Abstract

A photovoltaic-battery energy storage system (PV-BESS) based grid-tied Microgrid is presented in this paper. Maintaining grid voltage and controlling inverter current, coupled with uncertainties such as irradiation changes, are some of the challenges that affect grid-connected PV microgrids' power generation. To address these, an adaptive control mechanism for a three-phase inverter utilizing an Adaptive Neuro-fuzzy Inference System (ANFIS) was proposed in this paper. To effectively integrate the DC power sources(PV-BESS) into the proposed distribution network, an inductance-capacitance-inductance (LCL) filter was designed and utilized due to its capability to improve the isolation of grid impedance. The designed proposed inverter voltage and current controller employed a dq transformation framework technique. This enables the PV-BESS power source synchronization into a distribution network. The PV plant, BESS, and the modified IEEE14-bus distribution network test system were modeled and simulated using MATLAB/SIMULINK Software. The maximum power point tracking(MPPT) technique was utilized to maximize PV power generation. Additionally, in accomplishing stable power flow management, an ANFIS-based buck/boost converter was used for controlling the BESS. Operating scenarios of PV plant irradiance variation were assessed, focusing on the impact of PV plant irradiance variation on power flow. The findings demonstrate that, under system current changes from 200A, 315A, 400A, and 600A, respectively, controlling an inverter with ANFIS resulted in less phase-phase inverter current loss between 0.05A and 1.7A than using a PI controller, which has a current loss between 0.98A and 2.4A. Furthermore, the proposed adaptive control mechanism maintains the proposed inverter input voltage at 600 V and grid voltage at 380 V. In conclusion, the proposed controller was able to adapt to solar PV irradiation changes, system voltage, and current variation when examined under PV plant irradiance variations.