ABSTRACT

In a Microgrid system that relies on renewable energy generation, one of the most important constituent systems is the Battery Energy Storage System because of its vital role in maintaining the stability of the Microgrid in providing power to the load. However, to operate the battery, a Battery Management System is needed to ensure the battery operates at the desired working range, so that battery reliability can be maintained.

To determine the behavior of the Microgrid and the designed BMS in accordance with the desired specifications, a Hardware-in-the-Loop (HIL) Simulation has been designed using Simulink to model a DC Microgrid which consists of several sub-systems such as: An ideally designed generator and load as a tester, a bidirectional buck and boost konverter with a PI controller, and a battery system equipped with a Switched Shunt Resistor Cell Balancing type, all controlled using the BMS algorithm implemented on Arduino.

From the test results, it is found that HIL can communicate with good QoS on various inputs as long as the Arduino sample time meets. Then the PI controller with HIL was able to improve konverter performance and also succeeded in controlling cell balancing with the efficiency of pengisian and idle modes of 99% and 99.4% respectively. Finally, in testing the integrated system, the BMS can maintain the performance of the Microgrid with bus voltage and battery current parameters in various SoC conditions and generator voltage fluctuations, even though there are high voltage transients.

***Keywords*:** *Hardware-in-the-Loop, Direct Current Microgrid, Battery Management System, Cell Balancing, Konverter bidirectional*