EVERSOURCE

RELIABILITY & RESILIENCY PLANNING

Reliability Budget Optimization

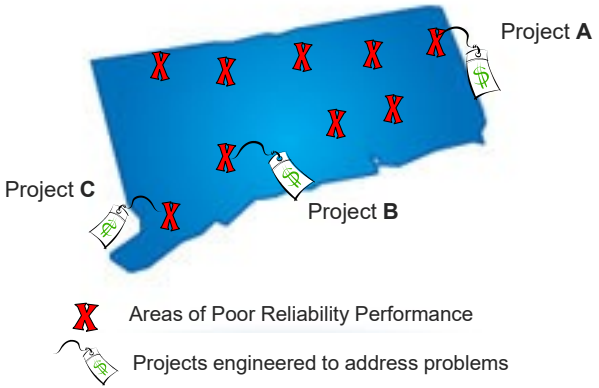
October 2026

Overview

- Investment Prioritization Methodologies
- BCA: Cost Effectiveness of Outage Mitigation Strategies
- Data Automation
- ReBOT: Investment Optimization Model
- Appendix: Work Type Specific Analysis

Reliability Optimization Model

Comparison of Investment Generation and Prioritization Methodologies

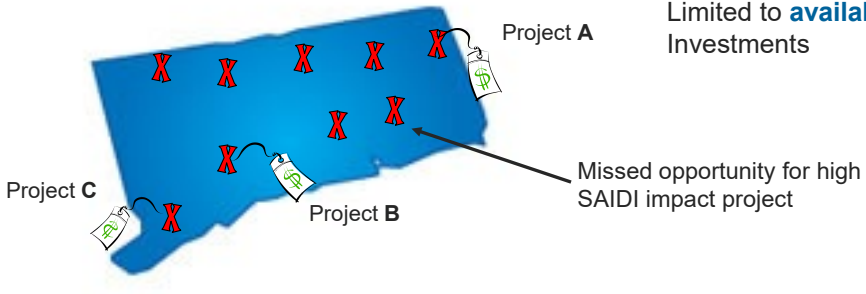


Option 1: Decentralized Model where Engineers propose projects within their designated areas of responsibility

Annual prioritization to determine which are the best projects to move forward with in upcoming budget year

Reliability Optimization Model

Comparison of Investment Generation and Prioritization Methodologies



Need to ensure the right investments are **generated**

Reliability Optimization Model

Comparison of Prioritization Methods

Option 2: Program Allocated - Allocate budgets to programs, then select best options within each program

Funding Level

Distribution Automation		
Project	Cost ($000s)	$/CMI Saved
Proj A	$125	$0.50
Proj B	$200	$0.75
Proj C	$150	$1.00
Proj D	$175	$1.25
Proj E	$100	$1.50
Proj F	$125	$1.75

TripSavers		
Project	Cost ($000s)	$/CMI Saved
Proj A	$10	$0.60
Proj B	$25	$0.75
Proj C	$25	$0.94
Proj D	$25	$1.17
Proj E	$10	$1.46
Proj F	$10	$1.83

Reconductoring		
Project	Cost ($000s)	$/CMI Saved
Proj A	$500	$2.50
Proj B	$1,500	$3.00
Proj C	$750	$3.60
Proj D	$275	$4.32
Proj E	$1,200	$5.18
Proj F	$400	$6.22

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Reliability Optimization Model

Comparison of Prioritization Methods

Option 3: Desired Methodology

Rank paired mitigation strategies with worst performing devices and prioritize **across** programs

Program	Project	Cost ($000s)	$/CMI Saved
Distribution Automation	Proj A	$125	$0.50
TripSaver	Proj A	$10	$0.60
Distribution Automation	Proj B	$200	$0.75
TripSaver	Proj B	$25	$0.75
TripSaver	Proj C	$25	$0.94
Distribution Automation	Proj C	$150	$1.00
TripSaver	Proj D	$25	$1.25
Distribution Automation	Proj D	$175	$1.25
TripSaver	Proj E	$10	$1.56
Distribution Automation	Proj E	$100	$1.50
Distribution Automation	Proj F	$125	$1.75
TripSaver	Proj F	$10	$2.19
Reconductoring	Proj A	$500	$2.50
Reconductoring	Proj B	$1,500	$3.00
Reconductoring	Proj C	$750	$3.60

Funding Level

Cost Effectiveness of Outage Mitigation Strategies

2023 Benefit Cost Analysis Study

Objective: Calculate the Cost Effectiveness of Existing Reliability Programs

1. Evaluate reliability performance before versus after construction
2. Relate investment costs to reliability benefits
   - $ Per CMI Saved
   - $ Per CI Saved
3. Use results to generate investments that **minimize cost** and **maximize benefit**

Cost Effectiveness of Outage Mitigation Strategies

2023 Benefit Cost Analysis Study

Analyzed six commonly used 'Work Types':

- Backbone 3-PH Sectionalizing
- Direct Buried Cable Replacement
- Enhanced Tree Trimming
- Reconductoring
- Transformer Fusing
- TripSaver Installations

Population included:

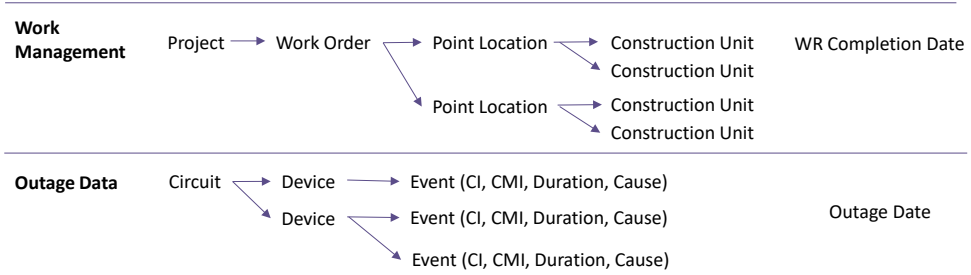
- Over $250 Million of Investments
- Completed between 2010 - 2020



Cost Effectiveness of Outage Mitigation Strategies

Data Complications – Work Management Data

- To calculate benefits, a relationship between Work Order data and Outage Data must be established
- STORMS WMS data contains locations for each "point" which represents a structure location
- Point location data in STORMS WMS was freeform and **not easily associated to GIS locations**
- Significant time was required to simply match poles between STORMS and GIS



Maximo allows (**but does not require**) selecting the specific GIS pole location for each station. Ensuring that a valid pole is selected properly for all reliability work will help to automate this work going forward for all 3 states

Cost Effectiveness of Outage Mitigation Strategies

Data Complications – Work Management to Outage Management Data

STEP 1: STORMS WMS Points – Match to GIS Structures



STEP 2: Identify the isolating device at the head of the zone

Use the structures that have a device on them, and identify their parent through **sequencing** data

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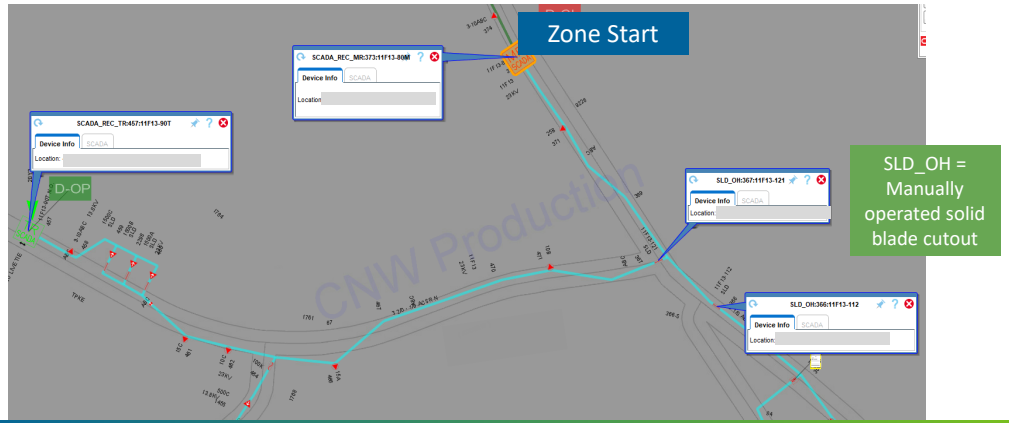
Cost Effectiveness of Outage Mitigation Strategies

Data Complications – Historical Outage Data Mapping

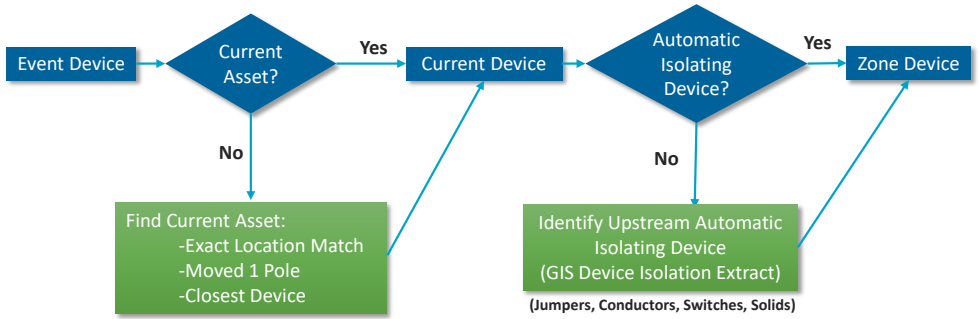


Step restoration and nested outages result in some of the outage records to be associated with manually operated devices within the zone – diluting the outage data across multiple devices

Cost Effectiveness of Outage Mitigation Strategies

Data Complications

Solution: ETL process to align all data with current system configuration

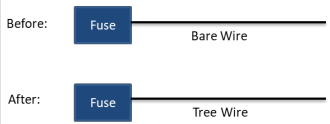
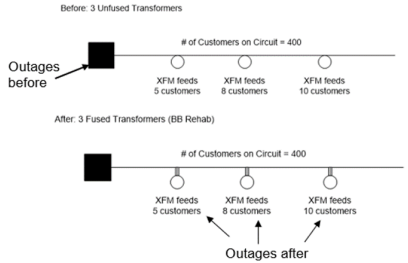


Work Type Identification

- Certain types of work are easy to infer based on the program:
  - TripSavers – CT uses a blanket project for these work orders, so they are easily identified
  - Distribution Automation = Sectionalizing
  - DB Cable Replacement
- Others are more difficult:
  - Many projects contain multiple solutions
  - May have a general category of “Reliability Other” or “Worst Circuit”
- Identification of the work type informs the process on what type of data is needed to evaluate the performance

Cost Effectiveness of Outage Mitigation Strategies

Sample Analysis

Work Type	Reconductoring	Transformer Fusing
Expected Benefit	Elimination of outages	Mitigation of the impact of outages
Scenario		
Asset/Analysis Required	Comparison of outages before versus after construction at fuse device	Comparison of outages at upstream isolating device before versus after, along with outages occurring after at transformer devices that were fused.

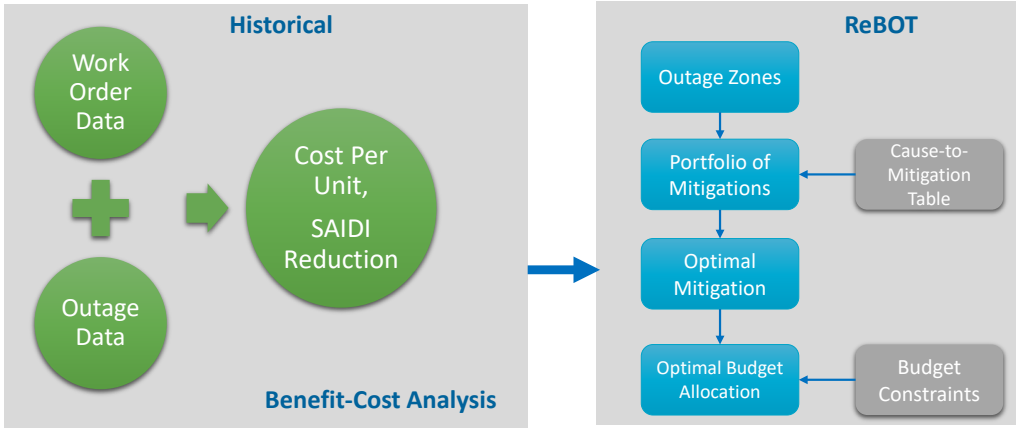
Cost Effectiveness of Outage Mitigation Strategies

Study Results

Average Improvements Experienced by Historical Investments

Work Type	Investments / Locations in Sample	Customer Minutes Interrupted (CMI)	Customers Interrupted (CI)
DB Cable Replacement	436	-79%	-70%
Enhanced Tree Trimming	1,552	-55%	-59%
Reconductoring	145	-80%	-60%
Backbone Sectionalizing	45	-53%	-43%
TripSaver	516	-32%	-50%
Transformer Fusing	2,669	-84%	-85%

Incorporation of BCA Results into ReBOT



- **BCA Output:** Historical cost and performance relationships by work type.
- **ReBOT Input:** BCA-derived improvement factors and cost assumptions applied to current outage zones.

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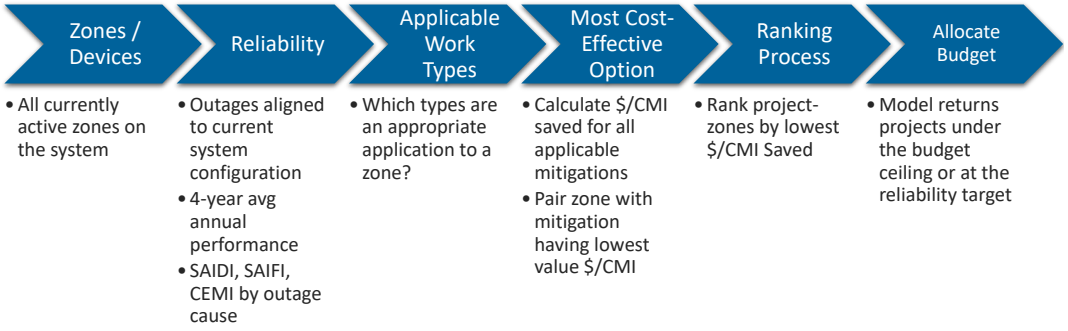
Reliability Optimization Model

Model Workflow



Note: CMI used for illustrative purposes. Model can also rank by CMI, CI or CEMI CI

Reliability Optimization Model

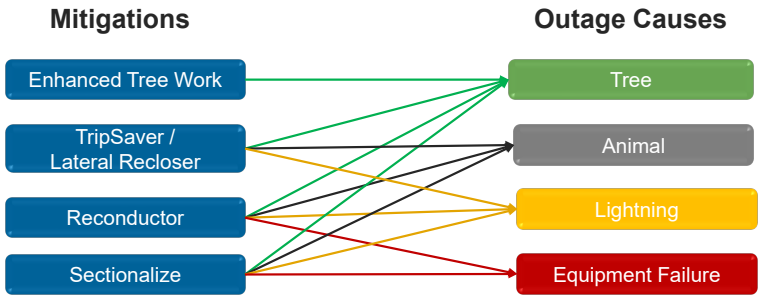
Work Type Criteria

Every current zone is assessed to determine which mitigations apply

Work Type	Criteria
Backbone Sectionalizing	• Existing Device = Breaker, 3PH Recloser • Customers In Zone >=300
TripSaver Installation	• Existing Device = Fuse (size between 25K and 140K) • Fault Current <6300A • Exclude 4.8/27.6KV
Reconductoring	• Bare Conductor • >500 feet • >30% of the total zone length
Etc.	

Reliability Optimization Model

Association of Mitigations to Outage Causes



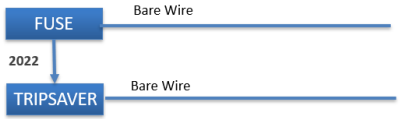
Reliability Optimization Model

Accounting for Prior Improvements

- Zones that have had a recent mitigation may still rank highly due to use of 4-year outage history.
- Opportunities for additional improvements may still exist, so we do not exclude all together.
- Where known improvements have been made, outage history is adjusted to account for expected benefits.

TripSaver Installation Example:

WORKTYPE	CMI % IMP
TRIPSAVER	46%



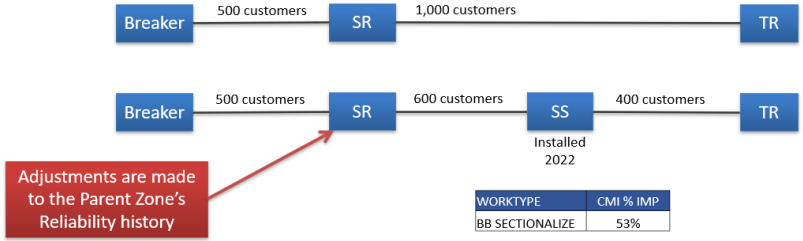
OUTAGE YEAR	TS INSTALL	ADJUST?	CMI FACTOR (1-CMI % IMP)	ORIGINAL CMI	ADJUSTED CMI
2020		Y	0.54	100,000	54,000
2021		Y	0.54	100,000	54,000
2022	2022	Y	0.54	100,000	54,000
2023		N	1	100,000	100,000
TOTAL				400,000	262,000

- Adjusted data is utilized to assess for potential Reconductoring or Veg Mgt at location

Reliability Optimization Model

Accounting for Prior Improvements

Backbone Sectionalizing – Smart Switch Installation Example:



WORKTYPE	CMI % IMP
BB SECTIONALIZE	53%

OUTAGE YEAR	SMART SWITCH INSTALL	ADJUST?	CMI FACTOR (1-CMI % IMP)	ORIGINAL CMI	ADJUSTED CMI
2020		Y	0.47	100,000	47,000
2021		Y	0.47	100,000	47,000
2022	2022	Y	0.47	100,000	47,000
2023		N	1	100,000	100,000
TOTAL				400,000	241,000

Reliability Optimization Model

Logic for Zone Optimal Mitigation Selection

Zone Data

Circuit	Device:	Segment Type	Phases	OH Length	Fault Current	Avg Annual Total CMI
11C12	FUSE_OH: 123	Lateral	3	0.5 Miles	4,200A	40,000

Mitigation Options

Work Type	Outage Causes Addressed	Applicable CMI	BCA % Improvement	Avg CMI Saved	Estimated Cost	$/CMI Saved
Enhanced Tree Trim	Tree	32,000	55%	17,600	$100,000	$5.68
Reconductor	All	40,000	80%	32,000	$500,000	$15.62
TripSaver	Tree, Anim, Lightning, PTNF	37,000	32%	11,840	$23,000	$1.94
Lateral Recloser	Tree, Anim, Lightning, PTNF	37,000	32%	11,840	$65,000	$5.48
BB Sectionalize	All	40,000	53%	N/A	N/A	N/A

Result: Install TripSaver

Reliability Optimization Model

Zone Ranking Logic

- Rank each zone's mitigation based on $/CMI saved
- Draw the line based on $ constraints or target CMI reduction

Rank

Device:	Work Type	Applicable CMI	BCA % Improvement	Avg CMI Saved	Estimated Cost	$/CMI Saved	Cumulative Cost	Cumulative CMI Saved
FUSE_OH: 456	Transformer Fusing	15,000	84%	12,600	$5,000	$0.40	$5,000	12,600
SCADA_SR ABC	BB Sectionalizing	260,000	53%	137,800	$100,000	$0.73	$105,000	150,400
FUSE_OH: 345	TripSaver	50,000	32%	16,000	$23,000	$1.44	$128,000	166,400
FUSE_OH: 123	TripSaver	37,000	32%	11,840	$23,000	$1.94	$151,000	178,240
FUSE_OH: 234	Reconductoring	150,000	80%	120,000	$275,000	$2.29	$426,000	298,240

Select investments based on: Available Budget | Desired SAIDI Savings

The $/CMI Saved values used for ranking are calculated using BCA-derived performance assumptions and ReBOT cost estimates.

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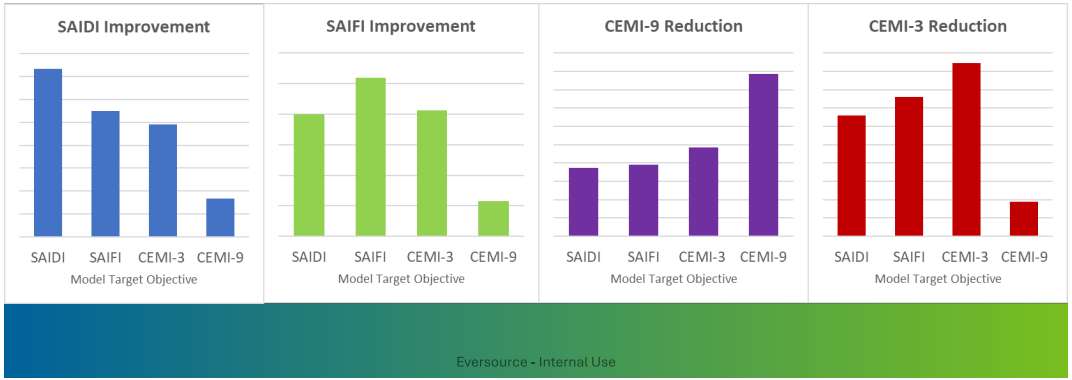
Reliability Optimization Model Output

Comparison of $X Investment with Various Objectives

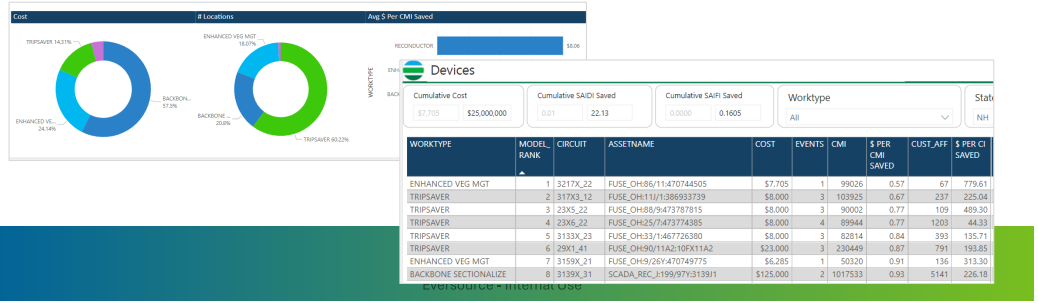
- The model's target objective can be set to maximize improvements in SAIDI, SAIFI or CEMI
- Estimated improvements for the same $ investment level, but different objectives:



Reliability Optimization Model Output

Communicating Results

- Model Output is communicated through a Power BI Dashboard that allows users to browse investments.
- A Power App is currently being integrated with the dashboard to allow Engineers to provide notes regarding feasibility or to associate any existing projects or work order numbers.
- This feedback loop will be used to further refine the model and automate future analysis.



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Reliability Optimization Model

Plans & Limitations

- Model is still under development, further review and validation required
- Model identifies the most cost-effective investments with the potential to improve reliability; however, it cannot guarantee results will be achieved at each location
- As a stand-alone model, cannot be used to forecast future reliability metric performance (does not account for variations in weather, system degradation, changes in restoration practices, line crew resource levels, etc.)

Future/Work In Progress Includes:

Incorporating additional work types:

- Circuit Ties
- Circuit Rebuilds
- Undergrounding
- Battery Storage

Further Automation & Refinement:

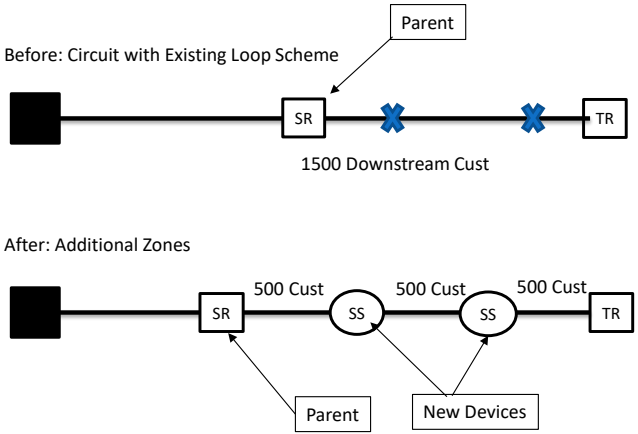
- More accurate fault current calculations (estimates based on assumptions utilized)
- Improvements in ETLs utilized to establish data relationships between Work Management & Outage Management Systems

Appendix

Work Type Specific Logic

- Backbone Sectionalizing
- Reconductoring
- TripSaver
- DB Cable Replacement
- Backbone Sectionalizing – Radial Reclosers

Sectionalizing Outage Trend Analysis (Before vs After Construction)



Logic:

- Pull all outages for Parent Device and Newly Installed Devices
- Compare performance before versus after construction

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Reconductoring Outage Trend Analysis

Backbone Reconductoring performed 2013:



Smart Switch installed 2015:



Logic:

- Identify all structure locations found in reconductoring work orders
- Associate them with current upstream isolating devices
- Some devices may have been installed AFTER reconductoring occurred; we still need to include the outages associated with them

TripSaver Outage Trend Analysis

Before:



After:



Logic:

- Identify TripSaver Work order structure locations
- Identify New TripSaver device and Prior Fuse device
- Compare performance before versus after installation

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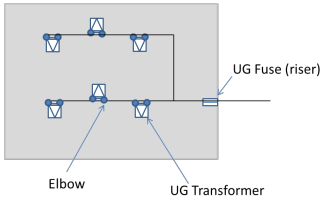
URD / DB Cable

There are 2 main setups for how direct buried cable is installed:

1. In an **Underground Residential Development (URD),** also known as residential subdivision. In this case, there is typically a "DB Map" available.
   - Radial URDs: one supply/source to the development, so a failure can affect all the downstream customers until a repair is made or generation provided.
   - Looped URDs: two or more sources available to the development, so most customers can be restored through switching while the lengthy repairs are made.
2. From a **single riser** feeding one customer direct buried off the overhead system. There are no "DB Maps" associated for these scenarios.

Simple diagram of the assets found in a URD:



Failures will typically be associated with the UG_FUSE that supplies the URD. However, there are other isolation points that may appear as the device on a failure event, including UG Transformers, Elbows, and Conductors.

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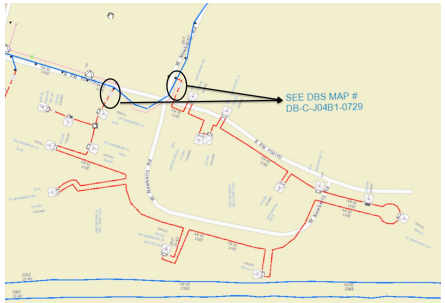
URD / DB Cable

Example of a "Looped" development, which has two available UG fuses to supply customers:



Note that there is a text reference to a DB Map Name. In the past, this DB Map Name was just a text box on the display, it wasn't directly associated with any assets in the GIS/OMS.

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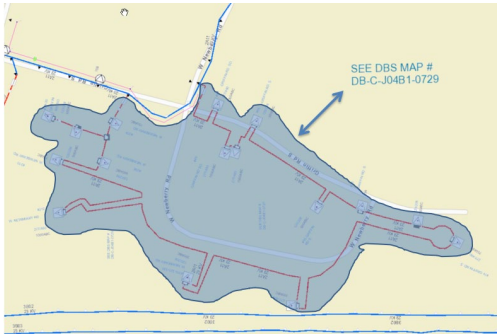
URD / DB Cable

The GIS group has created “Shape Files” in the GIS around each of these DB Map areas. By creating these shapes, we can associate all the assets within the shape with a DB Map.



This attribute is now associated with outage events as they occur; however, this is new functionality, so it is not available for all historical events

A process was used to identify any current assets that are associated with historical outages and to update the DB MAP ID for each of those events

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Radial Recloser Zone Benefit Calculation

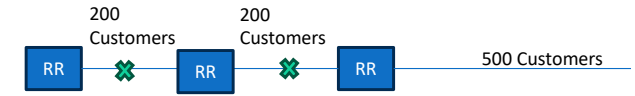
Applicable to backbone devices where there is no alternate source/tie

Example: Total Downstream = 900 customers

Before: 900 Customers Affected x 2 Outage = 1800 Customers Affected



After: 700 + 900 Customers Affected = 1600 Customers Affected



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Logic to calculate benefit

- Assumes placement at midpoint
- Assumes half of the customers will benefit, half of the time

Customers In Zone / 2 * 50% outages avoided
Total Downstream Customers

400/2=200 * 50% = 100
100/900=11% reduction

Apply to both CMI and CI

The maximum benefit that can be achieved is 25%, this applies when the customers in zone = total customers down stream

Note: New work type added in 2026