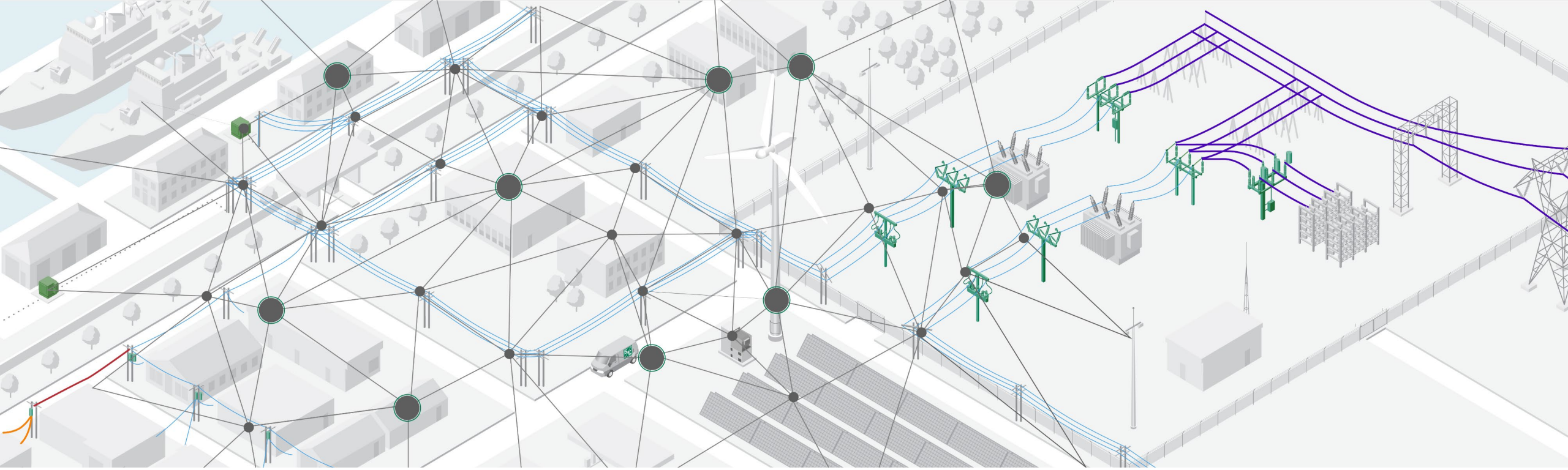


Changing Landscape of Lateral Automation

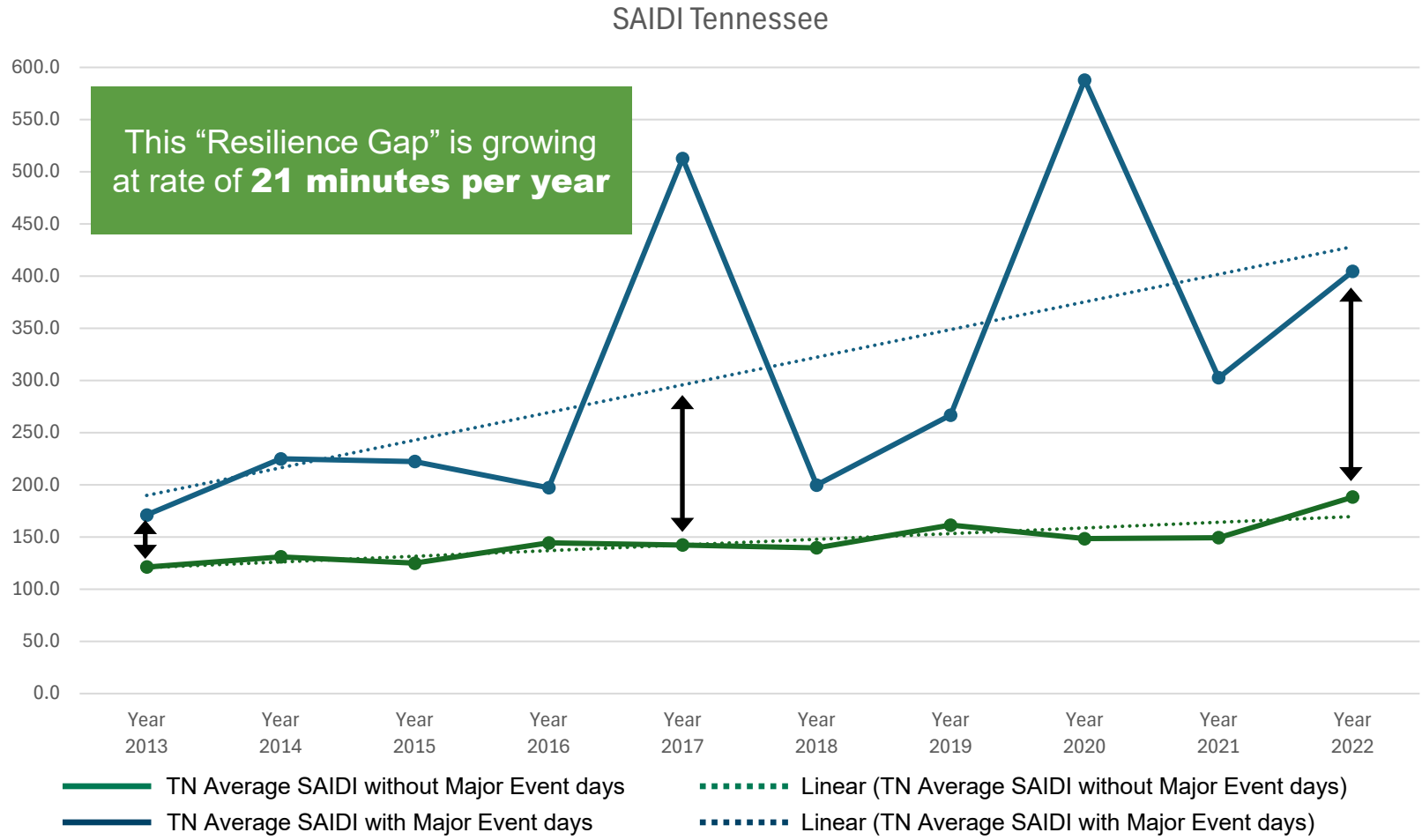
Presented by:

Ryan McAndrews, PE

Application Manager –
Automation Systems

The Increasing Resilience Gap

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

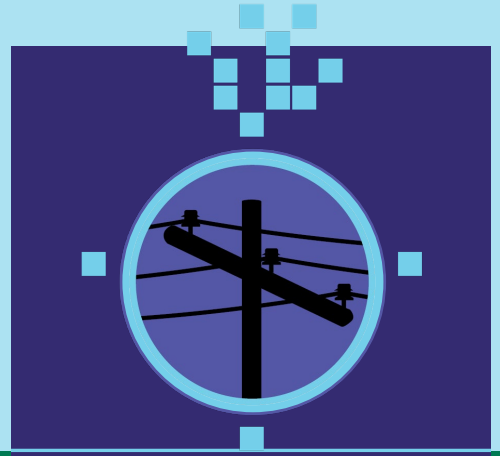


Agenda

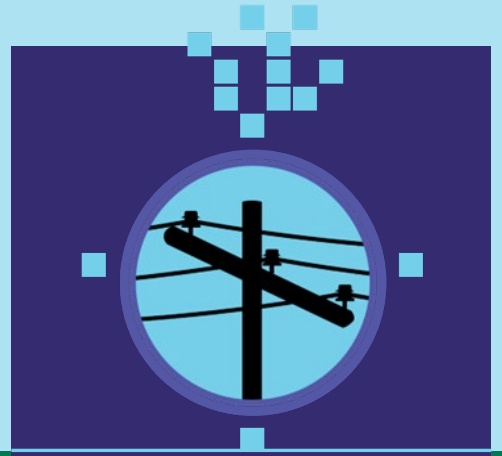
History

Lateral Advancement

Protection

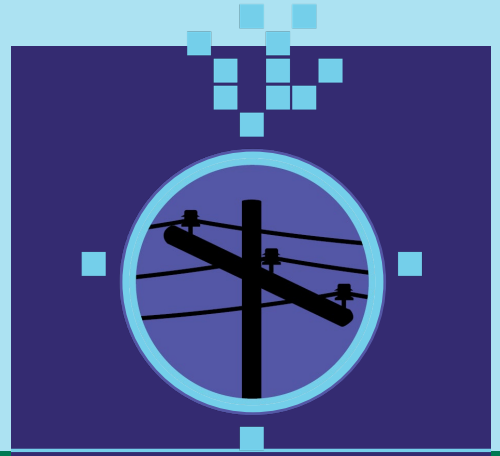


Feeder Automation

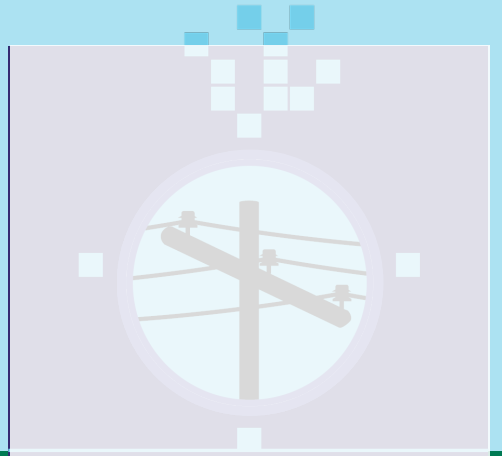


Lateral Automation

- Overhead
- Underground



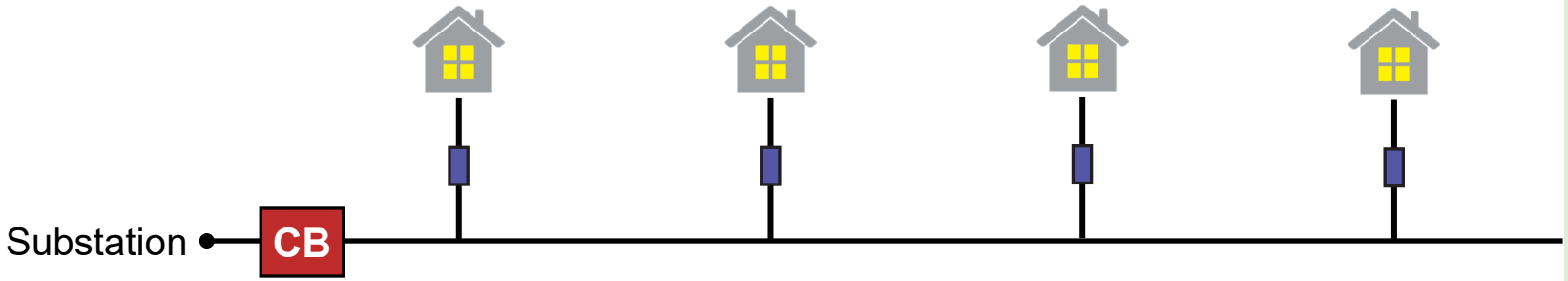
Feeder Automation



Lateral Automation

- Overhead
- Underground

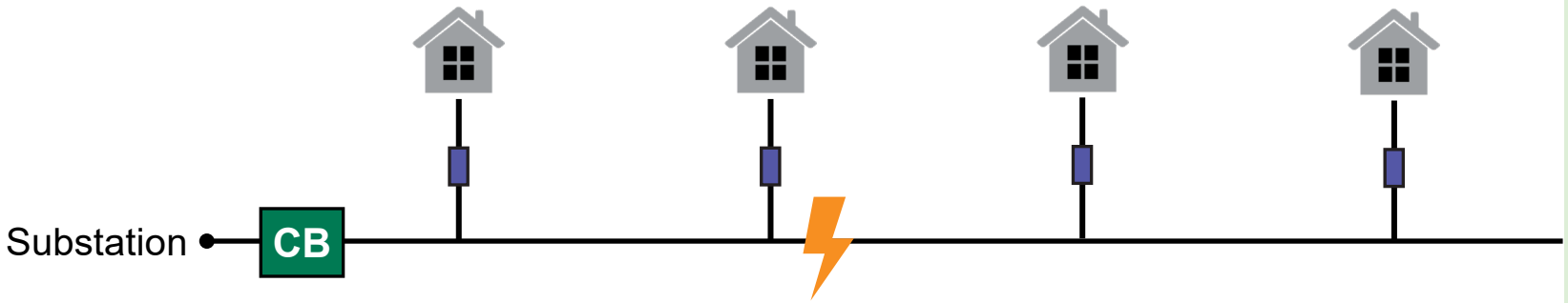
Starting Point: Radial Lines



Problem:

When a fault occurs, it causes a widespread outage.

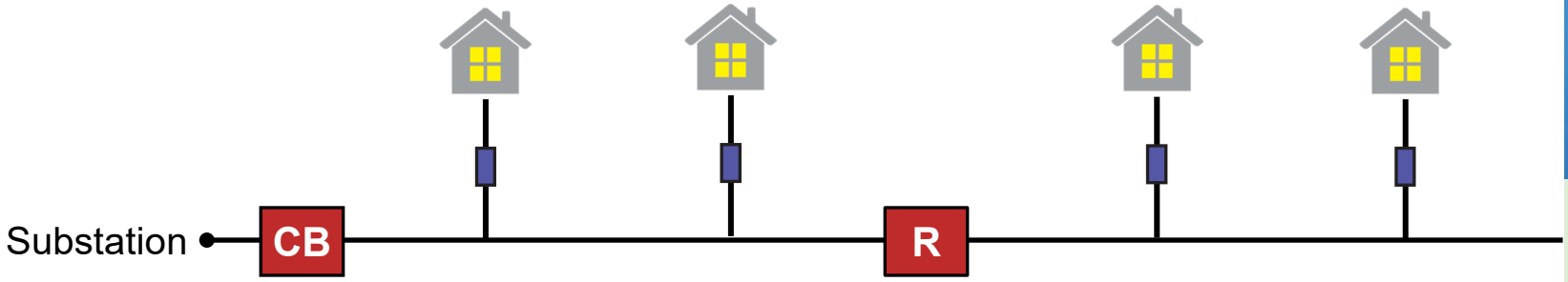
Starting Point: Radial Lines



Problem:

When a fault occurs, it causes a widespread outage.

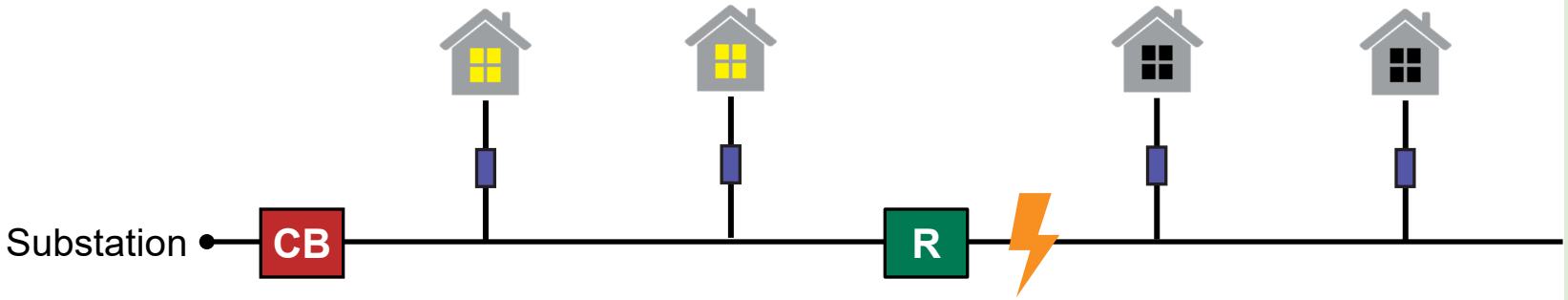
Solution: Segmentation



How it Works:

Add a protective device to segment the line.

Solution: Segmentation



How it Works:

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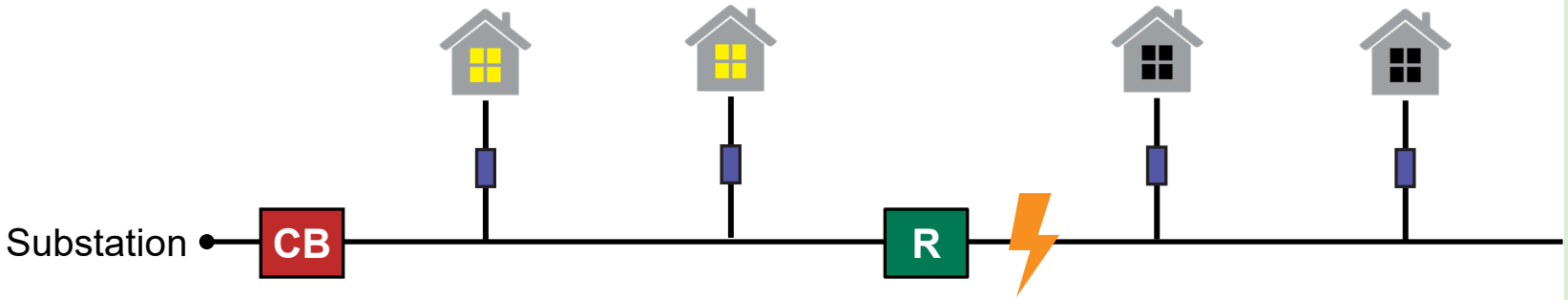
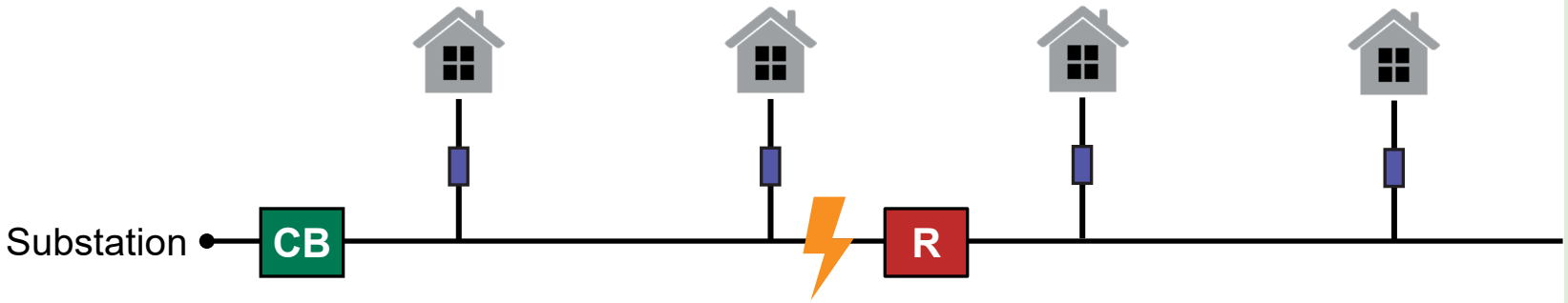


Benefits:

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

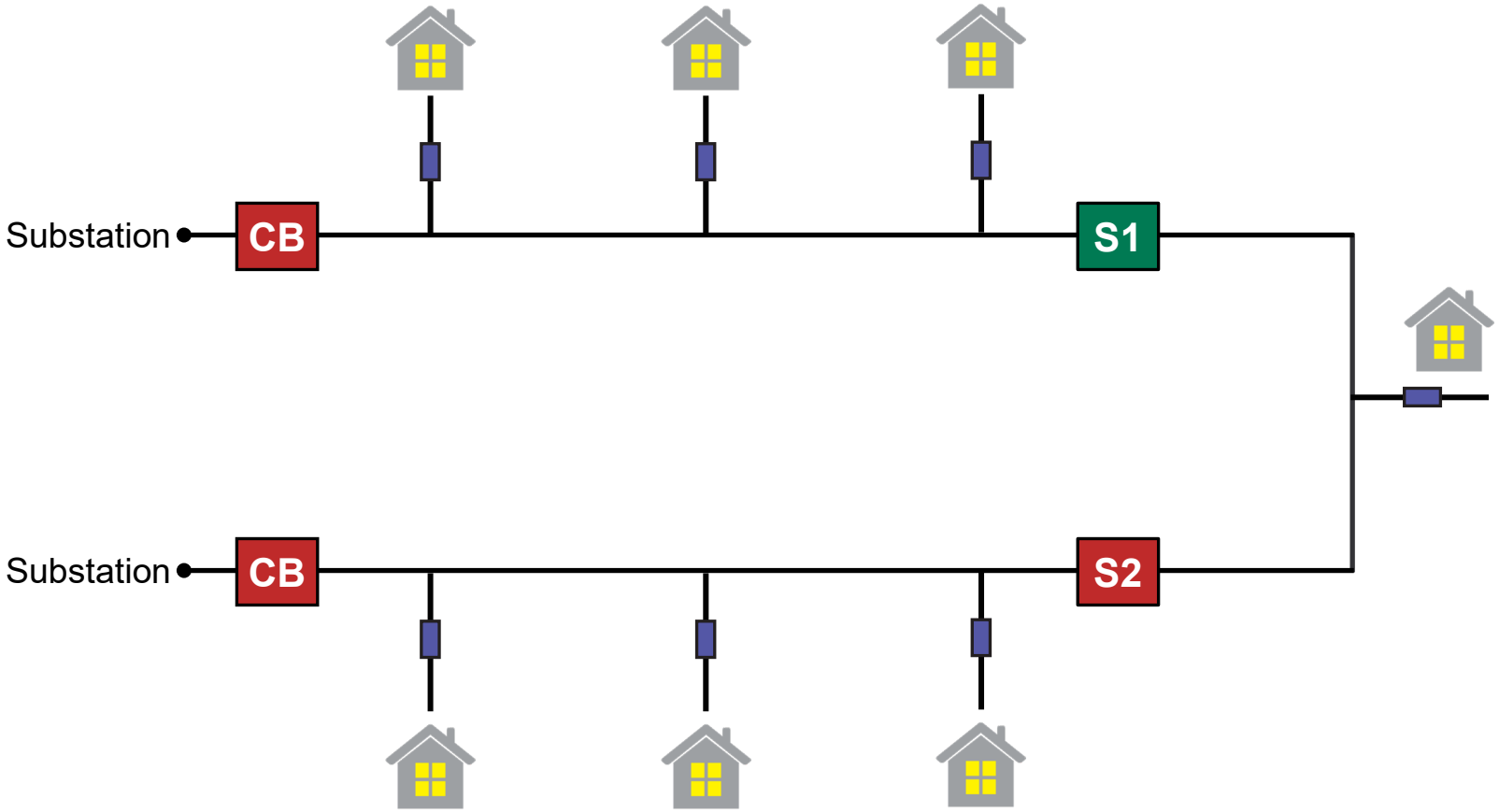
Solution: Segmentation



BUT:

Results in marginal improvements.

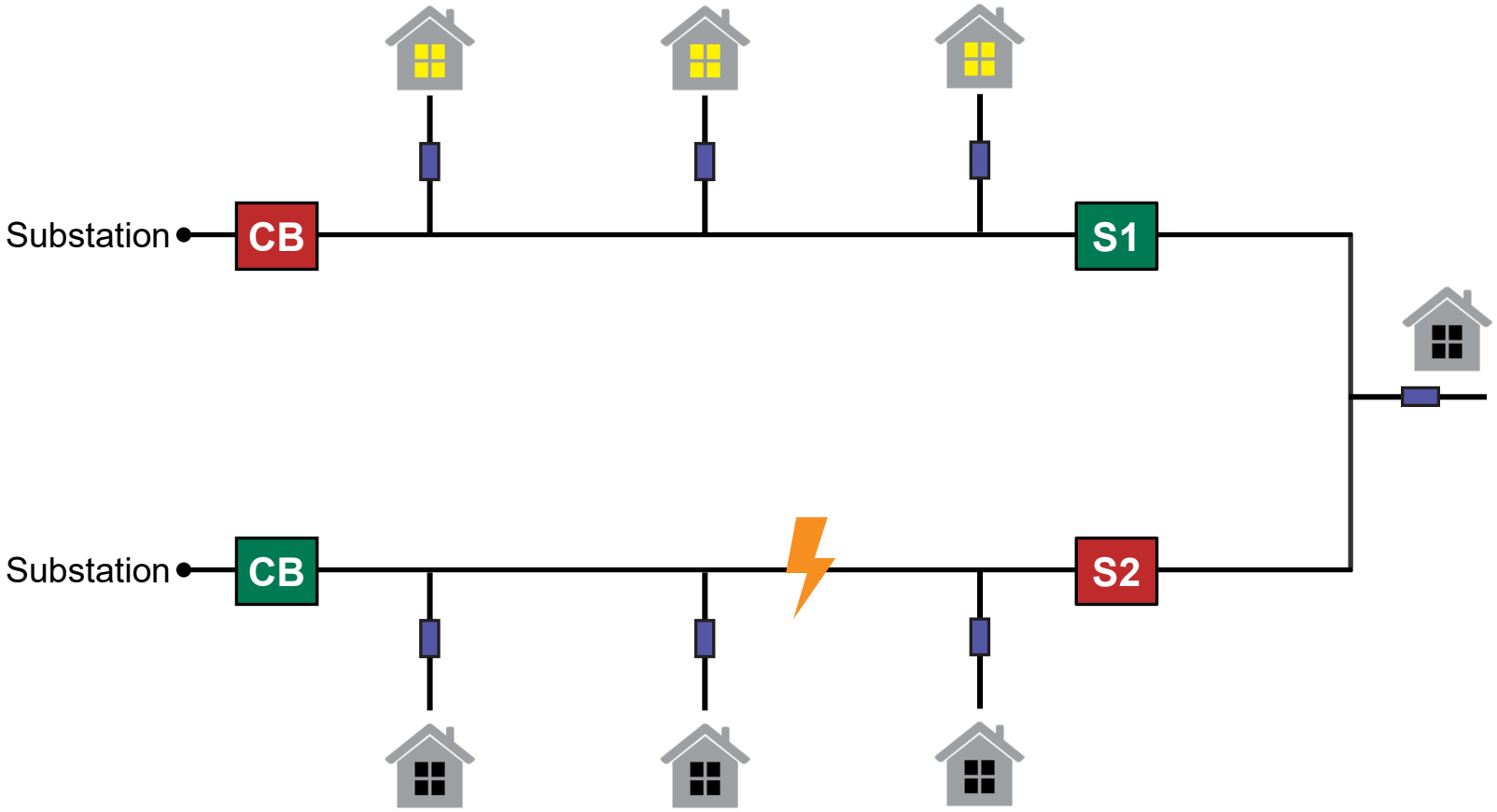
Solution: Add a Tie



How it Works:

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

Solution: Source Transfer

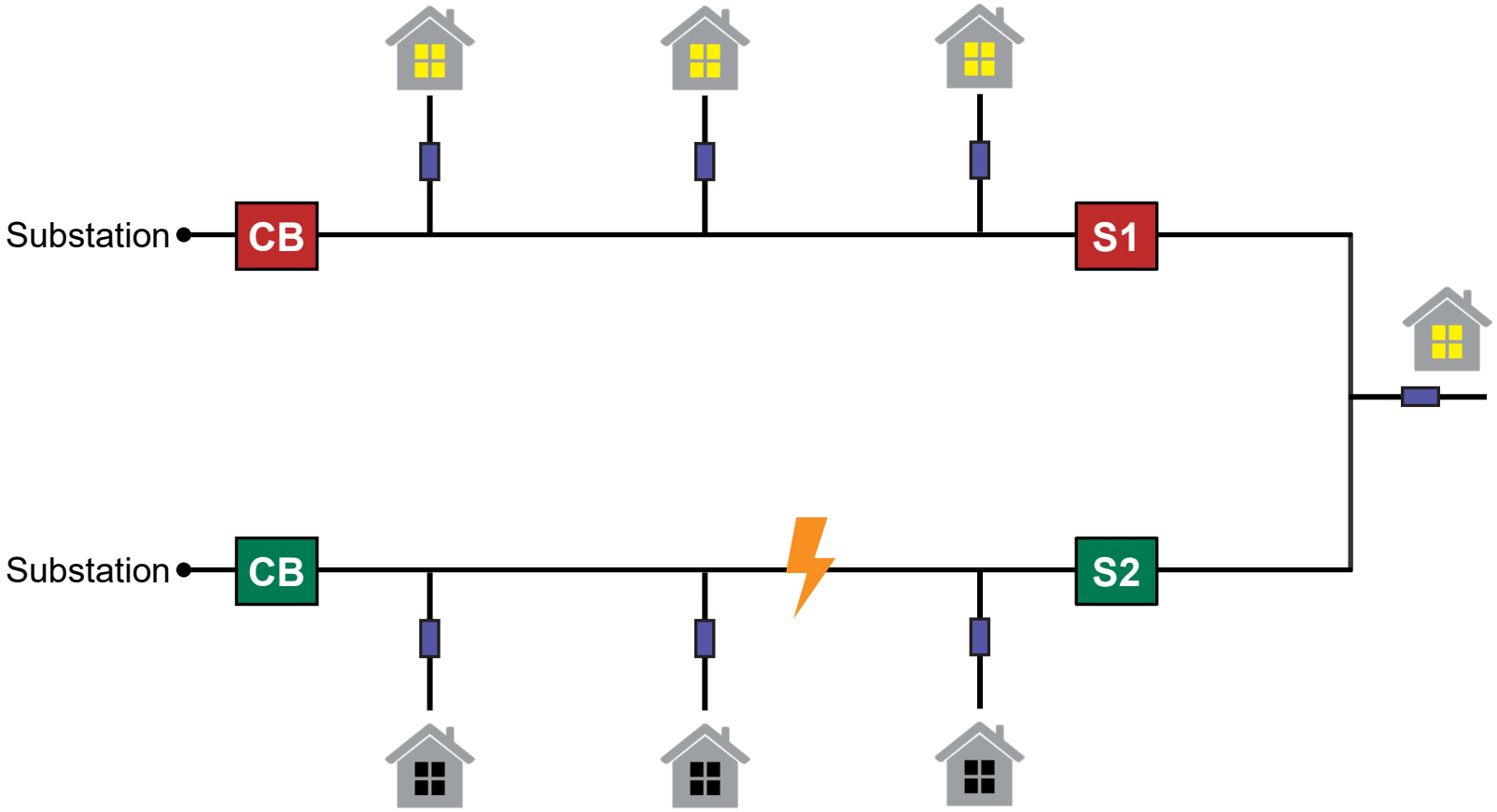


How it Works:

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

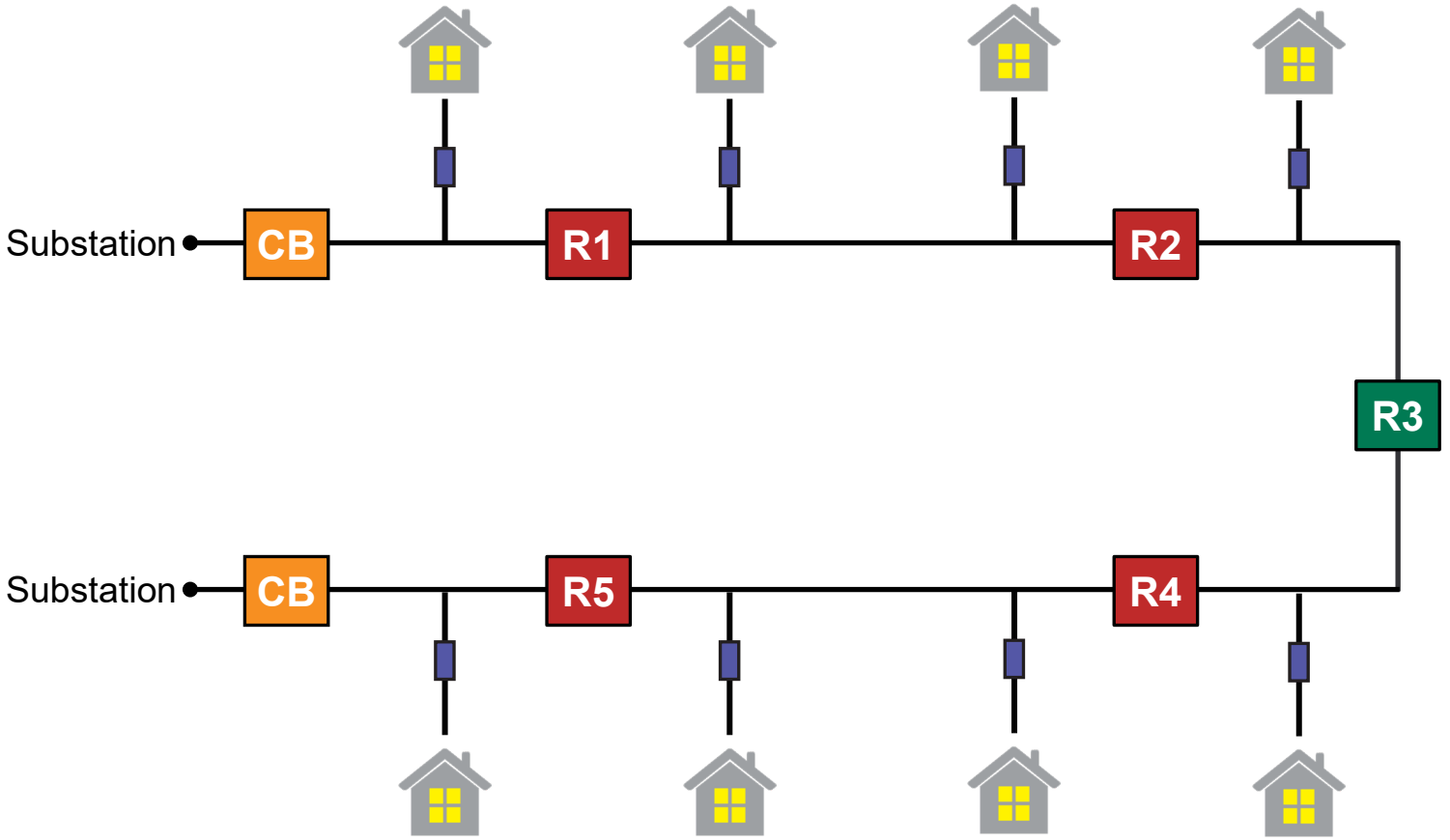


Note:

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

Solution: Loop Scheme

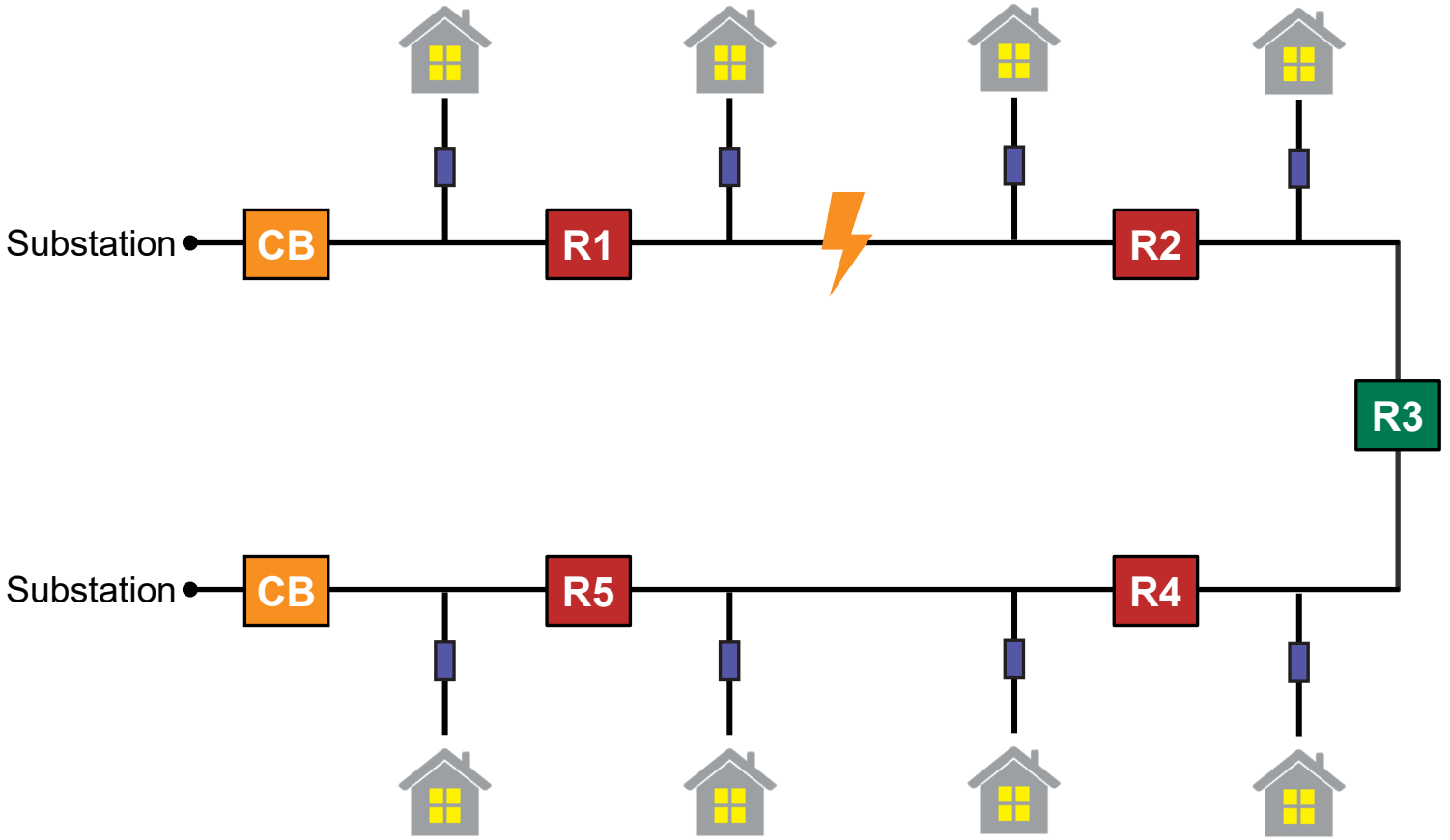


How it Works:

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

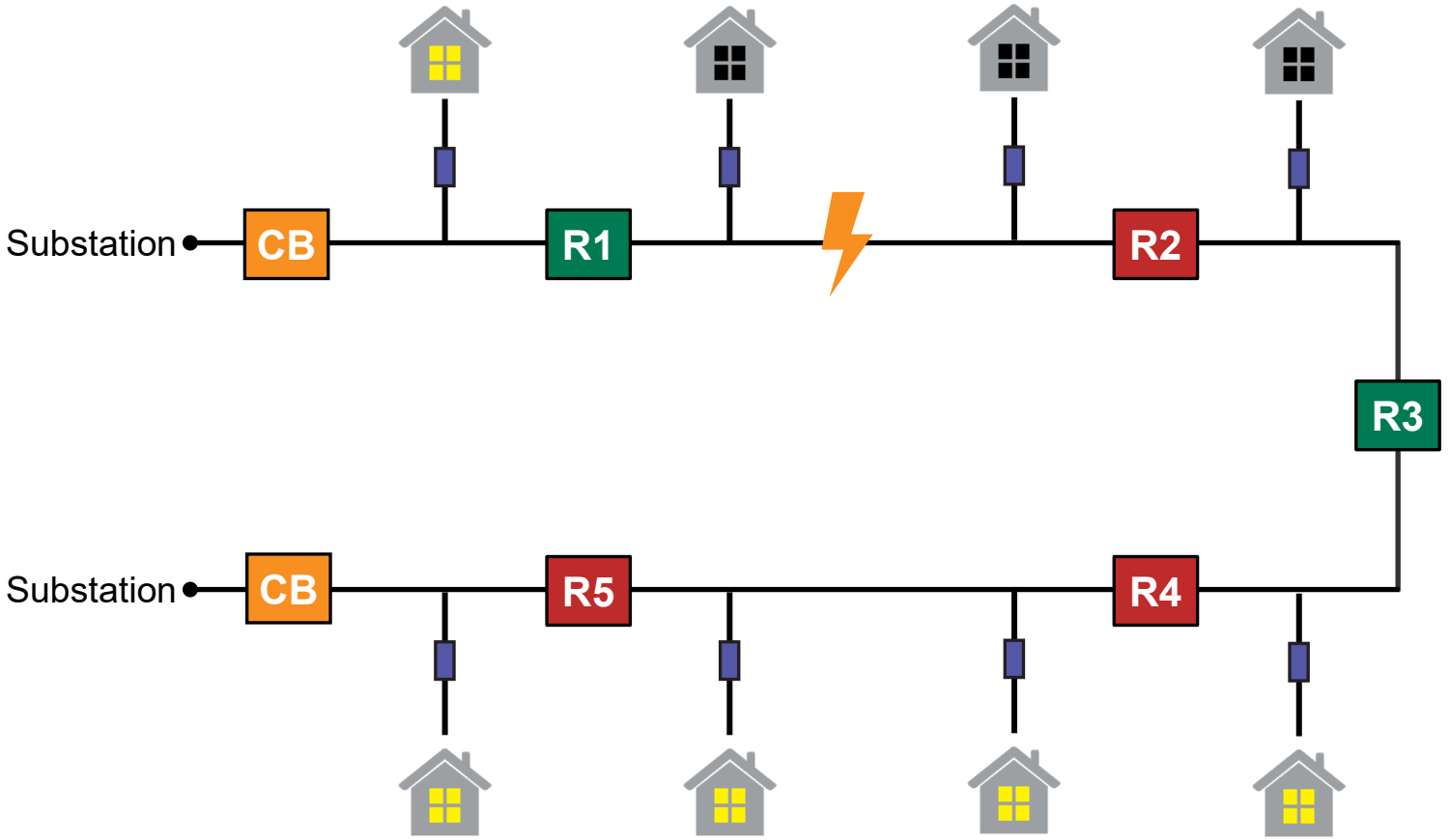
Solution: Loop Scheme



Benefits:

If one power source fails, switches are opened to obtain another source of power—quicker service restoration than manual.

Solution: Loop Scheme



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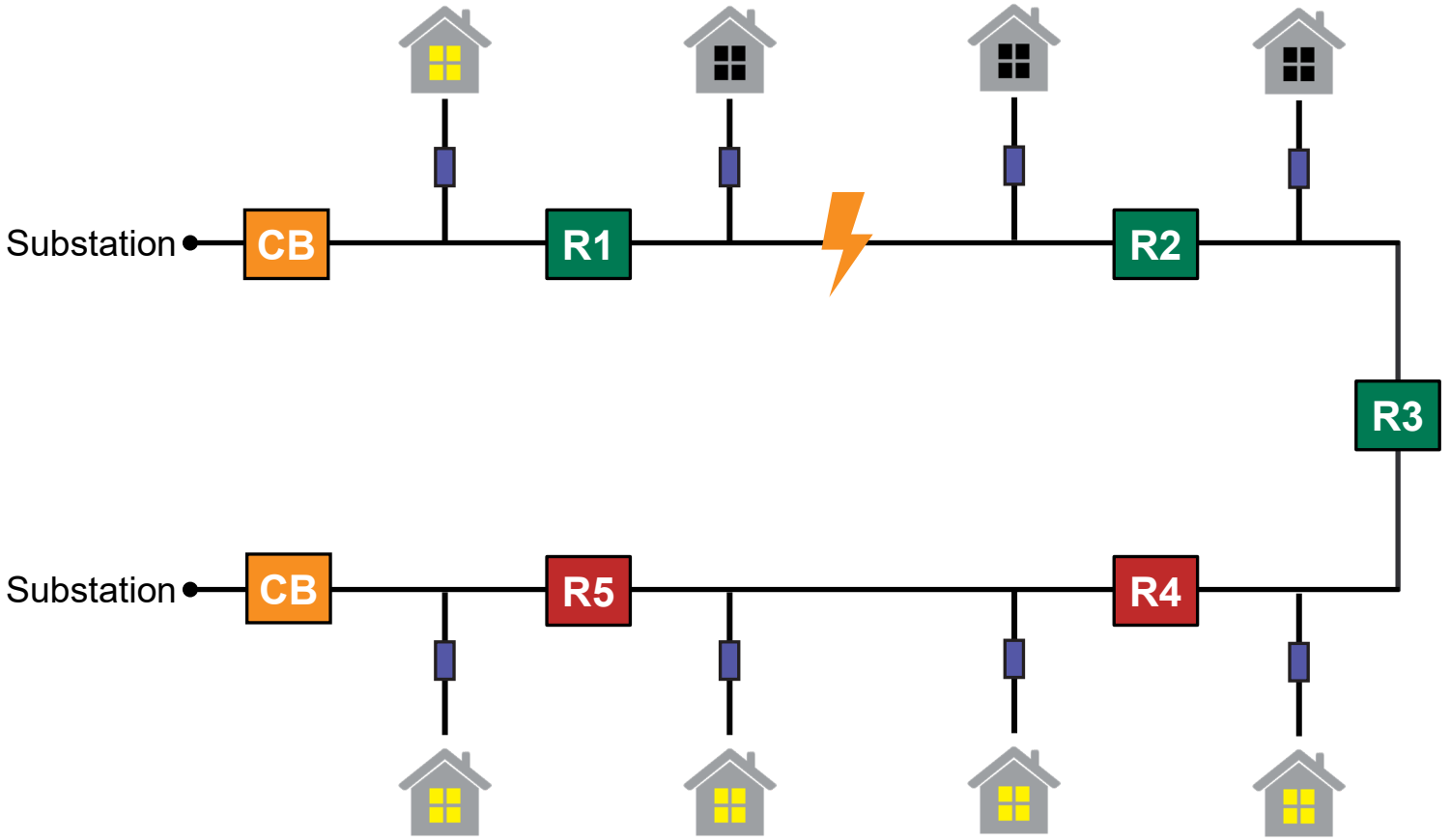

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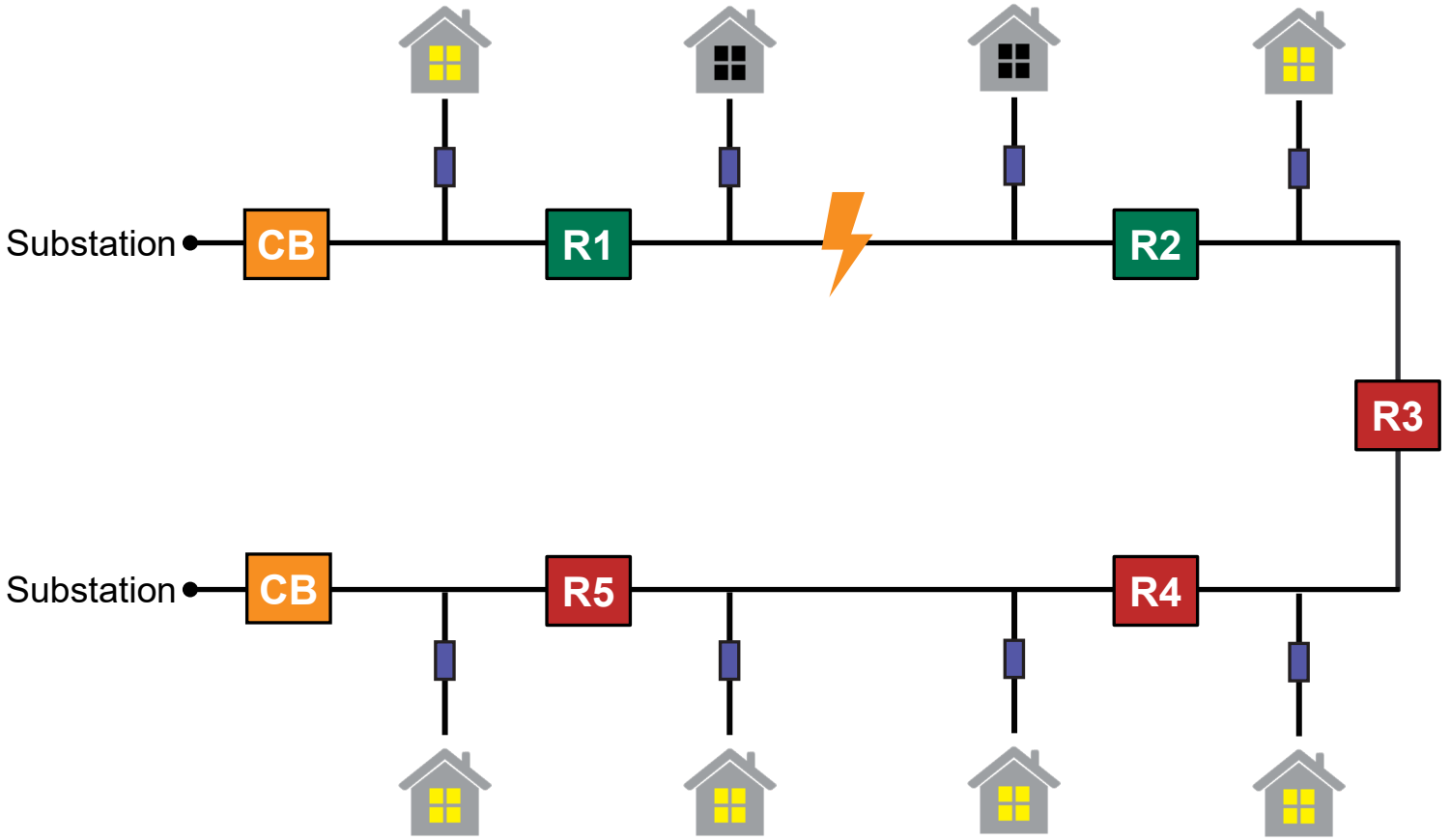

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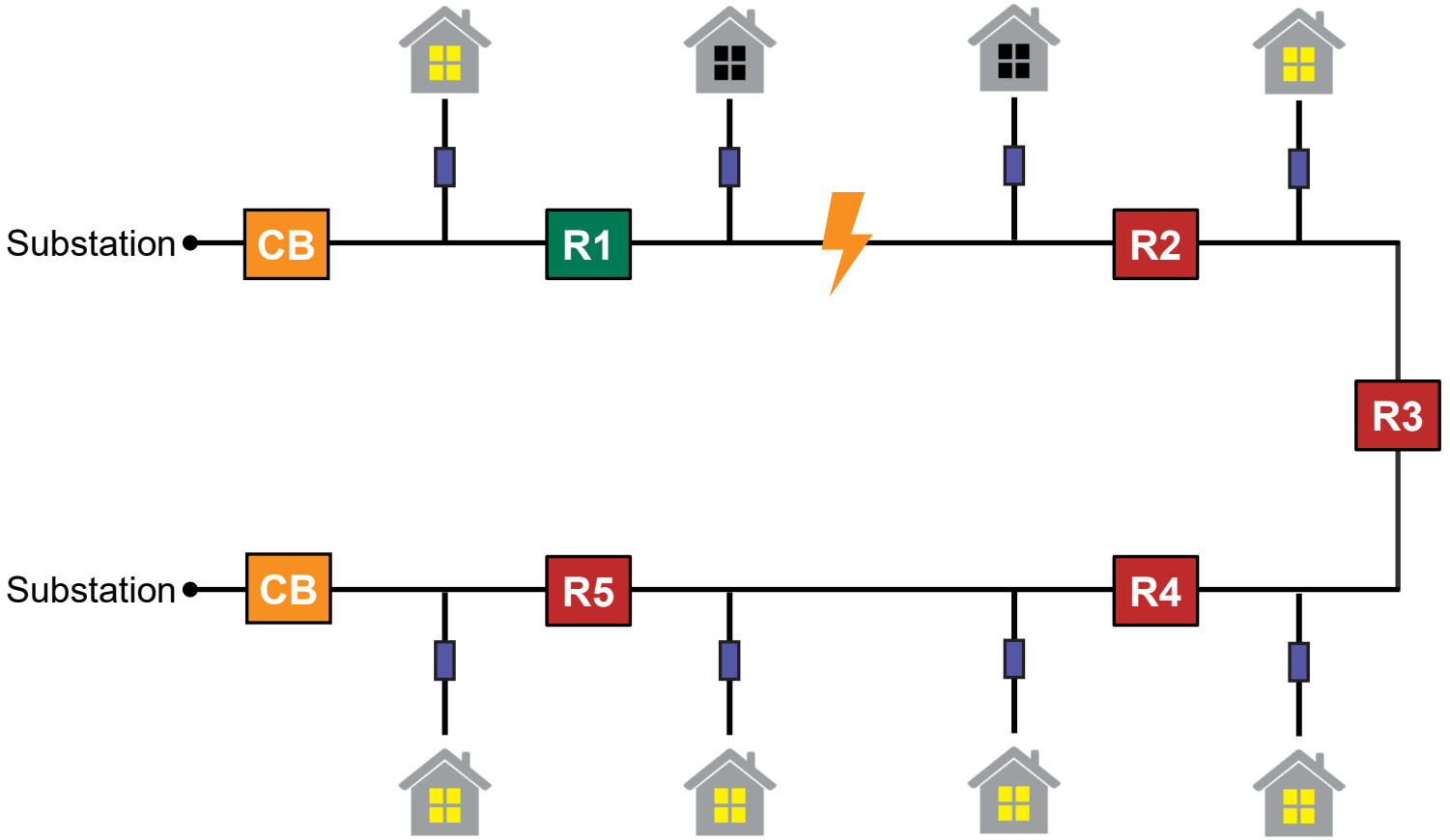
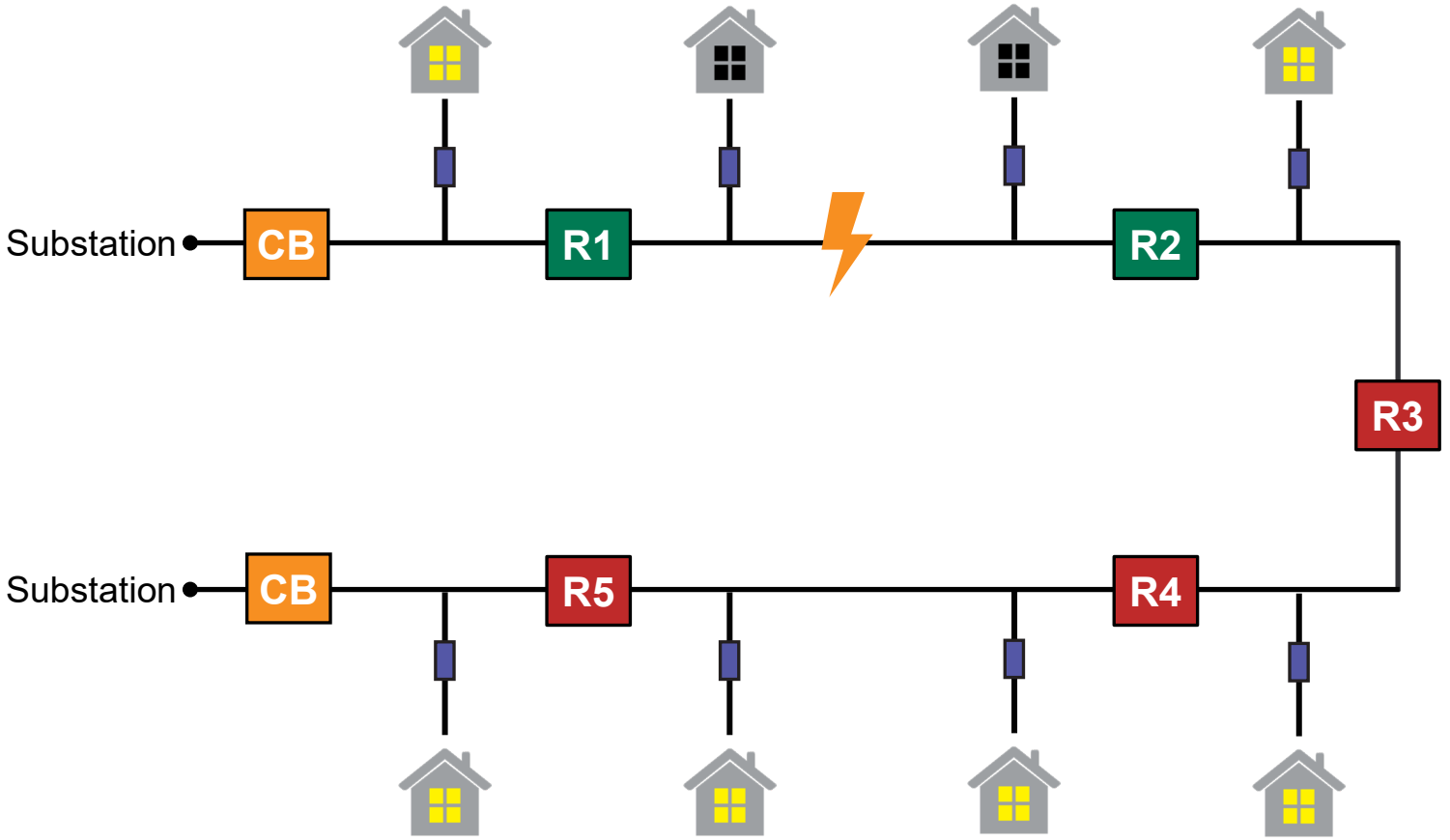


R2 will close into the fault before going into lock-out

This subjects the other feeder to voltage sags

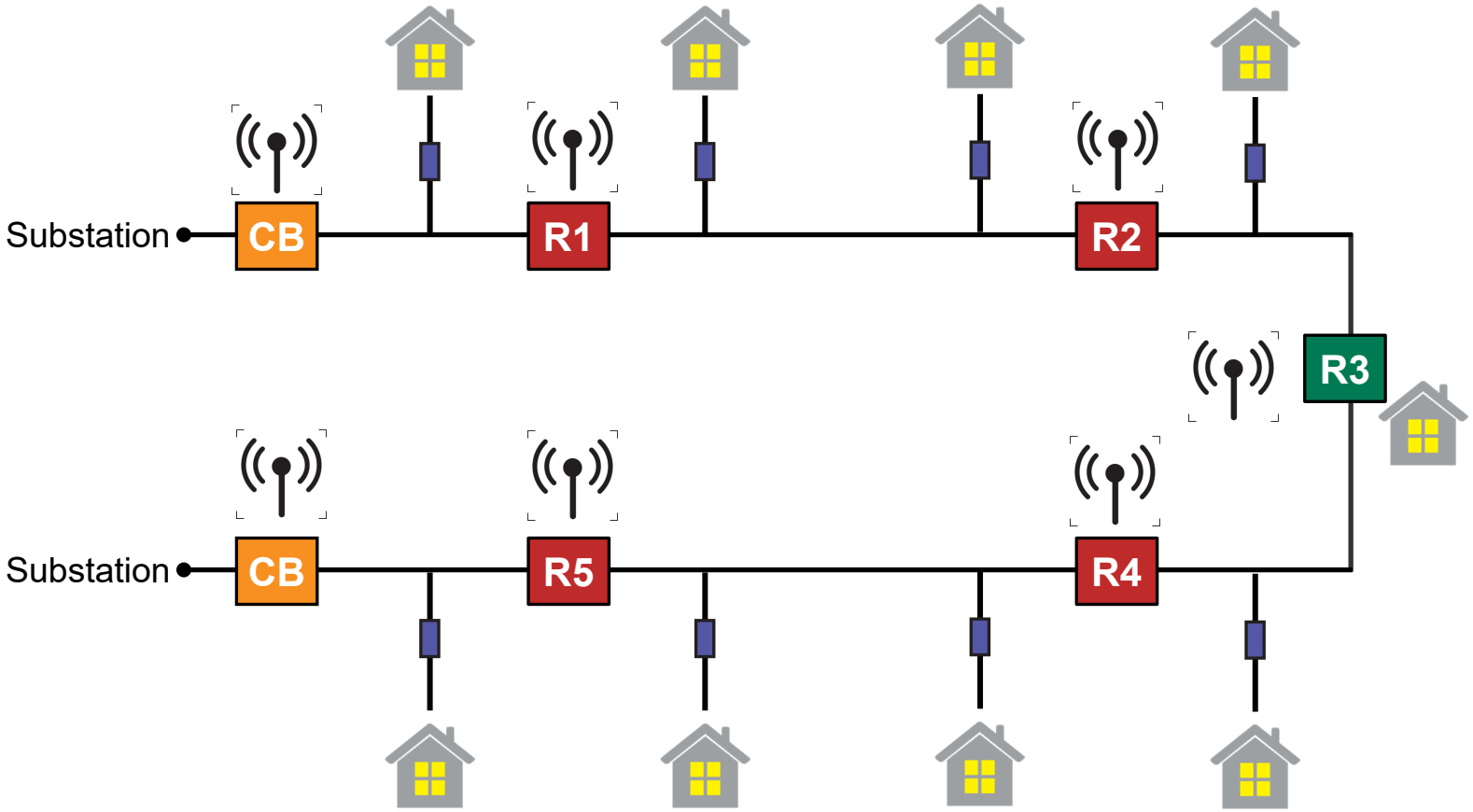
Solution: Loop Scheme



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

This subjects the other feeder to voltage sags

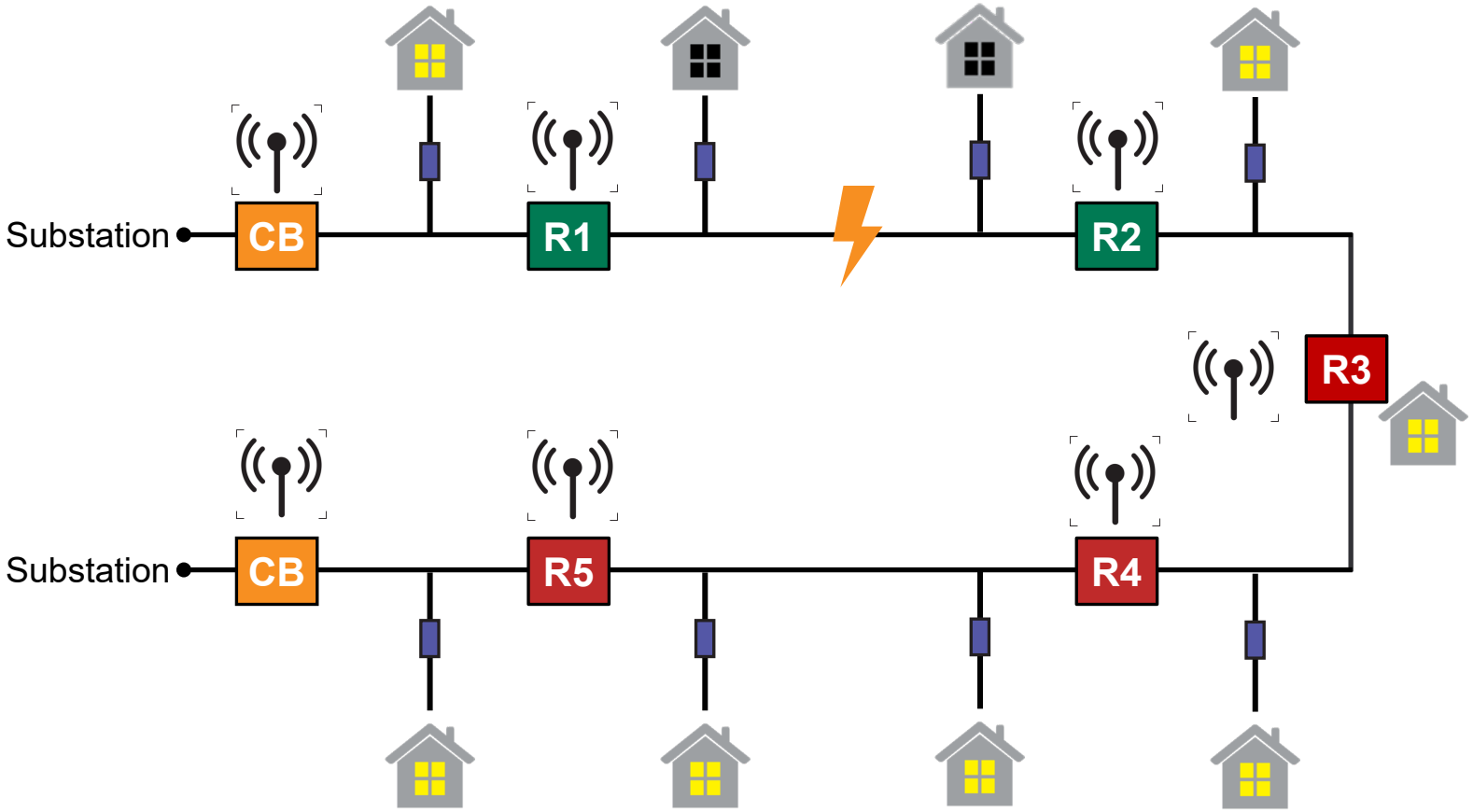
Solution: FLISR



How it Works:

Add communication devices to loop circuits.

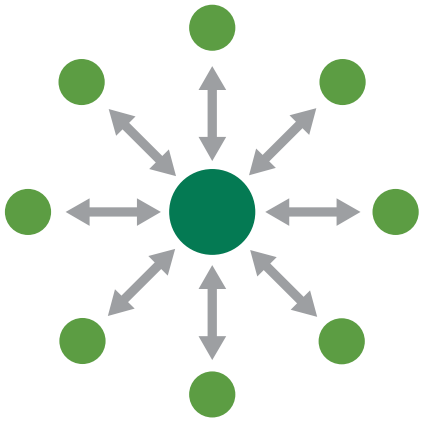
Solution: FLISR (Fault Location, Isolation, System Restoration)



Benefits:

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

Centralized

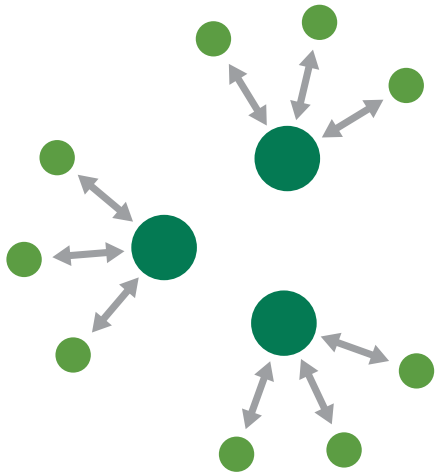


- Central location for automation logic
- Local problems are solved with a system-wide view
- Many contingencies to consider

Examples:

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

Regional

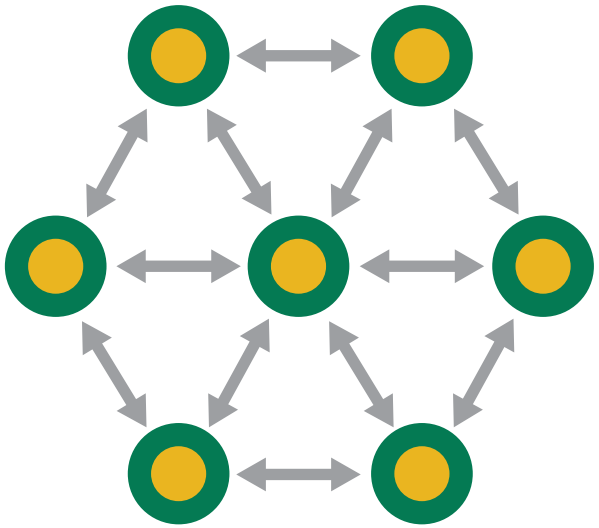


- Same as centralized system, but with local controller “nodes”
- Smaller
- Less complex
- Often custom programming is involved

Examples:

- SEL RTAC
- NovaTech Orion

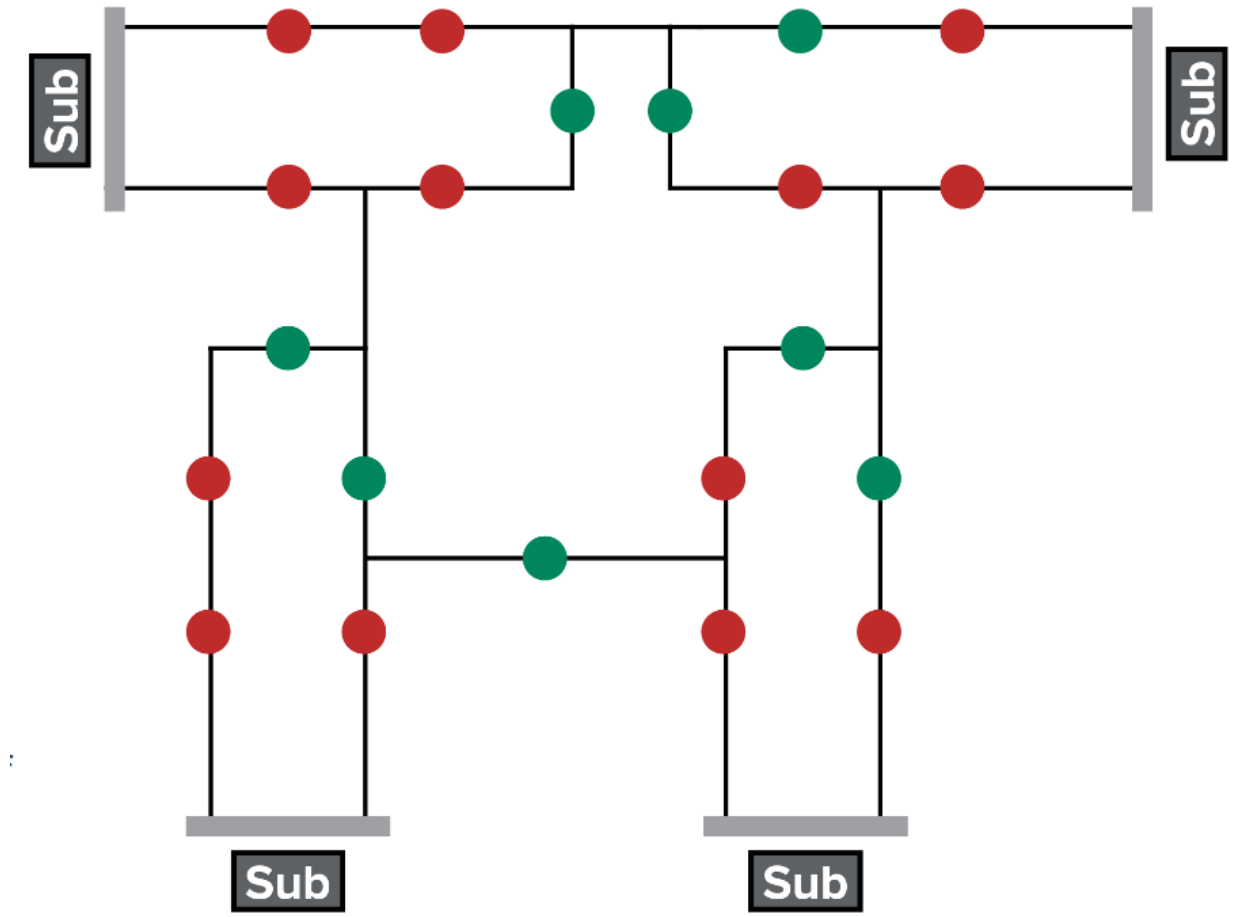
Peer-to-Peer



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

Examples:

- IntelliTeam® Automatic Restoration System



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

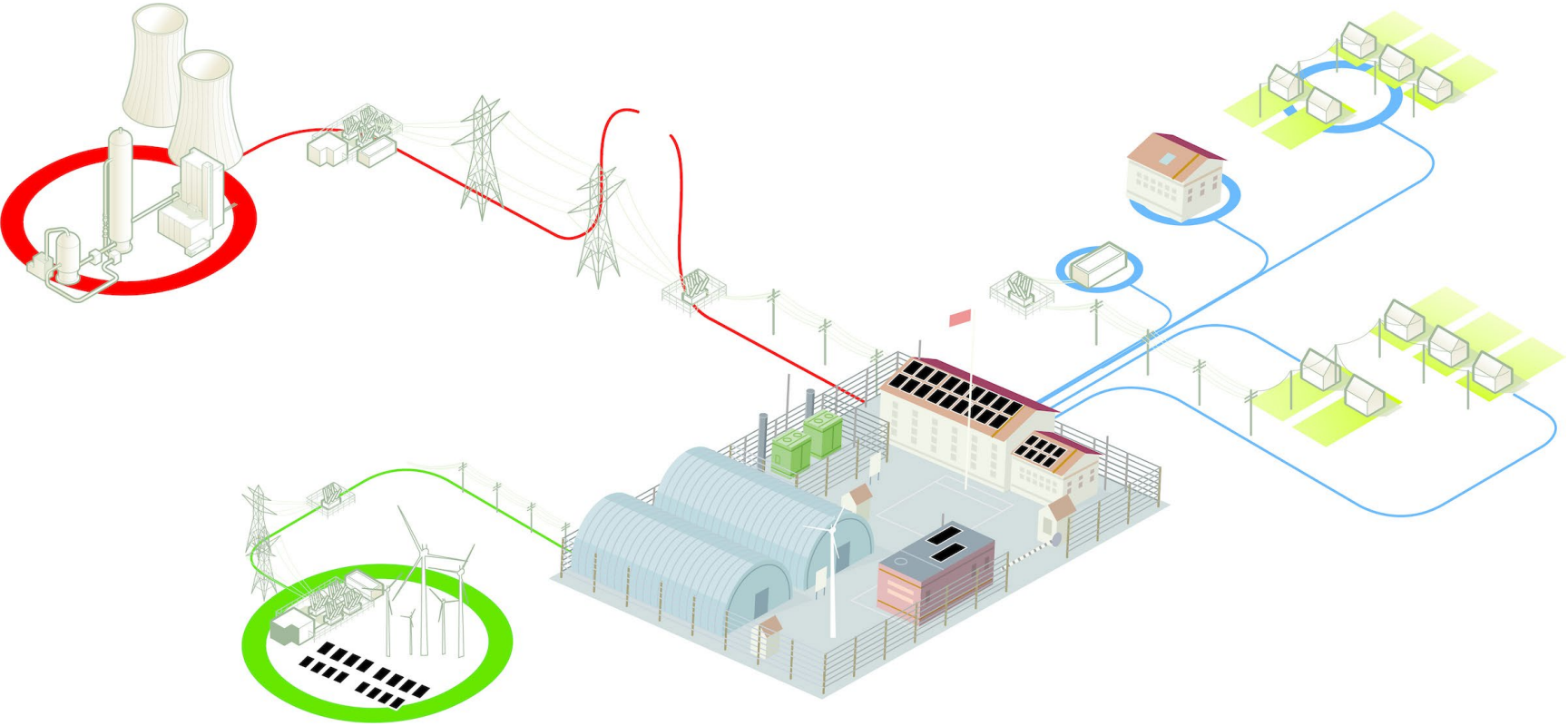
Were these ideas invented for distribution?

No – most of these ideas were taken from substation automation

Additional Challenges

Substation	Distribution
Communications: Contained	Communication: Large area, previously non-communicating
Right of Way: Real Estate	Right of way: Access to tie circuits/subs together may be challenging, or some cases impossible
Capacity: In-Design	Capacity: Mostly upgrading existing systems
Bi-Directionality: Uncommon	Bi-Directionality: Common

Feeder Automation | **Continuing Advancement**



Future

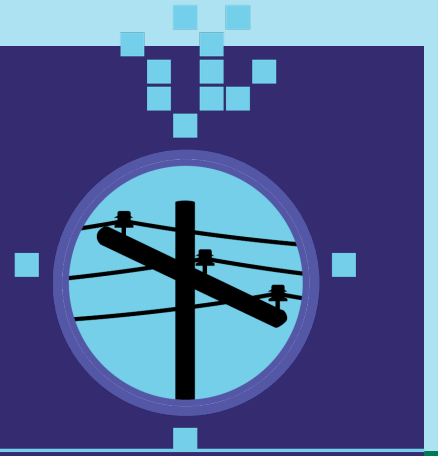
- DER Integration
- Microgrids
- Virtual Power Plants

Challenges

- Electrification
- DER Contribution
- Increased MED

Any Questions so Far?

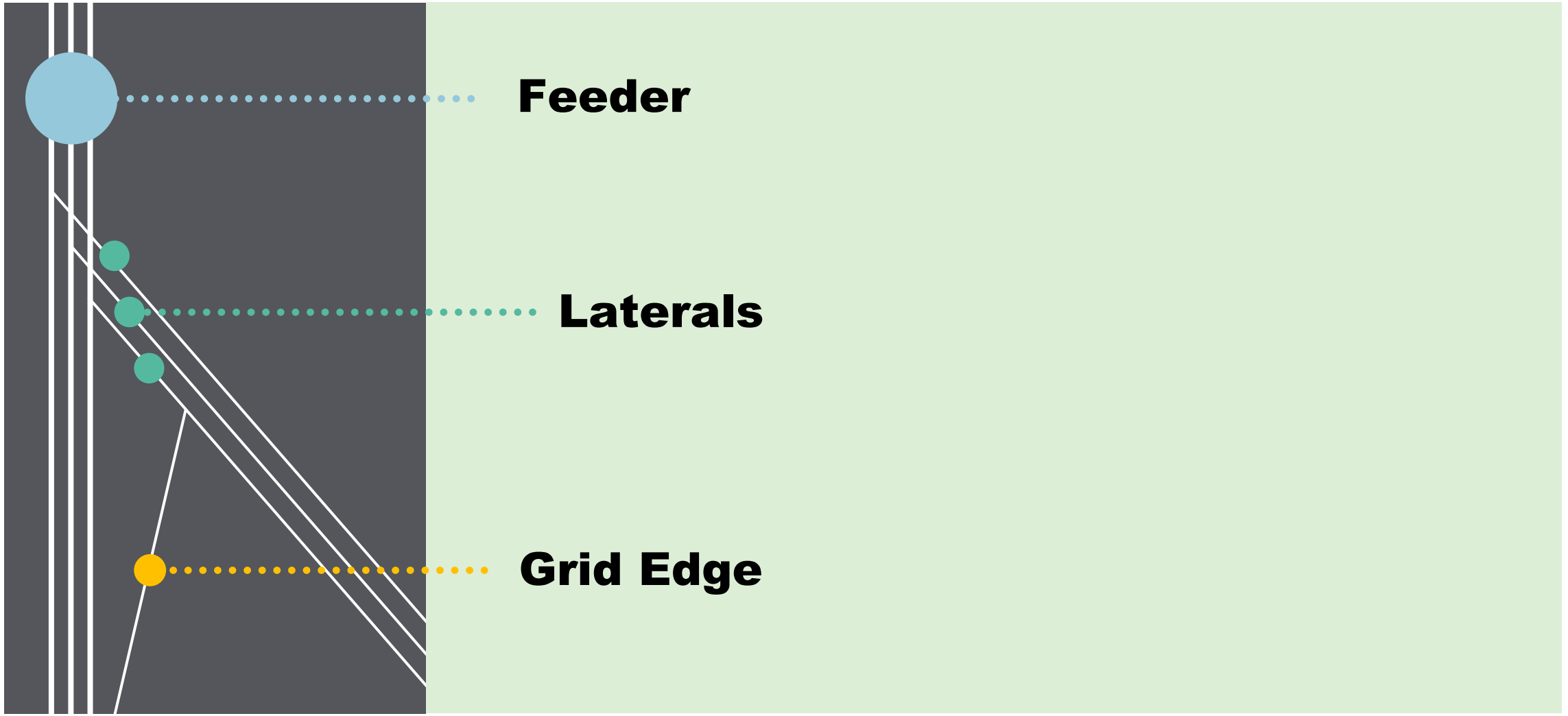
Feeder Automation



Lateral Automation

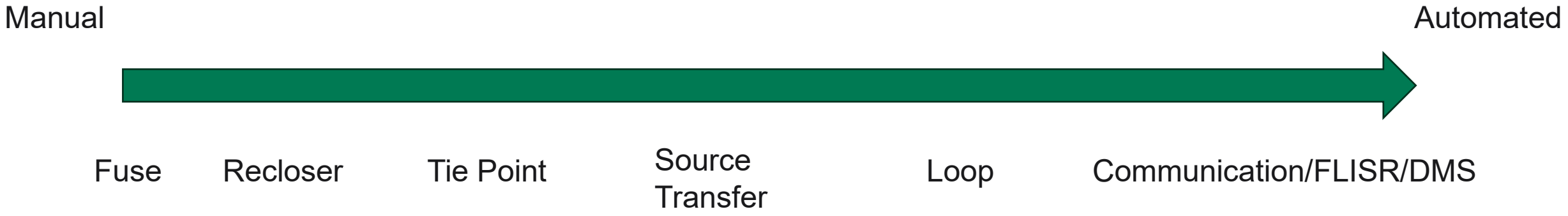
- Overhead
- Underground

Lateral Automation |

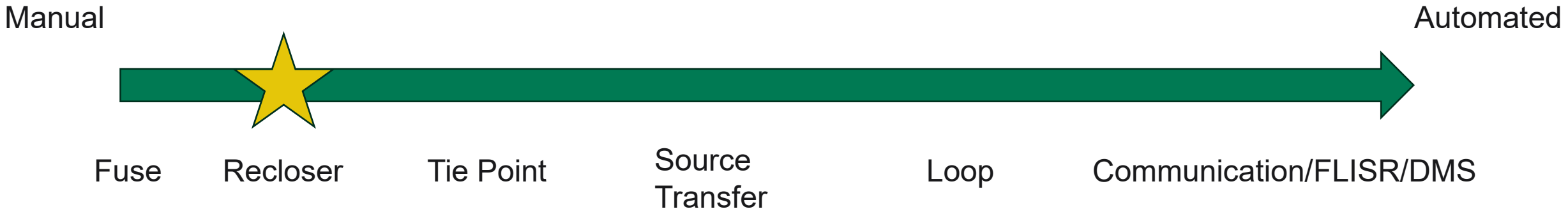


Lateral Automation | **Moving Target**

Feeders



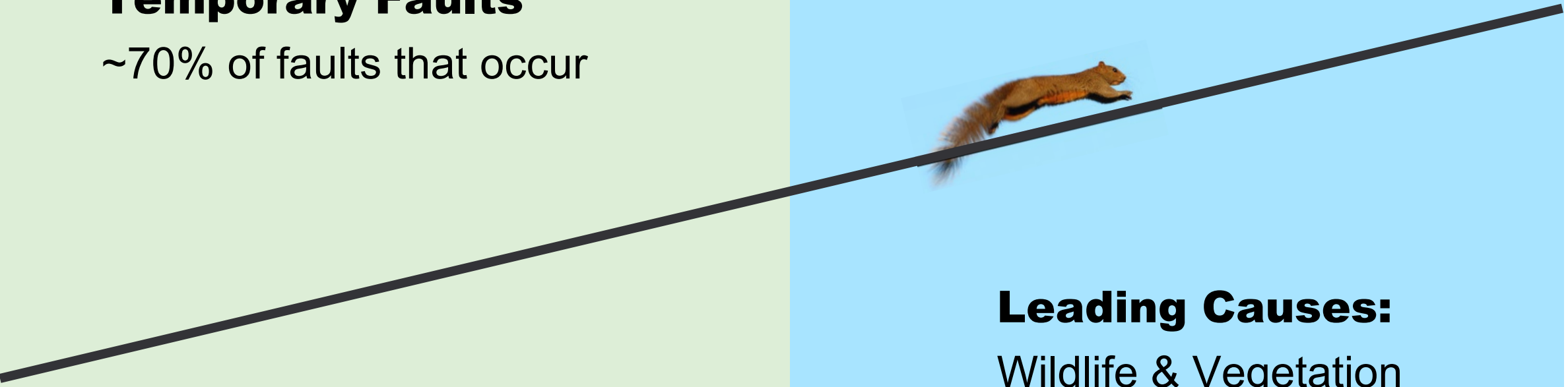
Laterals



Lateral Automation | **Overhead**

Temporary Faults

~70% of faults that occur

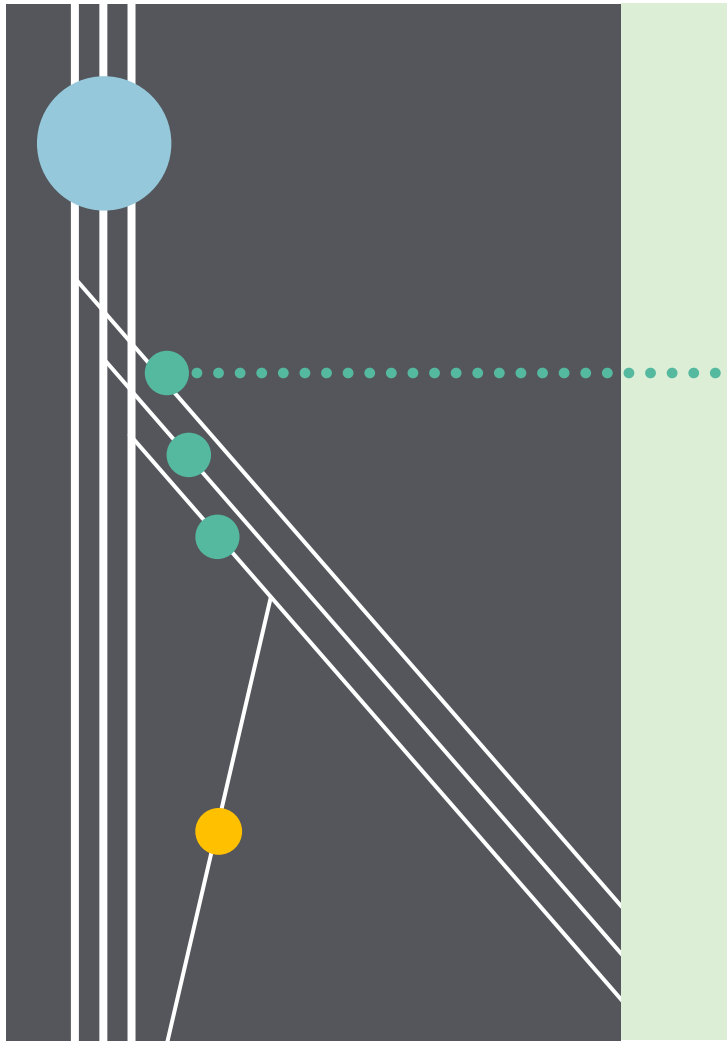


Leading Causes:

Wildlife & Vegetation

Fault Locations

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



Overhead Laterals

- Large benefits from reclosing
- Large benefits from FLISR

Alabama Power

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

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

Alabama Power

(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.

RESULTS

12 Month Avg Before:

2.297

12 Month Avg After:

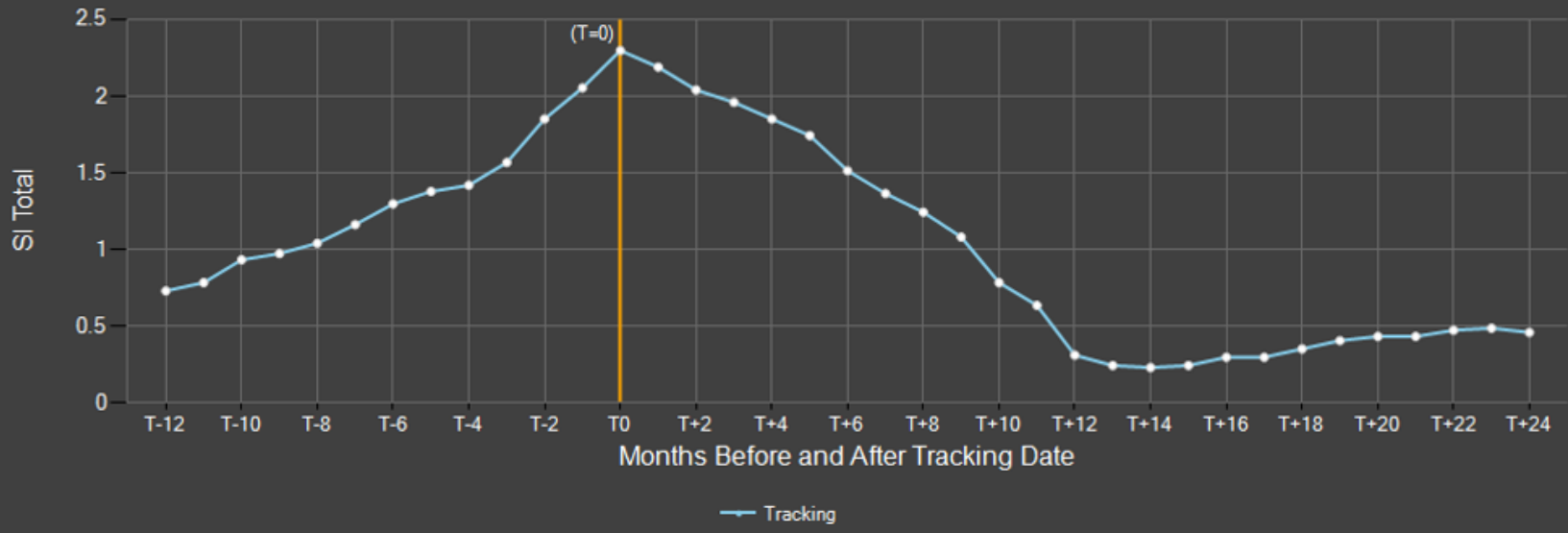
.311

Net (+/-):

1.986

Net %:

86.47%



Alabama Power

(SI) – Monthly Total

After installation, customers went from a monthly average of **0.2** interruptions per month to **0.03** interruptions per month.

Customers went from a sustained outage every 157 days to a sustained outage every 1,086 days, representing an 86% improvement.

RESULTS

12 Month Avg Before:

.194

12 Month Avg After:

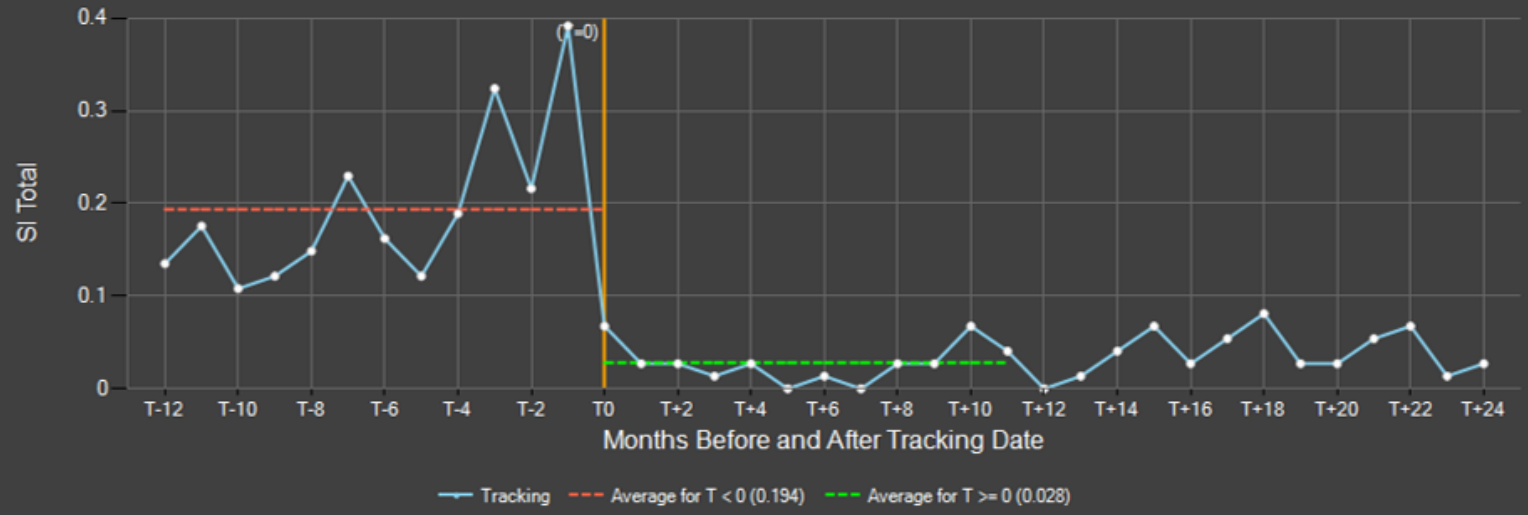
.028

Net (+/-):

0.166

Net %:

85.57%



Alabama Power

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**

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

Alabama Power

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)**.

RESULTS

12 Month Avg Before:

54.757

12 Month Avg After:

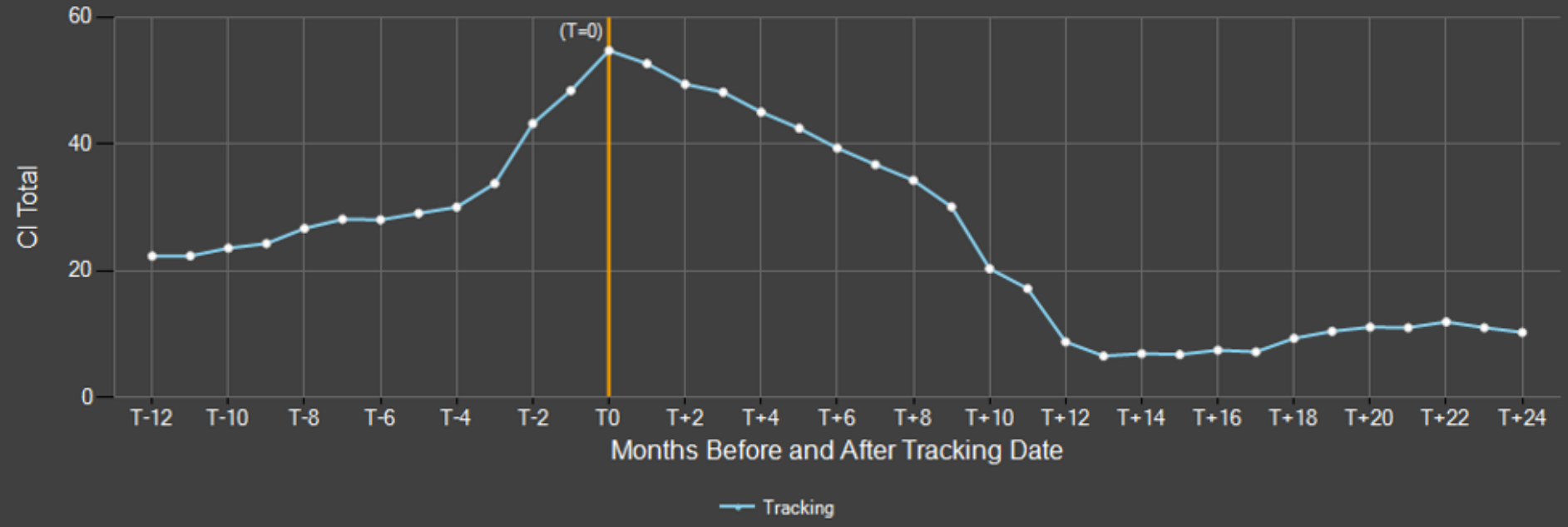
8.77

Net (+/-):

45.986

Net %:

83.98%



Alabama Power

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)**.

RESULTS

12 Month Avg Before:

7143.716

12 Month Avg After:

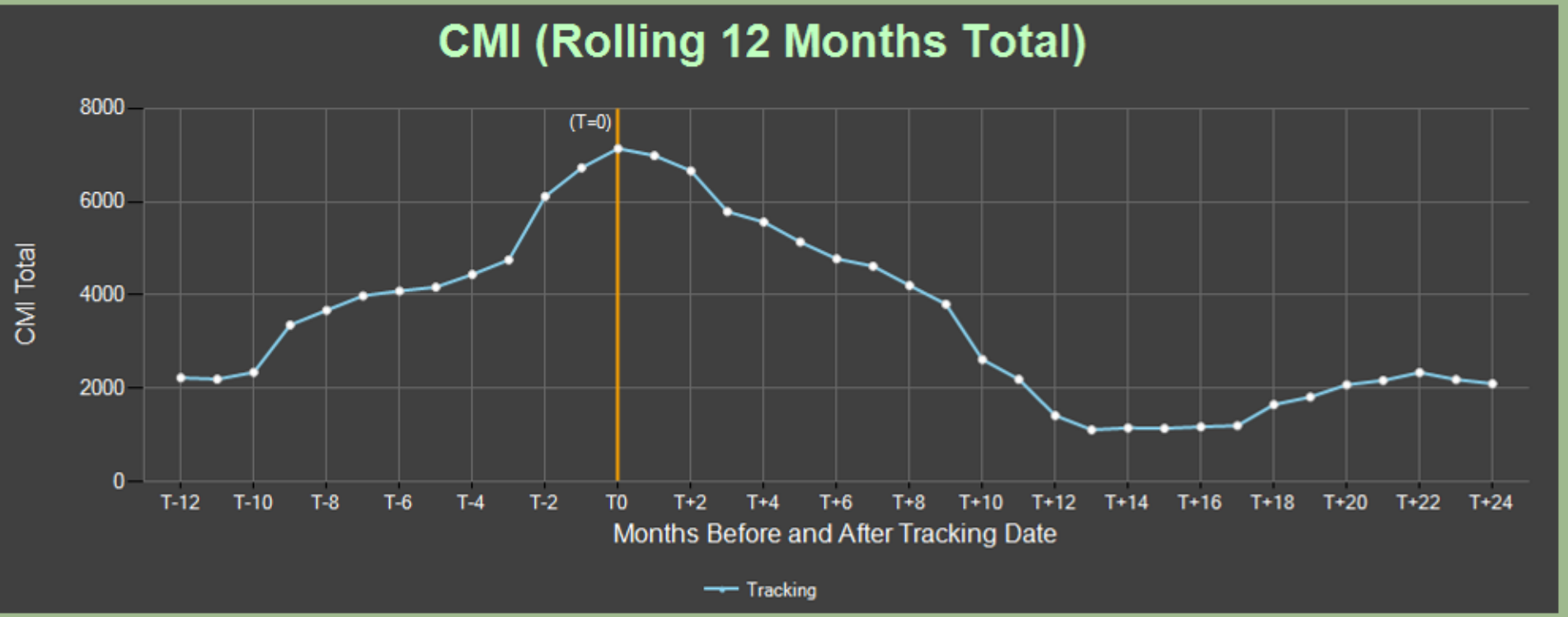
1421.135

Net (+/-):

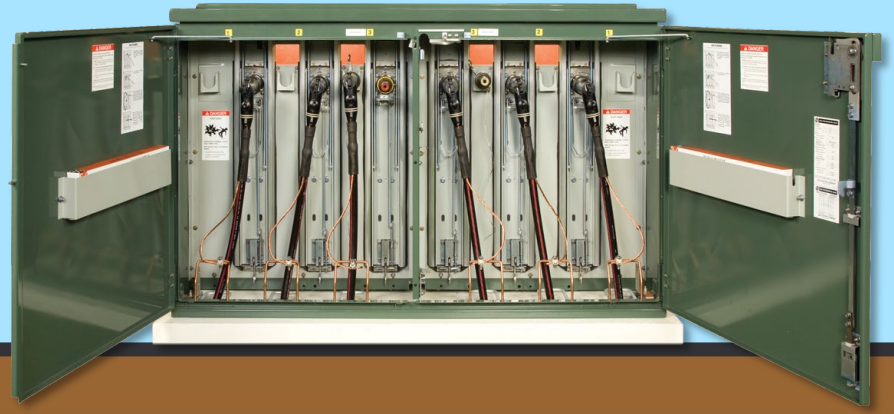
5722.581

Net %:

80.11%



Lateral Automation | **Underground**



Temporary Faults

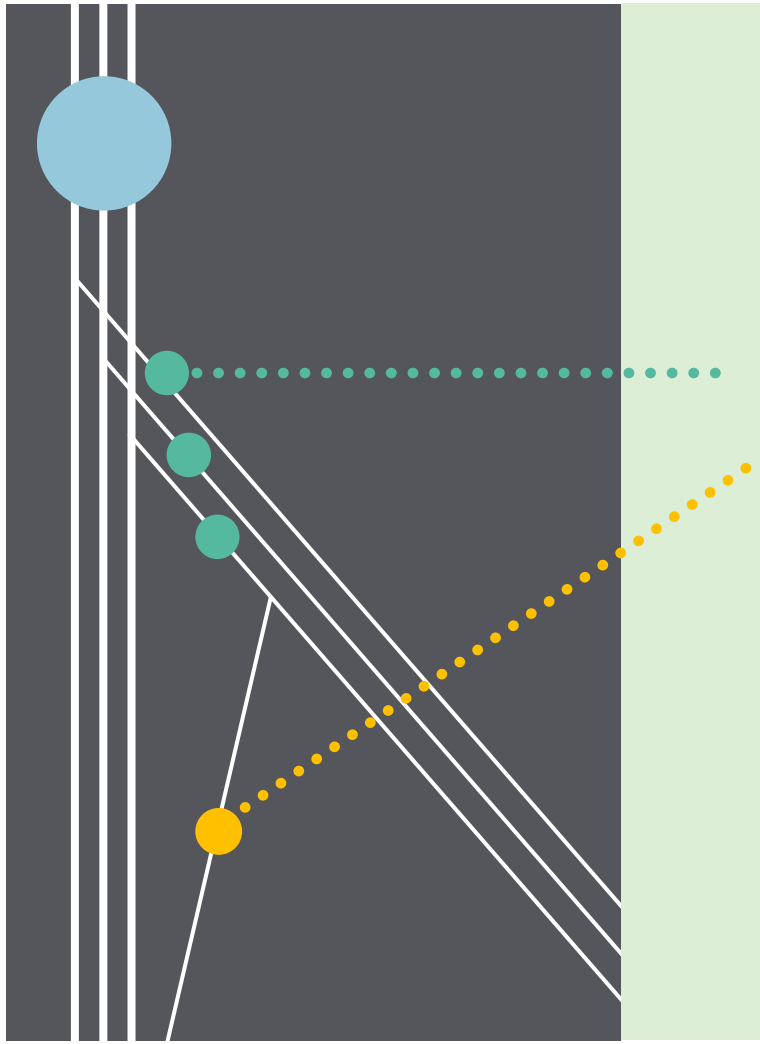
<10% of faults that occur

Leading Causes:

Wildlife

Aging Equipment

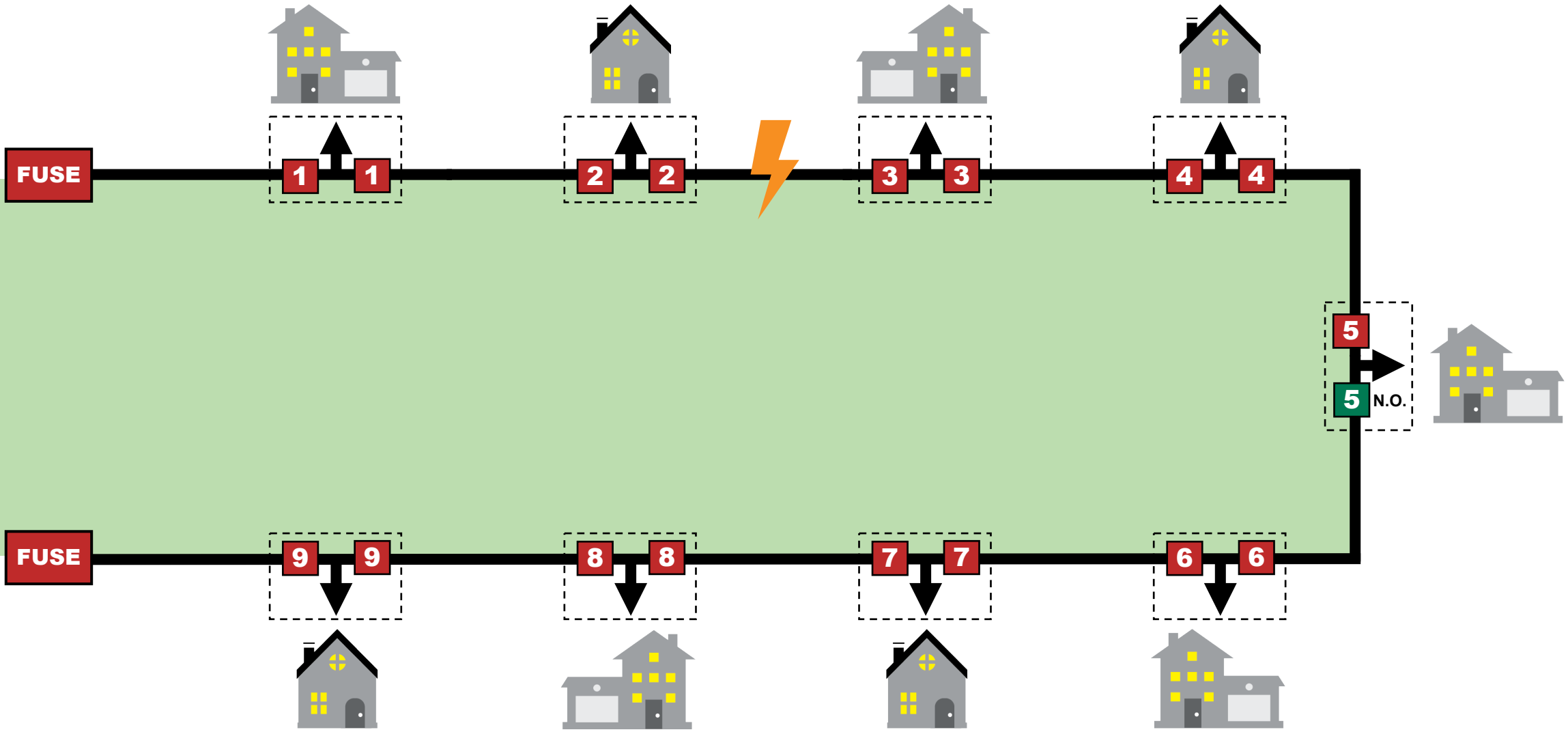
Lightning



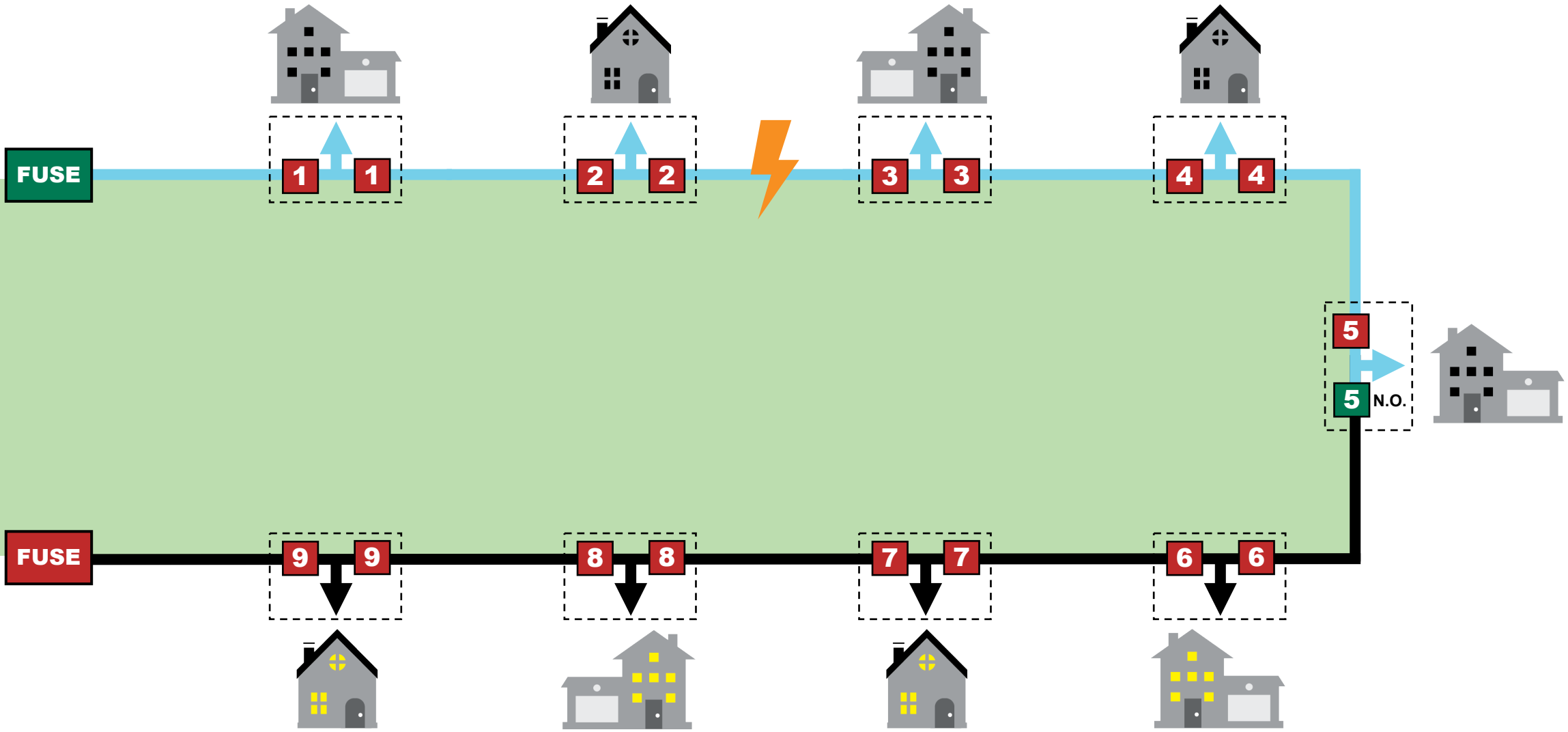
Underground Laterals

- Low benefit from reclosing
- Large benefits from FLISR

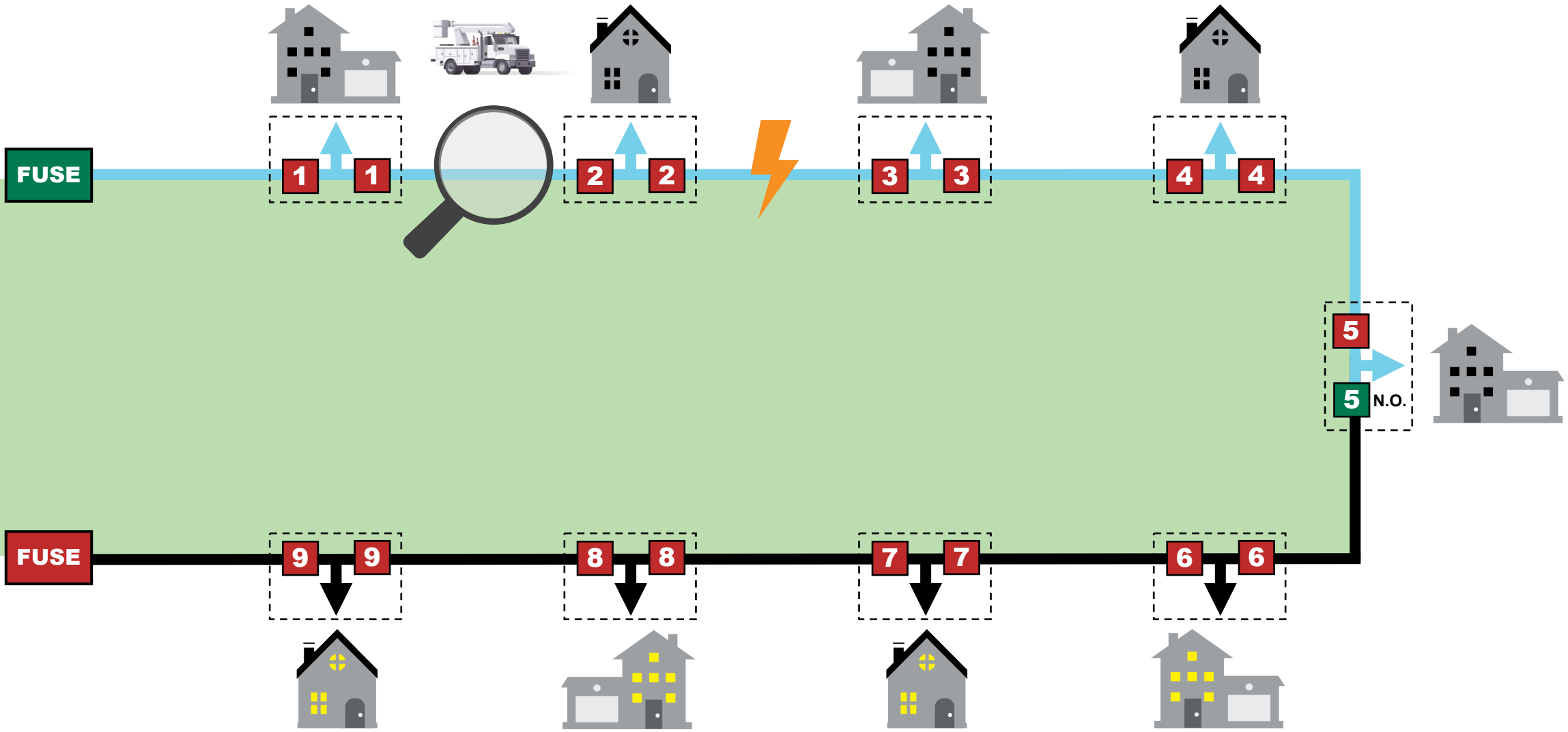
Protection Challenges | Locating Underground Faults



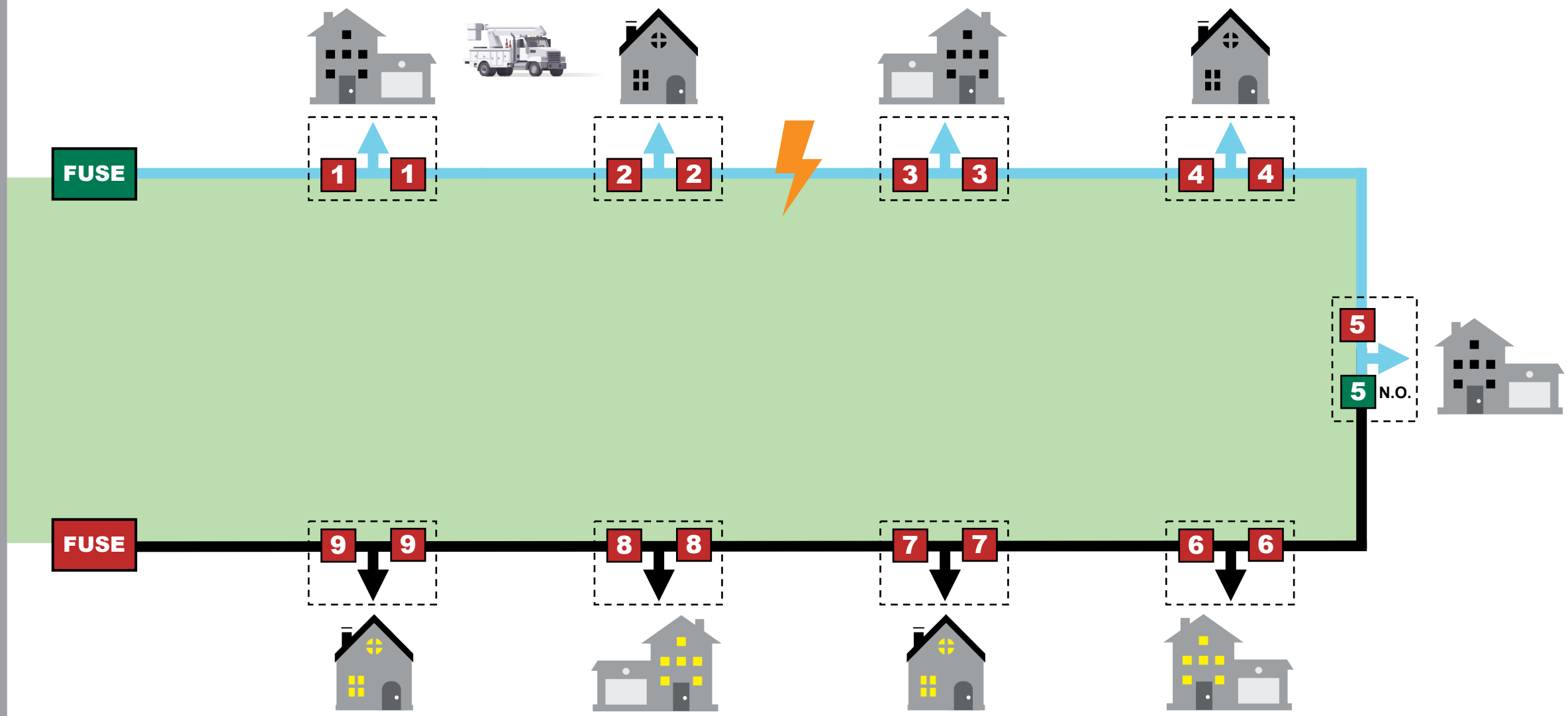
Protection Challenges | Locating Underground Faults



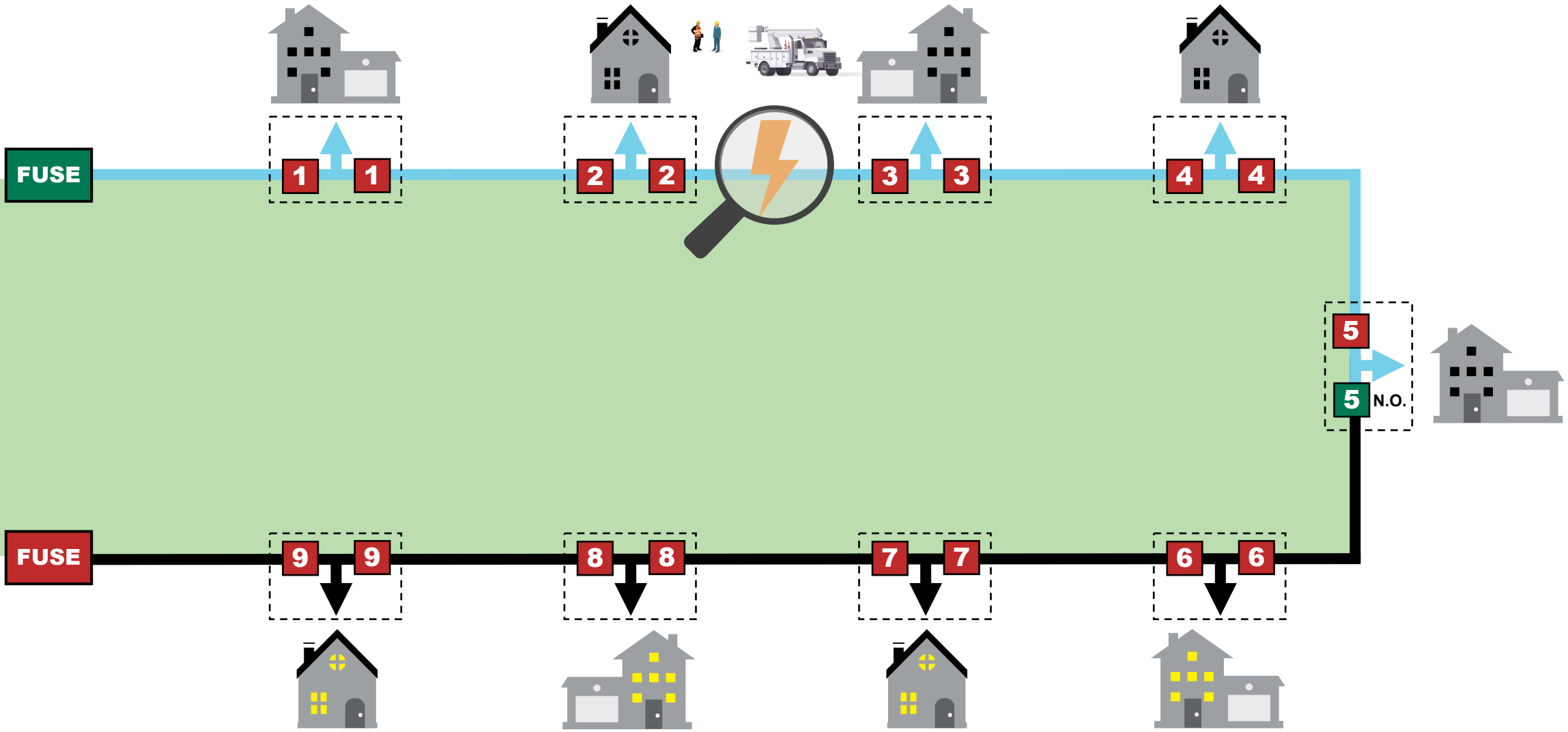
Protection Challenges | Locating Underground Faults



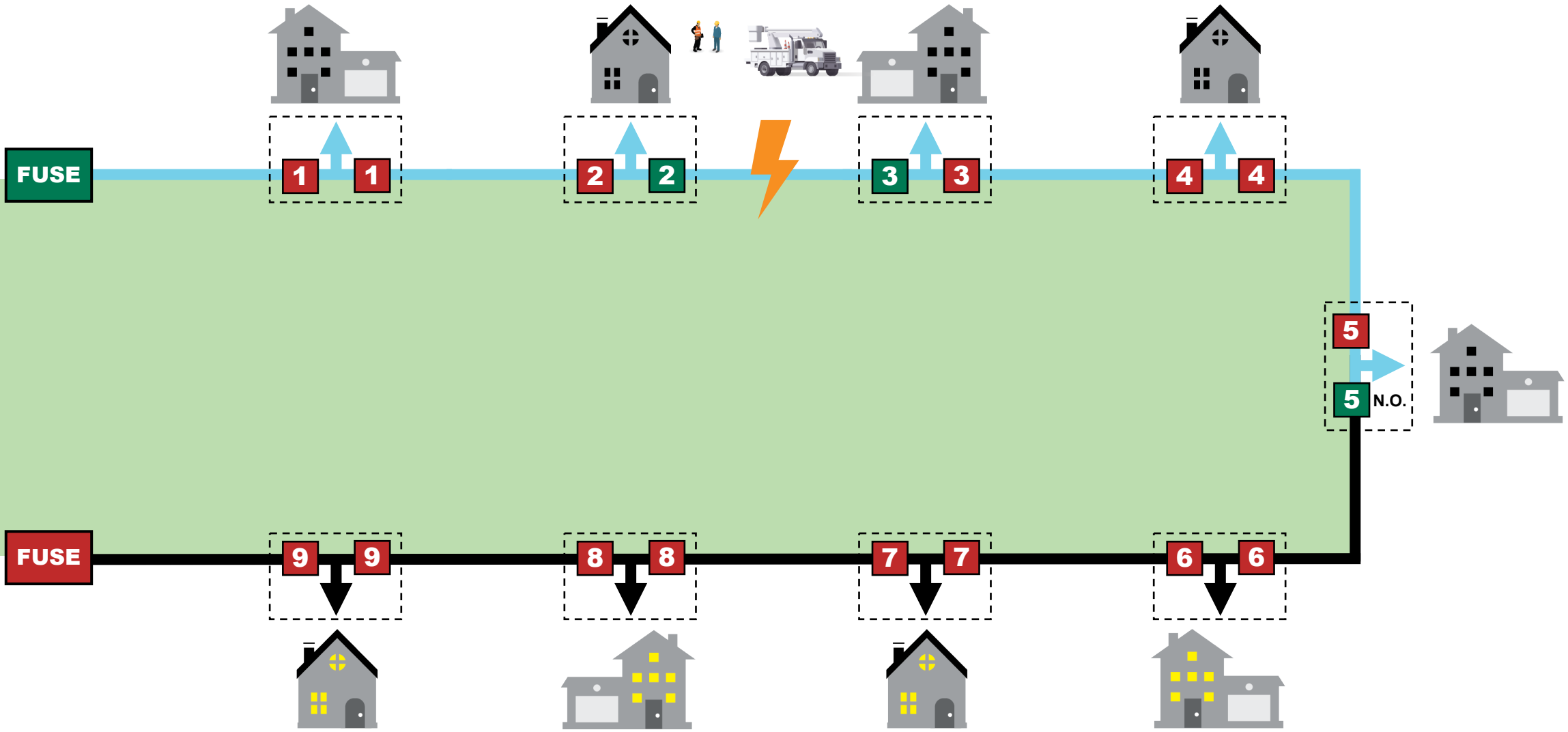
Protection Challenges | Locating Underground Faults



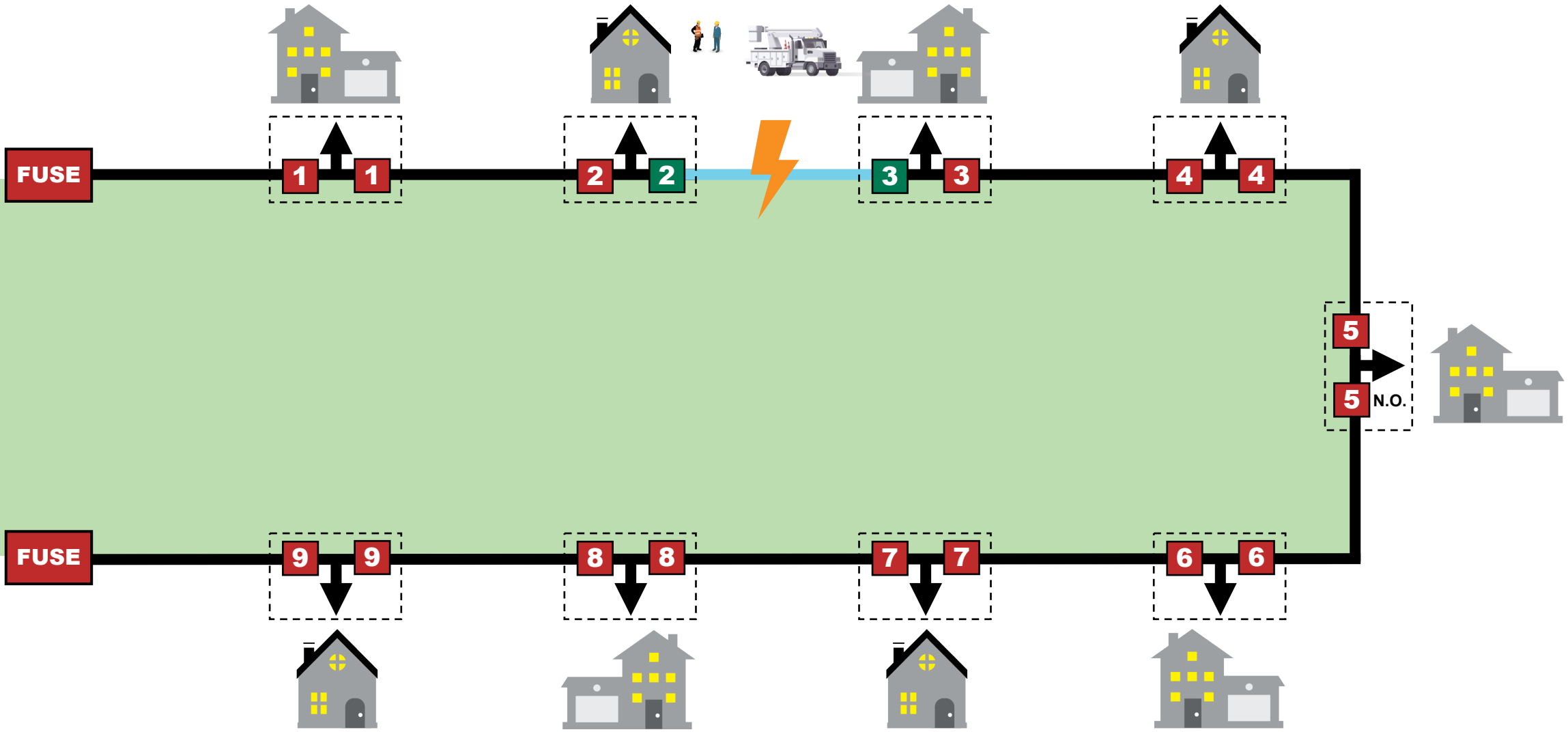
Protection Challenges | Locating Underground Faults



Protection Challenges | Locating Underground Faults



Protection Challenges | Locating Underground Faults

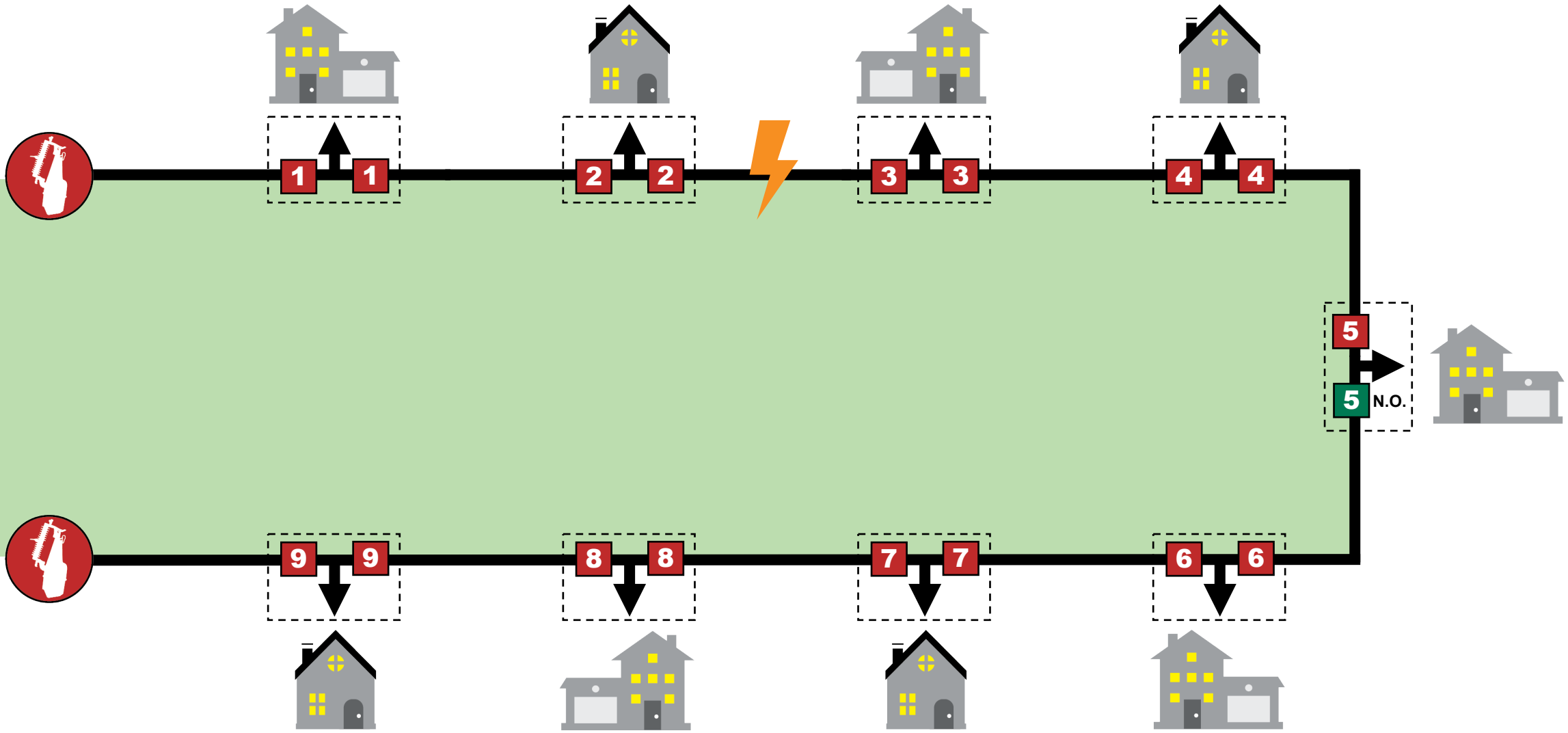


Underground Residential | **Adding Automation**

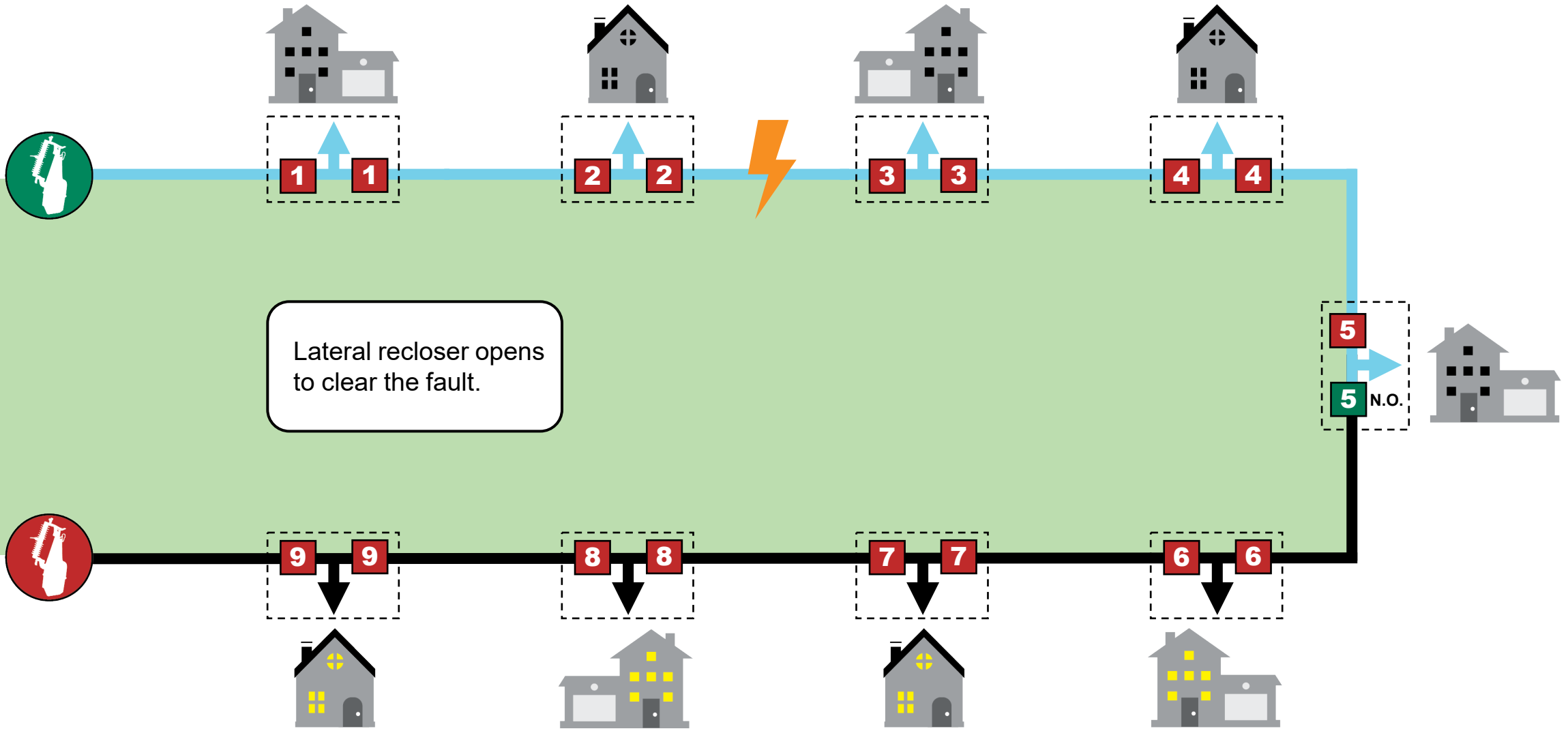
1. **Add** automation devices to the Transformers

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

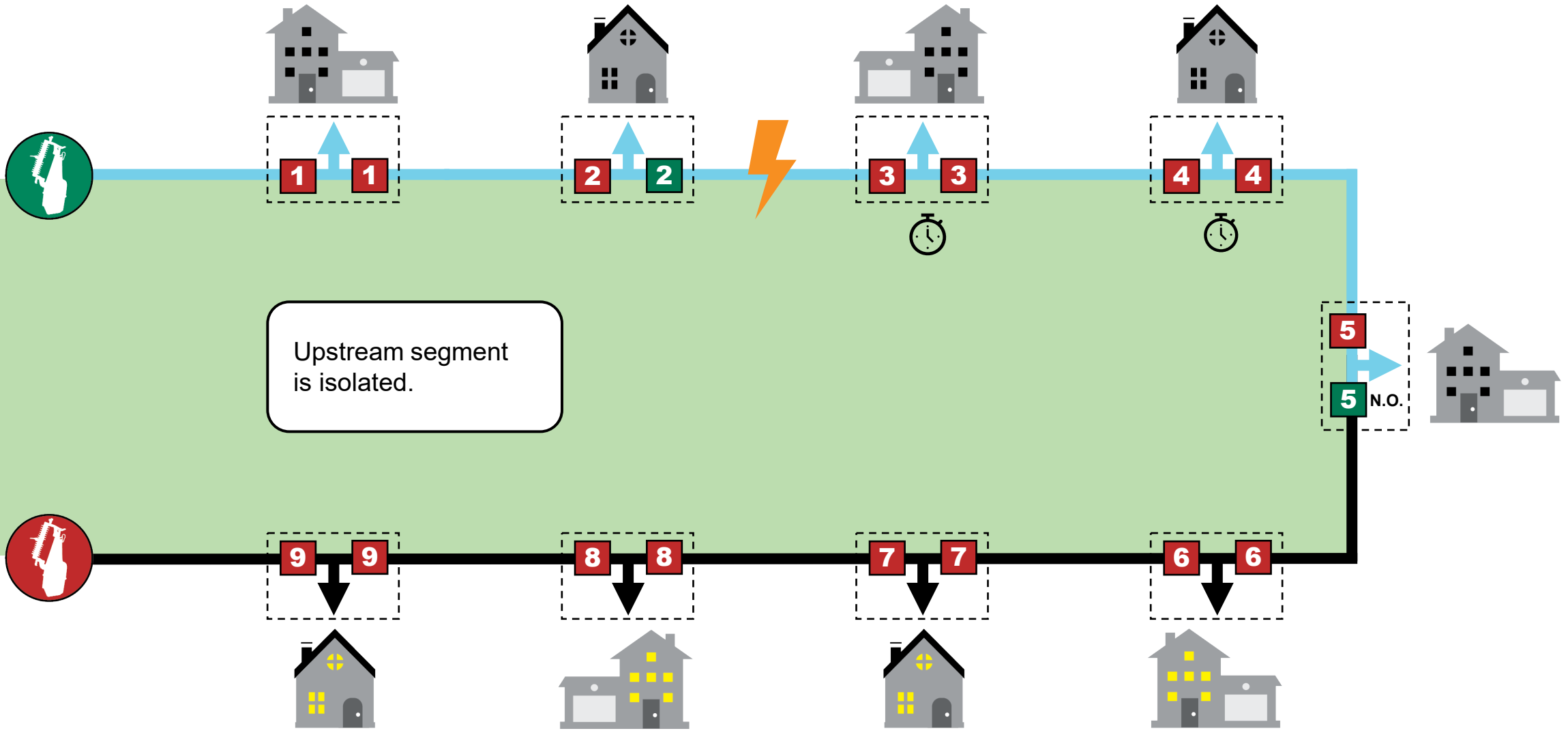
Underground Residential | Automatic Fault Location



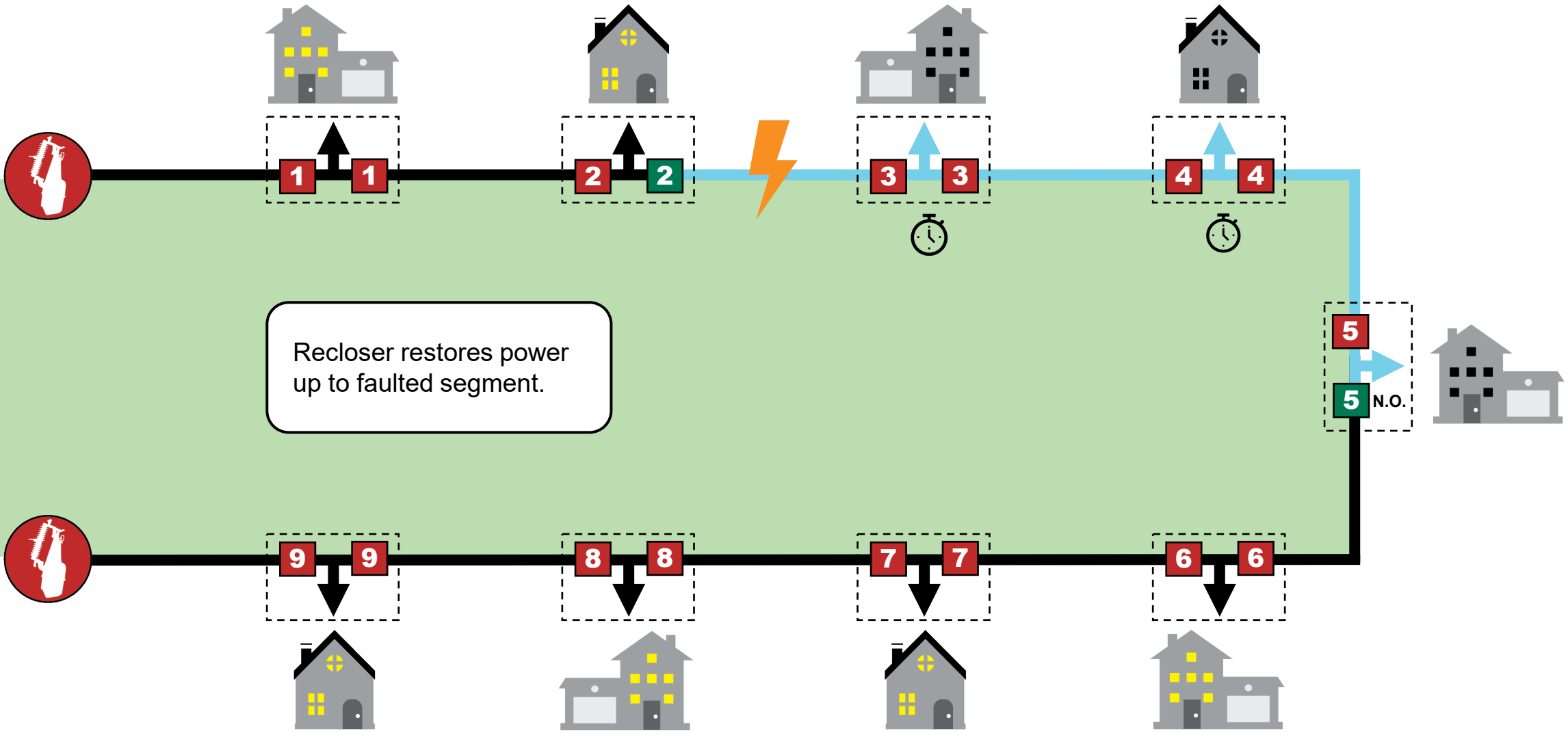
Underground Residential | Automatic Fault Location



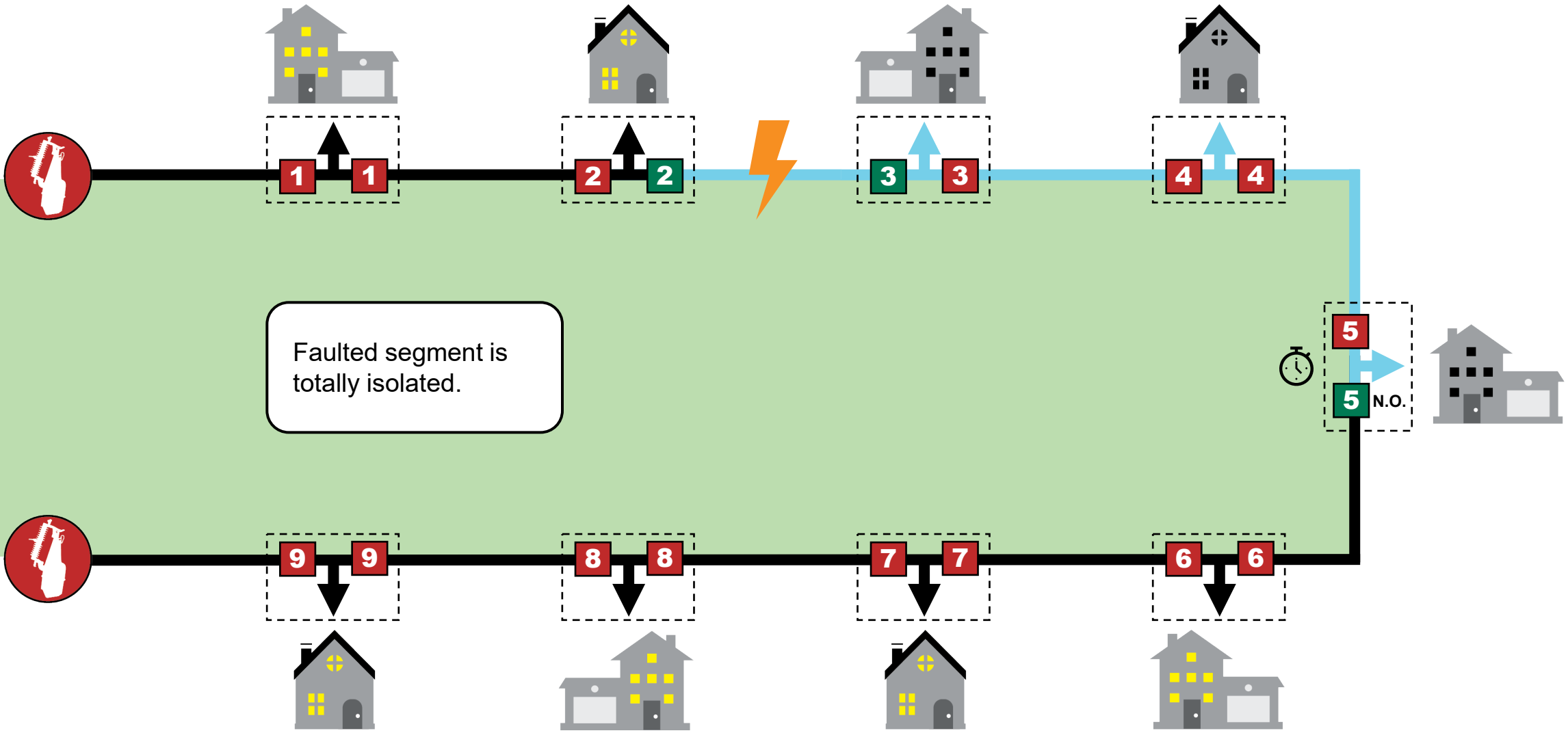
Underground Residential | Automatic Fault Location



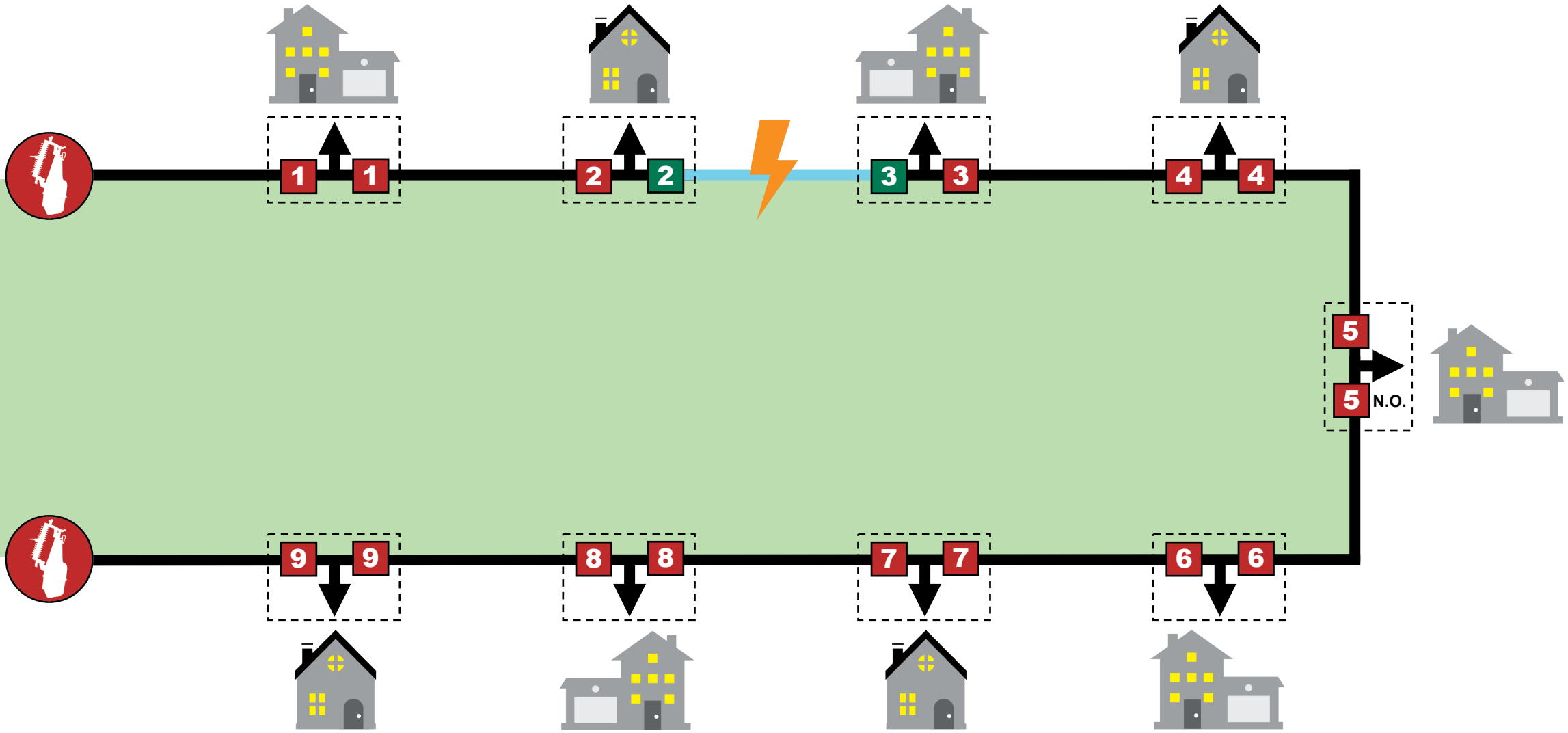
Underground Residential | Automatic Fault Location



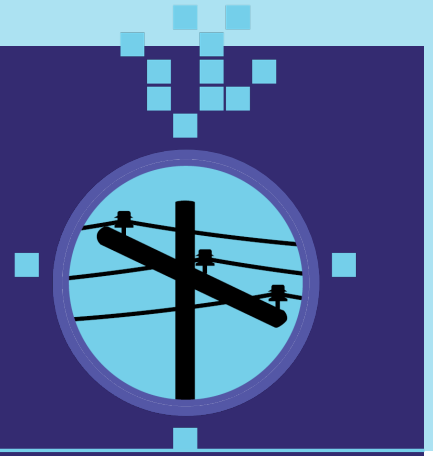
Underground Residential | Automatic Fault Location



Underground Residential | Automatic Fault Location



Feeder Automation



Lateral Automation

- Overhead
- Underground

Lateral Automation | **Challenges**

- **Communications**
- **Right of Way**
- **Capacity**
- **Bi-Directionality**

Lateral Automation | **Key Points & Takeaways**

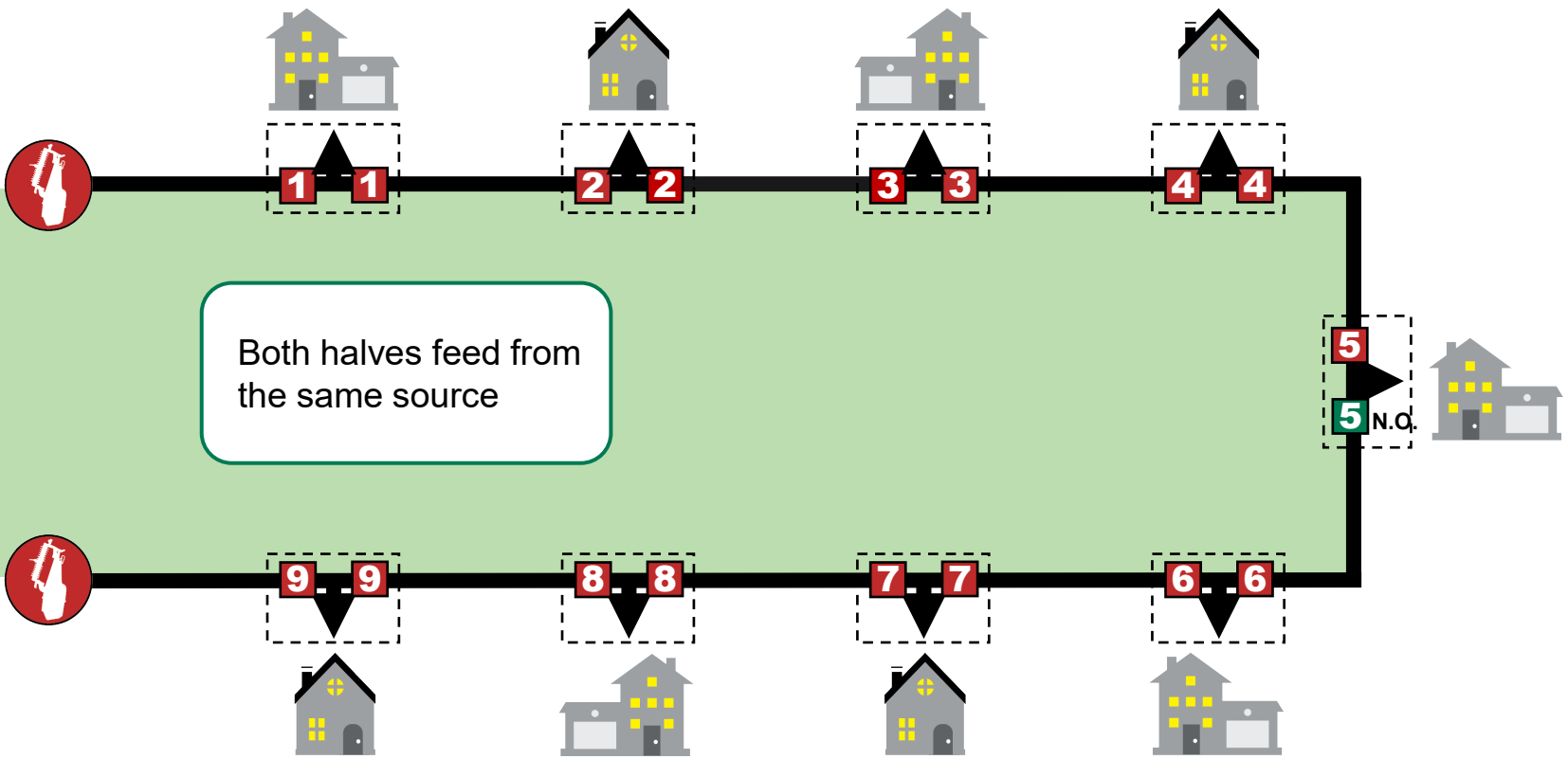
Key Points

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

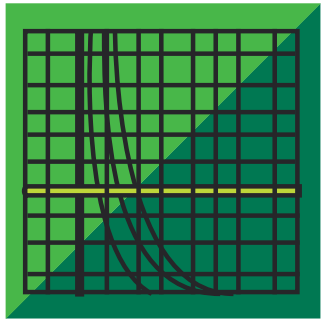
- 80% of URD outages are Loss of Voltage
- Not independent sources

Result: No reliability benefits 4 out of 5 events

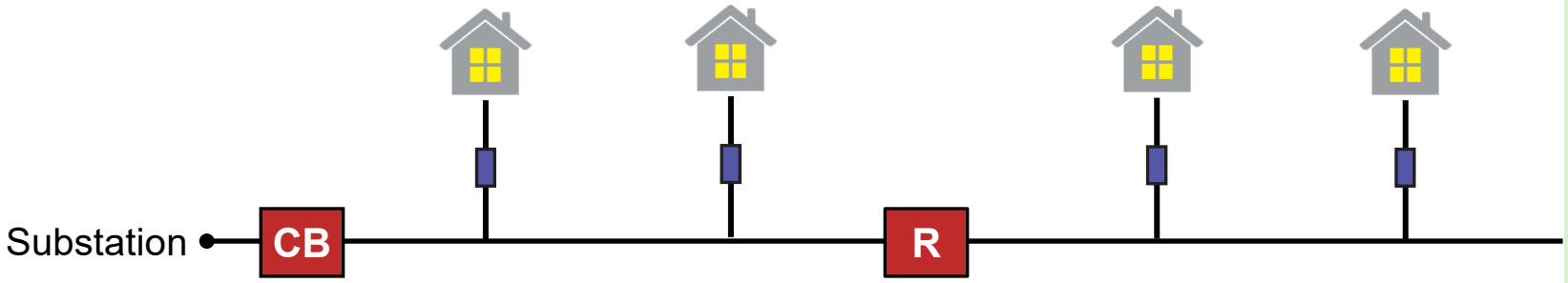
Agenda

History

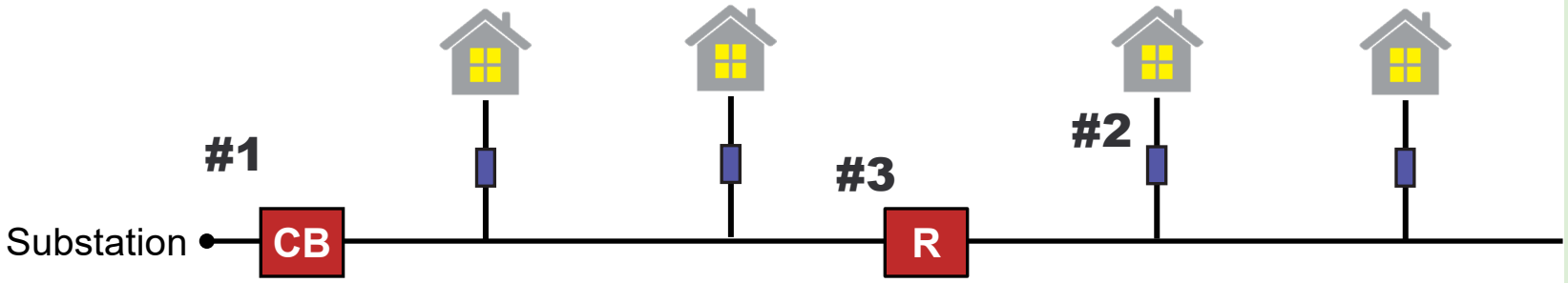
Lateral Advancement



Protection



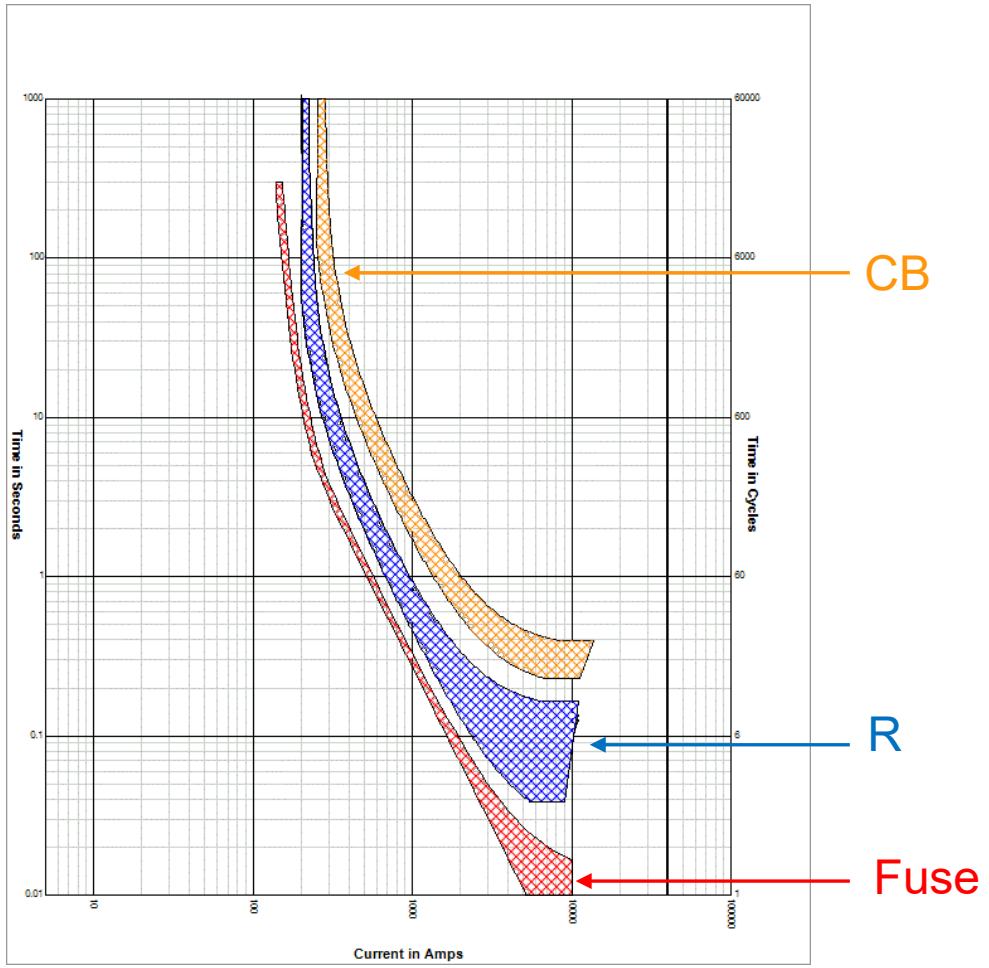
Coordinated Devices: More devices means less impact from an outage



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

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

#3. Add reclosers as applicable



Current Tolerances:

CB & R: -5% to +15%

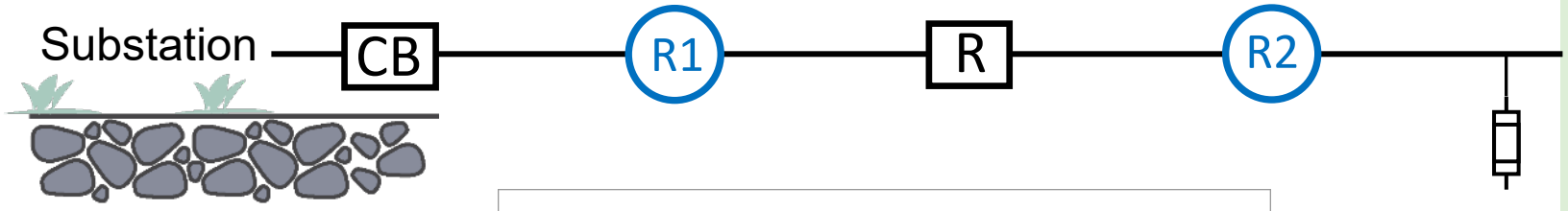
Fuses: +/- 10%-20%

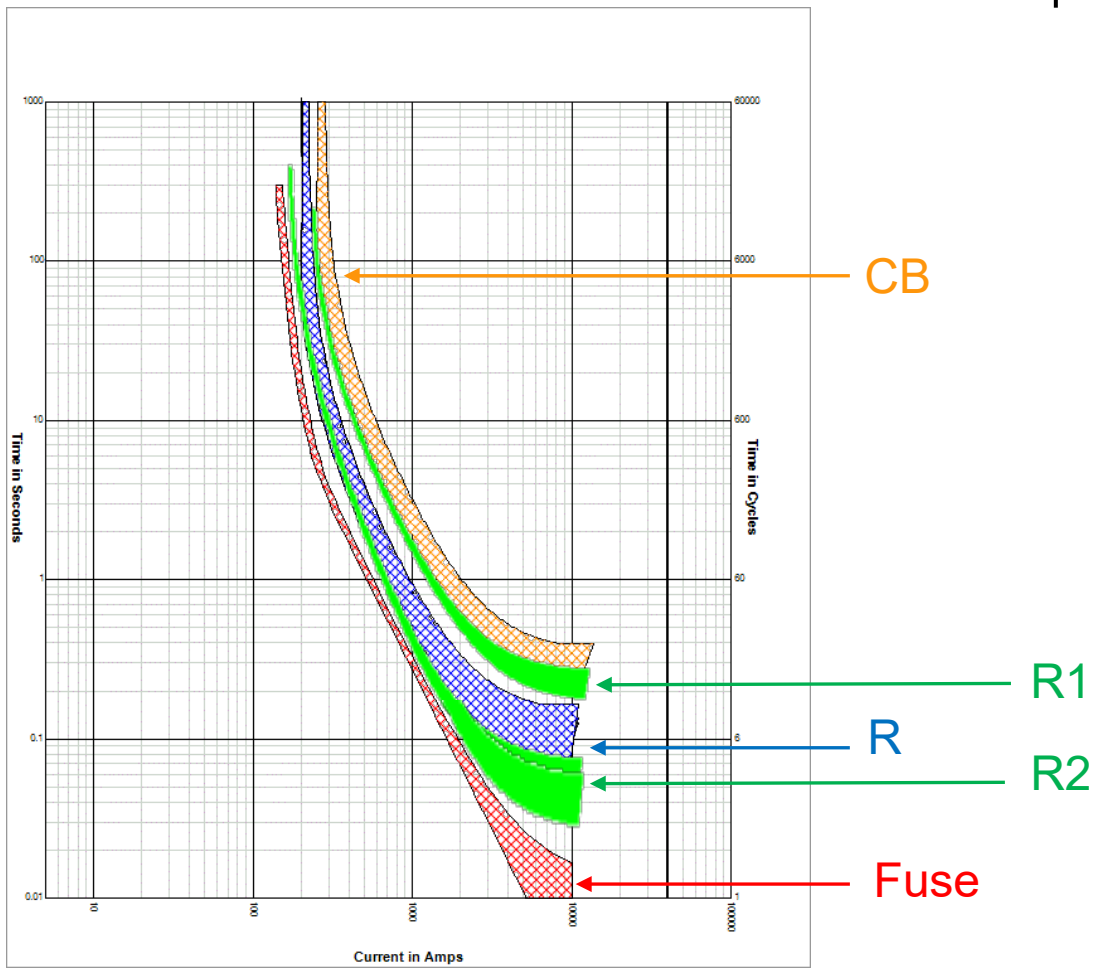
Timing Tolerances:

IEEE 242-2001

CB & R: +/- 5%

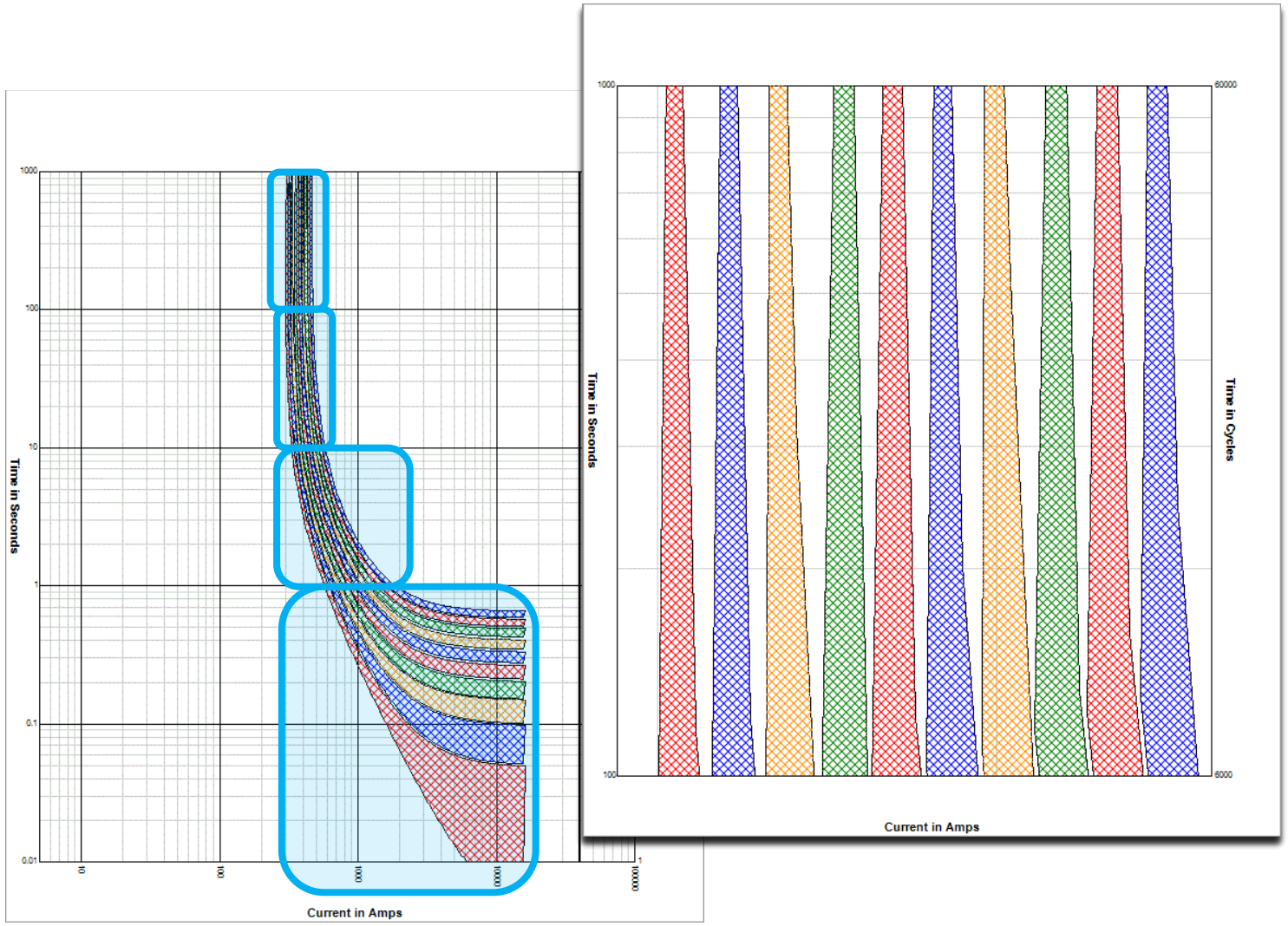
Feeder Protection | **TCC Curves**





TCC Curves don't allow for further coordinated protection devices

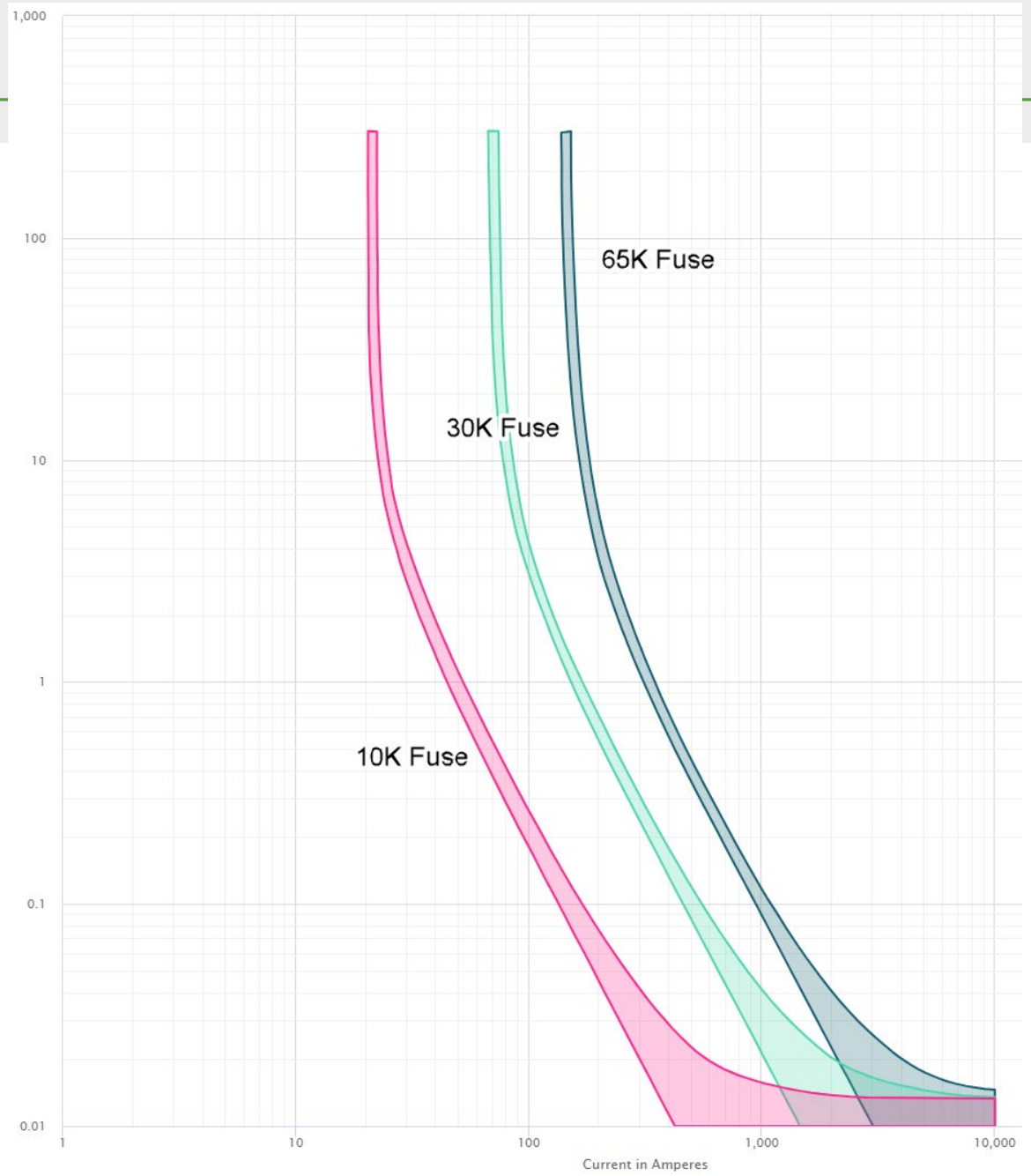
Feeder Protection | **TCC Curves**



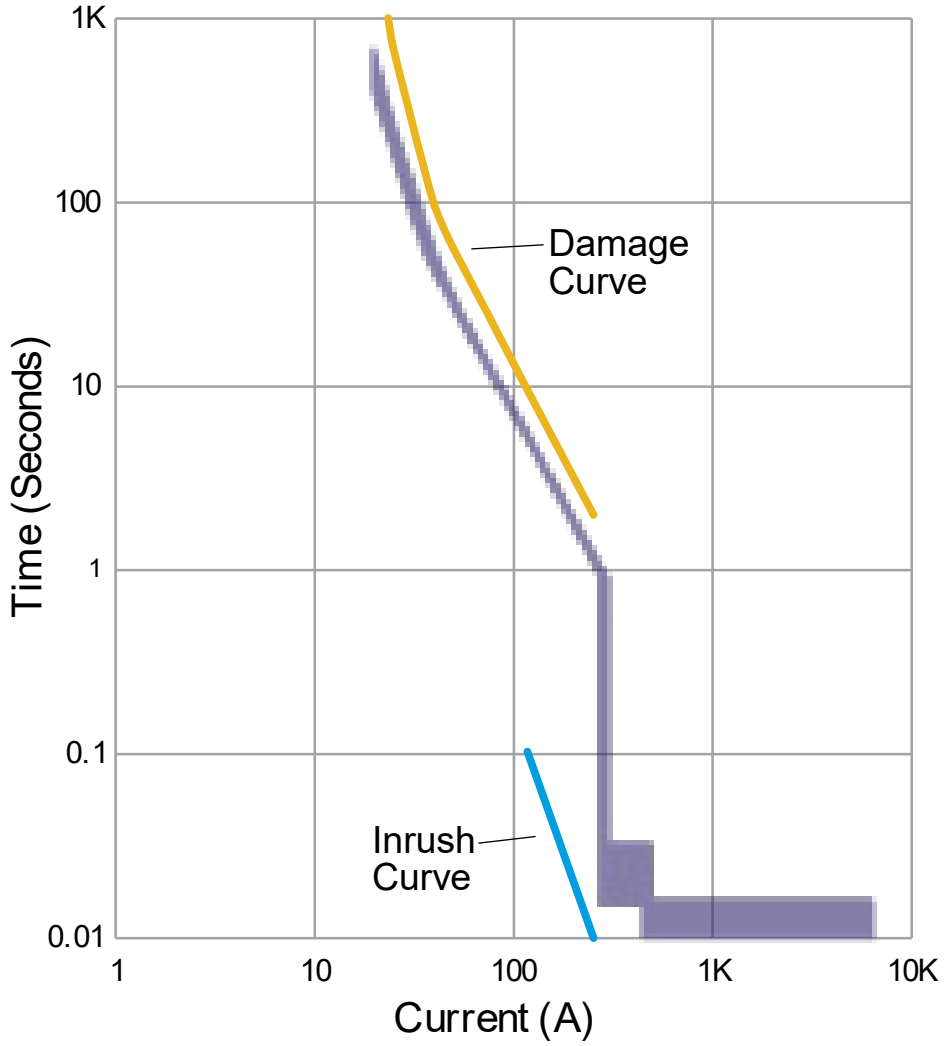
2% Tolerance would put 10 devices in the original TCC plot area.

Lateral Protection | **New Options**

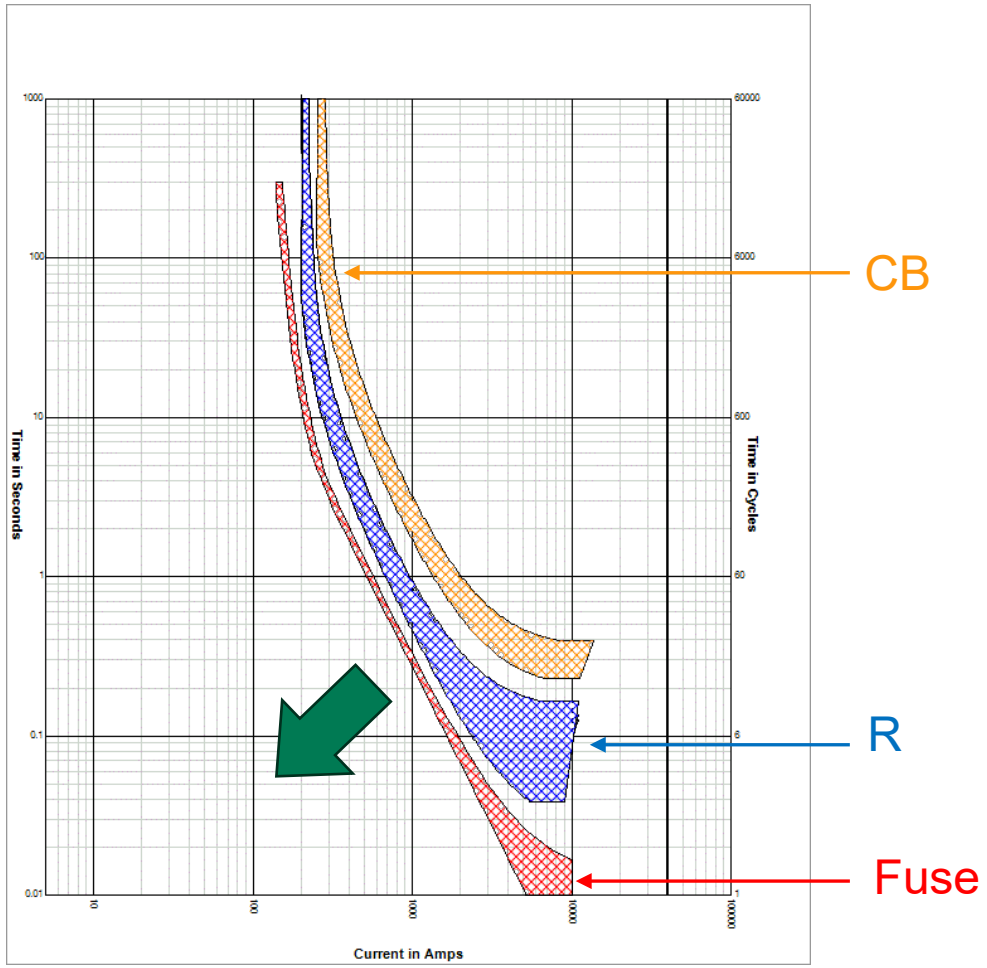
Lateral Protection | **Fuse Space**



Lateral Protection | **New Options – New Protection Options**



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



Replacing Fuses with Microprocessor Devices Increases Space

Any final questions?