Hardware-in-the-Loop Test Bed and Test Methodology for Microgrid Controller Evaluation
Kumaraguru Prabakar¹, Annabelle Pratt¹, Dheepak Krishnamurthy¹, and Arindam Maitra²
¹National Renewable Energy Laboratory, ²Electric Power Research Institute

This work was authored by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by the U.S. Department of Energy Office of Electricity Delivery and Energy Reliability. The views expressed in the article do not necessarily represent the views of the U.S. Government.

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This project was funded under the DE-FOA-0000997, which supports the development and testing of advanced, commercial-grade microgrid controllers that can manage aggregated generation capacity from 1–10 MW.

This paper describes a controller hardware-in-the-loop (CHIL) and power hardware-in-the-loop (PHIL) microgrid controller test bed that was designed and constructed to evaluate the capabilities of a microgrid controller for a proposed campus microgrid.

This paper also presents a test methodology to evaluate the microgrid controller and the controller assessment through the application of different test scenarios.

Test Case A1: Normal Grid-Connected Operation with No Dispatch (Baseline)
Test Case A2: Normal Grid-Connected Operation with Dispatch
Test Case B1: Planned Separation
Test Case B2: Unplanned Separation Due to an External Fault
Test Case B3: Unplanned Separation Due to Loss of Utility
Test Case C1: Normal Islanded Operation

Conclusions:
1. This paper presented the development of a test bed for evaluating the functional capabilities of a microgrid controller.
2. The test bed incorporates both CHIL and PHIL elements in the experimental setup. A campus microgrid was modeled in a digital real-time simulator, and communications were enabled among the microgrid controller hardware and the simulated assets, circuit breakers, and loads as well as with the battery inverter hardware via a PHIL interface.
3. This paper also presents a test methodology to evaluate the microgrid controller through the application of different test scenarios. Hardware-in-the-loop simulation results provide insight into the test bed’s capabilities and the types of evaluations that could be performed by using it. Such a test bed is valuable to help microgrid controller providers, microgrid developers, and owners evaluate performance prior to field deployment.