

Abstract

The power system network is changed to a new dimension by the incorporation of microgrids in its structure. The microgrids are usually formed within the distribution networks and it will control and coordinate the sources and loads in a clearly defined boundary. The microgrid exchanges power with the grid in grid connected mode of operation and operate in islanded mode due to lack of power generation, reliability, security, and occurrence of faults in the main grid.

The optimal energy management among distributed energy resources (DERs) in a microgrid is pivotal for its satisfactory operation. Nowadays, as the demand for heat and electricity increases monotonically, combined heat and power (CHP) units are utilized in the microgrid. Further, the microgrid integrates the renewable energy sources (RES) such as photovoltaic (PV) and wind turbine (WT) units to a larger extent for sustainable energy development. The storage system can operate as a source or sink and thus providing flexibility to the microgrid operation. The optimal economic-emission dispatch is acquired through optimal energy management of different types of sources in the microgrid. In this thesis, optimal scheduling of CHP units, RES, shunt capacitors, and a heat boiler is determined in grid connected mode of microgrid and zero bus concept based microgrid (ZBMG). In ZBMG, a predefined amount of power is injected from the grid. Load models have gained significant interest due to technological innovations in the power system. This thesis aims to conduct the optimal allocation and scheduling of CHP units, RES, shunt capacitors, and heat boiler for various voltage dependent load models in case of grid connected microgrid system. In this thesis, multiple objectives such as total cost, emission, and energy loss are solved using fuzzy technique and particle swarm optimization (PSO) algorithm. Also, point estimate method (PEM) is implemented to handle the uncertainty in renewables.

Finally, the planning of droop controlled islanded microgrid with biomass DERs, battery storage, and shunt capacitors is presented in this dissertation by considering life period of sources and annual load growth.

Keywords: Optimal dispatch, zero bus concept based microgrid, particle swarm optimization, fuzzy, uncertainty, load model, droop.