UES Capital

Reliability Study

2024

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Table of Contents

1 Executive Summary

The purpose of this document is to report on the overall reliability performance of the UES Capital system from January 1, 2023 through December 31, 2023. The scope of this report will also evaluate individual circuit reliability performance over the same time period. The outage data used in this report excludes outages that occurred during IEEE Major Event Days (MEDs). The UES-Capital 2023 MEDs are listed in the table below.

# MEDs in Event	Date of MEDs	Interruptions	Customer Interruptions	Cust-Min of Interruption
1	1/23/2023	41	5,439	698,862
1	3/14/2023	75	5,178	1,333,628
1	9/16/2023	23	6,983	496,291

The following projects are proposed from the results of this study and are focused on improving the worst performing circuits as well as the overall UES Capital system reliability. These recommendations are provided for consideration and will be further developed with the intention to be incorporated into the 2024 budget development process.

Circuit / Line / Substation	Proposed Project	Cost ($)
4W3	Reconductor Sewalls Falls Rd	$TBD
4W3	Install a FuseSaver on Mountain Rd	$TBD
4W4	Install a FuseSaver on Ferrin Rd	$TBD
13W1	Reconductor Old Tilton Rd	$TBD
13W3	Reconductor High St	$TBD
15W1	Reconductor East Side Drive	$TBD
22W3	Reconductor White Rock Hill Rd	$TBD

Note: estimates do not include general construction overheads

The 2023 annual UES Capital system reliability benchmark was 110.98 minutes, after removing Major Event Days. The UES Capital SAIDI performance in 2023 was 76.79 minutes. Charts 1, 2, and 3 below show UES Capital SAIDI, SAIFI, and CAIDI, respectively, over the past five years.

Chart 1
Annual Capital SAIDI

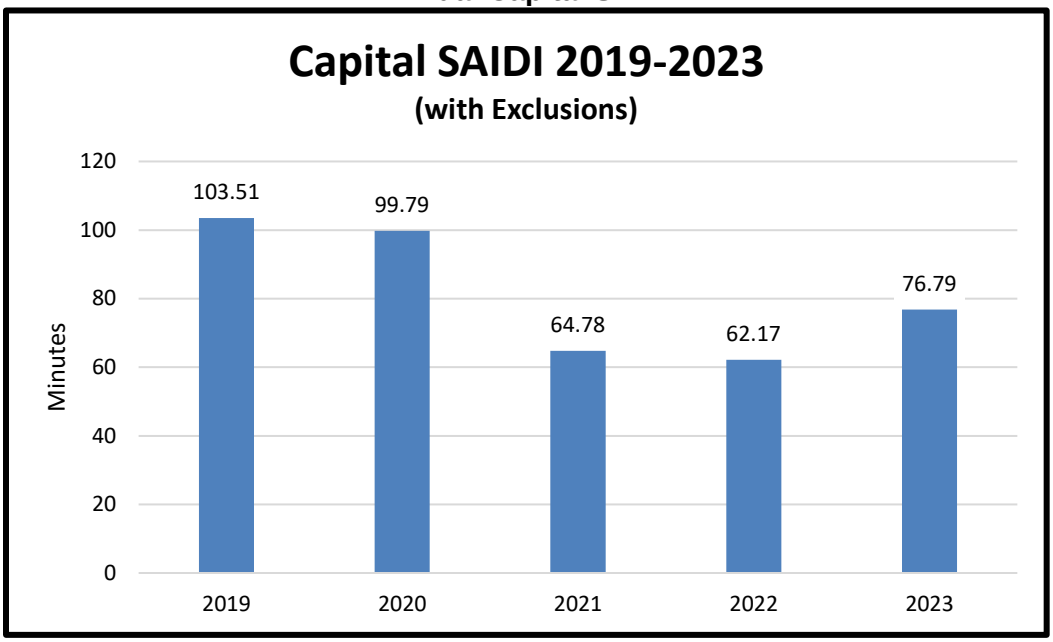


Chart 2
Annual Capital SAIFI

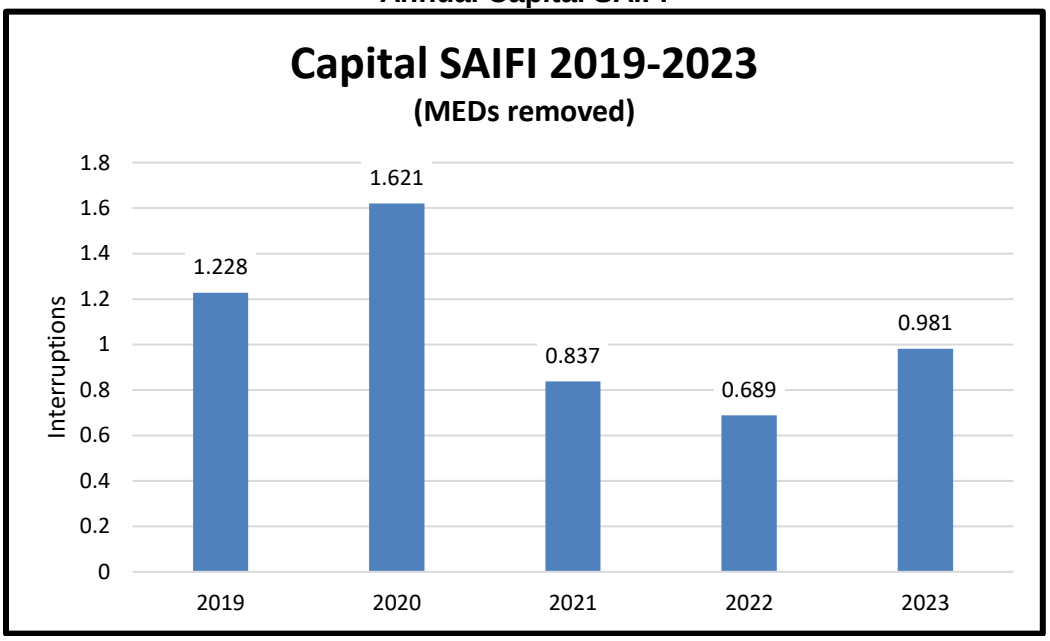
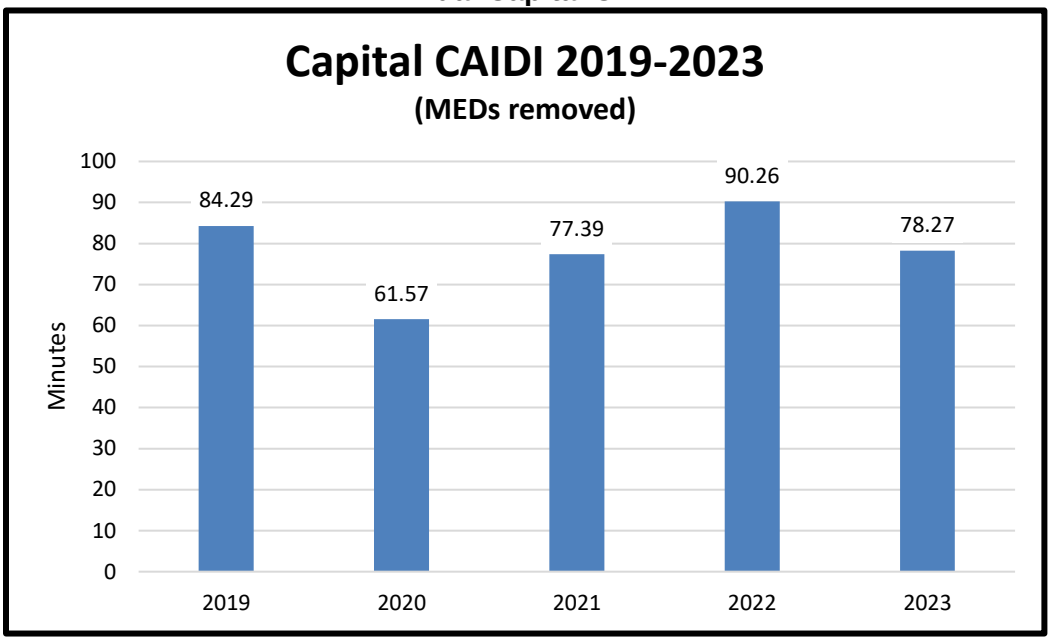


Chart 3
Annual Capital CAIDI



2 Reliability Benchmarks

The new annual UES Capital system reliability benchmark for 2024 is set at 117.08 SAIDI minutes. This was developed by calculating the typical contribution of UES Capital reliability performance to the Unitil system performance using the past five year average. The contribution factor was then set against the 2024 Unitil System goal. The 2024 Unitil System goal was developed through benchmarking the Unitil system performance with nationwide utilities.

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

3 Outages by Cause

This section provides a breakdown of all outages by cause code experienced during 2023. Charts 4, 5, and 6 show the number of interruptions, the number of customer interruptions, and total customer-minutes of interruption due to each cause, respectively. Only the causes contributing 5% or greater of the total are labeled. Table 1 shows the number of interruptions for the top three trouble causes for the previous five years.

Chart 4
Number of Interruptions by Cause

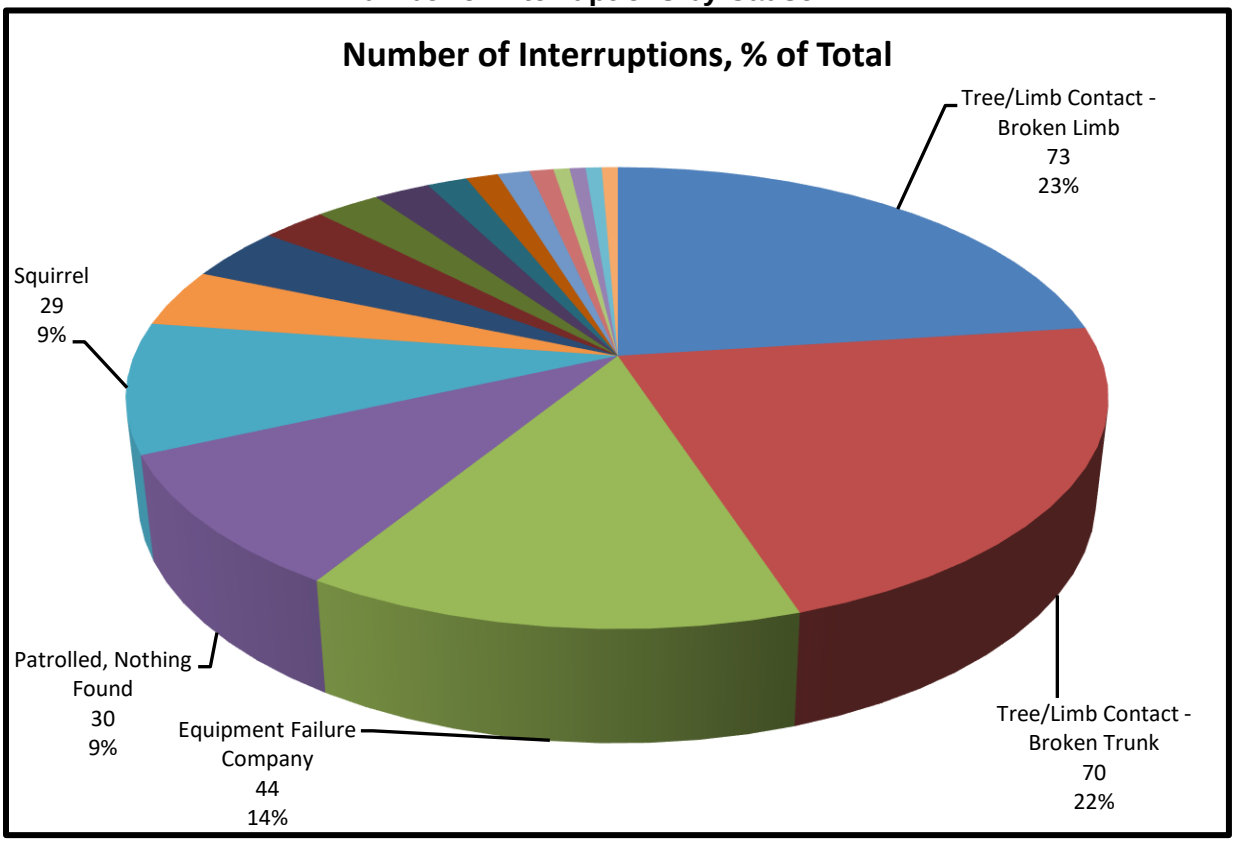


Chart 5
Number of Customer Interruptions by Cause

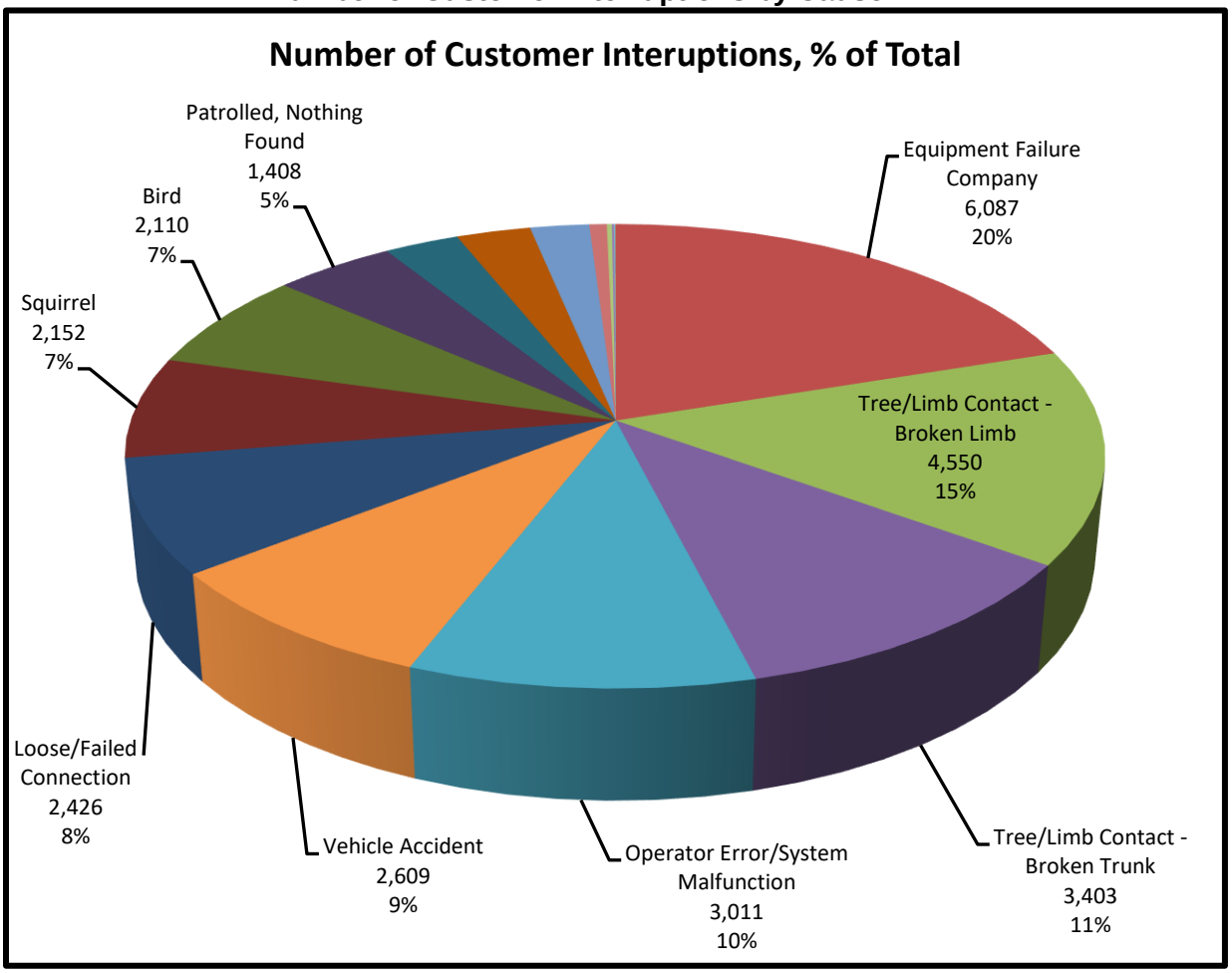


Chart 6
Percent of Customer-Minutes of Interruption by Cause

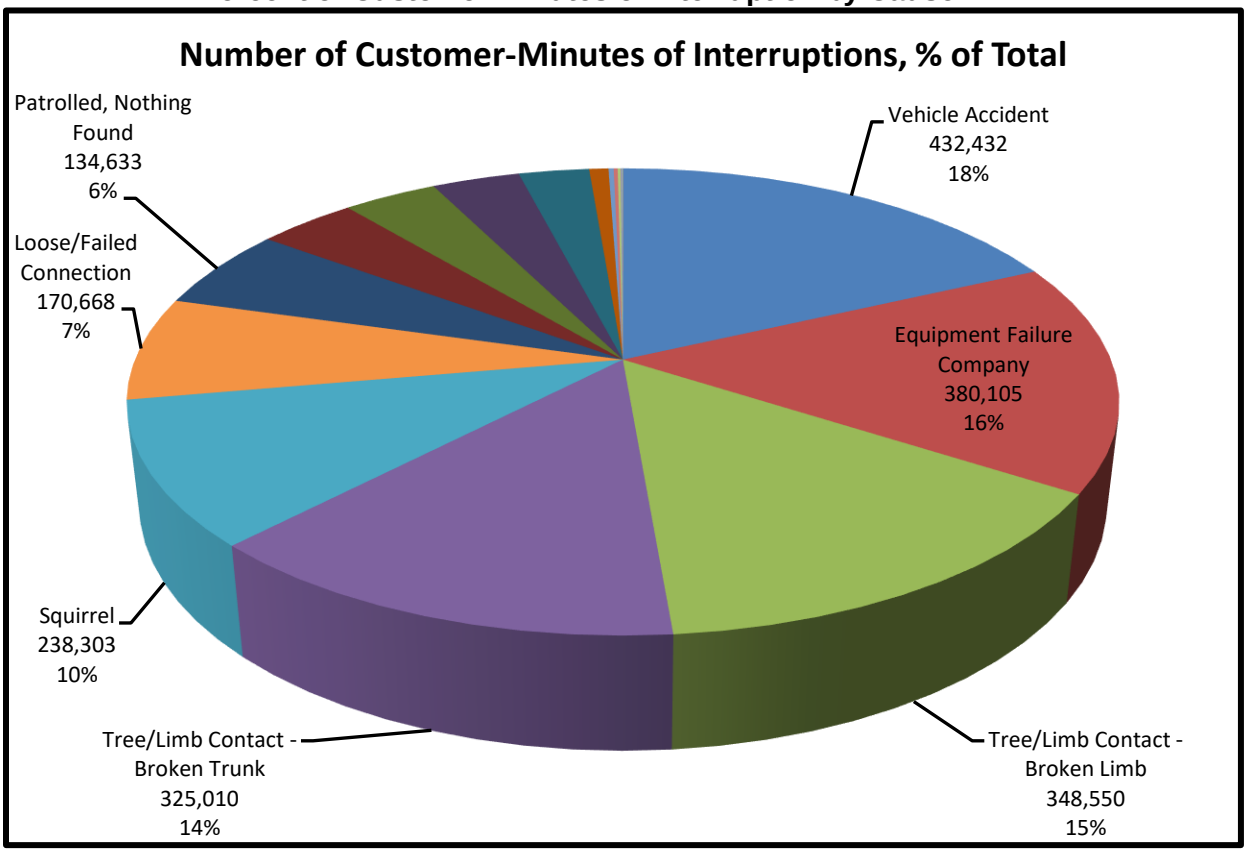


Table 1
Five-Year History of the Number of Interruptions for the Worst Three Trouble Causes

Year	# of Interruptions Per Trouble Cause		
	Tree/Limb Contact - Broken Limb	Tree/Limb Contact - Broken Trunk	Equipment Failure Company
2023	73	70	44
2022	68	76	54
2021	62	99	54
2020	133	93	64
2019	74	67	64

4 10 Worst Distribution Outages

The ten worst distribution outages ranked by customer-minutes of interruption during the time period from January 1, 2023 through December 31, 2023 are summarized in Table 2 below.

Table 2
Worst Ten Distribution Outages

Circuit	Date/Cause	Customer Interruptions	Cust-Min of Interruption	Capital SAIDI	Capital SAIFI
C7W3	1/29/2023 Vehicle Accident	1,278	170,335	133.28	1.000
C4X1	1/6/2023 Loose/Failed Connection	2,026	155,293	76.65	1.000
C15W1	12/18/2023 Tree/Limb Contact – Broken Limb	1,015	132,440	130.48	1.000
C8X3	7/30/2023 Vehicle Accident	457	112,005	37.64	0.154
C4W4	4/8/2023 Vehicle Accident	641	98,479	41.85	0.272
C13W2	12/27/2023 Squirrel	1,000	96,083	96.08	1.000
C13W1	12/27/2023 Squirrel	507	93,187	183.80	1.000
C13W3	3/19/2023 Tree/Limb Contact – Uprooted Tree	518	77,588	46.46	0.310
C8X5	4/2/2023 Tree/Limb Contact – Broken Trunk	827	57,242	69.22	1.000
C2H1	12/23/2023 Equipment Failure Company	1,070	52,430	49.00	1.000

Note: This table does not include outages that occurred at substations or on the subtransmission system, scheduled/planned work outages, or outages that occurred during IEEE MEDs.

5 Subtransmission and Substation Outages

This section describes the contribution of sub-transmission line and substation outages on the UES Capital system.

All substation and sub-transmission outages, including those that occurred during IEEE MEDs ranked by customer-minutes of interruption during the time period from January 1, 2023 through December 31, 2023 are summarized in Table 3 below.

In aggregate, sub-transmission line and substation outages accounted for 19% of the total (including MEDs) customer-minutes of interruption for UES Capital.

Table 3 Subtransmission and Substation Outages

Line / Substation	Affected Circuits	Date/Cause	Customer Interruptions	Cust-Min of Interruption	SAIDI	SAIFI	Number of Outages in Prior Four Years
34 Line	C2H1, C2H4, C21W1A, C34X2, C34X4, C33X4, C33X5, C33X6	07/05/2023 Bird	1,649	75,404	2.43	0.053	2
	C2H1, C2H4, C21W1A, C34X1, C34X2, C34X3, C34X4, C33X4, C33X5, C33X6	12/23/2023 Equipment Failure Company	2,007	136,532	4.39	0.065	
	C2H1, C2H4, C34X2, C34X4, C33X4, C33X5, C33X6	3/15/2023 Tree/Limb Contact - Broken Trunk	1,718	208,095	6.70	0.055	
Bridge St S/S	C1H3, C1H4	11/21/2023 Error/System	941	27,195	0.88	0.030	2
Boscawen S/S	C13W1, C13W2	10/24/2023 Equipment Failure Company	1,504	40,650	1.31	0.048	0
		12/27/2023 Squirrel	1,507	189,270	6.09	0.048	
375 Line / Bridge St S/S	C1H2, C1H3, C1H4, C1X7P, C16H1, C16H3, C16X4, C16X5, C16X6, C15W1, C15W2, C15H3, C375X1, C35X1, C35X2, C35X3, C35X4	9/16/2023 Patrolled, Nothing Found	3,828	250,584	8.06	0.123	1

6 Worst Performing Circuits

This section compares the reliability of the worst performing circuits using various performance measures. All circuit reliability data presented in this section includes sub-transmission or substation supply outages unless noted otherwise.

6.1 Worst Performing Circuits in Past Year (1/1/23 – 12/31/23)

A summary of the worst performing circuits during the time period between January 1, 2023 and December 31, 2023 is included in the tables below.

Table 5 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 6 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 during 2023.

Circuits having one outage contributing more than 80% of the Customer-Minutes of interruption were excluded from this analysis.

Table 4
Worst Performing Circuits Ranked by Customer-Minutes

Circuit	Customer Interruptions (CI)	Worst Event (% of CI)	Cust-Min of Interruption (CMI)	Worst Event (% of CMI)	SAIDI	SAIFI	CAIDI
C8X3	2,774	16%	370,435	30%	124.77	0.934	133.54
C7W3	1,862	69%	236,698	72%	183.49	1.443	127.12
C13W2	4,207	24%	206,899	46%	208.57	4.241	49.18
C13W1	1,959	26%	188,207	50%	373.43	3.887	96.07
C15W1	1,521	67%	180,374	73%	178.06	1.501	118.59
C13W3	1,534	34%	156,514	50%	94.68	0.928	102.03
C4W4	2,401	27%	152,299	65%	64.56	1.018	63.43
C8X5	1,101	75%	89,549	64%	108.02	1.328	81.33
C22W3	671	37%	66,448	51%	43.74	0.442	99.03
C4W3	1,192	46%	59,279	48%	40.91	0.823	49.73

Note: all percentages and indices are calculated on a circuit basis

Table 5
Circuit Interruption Analysis by Cause

Circuit	Customer – Minutes of Interruption / # of Outages					
	Vehicle Accident	Equipment Failure Company	Tree/Limb Contact - Broken Limb	Tree/Limb Contact - Broken Trunk	Squirrel	Loose/ Failed Connection
C8X3	153,225 / 2	61,313 / 10	67,735 / 19	25,779 / 10	476 / 4	2,446 / 1
C7W3	170,335 / 1	514 / 2	5,504 / 4	11,068 / 3	28,319 / 4	0 / 0
C13W2	0 / 0	82,501 / 4	60 / 1	9,494 / 1	96,083 / 1	0 / 0
C13W1	0 / 0	17,298 / 2	12,867 / 9	59,651 / 11	93,347 / 3	0 / 0
C15W1	0 / 0	111 / 1	135,200 / 2	5,837 / 2	0 / 0	0 / 0
C13W3	0 / 0	2,698 / 3	26,355 / 10	31,036 / 17	133 / 2	4,361 / 1
C4W4	98,479 / 1	1,756 / 3	9,465 / 1	20,229 / 3	6,515 / 2	0 / 0
C8X5	279 / 1	704 / 1	0 / 0	60,674 / 2	2,541 / 1	0 / 0
C22W3	0 / 0	0 / 0	19,532 / 14	39,291 / 5	1,645 / 4	0 / 0
C4W3	0 / 0	3,563 / 1	43,801 / 4	3,729 / 1	0 / 0	7,304 / 1

6.2 Worst Performing Circuits of the Past Five Years (2019 – 2023)

The annual performance of the ten worst circuits in terms of circuit SAIDI and SAIFI for each of the past five years is shown in the tables below. Table 7 lists the ten worst performing circuits ranked by SAIDI and Table 8 lists the ten worst performing circuits ranked by SAIFI. Table 9 lists the ten worst performing circuits ranked by SAIDI and SAIFI over the past five years.

The data used in this analysis includes all system outages except those outages that occurred during IEEE major event days.

The data used in this analysis includes all distribution circuits except those that do not have an interrupting device, e.g. fuse or recloser, at their tap location.

Table 6
Circuit SAIFI

Circuit Ranking (1 = worst)	2023		2022		2021		2020		2019	
	Circuit	SAIFI	Circuit	SAIFI	Circuit	SAIFI	Circuit	SAIFI	Circuit	SAIFI
1	C13W2	4.241	C33X4	2.129	C18W2	3.946	C4W3	3.933	C2H2	3.664
2	C13W1	3.887	C2H2	2.025	C13W3	3.258	C7W3	2.685	C8X5	3.388
3	C33X4	2.971	C2H4	2.000	C13W1	3.082	C22W1	2.612	C18W2	1.778
4	C34X4	2.000	C16H1	2.000	C37X1	3.071	C13W2	2.483	C13W3	1.641
5	C34X2	2.000	C7X1	2.000	C14X3	2.000	C4X1	2.458	C37X1	1.506
6	C33X5	2.000	C1X7P	1.875	C15W1	1.515	C16X4	2.359	C3H3	1.383
7	C33X6	2.000	C7W4	1.819	C15W2	1.500	C13W1	2.219	C8X3	1.365
8	C37X1	1.827	C13W3	1.645	C13W2	1.455	C1H1	2.199	C15W2	1.350
9	C21W1A	1.654	C13W1	1.478	C4W3	1.451	C37X1	1.568	C13W2	1.335
10	C15W1	1.501	C18W2	1.319	C21W1P	1.199	C15W2	1.228	C6X3	1.294

Table 7
Circuit SAIDI

Circuit Ranking (1 = worst)	2023		2022		2021		2020		2019	
	Circuit	SAIDI	Circuit	SAIDI	Circuit	SAIDI	Circuit	SAIDI	Circuit	SAIDI
1	C13W1	373.43	C17X1	510.00	C14X3	613.00	C4W3	243.64	C2H2	467.50
2	C33X4	263.33	C37X2	295.90	C18W2	322.92	C13W1	198.35	C8X5	256.74
3	C13W2	208.57	C18W2	262.37	C13W3	220.50	C7W3	197.61	C13W3	214.08
4	C7W3	183.49	C16X5	227.00	C37X1	211.71	C4X1	154.72	C6X3	166.25
5	C15W1	178.06	C374X1	202.28	C13W1	178.93	C15W1	135.00	C8X3	141.38
6	C15W2	158.34	C33X4	198.82	C15W1	139.86	C22W1	133.56	C13W2	134.14
7	C37X1	143.70	C2H2	198.59	C4W3	130.19	C13W2	129.10	C18W2	121.03
8	C8X3	124.77	C13W3	164.22	C8X5	125.24	C13W3	115.33	C15W1	118.34
9	C34X4	116.00	C13W1	141.86	C8X3	83.85	C34X2	111.11	C37X1	117.78
10	C8X5	108.02	C2H4	135.05	C1H3	79.97	C37X1	102.09	C13W1	108.30

Table 8
Worst Performing Circuit past Five Years

SAIFI			SAIDI		
Circuit Ranking	**Circuit**	**# Appearances**	**Circuit Ranking**	**Circuit**	**# Appearances**
1	C13W2	4	**1**	C13W1	5
2	C13W1	4	**2**	C33X4	2
3	C33X4	2	**3**	C13W2	3
4	C34X4	1	**4**	C7W3	2
5	C34X2	1	**5**	C15W1	4
6	C33X5	1	**6**	C15W2	1
7	C33X6	1	**7**	C37X1	4
8	C37X1	4	**8**	C8X3	3
9	C21W1A	1	**9**	C34X4	1
10	C15W1	2	**10**	C8X5	3

6.3 System Reliability Improvements (2023 and 2024)

Vegetation management projects completed in 2023 or planned for 2024 that are expected to improve the reliability of the 2023 worst performing circuits are included in table 10 below. Table 11 below details electric system upgrades that are scheduled to be completed in 2024, or were completed in 2023, that were performed to improve system reliability.

Table 9
Vegetation Management Projects on Worst Performing Circuits

Circuit(s)	Year of Completion	Project Description
C13W3	2023	Cycle Pruning
C24H1	2023	Cycle Pruning
C24H2	2023	Cycle Pruning
C33X4	2023	Cycle Pruning
C34X4	2023	Cycle Pruning
C13W2	2023	Cycle Pruning
C15W1	2023	Hazard Tree Mitigation/Mid Cycle Review
C15W2	2023	Hazard Tree Mitigation/Mid Cycle Review
C22W3	2023	Hazard Tree Mitigation/Mid Cycle Review

Circuit(s)	Year of Completion	Project Description
C3W1	2023	Mid Cycle Review
C3W3	2023	Mid Cycle Review
C7X1	2023	Mid Cycle Review
C7W3	2023/2024	Hazard Tree Mitigation/Mid Cycle Review/Storm Resiliency Program
C13W1	2024	Cycle Pruning/Storm Resiliency Program
C4W4	2024	Cycle Pruning
C4X1	2024	Cycle Pruning/Storm Resiliency Program
C22W1	2024	Cycle Pruning
C22W2	2024	Cycle Pruning
C38	2024	Cycle Pruning
C7W4	2024	Cycle Pruning
C8H1	2024	Cycle Pruning
C8H2	2024	Cycle Pruning
C8X5	2024	Cycle Pruning
C37X1	2024	Storm Resiliency Program/Mid Cycle Review
C18W2	2024	Storm Resiliency Program/Hazard Tree Mitigation/Mid Cycle Review
C4W3	2024	Hazard Tree Mitigation/Mid Cycle Review
C6X3	2024	Hazard Tree Mitigation/Mid Cycle Review
C13X4	2024	Mid Cycle Review
C16X4	2024	Mid Cycle Review
C21W1P	2024	Mid Cycle Review
C2H2	2024	Mid Cycle Review

Table 10
Electric System Improvements Performed to Improve Reliability

Circuit(s)	Year of Completion	Project Description
Various	2023/2024	Install Animal Guards
18W2	2023	Reconductor Bow Center Rd
8X3	2023	Install a Fuse Saver on Horse Corner Rd
8X3	2023	Install a Fuse Saver on Mountain Rd
8X3	2024	Install a Fuse Saver on Bear Hill Rd
15W2	2024	Install Cutout Mounted Sectionalizer
4W4	2024	Hutchins St Recloser Removal

7 Tree Related Outages in Past Year

This section summarizes the worst performing circuits by tree related outage during the time period between January 1, 2023 and December 31, 2023. This section does not include subtransmission outages.

Table 12 shows the ten worst circuits ranked by the total number of Customer-Minutes of interruption. The number of customer-interruptions and number of outages are also listed in this table.

All streets on the UES CAPITAL system with three or more tree related outages are shown in Table 13 below. The table is sorted by number of interruptions and customer-minutes of interruption.

Table 11
Worst Performing Circuits – Tree Related Outages

Circuit	Customer Interruptions	Cust-Min of Interruption	No. of Interruptions
C13W3	1,259	143,431	31
C15W1	1,182	142,549	5
C8X3	921	95,003	31
C13W1	936	77,263	22
C8X5	849	60,674	2
C22W3	577	58,966	20
C4W3	945	47,882	6
C4W4	801	30,382	5

Circuit	Customer Interruptions	Cust-Min of Interruption	No. of Interruptions
C18W2	122	22,844	8
C37X1	334	20,544	5

Table 12
Multiple Tree Related Outages by Street

Circuit	Street, Town	No. Of Outages	Customer-Minutes of Interruption	Number of Customer Interruptions
C13W1	Wilson Rd, Canterbury	3	5,052	45
C13W1	Old Tilton Rd, Canterbury	3	29,554	150
C13W3	Daniel Webster Hwy, Boscawen	3	1,561	18

8 Failed Equipment

This section is intended to clearly show all equipment failures throughout the study period from January 1, 2023 through December 31, 2023. Chart 7 shows all equipment failures throughout the study period. Chart 8 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 9.

Chart 7
Equipment Failure Analysis by Cause

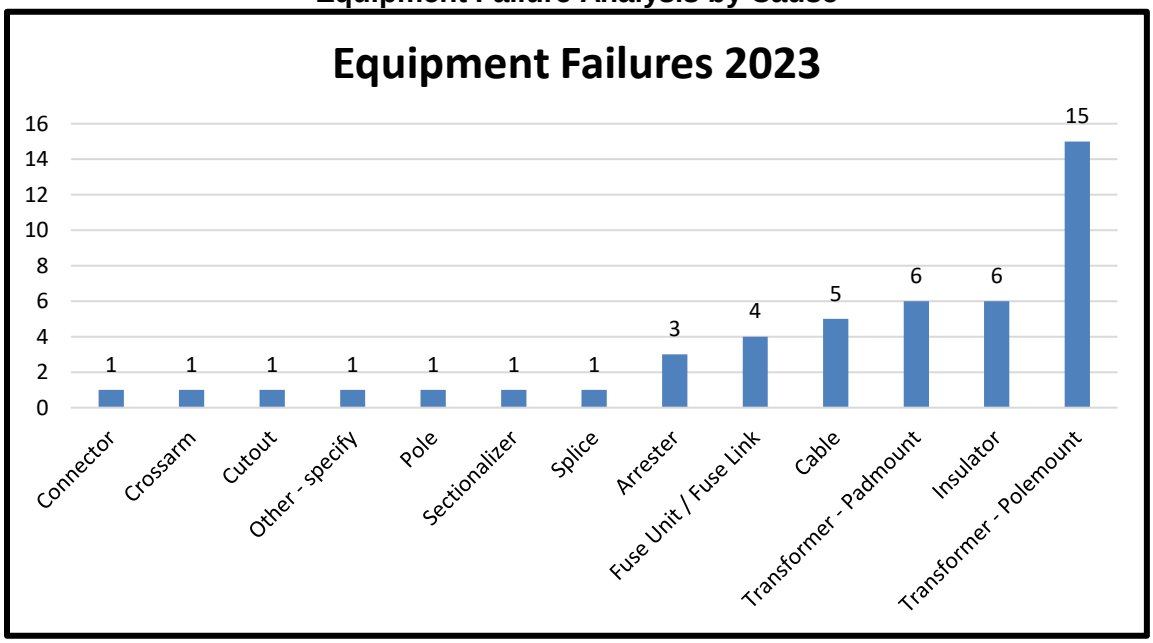


Chart 8
Equipment Failure Analysis by Percentage of Total Failures

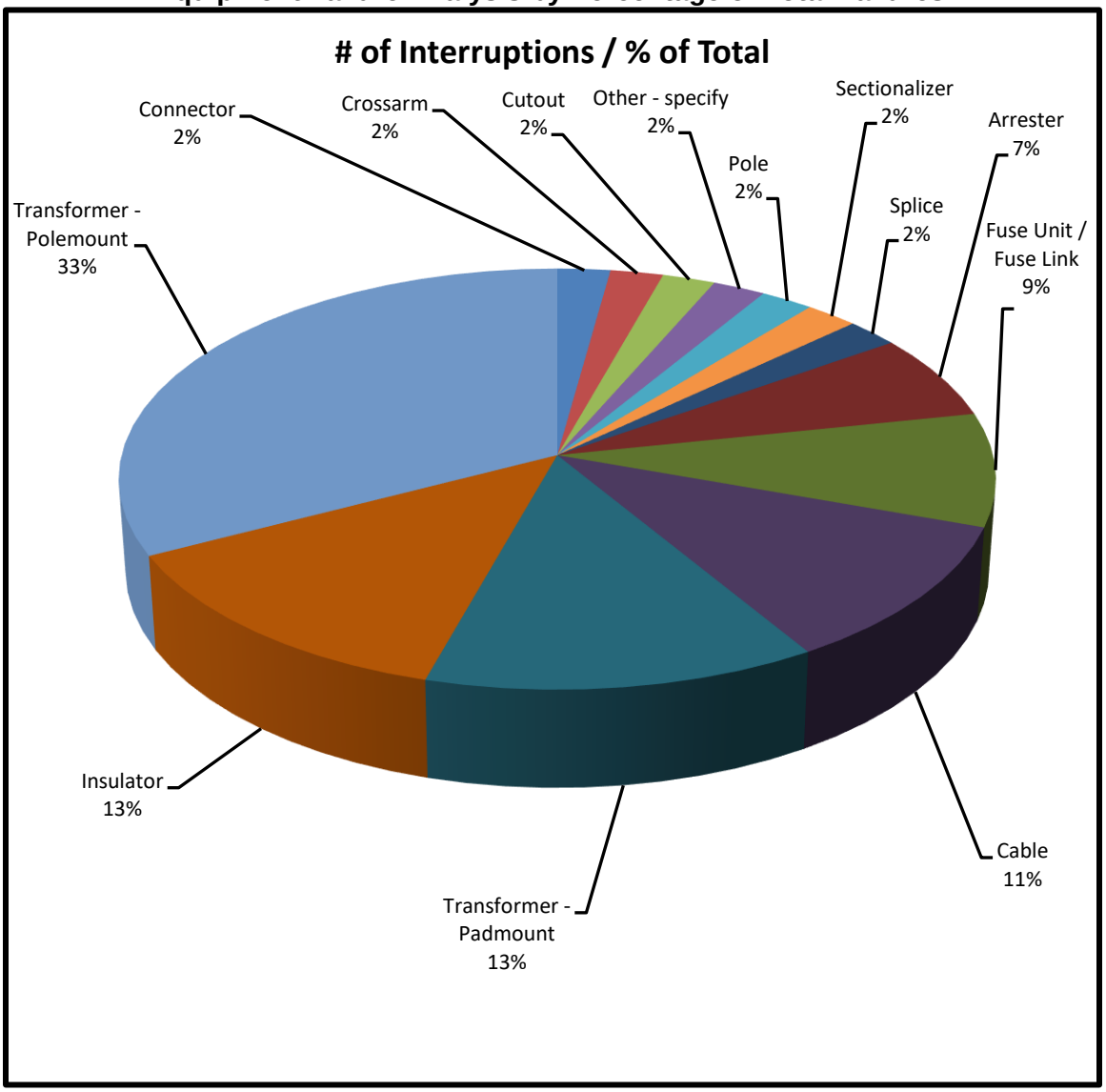
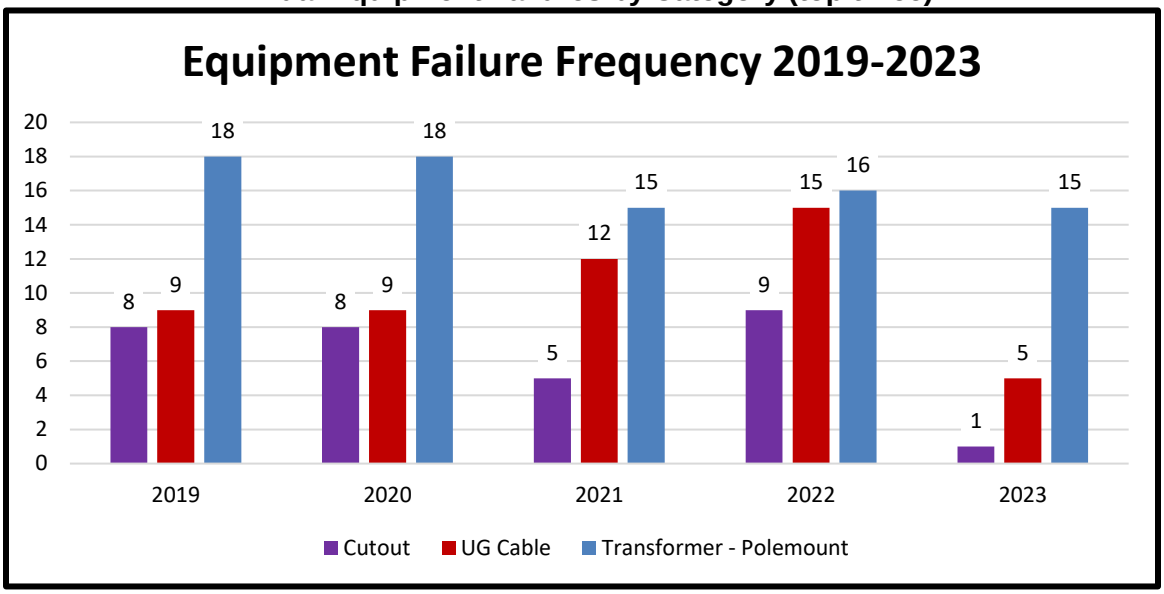


Chart 9
Annual Equipment Failures by Category (top three)



The top three equipment failures continue to be cutouts, underground cables, and polemount transformers. The polemount transformer failures, although high, do not show signs of decreasing over the last 5 years. Cutout failures also show signs of decreasing over the past year, likely due to the cutout replacement program. Operations and engineering will continue to review locations in which cable injection and replacement of direct buried cable could reduce the frequency of underground cable failures.

9 Multiple Device Operations and Streets with Highest Number of Outages

A summary of the devices that have operated four or more times from January 1, 2023 to December 31, 2023 are included in table 14 below. Refer to section 11 for project recommendations that address some of the areas identified.

A summary of the streets on the UES Capital system that had customers with 7 or more non-exclusionary outages in 2023 is included in Table 15 below. The table is sorted by circuit and then the maximum number of outages seen by a single customer on that street.

Table 13
Multiple Device Operations

Circuit	Number of Operations	Device	Customer Minutes	Customer Interruptions	# of Times on List in Previous 4 Years
C13W3	3	Fuse, Pole 332, Daniel Webster Highway, Boscawen	1,561	18	0
C7W3	3	Fuse, Pole 1, Woodhill Hooksett Rd. South, Bow	13,282	105	0
C13W1	3	Fuse, Pole 1, Wilson Rd, Canterbury	5,052	45	0
C13W1	3	Fuse, Pole 9, Old Tilton Rd, Canterbury	29,554	150	0
C4W4	3	Fuse, Pole 1, Ferrin Rd, Concord	1,005	21	0

Table 14
Streets with the Highest Number of Outages

Circuit	Street	Max Number of Outages Seen by a Single Customer	Number of Times on List in Previous 4 Years
C4W4	Carter Hill Rd	7	0
C4W4	District 5 Rd	8	1
C4W4	Ferrin Rd	8	2

10 Other Concerns

This section is intended to identify other reliability concerns that would not necessarily be identified from the analysis above.

10.1 URD Cable Failure

URD cables are failing at an average rate of 10 failures per year over the last five years, for a total of 50 cable failures in the past five years. When a direct buried cable fails, Unitil typically excavates the area of the failure and splices in a small section of new cable into the existing cable. In these cases the remaining aged cable in the area remains. Generally, cable failures in conduit result in the cable run being replaced. In recent years, projects to address direct buried cable failures have included cable injection and replacement with cable in conduit where cable injection has been deemed unfeasible. It is

anticipated that additional projects for cable injection and or direct buried cable replacement will be proposed in future years.

11 Recommendations

This following section describes recommendations on circuits, sub-transmission lines and substations to improve overall system reliability. The recommendations listed below will be compared to the other proposed reliability projects on a system-wide basis. A cost benefit analysis will determine the priority ranking of projects for the 2025 capital budget. All project costs are shown without general construction overheads.

11.1. Circuit 4W3: 4W3 Spacer Cable Installation and FuseSaver

11.1.1. Identified Concerns

Circuit 4W3 is 7 on the Worst Performing Circuits – Tree Related Outages list. 83% of the tree-related customer minutes of interruption on 4W3 were caused by a tree-related outage on Sewalls Falls Rd which impacted 552 customers. Addressing the vulnerability on this street with a project could greatly reduce the impact of outages from this location in the future especially considering that outages on Sewalls Falls Rd will impact circuit 4W4 if the circuits are tied.

11.1.2. Recommendations

11.1.2.1. Reconductor Sewalls Falls Rd

Reconductor Sewalls Falls Rd from pole 53 to pole 16 with 336Al spacer cable, 052AWA messenger and 4/0 ACSR neutral.

Estimated Project Cost (without construction overheads): $341,059

Estimated Annual Savings:

Customer Minutes: 8,581

Customer Interruptions: 105

11.1.2.2. Install a FuseSaver on Mountain Rd

Install a 100 A FuseSaver on pole 158 on Mountain Rd.

Estimated Project Cost (without construction overheads): $12,491 (Doesn’t include the cost of the FuseSaver)

Estimated Annual Savings:

Customer Minutes: 3,204

Customer Interruptions: 39

11.2. Circuit 4W4: 4W4 FuseSaver

11.2.1. Identified Concerns

The fuse on pole 1 Ferrin Rd operated 3 times in 2023 due to squirrel related faults.

11.2.2. Recommendations

11.2.2.1. Install a FuseSaver on Ferrin Rd

Install a 100 A FuseSaver on pole 1 on Ferrin Rd.

Estimated Project Cost (without construction overheads): $11,636 (Doesn't include the cost of the FuseSaver)

Estimated Annual Savings:

Customer Minutes: 7,620

Customer Interruptions: 168

11.3. Circuit 13W1: 13W1 Spacer Cable Installation

11.3.1. Identified Concerns

Circuit 13W1 was on the SAIDI worst performing circuit list 5 times in the past 5 years and was on the SAIFI worst performing circuit list 4 times in the past 5 years. It is also 4th place on the Worst Performing Circuits – Tree Related Outages list.

Tree outages on Old Tilton Rd and its laterals were responsible for 33,769 customer minutes of interruption, making up 43% of 13W1's outage customer minutes of interruption from tree-related outages.

11.3.2. Recommendations

11.3.2.1. Reconductor Old Tilton Rd

Reconductor Old Tilton Rd from pole 9 Old Tilton Rd to pole 50 Borough Rd with single phase 336Al spacer cable, 052AWA messenger and 4/0ACSR neutral.

Estimated Project Cost (without construction overheads): $456,003

Estimated Annual Savings:

Customer Minutes: 2,785

Customer Interruptions: 35

11.4. Circuit 13W3: 13W3 Spacer Cable Installation

11.4.1. Identified Concerns

Circuit 13W3 is the worst circuit on the Worst Performing Circuits – Tree Related Outages list. 13W3 is a radial circuit with no back up to adjacent circuits.

11.4.2. Recommendation

11.4.2.1. Reconductor High St

Reconductor High St from pole 139 to pole 179 with 336Al spacer cable, 052AWA messenger and 4/0ACSR neutral.

Estimated Project Cost (without construction overheads): $353,424

Estimated Annual Savings:

Customer Minutes: 12,144

Customer Interruptions: 147

11.5. Circuit 15W1: 15W1 Spacer Cable Installation

11.5.1. Identified Concerns

Circuit 15W1 was on the SAIDI worst performing circuit list 4 times in the past 5 years and was on the SAIFI worst performing circuit list 2 times in the past 5 years. It is also 2nd place on the Worst Performing Circuits – Tree Related Outages list.

A half mile long stretch of the circuit on East Side Drive has had 8 recorded tree-related outages, with 3 of them taking place in 2023 which made up over 30,000 customer minutes of interruption.

11.5.2. Recommendation

11.5.2.1. Reconductor East Side Drive

Reconductor East Side Drive from pole 73 Eastman St to pole 65 East Side Drive with 336Al spacer cable, 052AWA messenger and 4/0ACSR neutral.

Estimated Project Cost (without construction overheads): $189,827

Estimated Annual Savings:

Customer Minutes: 1,560

Customer Interruptions: 18

11.6. Circuit 22W3: 22W3 Spacer Cable Installation

11.6.1. Identified Concerns

Circuit 22W3 is the sixth worst circuit on the Worst Performing Circuits – Tree Related Outages list.

11.6.2. Recommendation

11.6.2.1. Reconductor White Rock Hill Rd

Reconductor White Rock Hill Rd from pole 19 to pole 52 with 336Al spacer cable, 052AWA messenger and 4/0ACSR neutral.

Estimated Project Cost (without construction overheads): $387,407

Estimated Annual Savings:

Customer Minutes: 6,016

Customer Interruptions: 79

11.7. Miscellaneous Circuit Improvements to Reduce Recurring Outages

11.7.1. Identified Concerns & Recommendations

The following concerns were identified based on a review of Tables 12 & 13 of this report; Multiple Tree Related Outages by Street and Multiple Device Operations respectively and reviewing the fault locations on the worst performing circuits.

Forestry Reviews

It is recommended that a forestry review of the areas below be performed in order to identify and address any mid-cycle growth or hazard tree problems.

- C15W1
  - East Side Dr area, Concord
  - Old Oak Hill Rd area, Concord/Loudon
- C13W1
  - Old Tilton Rd area, Canterbury
  - Wilson Rd area, Canterbury

- C6X3
  - Hopkinton Rd area, Concord
- C7W3
  - Allen Rd area, Bow
  - Woodhill Hooksett Rd South area, Bow
- C4W4

  - District #5 Rd area, Concord
  - Hutchins St/Lakeview Dr area, Concord
- C13W3
  - Warner Rd area, Salisbury
  - Center Range Rd area, Salisbury
- C16X4
  - Garvins Falls Rd area, Concord
- C18W2
  - Putney Rd area, Bow
  - S Bow Rd area, Bow
- C22W3
  - Hooksett Tpke area, Concord/Bow/Hopkinton
  - White Rock Hill Rd area, Bow
- C8X3
  - Ricker Rd area, Loudon
  - Hutchinson Rd area, Chichester
  - Jug City Rd area, Epsom
  - Mill House Rd area, Epsom
  - Mt Delight Rd area, Epsom
  - New Orchard Rd area, Epsom
  - Suncook Valley Highway area, Epsom
  - New Rye Rd area, Epsom
  - Trap Rd area, Chichester

Animal Guard Installation Recommendations

It is recommended that the on-going animal guard installation program be continued in 2025. The areas identified below should be reviewed and have animal guards installed where needed.

- C4W3
  - Pole 407/158-8 Mountain Rd area, Concord
- C4W4
  - Ferrin Rd area, Concord
  - Winsor Ave area, Concord
  - Scott Ave area, Concord
- C7W4
  - Rockingham St area, Concord
- C15W2
  - Tara Dr area, Concord
- C22W1
  - Cypress St area, Concord
- C8X3
  - Pole 16 Ricker Rd lateral area, Pembroke
  - Bear Hill Rd area, Loudon
  - Goboro Rd area, Epsom
  - Center Hill Rd area, Epsom

12 Conclusion

During 2023, tree related outages still present one of the largest problems in the UES-Capital System, compared to other causes. Although compared to previous years, the worst performing circuits have seen a dramatic decrease in Customer Minutes of Interruption from tree related outages. Enhanced tree trimming efforts are still being implemented, which is expected to improve reliability along the mainlines for most of the worst performing circuits identified in this study.

Due to the number of animal related outages that occur on the UES-Capital system an animal guard installation program began in 2019. This program is expected to continue in 2025. Furthermore, animal guards are continually being placed on equipment whenever an animal causes an outage. In addition, when there is an animal-related outage, any equipment in the vicinity will be checked. If nearby equipment does not have animal guards, animal guards will be installed at that location. Also, streets and circuits identified as having high numbers of animal related outages will be checked and proper animal protection will be installed where applicable.

Recommendations developed from this study are mainly focused on reducing the impact of multiple permanent outages. This report is also intended to assist Unitil Forestry in identifying areas of the system that are being frequently affected by tree related outages to allow proactive measures to be taken. In addition, new ideas and solutions to reliability problems are always being explored in an attempt to provide the most reliable service possible.

Unitil Energy Systems – Seacoast

Reliability Study
2024

Prepared By:

Jameson Tucker
Unitil Service Corp.
October 25, 2024

Table of Contents

1 Executive Summary

The purpose of this document is to report on the overall reliability performance of the Unitil Energy Systems – Seacoast (UES-Seacoast) system from January 1, 2023 through December 31, 2023. The scope of this report will also evaluate individual circuit reliability performance over the same time period. The outage data used in this report excludes sub-transmission and substation outages (listed in Section 5), as well as outages during IEEE Major Event Days (MEDs). UES-Seacoast MEDs are listed in the table below:

# MEDs in Event	Dates of MEDs	Interruptions	Customer Interruptions	Cust-Min of Interruption
1	1/23/2023	115	9746	3,906,331
1	9/8/2023	30	7881	965,437
1	12/18/2023	128	18,599	5,751,304

The following projects are proposed from the results of this study and 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 2025 budget development process.

Circuit / Line / Substation	Proposed Project	Cost ($)
6W1/6W2	Construct Circuit Tie	$1,330,000
58X1/5X3/3358	Increase Circuit Tie Capacity and Reconfigure	$1,350,000

Note: estimates do not include general construction overheads

The 2023 annual UES-Seacoast system reliability goal was set at 124.56 SAIDI minutes, after removing exclusionary outages. UES-Seacoast's SAIDI performance in 2023 was 100.06 minutes. Charts 1, 2, and 3 below show UES-Seacoast's SAIDI, SAIFI, and CAIDI performance over the past five years.

Chart 1
Annual UES-Seacoast SAIDI

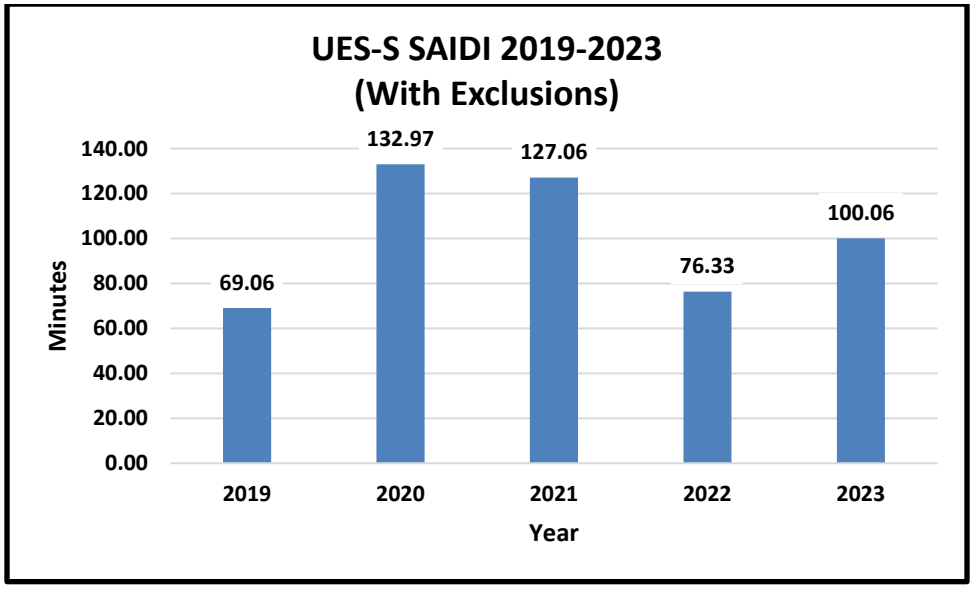


Chart 2
Annual UES-Seacoast SAIFI

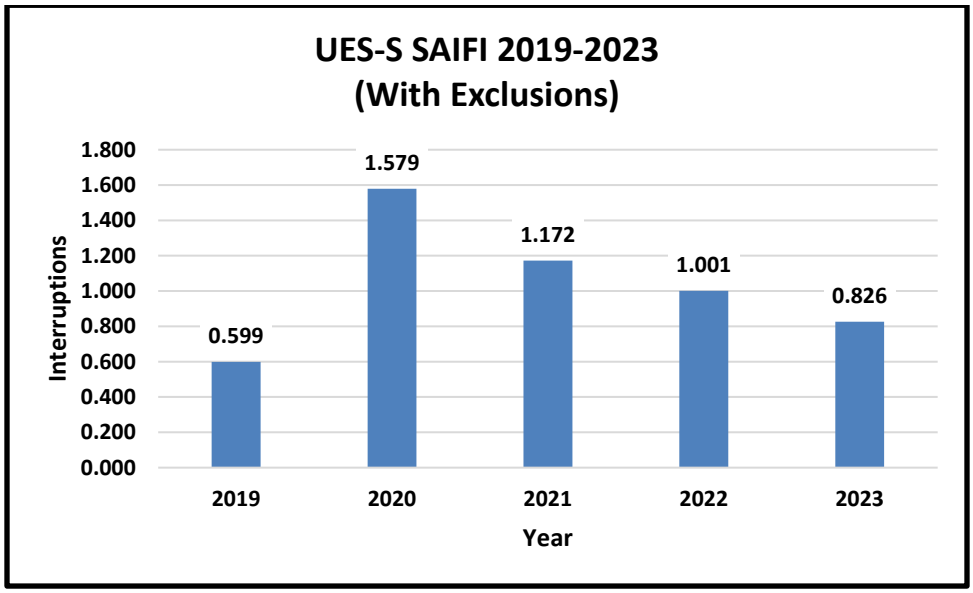
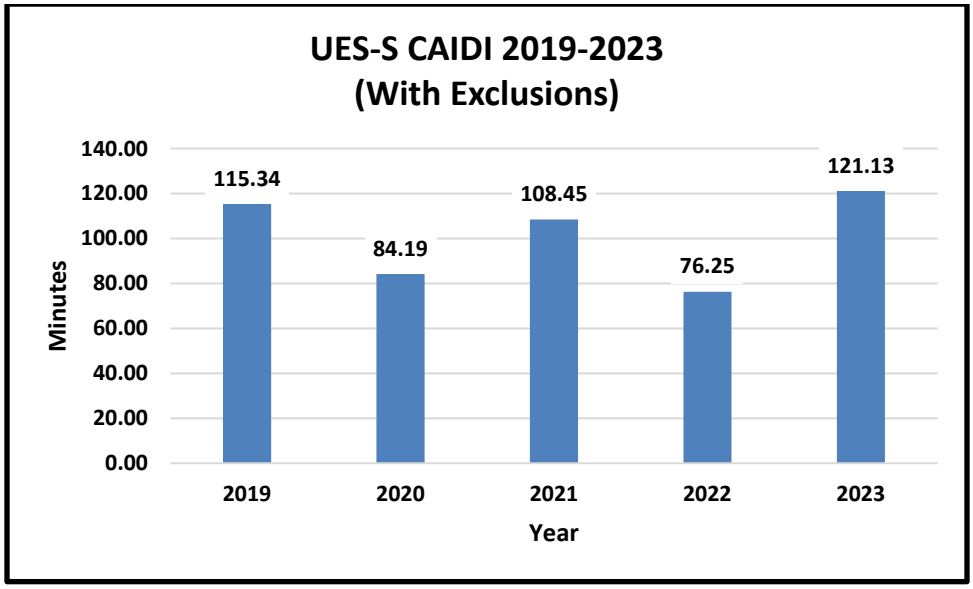


Chart 3
Annual UES-Seacoast CAIDI



2 Reliability Benchmarks

The new annual UES-Seacoast system reliability benchmark for 2024 is 141.41 SAIDI minutes. This was developed by calculating the contribution of UES-Seacoast to the Unitil system performance using the past five-year average. The contribution factor was then set against the 2024 Unitil system goal. The 2024 Unitil system goal was developed through benchmarking the Unitil system performance with nationwide utilities.

Individual circuits will be analyzed based upon circuit SAIDI, SAIFI, and CAIDI. Analysis of individual circuits along with analysis of the entire UES-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 Outages by Cause

This section provides a breakdown of all outages by cause code experienced during 2023. Charts 4, 5, and 6 list the number of interruptions, the number of customer interruptions, and total customer-minutes of interruption due to each cause respectively. Only the causes contributing 3% or greater of the total are labeled. Table 1 shows the number of interruptions for the top three trouble causes for the previous five years.

Chart 4
Number of Interruptions by Cause

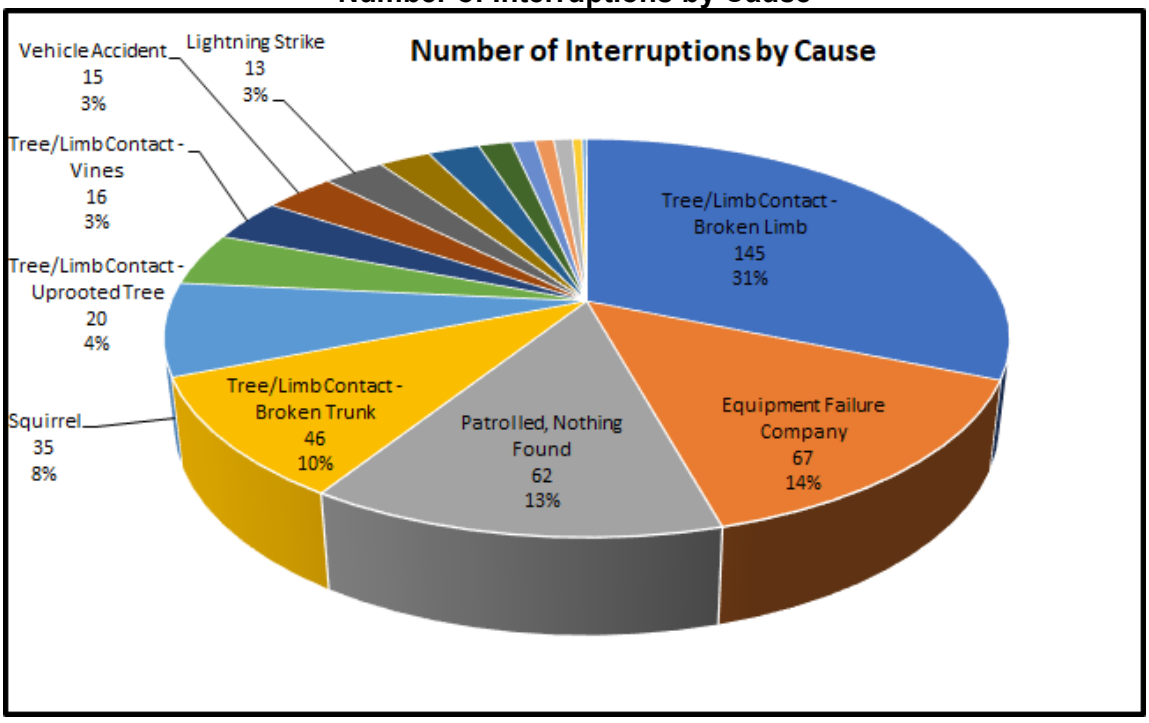


Chart 5
Number of Customer Interruptions by Cause

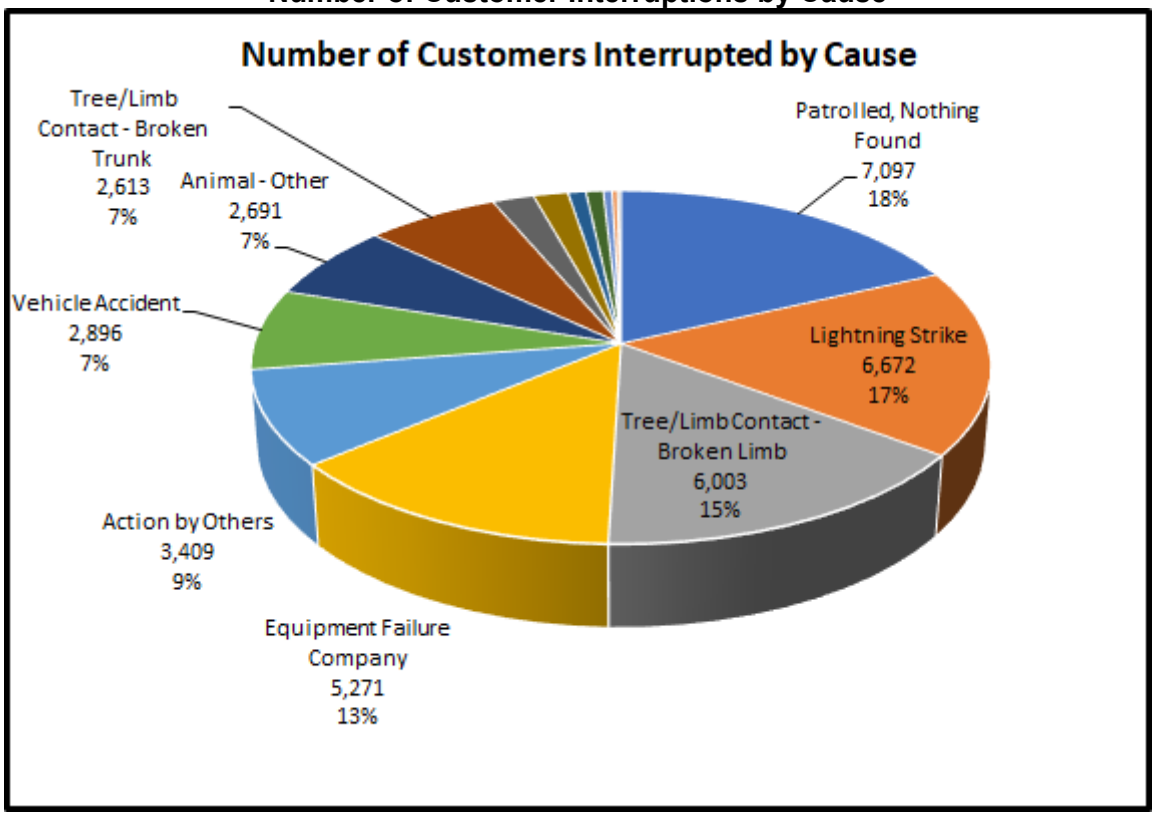


Chart 6
Percent of Customer-Minutes of Interruption by Cause

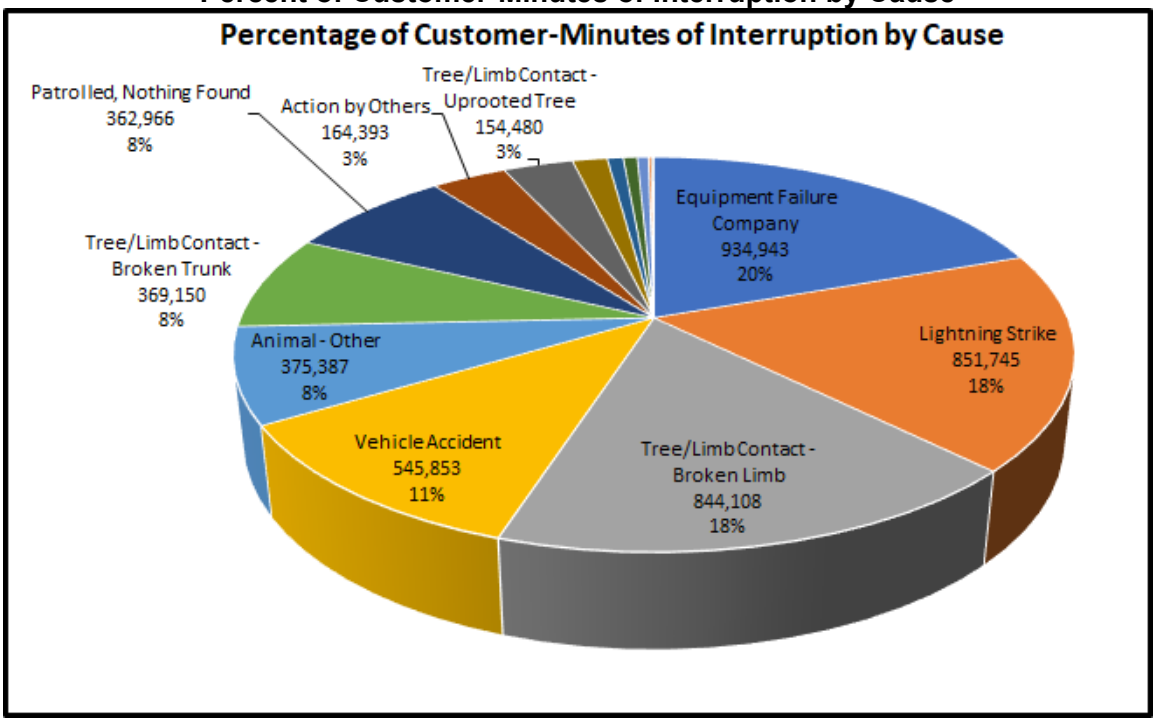


Table 1
Worst Three Trouble Causes over Past Five-Years
Number of Interruption

Year	# of Interruptions Per Trouble Cause		
	Tree/Limb Contact - Broken Limb	Equipment Failure Company	Tree/Limb Contact - Broken Trunk
2023	145	67	46
2022	96	50	74
2021	128	77	109
2020	132	84	61
2019	88	69	68

4 10 Worst Distribution Outages

The ten worst distribution outages ranked by customer-minutes of interruption during the time period from January 1, 2023 through December 31, 2023 are summarized in Table 2 below.

Table 2
Worst Ten Distribution Outages

Circuit	Date/Cause	Customer Interruptions	Cust-Min of Interruption	SAIDI	SAIFI
E51X1	04/23/2023 Equipment Failure Company	1,103	443,624	9.18	0.023
E54X2	06/16/2023 Lightning Strike	1,033	182,418	3.78	0.021
E51X1	07/06/2023 Tree/Limb Contact - Broken Trunk	1,105	158,416	3.28	0.023
E7W1	10/18/2023 Vehicle Accident	1,217	156,202	3.23	0.025
E27X1	01/25/2023 Vehicle Accident	393	149,569	3.1	0.008
E13W2	01/20/2023 Tree/Limb Contact - Broken Limb	148	122,100	2.53	0.003
E7W1	03/01/2023 Equipment Failure Company	1,219	110,990	2.3	0.025
E54X2	01/25/2023 Vehicle Accident	243	87,810	1.82	0.005
E28X1	03/14/2023 Tree/Limb Contact - Broken Limb	394	80,376	1.66	0.008
E21W2	01/21/2023 Tree/Limb Contact - Broken Trunk	217	68,677	1.42	0.004

5 Sub-transmission and Substation Outages

This section describes the contribution of sub-transmission line and substation outages on the UES-Seacoast system.

All substation and sub-transmission outages, including those that occurred during IEEE MEDs, ranked by customer-minutes of interruption during the time period from January 1, 2023 through December 31, 2023 are summarized in Table 3 below.

In aggregate, sub-transmission line and substation outages accounted for 31% of the total (including IEEE MEDs) customer-minutes of interruption for UES-Seacoast.

Table 3
Sub-transmission and Substation Outages

Line / Substation	Affected Circuits	Date/Cause	Customer Interruptions	Cust-Min of Interruption	SAIDI	SAIFI	Number of Outages in Prior Four Years
Winnacunnet Rd Tap	E46X1	02/04/2023 Equipment Failure Company	830	170,557	3.53	0.017	0
High St S/S	E17W1, E17W2	05/13/2023 Animal - Other	2,654	371,314	7.69	0.055	1
3362 Line	E1H3, E1H4, E19X2, E19X3, PEA	05/30/2023 Patrolled, Nothing Found	5,209	182,315	3.77	0.108	1
3358 Line	E21W1, E21W2, E58X1	08/08/2023 Lightning Strike	5,324	636,331	13.17	0.110	0
3359 Line	E15X1, E23X1, E59X1	08/24/2023 Action by Others	3,012	132,528	2.74	0.062	2
Seabrook S/S	E7W1, E7X2	09/08/2023 Lightning Strike	3,047	492,305	10.19	0.063	1
3356 Line	E56X1, E5X3, E13W1, E13W2, E13X3	12/18/2023 Tree/Limb Contact - Broken Limb	5,959	746,441	15.45	0.123	0
3354 Line	E27X1, E27X2, E28X1	12/18/2023 Tree/Limb Contact - Broken Trunk	1,663	391,609	8.11	0.034	0

6 Worst Performing Circuits

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

6.1 Worst Performing Circuits in Past Year

A summary of the worst performing circuits during the time period between January 1, 2023 and December 31, 2023 is included in the tables below.

Table 4 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 5 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 during 2023.

Circuits having one outage contributing more than 80% of the Customer-Minutes of interruption were excluded from this analysis.

Table 4
Worst Performing Circuits Ranked by Customer-Minutes

Circuit	Customer Interruptions	Worst Event (% of CI)	Cust-Min of Interruption	Worst Event (% of CMI)	SAIDI	SAIFI	CAIDI
E23X1	1,460	0%	125,865	0.0%	131.38	1.52	86.21
E54X2	1,803	2%	343,320	0.5%	332.67	1.75	190.42
E7W1	2,580	0%	276,102	0.1%	226.50	2.12	107.02
E51X1	2,742	0%	681,736	0.1%	345.84	1.39	248.59
E17W2	364	26%	33,864	50.4%	53.16	0.57	93.03
E58X1	3,860	0%	441,266	0.0%	194.48	1.70	114.32
E43X1	1,601	3%	94,317	5.7%	56.99	0.97	58.91
E27X1	1,154	0%	188,823	0.2%	268.90	1.64	163.58
E47X1	795	9%	100,428	15.8%	64.96	0.51	126.32
E13W2	872	6%	198,943	3.2%	120.86	0.53	228.14

Note: all percentages and indices are calculated on a circuit basis

Table 5
Circuit Interruption Analysis by Cause

Circuit	Customer-Minutes of Interruption / # of Outages					
	Tree/Limb Contact - Broken Limb	Equipment Failure Company	Patrolled, Nothing Found	Squirrel	Tree/Limb Contact - Broken Trunk	Vehicle Accident
E23X1	59,602 / 7	1,192 / 1	0 / 0	0 / 0	816 / 1	8,190 / 2
E54X2	63,175 / 6	546 / 1	1,618 / 2	0 / 0	3,623 / 2	91,002 / 3
E7W1	3,239 / 3	111,554 / 3	4,551 / 2	0 / 0	0 / 0	156,202 / 1
E51X1	21,997 / 8	458,785 / 4	882 / 3	7,474 / 3	158,668 / 2	99 / 1
E17W2	24,514 / 2	0 / 0	6,154 / 2	2,938 / 2	108 / 1	0 / 0
E58X1	78,189 / 11	1,593 / 3	8,684 / 2	12,037 / 1	22,405 / 1	0 / 0
E43X1	11,488 / 5	57,243 / 4	568 / 3	888 / 3	14,161 / 3	0 / 0
E27X1	24,327 / 7	0 / 0	13,652 / 3	0 / 0	1,206 / 3	149,569 / 1
E47X1	26,260 / 4	17,041 / 2	10,214 / 5	8,273 / 1	29,972 / 2	0 / 0
E13W2	134,384 / 12	9,352 / 6	71 / 1	19,784 / 7	14,122 / 2	0 / 0

6.2 Worst Performing Circuits of the Past Five Years

The annual performance of the ten worst circuits in terms of SAIDI and SAIFI for each of the past five years is shown in the tables below. Table 6 lists the ten worst performing circuits ranked by SAIFI and Table 7 lists the ten worst performing circuits ranked by SAIDI. Table 8 lists the ten worst circuits in terms of SAIFI and SAIDI for the past five years.

The data used in this analysis includes all system outages except those outages that occurred during the IEEE MEDs in 2019 through 2023.

Table 6
Circuit SAIFI

Circuit Ranking (1=worst)	2023		2022		2021		2020		2019	
	Circuit	SAIFI	Circuit	SAIFI	Circuit	SAIFI	Circuit	SAIFI	Circuit	SAIFI
1	E7W1	2.116	E54X1	3.217	E21W1	4.395	E15X1	3.597	E3W1	2.062
2	E54X2	1.747	E22X1	2.811	E15X1	3.587	E21W1	2.924	E6W1	1.991
3	E58X1	1.701	E2H1	2.000	E23X1	3.148	E51X1	2.486	E22X1	1.758
4	E27X1	1.644	E27X1	1.719	E59X1	2.473	E6W2	2.103	E51X1	1.693
5	E23X1	1.524	E47X1	1.634	E27X1	2.384	E13X3	2.000	E23X1	1.677
6	E51X1	1.391	E13W2	1.457	E6W1	2.256	E19H1	2.000	E11X1	1.356
7	E19X3	1.390	E6W1	1.418	E54X1	2.154	E17W2	1.518	E21W1	1.290
8	E59X1	1.373	E56X1	1.396	E22X1	1.957	E6W1	1.505	E18X1	1.261
9	E15X1	1.305	E13W1	1.193	E18X1	1.718	E56X1	1.484	E17W2	0.998
10	E19X2	1.161	E51X1	1.153	E7X2	1.467	E2H1	1.223	E6W2	0.901

Table 7
Circuit SAIDI

Circuit Ranking (1=worst)	2023		2022		2021		2020		2019	
	Circuit	SAIDI	Circuit	SAIDI	Circuit	SAIDI	Circuit	SAIDI	Circuit	SAIDI
1	E51X1	345.84	E27X1	354.34	E21W1	517.49	E51X1	370.76	E6W1	459.13
2	E54X2	332.67	E56X1	281.02	E15X1	387.02	E13X3	335.64	E51X1	354.92
3	E27X1	268.90	E54X1	240.82	E22X1	371.47	E15X1	283.77	E21W1	176.68
4	E7W1	226.50	E2H1	239.32	E23X1	303.66	E21W1	240.24	E22X1	170.09
5	E58X1	194.48	E23X1	152.95	E27X1	283.93	E6W2	225.28	E11X1	167.39
6	E28X1	158.14	E51X1	143.30	E59X1	258.19	E21W2	219.48	E15X1	116.15
7	E6W1	152.69	E6W1	141.70	E27X2	218.64	E6W1	166.78	E17W2	115.43
8	E23X1	131.38	E47X1	133.26	E47X1	182.46	E22X2	154.73	E13W1	113.6
9	E13W2	120.86	E3W4	109.60	E54X1	172.53	E22X1	153.4	E23X1	112.91
10	E15X1	97.67	E22X1	107.30	E6W1	148.9	E19H1	147.89	E6W2	93.03

Table 8
Worst Performing Circuits in Past Five Years

SAIFI			SAIDI		
Circuit Ranking (1=worst)	Circuit	# of Times in Worst 10	Circuit Ranking (1=worst)	Circuit	# of Times in Worst 10
1	E51X1	4	**1**	E7W1	1
2	E54X2	1	**2**	E54X2	1
3	E27X1	3	**3**	E58X1	1
4	E7W1	1	**4**	E27X1	3
5	E58X1	1	**5**	E23X1	4
6	E28X1	0	**6**	E51X1	4
7	E6W1	4	**7**	E19X3	0
8	E23X1	3	**8**	E59X1	1
9	E13W2	1	**9**	E15X1	4
10	E15X1	3	**10**	E19X2	0

6.3 System Reliability Improvements

Vegetation management projects completed in 2023 or planned for 2024 that are expected to improve the reliability of the 2023 worst performing circuits are included in Table 9 below. Table 10 below details electric system capital projects that were completed in 2023 or are budgeted in 2024 to improve system reliability.

Table 9
Vegetation Management Projects Worst Performing Circuits

Circuit(s)	Year of Completion	Project Description
E28X1	2023	Storm Resiliency Pruning
E15X1	2023	Storm Resiliency Pruning and Cycle Pruning and Hazard Tree Removal
E22X2	2023	Storm Resiliency Pruning
E13W2	2023	Storm Resiliency Pruning and Cycle Pruning and Hazard Tree Removal
E58X1	2023	Storm Resiliency Pruning and Cycle Pruning and Hazard Tree Removal
E2H1	2023	Cycle Pruning and Hazard Tree Removal
E5X3	2023	Cycle Pruning and Hazard Tree Removal
E13X3	2023	Cycle Pruning and Hazard Tree Removal
E17W1	2023	Cycle Pruning and Hazard Tree Removal
E27X1	2023	Cycle Pruning and Hazard Tree Removal
E27X2	2023	Cycle Pruning and Hazard Tree Removal

Circuit(s)	Year of Completion	Project Description
E56X2	2023	Cycle Pruning and Hazard Tree Removal
3343/3354 Lines	2023	Cycle Pruning and Hazard Tree Removal
3348/3353 Lines	2024	Cycle Pruning and Hazard Tree Removal
E7X2	2024	Cycle Pruning and Hazard Tree Removal
E13W1	2024	Cycle Pruning and Hazard Tree Removal
E18X1	2024	Cycle Pruning and Hazard Tree Removal
E21W1	2024	Storm Resiliency Pruning and Cycle Pruning and Hazard Tree Removal
E21W2	2024	Cycle Pruning and Hazard Tree Removal
E47X1	2024	Cycle Pruning and Hazard Tree Removal
E2X3	2024	Forestry Reliability on Exeter Rd in Hampton Falls
E56X1	2024	Forestry Reliability on Hunt Rd in Kingston
E23X1	2024	Forestry Reliability on Woodman Rd in South Hampton

Table 10
Electric System Improvements Performed to Improve Reliability

Circuit(s)	Year of Completion	Project Description
E22X1 / E54X1	2024	Implement automatic restoration scheme
E27X1 / E23X1	2024	Convert, install reclosers and implement an automatic restoration scheme
3348/3350	2024	Year of infrastructure replacement along the salt marsh
E2X2 / E46X1	2025	Convert circuit E46X1 and create circuit tie with E2X2

7 Tree Related Outages in Past Year

This section summarizes the worst performing circuits by tree related outage during the time period between January 1, 2023 and December 31, 2023.

Table 11 shows the ten worst circuits ranked by the total number of Customer-Minutes of interruption. The number of customer-interruptions and number of outages are also listed in this table.

All streets on the UES-Seacoast system with three or more tree related outages are shown in Table 12 below. The table is sorted by number of interruptions and customer-minutes of interruption.

Table 12 indicates that there were thirteen streets that experienced three or more tree related outages in 2023. It is recommended that a forestry review of the areas identified in Table 13 be performed in 2024 in order to identify and address any growth or hazard tree problems.

Table 11
Worst Performing Circuits – Tree Related Outages

Circuit	Customer Minutes of Interruption	Number of Customers Interrupted	No. of Interruptions
E51X1	210,516	1,457	13
E13W2	166,397	496	17
E58X1	113,628	1,180	14
E21W2	91,867	410	15
E28X1	81,299	401	7
E23X1	74,287	417	10
E54X2	66,798	431	8
E19X3	65,830	658	18
E13W1	64,285	639	13
E54X1	62,664	331	7

Table 12
Multiple Tree Related Outages by Street

Circuit(s)	Street, Town	# Outages	Customer-Minutes of Interruption	Number of Customer Interruptions
E28X1	Exeter Rd, Hampton Falls	7	81,299	401
E13W1	North Main St, Plaistow	6	37,946	389
E23X1, E6W1	South Rd / Rt 107, Kensington	5	42,945	365
E18X1	Exeter Rd, Hampton	5	42,933	192
E21W2	Maple Ave, Atkinson	5	1,139	16
E19X3	Brentwood Rd, Exeter	4	31,997	132
E58X1	Sawyer Ave, Atkinson	4	1,823	44
E13W2	Thornell Rd, Newton	3	132,697	294
E54X1	Amesbury Rd, Newton	3	54,293	276
E13W1, E58X1	Main St, Plaistow	3	49,198	593
E43X1	Giles Rd, East Kingston	3	12,753	107
E59X1	Crank Rd, Hampton Falls	3	10,465	67
E1H4	School St, Exeter	3	7,059	88

8 Failed Equipment

This section is intended to clearly show all equipment failures throughout the study period from January 1, 2023 through December 31, 2023. Chart 7 shows all equipment failures throughout the study period. Chart 8 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 9.

Chart 7
Equipment Failure Analysis by Cause

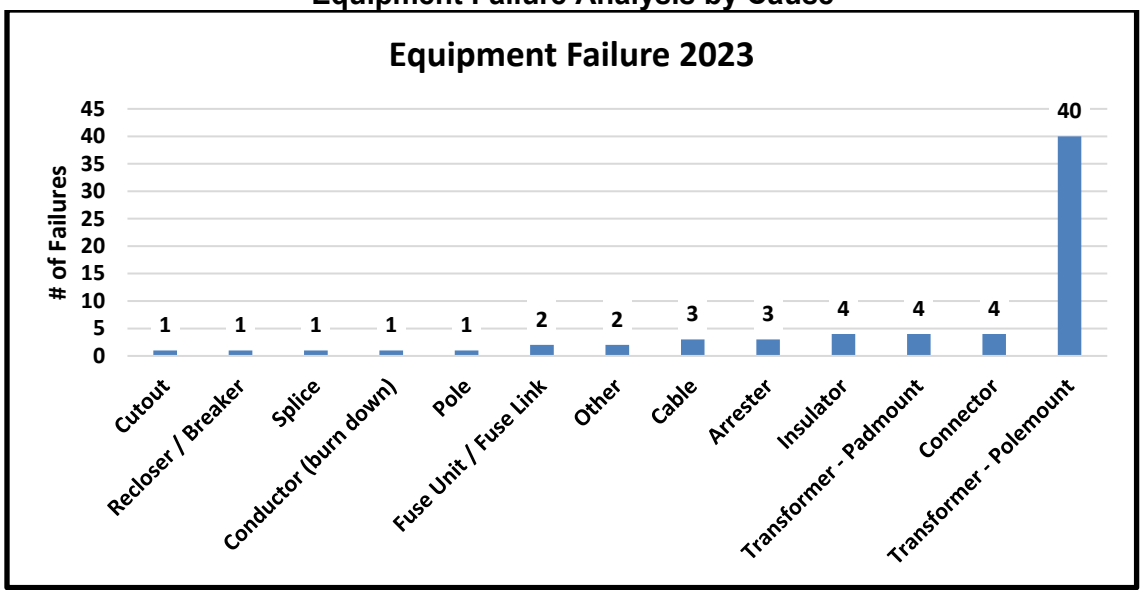


Chart 8
Equipment Failure Analysis by Percentage of Total Failures

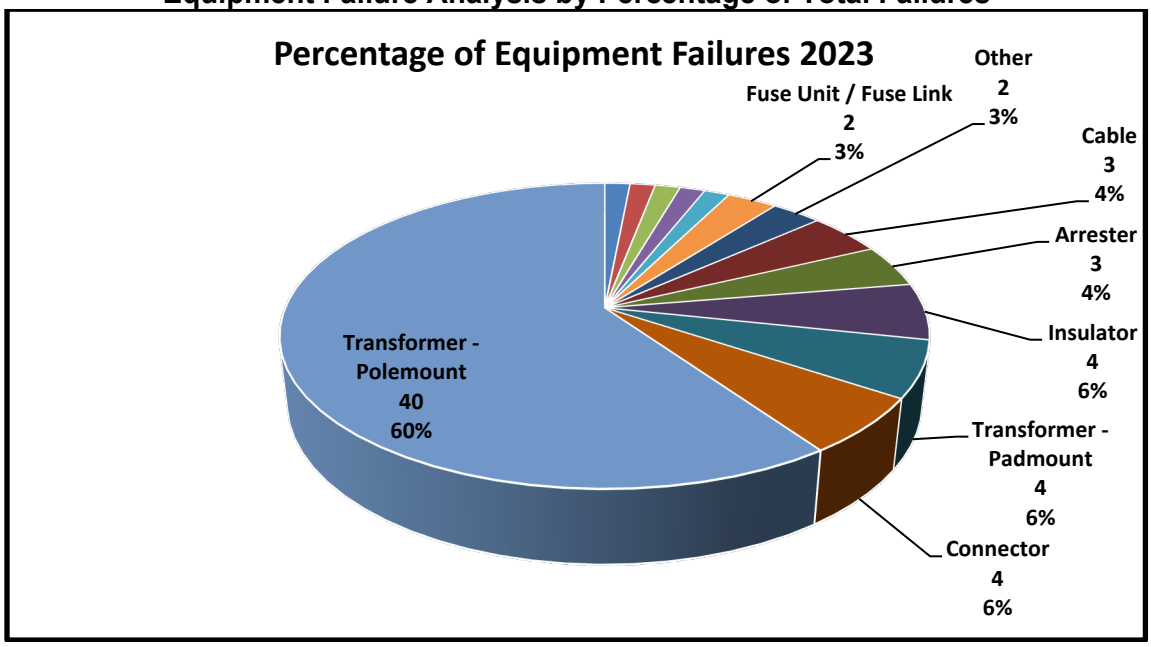
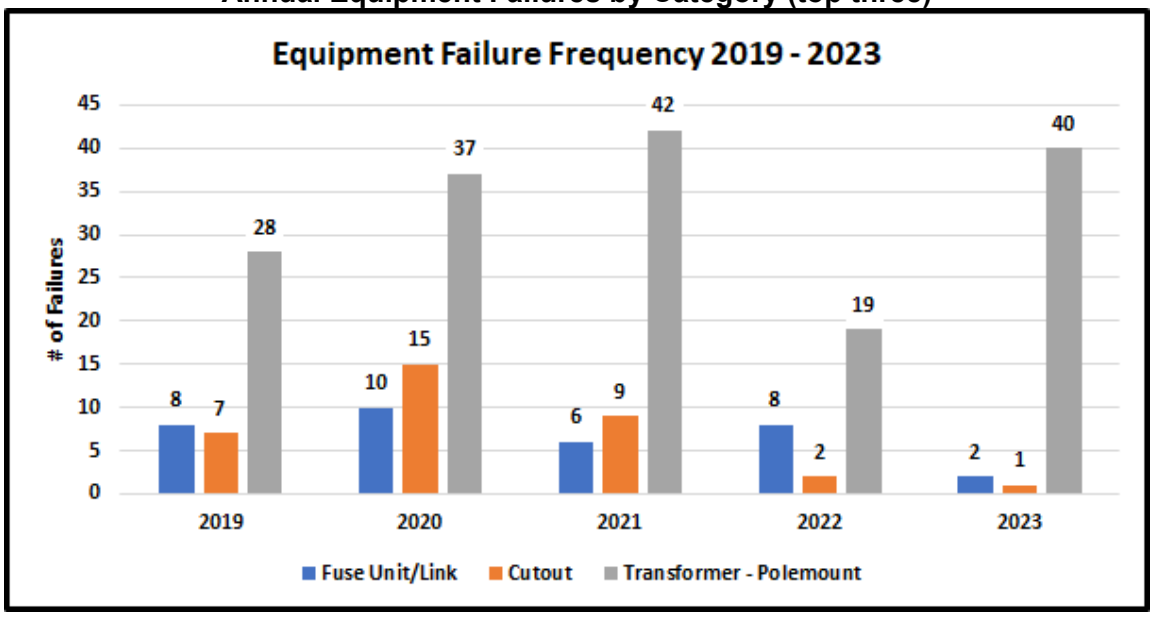


Chart 9
Annual Equipment Failures by Category (top three)



9 Multiple Device Operations and Streets with Highest Number of Outages

A summary of the devices that have operated three or more times from January 1, 2023 to December 31, 2023 is included in Table 13 below.

A summary of the of the streets on the UES-Seacoast system that had customers with 5 or more non-exclusionary outages in 2023 is included in Table 14 below. The table is sorted by circuit and then the maximum number of outages seen by a single customer on that street

Table 13
Multiple Device Operations

Circuit	Number of Operations	Device	Customer Minutes	Customer Interruptions	# of Times on List in Previous 4 Years
E6W1	4	60QA Fuse, P45 Haverhill Rd, East Kingston	17,080	220	0
E19X3	4	150QA Fuse, P74 Brentwood Rd, Exeter	32,997	132	0
E58X1	4	125QA Fuse, P26 Newton Rd, Plaistow	80,992	1068	0
E13W1	4	75QA Fuse, P54 North Main St, Plaistow	34,812	389	2
E13W1	3	60QA Fuse, P6 Crystal Hill Rd, Atkinson	1,044	9	0
E3W4	3	75QA Fuse, P7 Ashworth Ave, Hampton	31,029	244	0

Circuit	Number of Operations	Device	Customer Minutes	Customer Interruptions	# of Times on List in Previous 4 Years
E18X1	4	175QA Fuse, P84 Exeter Rd, Hampton	38,819	135	0
E23X1	3	300 Solid Fuse, P82 South Rd / Rt 107, Kensington	29,319	327	0
E6W2	3	10QA Fuse, P9 North Rd, Kingston	2,727	27	0
E13W2	3	30QA Fuse, P8 Wenmarks Rd, Newton	25,126	288	0
E47X1	3	50QA Fuse, P39 Frying Pan Lane, Stratham	3,266	40	0

Table 14
Streets with the Highest Number of Outages

Circuit	Street	Max Number of Outages Seen by a Single Customer	Number of Times on List in Previous 4 Years
E28X1	Exeter Rd	10	0
E13W1	North Main St	7	0
E21W2	Maple Ave	7	0
E23X1	South Rd / Rt 107	6	0
E7W1	Ocean Blvd	6	1
E18X1	Exeter Rd	5	0
E6W1	Haverhill Rd	5	0
E54X2	Ball Rd	5	0

10 Recommendations

This following section describes recommendations on circuits, sub-transmission lines and substations to improve overall system reliability. The recommendations listed below will be compared to the other proposed reliability projects on a system-wide basis. A cost benefit analysis will determine the priority ranking of projects for the 2025 capital budget. All project costs are shown without general construction overheads.

10.1 Circuits 6W1 and 6W2 – Construct Circuit Tie

10.1.1 Identified Concerns

Circuit 6W1 has been one of the ten worst performing circuits in the UES-Seacoast system in terms of SAIDI and SAIFI for each of the past ten years. Additionally, the owner of a section of property along South Road on 6W1 has repeatedly refused to allow effective pruning and

hazard tree mitigation, and this section has been the cause of several tree outages over the past several years.

A project to re-conductor the section of South Road with spacer has been proposed in the past, but even if the project could have been justified for reliability spending, it was impossible to construct because the level of trimming needed for the spacer cable construction wasn't achievable.

10.1.2 Recommendation

This project will consist of rebuilding and converting portions of circuit 6W1 and 6W2 from 4.16kV operation to 13.8kV to create a new circuit tie between the two circuits.

Circuits 6W1 and 6W2 along Powwow River Road and Burnt Swamp Road from pole 28 Depot Road Kingston to pole 1 South Road, South Hampton will be rebuilt and converted to three-phase 13.8kV operation.

A new normally open recloser between the circuits will be installed in the vicinity of pole 1 South Road, South Hampton. A normally closed recloser will also be installed at pole 1 South Road in South Hampton.

This project sets the stage for the installation of additional reclosers and the implementation of a future distribution automation scheme.

Customer Exposure = 771 customers

The projected average annual savings for this project is 105,000 customer minutes of interruptions and 0 customer interruptions.

Estimated Project Cost: $1,330,000

10.2 Circuits 58X1 and 5X3 – Increase Circuit Tie Capacity and Reconfigure

10.2.1 Identified Concerns

Circuit 58X1 and Westville substation as served via the aging radial 3358 line. There is not sufficient distribution circuit tie capacity to restore circuit 58X1 and/or Westville substation for the loss of the 3358 line. Additionally, circuit 58X1 is one of the larger circuits of the UES Seacoast system, serving nearly 11.5MW of load and over 2,250 customers.

10.2.2 Recommendation

This project will consist of rebuilding and converting circuit 5X3 from Plaistow substation to the intersection of Sweet Hill Road and Pollard Road. This will allow a majority of the eastern portion of circuit 58X1 to be transferred to circuit 5X3.

To accommodate this load transfer the 5X3 regulators at Plaistow substation will be upgraded to larger units.

The larger 5X3 regulators and the installation of a new gang-operated switch on the 3358 line should provide circuit 5X3 will sufficient capacity to restore circuit 58X1 and Westville substation for the loss of the 3358 line.

Customer Exposure = 5,280 customers (3358 line)

The projected average annual savings for this project is 235,000 customer minutes of interruptions and 450 customer interruptions.

Estimated Project Cost: $1,350,000

11 Conclusion

The annual electric service reliability of the UES-Seacoast system has seen improvement in the last ten years over prior years after discounting MEDs. Much of the overall improvement in reliability can be attributed to an aggressive vegetation management program; however, the most significant risk to reliability of the electric system continues to be vegetation.

The recommendations in this report focus on creating new circuit ties to increase the flexibility of the system to facilitate quicker restoration of customers that can be isolated from faulted sections of the system. This includes upgrading portions of circuits to create back-up supply to the worst performing circuit over the past five years and radial subtransmission lines. This report is also intended to assist the Unitil Forestry group in identifying areas of the system that are being frequently affected by tree related outages to allow proactive measures to be taken.