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قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها

علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

Ain Shams University
Faculty Of Engineering
Electronics and Communication Engineering Department

Supercapacitors Applications in Photovoltaic Systems

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STATEMENT

This thesis is submitted to Ain Shams University for the degree of Master of Science in Electrical Engineering.

The work included in this thesis was carried out by the author at the Electronics and Communications Engineering Department, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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ABSTRACT

The economics of PV systems is a very important topic. The cost of generated kwh obtained from PV system is always compared with the cost of generated kwh obtained from conventional systems. Recently, the cost of PV modules has drastically decreased so that the cost of generated kwh of PV systems is significantly dropped. However, the stand-alone systems include battery storage to guarantee power supply day and night. As battery storage increases, the system Reliability increases, but the increase of battery storage size, increases the cost of generated kwh. The decision of how storage size is selected depends on the required reliability. For critical loads, such as refrigerator used to keep drugs in remote area, the reliability should be 100% and it is allowed to be less than 100% for loads such as lighting, it is allowed to have reliability less than 100% if lower cost is required. Thus, the accepted Reliability depends on system design vision. This thesis presents a study on a stand-alone photovoltaic (PV) system to provide the required electricity for a single residential household in a remote area. The complete design of the suggested system is carried out, such that the site radiation data and the electrical load data of a typical household in the considered site are taken into account during the design steps. Also, the life cycle cost (LCC) analysis is conducted to assess the economic viability of the system. The results of the study encouraged the use of the PV systems to electrify in remote sites of tropical areas. This thesis presents a study on the design and economic analysis of a stand-alone PV system to provide the required electrical energy for a single residential household in Egypt. The Egyptian location selected is Cairo (30^{o} N). This thesis showed supercapacitor can store about 50 % of the PV array energy and this way half of the battery size can be replaced by a supercapacitor and this leads to a significant reduction in PV system cost

Keywords:

Renewable energy resources, PV system, Reliability, Cost of kWh generated, Array factor (F_A). State Of Charge (SOC), System economics.

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Research Paper has been published in Advances in Mechanics, China. ResearchPaper title is “**Cost Versus Reliability Study For Stand-Alone PV Systems In Tropical Climates”** in **July, 2021**.

SUMMARY

This thesis discusses one of the hotspot topics and one of the significant challenges in the Photo Voltaic (PV) systems which cause serious energy loss of the PV energy.

Chapter 1: This chapter discusses short introduction about energy, types of energy, Different Types generations of solar cells and solar cells applications.

Chapter 2: This chapter discusses short introduction about solar cell, history, solar PV, super capacitor for solar PV, Generations of solar cells and Hybrid batteries/supercapacitors energy storage system configuration.

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Chapter 3: This chapter discusses solar radiation and mathematical model, Coupling the supercapacitor with the photovoltaic and Buck (Down) Converter.

Chapter 4: This chapter discusses system Reliability and economy calculations in US dollar ($) for the system model according to market prices.

Chapter 5: This chapter discusses simulation model and results of the system. and Flowchart of procedure

Chapter 6: This chapter contains conclusion and future work for this thesis.

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