

A Hybrid Energy Storage Module for the Emergency Energy System of the Community Shelter in Yucatán, México

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Abstract : Sierra Papacal commissary is located north of Merida, Yucatan, México, where the indigenous Maya population predominates. Due to its location, the region has an elevation of fewer than 4.5 meters above sea level, with a high risk of flooding associated with storms and hurricanes and a high vulnerability of infrastructure and housing in the presence of strong gusts of wind. In environmental contingencies, the challenge is providing an autonomous electrical supply using renewable energy sources that cover vulnerable populations' health, food, and water pumping needs. To address this challenge, a hybrid energy storage module is proposed for the emergency photovoltaic (PV) system of the community shelter in Sierra Papacal, Yucatán, which combines high-energy-density batteries and high-power-density supercapacitors (SC) in a single module, providing a quick response to energy demand, reducing the thermal stress on batteries and extending their useful life. Incorporating SC in energy storage modules can provide fast response times to power variations and balanced energy extraction, ensuring a more extended period of electrical supply to vulnerable populations during contingencies. The implemented control strategy increases the module's overall performance by ensuring the optimal use of devices and balanced energy exploitation. The operation of the module with the control algorithm is validated with MATLAB/Simulink® and experimental tests.

Keywords : batteries, community shelter, environmental contingencies, hybrid energy storage, isolated photovoltaic system, supercapacitors

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