Ain Shams University
Faculty of Engineering
Electrical Power & Machines Department

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
CAIRO - A. R. E.

Voltage Stability in Power Systems with Different Wind Energy Generating Capacities

By

Eng. Marwa Salah Hassan H. El-Sabaa

A THESIS

Submitted in partial fulfillment of the requirements for the degree of PhD in Electrical Engineering

Supervised by:

Prof. Dr. Mohamed Abdel-latif Badr
Prof. Dr. Abla Soliman Attia
Dr. Rania AbdelWahed Sweif
Dr. Iman Hassan Beshr

Cairo 2014

APPROVAL SHEET

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I wish to present my success

To My Parents…

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List of Abbreviations

DG	Distributed Generator
MV	Medium Voltage
LV	Low Voltage
DFIG	Doubly Fed Induction Generator
KVL	Kirchhoff's Voltage Law
KCL	Kirchhoff's Current Law
GHG	Green House Gases
RES	Renewable Energy Sources
ppm	Part Per Million
PVs	PhotoVoltaic Units
WTGs	Wind Turbine Generators
GA	Genetic Algorithm
AI	Artificial Intelligence
VPII	Voltage Profile Improvement Index
LLRI	Line Losses Reduction Index
VSM	Voltage Stability Margin

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ABSTRACT

The thesis presents a detailed study of the influence of distributed generation penetration in distribution networks towards the enhancement of voltage profile on distribution feeders and voltage stability margin determination so that no voltage instability problem may occur. Distributed generation in the modern systems may include both renewable sources such as wind and PV installations, as well as conventional such as diesel-electric units. The main purpose of the implementation of distributed generation is to avoid the voltage collapse and maintain the voltage profile over feeders. Hence avoiding any probability of voltage instability as well as reduction of power losses over lines. The thesis also presents a survey of the relevant published studies on this subject. The research work here is divided according to subjects such as types of DG applied, methods of optimization used, and renewable sources of energy.

The problem formulation and methods of DG application in the distribution network are also presented. The methods of problem solution using computer modeling and simulation techniques is described and thoroughly discussed.

Detailed studies of different types of DG applicable in distribution systems are considered and performed. Studies show the differences between famous DG technologies and conditions of their integration with distribution networks.

The thesis is divided into two main parts concerned to the two presented studies. The first part is concerning by the voltage profile and losses study. The study is performed on two phases. First is the study the effect of integrating different types of distribution generators on the voltage profile. Second is the study of the effect of integrating the wind turbine generators in different penetration levels into the distribution network on the voltage profile and the line losses. The voltage profile and losses study is applied to the two case studies.