STUDYING THE EFFECTS OF DIFFERENT WIND FARM TOPOLOGIES ON SWITCHING OVER VOLTAGES

By

Ahmed Ragab Abd El Aziz Aly

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

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Title of Thesis:

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Key Words: Wind Farm Topologies, Switching Over Voltages, Wind Turbines Transformers

Summary:

Switching processes are frequently repeated in wind farms which may cause destructive over-voltages to the wind turbines components. This problem becomes prominent in almost all wind farms. This thesis establishes a transient frequency-dependent model using DIGSILENT software to simulate switching actions in a real wind farm (ZAFRANA wind farm in Egypt). The main purpose of this work is to show the effect of the different wind farm topologies on the value of the transient over-voltage peak. The radial design of ZAFRANA wind farm is firstly simulated under different energizing events. The topology is then changed to be a single side ring, double sided ring and star topologies. Simulations under the same switching conditions are simulated and analysed in each topology. The over-voltages are recorded in each case across the wind turbines transformers. The results show that the radial topology shows the highest over-voltages among all topologies. Transformers in the single sided ring and double-sided ring topologies suffer less transient over-voltage compared to that in radial and star topologies. A new switching methodology is suggested in the radial topology to maintain the radial design benefits over the over-voltage problem. The proposed splitting switching of radial feeder reduces the over-voltage level to a value can be mitigated by the exiting protective devices.

This work is gratefully dedicated to:

My dear mother and my dear father

ACKNOWLEDGMENTS

Foremost, all praise be to **ALLAH**, who enabled me to accomplish this work successfully.

Then, I would like to express my sincere gratitude and appreciation to my supervisors; Prof. Dr. Mahmoud Ibrahim Gilany (Cairo University), Dr. Moustafa Ahmed El Shahed (Cairo University) and Dr. Mahmoud Mohammed El Sayed (Cairo University), for their valuable advice and suggestions that improved the whole thesis and also their patience and encouragement throughout the period of the research.

Furthermore, I would like to express my deepest gratitude and thanks to all members in ZAFRANA wind farm, for their great support during my study and for their insightful discussions, and kind help.

Finally, I can’t forget to express my deep thanks and sincere gratitude to my dear parents for their patience, strong encouragement and kind support.

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