Faculty of Engineering Cairo University

Multi Objective Optimization for Distributed Generation Allocation in Distribution Systems

By

Mena Ragy Amen Girgis

A Thesis Submitted to the

Faculty of Engineering at Cairo University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science

In

Electrical Power and Machines Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY

GIZA, EGYPT

2015

Multi Objective Optimization for Distributed Generation Allocation in Distribution Systems

By

Mena Ragy Amen Girgis

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science
In
Electrical Power and Machines Engineering

Under the Supervision of

Prof. Dr.
Zeinab H. M. Osman

Electrical power Engineering Department
Faculty of Engineering,
Cairo University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT

2015

Multi Objective Optimization for Distributed Generation Allocation in Distribution Systems

By

Mena Ragy Amen Girgis

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
Master of Science
In
Electrical Power and Machines Engineering

Approved by the

Examining Committee

_____

Prof. Dr.Zeinab H. M. OsmanThesis Advisor
Professor in Electrical Power and Machines Department

_____

Prof. Dr. Hussein Attia Internal Examiner
Professor in Electrical Power and Machines Department

_____

Prof. Dr. Ebtisam Mostafa Mohamed SaiedExternal Examiner
Professor in Electrical Engineering Department
Banha University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2015

Declaration for the Master's Thesis

I hereby affirm that the master thesis at hand is my own written work and that I have used no other sources and aids others than those indicated. Only the sources cited have been used. Those parts which are direct quotes or paraphrases are identified as such.

Mena Ragy Amen

Engineer: **Mena Ragy Amen**
Date of Birth :08 / 03 / 1987
Nationality :Egypt
E-mail : **eng_mena_ragy@yahoo.com**
Phone. : **01003783770**
Address : **Al Zaytoun - Cairo**

Registration Date :1 / 10 / 2010
Awarding Date : / / 2015
Degree :Master of Science
Department :Electrical Power and Machines Engineering

Supervisors : Prof. Dr. Zeinab H. M. Osman

Examiners :Prof. Dr. Zeinab H. M. Osman
Prof. Dr. Hussein Attia
Prof. Dr. Ebtisam Mostafa Mohamed Saied

Title of Thesis : **Multi Objective Optimization for Distributed Generation Allocation in Distribution Systems**

Key Words: **Distributed Generation (DG)- Multi objective optimization- DG Cost- Distribution system losses- Voltage Deviations.**

Summary :

The main contributions of this thesis are using multi objective function to formulate DG allocation problem in Distribution System and considering economical aspects. This thesis presents a model which differentiates between different technologies of DG applications. The objectives are minimization of capital and operation cost of DG units; minimization of system peak loss; and minimization of voltage deviations with respect to nominal bus voltage. The proposed methodology can determine the optimal solution in case of only one objective function, as well as give a compromise solution according to the considered objectives. The proposed algorithm has been applied on IEEE 69- bus system. A comparative results of the given in literature studies of 69 standard distribution system demonstrate the superiority of the developed model.

Acknowledgments

It's my honor to extend my gratitude and thanks to my supervisor, teacher and mentor

Prof. Zeinab H. Osman, electrical power and machine department, Cairo University for her excellent thesis supervision and the guidance she extended. She provided me the great opportunity to work on this thesis and meticulous help regarding this research. What I am today is because of my Father, my family and friends. They have been blessing me with their unconditional support and love throughout my life. They are always there for me for everyups and downs of my life. I am grateful to all of them.

Whatever I have tried to present in this thesis would remain incomplete, unless and until I extend my heartiest thanks to all people who have spent their valuable time to help and explain to me all that I want to know; words will fall short in explaining their dedication.

Table of Contents

List of Tables

List of Figures

Nomenclature

AC	Alternating Current
AGC	Automatic Generation Control
AIS	Air-insulated Switchgear
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
DC	Direct Current
DG	Distributed Generation
DiSco	Distribution Companies
DS	Distribution System
EIRI	Environment Impact Reduction Index
EMS	Energy Management System
EPQ	Electric Power Quality
ES	Evolution Strategy
FOR	Forced Outage Rate
GA	Genetic Algorithm
GIS	Gas-insulated Switchgear
IEC	International Electro-technical Commission
IEEE	The Institute of Electrical and Electronics Engineers
ISCCS	Integrated Solar Combined Cycle Systems
kV	Kilo Volts
kVA	Kilo Volt Amper
kW	Kilo Watt
LCOE	Levelized Cost of Energy
LV	Low voltage
LLRI	Line Loss reduction Index
M	Total number of lines (sections plus tie lines)
MOA	Multi-objective optimization algorithm
MHD	Magneto Hydro Dynamic
MW	Mega Watt
NERA	National Economic Research Association