Improving Reliability on Mixed Overhead and Underground Distribution Feeders

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Hybrid Distribution Feeders

Sections of overhead (OH) distribution feeders are being converted to underground (UG) for several reasons:

- Resiliency upgrading
- Reliability improvement
- Local customer demands (aesthetics)

Distribution Feeder Protection Practices

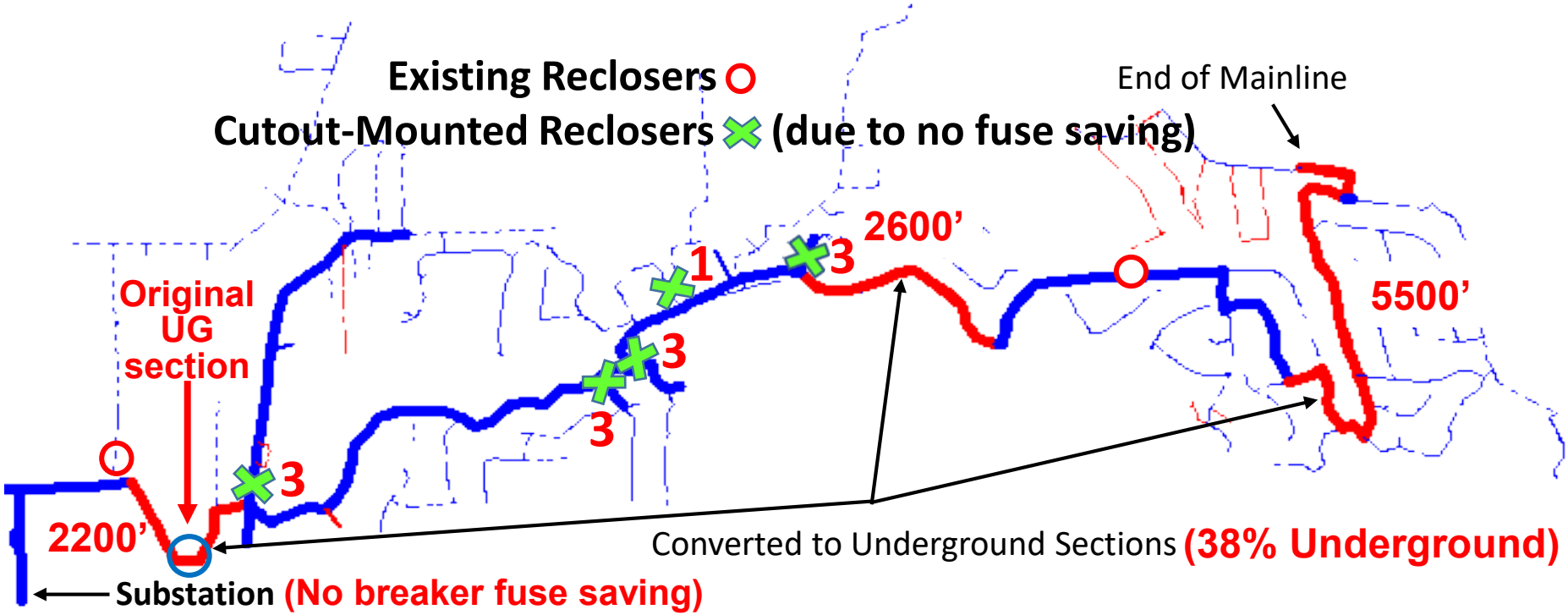
- Detect any fault event & trip the closest device to clear the fault
- Enable reclosing to restore service for transient faults
- Apply fused-lateral saving/sacrifice strategies to reduce momentary & sustained outages
- Replace lateral fuses with cutout-mounted reclosers
  - ✓ Eliminates main feeder fuse saving which further reduces momentaries
  - ✓ Reduces O&M expenses (fewer truck rolls)
- Occasionally use a different strategy for OH vs UG

OH/UG Reliability Improvement Strategy

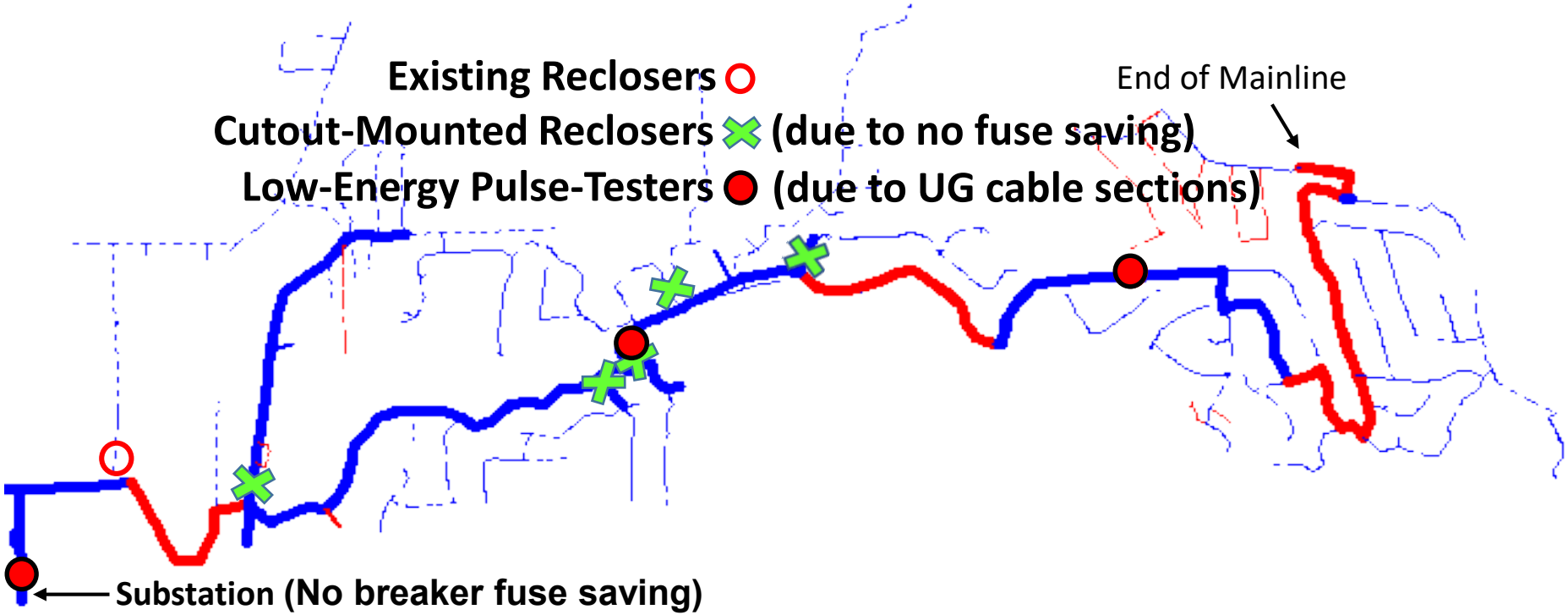
- Consider fault rate (faults/mile/year) when applying interim feeder fault interrupting devices, e.g., reclosers
- Use automatic reclosing to eliminate outages for transient faults in OH sections
- Use pulse-testing technology to avoid reclosing on UG cable faults
- Sectionalize the system to minimize number of customers impacted by transient & persistent faults
- Add tie points & apply automation systems to manage devices following persistent fault events

Distribution Feeder Example

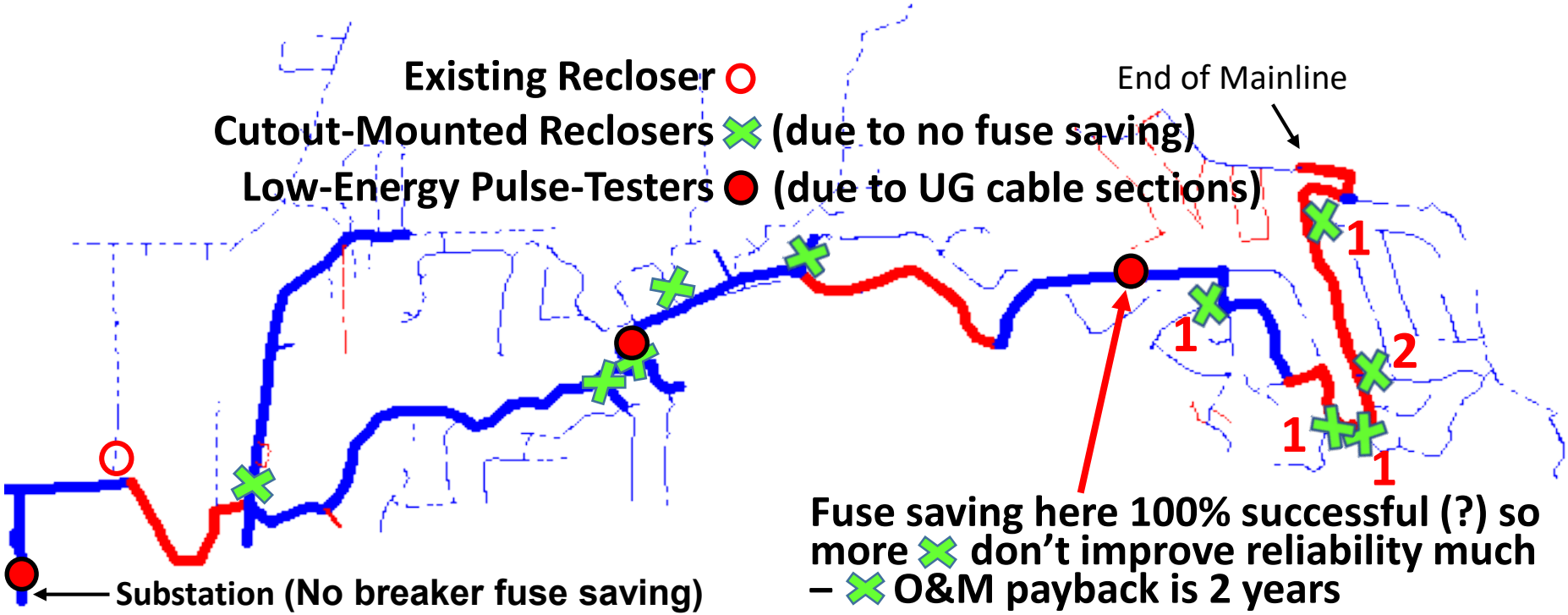
- 12.47 kV, 1300 Customers
- Main line – 6 miles radial
- One very short main line UG section
- Total – 20 Miles OH; 2 Miles UG
- Two reclosers – one on main line
- **Converting main line to 38% UG**



Before undergrounding	After UG w/breaker reclosing + 13		After UG w/o breaker reclosing + 13	
SAIFI: 11.97	SAIFI: 7.63	36%	SAIFI: 18.27	53%
SAIDI: 20.44	SAIDI: 13.85	32%	SAIDI: 23.31	14%
MAIFIe: 22.83	MAIFIe: 18.84	17%	MAIFIe: 1.32	94%



Before undergrounding		After UG w/breaker reclosing + 13			After UG w/o breaker reclosing + 13 + 3		
SAIFI:	11.97	SAIFI:	7.63	**36%**	SAIFI:	7.16	**40%**
SAIDI:	20.44	SAIDI:	13.85	**32%**	SAIDI:	11.82	**42%**
MAIFIe:	22.83	MAIFIe:	18.84	**17%**	MAIFIe:	4.29	**81%**



After UG w/breaker reclosing + 13

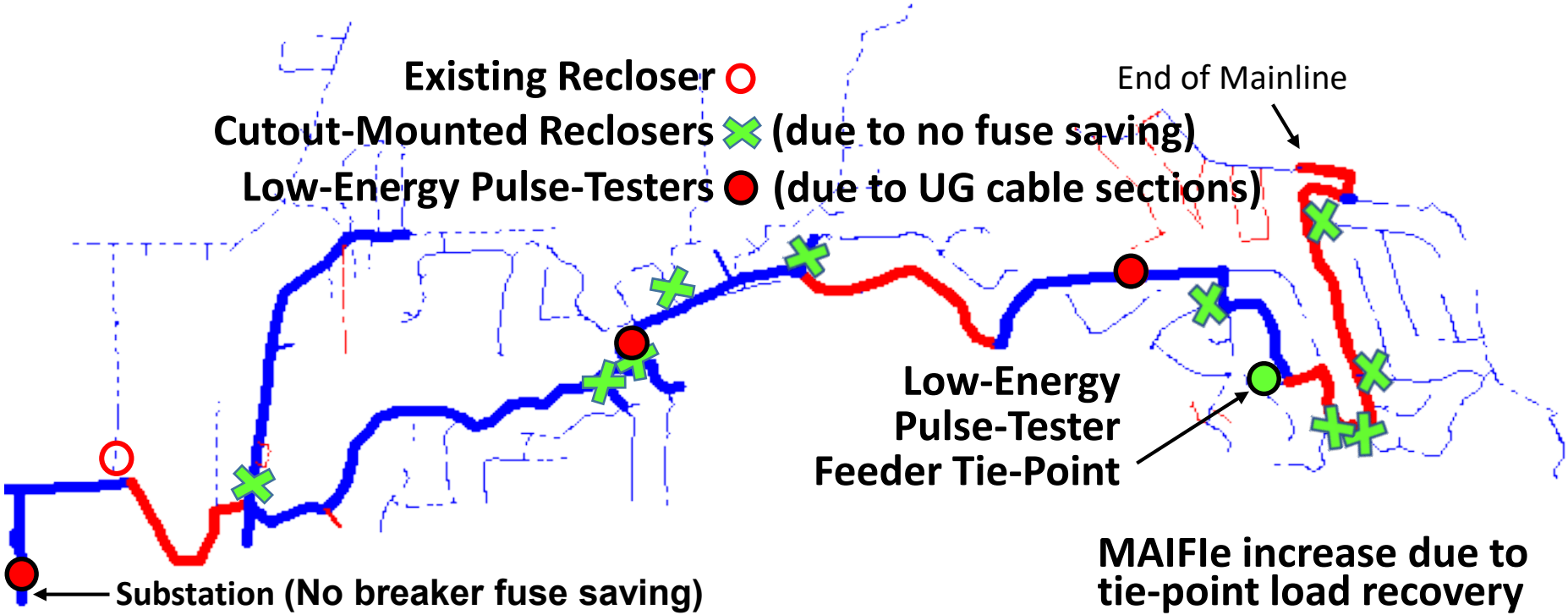
SAIFI:	7.63	**36%**
SAIDI:	13.8	**32%**
MAIFIe:	18.84	**17%**

After UG w/o breaker reclosing + 13 + 3

SAIFI:	7.16	**40%**
SAIDI:	11.82	**42%**
MAIFIe:	4.29	**81%**

After UG w/o breaker reclosing + 19 + 3

SAIFI:	6.86	**43%**
SAIDI:	11.61	**43%**
MAIFIe:	4.64	**80%**



MAIFIe increase due to tie-point load recovery

	After UG w/breaker reclosing + 13		After UG w/o breaker reclosing + 19 + 3		After UG w/o breaker reclosing + 19 + 3 + 1	
SAIFI:	7.63	**36%**	6.86	**43%**	4.45	**63%**
SAIDI:	13.8	**32%**	11.61	**43%**	3.00	**85%**
MAIFIe:	18.84	**17%**	4.64	**80%**	7.05	**69%**


Questions?

Coordinating Overcurrent Devices Placed on the Feeder