


Hardware-in-the-loop Testing of Overcurrent Protection in a Substation System with PV Generation

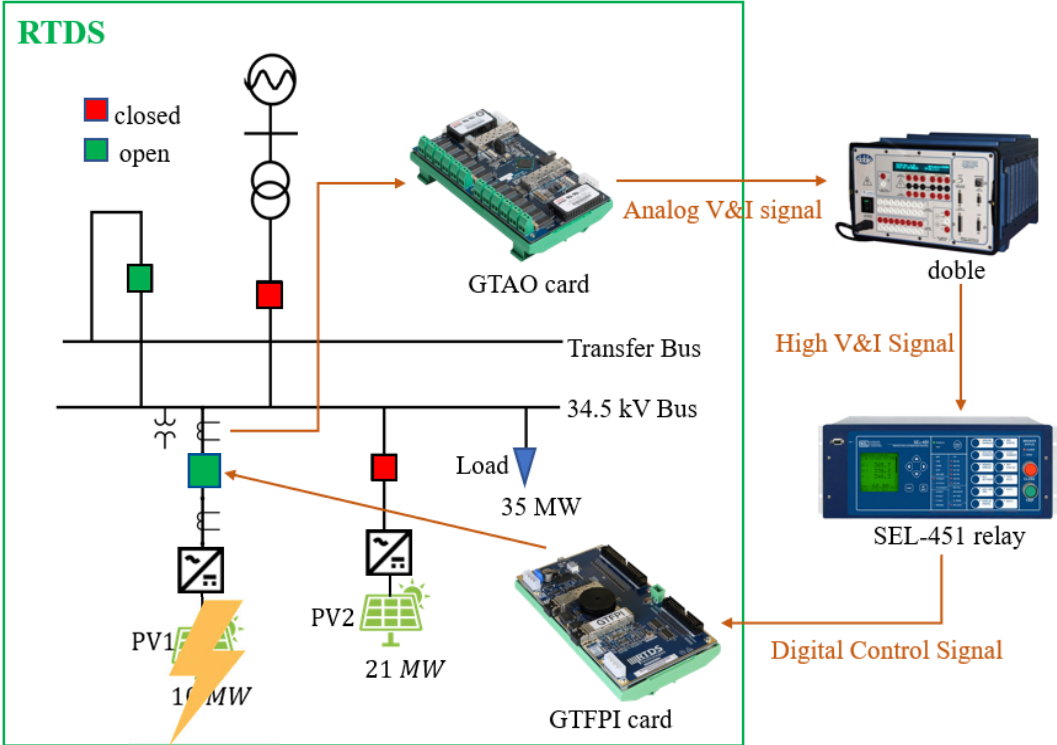
Biqi Wang, Dr. Ren Liu, Genesis Alvarez, Dr. Micah J Till

Background

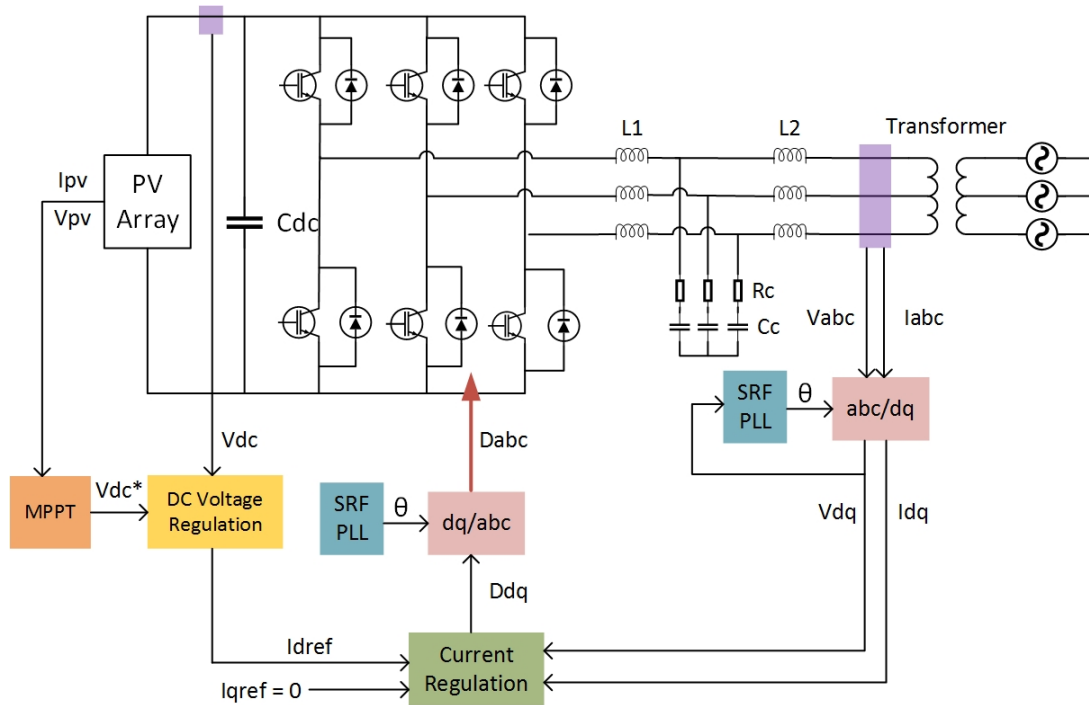
- DER penetration increase: cause changes in distribution system fault current profile
- Necessary to do fault analysis and relay assessment under high DER penetration
- Overcurrent relay testing in Training Center virtual substation with utility-scaled PV generations
 - RTDS HIL simulation 



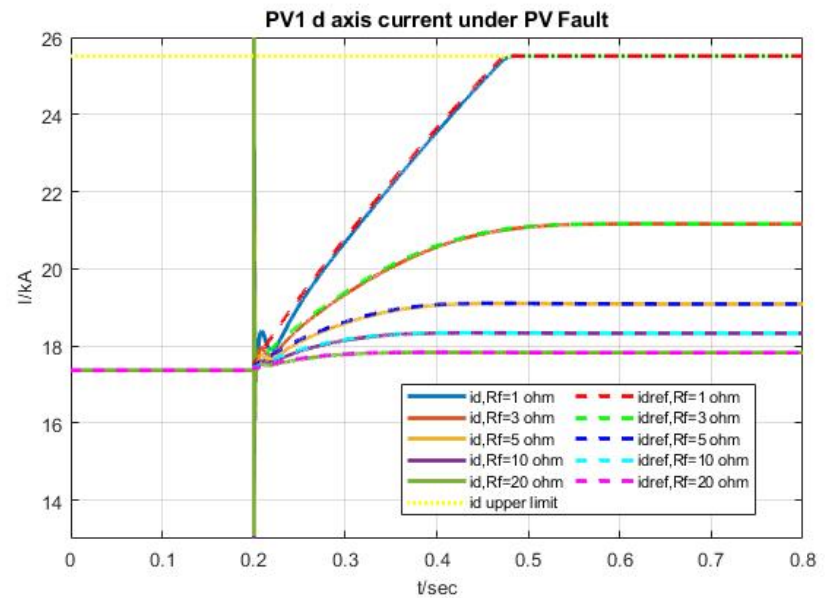
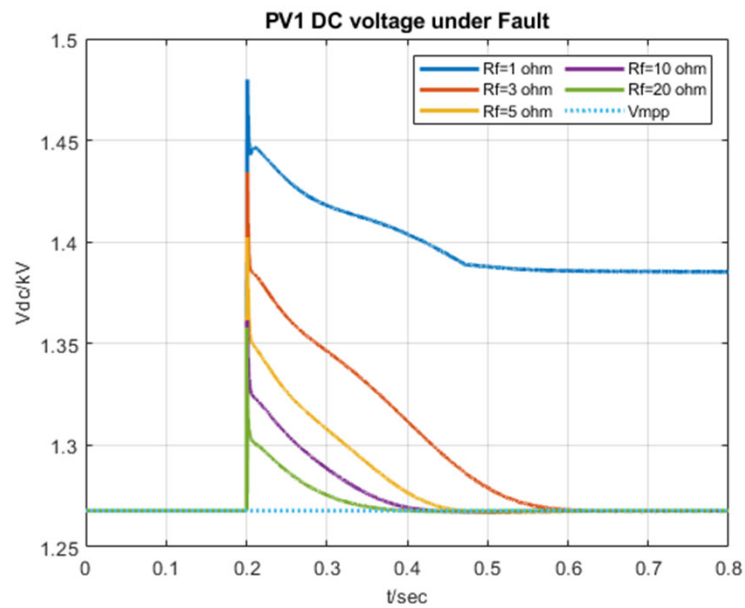
RTDS HIL Simulation Testbed



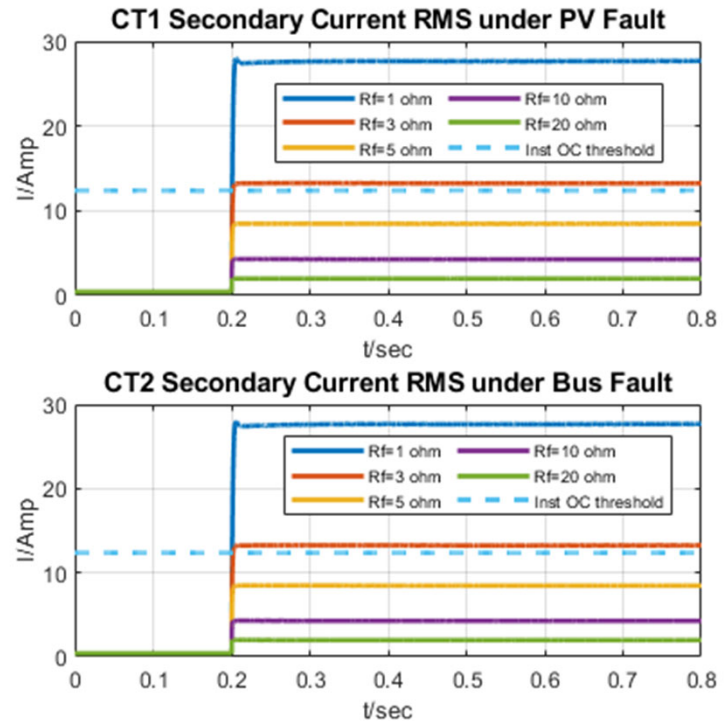
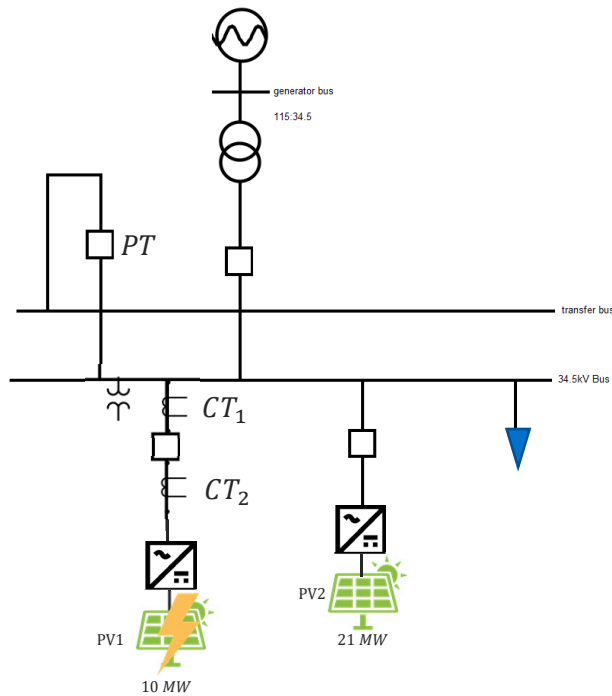
PV Facilities Topology and Control



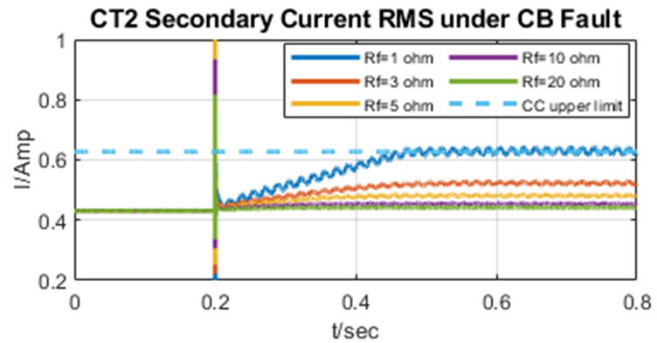
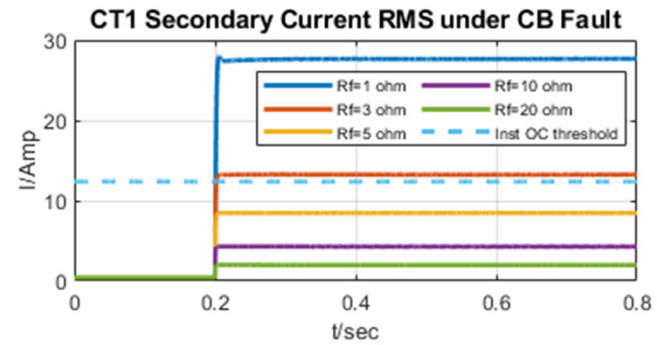
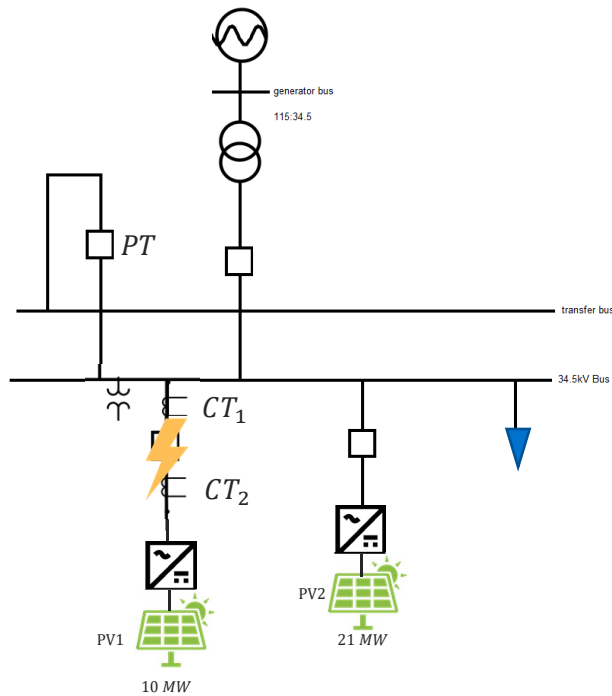
PV Inverter Fault Response



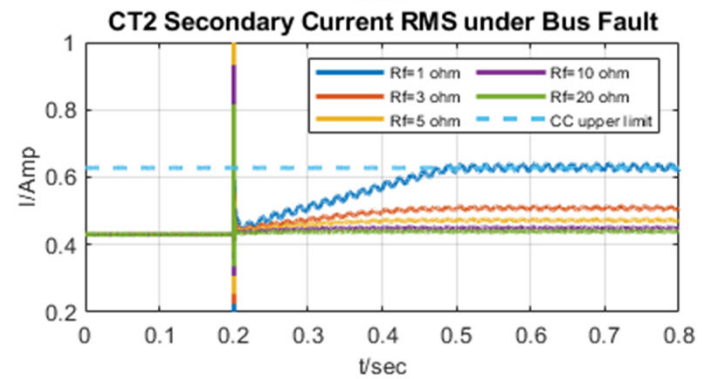
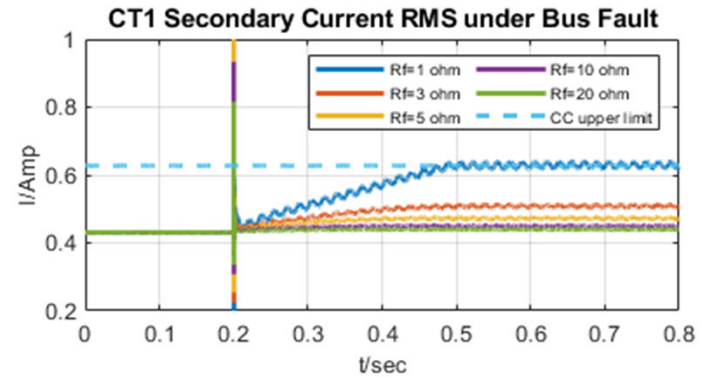
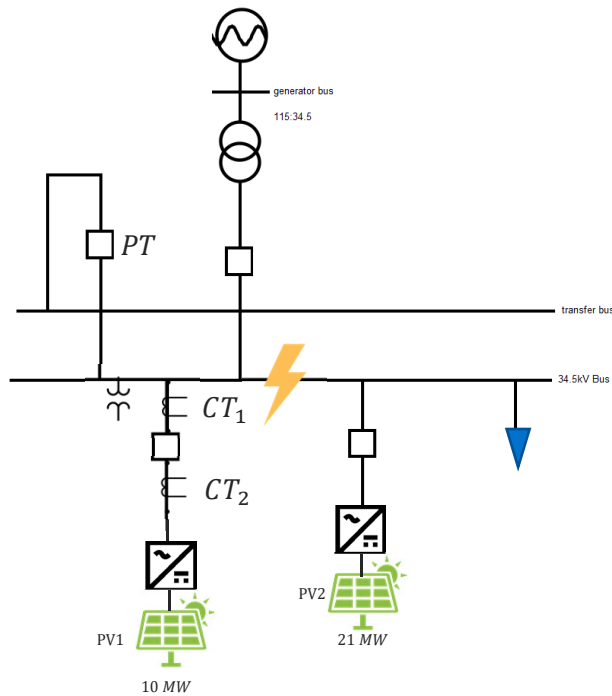
PV Internal Fault Current Response



CB Internal Fault Current Response



Bus Fault Current Response



Contributions

This project has contributed in the following ways:

- The PV inverter fault response and relay fault current profile were analyzed under various fault scenarios
 - different locations
 - different fault severity
- The fault analysis methodology provides a practical reference for the relay designing in DER-dominated distribution systems
- The HIL testing results provides a benchmark for Dominion Energy Training Center's future HIL demonstration

Thank you

Biqi Wang
biqw@vt.edu