TITLE: resiMG [02.214-2021]

AUTHOR: Athanasios Krontiris
DATE: 21-09-21

Object under Investigation (*OuI*)

1. Solar Inverter (available in lab)
2. PLC Controller PFC200 (BYOD)
3. Islanding detection algorithm (in MATLAB Simulink)
4. Feeder relay (available in lab)

Function(s) under Investigation (*FuI*)

1. Short-circuit current injection
2. Modbus connectivity
3. Island detection
4. Inverse Definite Time Overcurrent protection

Domain under Investigation (*DuI*):

1. PHIL
2. Realt-time SCADA
3. CHIL
4. CHIL

Target metrics (*TM*)

1. Node voltage from HIL, inverter terminal current
2. SCADA indication, PLC interface
3. Signals from HIL and real-time scoping in MATLAB Simulink
4. Signals from HIL, protection relay interface

Test Objectives

1. Short-circuit behavior not known, current contribution important in active distribution grids
2. Secondary measurements from many PLC controllers need to be integrated in distribution grid SCADA
3. Distributed generators must fulfill islanding detection, but details of algorithms are proprietary
4. Protection blinding may occur when integrating DG in distribution feeders

Purpose of Investigation *(PoI)*

1. Characterize the inverter's short-circuit current waveform
2. Validate that the controller can integrate into the lab's SCADA (IGSS)
3. Verify the island detection algorithm
4. Verify the protection settings for a sample feeder configuration

Test criteria *(TCR)*

1. Manual fault inception in PHIL, correct voltage-sag-dependent fault current injection (according to grid codes) measured at device's physical terminals
2. Correct indication of reference analogue signals in SCADA, parallel operation with existing measurement systems and cross-comparison
3. Unintentional islanding triggered manually in HIL, correct detection and breaker trip order from protection controller monitored in real-time scope
4. Manual fault inception in HIL, observe tripping time of protective relay

Quality attributes *(QA)*

1. Fault current injection according to grid codes, waveform assessment
1. Comparison of analogue signals between PLC interface, SCADA indication and reference measurement devices
2. Detection upon manually triggered islanding
3. Detection upon manually triggered fault

System under Test (*SuT*)

1. Solar Inverter in PHIL
2. PLC Controller PFC200 in SCADA
3. Islanding detection algorithm in CHIL
4. Feeder relay in CHIL

Functions under Test (*FuT*)

1. Short-circuit current injection
2. Modbus connectivity
3. Island detection
4. Inverse Definite Time Overcurrent protection

Variability attributes *(VA)*

1. Fault duration, remaining voltage during fault
2. Load currents, node voltages
3. Inverter pre-fault loading (active and reactive), fault inception time
4. DG fault-current injection