Faculty of Engineering
Electrical Power and Machines Department

Power Management in a micro-distribution system including distributed generation

M.Sc. Thesis
By

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Submitted in partial fulfillment of the requirements for the
M.Sc. degree in
Electrical Engineering

Supervised by:
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STATEMENT

This Thesis is submitted to Ain Shams University in partial fulfillment of the requirements of Master of Science degree in Electrical Engineering.

The work in this thesis has been carried out by the author at the Department of Electrical Power and Machines, Ain Shams University. No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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Abstract

Microgrids are usually a part of electrical distribution system, that include combination of loads, distributed generation, and energy storage systems, they are capable of supplying power to loads in the islanded mode and grid connected mode. In grid connected mode the distribution substation is the main source of power. Hence distributed generation and storage units can be controlled in this mode to obtain techno-economical-environmental benefit. On the other hand, in the islanded mode the distributed generation and storage units are the only sources of power. Hence the main challenge in this mode is to supply loads without interruption as much as it could be. This could be achieved by utilizing a rigid operation strategy to balance generation and demand.

In this work, a two-stage operation strategy is proposed to operate microgrids in the islanded mode. In the first stage, an operational planning is performed in the grid connected mode to prepare the operating set points of the available resources in case of islanded mode. This stage is based on the forecasted generation data and load data for the supply system and is performed periodically (e.g., every 30 minutes). The aim of this stage is to minimize network losses if the forecasted generation is expected to be more than the forecasted demand. Otherwise, the load shedding is minimized if the forecasted generation is expected to be less than the forecasted demand. The second stage is a real time operation stage implemented using a multiagent (MAS) system. This stage is based on actual field measurements to fine tune the set points obtained from the forecasted data used in the first stage. This stage is initiated once the islanded condition is detected.

The first stage is implemented in the MATLAB environment while the second stage is implemented in the JADE environment, which is an open source agent platform based on Foundation of Intelligent Physical Agents (FIPA). Different case studies with different generation and demand mixes are performed to validate the proposed operation strategies.

Keywords: microgrid, islanded systems, multi-agent system, optimal power flow, power management, centralized control, hierarchical control.

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