	3,690	0	5,348
17W1	490,594	1,764	0	780	0	4,950
Total	**4,552,058**	**1,880,851**	**269,338**	**229,957**	**769,927**	**85,095**

5.2 Worst Performing Circuits of the Past Five Years (2006 – 2010)

The annual performance of the ten worst circuits for the past five years has been ranked in the tables below. *Table 5* lists the ten worst circuits ranked by SAIDI performance. *Table 6* lists the ten worst performing circuits ranked by SAIFI.

Table 5
Circuit SAIDI

Circuit Ranking (1 = worst)	2010		2009		2008		2007		2006	
	Circuit	SAIDI	Circuit	SAIDI	Circuit	SAIDI	Circuit	SAIDI	Circuit	SAIDI
1	51X1	582.06	15X1	526.90	6W1	1033.5	21W1	1082.1	51X1	952.13
2	3H2	575.51	22X1	526.47	21W1	580.27	13W2	1031.4	21W1	754.86
3	22X1	518.07	5H2	444.34	5H2	442.97	27X1	974.02	13W2	730.43
4	59X1	509.53	56X2	430.31	51X1	438.66	22X1	697.94	7W1	583.70
5	15X1	387.88	13W2	414.30	20H1	360.47	13W1	613.90	6W1	583.62
6	23X1	378.56	13W1	365.14	21W2	350.88	11W1	592.79	1X5	519.69
7	17W2	361.53	23X1	339.98	7X2	347.68	18X1	521.24	47X1	499.60
8	58X1	308.72	18X1	323.54	56X2	323.79	47X1	517.21	11W1	439.01
9	46X1	306.30	3H1	260.91	58X1	308.38	6W1	480.12	18X1	381.52
10	21W1	291.33	21W2	260.71	23X1	284.28	7W1	465.33	5H2	354.85

Circuit 22X1 and circuit 15X1 are the only two circuits that are in the worst 5 performing circuits (worst 10% of circuits) the past two years. There are projects to install reclosers on 15X1 and 22X1 that should be completed in late 2011 or early 2012 that should help improve reliability on these circuits.

Circuit 51X1 was the worst performing circuit in 2010 mostly due to the 51X1 recloser failing at Winnicutt Road tap. Circuit 51X1 has recently been aggressively trimmed and cutout mounted sectionalizers where recommended in this study for improved sectionalizing.

Table 6
Circuit SAIFI

Circuit Ranking (1 = worst)	2010		2009		2008		2007		2006	
	Circuit	SAIFI	Circuit	SAIFI	Circuit	SAIFI	Circuit	SAIFI	Circuit	SAIFI
1	51X1	6.65	22X1	6.10	21W1	5.35	27X1	9.573	13W2	7.982
2	3H2	6.01	18X1	5.23	51X1	4.41	13W2	9.565	21W1	7.419
3	22X1	5.21	5H2	5.06	6W1	2.83	21W1	8.570	51X1	6.574
4	15X1	4.38	15X1	4.96	20H1	2.46	22X1	7.889	1H2	6.031
5	23X1	3.77	13W2	4.70	56X2	2.33	18X1	5.156	1X5	5.431
6	59X1	3.43	56X2	4.52	21W2	2.33	13W1	4.673	1H3	5.233
7	11W1	3.29	3H1	4.06	23X1	2.31	47X1	4.639	1H4	5.005
8	13W2	3.21	13W1	3.91	7X2	2.17	11W1	4.615	19H1	4.738
9	28X1	3.07	21W2	3.91	59X1	2.14	6W1	4.235	19X2	4.434
10	20H1	3.01	21W1	3.89	5H2	1.94	43X1	4.057	22X1	4.017

6 Analysis and Recommendations

This section discusses the major reliability performance problems associated with the circuits identified above and provides recommendations to improve their overall performance. The analysis performed as part of this study has identified unacceptable conditions as well as common themes on the circuit level. This section also includes recommendations on circuits, sub-transmission lines and substations not necessarily mentioned above, but that have developed and recommended for additional system reliability improvement. The recommendations listed below will be compared to the other proposed reliability projects on a system-wide basis. A cost benefit analysis focused on saved customer minutes and saved customer interruptions will determine the priority ranking of projects for the 2012 capital budget. Customer-minutes and customer-interruptions saved are calculated for each recommended project using a select number of historical Trouble Interruption Reports (TIRs) relevant to the circuit which will benefit from the project. The raw outage data from the outage database is reviewed, and based on the project scope, a certain percentage of the total minutes of interruption and customer interruptions can be saved by performing that specific project. All project costs are shown without general construction overheads.

6.1 3359 Line

6.1.1 Identified Concerns

Two outages, one caused by a broken tree/limb and one caused by an equipment failure have accounted for a total of 320,682 customer-minutes of interruption and 14,316 customer interruptions from January 1, 2010 to June 30, 2011.

Referenced Trouble Interruption Reports: E14091 and E14199

6.1.2 Recommendation

Install (3) – SCADA controlled switching devices in place of the existing 2X3J15X1, 15X1J59X1-1 and 23X1J59X1 gang operated switches. By having SCADA control of these switching points will allow all restoration switching for circuits 15X1, 23X1 and 59X1 to be accomplished via SCADA for loss of the 3359 line. The customer minute savings are based on reduced outage times of 10 minutes for E14091 and 30 minutes for E14199.

- Estimated annual customer-minutes savings = 269,929
- Estimated annual customer-interruption savings = 1,857

Estimated Project Cost: $177,702

6.2 Circuit 3H2 – Brown Avenue

6.2.1 Identified Concerns

Four outages caused by the phase conductors galloping and coming in contact with each other on 3H2 accounted for a total of 153,897 customer-minutes of interruption and 1,367 customer interruptions from January 1, 2010 to June 30, 2011. It has been determined that the existing single pin spacing for circuits 3H2 and 3H3 is not sufficient to prevent the phase conductors from coming in contact with each other during galloping conditions.

Referenced Trouble Interruption Reports: E14044, E14048, E14077 and E15534

6.2.2 Recommendation

On Brown Avenue from pole 49/19 to 39/6, replace the existing 8 foot crossarms currently supporting circuit 3H2 and 3H3 with 12 foot cross arms to achieve double pin phase spacing.

- Estimated annual customer-minutes savings = 102,598
- Estimated annual customer-interruption savings = 911

Estimated Project Cost: $16,601

6.3 Circuit 13W2 – Thornell Road

6.3.1 Identified Concerns

Five outages, three caused by broken tree limbs, one lightning strike (with no associated damage) and one tree contact on 13W2 in Newton accounted for a total of 62,503 customer-minutes of interruption and 697 customer interruptions from January 1, 2010 to June 30, 2011.

Referenced Trouble Interruption Reports: E14590, E14798, E15087, E15228 and E15915

6.3.2 Recommendation

Install (3) – Cooper V4L 140 A reclosers on pole 29/33 Thornell Road in Newton. Relocate the existing cutout mounted sectionalizers on pole 52/17 Main Street to pole 36/27 Crane's Crossing Road in Newton.

- Estimated annual customer-minutes savings = 22,761
- Estimated annual customer-interruption savings = 242

Estimated Project Cost: $34,322

6.4 Circuit 18X1

6.4.1 Identified Concerns

Eight outages on circuit 18X1 in Hampton accounted for a total of 1,357,438 customer-minutes of interruption and 19,423 customer interruptions from April 30, 2008 to April 30, 2011.

Referenced Trouble Interruption Reports: E13354, E12068, E13692, E12960, E14076, E15089, E13366 and E15938

6.4.2 Recommendation

Install three phase reclosers; one on pole 123 Exeter Road, pole 153 Exeter Road and pole 65 Lafayette Road. The recloser being installed on pole 103 Exeter Road will also be utilized. A distribution automation scheme will be set up using SEL radio and antenna technology between the four distribution reclosers and the circuit 18X1 breaker and circuit 2X2 recloser. A distribution automation controller will also be purchased and installed to manage the scheme.

- Estimated annual customer-minutes savings = 88,611
- Estimated annual customer-interruption savings = 1,606

Estimated Project Cost: $202,500

6.5 Circuit 19X3

6.5.1 Identified Concerns

Four outages, two caused by broken tree limbs, one loose/failed connection and one patrolled nothing found on 19X3 in Exeter accounted for a total of 271,635 customer-minutes of interruption and 4,344 customer interruptions from June 30, 2009 to June 30, 2011.

Referenced Trouble Interruption Reports: E14662, E13005, E15552 and E16483

6.5.2 Recommendation

Install (3) – cutout mounted sectionalizers on pole 61/15 Epping Road in Exeter. Relocate the existing cutout mounted sectionalizers on pole 149/2 Pine Street to pole 70/29 Front Street in Exeter.

- Estimated annual customer-minutes savings = 89,729
- Estimated annual customer-interruption savings = 1,423

Estimated Project Cost: $11,508

6.6 Circuit 43X1 – Willow Road Tap

6.6.1 Identified Concerns

One outage caused by a broken tree limb on the 3343 Line has accounted for a total of 145,388 customer-minutes of interruption and 2,357 customer interruptions from January 1, 2010 to June 30, 2011. Historically faults have occurred on the 3343 Line every two years or so.

Referenced Trouble Interruption Report: E14489

6.6.2 Recommendation

Install (2) - three phase load break switching devices at the Willow Road Tap on the 3343 and 3354 lines. The switching devices will be configured for automatic transfer for Willow Road Tap between the 3343 and 3354 lines.

- Estimated annual customer-minutes savings = 50,189
- Estimated annual customer- interruption savings = 881

Estimated Project Cost: $147,220

6.7 Circuit 43X1 – Exeter Road

6.7.1 Identified Concerns

Two outages caused by broken tree limbs on 43X1accounted for a total of 125,264 customer-minutes of interruption and 1,046 customer interruptions from June 30, 2009 to June 30, 2011.

Referenced Trouble Interruption Reports: E13526 and E14799

6.7.2 Recommendation

Install a three phase electronically controlled recloser on pole 47/55 Exeter Road in Kingston. Install (3) – cutout mounted sectionalizers on pole 219/77 Kingston Road in Exeter.

- Estimated annual customer-minutes savings = 23,640
- Estimated annual customer-interruption savings = 196

Estimated Project Cost: $49,719

6.8 Circuit 47X1 – Stratham Heights Road

6.8.1 Identified Concerns

Two outages caused by lightning (with no associated damage) on 47X1 accounted for a total of 53,724 customer-minutes of interruption and 484 customer interruptions from January 1, 2010 to June 30, 2011.

Referenced Trouble Interruption Reports: E14841 and E14573

6.8.2 Recommendation

Install a three phase electronically controlled recloser on pole 112/73 Stratham Heights Road in Stratham. Install (3) – cutout mounted sectionalizers on pole 16/71 and (3) on pole 16/70 Heights Road in Stratham.

- Estimated annual customer-minutes savings = 35,816
- Estimated annual customer-interruption savings = 323

Estimated Project Cost: $52,615

6.9 Circuit 51X1 – Winnicutt Road

6.9.1 Identified Concerns

Five outages, two caused by tree contact/growth into line and three caused by broken tree limbs on 51X1 on Winnicutt Road in Stratham accounted for a total of 405,812 customer-minutes of interruption and 4,441 customer interruptions from January 1, 2010 to June 30, 2011.

Referenced Trouble Interruption Reports: E13773, E14335, E14908, E15112 and E15190

6.9.2 Recommendation

Install (3) – cutout mounted sectionalizers on pole 107/36 Winnicutt Road in Stratham.

- Estimated annual customer-minutes savings = 4,434
- Estimated annual customer-interruption savings = 48

Estimated Project Cost: $9,124

6.10 Circuit 51X1 – Union Road

6.10.1 Identified Concerns

Three outages, two caused by broken tree limbs and one equipment failure beyond the 51X1U recloser on Winnicutt Road in Stratham accounted for a total of 123,832 customer-minutes of interruption and 1,537 customer interruptions from June 30, 2009 to June 30, 2011.

Referenced Trouble Interruption Reports: E14672, E12865 and E13528

6.10.2 Recommendation

Install (3) – cutout mounted sectionalizers on pole 40/43 High Street in Stratham.

- Estimated annual customer-minutes savings = 23,055
- Estimated annual customer-interruption savings = 317

Estimated Project Cost: $9,124

6.11 Circuit 58X1

6.11.1 Identified Concerns

Three outages caused by broken tree limbs on 58X1 on South Main Street in Plaistow accounted for a total of 74,897 customer-minutes of interruption and 669 customer interruptions from June 30, 2009 to June 30, 2011.

Referenced Trouble Interruption Reports: E14434, E13513, E13632

6.11.2 Recommendation

Install (3) – cutout mounted sectionalizers on pole 91/51 South Main Street in Plaistow.

- Estimated annual customer-minutes savings = 12,358
- Estimated annual customer-interruption savings = 110

Estimated Project Cost: $9,124

Table 7
Summary of Recommended Projects

Circuit /Line	# of years in Worst 10%		Proposed Project	Annual Savings		Cost ($)	Cost/ Cust. Min.
	SADI	SAFI		Customer Min.	Customer Int.		
3359 Line (23X1, 59X1, 15X1)	1	2	Install SCADA Operated Switches 2X3, 15X1, 23X1, 59X1	269,929	1,857	$ 177,702	$ 0.52
3H2	1	1	Circuit 3H2/3H3 Increase Phase Spacing	102,598	911	$ 16,601	$ 0.16
13W2	2	2	Circuit 13W2 Install Reclosers Thornell Road	22,761	242	$ 34,322	$ 1.51
18X1, 2X2	0	1	Circuit 18X1, 2X2 Distribution Automation	88,611	1,606	$ 202,500	$ 2.29
19X3	0	0	Circuit 19X3 Install Cutout Mounted Sectionalizers	89,729	1,423	$ 11,508	$ 0.13
43X1	0	0	Willow Road Tap Autotransfer	50,189	881	$ 147,220	$ 2.93
43X1	0	0	Circuit 43X1 Install Recloser Exeter Road	23,640	196	$ 49,719	$ 2.10
47X1	0	0	Circuit 47X1 Install Recloser Stratham Heights Road	35,816	323	$ 52,615	$ 1.47
51X1	2	3	Circuit 51X1 Install Cutout Mounted Sectionalizers Winnicutt Road	4,434	48	$ 9,124	$ 2.06
51X1	2	3	Circuit 51X1 Install Cutout Mounted Sectionalizers High Street	23,055	317	$ 9,124	$ 0.40
58X1	0	0	Circuit 58X1 Install Cutout Mounted Sectionalizers South Main Street	12,358	110	$ 9,124	$ 0.74
Total:				**723,120**	**7,914**	**$719,559**	

7 Failed Equipment

This section is intended to clearly show all equipment failures throughout the study period from January 2010 through June 2011. It is important to track these failures so that trends, if any exist, can be observed and corrected in an effort to reduce failures of a specific type of equipment in the future. *Chart 1*, shown below, shows all equipment failures throughout the study period. In addition, *Chart 2* shows each equipment failure as a percentage of the total failures within this same study period. The number of equipment failures in each of the top three categories of failed equipment for the past five years are shown below in *Chart 3*.

Chart 1
Circuit Interruption Analysis by Cause

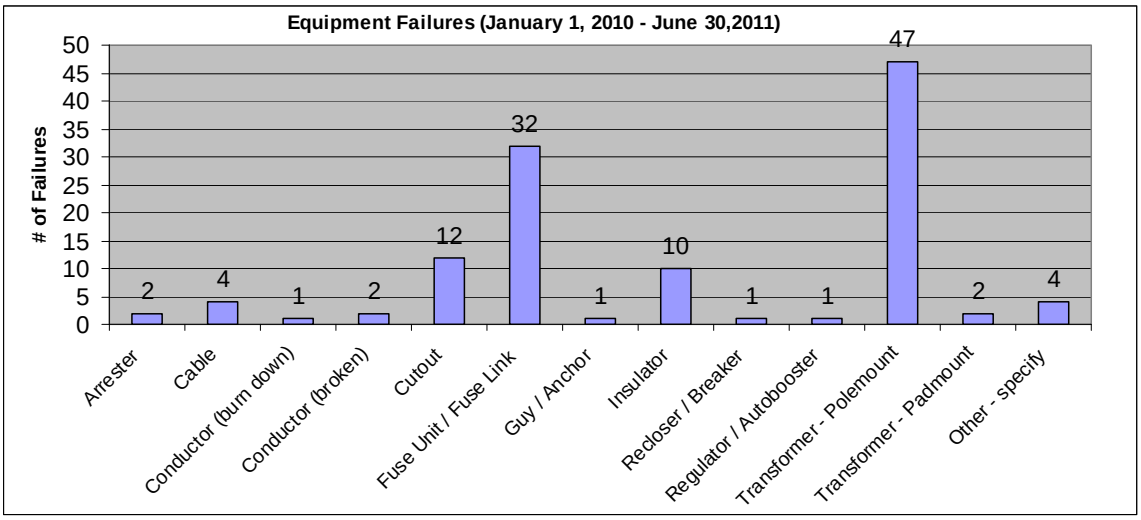


Chart 2
Circuit Interruption Analysis by Percentage of Total Failures

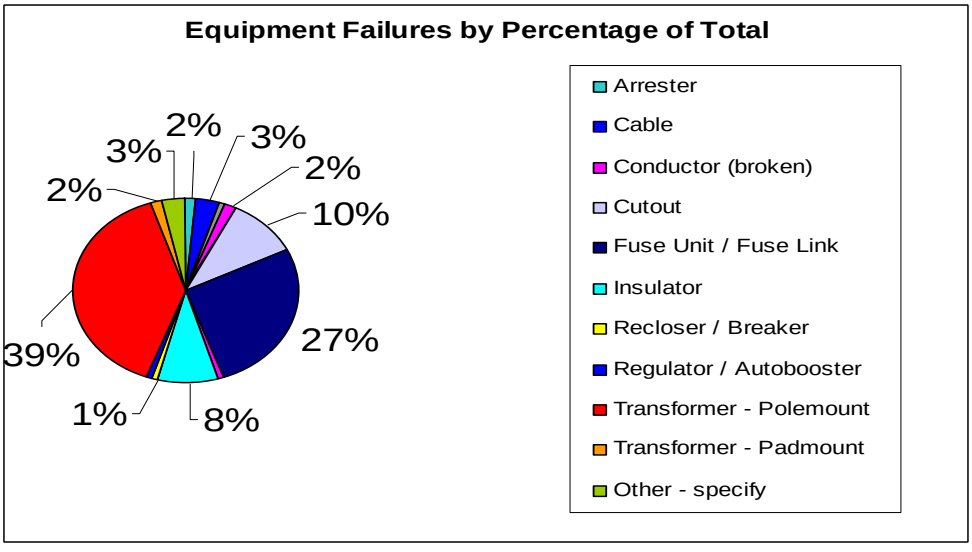
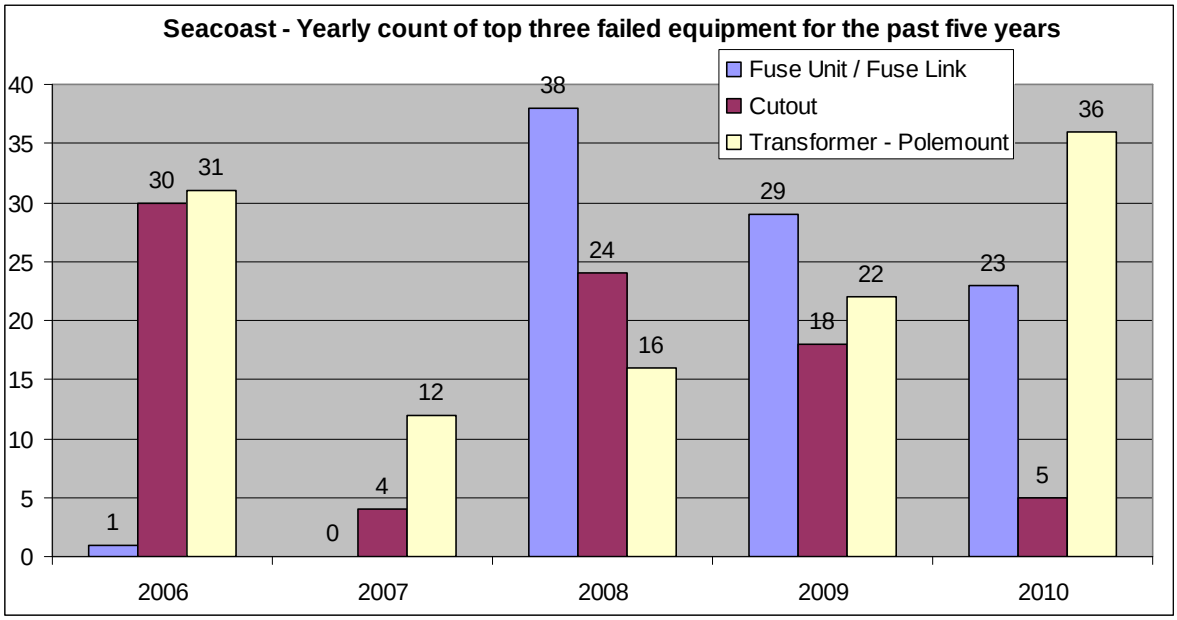


Chart 3
Annual Equipment Failures by Category (top three)



Note: Fuse Unit/Fuse link failures are failures of a particular model of Current Limiting Fuse known to be defective. The identified model of Current Limiting Fuse is no longer being installed and is being replaced when practical.

8 Tree Trimming Recommendations

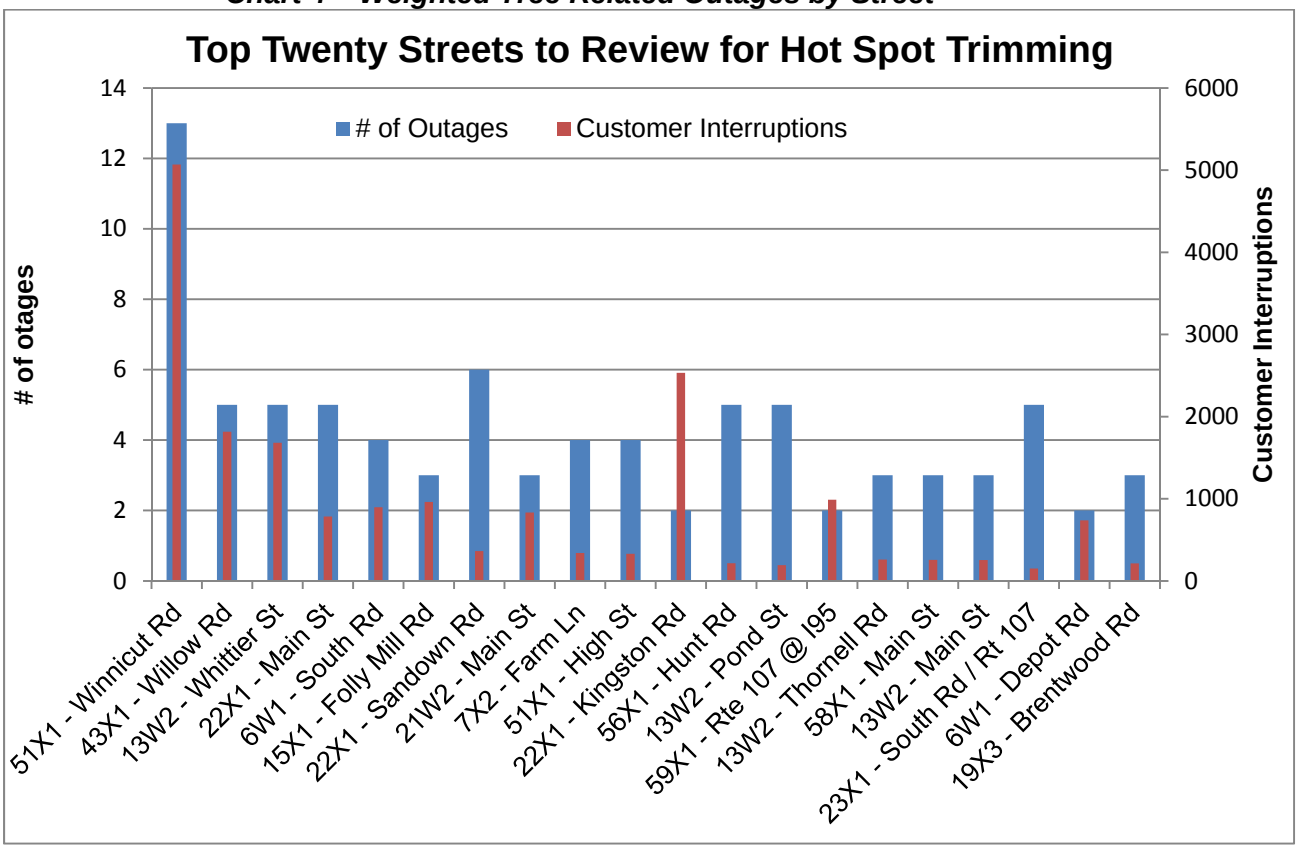
Tree related outages continue to be a major reliability concern. An effective way of using the tree trimming budget to minimize customer minutes of interruption is to spend more of the trimming budget to trim circuit mainline as well as single phase laterals which are found to be problem areas. In an effort to accurately identify these areas of concern, all tree related outages on the UES Seacoast System within the past 18 months were sorted by circuit and street and reviewed in terms of each streets contribution to the overall customer interruptions and outages experienced on the system as a whole. To accomplish this, the number of outages and the number of customer interruptions were ranked by street individually and the individual rankings were then summed to create the ranking listed below. Table 8 shown below details the 50 worst streets in terms of their overall contribution to tree related outages as compared to the entire UES –Seacoast System. The top 20 are shown graphically in Chart 4.

Table 8
Tree Related Outages by Street

Rank	Circuit	Street	# of Outages	Customer Interruptions
1	51X1	51X1 - Winnicutt Rd	13	5069
2	43X1	43X1 - Willow Rd	5	1816
3	13W2	13W2 - Whittier St	5	1681
4	22X1	22X1 - Main St	5	784
5	6W1	6W1 - South Rd	4	897
6	15X1	15X1 - Folly Mill Rd	3	961
7	22X1	22X1 - Sandown Rd	6	364
8	21W2	21W2 - Main St	3	833
9	7X2	7X2 - Farm Ln	4	339
10	51X1	51X1 - High St	4	330
11	22X1	22X1 - Kingston Rd	2	2533
12	56X1	56X1 - Hunt Rd	5	215
13	13W2	13W2 - Pond St	5	191
14	59X1	59X1 - Rt. 107 @ I95	2	989
15	13W2	13W2 - Thornell Rd	3	260
16	58X1	58X1 - Main St	3	256
17	13W2	13W2 - Main St	3	255
18	23X1	23X1 - South Rd / Rt. 107	5	151
19	6W1	6W1 - Depot Rd	2	738
20	19X3	19X3 - Brentwood Rd	3	214
21	43X1	43X1 - Kingston Rd	2	550
22	13W1	13W1 - North Main St	3	187
23	6W1	6W1 - North Rd	3	187
24	13W1	13W1 - Walton Rd	2	334
25	18X1	18X1 - Towle Farm Rd	2	323
26	21W1	21W1 - Coventry Rd	3	138
27	6W1	6W1 - Hilldale Ave / Peak Rd	6	84
28	58X1	58X1 - Whitton Pl	2	287
29	6W1	6W1 - Powwow River Rd	3	137

30	21W2	21W2 - Maple Ave	3	136
31	17W2	17W2 - Woodland Rd	2	222
32	2X3	2X3 - Drinkwater Rd	3	112
33	13W2	13W2 - Highland Rd	2	174
34	22X1	22X1 - Long Pond Rd	3	87
35	58X1	58X1 - Forest St	2	171
36	58X1	58X1 - Newton Rd	2	167
37	54X1	54X1 - Amesbury Rd	2	161
38	51X1	51X1 - Tansy Ave	2	154
39	58X1	58X1 - Sweet Hill Rd	1	2146
40	6W1	6W1 - Haverhill Rd	3	79
41	22X1	22X1 - Pleasant St	1	1982
42	19X3	19X3 - Railroad Ave	1	1740
43	13W2	13W2 - Cranes Crossing Rd	1	1448
44	11X2	11X2 - Hampton Falls Rd	2	128
45	21W1	21W1 - Walker Rd	2	121
46	19X3	19X3 - Beech Hill Rd	2	112
47	51X1	51X1 - Lovell Rd	1	752
48	13W2	13W2 - West Main St	1	625
49	18X1	18X1 - Mill Rd	2	99
50	20H1	20H1 - Exeter Rd	2	98

Chart 4 – Weighted Tree Related Outages by Street



9 Conclusion

The UES-Seacoast system continues to experience a large number of outages caused by tree contact. A more aggressive tree trimming program began this year and should start to reduce the number of tree related outages experienced in the future. Reliability projects are beginning to have a higher cost per customer minute ratio as the more cost effective projects have already been implemented. The recommendations made for capital improvement projects within this report are aimed at making use of reclosing, either by the installation of new reclosers or cutout mounted sectionalizers. It has been determined that the cutout mounted sectionalizers have a history of operating properly in a three phase application only when the up-line recloser is set for three phase tripping. The up-line recloser will be set for three phase tripping and single phase lockout for cutout mounted sectionalizer installations specified in the report.

Attachment 4

REP Project Listing

2011 Actual Expenditures

Unitil Energy Systems
REP Project Spending 2011
All projects closed to Plant In Service

Budget Number	Auth #	Description	Budget	Installation Costs	Cost of Removal	Salvage	Total Project Spending
System Hardening Reliability							
C-DPB01	C-1013	Distribution Pole Replacement	$335,286	$323,898	$52,359	($417)	$375,841
S-DPB01	E-1036	Distribution Pole Replacement	$549,698	$390,588	$98,448	($1,149)	$487,887
		Subtotal	$884,984	$714,486	$150,807	($1,566)	$863,728
Asset Replacement							
C-DRB08	C-1077	Sewalls Falls Rd., Concord - Install 3 Reclosers	$47,800	$28,780			$28,780
C-DRC14	C-1069	N Main St., Penacook Cir 4X1 Extension	$38,900	$40,764		($36)	$40,728
S-DRC01	E-0254	Install recloser at 22 X 1	$98,000	$102,893	$1,660	($11)	$104,542
S-DRC05	E-0256	Install recloser at 23 X 1	$101,400	$95,691	$6,493		$102,184
S-DRC02	E-0264	Install recloser at 18 X 1	$100,800	$89,306	$4,701		$94,007
S-DRC03	E-0255	Install recloser at 5H2	$100,100	$90,130	$4,743	($11)	$94,862
S-DRC14	E-1046	Install recloser at 15 X 1	$75,000	$61,095	$3,199	($321)	$63,973
S-BAB11	E-1000-0107	P 207/18 remove cap bank install fusing on circiut 2H1	T&D	$4,063	$6,205	($775)	$9,493
S-BAB11	E-1000-0094	P 75/161 installed cut out	T&D	$1,242			$1,242
S-BAB11	E-1000-0104	Main St / Highland Ave Newton	T&D	$6,537	$8,053		$14,589
S-BAB11	E-1000-0105	Whittier St Newton	T&D	$7,352	$8,863		$16,214
S-BAB11	E-1000-0106	Pond St / Marcoux Rd Newton	T&D	$2,166	$2,731		$4,897
S-BAB11	E-1000-0125	Various replace cut outs & dead ends / Hampton	T&D	$2,767	$4,219		$6,986
S-BAB11	E-1000-0074	Thornell Rd Newton	T&D	$2,708	$1,685		$4,392
		Subtotal	$562,000	$535,494	$52,550	($1,154)	$586,891
		Totals	**$1,446,984**	**$1,249,981**	**$203,357**	**($2,720)**	**$1,450,618**