Abstract

Batteries are commonly employed as energy storage systems for PV stand-alone microgrid. The instantaneous, diurnal, and seasonal variation in load and PV generation degrades the battery rapidly. This affects the life cycle cost of the system. This paper aims to combine battery storage with supercapacitor (short term) and hydrogen storage (long term) and investigate and compare the reliability and annualised life cycle cost of the system with manufacturers given life and by incorporating battery degradation. The hybrid storage system is simulated for two stand-alone PV microgrid contexts, i.e. off-grid telecom tower and an off-grid welding shop. From the simulation results, it is obtained that battery degradation is lowered with the use of hybrid storage. Based on the reliability (loss of load probability) and per unit cost of the system, the designer/consumer can select what type of storage combination will be suitable for the PV microgrid. As an example, the isolated welding shop with annual energy demand of 1408.5 kWh and the addition of supercapacitor improve the life of battery from 2 years to 8 years, thereby improving life cycle cost of the system from 18 ₹/kWh to 13 ₹/kWh. In addition, the daily LOLP is reduced from 7.2% to zero.

Keywords

Battery degradation, Hybrid energy storage, Life cycle costing, Loss of load probability, Microgrids