A Generic Microgrid Controller: Islanding Demo

OVERVIEW

A microgrid is a collection of generating resources, controllable loads, and energy storage that are operated and controlled as a single entity, with at least one point of connection to the utility grid. Since microgrids can operate both in grid-connected and islanded modes, they provide increased reliability and resiliency which is required to mitigate negative impacts of climate change such as extreme weather events.

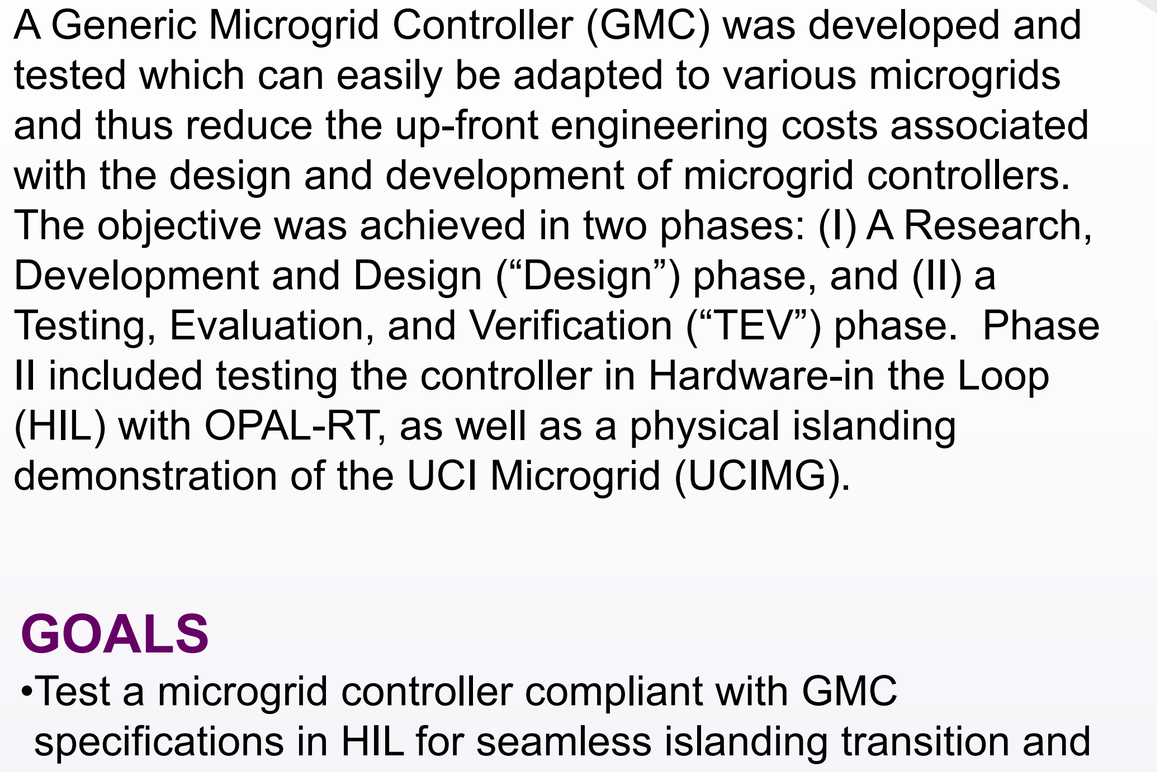
A Generic Microgrid Controller (GMC) was developed and tested which can easily be adapted to various microgrids and thus reduce the up-front engineering costs associated with the design and development of microgrid controllers. The objective was achieved in two phases: (I) A Research, Development and Design ("Design") phase, and (II) a Testing, Evaluation, and Verification ("TEV") phase. Phase II included testing the controller in Hardware-in the Loop (HIL) with OPAL-RT, as well as a physical islanding demonstration of the UCI Microgrid (UCIMG).

GOALS

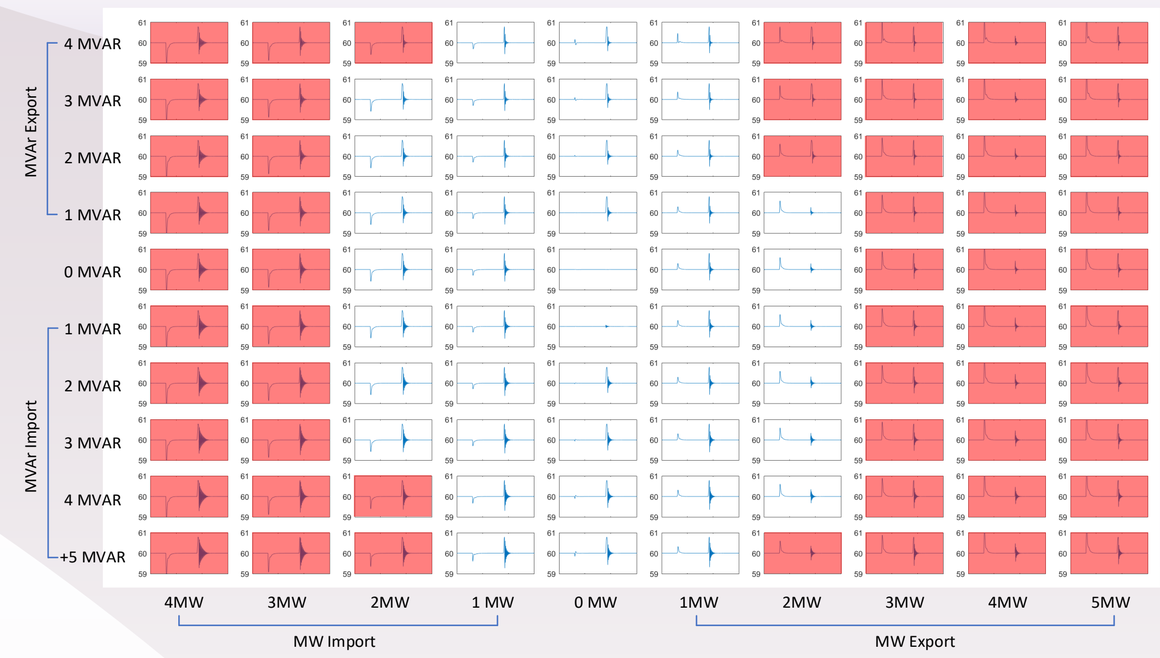
- Test a microgrid controller compliant with GMC specifications in HIL for seamless islanding transition and resynchronization
- Deploy the controller on UCIMG and conduct an islanding demonstration

RESULTS

A detailed model of the electrical distribution network containing full three-phase electromagnetic transient models of cable sections, distribution transformers, and critical system switches was developed with electrical parameters derived from existing load flow models of the UCIMG electrical system and surveyed nameplate data. This model was used to test the microgrid controller in HIL using OPAL-RT. The controller was tested for transition to islanded mode, operation in islanded mode and load changes, and reconnection and resynchronization. The results of HIL tests were used to determine a safe islanding zone. These conditions ensure a seamless transition to islanded.



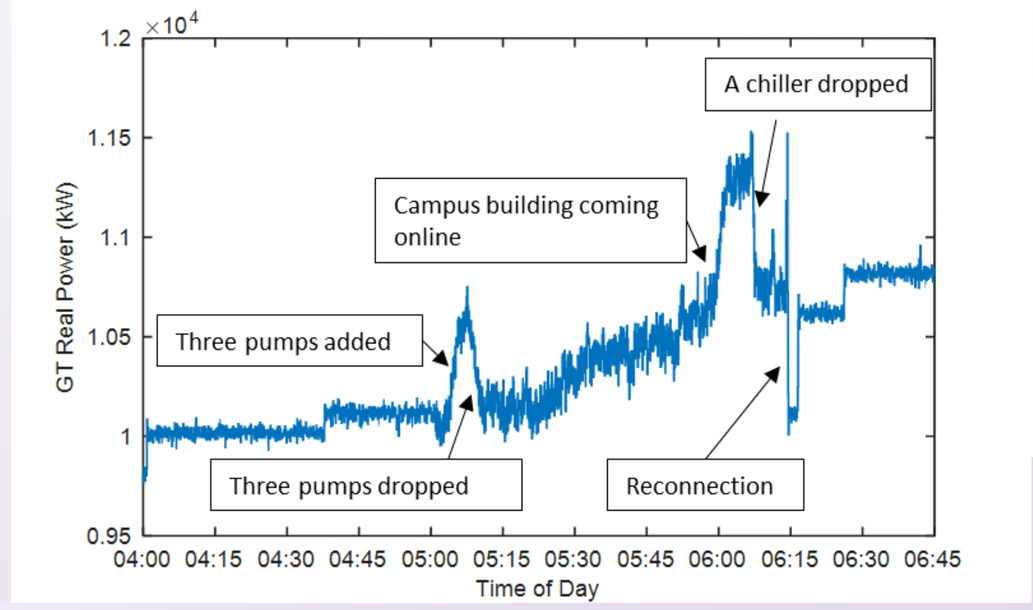
Distributed Energy Resources Available on UCIMG



Safe Islanding Zone Established by HIL Tests

RESULTS (continued)

After successful HIL tests, the controlled was deployed on UCIMG. A physical demonstration of controller operation was then performed in which the UCIMG was seamlessly transitioned to islanded mode. Loads were switched on and off to assess dispatch capacity while islanded, and after 75 minutes of islanded operation, the UCIMG was seamlessly reconnected to the grid. The entire demonstration was transparent to UCI community and all loads were served during the event.



UCIMG Load Profile During Islanded Demonstration

RECENT PUBLICATIONS/PAPERS

F. Gu, G. Razeghi, S. Samuelsen (2019). Islanding a 20MW-clase microgrid with sensitive loads. Electric Power Systems Research, Under Review

S. Samuelsen (2018). A Generic Microgrid Controller. Final Technical Report, DOE-UCI-00730.

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