

## Changing Landscape of Lateral Automation

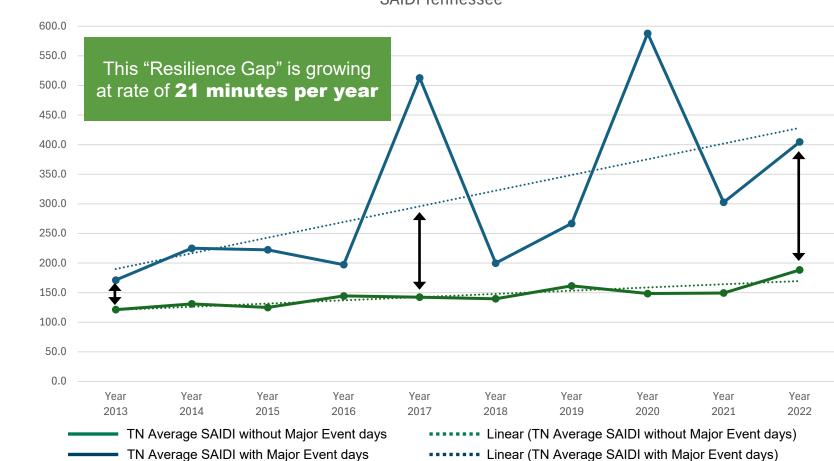
#### Presented by:

#### Ryan McAndrews, PE

Application Manager – Automation Systems







Expanding gap between SAIDI including and excluding major events highlights growing resilience challenge SAIDI Tennessee

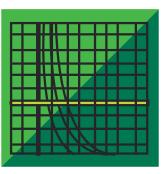




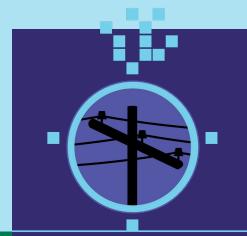
**History** 

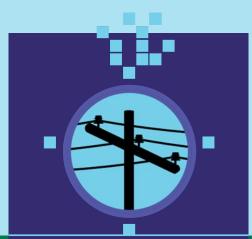


Lateral Advancement



**Protection** 

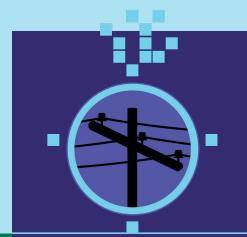




#### Feeder Automation

#### Lateral Automation

- Overhead
- Underground





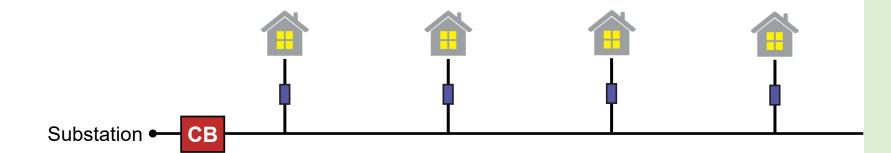
#### Feeder Automation

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#### **Starting Point: Radial Lines**

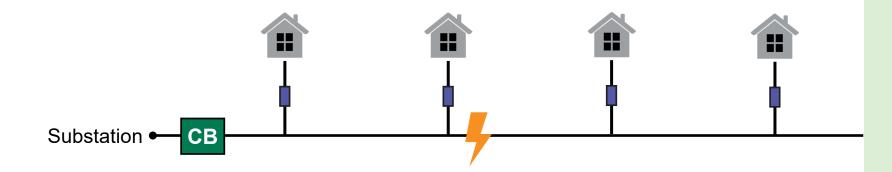


#### **Problem:**

When a fault occurs, it causes a widespread outage.



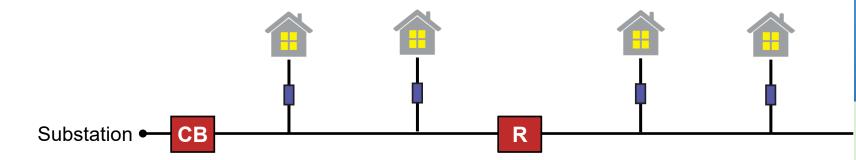
#### **Starting Point: Radial Lines**



#### **Problem:**

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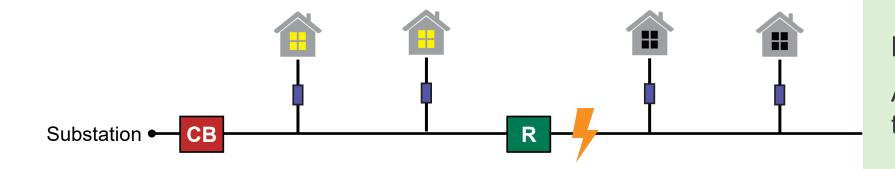




#### **How it Works:**

Add a protective device to segment the line.

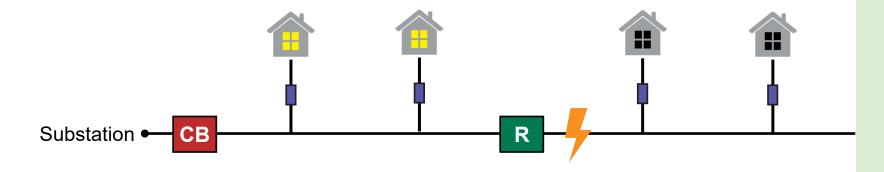




#### **How it Works:**

Add a protective device to segment the line.

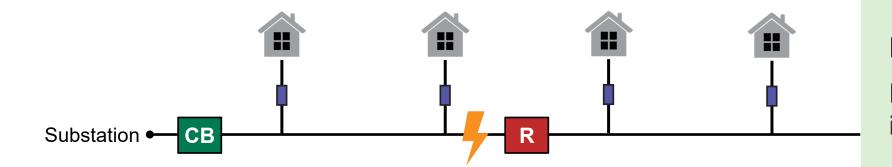




#### **Benefits:**

When a fault occurs, only part of the line experiences an outage.

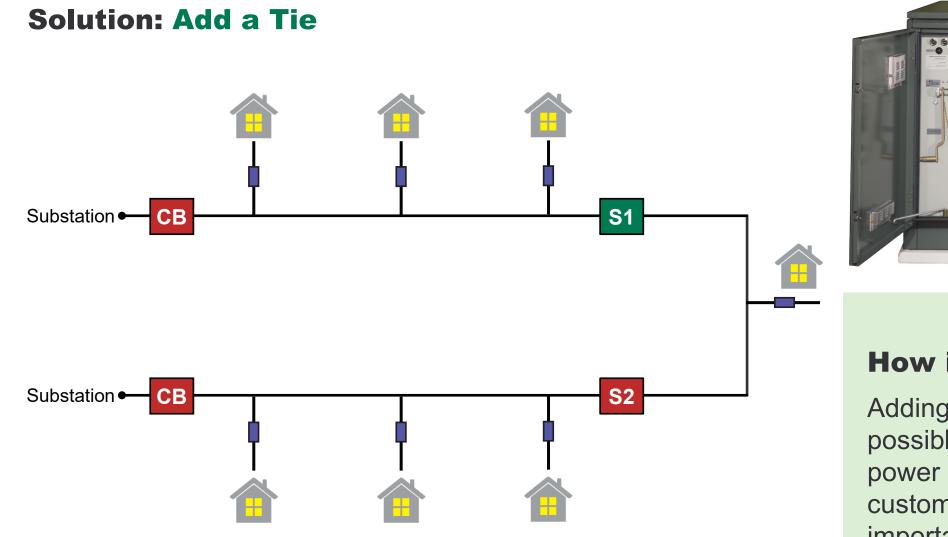




#### **BUT:**

Results in marginal improvements.





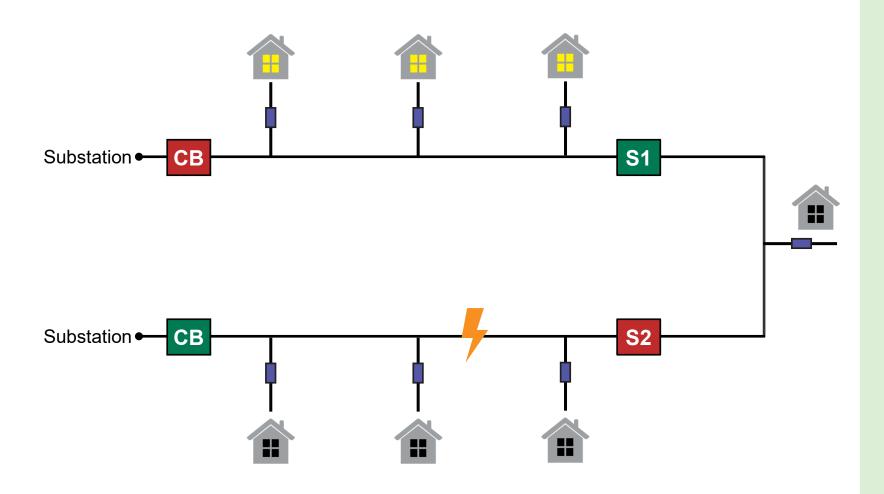


#### **How it Works:**

Adding a second possible source to power an important customer or a stretch of important customers.



#### **Solution: Source Transfer**



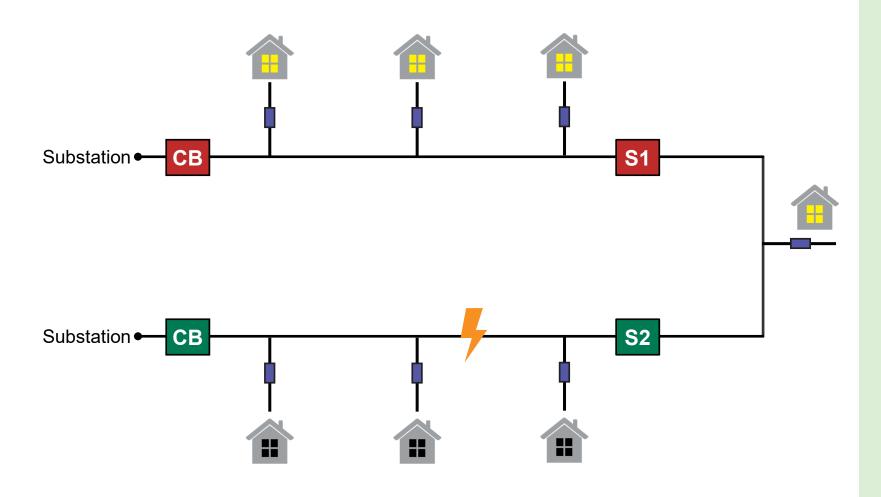
#### **How it Works:**

Done on any two overhead or underground feeders

When loss of source is detected on the other feeder, the secondary feeder tie will close after the primary feeder tie opens



#### **Solution: Source Transfer**

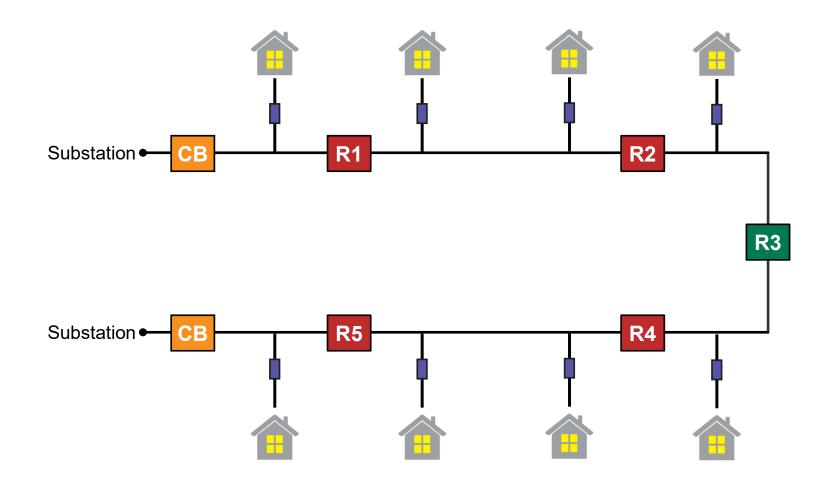


#### Note:

The source transfer scheme will not initiate a transfer if the segment in between the two ties is faulted

Most times, the source transfer scheme resides on one controller

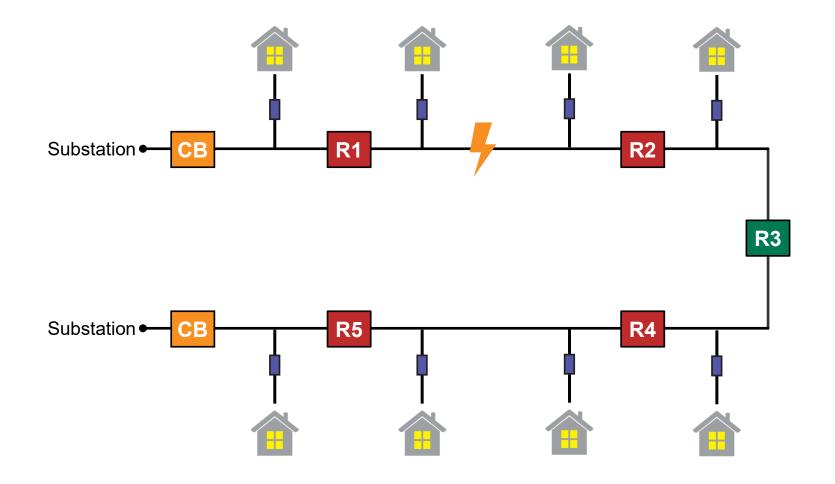




#### **How it Works:**

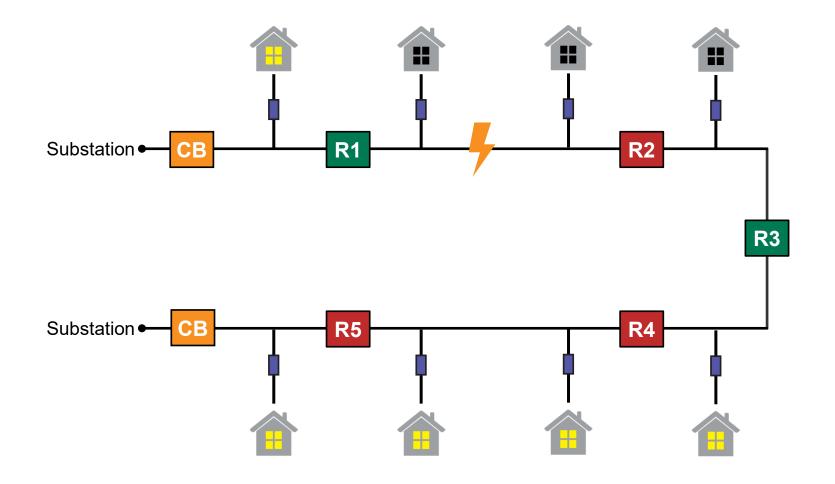
Add a second source and a normally open tie in between the two sources.

Each device acts independently based on loss of source and faulted conditions without any information on any other devices in the automated circuit



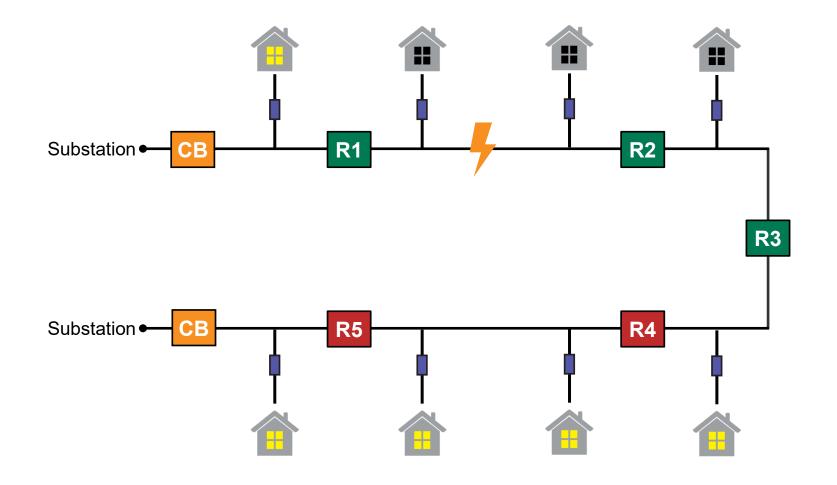
#### S<sub>8</sub>C

#### **Benefits:**



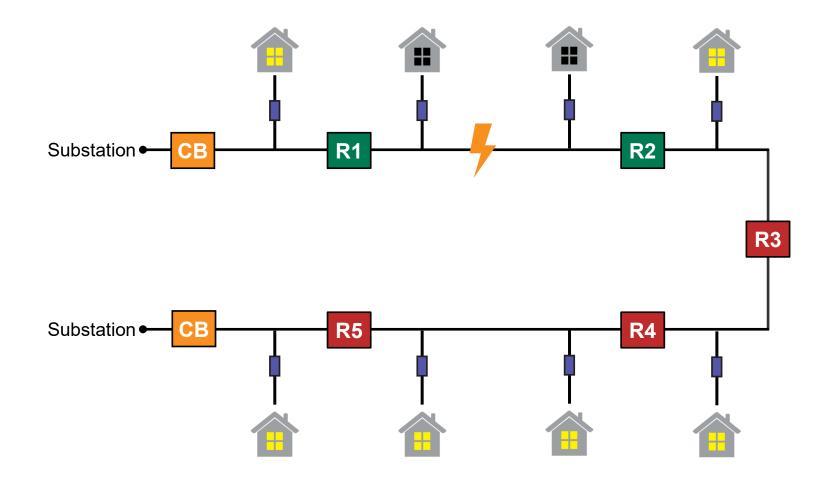


#### **Benefits:**



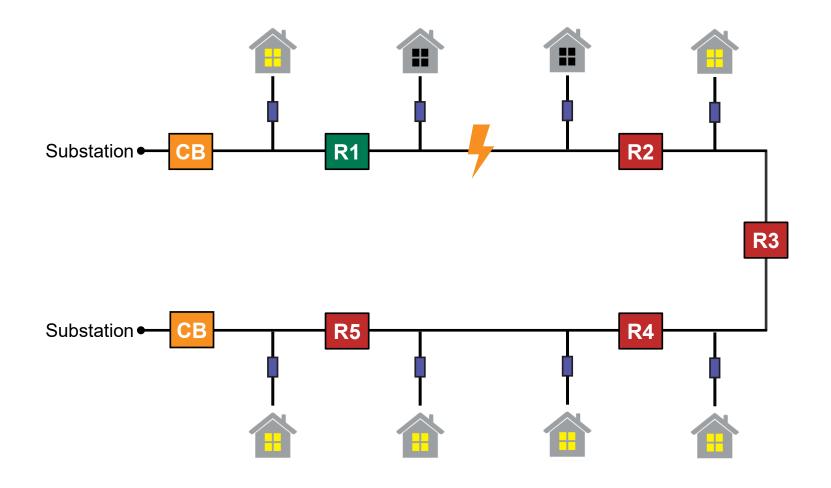
#### **Benefits:**





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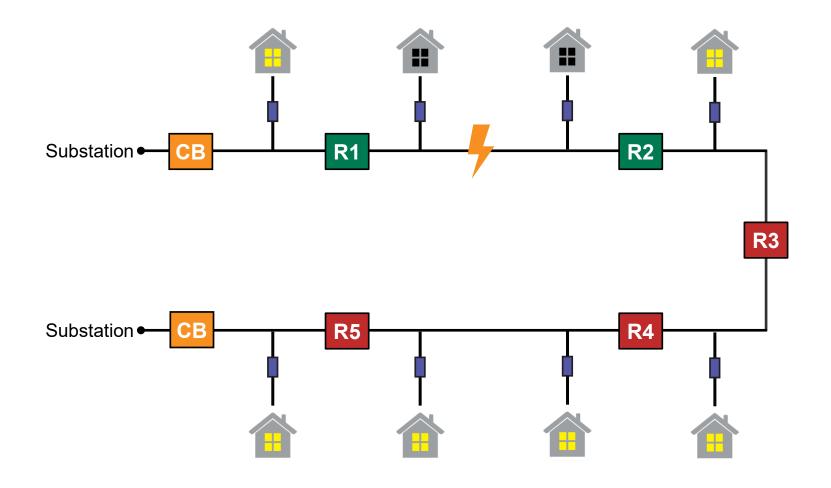






R2 will close into the fault before going into lock-out

This subjects the other feeder to voltage sags



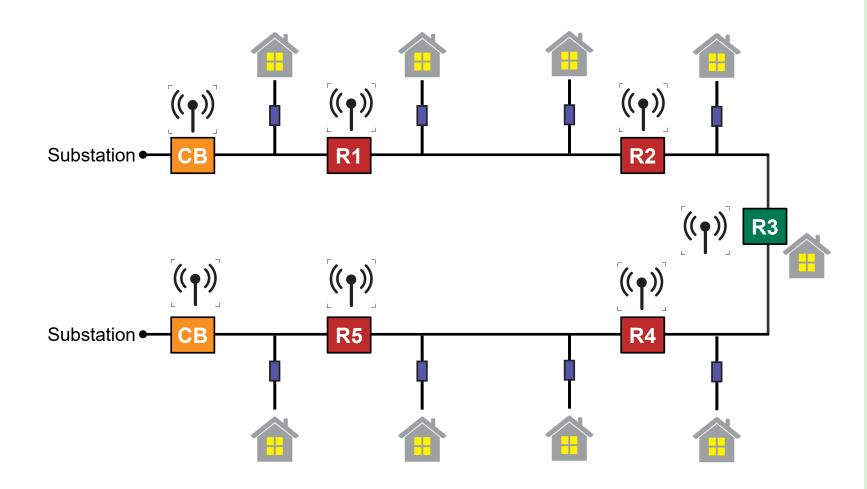


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S<sub>8</sub>C

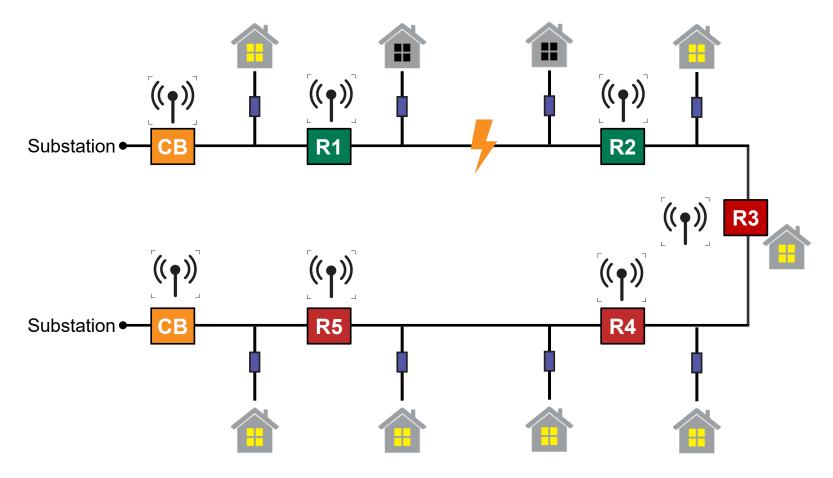
#### **Solution: FLISR**



#### **How it Works:**

Add communication devices to loop circuits.

## **Solution:** FLISR (Fault Location, Isolation, System Restoration)



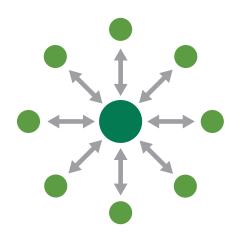
#### **Benefits:**

 Decisions are made by taking into consideration all the information available in the automated system





#### **Centralized**



Central location for automation logic

Local problems are solved with a system-wide view

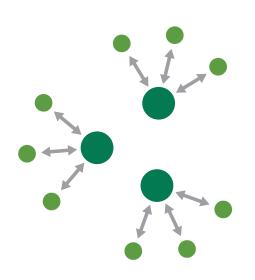
Many contingencies to consider

#### **Examples:**

- ADMS Systems(Survalent, Ventyx)
- SEL Blueframe
- G&W Lazer



### Regional



- Same as centralized system, but with local controller "nodes"
- Smaller
- Less complex
- Often custom programming is involved

#### **Examples:**

- SEL RTAC
- NovaTech Orion

#### S<sub>8</sub>C

#### **Peer-to-Peer**

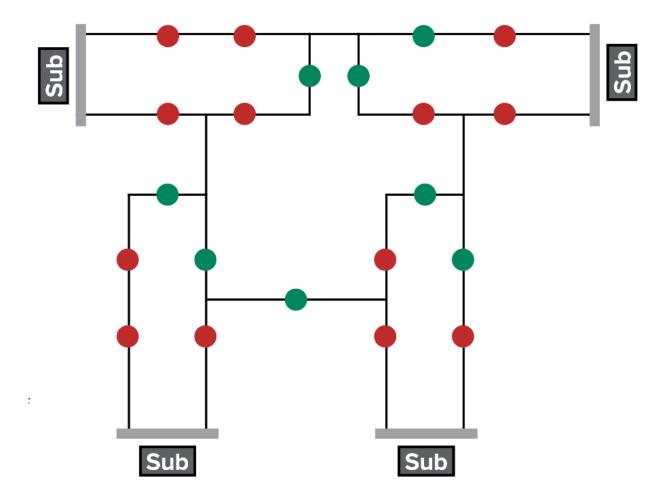
- Automation Logic lives within switchgear controls
  - System broken up into chunks, automation solves local problems
- Mesh Communication Network

#### **Examples:**

 IntelliTeam® Automatic Restoration System

#### Feeder Automation | FLISR Control Schemes



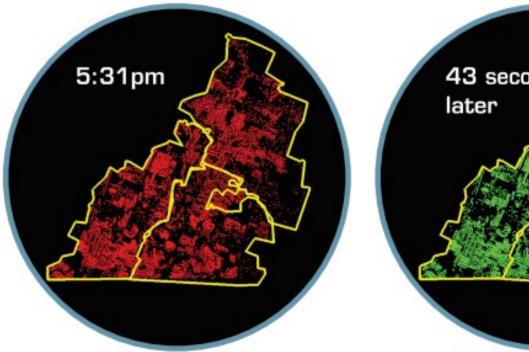


#### Multi-Source, Multi-Tie complex automation

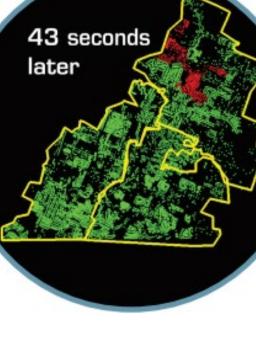
- Operational Decision: Do you disable the whole scheme if there is work being done in one section?
- Logistical Decision: Do all smart switches need to be installed before the automation is turned on?

#### Feeder Automation | **Resulting Benefits**





11,200



**500** 

#### **Benefits**

- Improved Experience
- Improved SAIFI and SAIDI metrics
- Reduced Outage Area

# Were these ideas invented for distribution?

No – most of these ideas were taken from substation automation

## Additional Challenges

#### **Substation**

**Communications: Contained** 

**Right of Way: Real Estate** 

**Capacity: In-Design** 

**Bi-Directionality: Uncommon** 

#### Distribution

Communication: Large area, previously noncommunicating

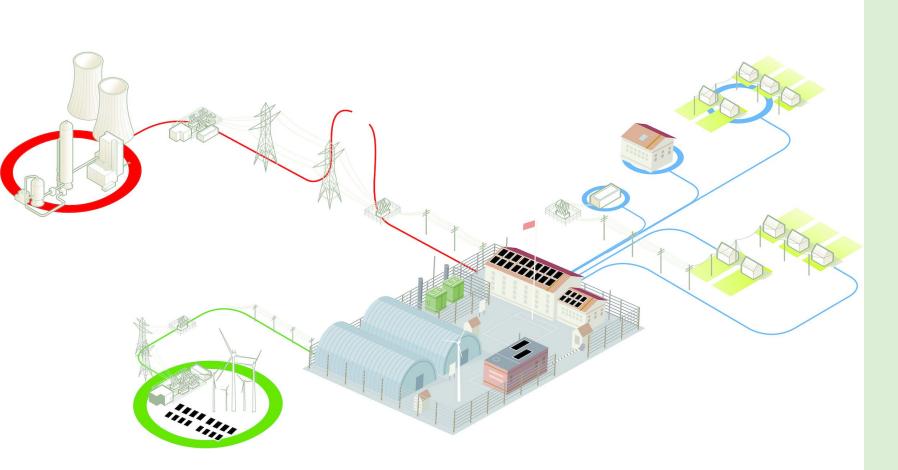
Right of way: Access to tie circuits/subs together may be challenging, or some cases impossible

Capacity: Mostly upgrading existing systems

Bi-Directionality: Common

#### Feeder Automation | Continuing Advancement





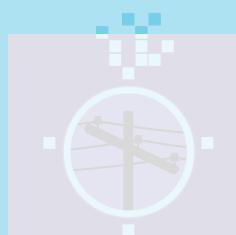
#### Future

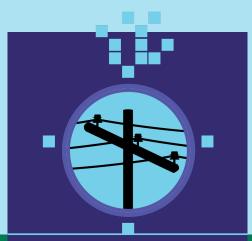
- DER Integration
- Microgrids
- Virtual Power Plants

#### **Challenges**

- Electrification
- DER Contribution
- Increased MED





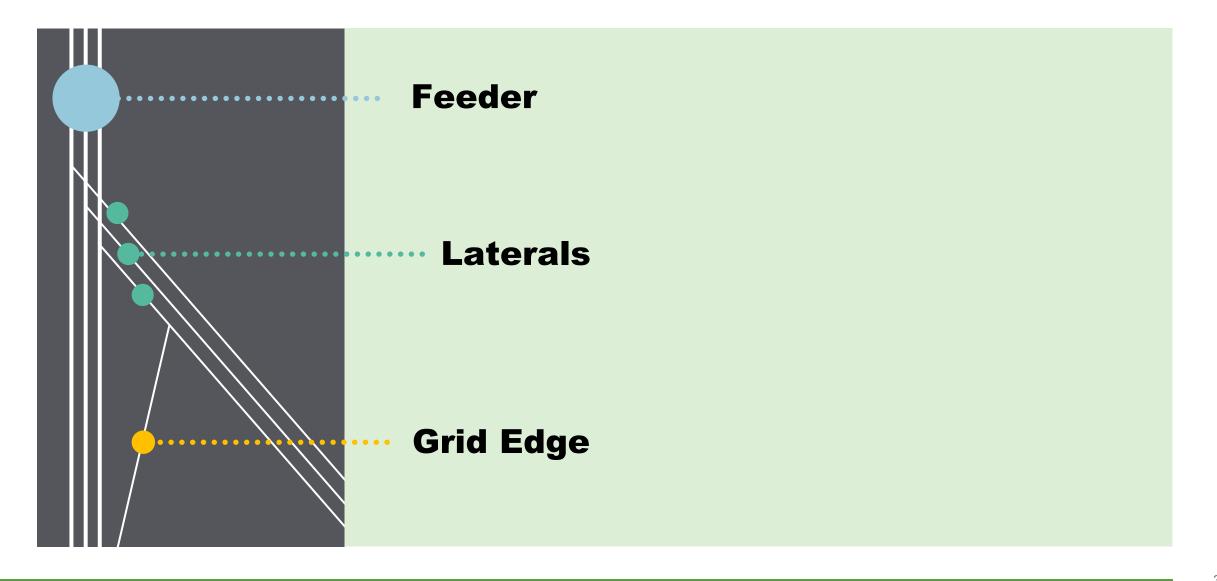


#### Feeder Automation

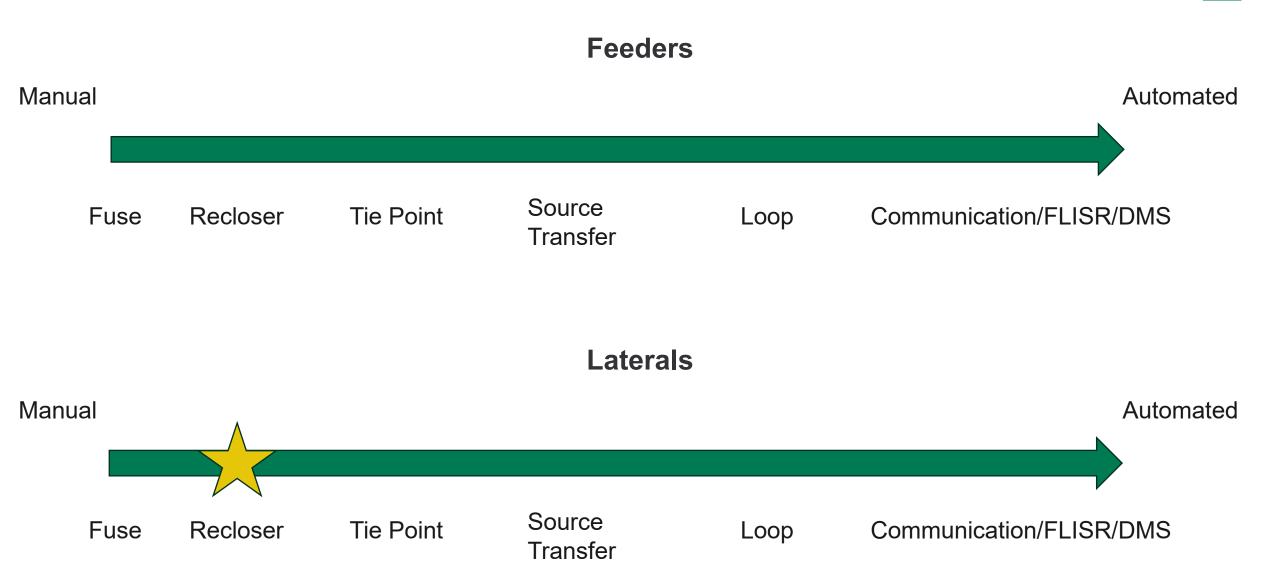
#### Lateral Automation

- Overhead
- Underground



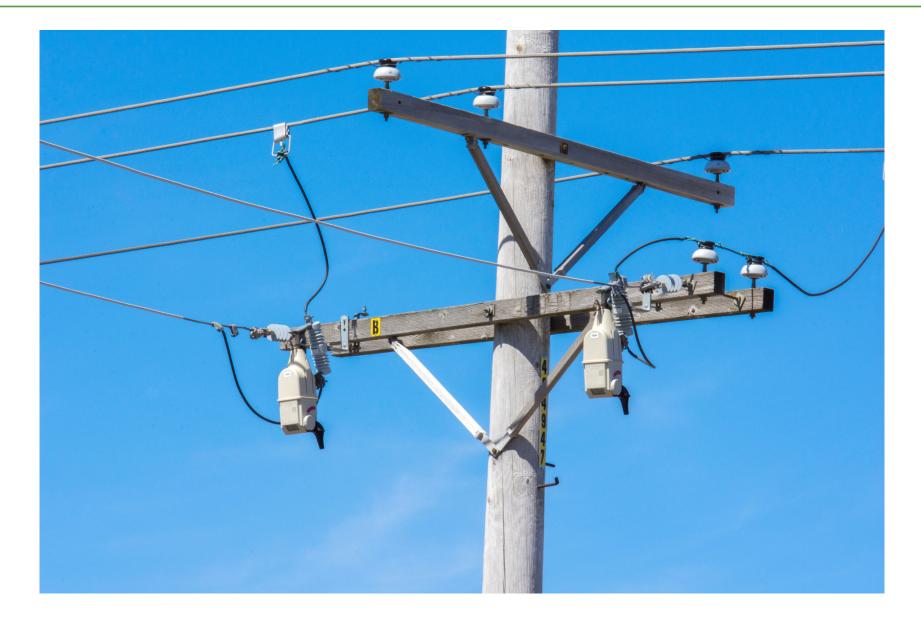






#### Lateral Automation | **Overhead**





### S<sub>r</sub>C

### **Temporary Faults**

~70% of faults that occur

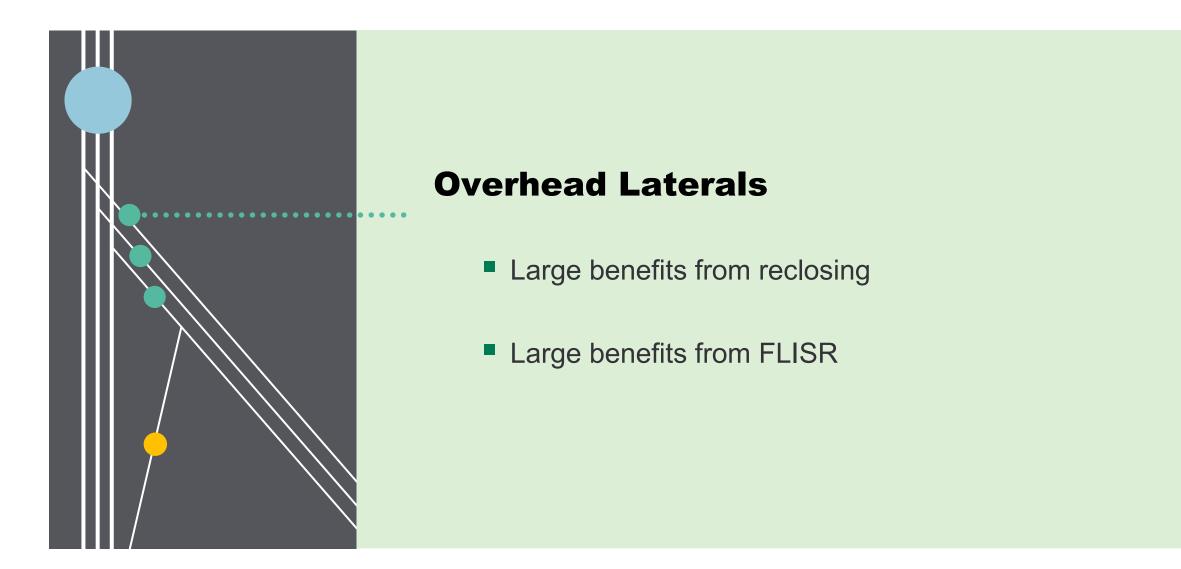
### **Leading Causes:**

Wildlife & Vegetation

### **Fault Locations**

~80% of faults are on the lateral, not the feeder







### Sample data consisted of **100** Single-Phase reclosers

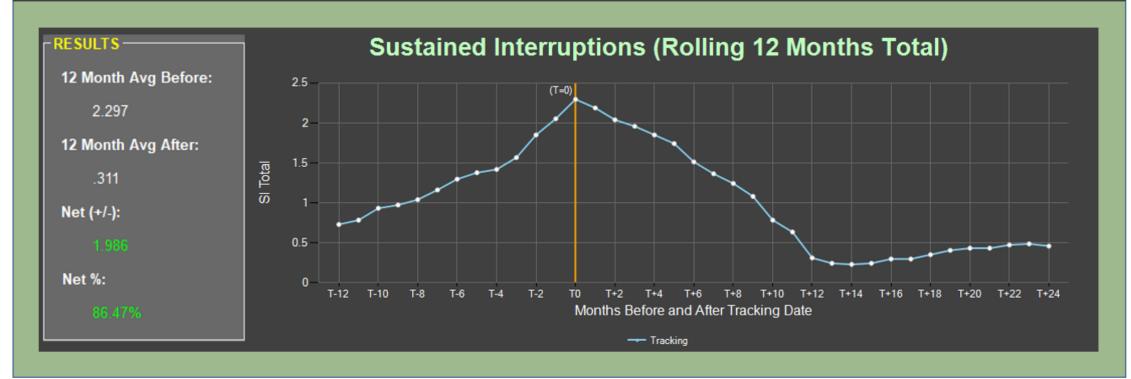


### Units were installed in 2018. Data were pulled 24 months after installation for accurate reliability comparison



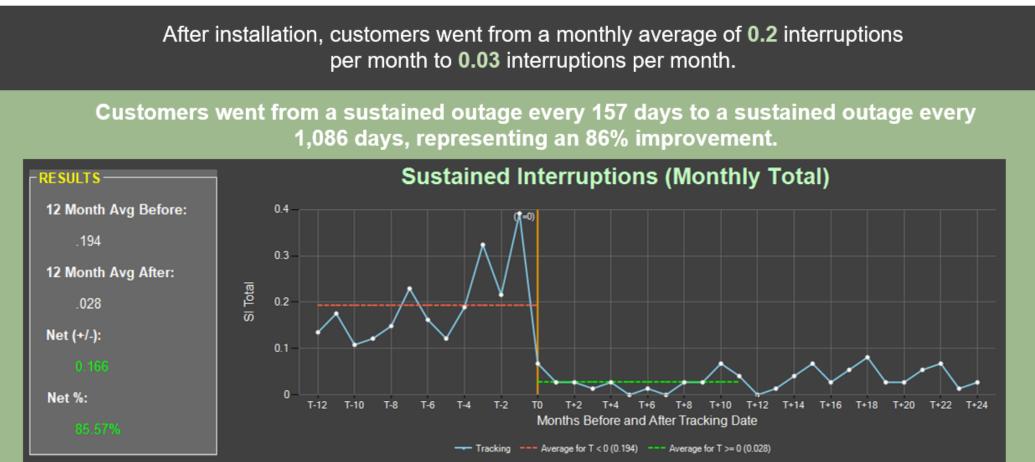
(SI) – Rolling 12 Month Total

After installation, each device went from an average of 2.3 sustained outages in 12 months to an average of 0.3 outages in 12 months, or an 86% improvement





(SI) - Monthly Total





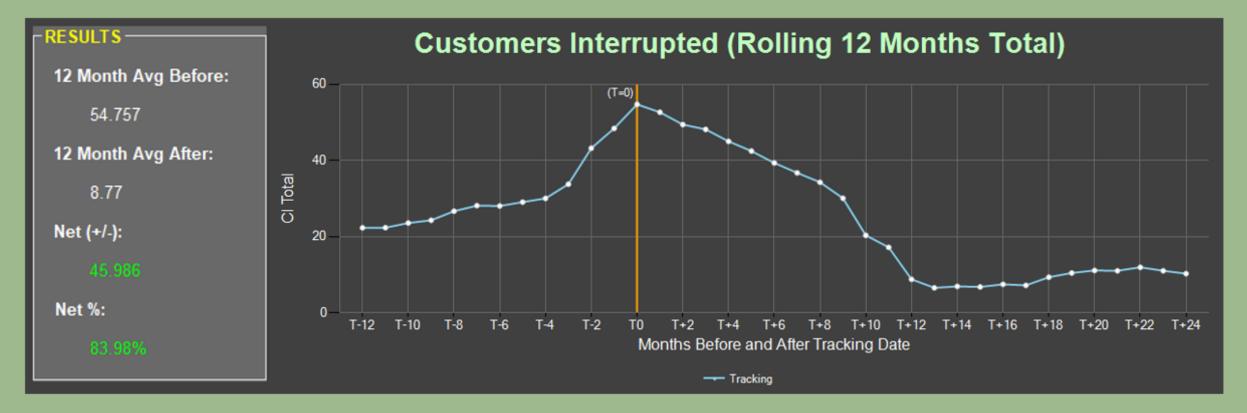
For these 100 devices, that's an estimated **200 less sustained interruptions** per year.

SI Change Calculations	
Average Monthly Total Before	0.194
- Avg Monthly Total After	0.028
Monthly Change	0.166
*Months in a Year	12
Yearly Change	1.992
* # of devices in Sample	100
Total Annual SI Change	199.21

**<u>NOTE</u>**: It is important to point out that this is <u>Sustained Interruptions</u> and that the customer will see an increase in <u>Momentary Interruptions</u> to their service.

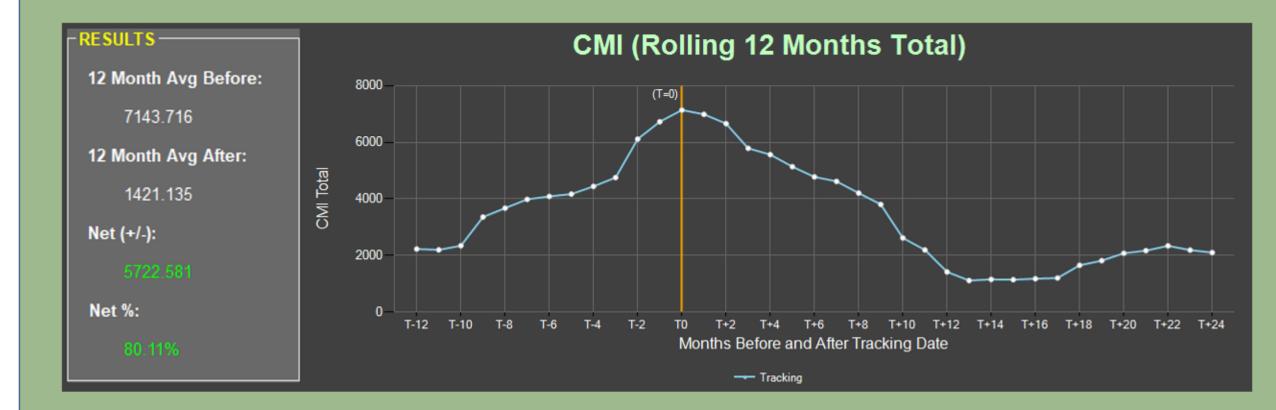


After installation, each device went from an average of 55 customers interrupted in 12 months to an average of 9 customers interrupted in 12 months, or an **84% reduction in SAIFI (CI)**.





After installation, each device went from an average of 7,100 CMI in 12 months to an average of 1,400 CMI in 12 months, or an 80% reduction in SAIDI (CMI).

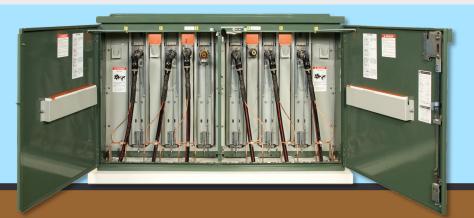


### Lateral Automation | **Underground**





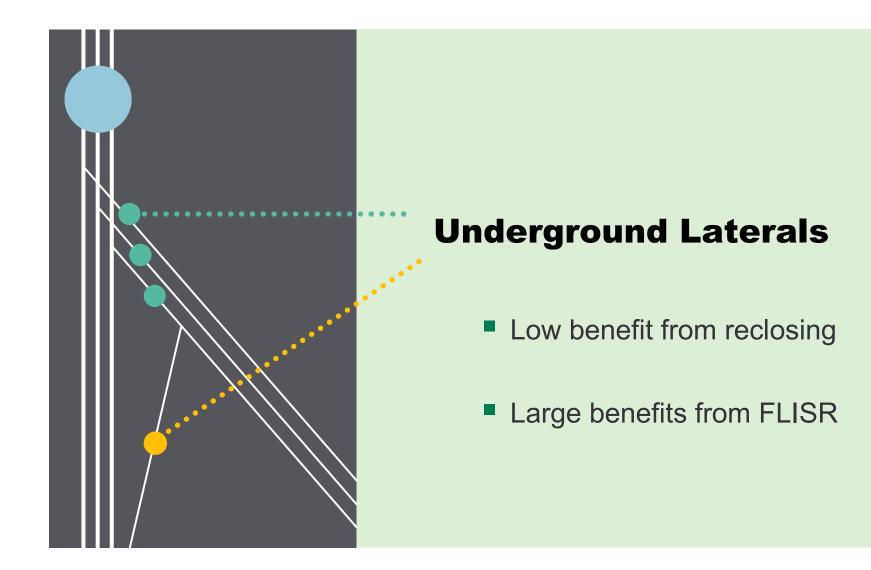


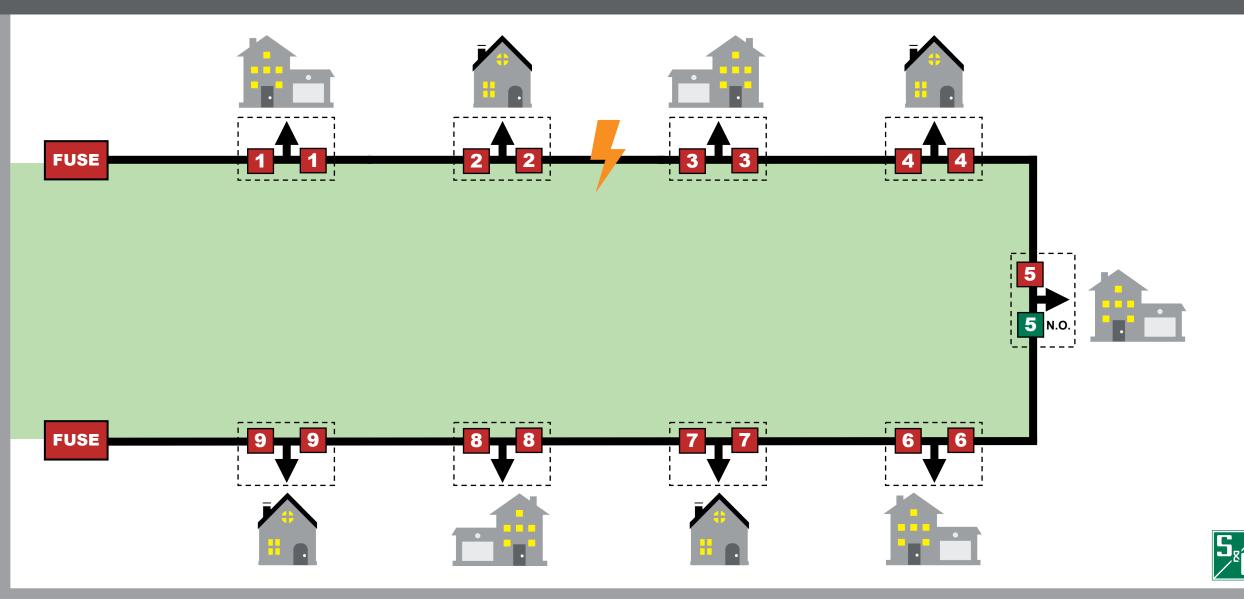


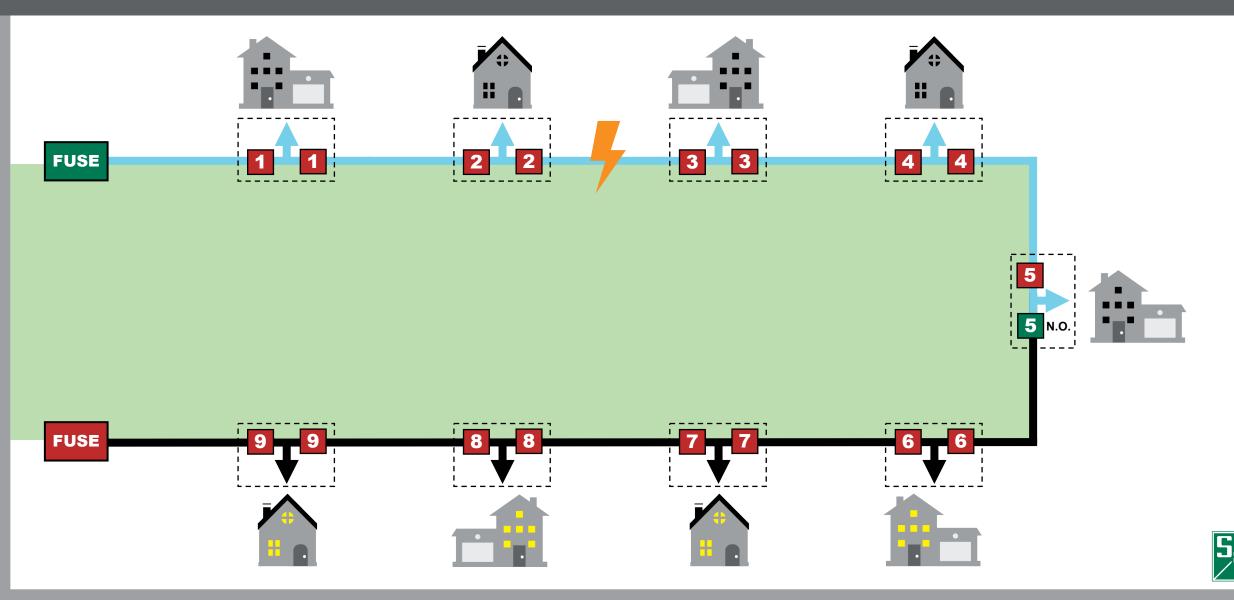
# **Temporary Faults** <10% of faults that occur

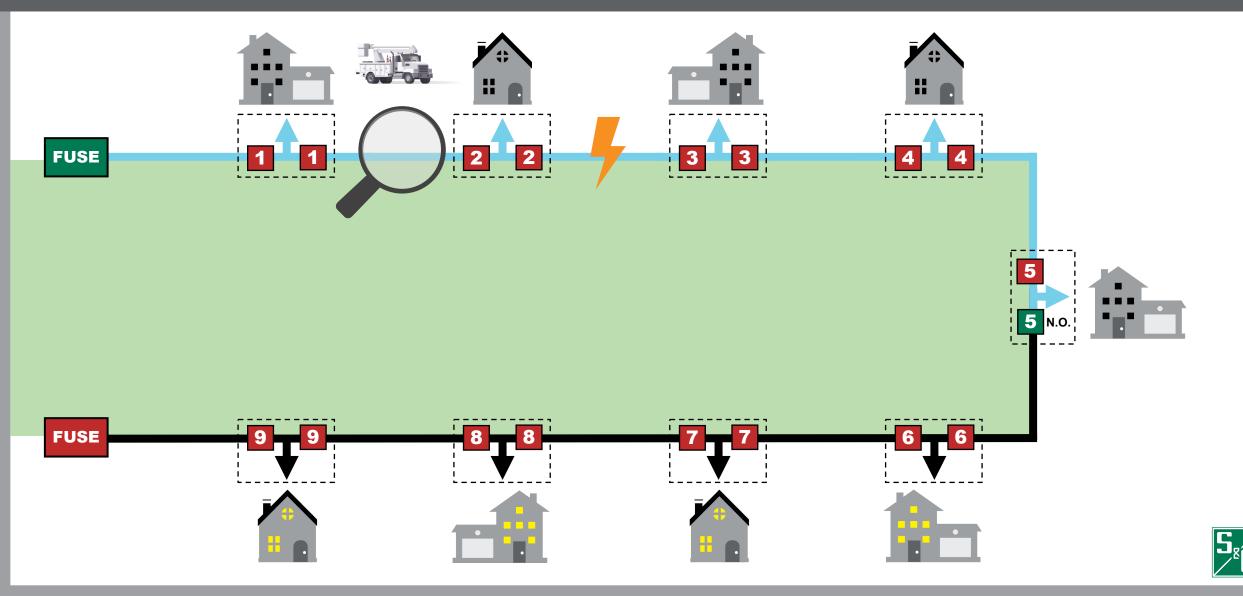
# Leading Causes: Wildlife Aging Equipment Lightning

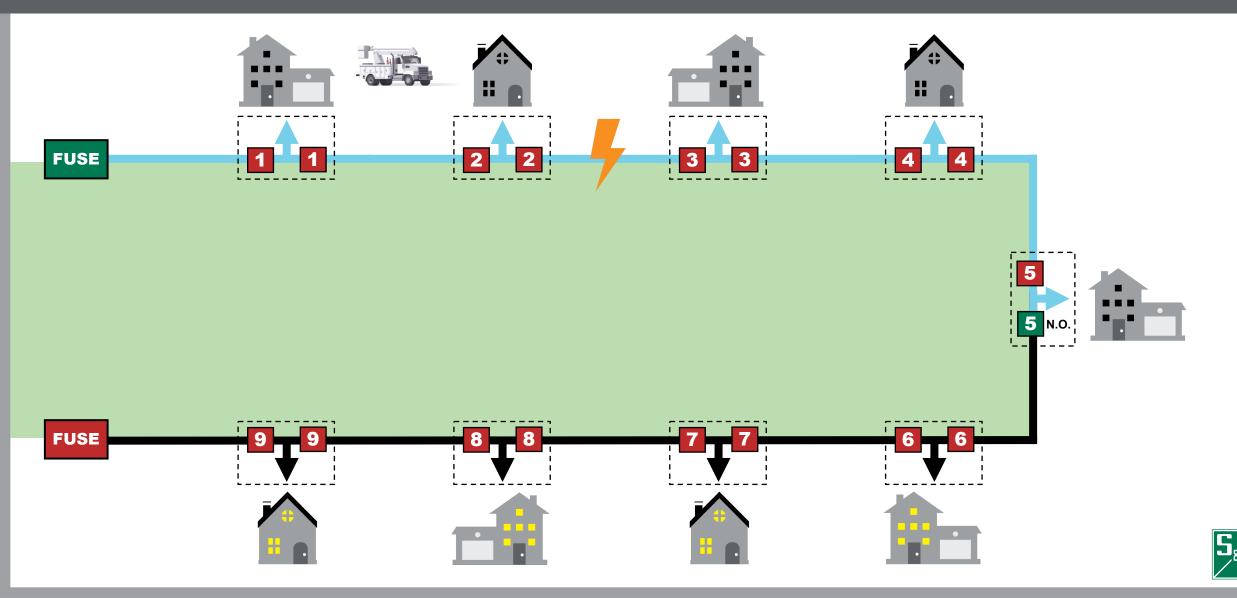


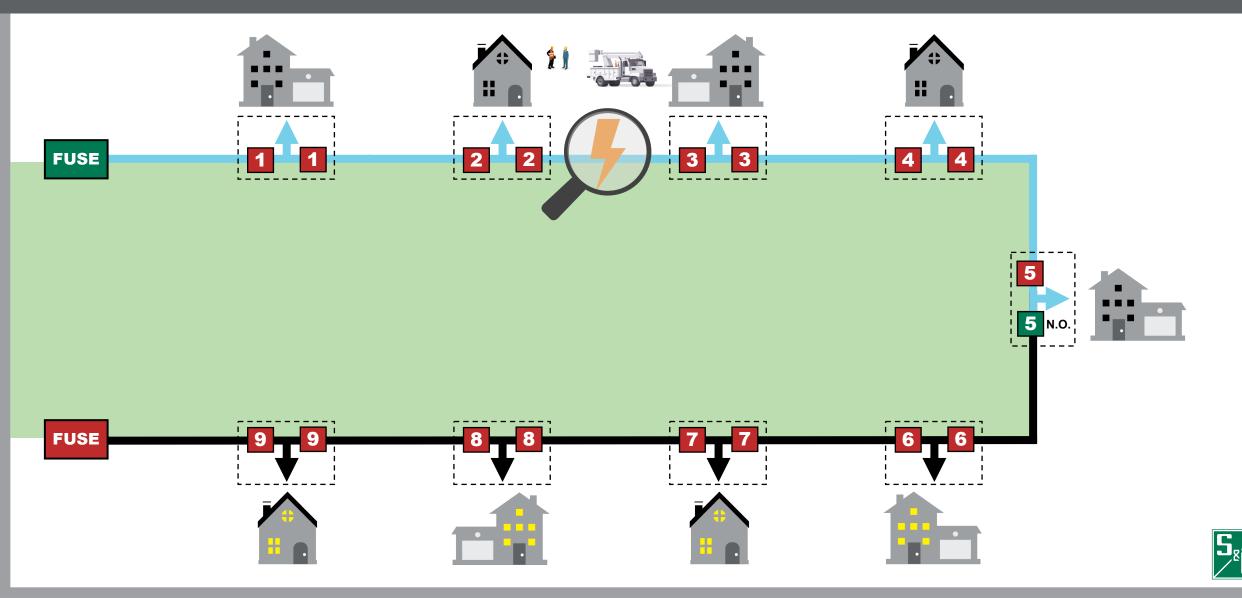


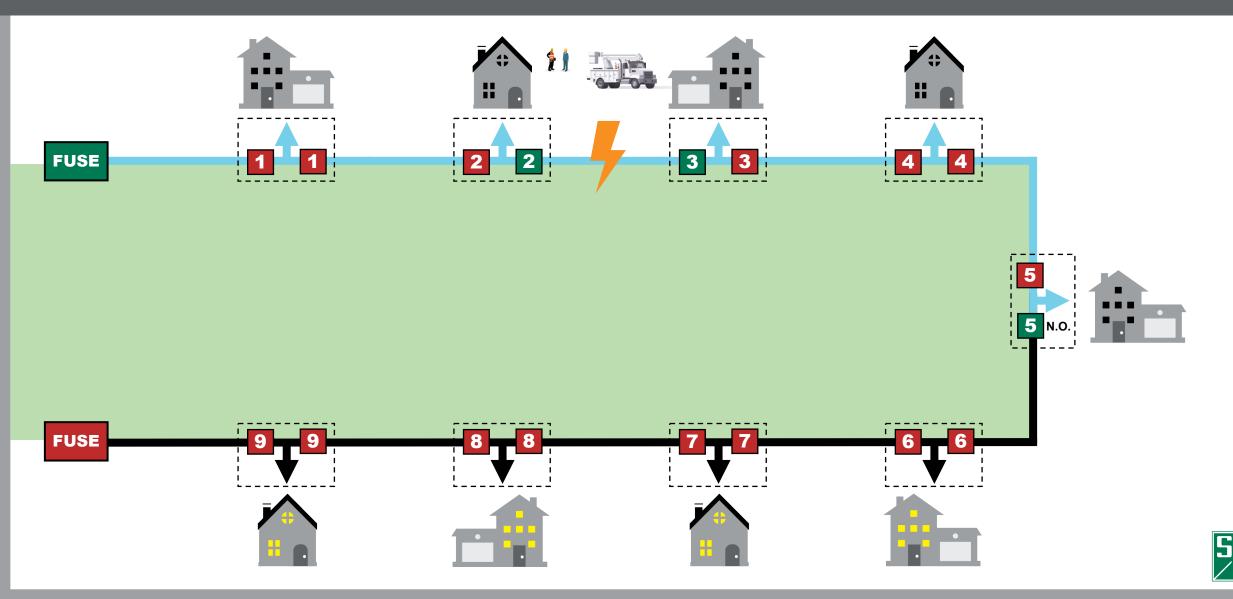


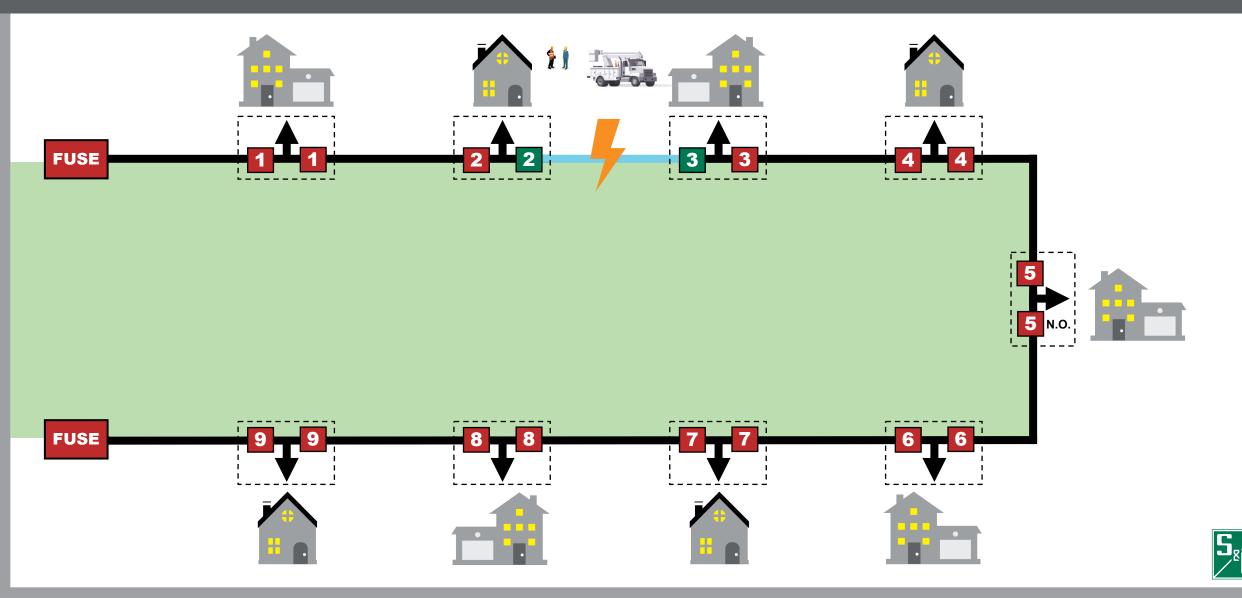




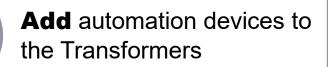








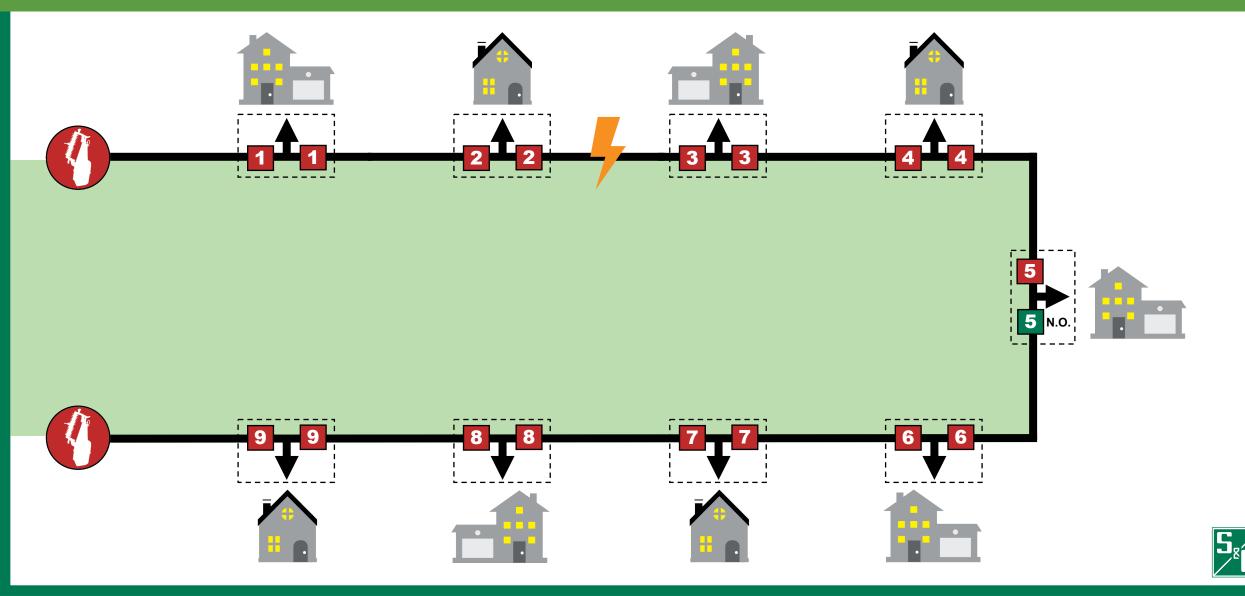
### Underground Residential Adding Automation

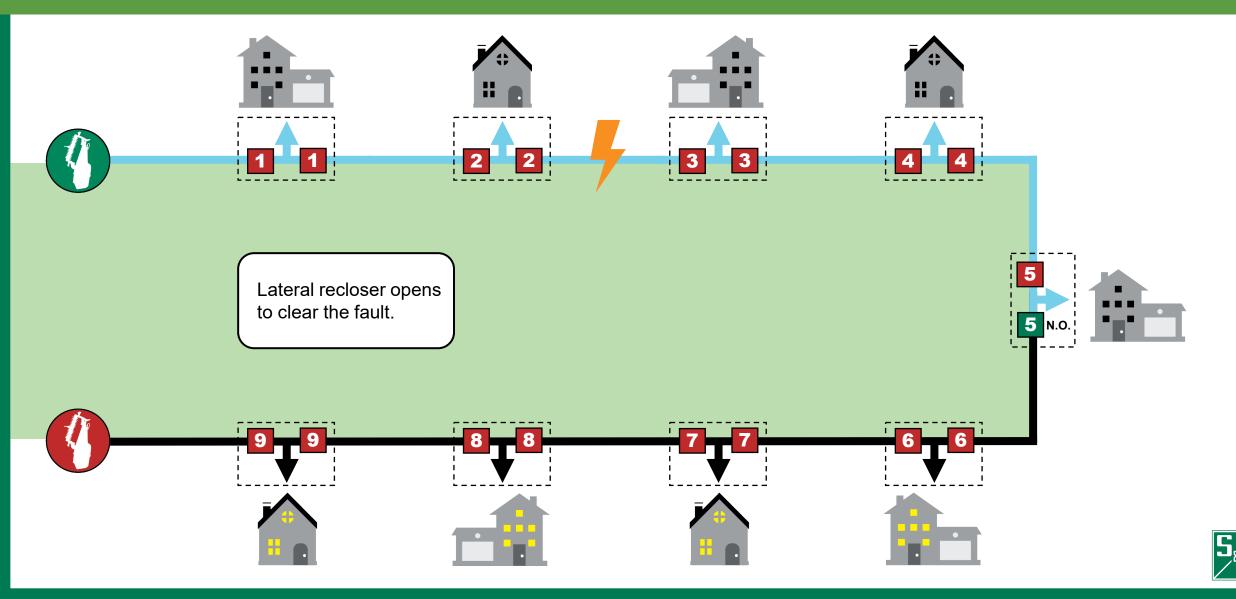


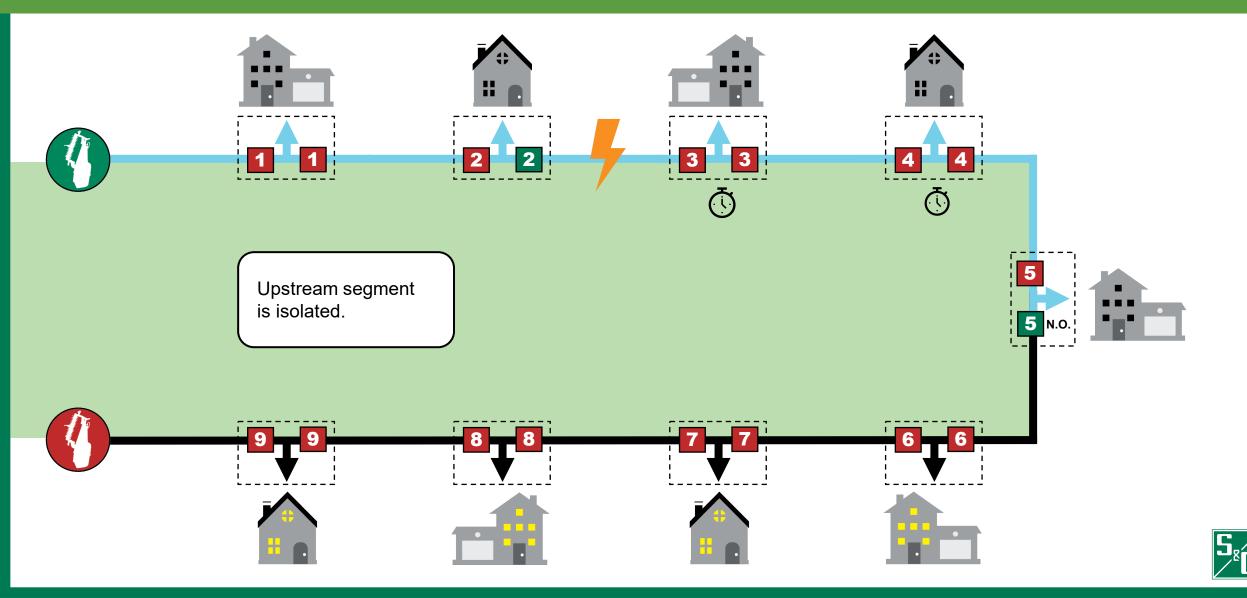


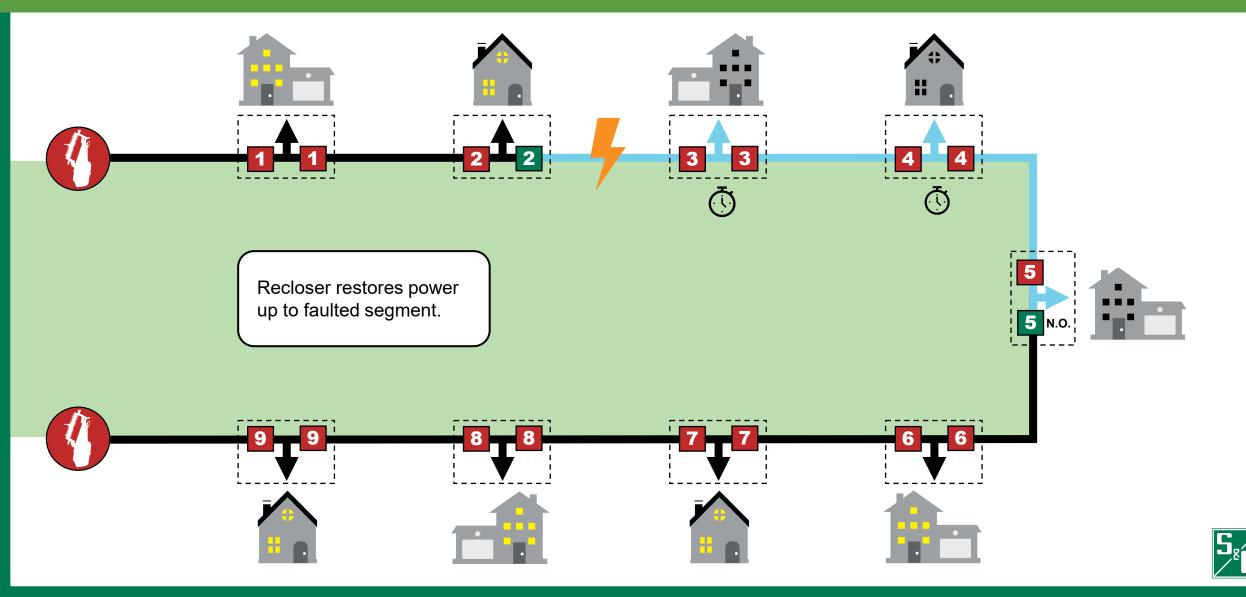
**Replace** fuses with lateral reclosers on the risers

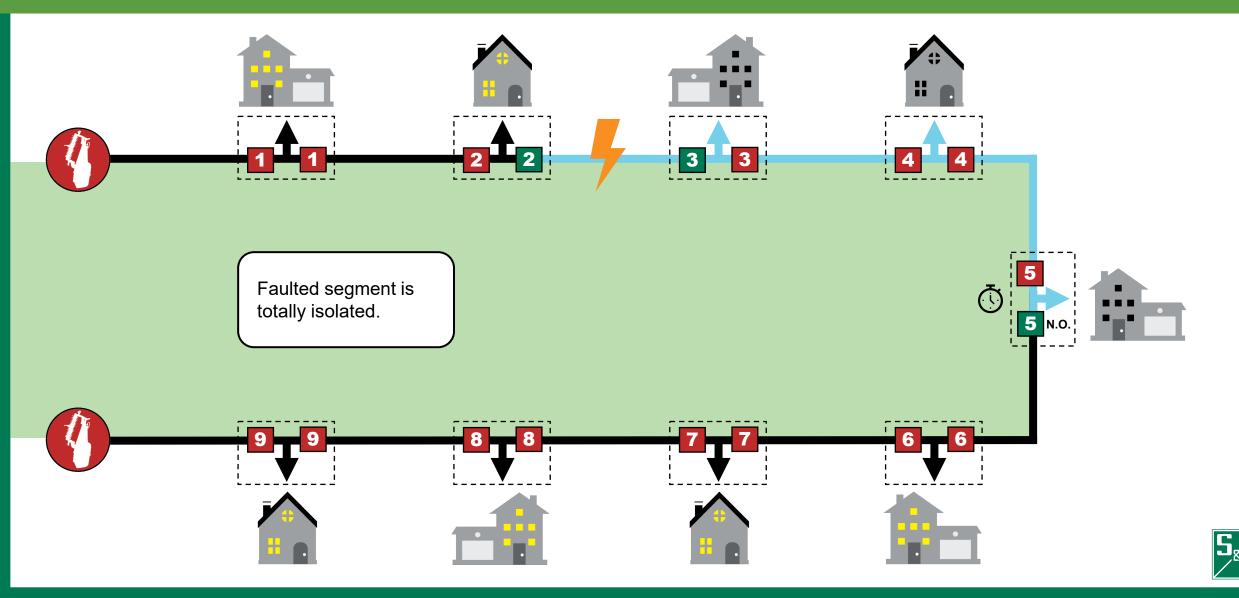


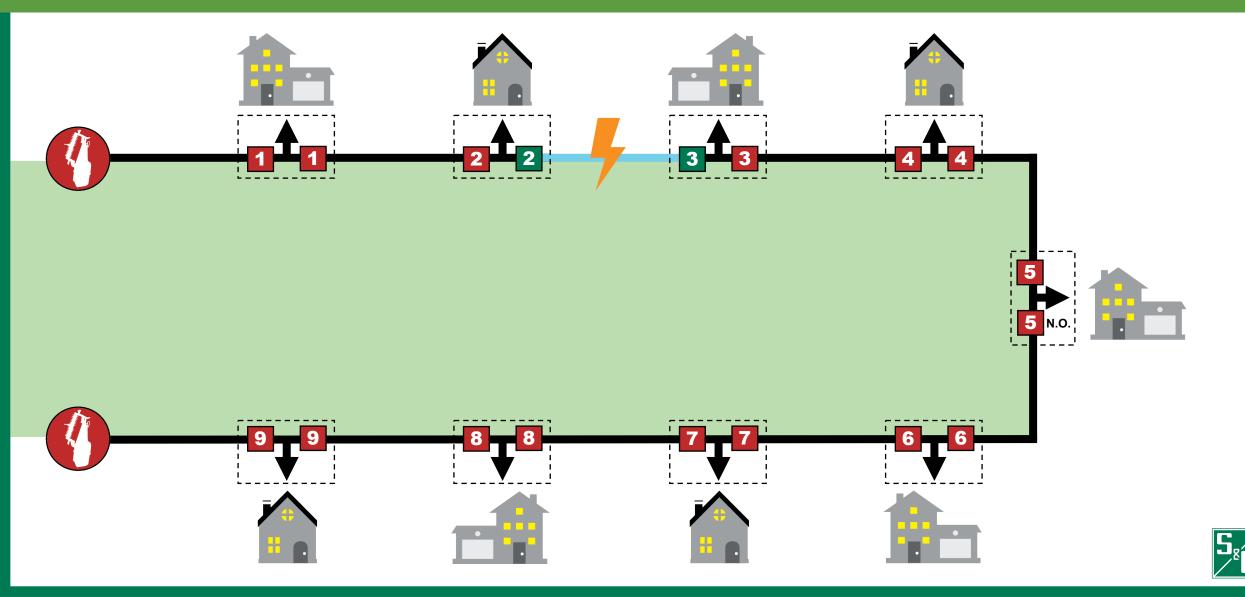


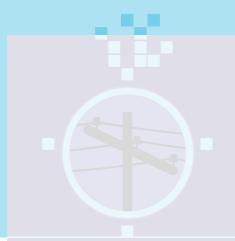




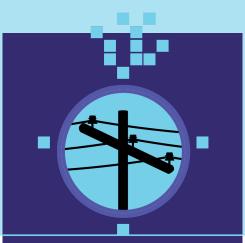








### Feeder Automation



### Lateral Automation

- Overhead
- Underground

Communications

Right of Way

Capacity

Bi-Directionality





#### **Key Points**

- 1) Overhead lateral automation gets the attention because commercial technology is already available
- 2) Technology advancement in Lateral Automation will move to underground laterals
- 3) Challenges at the Laterals mirror those at the Feeder

#### Takeaways

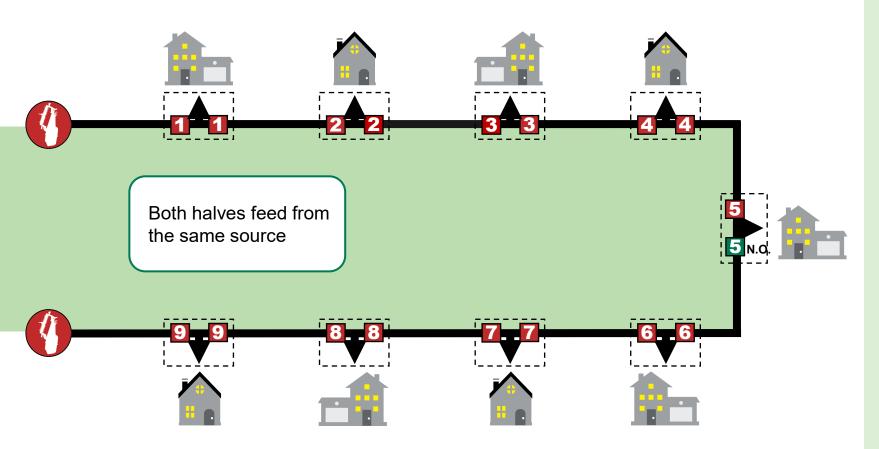
- 1) Use what you've learned rolling out feeder automation
- 2) Weigh your outage data heavily into the equation





#### Lateral Automation | Value





#### Example

- 80% of URD outages are Loss of Voltage
- Not independent sources

Result: No reliability benefits 4 out of 5 events

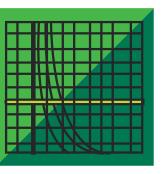






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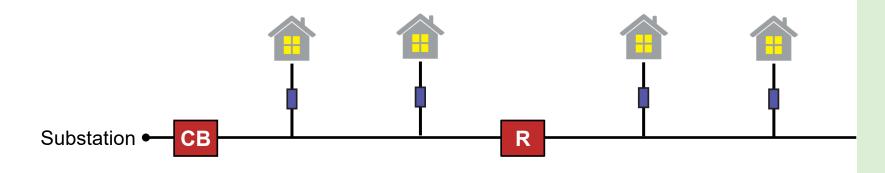
Lateral Advancement



**Protection** 

#### Feeder Protection | Segmentation

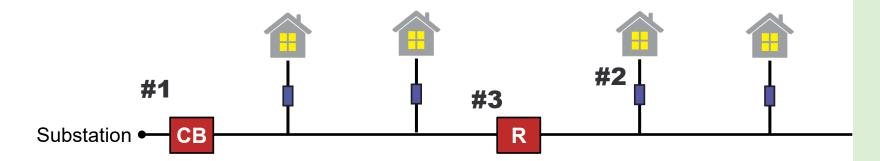




**Coordinated Devices: More devices means less impact from an outage** 



#1. Start with the breaker curve (upper bound)

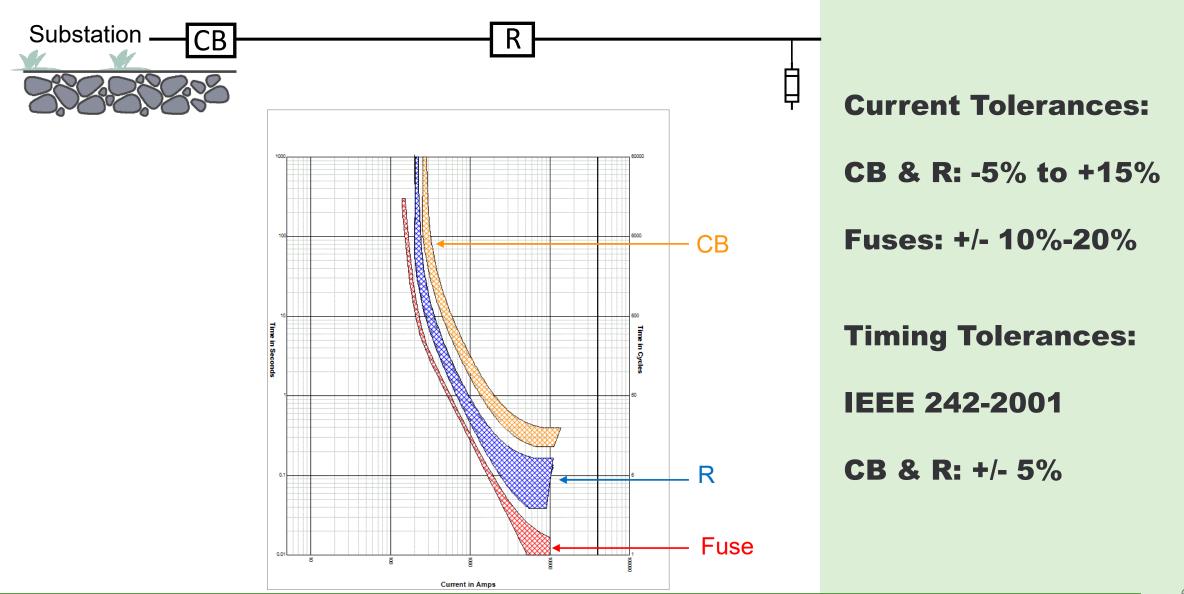


**#2. Start with your downstream fuse curve (lower bound)** 

**#3. Add reclosers** as applicable

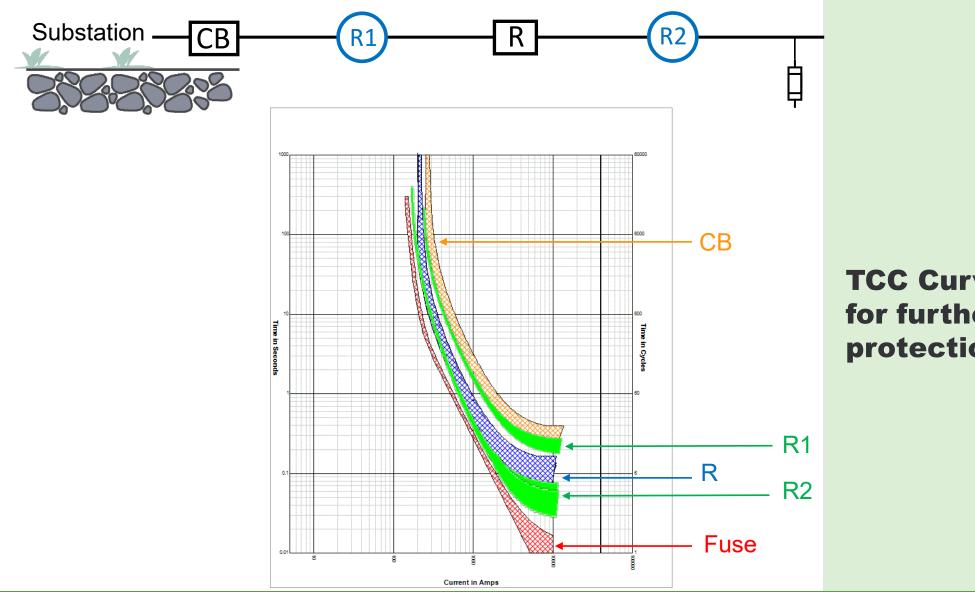
#### Feeder Protection | **TCC Curves**





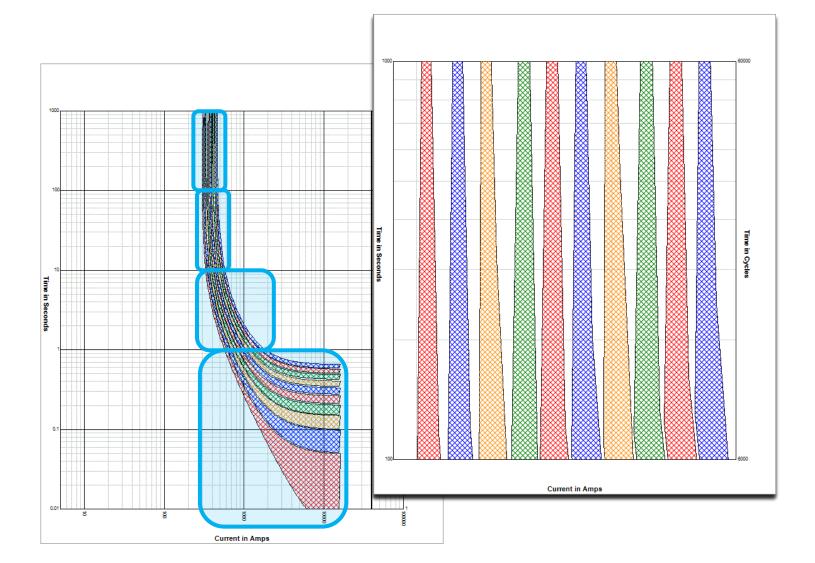
#### Feeder Protection | TCC Curves





#### TCC Curves don't allow for further coordinated protection devices

#### Feeder Protection | **TCC Curves**

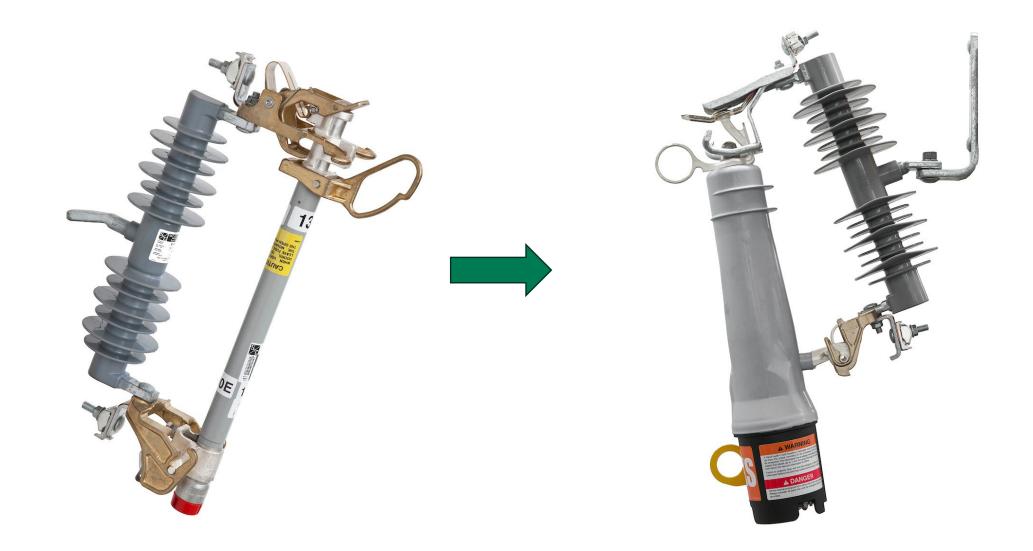




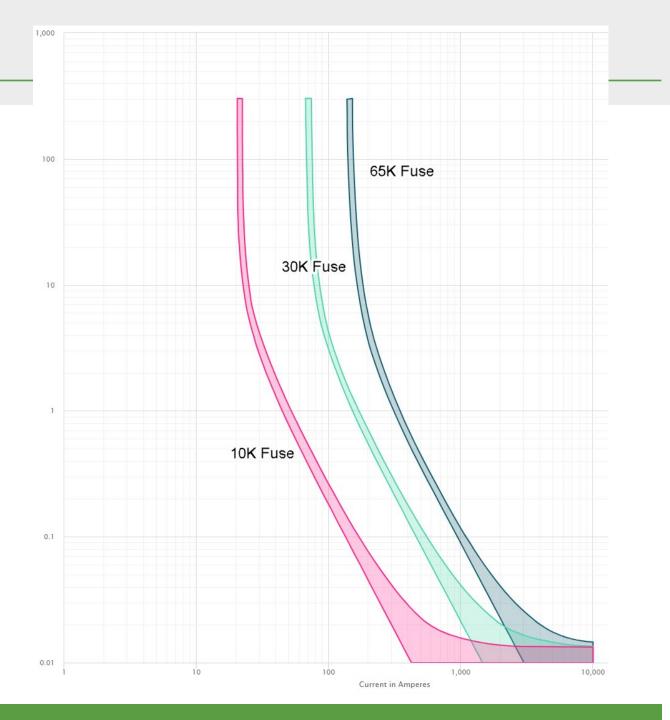
2% Tolerance would put 10 devices in the original TCC plot area.

#### Lateral Protection | New Options





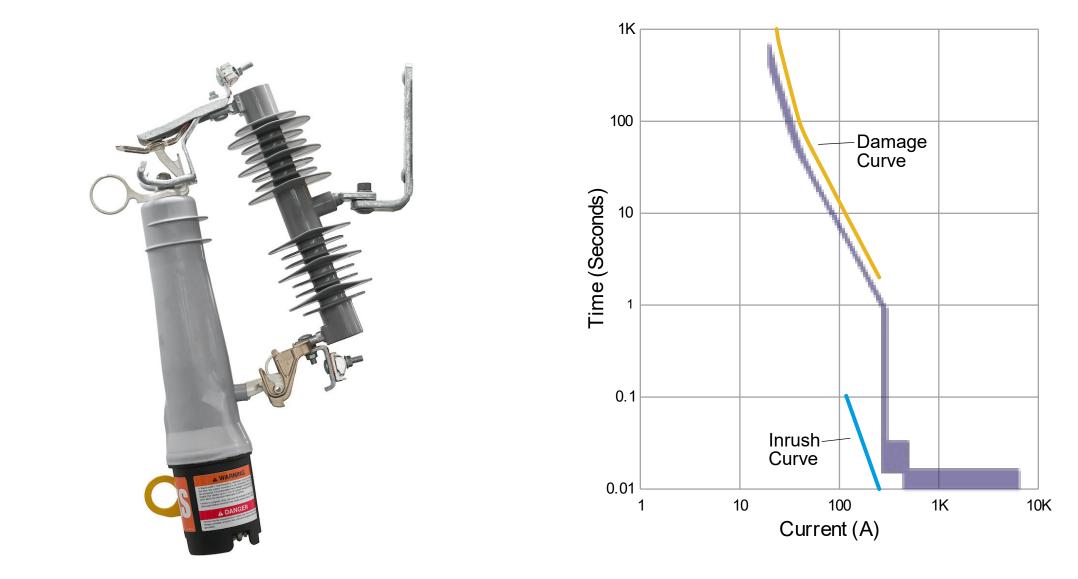
#### Lateral Protection | Fuse Space



S<sub>8</sub>C

#### Lateral Protection | New Options – New Protection Options





#### Lateral Protection | New Technology – Opens Space for Protection



