CONTROL OF WECS USING DOUBLY-FED INDUCTION GENERATOR

By

Eng. Mohamed Elsayed Abdallah

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
2016

CONTROL OF WECS USING DOUBLY-FED INDUCTION GENERATOR

By

Eng. Mohamed Elsayed Abdallah

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. Adel D. Shaltout

…….

Electrical Power and Machines Department
Faculty of Engineering, Cairo University

Prof. Dr. Abdel Latif Elshafei

…….

Electrical Power and Machines Department
Faculty of Engineering, Cairo University

Asst. Prof. Osama M. Arafa

…….

Power Electronics and Energy Conversion Department
Electronics Research Institute

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2016

CONTROL OF WECS USING DOUBLY-FED INDUCTION GENERATOR

By

Eng. Mohamed Elsayed Abdallah

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. Adel D. Shaltout Faculty of Engineering, Cairo University	Thesis Main Advisor ……
Prof. Dr. Mahmoud M. Abdel Hakiem Faculty of Engineering, Cairo University	Internal Examiner ……
Prof. Dr. Mohsen Taha El-hagery Power Electronics and Energy Conversion Department, Electronics Research Institute	External Examiner ……

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2016

Engineer: Mohamed Elsayed Abdallah Abdelmagied
Date of Birth: 03 / 01 / 1989
Nationality: Egyptian
E-mail : eng.msa12@eri.sci.eg
Phone. : +201151141130
Address : 33 Tahrir st., Dokki, Giza, Egypt.

Registration Date: 1/10 / 2013
Awarding Date: / / 2016
Degree: Master of Science
Department : Electrical Power and Machines Engineering

Supervisors : Prof. Dr. Adel Diyaa Eldin Shaltout
Prof. Dr. Abdel Latif Elshafei
Assoc. Prof. Dr. Osama M. Arafa (Electronics Research Institiute)

Examiners : Prof. Dr. Adel Diyaa Eldin Shaltout
Prof. Dr. Mahmoud Mohammed Abdel Hakiem
Prof. Dr. Mohsen Taha El-hagery (Electronics Research Institute)

Title of Thesis: **CONTROL OF WECS USING DOUBLY-FED INDUCTION GENERATOR**

Key Words: Double-fed induction generator, Wind energy conversion systems, Wind turbine emulator, Maximum power point tracking.

Summary:

This thesis provides the complete design of DFIG-based WECS. This system is consisted of three parts the GSC, PMSM for wind emulation and the RSC which drive the DFIG. The performance of the system has been studied in the simulation and the experimental work using different types of controllers (PI-controller, MRAC and L1 adaptive controller).

The main advantage of DFIG system for WECS is that it offers separate real and reactive power controller, like a synchronous generator, even though the ability to run asynchronously. Another advantage is that the back-to-back power converter doesn't have to handle the system rated power, it just handles a fraction of the total generator power depending on the selected speed range. The typical speed range of this system is $\pm 30\%$ around the synchronous speed.

Acknowledgments

Most of all thanks to the God who gives me the strength while doing this work.

I would like to express my sincere gratitude and thanks to my supervisor Prof. Adel Shaltout for his supervision, continued advice, and helpful suggestions.

I would also like to express my sincere appreciation and thanks to my supervisor Prof. Abdel Latif Elshafi for his continuous help, support and advice.

My sincere thanks to my supervisor Assoc. Prof. Osama M. Arafa for his assistance specially in selecting thesis topic, kind encouragement, and experimental validation of the thesis.

I would like to express my gratitude to Assoc. Prof Dr. Ahmed Mansour, Dr. Ghada A. Abdel Azziz, Eng. Alaa Omar, Eng. Mohamed Samir, Prof. Hanafi H. Hanafi and Prof. Naser Abdel Rehim for their help and advices.

My sincere thanks to the Electronics Research Institute for the financial support of this research. Thanks to the Power Electronics and Energy Conversion Department for providing facilities.

My thanks to everyone stands beside me even with a word encouragement.

Eng. Mohamed Elsayed Abdallah

Dedication

TO

My parents, my brothers and my sister.

Table of contents