

Performance Evaluation of Microgrid Management System by using a Hardware-In-Loop-Simulation Method

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Abstract. This paper presents a real time digital simulator based test system as a new method for testing microgrid management system (MMS). This system is composed of a real time digital simulator and a developed communication emulator. Real time digital simulator runs a simulation case for microgrid model and distributed generation source model. Communication module emulates communication functions of micro-sources in microgrid by transmitting the simulated signals to MMS. The MMS controls operation of micro-sources to control the power flow at the point of common coupling (PCC) and the voltage and frequency of microgrid. A prototype MMS was tested for stand-alone and grid-connected operation to verify the validation of the developed HILS system.

Key words

Microgrid, HILS, MMS, RTDS

1. Proposed HILS Test System

Proposed HILS system is a test system for management and communication functions of MMS in real-time. This system is made up of a specifically designed communication emulator and a RTDS.

and the load shedding process. In addition to this function, the MMS is responsible for the supervisory control of micro sources and the energy storage system. Using collected local information, the MMS generates power output set points and provides them to the LCs. A LC is a local controller that is located at each micro source and controls the power output according to the command from the MMS. This LC may be a PCS for RES or a governor for a synchronous generator type source.

Figure 1 shows a schematic diagram of the proposed HILS system for testing MMS in real-time. The HILS system is made up of three major parts, which are a MMS under test, a communication emulator for interfacing between MMS and RTDS and a RTDS for real-time simulation of a microgrid.

In figure 1, MMS is a device under test. A major object of this HILS system is a microgrid management function test of MMS. RTDS simulates a microgrid model including microsources, loads, distribution line in real-time. Communication emulator transfers system status and monitoring data of real-time simulated microgrid in RTDS and control command of MMS by communication methods. It is an important role in this system. MMS controls microgrid components by communication methods. For that reason, the interface between MMS and microgrid components is only communication ports. For testing management function of MMS, a real-time device for microgrid simulation must have communication methods. In our case, there is no real-time simulator with available communication methods. RTDS, a real-time power system simulator, has only hardwired interface method. Therefore, communication emulator provides an interface method between MMS and RTDS. As using a developed communication emulator, this system can test communication functions of MMS such as communication protocols.

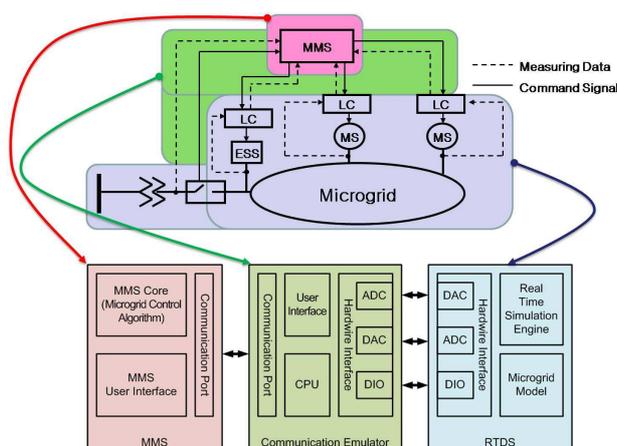


Fig. 1. The hierarchical control structure of microgrid and a schematic diagram of the proposed HILS test system

The microgrid has a hierarchical control structure as shown in figure 1. It has two control layers: MMS and local controller (LC). The MMS is a centralized controller that deals with management functions such as disconnection and re-synchronization of the microgrid