

Distribution Automation in Residential Underground Laterals

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SAIDI & SAIFI



- High-impact, low frequency events (HILF) are making resiliency a critical focus
- SAIDI and SAIFI drive investments
- Undergrounding is an important tool for resiliency and is demanded by customers
- But undergrounding can negatively impact SAIDI
- Automate and segment UG networks for resiliency while keeping SAIDI low



What is the research saying?

“The current state of reliability is insufficient. Strategic increased expenditure to improve resilience will reduce outages and improve restoration time due to storms”

Maryland, 2012

Questions the state of the grid after Hurricane Ike took two full weeks to recover from 3.5 million customers out of power. Predominant root cause was falling tree limbs (not wind or water directly). Selective undergrounding makes sense.

Texas, 2009

UG transformers and junction structures not in storm surge areas had very low failure rates. Wind gusts were a critical factor in infrastructure damage.

Florida, 2018

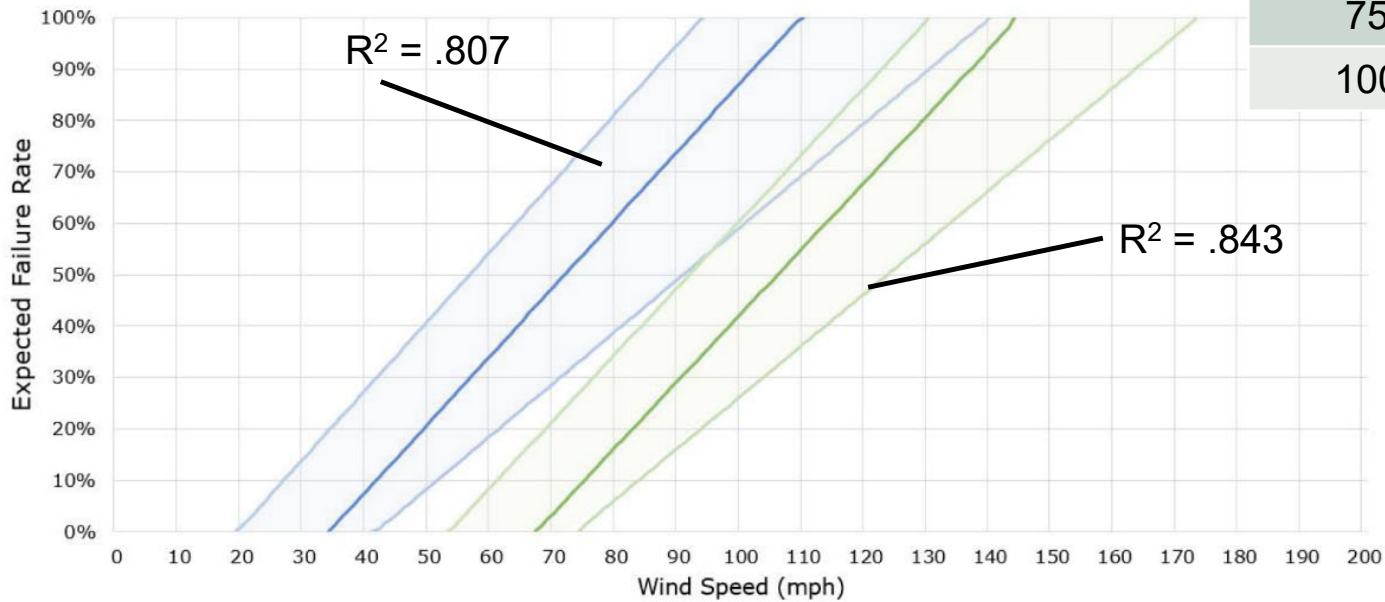
	Interruptions / Mile / Year	Avg. Restoration Time (min)
Overhead	0.57	92
Underground	0.3	145

North Carolina, 2003



Wind as instigator of damage

Likelihood of Damage	Wind Speed mph (kph)	Wind Gust mph (kph)
25%	53 (85)	88 (142)
50%	72 (116)	105 (169)
75%	90 (145)	125 (201)
100%	110 (177)	144 (232)

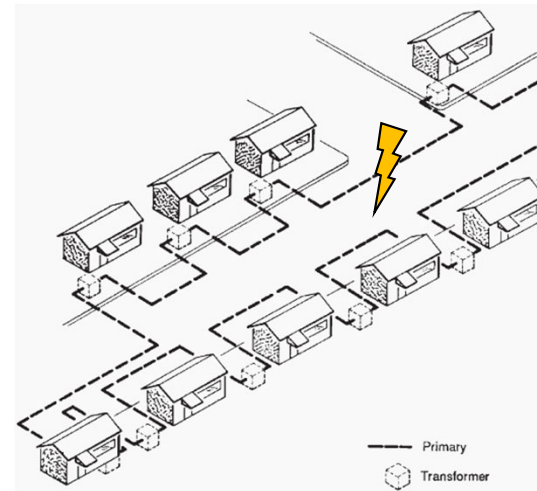
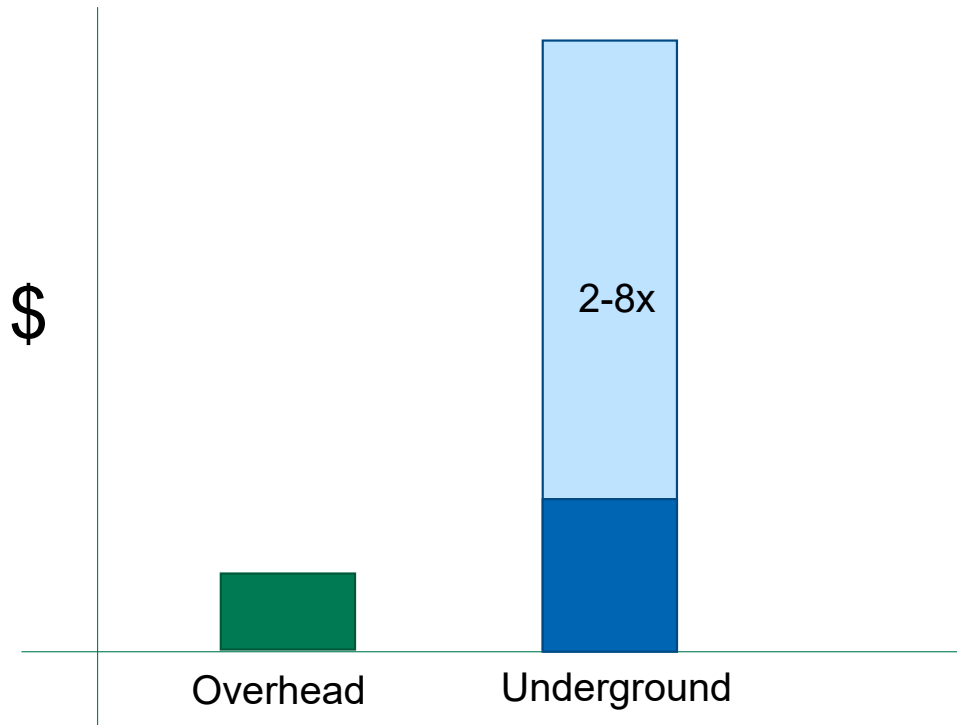


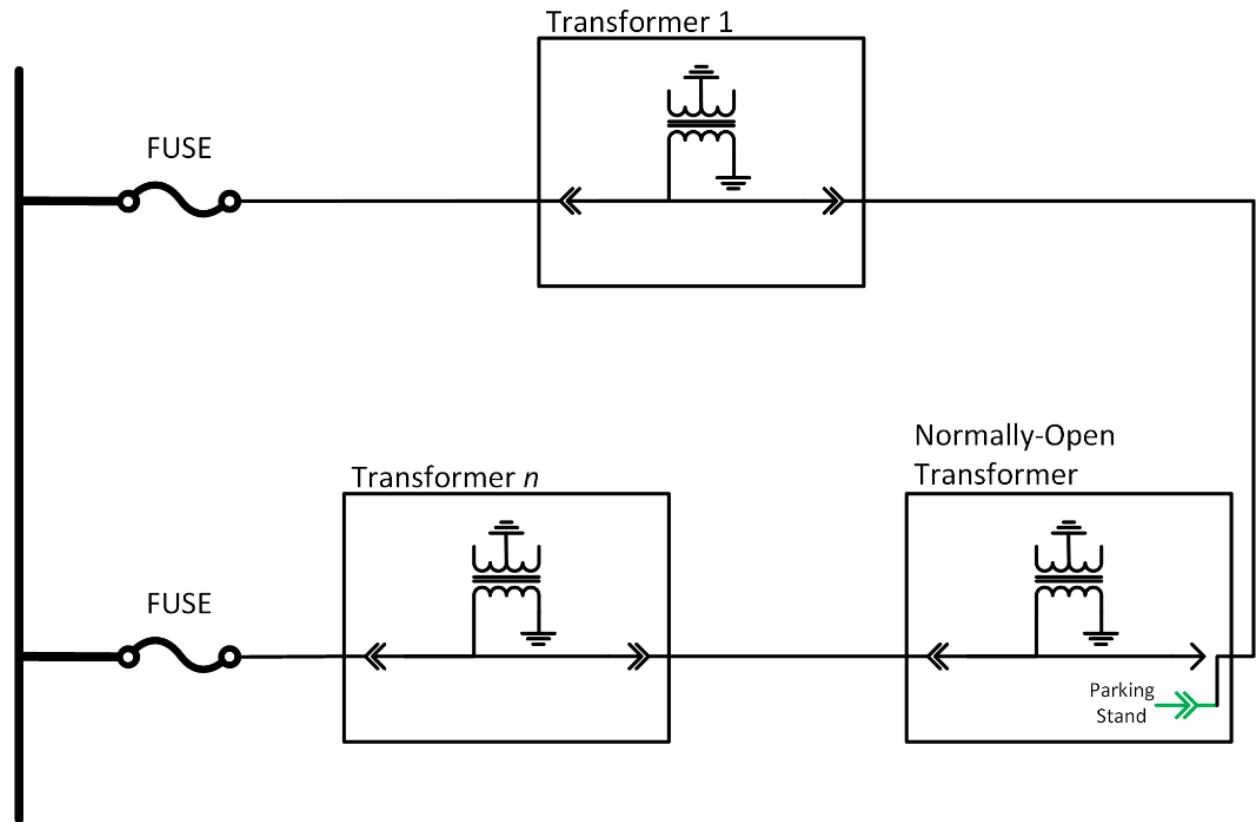
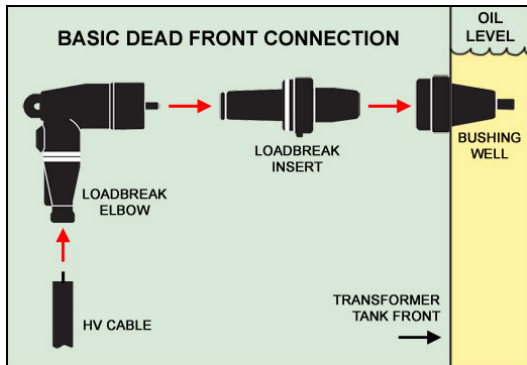
- Average Sustained Wind Speed Estimated Failure Rate
- Maximum Wind Gust Estimated Failure Rate

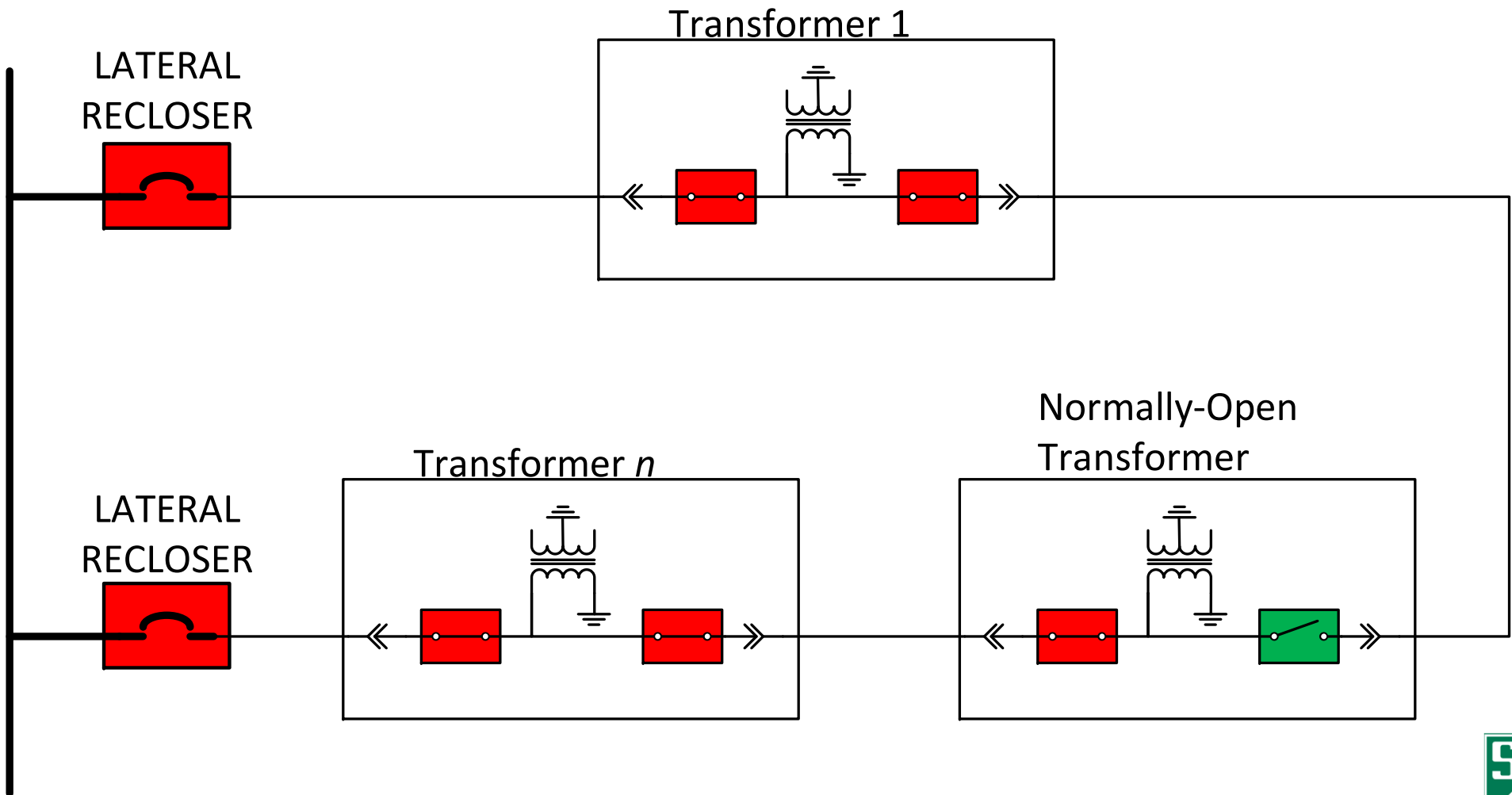


Undergrounding is expensive

Relative Installation Cost, Overhead v. Underground







	Prior State	Current State	Future State	Future + URD Automation
Feeder Construction	OH	OH	OH	OH
Feeder Protection	Automated	Automated	Automated	Automated
Lateral Construction	OH	OH	UG	UG
Lateral Protection	Fuses	Reclosers	Reclosers	Reclosers + URD Sectionalizers
% Lateral Faults Resulting in Permanent Outage	100%	30%	90%	0%**
HILF Susceptibility	High	High	Low*	Low*

*Primary HILF susceptibility is storm surge

**For single cable failure, does not fully resolve multiple contingencies



Summary

- Undergrounding aids resiliency but can negatively affect SAIDI
- Residential underground loops do not have a fault isolation solution today other than crew dispatch
- Lateral reclosers enable an automated sectionalizing approach (and can automatically restore in case of any temporary underground faults)
- Sectionalizers isolate faulted segments or restore an entire loop during a loss of source
- SAIDI drastically reduced for underground cable faults





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