Yarmouk University

Hijjawi Faculty for Engineering Technology

Feasibility Study Of A Hybrid Wind/PV System Connected To The Jordanian Grid

A Thesis Presented to
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In Electrical Power Engineering

By
Hussein Mohammad Khalaf Al-Masri

Supervisor
Dr. Fathi Amoura

Irbid, Jordan

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By:

Hussein Mohammad Khalaf Al-Masri

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science, The Department of Electrical Power Engineering, Yarmouk University, Irbid, Jordan

Approved by:

Dr. Fathi Amoura ...................................................(Chairman)
Associate Professor of Power Engineering, Yarmouk University.

Dr. Abedalgany Athamneh ......................................(Member)
Assistant Professor of Power Engineering, Yarmouk University.

Dr. Abdulla Al-Zyoud ..........................................(Member)
Associate Professor of Power Engineering, Al-Balqa University.

July, 2012
I would like to thank my mother for her encouragement, love and sacrifices and to my father for his patience, advise, love and support. To my mother and to my father I dedicate this work.

Hussein Al-Masri
ACKNOWLEDGMENT

At the outset, I would like to offer a word of thanks to my parents, sisters and brother who deserve more than words of gratitude. I don't know how to thank them, but it was their ever-present inspiration, encouragement and support, both emotional and spiritual, that have seen me through this very critical period. Their prayers have instilled in me the strength to patiently succeed, as I feel I have today.

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Eng.Hussein Al-Masri
ABSTRACT

Al-Masri, Hussein Mohammad Khalaf, feasibility study of hybrid wind/PV system connected to the Jordanian grid.

A MATLAB software and Hybrid Optimization Model for Electric Renewables (HOMER) software are used to investigate the feasibility of connecting wind/PV hybrid system to the Jordanian grid.

The data collected from formal organizations (Royal Scientific Society, National Center for Research and Development and Ministry of Energy and Mineral Resources) indicates that Ras Elnaqab (located south of Jordan) is an optimal location. This is because it enjoys to be one of the highest yearly average of both wind speed and solar radiation. It is interesting to know that it is rarely to locate a site that enjoys both high wind speed and high solar radiation. Normally, locations with high speed are deprived from high solar radiation and vice versa.

From the daily load data for a whole year, an average daily load curve for each month of the year has been calculated.

These data has been supplied to HOMER software and from the interaction with MATLAB software; two important results are calculated. The first is sharing percent between the wind energy (77.62%) and the PV energy (22.38%).

The second result is sizing the units. i.e. size of each wind turbine and their numbers (38 wind turbines each of 1.5MW) and size of PV panels and their numbers (76,124 each of 280 Watt).

The study indicates that wind/PV hybrid system sells to and purchases kWhr from the national grid given that the local load is satisfied at any time. The net result (for the whole year of 2011) is 2,254,382 kWhr to be sold to the national grid.

In conclusion, the application is feasible.

Keywords — HOMER, Hybrid wind/PV power system, feasibility study.
LIST OF SYMBOLS

$PV$ : Photo-voltaic.

$HAWT$ : Horizontal Axis Wind Turbine.

$VAWT$ : Vertical Axis Wind Turbine.

$BTU$ : British Thermal Unit.

$HOMER$ : Hybrid Optimization Model for Electric Renewables.

$DC$ : Direct Current.

$AC$ : Alternating Current.

$NPC$ : Net Present Cost in $.

$COE$ : Cost Of Energy in $/KWh.

$C_p$ : Power Coefficient.

$V_{mp}$ & $I_{mp}$ : Voltage and Current at maximum power extracted from PV module.

$RSS$ : Royal Scientific Society.

$NCRD$ : National Centre for Research and Development.

$EC$ : Energy Centre.


$JD$ : Jordanian Dinar.

$RF$ : Renewable Fraction.

$RPM$ : Revolutions Per Minute.
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