

Eversource

Reliability Enhancement Program

Executive Summary

Executive Summary Eversource Reliability Enhancement Program

This report provides program-specific details for Eversource's Reliability Enhancement Program (REP). This includes Operation and Maintenance (O&M) expenditures from the initial REP program (Base REP) and the 2018 extension of REP for the period January 1, 2018 through December 31, 2018.

The initial REP was established under the settlement agreement approved by the Commission in Order No. 24,750 in Docket No. DE 06-028 and became effective July 1, 2007. The results of the reliability work under the initial REP were documented in the report submitted by Eversource on February 18, 2011.

As part of the Settlement Agreement on Permanent Distribution Rates approved by the Commission in Order No. 25,123 issued in Docket No. DE 09-035, the settling parties agreed that Eversource should continue its existing REP expenditures from the initial REP and incorporate the revenue requirement for the O&M portion into base distribution rates. Additionally, the Settlement Agreement provided for an additional \$4 million per year of revenue for the duration of the Settlement to support enhanced O&M and capital spending under a so-called "REP II" initiative. The REP II initiative ended in 2015 and the final results of that program were included in the report submitted by Eversource on September 30, 2016.

The "REP 3" initiative was a two year extension of REP and was included in the Generation Divestiture settlement agreement of Docket No. DE 14-238. It became effective July 1, 2015, and continued for two years through June 30, 2017. The final results of that program were included in the report submitted by Eversource on May 15, 2018.

A further extension was agreed to as part of Docket No. 17-076 (REP 4). It became effective July 1, 2017 and continued for six months, ending December 31, 2017. The final results of that program were included in the report submitted by Eversource on May 15, 2018.

REP was extended again for calendar year 2018 under Docket No. 17-196. This report covers calendar year 2018 expenditures and results for base REP and the 2018 extension.

O&M

Actual O&M spending for the twelve months ended December 31, 2018 for projects initiated under the Base REP program was \$8.37 million. See Section 2 *Base REP O&M Summary* for details on individual activity cost and unit count.

Actual O&M spending for the twelve months ended December 31, 2018 under 2018 REP program was \$2.03 million. See Section 4 *REP O&M Summary* for details on individual activity cost.

Capital

Capital expenditures for the twelve months ended December 31, 2018 for projects initiated under the Base REP program was \$2.53 million. See Section 3 *Base REP Capital* for details on budget item/project descriptions and expenditures by item or project.

Capital plant in service for the twelve months ended December 31, 2018 under the 2018 REP program was \$2.66 million. See section 5 *Capital Summary* for details on the individual projects.

Reliability

Eversource's SAIDI performance improved in 2018, despite having experienced more storms than in 2017. See Section 1 *NHPUC Reliability Graphs*.

Since the REP was implemented, the trend from 2006 onward has been improved reliability on a weather normalized basis. Eversource's customers continue to see benefits from the REP activities. REP programs are preventing problems from occurring (improving SAIFI) and reducing outage times (improving SAIDI). The REP activities are critical and important in concert with Eversource's continued efforts to maintain and improve the system in the normal course of business.

Section 1

NHPUC Reliability Graphs

NHPUC SAIDI Graphs Summary Reliability Enhancement Program

The following is a brief description of the SAIDI Graphs contained in this section and the related REP activities for them. All graphs represent data through the end of 2018.

1. Graphs 1 and 2 depict the Eversource SAIDI – NHPUC Criteria. The Company SAIDI improved in 2018 compared to 2017. The pre-REP trend lines shown are based on data for 1989 through 2005 and are intended to show where SAIDI might have been without the REP program. The second chart shows a trend line for SAIDI for the period since the implementation of REP.
2. Graphs 3 and 4 depict the Eversource SAIDI – NHPUC Criteria With and Without Storms. NHPUC SAIDI (pink line) does not include emergency events which are classified as PUC Major Storms. A Major Storm is defined as an event that results in either: a) 10% or more of Eversource's retail customers being without power in conjunction with more than 200 reported troubles; or b) more than 300 reported troubles during the event. See *Order No. 25,465* at 1. Eversource experienced a total of 9 major storms in 2018 compared to 4 in 2017, and one in 2016. These larger events are shown on this chart over and above the NHPUC reported SAIDI as the dark blue line. Off-scale impacts are shown for the December Ice Storm in 2008, the February wind storm in 2010, Tropical Storm Irene in August 2011, a major snowstorm in October 2011, Hurricane Sandy in 2012, the Thanksgiving weekend storm in 2014, and the October windstorm in 2017.

Eversource also tracks minor storms when 100 or more primary power outages occur within a storm timeframe and not deemed a NHPUC major storm. Eversource experienced a total of 21 minor storm days in 2018 compared to 25 in 2017, and 20 in 2016⁽¹⁾. These storms contributed 33 minutes to Eversource's SAIDI performance in 2018, compared to 50 minutes in 2017, and 53 minutes in 2016.

Subtracting major and minor storm impacts from NHPUC reported SAIDI leaves a Weather normalized SAIDI, which is the yellow line on the graph. As shown, that component continues to be below levels present when REP was initiated in July 2007 and continues to be on a downward trend since that time.

3. Eversource Tree Related SAIDI (graph 5). The largest cause group for SAIDI is trees and limbs, primarily from outside of the clearance area. Tree related SAIDI and the NHPUC reported SAIDI trend very closely and are sensitive to weather. Weather Normalized Tree SAIDI had been trending upward slightly, although it did dip downward slightly in 2018. There is a cumulative effect for vegetation management and we believe the effort from the last half of 2007 through year end 2018 is showing results. Our efforts to establish the target 4.5 year trimming cycle for the distribution system have succeeded. Eversource's trimming cycle remains at approximately 3.9 years, well below the maximum five year cycle required by Puc 307.10 Tree-Pruning Standards. REP activities relating to this are Enhanced Tree Trimming specifications for establishing larger clearance zones and Hazard Tree Removals for trees outside the trim zone identified as having the potential to fall into the lines. Both of these activities were capital work in 2018.
4. Eversource Equipment Related SAIDI (graph 6). The second largest cause group for SAIDI is equipment failures in substations and on distribution lines. These outages have very low correlation to weather so the difference between NHPUC criteria performance and weather normalized performance is small. Results in this area showed a slight uptick in 2018, mostly due to a manufacturing defect on a particular model of recloser. All the affected units were replaced with refurbished units in the first quarter of 2018.

⁽¹⁾ For internal reporting purposes, these are referred to as "minor" and "work order" storm days. There were 14 minor storm days plus 7 work order storm days in 2018. These storms are included in reliability reporting statistics.

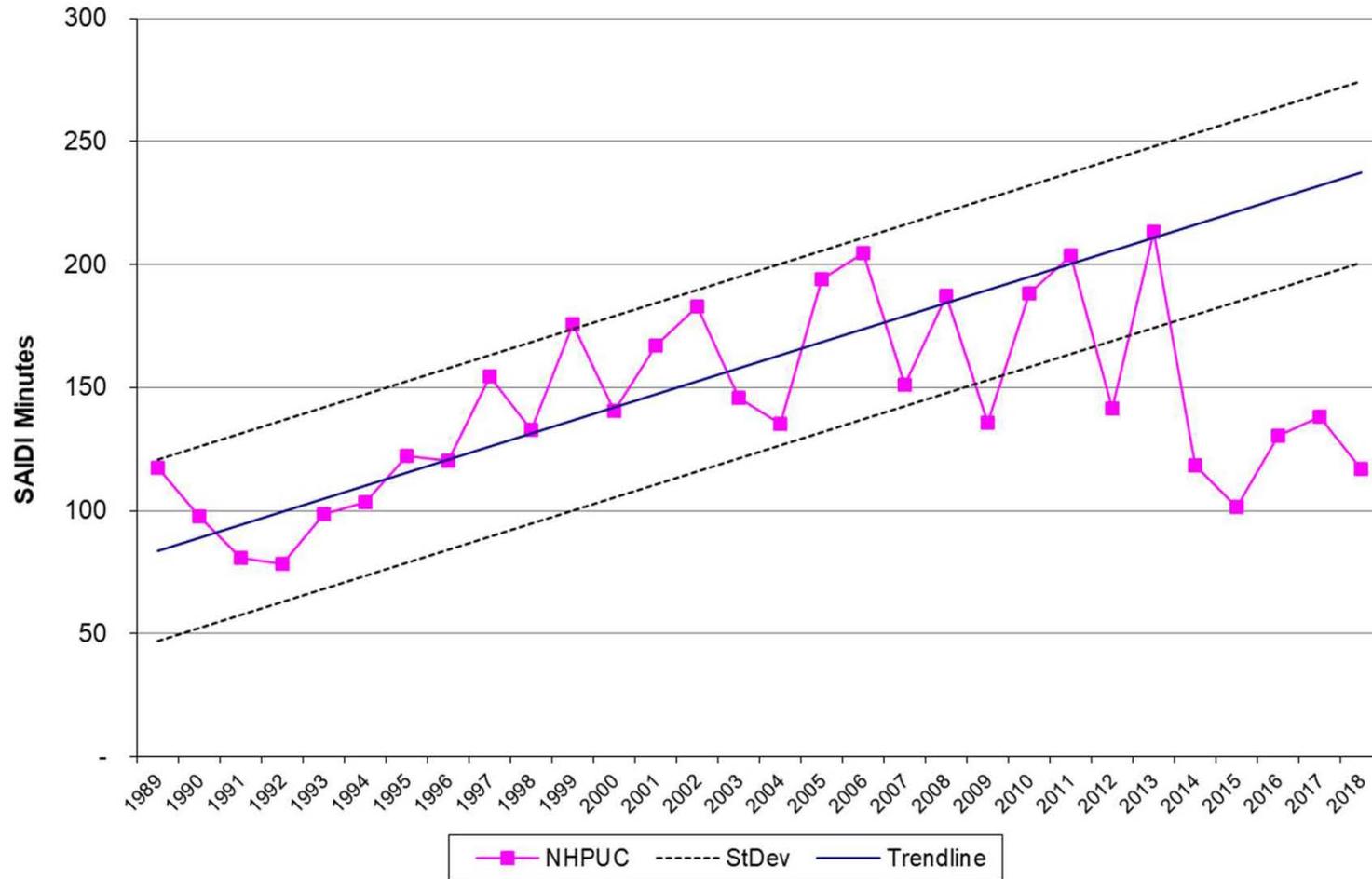
NHPUC SAIDI Graphs Summary Reliability Enhancement Program

5. Eversource SAIDI – NHPUC Criteria Substation Reliability (graph 7). Power outages caused by actions or problems inside substations are typically large and widespread. The amount of SAIDI minutes relating to these events is generally declining and there is essentially no difference due to weather. Substation SAIDI increased in 2018 due in large part to an instrumentation potential transformer failure at Monadnock Substation in Troy. This event impacted 8,396 customers for up to 83 minutes. Despite this increase substation SAIDI remains below the levels before implementation of the REP. There were a total of six substation events in 2018, four of which were animal related.

6. Top 50 Hit List SAIDI Contribution from Year to Year (graph 8). Each year Eversource reviews SAIDI by circuit and determines which circuits have contributed the most minutes according to the NHPUC Criteria. Shown on this graphic are the total SAIDI minutes for the top 50 circuits in a year, the amount of SAIDI minutes for those circuits remaining on the top 50 list from the previous year, and the percentage of SAIDI these carry forward circuits represent compared to the Top 50 total. The Top 50 contributed slightly more than 60 minutes to company SAIDI in 2018 (yellow bar). This compares to less than 60 minutes in 2017 and almost 70 minutes in 2015. Two thirds of these minutes (pink line) were due to circuits which were also on the 2017 Top 50 list (purple bar).

PSNH SAIDI - NHPUC Criteria

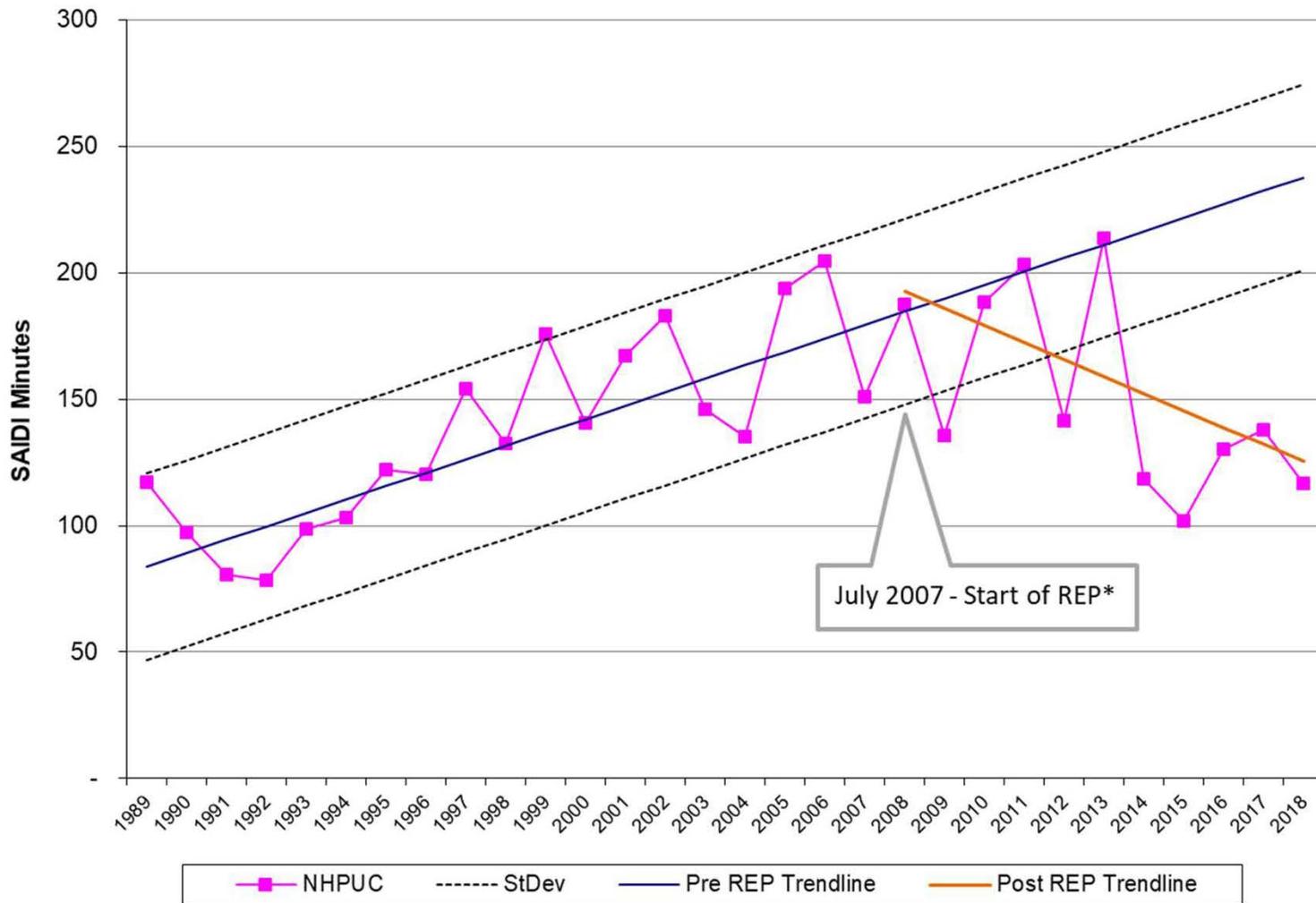
Original trendline



Trend Lines are based upon 1989 - 2005 data and are intended to depict where SAIDI might have tracked without the REP Program

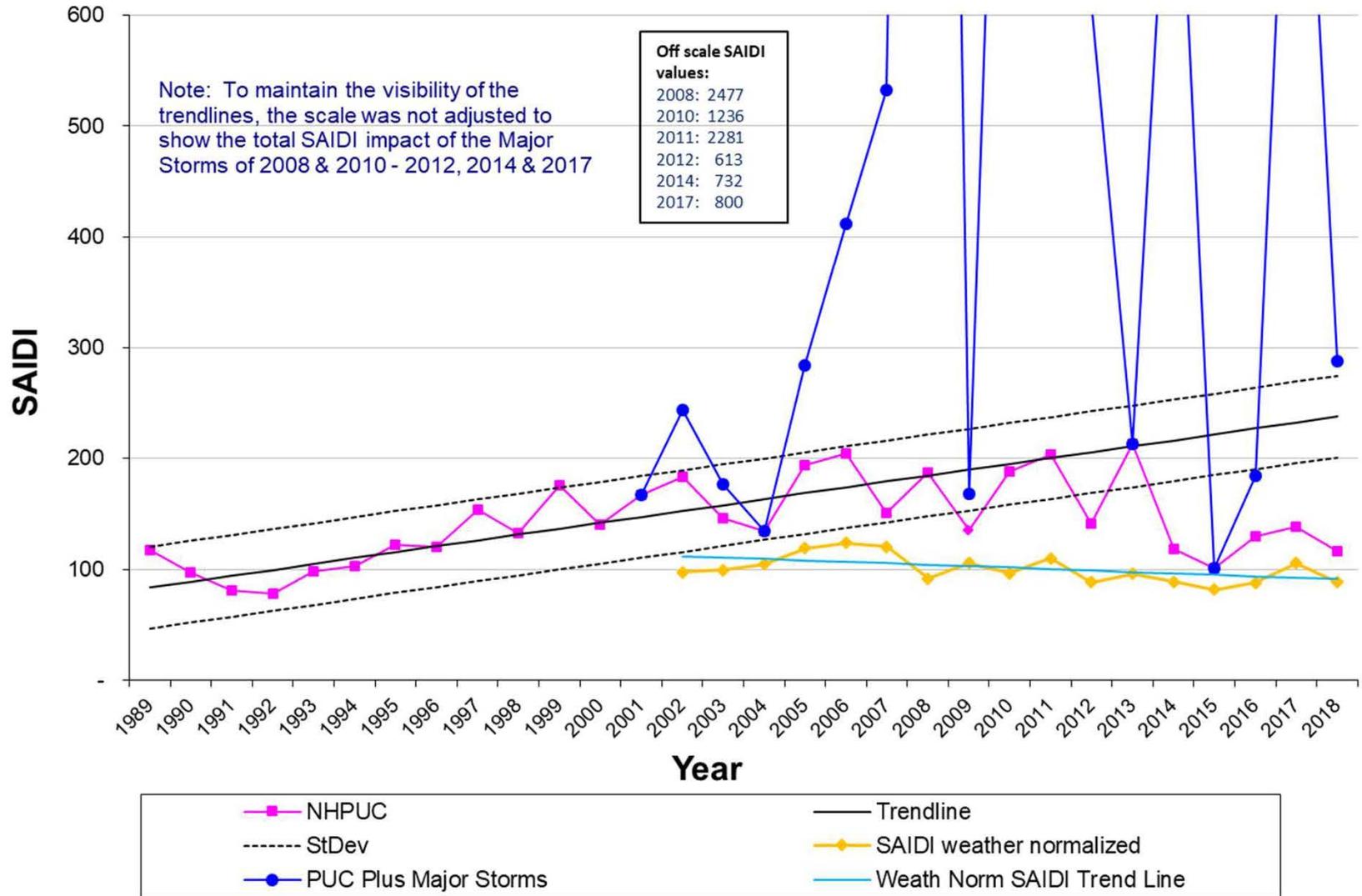
Eversource SAIDI - NHPUC Criteria

Post REP Trendline



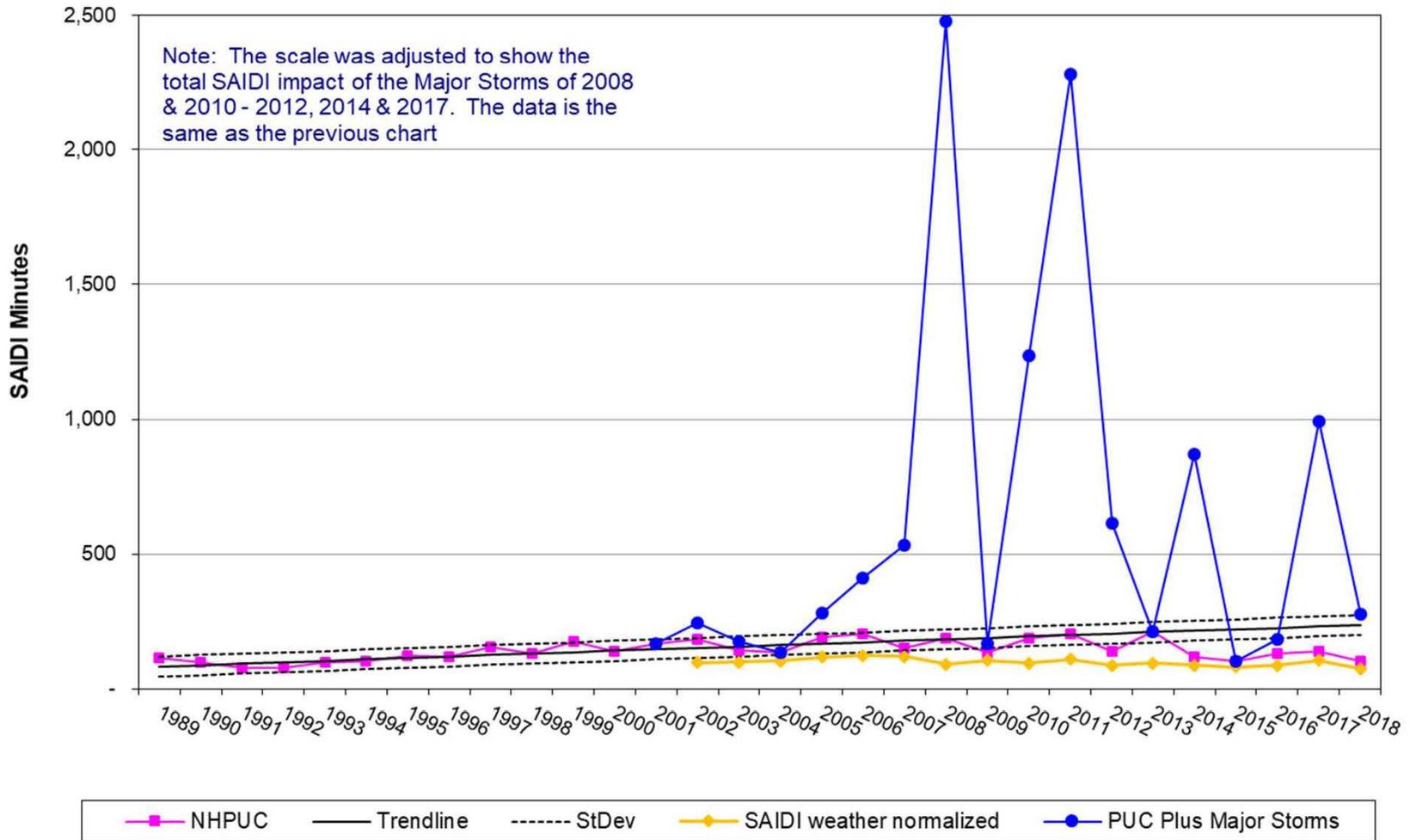
Eversource SAIDI - NHPUC Criteria

With and Without Storms



Eversource SAIDI - NHPUC Criteria

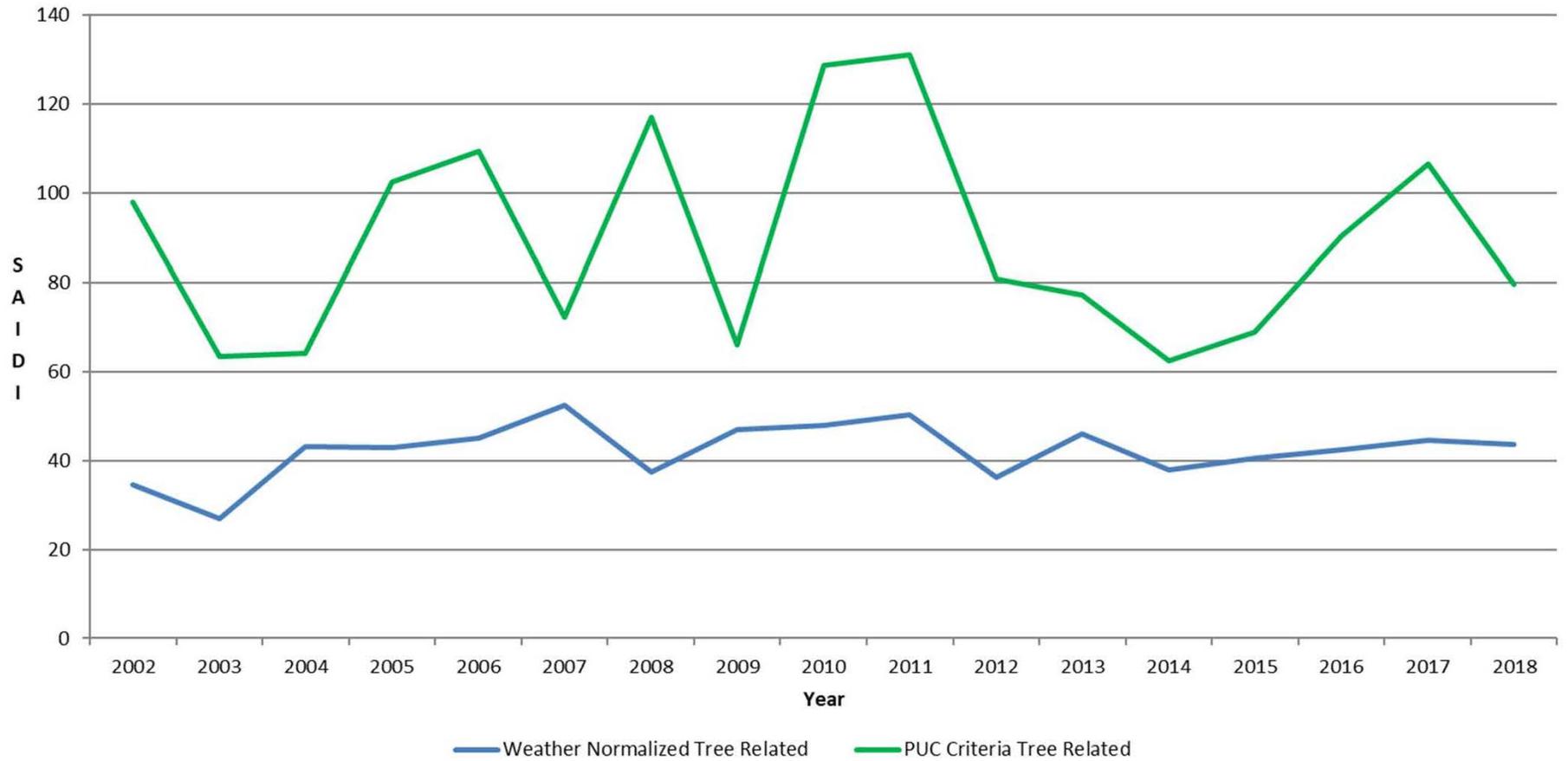
With and Without Storms



Eversource Tree Related SAIDI

NHPUC Criteria

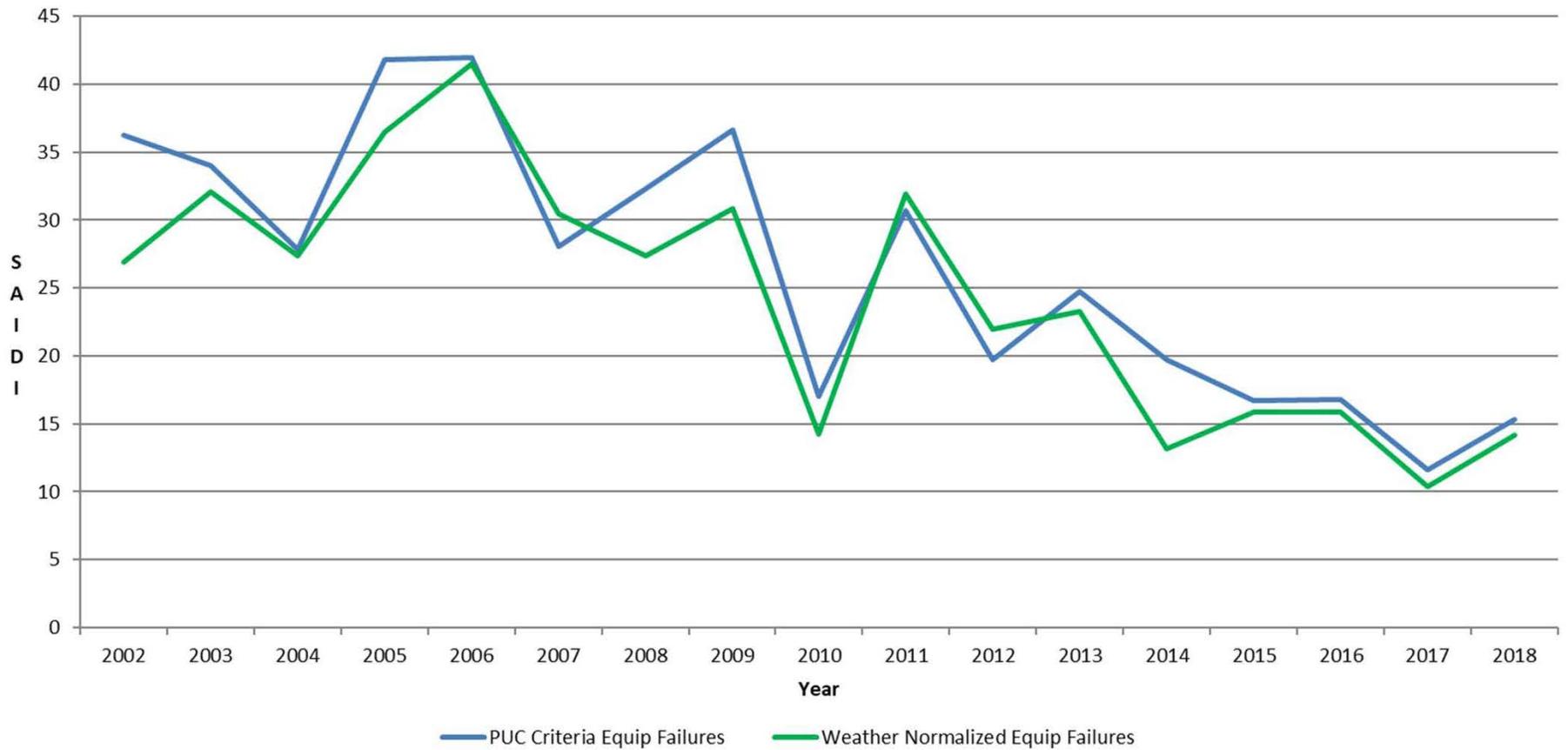
100% of Trees/Limbs, 50% of Snow/Ice Loading, 40% of Patrolled Nothing Found related troubles)



Eversource Equipment Failure Related SAIDI

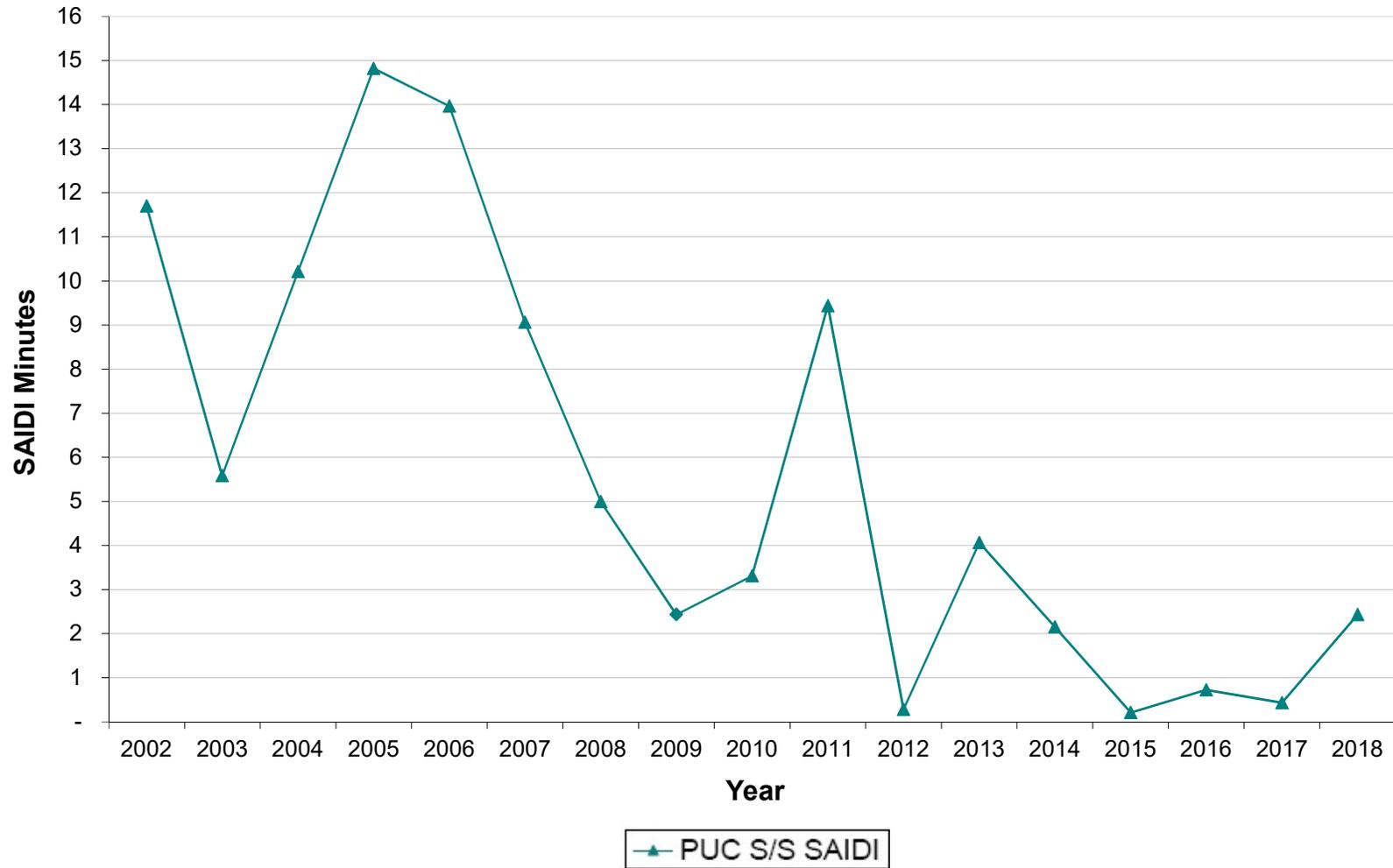
NHPUC Criteria

100% Equipment Failure and Overload Events



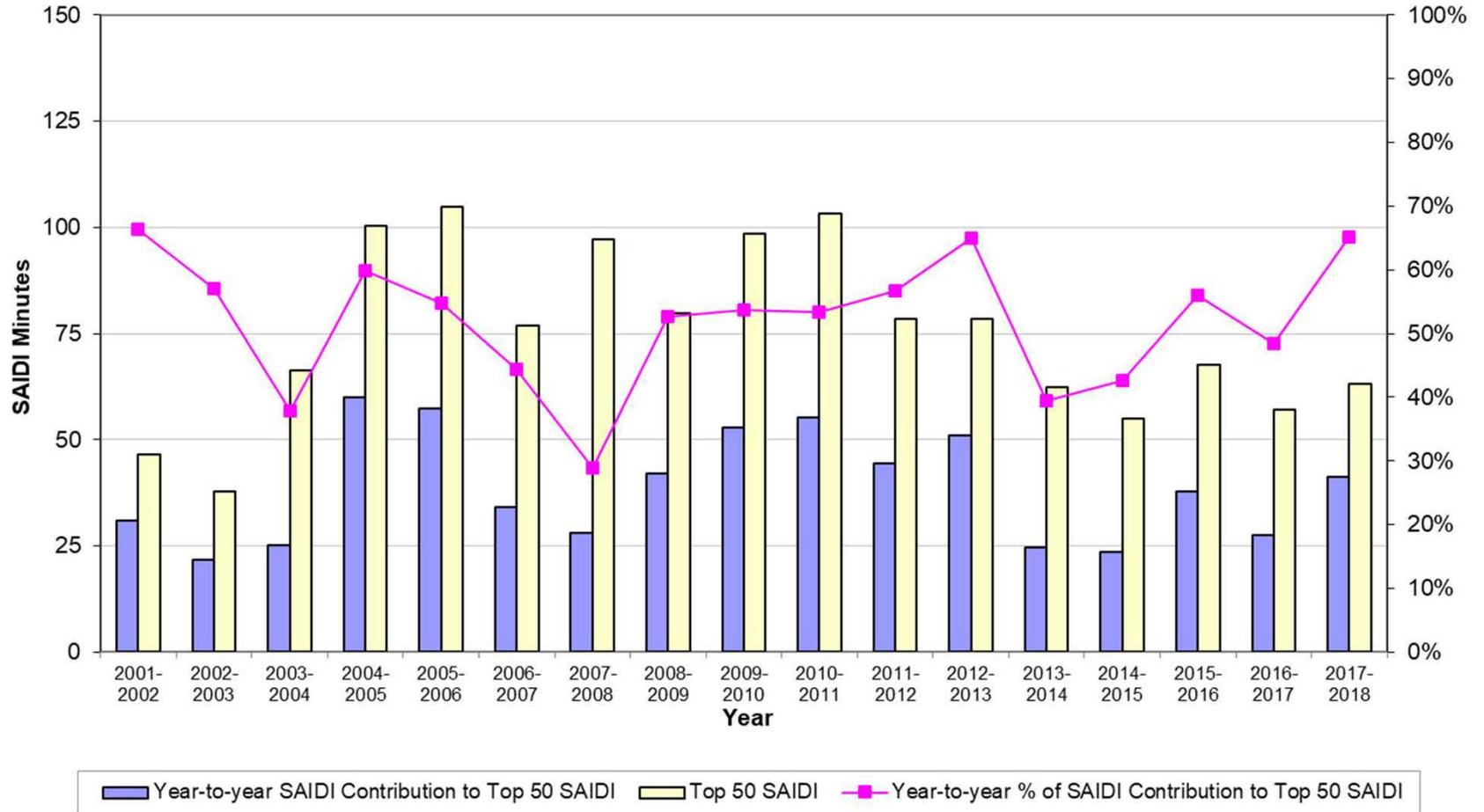
Eversource SAIDI - NHPUC Criteria

Substation Reliability



Top 50 Hit List SAIDI Contribution from year to year

NHPUC Criteria



Section 2

Base REP O&M Summary

January 1, 2018 – December 31, 2018

Year End 2018 - Base REP
Summary of Eversource Reliability Enhancement Program – O&M



Jan 1 2018 - Dec 31 2018

TRIMRC - VEGETATION MANAGEMENT (O&M)						
	Units	\$ Planned	\$ Expended	Units Planned	Units Completed	Cost Per Unit
Reduce Scheduled Maintenance Trim Cycle	Miles	\$6,639,500	\$6,862,827	1,413	1,147	\$5,983
Hot Spot Trimming	Locations	N/A	\$0	N/A	0	N/A
Mid Cycle Trimming	Miles	0	0	0	0	N/A
Inspect Contractor	Miles	N/A ⁽²⁾	N/A ⁽²⁾		N/A ⁽²⁾	N/A
Distribution Rights-of-Way Maintenance Cycle	Acres	\$250,000	\$223,461	650	581	\$385
Total TRIMRC		\$ 6,889,500	\$7,086,288	2,063	1,728	

NESCRC - National Electrical Safety Code (O&M)						
	Units	\$ Planned	\$ Expended	Units Planned	Units Completed	Cost Per Unit
Full Circuit Patrol	Miles	N/A ⁽¹⁾	\$244,600	0	43,610	\$6
Inspect and Repair Underground Systems	Maps	N/A ⁽¹⁾	\$556,750	270	296	\$1,881
Inspect Manholes	Manholes	N/A ⁽¹⁾	N/A ⁽²⁾	N/A ⁽²⁾	N/A ⁽²⁾	N/A
Pole Inspection and Treatment	Poles	N/A ⁽¹⁾	\$467,000	24,000	21,964	\$21
Overhead Repair Activity	Repair Orders	N/A ⁽¹⁾	\$457	N/A	26	\$18
Foot Patrol ROW	Miles	N/A ⁽¹⁾	\$1,842	0	2 ⁽³⁾	\$2,379
Total NESCRC		N/A ⁽¹⁾	\$1,270,649	24,270	65,896	

RELIOM - RELIABILITY (O&M)						
	Units	\$ Planned	\$ Expended	Units Planned	Units Completed	Cost Per Unit
Overhead Switch Maintenance	Switches	N/A ⁽¹⁾	\$12,564	88	85	\$148
Recloser Maintenance	Reclosers	N/A ⁽¹⁾	\$0	0	0	N/A
Fault Indicators	Units	N/A ⁽¹⁾	\$5,029	6	6	\$838
Test & Repair Direct Buried Unjacketed Cable	Runs	N/A ⁽¹⁾	\$0	0	0	N/A
Total RELIOM		N/A ⁽¹⁾	\$17,593	94	91	

TOTAL O&M ONGOING FROM BASE REP			\$ 8,374,530	26,427	67,715	
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(1) O&M budgets are no longer developed at this level of detail

(2) Data is embedded in another category as specified in O&M Briefing Sections.

(3) Partial foot patrols completed by Troubleshooters in August and October

O&M – BASE REP - 2018

REDUCE SCHEDULED MAINTENANCE TRIM CYCLE (BASE REP):

Program Description: Eversource is responsible for trimming approximately 11,000 miles of overhead distribution lines. Reduce the schedule maintenance trimming (SMT) cycle to a system average of less than 4.5 years.

Maintenance Cycle: For 2018, the trim cycle is 4.2 years – 2,294 miles of regular maintenance, 97 miles of ETT Maintenance (METT) and 126 miles of ETT.

Results: 1,147 miles were trimmed under this program in 2018

\$ Plan	\$ Actual	\$ Variance
\$6,639,500	\$6,862,827	\$223,327

HOT SPOT TRIMMING (BASE REP)

Program Description: Trim locations identified outside normal maintenance cycle that have been identified during reliability improvement inspections.

Maintenance Cycle: None.

Results: No hot spot trimming was performed in 2018.

\$ Plan	\$ Actual	\$ Variance
\$0	\$0	\$0

MID CYCLE TRIMMING (BASE REP):

Program Description: Perform mid-cycle trimming in areas where vegetation problems develop between maintenance cycles.

Maintenance Cycle: Prior to 2010, the maintenance trimming program did not identify areas that could benefit from trimming between cycles. The Reliability Enhancement Program targeted a limited mid-cycle program of approximately 50 miles in 2010 and 100 miles annually thereafter. By reducing the maintenance trimming cycle to less than four years, mid-cycle trimming needs have been significantly reduced.

Results: With a trim cycle of under four years, no mid-cycle trimming was required.

\$ Plan	\$ Actual	\$ Variance
\$0	\$0	\$0

INSPECT ALL CONTRACTOR WORK (BASE REP):

Program Description: Inspect 100% scheduled maintenance trimming to ensure that the contractor is trimming to specification within the bounds of owner permissions.

Inspection Cycle: The quality assurance program currently targets inspections on approximately 80% of the circuit miles. The Reliability Enhancement Program will target inspecting 100% of the circuit miles trimmed annually. The cost of this program is included within the maintenance trimming budget

\$ Plan	\$ Actual	\$ Variance
\$0	\$0	\$0

REDUCE DISTRIBUTION RIGHTS-OF-WAY (ROW) MOWING CYCLE (BASE REP):

Program Description: Reduce the average maintenance mowing cycle of 34.5 kV rights-of-way to an average of 4 years.

Total Unit Population: Eversource is responsible for mowing approximately 7,930 acres of 34.5 kV rights-of-way.

Inspection Cycle: ROW mowing averages 1,660 acres per year, which results in a four year cycle.

Results: In 2018, 581 acres were completed under this program, plus 581 acres under base budget.

\$ Plan	\$ Actual	\$ Variance
\$250,000	\$223,461	(\$26,539)

FULL CIRCUIT PATROL (BASE REP):

Program Description: Establish a full circuit patrol cycle for distribution lines to inspect for adherence to the National Electrical Safety Code including primary distribution lines, secondaries and services. This provides proactive identification of potential problems related to safety, grounding, clearance, attachments, asset maintenance and replacement. Starting in 2017 NESC circuit patrols are performed by the contractors performing pole inspections, so every pole will be inspected every 10 years, including poles maintained by Eversource and poles maintained by joint owners.

Total Unit Population: Eversource is responsible for approximately 11,000 circuit miles of distribution lines.

Maintenance Cycle: A full circuit patrol of the 11,000 miles was completed in four years. Beyond the initial cycle, perform full circuit patrols on a cycle similar to scheduled maintenance trimming (SMT).

Results: In 2018, 43,610 poles were inspected for overhead deficiencies. Note that O&M budgets are no longer developed at this level of detail.

\$ Plan	\$ Actual	\$ Variance
N/A	\$244,600	\$244,600

INSPECT & REPAIR UNDERGROUND SYSTEMS (BASE REP):

Program Description: Establish an inspection cycle for underground systems to identify and repair any issues and to install fault indicators.

Total Unit Population: Eversource is responsible for approximately 2,142 underground development system maps in addition to underground facilities providing service from the company's overhead system.

Maintenance Cycle: A complete cycle of the underground system maps was completed in 2014. Eversource Maintenance requirements were revised in 2013 incorporating a 10-year inspection cycle.

Results: Two hundred and seventy (270) inspections and 26 repairs were completed in 2018. Note that O&M budgets are no longer developed at this level of detail.

\$ Plan	\$ Actual	\$ Variance
N/A	\$556,750	\$556,780

INSPECT MANHOLES (BASE REP):

Program Description: Establish a cycle program to inspect manholes. A rating is given to each manhole to indicate the structural condition. A program has been established to replace the structurally deficient manholes.

Total Unit Population: Eversource has approximately 634 manholes.

Maintenance Cycle: Inspect on a cycle not to exceed ten years per NU Maintenance Manual, except those requiring inspection more frequently. This program is now part of Inspect and Repair Underground Systems.

POLE INSPECT AND TREAT (BASE REP):

Program Description: Establish a long-term preventive maintenance cycle for roadside distribution poles to inspect, treat, reinforce or replace decayed or damaged poles to ensure reliable and safe use of this asset.

Total Unit Population: Eversource is responsible for approximately 276,000 poles to inspect and treat. Eversource performs pole inspect and treatment in Eversource set areas only.

Maintenance Cycle: 10 years at approximately 28,000 poles annually to inspect and treat (276,000 divided by 10).

Results:

In 2018, 21,964 poles were inspected with 558 found to be defective and requiring replacement (2.5 % defective rate). Due to the change in standard pole from a Class 4 to a Class 2, deficient poles are replaced rather than treated in an effort to harden the system. Note that O&M budgets are no longer developed at this level of detail.

\$ Plan	\$ Actual	\$ Variance
N/A	\$467,000	\$467,000

OVERHEAD REPAIR ACTIVITY (BASE REP):

Program Description: Complete O&M maintenance orders generated from National Electrical Safety Code (NESC) inspection including work associated with animal guards. This provides proactive identification of potential problems related to safety, grounding, clearance, attachments, asset maintenance and replacement. Items are prioritized from 1 (correct immediately) to 5 (low priority work to be scheduled in conjunction with other work).

Total Unit Population: Dependent on program inspection results.

Maintenance Cycle: Complete maintenance orders within a reasonable period of time from initial identification.

Results: Twenty six corrective items in the priority 1-3 category were completed in 2018. Note that O&M budgets are no longer developed at this level of detail.

\$ Plan	\$ Actual	\$ Variance
N/A	\$457	\$457

FOOT PATROL RIGHT-OF-WAY (BASE REP):

Program Description: Inspect from the ground the 862 miles of overhead line in ROW. Identify for correction all NESC code violations and reliability issues.

Total Unit Population: 862 miles (171 lines)

Maintenance Cycle: Starting in 2015, the Eversource Maintenance Manual recommends an annual helicopter patrol or foot patrol.

Results: All 862 miles were patrolled by helicopter in 2018 (171 lines). Two distribution ROW lines were foot patrolled under this program. Note that O&M budgets are no longer developed at this level of detail.

\$ Plan	\$ Actual	\$ Variance
N/A	\$1,842	\$1,842

OVERHEAD LINE SWITCH MAINTENANCE (BASE REP):

Program Description: Establish program to maintain and exercise overhead switches to ensure reliable operation when needed. Bypass switching will be installed as needed to facilitate this program going forward.

Total Unit Population: Eversource has approximately 363 switches remaining on the distribution system included in this program. Switches are being replaced with Distribution Automation devices as part of the Distribution Automation program, so the population of switches decreases every year.

Maintenance Cycle: Eversource Maintenance Manual specifies a six year maintenance cycle.

Results:

In 2018, 85 switches were maintained. Note that O&M budgets are no longer developed at this level of detail.

\$ Plan	\$ Actual	\$ Variance
N/A	\$12,564	\$12,564

OVERHEAD RECLOSER MAINTENANCE (BASE REP):

Program Description:

Reclosers are scheduled to be maintained on a time and fault operation based frequency or based on remaining contact life.

Total Unit Population:

Eversource has 1,531 reclosers installed.

Maintenance Cycle:

Starting in 2013, Eversource Maintenance Manual specifies 12 years for oil type reclosers and ≤ 5% contact life or duty cycle for reclosers with contacts under vacuum and modern electronic controls.

Results:

No reclosers were due for maintenance in 2018 so none were completed. Note that O&M budgets are no longer developed at this level of detail.

\$ Plan	\$ Actual	\$ Variance
N/A	\$0	\$0

INSTALL FAULT INDICATORS (BASE REP):

Program Description:

Install fault indicators on equipment and at locations which will facilitate identifying the locations of faults on the distribution system. Installation will reduce the outage duration.

Total Unit Population:

Underground - 1:1 ratio with single phase padmount transformers, overhead to be determined.

Maintenance Cycle:

Battery life is in excess of 20 years. Fault indicators will be replaced before the end of their useful lives. Underground fault indicator battery replacement will be performed during underground inspections, within an appropriate timeframe. Overhead fault indicator locations will be entered into CASCADE maintenance data base with an appropriate trigger for replacement.

Results:

Six fault indicators required replacement in 2018 and these were completed. Note that O&M budgets are no longer developed at this level of detail.

\$ Plan	\$ Actual	\$ Variance
N/A	\$5,029	\$5,029

TEST & REPAIR DIRECT BURIED UNJACKETED CABLE - CONCENTRIC NEUTRALS (BASE REP):

Program Description:

Testing of direct buried unjacketed cable concentric neutral to determine if there is a sufficient neutral path. If the neutral has degraded to an inadequate level, the cable will be replaced.

Total Unit Population:

Eversource has approximately 2,000,000 feet or 5,764 runs of direct buried cable.

Maintenance Cycle:

Once.

Results:

No cable was tested in 2018. Note that O&M budgets are no longer developed at this level of detail.

\$ Plan	\$ Actual	\$ Variance
N/A	\$0	\$0

Section 3

Base REP Capital Summary

January 1, 2018 – December 31, 2018

Year End 2018 - Base REP
Summary of Eversource Reliability Enhancement Program – CAPITAL



Jan 1 2018 - Dec 30 2018

CAPITAL - DUE TO BASE REP			
	\$ PLAN	\$ ACTUAL	\$ VARIANCE
Reject Pole Replacement	\$849,700	\$1,962,900	\$1,113,200
Pole Reinforcement	\$0	\$0	\$0
NESC Capital Work	\$0	(\$1,400)	(\$1,400)
Airbreak Switch Replacement	\$0	\$0	\$0
Direct Buried Cable Replacement	\$699,900	\$574,000	(\$125,900)
Direct Buried Cable Injection	\$0	(\$1,100)	(\$1,100)
TOTAL BASE REP CAPITAL	\$1,549,600	\$2,534,400	\$984,800

CAPITAL - BASE REP - 2018

REJECT POLE REPLACEMENT (BASE REP):

Program Description: The preventive maintenance cycle for distribution poles to inspect, treat, reinforce or replace decayed or damaged poles to ensure reliable and safe use of this asset will generate approximately 2% of the poles inspected for replacement.

Eversource maintains 276,000 poles on its system. These are inspected every 10 years or an average of approximately 28,000 poles per year

Total Unit Population: Dependent upon inspection results, estimate 480 poles to replace each year.

Results: 21,964 poles were inspected for ground line decay in 2018. 558 poles were identified as requiring replacement (approximately 2.5%).

\$ Plan	\$ Actual	\$ Variance
\$849,700	\$1,962,900	\$1,113,200

POLE REINFORCEMENT (BASE REP):

Program Description: Inspection of poles generates approximately 0.6% of poles that require being made safe or replaced within five working days, approximately 0.8% of poles must be replaced within one year and approximately 0.5% are eligible for reinforcement. Each of the poles eligible for reinforcement are reviewed in the field to determine if they will be reinforced.

Total Unit Population: Dependent upon inspection results.

Results: Due to the change in standard pole from a Class 4 to a Class 2 to improve system hardness, the decision was made to replace rather than reinforce the smaller poles. Therefore, no poles were reinforced in 2018.

\$ Plan	\$ Actual	\$ Variance
\$0	\$0	\$0

NATIONAL ELECTRICAL SAFETY CODE (NESC) GENERATED CAPITAL WORK (BASE REP):

Program Description: Replace distribution plant units with deficiencies identified during NESC inspections which are required to conform to the National Electrical Safety Code (NESC). Correct NESC violations by installing plant units. Most often, the installation of poles and conductors are required to meet clearance problems to buildings, communications conductors, or over streets and roadways.

Total Unit Population: The backlog of NESC capital maintenance orders is 39. Additional units are identified during the Overhead Plant inspections.

Results:

The most common requirement is to replace poles to gain additional height to meet clearance to communications conductors or clearance to buildings or structures. Starting in 2018, this work completed under the "Repairs and Obsolescence" annual project. A small credit appears in the category due to accounting adjustments from prior year activities.

\$ Plan	\$ Actual	\$ Variance
\$0	\$(1,400)	\$(1,400)

AIRBREAK SWITCH REPLACEMENT (BASE REP):

Program Description:

Air break switches are being replaced with Distribution Automation devices. Of the 725 airbreak switches on the system at the beginning of the REP program, only 52 remain on distribution lines. This project accounts for the replacement of distribution line switches that are not suitable to be maintained and are not being changed to DA devices.

Total Unit Population:

52

Maintenance Cycle:

Airbreak Switches are maintained on a six year cycle with inspection every year.

Results:

No switches were replaced under this program in 2018.

\$ Plan	\$ Actual	\$ Variance
\$0	\$0	\$0

DIRECT BURIED CABLE REPLACEMENT (BASE REP):

Program Description:

Replace direct buried cable with cable in conduit.

2,000,000 feet of direct buried cable was installed at Eversource until 1985 with earliest vintages from 1970. Cable insulation is subject to age failure and bare concentric neutral conductors are subject to corrosion. Testing has indicated that in many locations the concentric neutral is no longer sufficient to provide a path to ground for the electric system. This project is to replace unjacketed direct buried cable in specific developments which have experienced a high failure rate or where cable has been rejected as a candidate for cable injection. Live front transformers and/or pre-1987 elbows are replaced along with the cable.

Total Unit Population:

2,000,000 feet

Results:

Approximately 4,800 feet of direct buried cable was replaced with new cable in conduit as part of this project in 2018.

\$ Plan	\$ Actual	\$ Variance
\$699,900	\$574,000	\$(125,900)

DIRECT BURIED CABLE INJECTION (BASE REP):

Program Description: 2,000,000 feet of direct buried cable was installed at Eversource until 1985 with earliest vintages from 1970. The cable insulation is subject to age failure and the bare concentric neutral is subject to corrosion. This project is to inject unjacketed direct buried cable if it has shown by test that the concentric neutral has the majority of its integrity remaining.

Total Unit Population: 2,000,000 feet of direct buried cable. The actual amount eligible for injection is determined after concentric neutral testing.

Results: No cable was injected in 2018. The small credit here was due to accounting adjustments on prior year activities.

\$ Plan	\$ Actual	\$ Variance
\$0	\$(1,100)	\$(1,100)

Section 4

REP O&M Summary

January 1 2018 – December 31 2018

Summary of Eversource Reliability Enhancement Program – O&M



January 1 2018 - December 31 2018

2018 REP O&M			
	\$ Planned	\$ Expended	Variance
O&M Portion of Capital	\$350,000	\$196,864	(\$153,136)
Troubleshooter Organization	\$2,000,000	\$1,829,603	(\$170,397)
TOTAL O&M	\$ 2,350,000	\$ 2,026,467	\$ (323,533)

O&M

O&M PORTION OF CAPITAL:

Program Description: This represents the O&M portion (allocation) from Capital work related to the Reliability Enhancement Program.

Results: The O&M portion of 2018 REP capital projects averaged 6.88% in 2018. Costs were lower than estimated due to the nature of the Capital work completed. New installations have a lower O&M component than relocations of existing facilities and the two capital circuit tie projects consisted of significant new capital plant additions.

\$ Plan	\$ Actual	\$ Variance
\$350,000	\$196,864	(\$153,136)

TROUBLESHOOTER ORGANIZATION:

Program Description: Similar to prior years, the REP provides approximately half of the funding for the original group of two supervisors and 18 Troubleshooter positions, broken up into three six-person teams working twelve hour shifts providing coverage 24 hours a day, 365 days a year to the primary coverage area. The primary coverage area consists of the Bedford, Derry, Hooksett, and Nashua Area Work Centers (AWCs). This coverage area includes 235,704 customers across 1,052 square miles. When available, the Troubleshooters also provide coverage to a secondary coverage area consisting of the Epping, Keene, Newport, Portsmouth, Rochester and Tilton AWCs. This secondary coverage area includes 229,341 customers across 2,642 square miles.

The Troubleshooter Organization was recently expanded and now consists of three supervisors and 30 Troubleshooter positions. In addition to the original coverage area, the organization now provides day shift coverage in Rochester and Keene and expanded second shift coverage in the Central region Monday through Friday. The expansion of the Troubleshooter program is not funded through REP.

Results: Eversource has utilized this organization to provide improved response times to emergency situations for both customers and municipal partners. Actual charges to REP activities were 8.5% lower than estimated.

\$ Plan	\$ Actual	\$ Variance
\$2,000,000	\$1,829,603	(\$170,397)

Section 5

Capital Summary

January 1 2018 – December 31 2018

Summary of Eversource Reliability Enhancement Program – CAPITAL



January 1 2018 - December 31 2018

CAPITAL			
	PLANT IN SERVICE PLAN	PLANT IN SERVICE ACTUAL	\$ VARIANCE
Overhead System Reliability	\$3,000,000	\$101,387	(\$2,898,613)
Circuit Tie Construction	\$3,000,000	\$101,387	(\$2,898,613)
Vegetation Management	\$6,000,000	\$2,558,341	(\$3,441,659)
Enhanced Tree Trimming	\$4,000,000	\$858,348	(\$3,141,652)
Hazard Tree Removal	\$2,000,000	\$1,699,993	(\$300,007)
	\$9,000,000	\$2,659,728	(\$6,340,272)

CAPITAL

Circuit Tie Construction:

Program Description: Construct circuit ties for large radial circuits which would allow a backup source of power with Distribution Automation.

Reliability Benefit: Constructing circuit ties and installing associated distribution automation devices allows for restoration of service to the majority of the customers fed from these circuits while repairs are made to the cause of the outage.

Plant in service:

\$ Plan	\$ Actual	\$ Variance
\$3,000,000	\$101,387	(\$2,898,613)

Results: Two projects were planned under this program – a circuit tie from Keene to Swanzey and a tie in Hinsdale.

The Keene to Swanzey circuit tie was constructed by a combination of Eversource and contract crews. This project was placed in service in January 2019. The STORMS estimate for the work was \$1,256,000. Actual cost of the work was \$1,389,983 for a difference of \$133,983 or 11%. A driver of the cost overrun on this project was Eversource labor. The labor to construct the off-road section by Eversource crews was nearly double the estimate due to the need to have specialized off-road crews travel from Hooksett to Swanzey. Contract labor charges on this project were lower than the estimate as a result of the bidding process. Both Keene and Swanzey are Consolidated Communications maintenance areas which delayed the work and added to costs as poles were not set in the proper location and had to be relocated.

The Hinsdale circuit tie was built by contractors, with the work awarded as a result of a competitive bid process. The project was placed in service in March 2019. The STORMS estimate for the work was \$1,577,856. Actual cost of the work was \$2,107,922 for a difference of \$530,066 or 33%. Direct charges (labor, material, and contract labor) exceeded the estimate by only 5.5%. Changes in overhead rates between the time the project was estimated and when it was completed drove the majority of the cost overrun. There were a number of causes for the failure to complete by the end of 2018, but the major driver was over-commitment by the lowest price bidder, who was working on multiple projects and was unable to ramp up their workforce.

Only work placed in service by December 31, 2018 is included in the reconciliation, so for these two Circuit Tie projects that amounts to \$101,387, reflecting the completion of the portion of the Keene to Swanzey circuit tie which was constructed by Eversource crews.

VEGETATION MANAGEMENT:

Program Description: This program consists of Enhanced tree trimming and Hazard tree removal.

Enhanced Tree Trimming (ETT):

Program Description: Trim main lines for reliability using an enhanced tree trimming (ETT) specification to create ground to sky clearance versus the standard maintenance trim zone. Expanded clearance is obtained by performing greater off zone takedowns and clearing and higher than normal vertical clearing. Approximately 11,000 miles of overhead line exists with the project targeted at up to 115 miles per year on circuits with worst tree related reliability (top 50 list).

Total Unit Population: Eversource is responsible for trimming approximately 11,000 miles of overhead distribution line. A portion of these miles are candidates for ETT to improve reliability on main lines.

Reliability Benefit: Increasing the trim zone at targeted main line locations significantly reduces the risk of tree outages associated with significant SAIDI (customer) impact.

Results: 28.67 miles of ETT was performed under the program at an average cost of \$29,939 per mile. Eversource was unable to complete the planned ETT work under this program due to several factors. A lack of contract tree crew resources hampered tree trimming activities. Eversource worked to address this by requesting up to 300 crews from outside New England. The Company was only able to secure approximately 50 additional crews, from as far away as Florida and Louisiana. In addition, significant storm impacts in Massachusetts and Connecticut in the spring of 2018 required the diversion of all available resources to assist in restoring power. Approximately eight weeks of crew resources were lost in NH due to these storm impacts. When the crews returned to NH they were directed to focus on completing scheduled maintenance trimming, rather than ETT, in order to maintain Eversource's overall trim cycle of four years or less. Actual work completed and the associated costs are as follows:

Town	Circuit	Miles	Cost
Nashua	3154x2	2.2	\$91,421
Troy	3120	1.7	\$29,542
Campton	27x1	6.78	\$259,022
Northfield	37x4	5	\$42,314
Freedom	346x1	4.67	\$164,606
Portsmouth	71w1	0.57	\$21,144
Lancaster	376x6	1.83	\$34,902
Derry	32w3	5.2	\$146,289
Derry	32w1	0.72	\$69,108
		28.67	\$858,348

Plant in service:

\$ Plan	\$ Actual	\$ Variance
\$4,000,000	\$858,348	(\$3,141,652)

Hazard Tree Removal:

Program Description:

Remove trees greater than 16 inches in diameter within the trim zone and others outside the trim zone that are identified as a hazard to falling onto primary conductors.

Total Unit Population:

Population is unknown. Candidates are identified during maintenance trimming and by employees during reliability investigations.

Reliability Benefit:

Identifying and removing trees that have a high likelihood of contacting primary conductors significantly reduces the risk of tree outages associated with significant SAIDI (customer) impact.

Results:

1,259 trees were removed under the program. This work was performed primarily on the 23X5 and 23X6 circuits in the Milford area. These circuits were chosen due to their recent poor performance and as part of an initiative targeting circuits with zones of greater than 900 customers between protective devices (LZ 900). Tree crew availability was also a problem in this category of Vegetation Management, with crews brought into New Hampshire from out of state by our largest contractor performing Vegetation Management work.

Plant in service:

\$ Plan	\$ Actual	\$ Variance
\$2,000,000	\$1,699,993	(\$300,007)