



SMART POWER GRID OPTIMAL DESIGN, ANALYSIS AND CONTROL INCLUDING DISPERSED RENEWABLE ENERGY GENERATION

By

Eng. Amal Abdel-Aal Hassan Mohamed

**A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfilment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY
in
ELECTRICAL POWER & MACHINES ENGINEERING**

**FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
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**Title of Thesis: Smart Power Grid Optimal Design, Analysis and Control
Including Dispersed Renewable Energy Generation**

Key Words: Distributed Renewable Energy Generation; Smart Grid; Multi-Objective Genetic Algorithm; Voltage Stability; PV and Wind Systems Control.

Summary:

This thesis presents an optimal design of a smart power grid based on distributed renewable energy generation, especially photovoltaic (PV) and wind turbines (WT). This includes optimal allocation and sizing to minimize the total power losses, minimize the total investment cost and improve the voltage stability. This thesis also proposes an advanced smart control for PV and WT systems aiming to track the maximum power, to control active and reactive power in order to deliver high power quality. Finally, dynamic modeling and simulation is presented to monitor the proposed systems and its mutual interactions to the tested power network.

ACKNOWLEDGEMENT

First of all, I Praise ***ALLAH***, the almighty, merciful and passionate, for providing me this opportunity and granting me the capability to proceed. I would like to express my sincere gratitude to my advisor ***Prof. Hosam Kamal Mohamed Youssef*** for the continuous support of my Ph.D. study and related research, for his patience, motivation, and immense knowledge. His guidance helped me during the time of research and writing of this thesis. I want to express my deep thanks to my advisor ***Prof. Faten Hosny Hussein Fahmy*** for the trust, the insightful discussion, offering valuable advice, for patience and guidance during the whole period of the study. I would like to thank ***Prof. Abdel Shafy Abdel-Kadr Nafeh*** for all his advice and support. Besides my advisors, I would like to thank and appreciate the rest of my thesis committee: ***Prof. Mohamed Abdel-Latif Badr & Prof. Mohamed Salah El-Sobki***, for their insightful comments and encouragement, and also for the questions which helped me to widen my research from various perspectives. My sincere thanks and appreciation also go to ***Prof. Mohamed Ahmed Hassan El-Sayed*** who helped me in preparing the research proposal of my thesis and also for his continuous support and encouragement. I would like to express my heartfelt gratitude to ***My Beloved Mother***, without her continuous love, Prayer, support and encouragement I never would have been able to achieve my goals. I am also grateful to ***all my family members*** for the continuous encouragement, concern and support. Last but not the least; I would like to thank ***my colleagues*** at the Electronics Research Institute for their cooperation and encouragement during the execution of my work.

DEDICATION

*This Thesis Is Dedicated To:
The Soul of My Beloved Father*

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