

Name: Mohammad Kalimullah

Supervisor: Dr. Sheeraz Kirmani

Department: Electrical Engineering

Title: “Optimal Operating Strategies for the Integration of Distributed Power Generation with Microgrid”

ABSTRACT

Distributed generation, also distributed energy, on-site generation or decentralized energy is electrical generation and storage performed by a variety of small, grid-connected devices referred to as distributed energy resources (DER). Distributed generation and storage enables collection of energy from many sources and lower environmental impacts and improve security of supply. Microgrids increasingly employ a mixture of different distributed energy resources, such as solar hybrid power systems, which reduce the amount of emitted carbon significantly.

The integration of distributed power generation with microgrid needs the analysis of the plant so that it could operate optimally. In this thesis, a solar photovoltaic rooftop power plant comprising twenty numbers of solar panels of cumulative capacity of 2 kW has been analysed. The solar plant comprises the panels of monocrystalline, polycrystalline and thin film technology installed on the rooftop of Faculty of Engineering and Technology, Jamia Millia Islamia building. A PVSyst simulation software has been used to simulate and analyze the effect of radiant flux on a photovoltaic module made of polycrystalline silicon (p-Si) of 500 Wp.

For optimal operation of distributed power generation integrated with microgrid, the power loss under voltage ripple with double line frequency, efficiency and degradation factor analysis is important. The 15-minute data have been collected from a solar photovoltaic

generating station installed on the rooftop of Faculty of Engineering and Technology, Jamia Millia Islamia building and degradation of solar panels have been analyzed and reported. Degradation factor varies between 0.55-0.95 percent per year.

The distributed energy resources integrated with microgrid makes the grid unstable but by using battery energy storage system (BESS), the instability problem in existing grid minimizes. A simulink model has been investigated with fuzzy members as PV power, battery power, load power, secondary power and state of charge (SOC). The charging and discharging of grid connected battery energy storage system with and without fuzzy control scheme has been analyzed and found that the load power, battery output power and the state of charge of the battery increases through fuzzy control scheme.

Distributed power generation integrated with microgrid operate efficiently when the microgrid reduces the green house gasses and mitigate the air pollution. A 25 kW solar photovoltaic power plant has been installed on a rooftop of New Horizon School building in New Delhi. The analysis shows that EPBT is lower than the lifetime of the plant and there are significant environmental advantages after EPBT period is over. Studies indicate that significant amount of air pollutants like nitrogen oxides, carbon monoxide, hydro carbons and particulate materials emitted from diesel generator sets can be mitigated.

Distributed power generation connected with microgrid is the only solution of power crisis facing by developing countries. The fossil fuel is going to deplete and the power crisis may arise globally in near future. Since the distributed power generation is modular in nature, more flexible and installed near the load centers minimizes the power loss, increases efficiency, and reduces the current carrying capacity of the cable which minimizes the transmission cost.

