



SweGRIDS

CP23: Fault location in resonant-earthed MV distribution systems

PhD student: Md Zakaria Habib, mzhabib@kth.se

Supervisor: Dr. Nathaniel Taylor (KTH)

Project funded by:



VATTENFALL



ELLEVIO

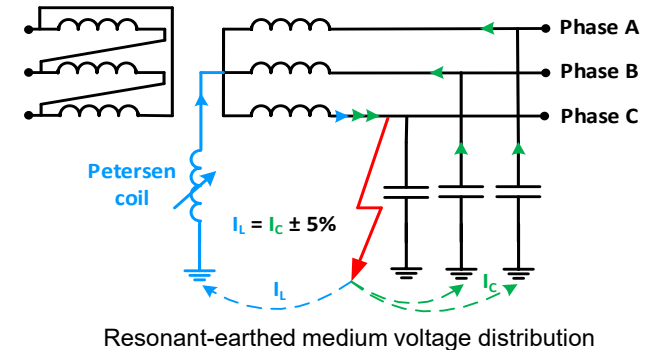
ABB

Background & Objective

SweGRIDS

Resonant-earthed systems

- The transformer neutral is connected to the earth through Petersen coil that is tuned to minimize the fault current through the fault location
- Transient faults become self-extinguishing: + good reliability
- Difficulties arise to locate earth-faults: - longer downtime



Main objectives

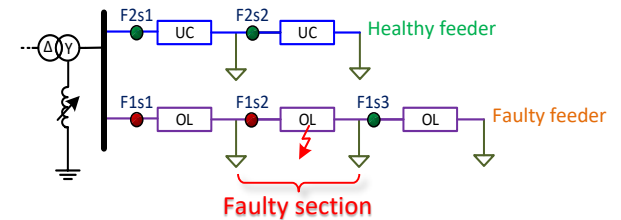
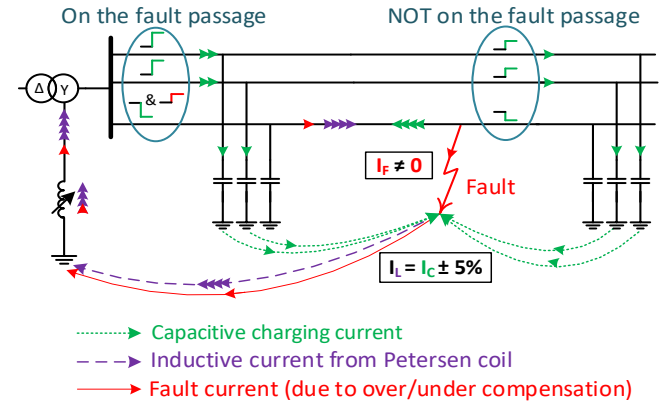
- Study the existing solutions and find their limitations for resonant-earthed system
- Propose a reliable and cost-effective **fault location method** for these systems

Proposed solution

SweGRIDS

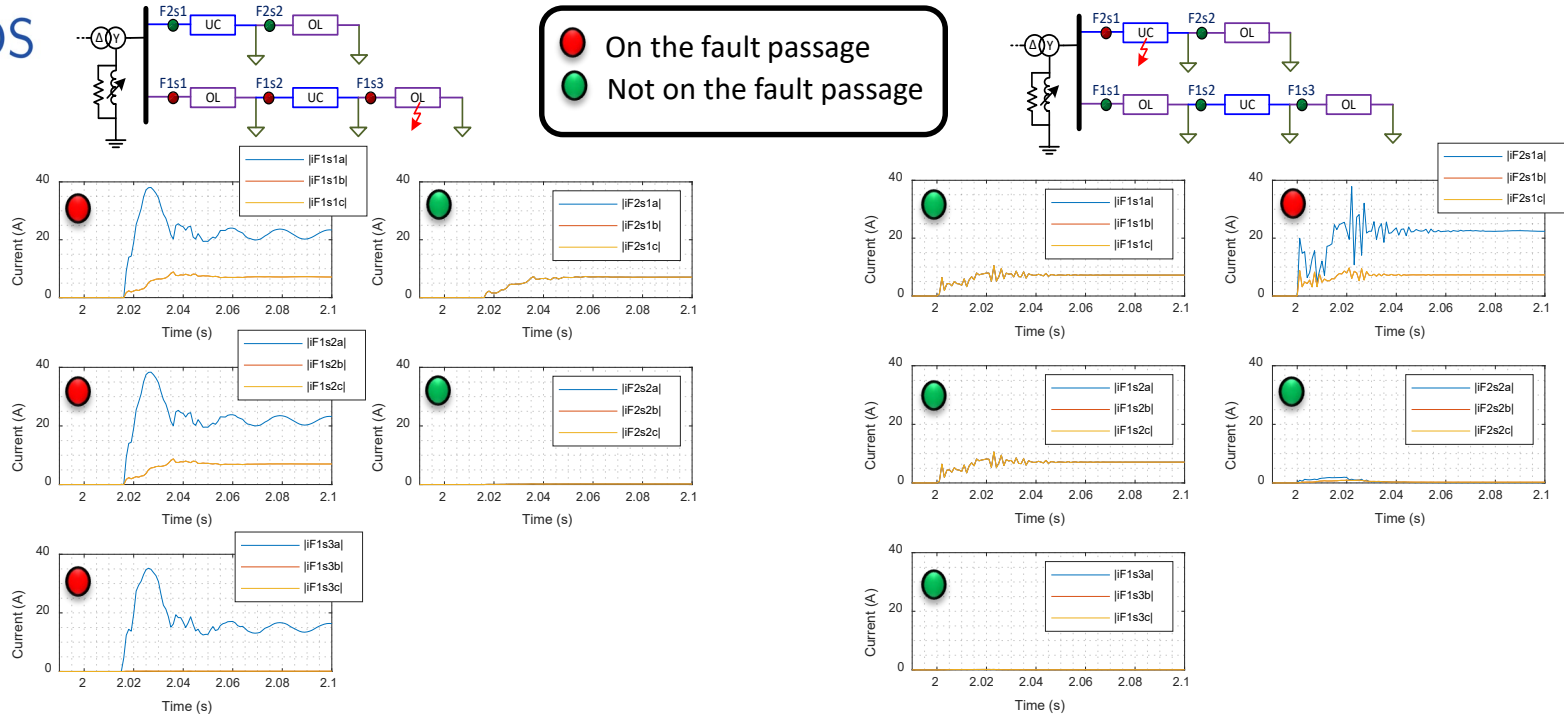
Method

- If the network is not tuned at the resonant point, the changes in phase-currents due to earth-faults are not equal on the fault passage
- The changes are (ideally) equal if the measurement location is not on the fault passage
- Number of devices are installed along the feeder and each device independently determines that is on the fault passage or not using only current information
- Faulty section is determined after collecting the information from devices



Results (1/3)

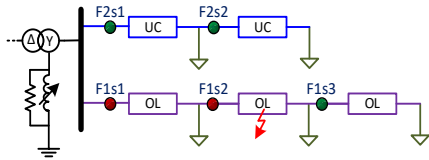
SweGRIDS



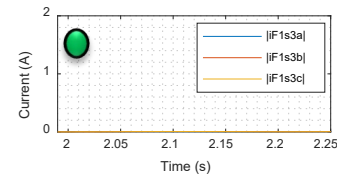
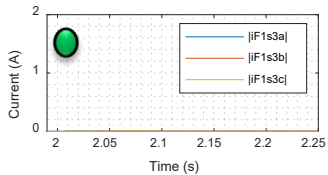
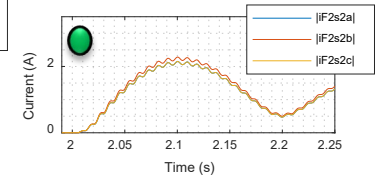
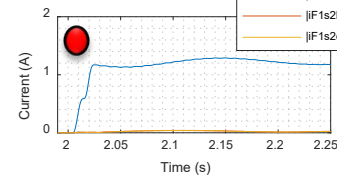
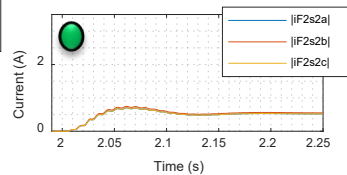
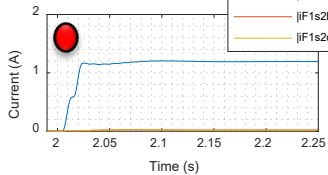
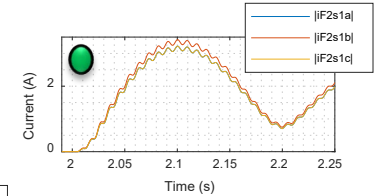
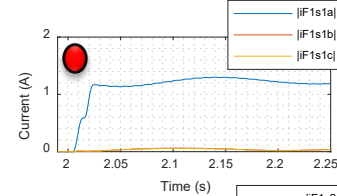
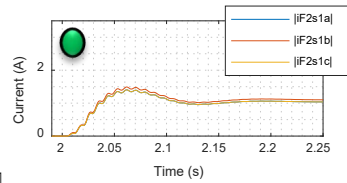
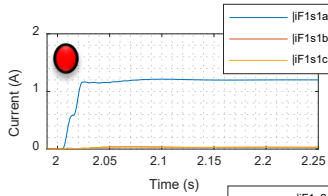
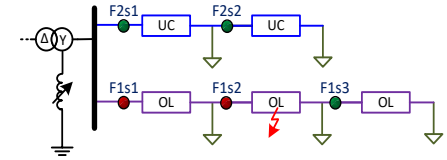
Good performance for mixed feeders with both overhead line and underground cables (fault resistance 5 kΩ)

Results (2/3)

SweGRIDS

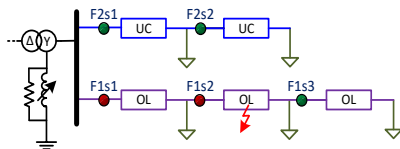


** Traditional Watt-metric method needs resistive current through the neutral



No requirement of **resistive current** through the **neutral** (fault resistance **5 kΩ**)

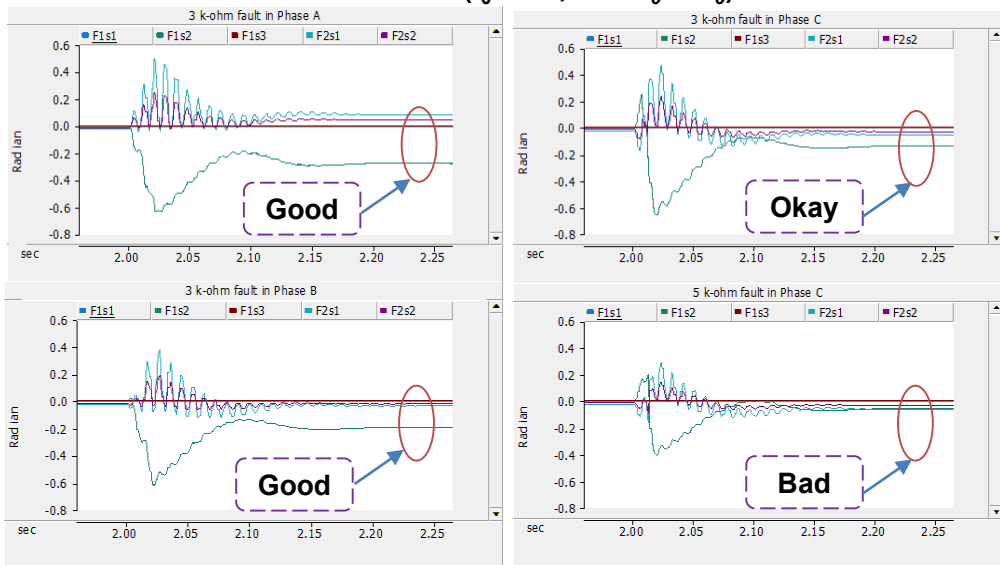
Results (3/3)



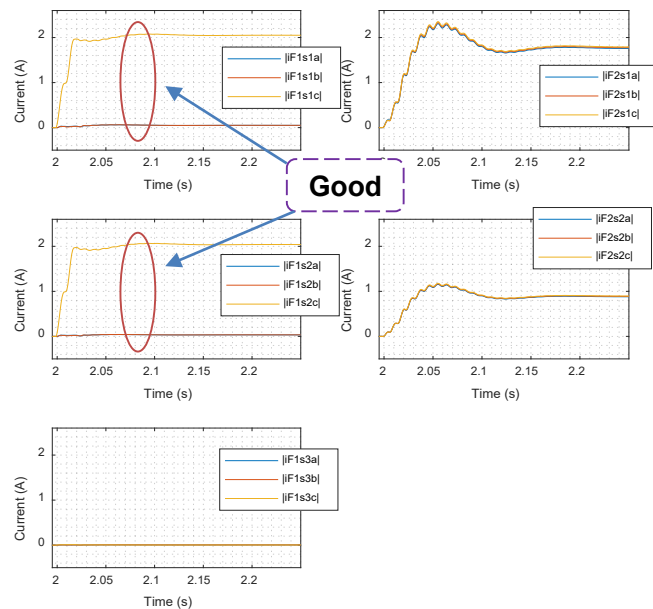
Phase A ↓
 Phase B □
 Phase C ↑

Negligible impact of **natural unbalance** in the network, $\pm 1\%$
 (Comparison with the watt-metric method)

Watt-metric ($I_0 \cos \theta$, $\theta = \angle V_0 - \angle I_0$)



Proposed method (5 kΩ)





Conclusions

SweGRIDS

- Traditional fault location methods struggle to provide acceptable performance in resonant-earthed distribution systems
- The proposed fault location method provides reliable decision in various fault conditions
- The proposed method should be cost-friendly since it does not require any voltage or high-frequency measurements

