

Distribution Network – Automation and Protection Laboratory

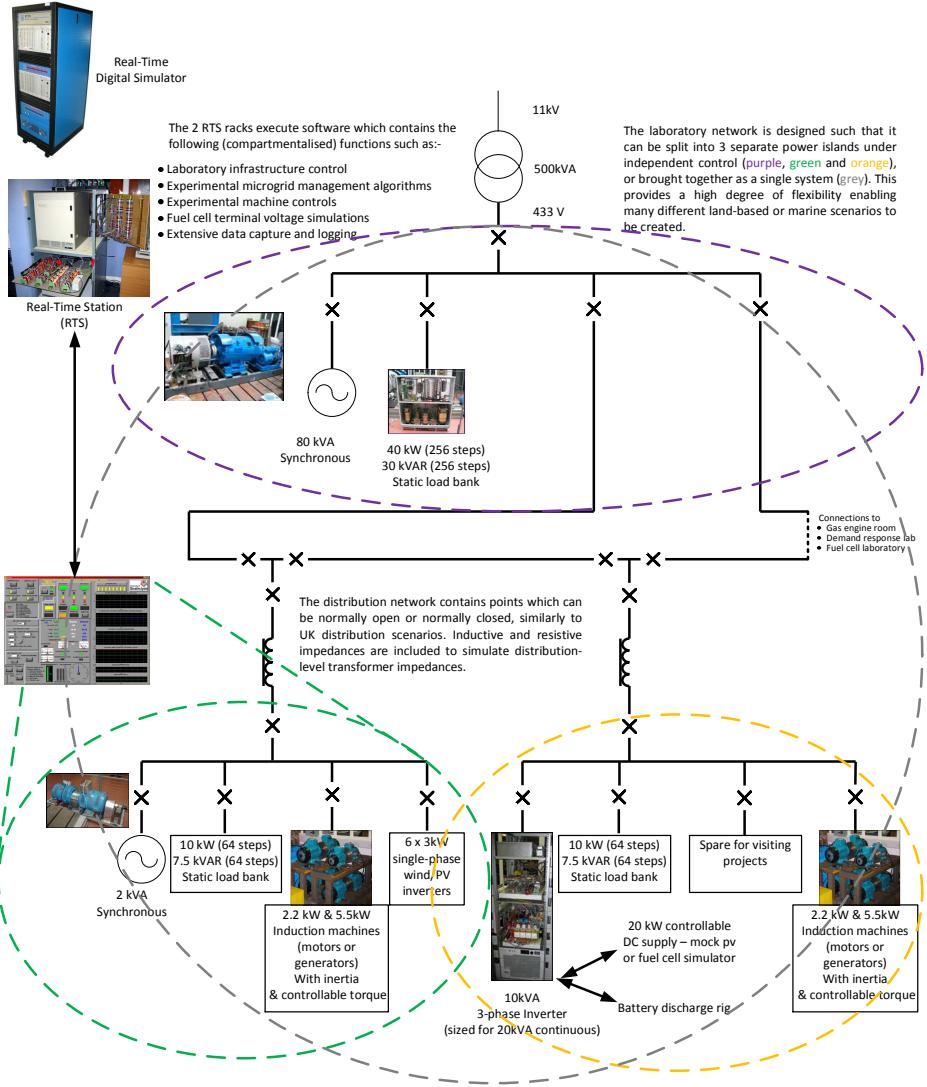
This laboratory is a three phase 430V electrical network that can split into a number of sub-networks or microgrids. The laboratory has an advanced custom designed control system with a large number of measurements being made, processed and logged. This is capable of supporting the testing and evaluation of power connected equipment, demonstration of communication system integration, along with evaluating protection systems.

The laboratory is capable of supporting and testing a number of communication protocols, including DNP-3, IEC 61850, IEC 61400 along with associated server software such as OPC.

There are three modes of operation of this facility, hardware in the loop simulation, pre-set scenario playback, and direct grid connection or islanded system operation.

1) Power Hardware-in-the-loop simulation

The 2-rack RTDS allows simulations of large power networks (up to 17 3-phase busses per rack), at simulation frame times of (typically) 50µs. The laboratory hardware downstream of the 80kVA generator and 40kW load bank can be placed as hardware-in-the-loop for this simulation, using a technique developed at the Strathclyde laboratory. The 80kVA generator must be phase-locked in real time to the simulation, and the measured currents injected back into the simulation.



2) Pre-set scenario playback

A set of sequence generators allows scenarios of frequency, voltage and demand deviations from nominal set points. The 80kVA generator and simulated customer loads can be programmed to follow these profiles, to see how the downstream network reacts. This provides a controllable and repeatable environment for standard tests, to be tried for new microgrid control algorithms.

3) Direct grid connected or islanded operation

The entire network (including the 80kVA generator and 40kW loadbank) may be directly connected to the local 433V grid, or run as a >80kVA power island. In this scenario, the 80kVA generator must be controlled as if it is grid connected or a lead/shared generator in a power island.

A mean-torque software model of a large diesel reciprocating engine can also be enabled, such that the 80kVA generator set behaves as if it is driven by such a prime mover, in a HIL environment