

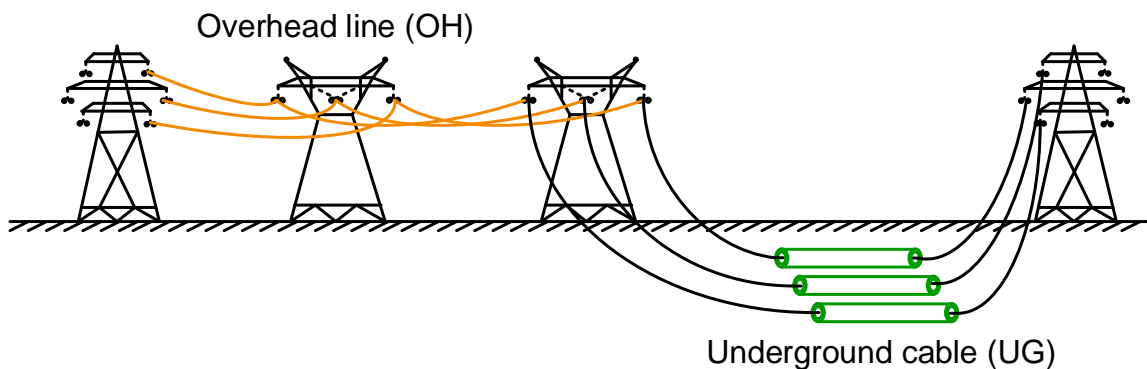
An Unlikely Pair? Combining Traveling Waves and Phasors for Reclosing on Hybrid Lines

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CenterPoint Energy

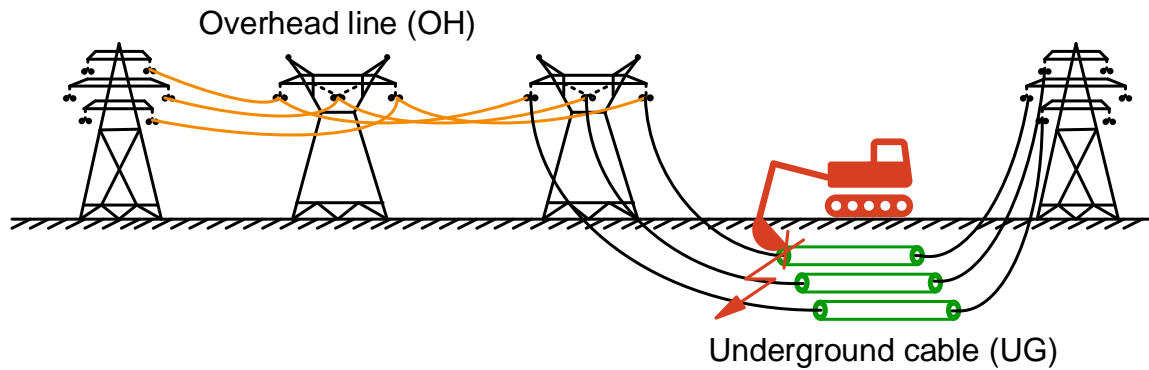
Swagata Das, Derrick Haas, and Praveen Iyer
Schweitzer Engineering Laboratories, Inc.

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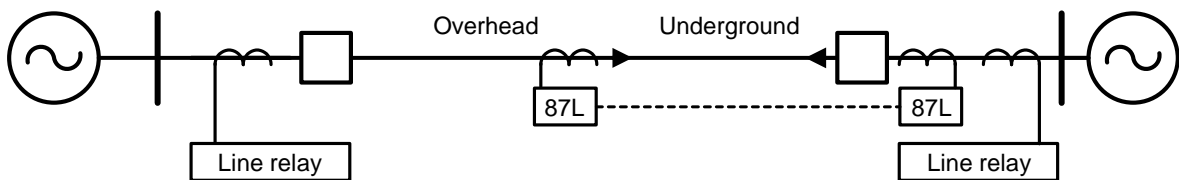
What are hybrid lines?



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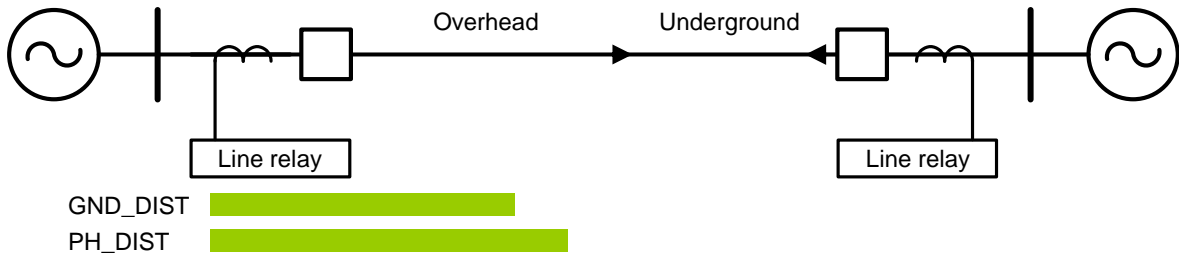


Identify faulted section with differential relays



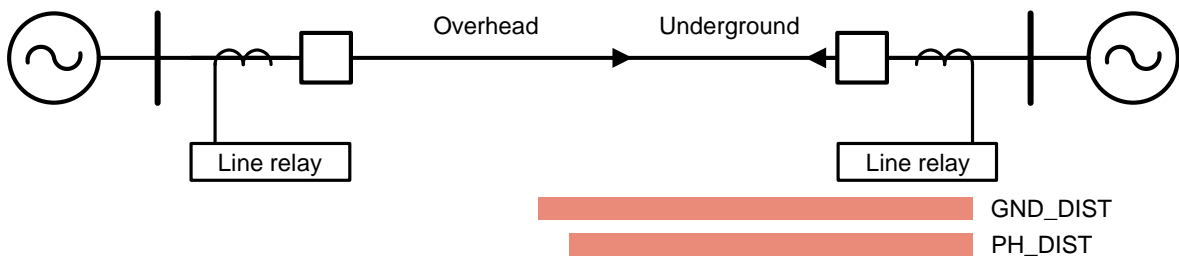
Differential relay asserts → block reclosing

Identify faulted section with distance relays



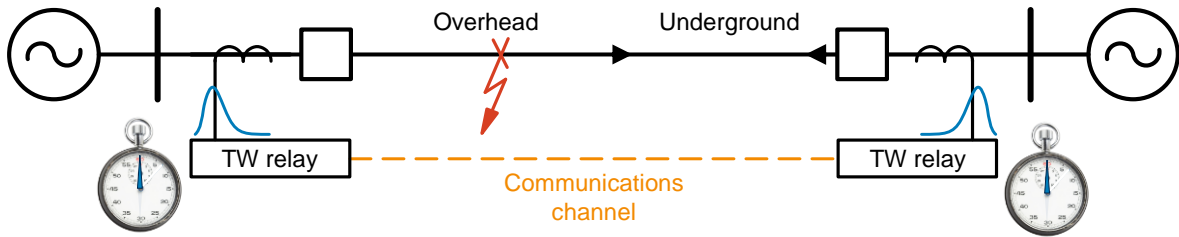
Distance elements assert → allow reclosing

Identify faulted section with distance relays

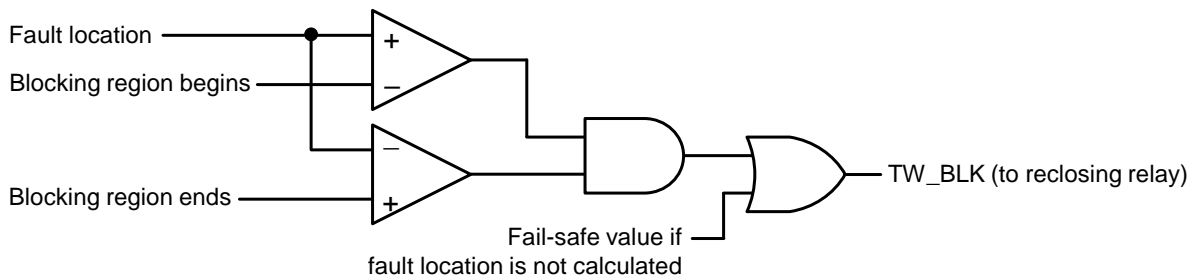
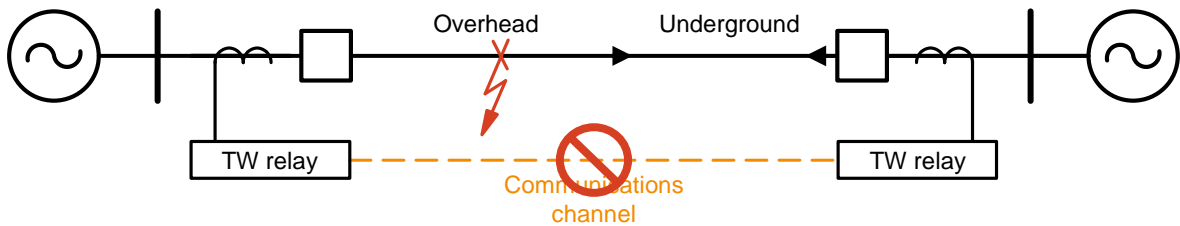


Distance elements assert → block reclosing

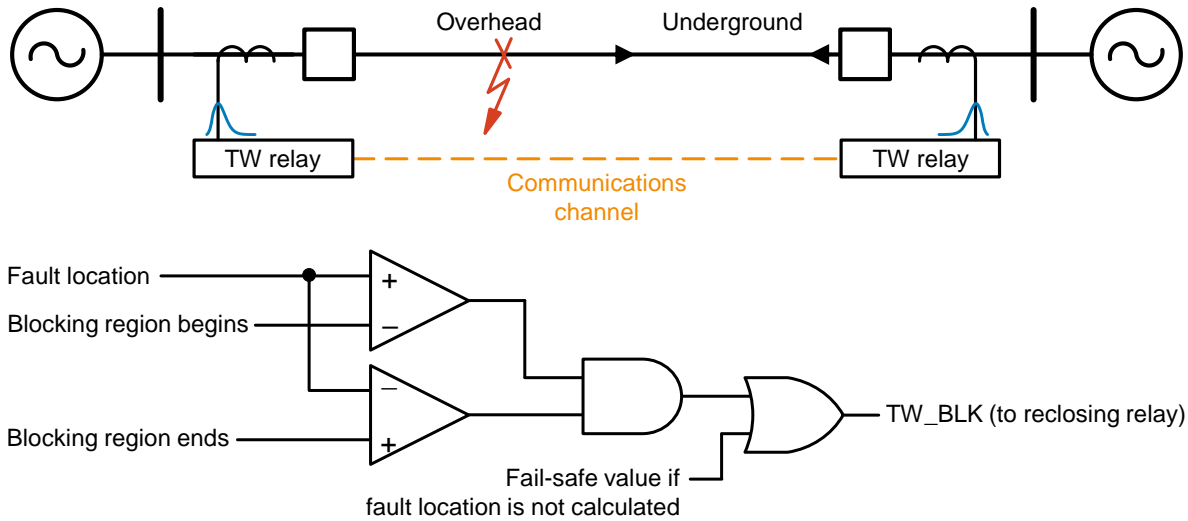
Identify faulted section with TWs



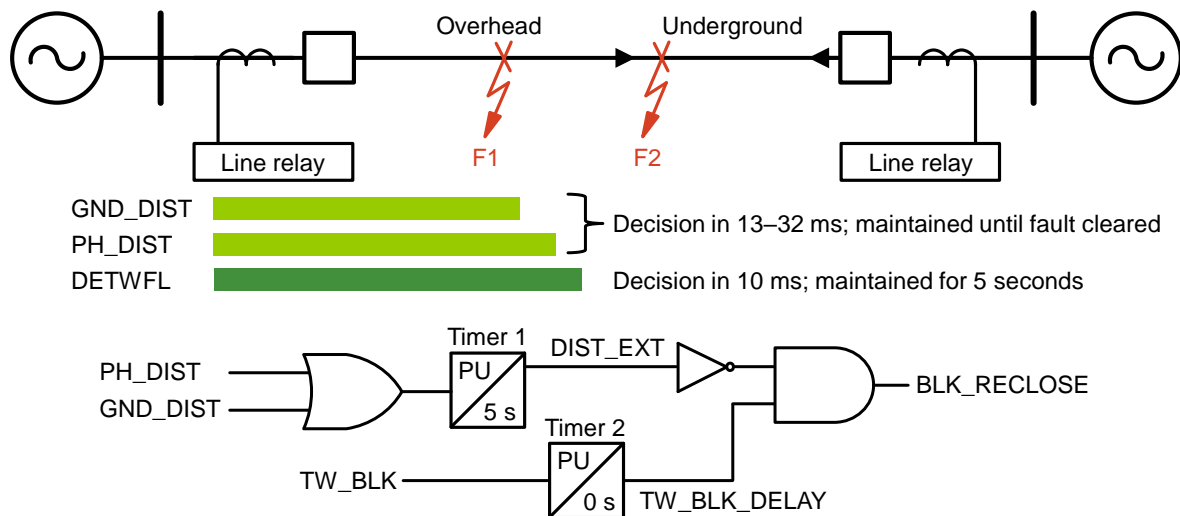
Identify faulted section with TWs



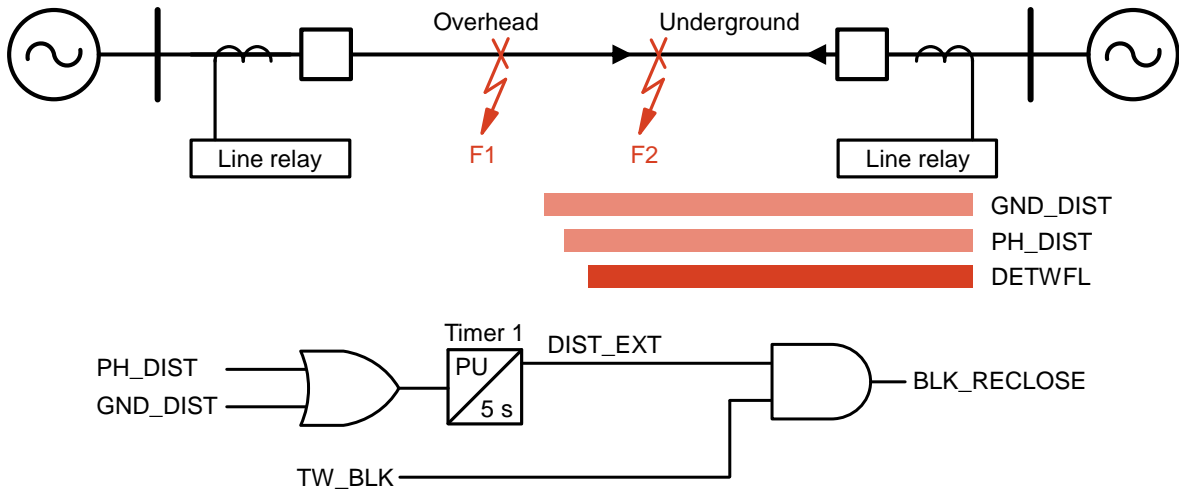
Identify faulted section with TWs



Identify faulted section with TWs and phasors



Identify faulted section with TWs and phasors



Security and dependability considerations

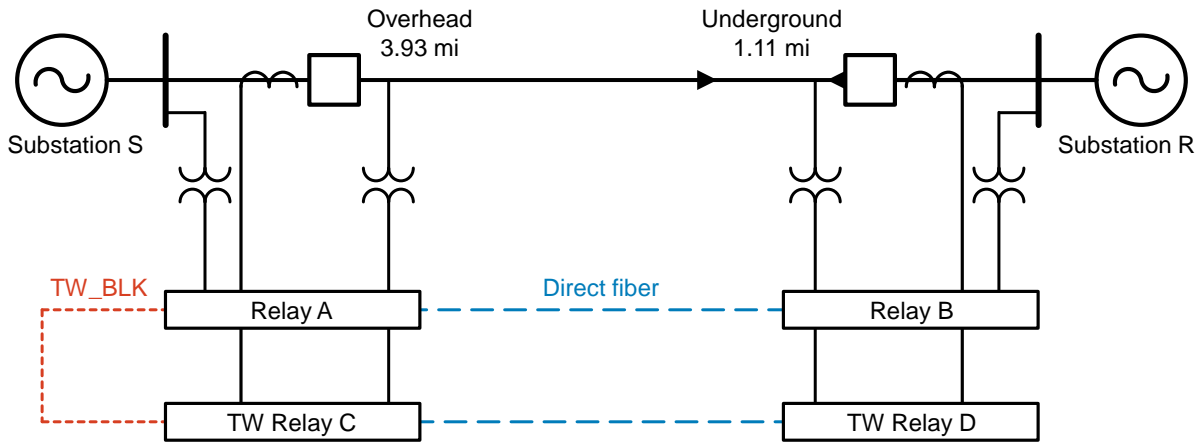
Instrument, relay, and settings errors

- CT/PT errors
- Relay transient and steady-state errors
- Line impedance errors

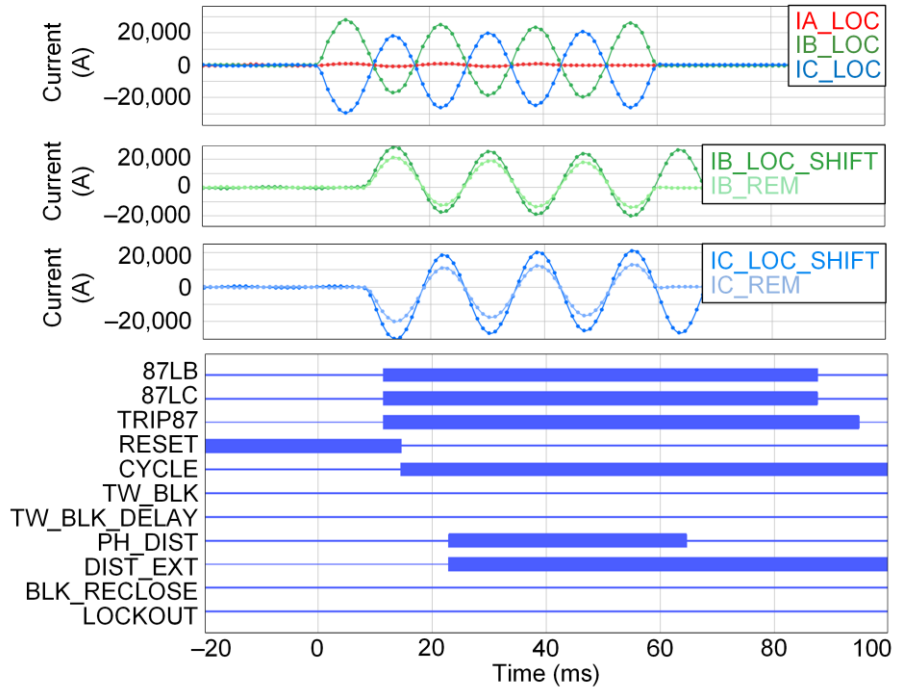
System errors

- Fault resistance
- Short lines
- Mutual coupling

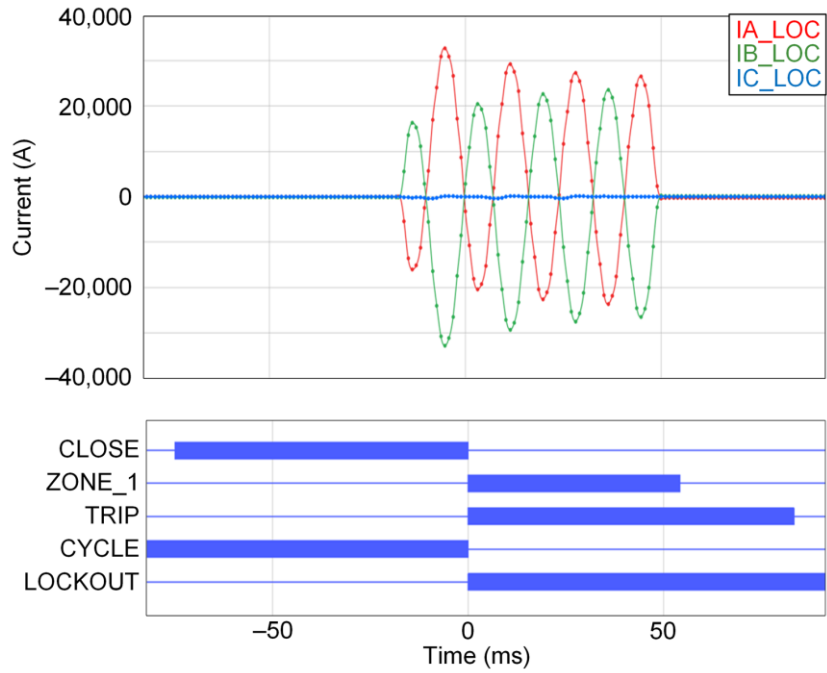
Application on 138 kV hybrid line



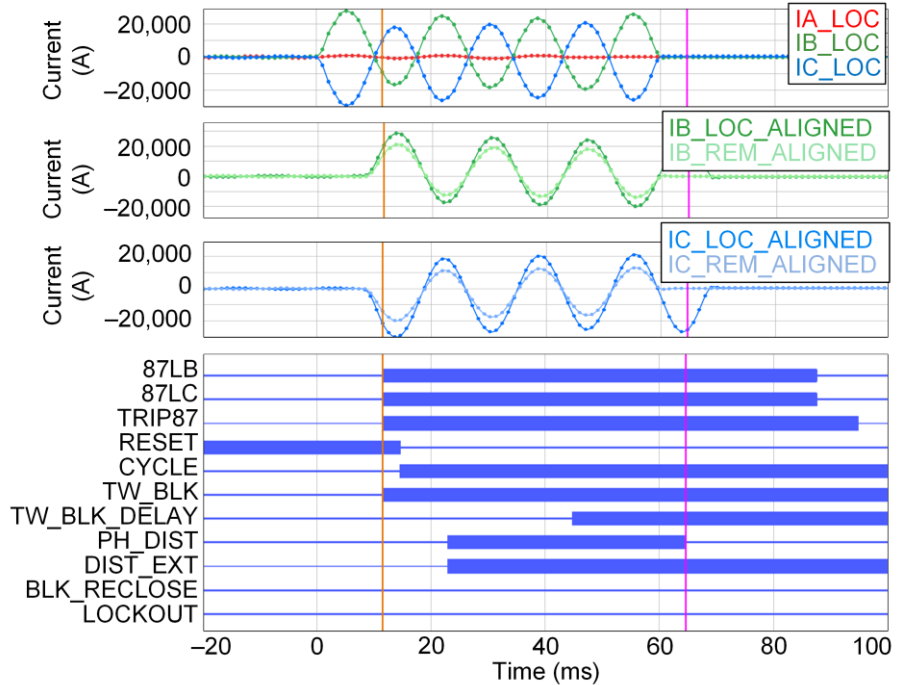
Initial fault



Fault on reclose



Event playback



Conclusions

- Decision to reclose or not on hybrid lines is a challenge
- DETWFL method can identify faulted section and allow reclose when fault is on overhead section
- Phase and ground distance elements can back up DETWFL method on simple hybrid lines
- Impacts of fault resistance, mutual coupling, and short lines need to be evaluated when setting distance elements

Phasors and TWs are not such an unlikely pair after all!



Questions?