Relay Communication with Real Time Microgrid Simulation

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What is a Microgrid?

A microgrid is a local energy grid with control capabilities, which allows them to be connected or disconnected from the traditional grid and still operate using renewable energy sources and batteries. The microgrid is connected to the traditional grid through a switch that switch can be manually or automatically flipped changing it from being connect to an independent energy grid.

Motivation

The protective relays play vital role in the grid reliability that involves monitoring power lines and mitigating blackouts. In a large power grid, the protective relays operate locally by controlling the opening and closing of switches (breakers) in power lines, which allows to disconnect or remove from service any part of the power system when it operates in abnormal manner that might cause damage to the rest of the system. However, these relays are prone to failures, which lead random opening/closing of the breakers. Therefore, to back up the protection systems, it is necessary to study the relays failures and it effect on a large power grid.

Objectives

- Relay Connect to OPAL-RT
- Relay receive a current and voltage from the OPAL-RT Simulation and register an Overcurrent
- Relay send a digital output to the OPAL-RT to simulate a breaker flipping if Relay detects an overcurrent.

Contact Information

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Experiments

▪ Hardware-In-the-Loop (HIL) testing platform

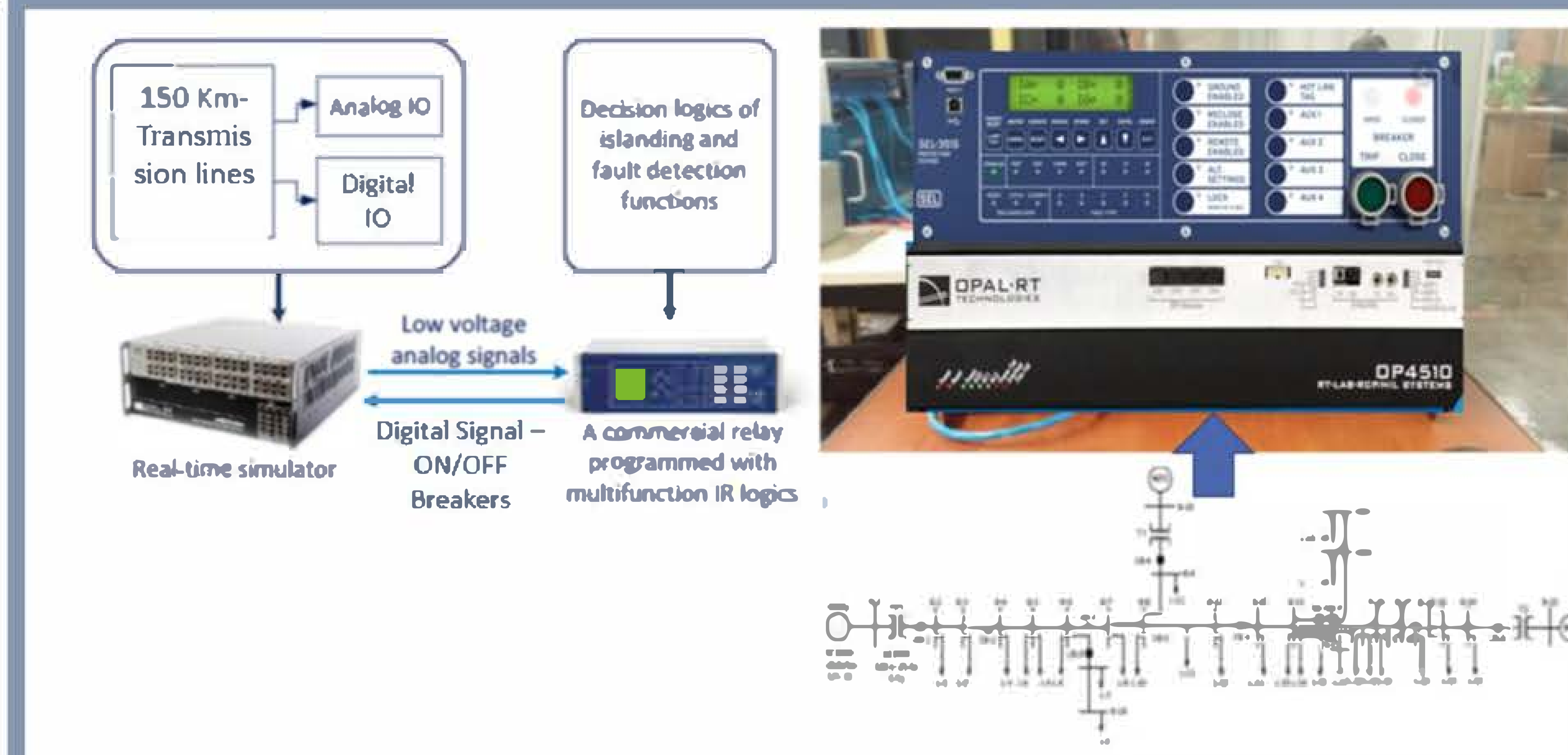

Figure 1:Hardware-In-the-Loop (HIL) testing platform

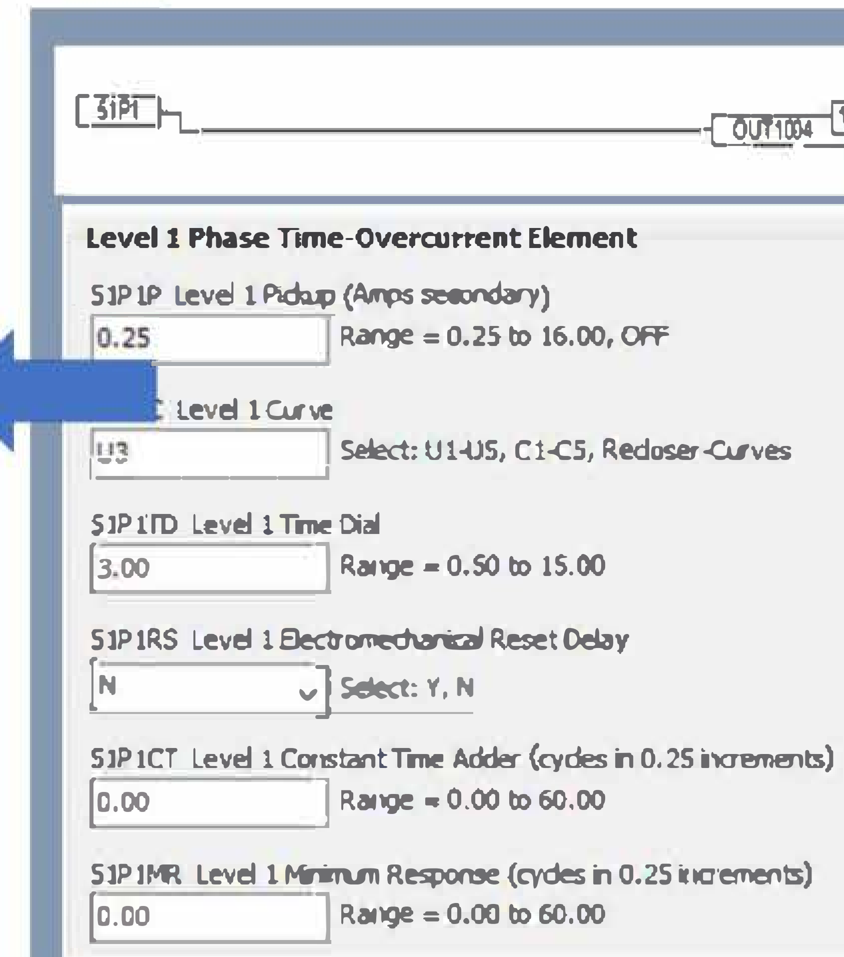

Figure 2: Parameters Settings for SEL-351S Phase Time-Overcurrent Fault

▪ Simulated Model using MATLAB/Simulink

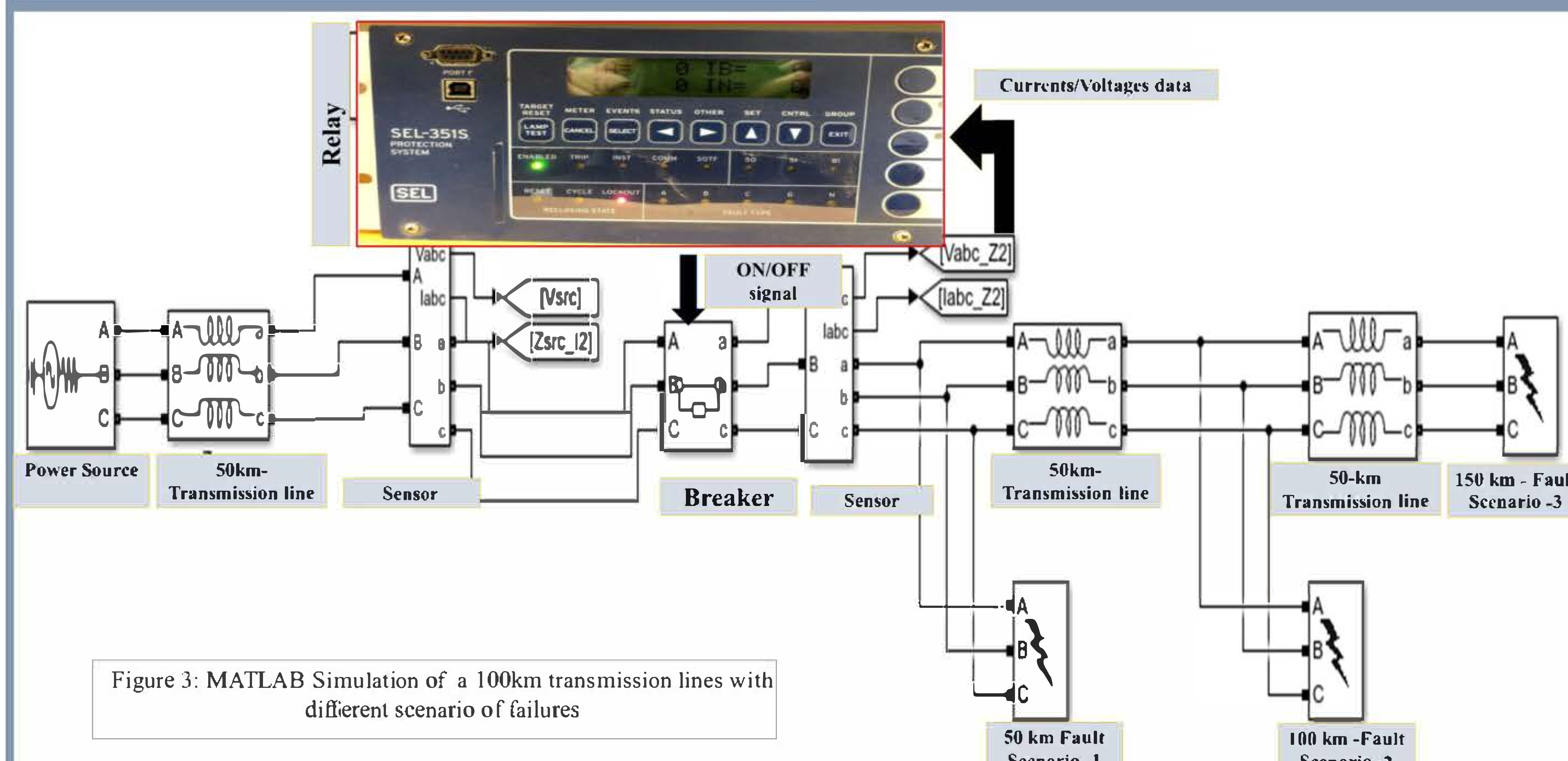

Figure 3: MATLAB Simulation of a 100km transmission lines with different scenario of failures

Results

The simulation model of the transmission line of Fig. 3 has been developed using Specialized Power Systems and RT-LAB toolboxes in MATLAB 2018a in conjunction with RT-LAB 2019.3.2 software. The simulation model and then loaded and executed in the OPAL-RT for a real time simulation.
Three fault scenario were tested to understand their effect on currents and voltages in the transmission lines and study the effectiveness of the relay in stopping these faults.

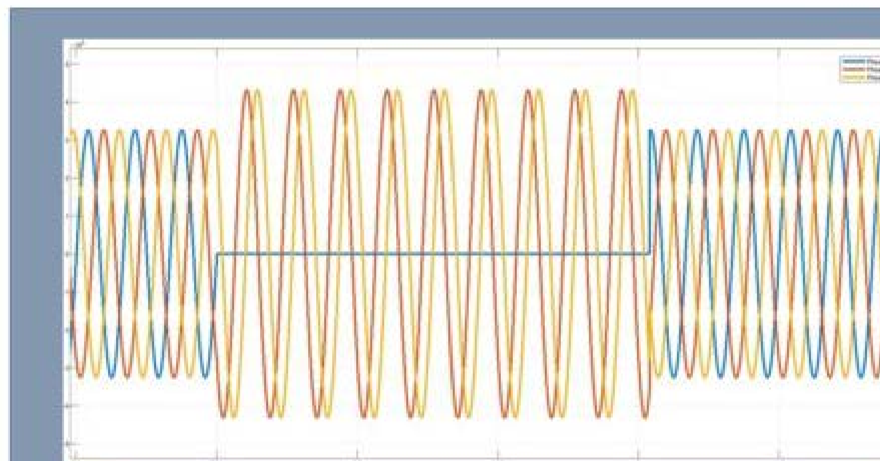

Figure 4:3-phase voltage - simulation with 50 Km fault in scenario -1

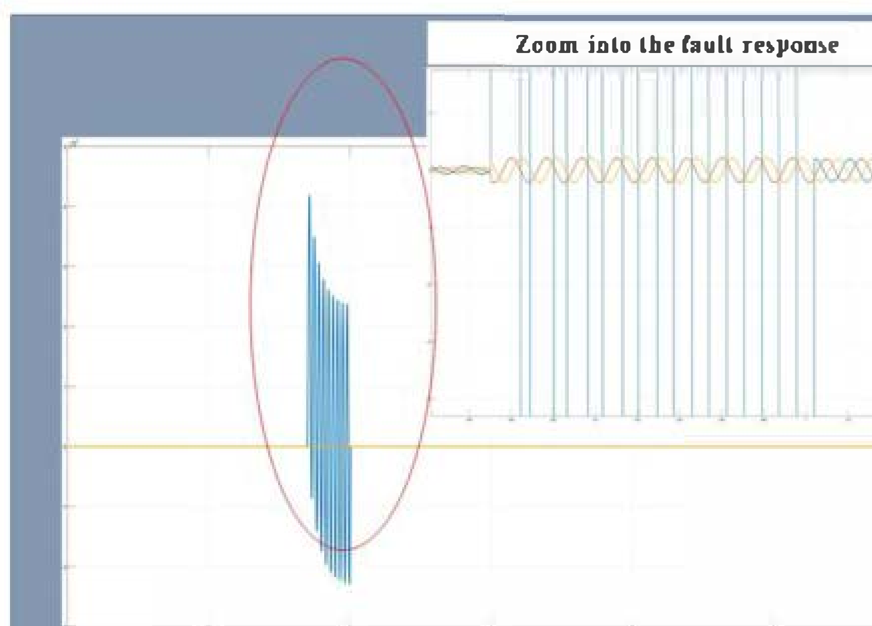

Figure 5:3-phase current - simulation with fault scenario -1

Conclusion

Successfully simulated a three fault scenario to understand their effect on current and voltages.
The next objective is to have the SEL-351S receive a current and voltage from the OPAL-RT Simulation and register an Overcurrent, if present.
Then with our last being to have the SEL-351S send a digital bit to the OPAL-RT simulation to simulate a breaker flipping based on the Overcurrent.

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