Impact of the distributed generation on the protection of power system grid

By

Ahmad Gamal Ahmad Abd-Elkader

Teaching Assistant, Electrical Engineering Department

Faculty of Engineering, Fayoum University

A thesis submitted in partial fulfillment

Of

The requirements for the degree of

Doctor of Philosophy

In

Electrical Power and Machines Engineering

(Power System Protection)

Electrical Engineering Department

Faculty of Engineering, Fayoum

Fayoum University

2020

Impact of the distributed generation on the protection of power system grid

By

Ahmad Gamal Ahmad Abd-Elkader

Electrical Engineering Department

Faculty of Engineering

Fayoum University

Supervision

Prof. Dr. M. Magdy Eteiba

Electrical Engineering Department
Faculty of Engineering, Fayoum University

Associate .Prof. Saber Mohamad Saleh

Electrical Engineering Department
Faculty of Engineering, Fayoum University

ABSTRACT

Distributed generation units (DGs) are a modern technology that has the ability to improve the power system efficiency, reliability, and increases the system flexibility. However, the integration of distributed generation units creates additional problems and challenges to the effective operation and protection of the distribution network. The most important issue related to DG units is the islanding operation**.** The main objective of this thesis is to deal with this problem moreover proposes integrated solutions to solve it.

This thesis proposes new islanding detection methods. In chapter 3, In order to reduce the non-detection zone and improve the accuracy of the islanding detection methods, a passive islanding detection method for multiple DG units is proposed. The proposed strategy depends on a main index called the voltage index to detect islanding operation. Also, the proposed strategy uses the line current of the front transmission line at each DG bus as a secondary index. From the results of simulation for the study cases under consideration, it is noted that the proposed strategy can easily detect islanding operation.

In chapter 4, another passive islanding detection method for multiple DFIG based DG units is proposed. The proposed scheme is based on a new index entitled the islanding index to detect the islanding event of DG units. The proposed islanding index mainly relies on the changes in the frequency and voltage. Also the proposed scheme utilizes the zero sequence voltage and the harmonics index as further indices to assist the detection of the islanding condition. Disturbances such sudden load changes or DG tripping or capacitor switching have no effect on the proposed strategy. Furthermore, the proposed methods have zero non detection zone.

In chapter 5 the results of the proposed islanding detection methods introduced in chapters 3 and 4 are verified by swapping the models used to get the results mentioned in chapters 3 and 4.

Finally, Chapter 6 is conclusions and comparison between the proposed solutions explained in this thesis.