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A Microgrid Based on Wind Driven DFIG, DG and Solar PV Array for Optimal Fuel Consumption

In this project, a green energy solution to a micro-grid for a location dependent on a Diesel Generator (DG) is presented to meet its electricity requirement. This micro-grid is powered by two renewable energy sources namely wind energy using Doubly Fed Induction Generator (DFIG) and solar Photo Voltaic (PV) array. The solar PV array is directly connected to common DC bus of back-back Voltage Source Converters (VSCs), which are connected in the rotor side of DFIG. Moreover, a Battery Energy Storage (BES) is connected at same DC bus through a bidirectional buck/boost DC-DC converter to provide path for excess stator power of DFIG. The extraction of maximum power from both wind and solar, is achieved through rotor side VSC control and bidirectional buck/boost DC-DC converter control, respectively. A modified Perturb and Observe (P&O) algorithm is presented to extract maximum power from a solar PV array. Moreover, the control of load side VSC, is designed to optimize the fuel consumption of DG. A novel generalized concept is used to compute the reference DG power output for optimal fuel consumption. The micro-grid is modelled and simulated using SimPowerSystems tool box of MATLAB, for various scenarios such as varying wind speeds, varying insolation, effect of load variation on a bidirectional converter and unbalanced nonlinear load connected at Point of Common Coupling (PCC). The DFIG stator currents and DG currents, are found balanced and sinusoidal. Finally, a prototype is developed in the laboratory to validate the design and control of it

Domain: Power Systems _ Hybrid Systems

Technology: Electrical