



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكرو فيلم

بسم الله الرحمن الرحيم



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شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم



شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



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جامعة عين شمس التوثيق الإلكتروني والميكروفيلم

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AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Electrical Power and Machines Engineering

Design and Sizing of Photovoltaic – Battery System

A Thesis submitted in partial fulfilment of the requirements of the degree of

Doctor of Philosophy in Electrical Engineering

(Electrical Power and Machines Engineering)

by

Eng. Mahmoud Aboubakr Mahmoud Elsayed

Master of Science in Electrical Engineering

(Electrical Power and Machines Engineering)

Faculty of Engineering, Ain Shams, 2017

Supervised By

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Cairo – 2021



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I. Statement

This thesis is submitted as a partial fulfilment of Doctor of Philosophy in Electrical Engineering Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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III. Thesis Summary

Today's world is at a turning point. Resources are running out, pollution is increasing, and the climate is changing. The fossil fuels in the next few decades are expected to be vanished. Finding a suitable substitution that will guarantee sustainability and growth on a long-term basis is wishful. Photovoltaic (PV) system is already offering appropriately. But this technology has flaws. The production of this energy source is highly varying, difficult to predict. Besides, the sun isn't always shining. The amount of electricity fed into the power grid must always remain on the same level as demanded by the consumers to prevent blackouts and damage to the grid. So, it is impossible to obtain energy production only from photovoltaic system among the grid. To suppress this problem, storing energy come into play.

The battery is considered the most realistic choice for energy storage because its mechanism is well-known. In the last decade, battery proved its performance and efficiency in PV application and that led to being massively popular usage as rechargeable secondary power supply. It has long charge and discharge cycles, bulk energy density, high cell voltage. Besides, it has miscellaneous types.

This thesis focuses on designing the primary source with an auxiliary source as a complementary source to electrify loads under any circumstances. PV is selected to be the primary source and it should carry out two duties. During the hours of sunshine, the PV system is directly feeding the load and any surplus electrical energy is stored in the battery. During the night, or during a period of low solar irradiation, the energy is supplied to the load from the battery. Several types of batteries are selected to be rechargeable secondary storage sources and they have to supply the loads during off-light intervals. Software programs like MATLAB are used to establishing the mathematical model.

Finally, different cases scenarios will be developed including the sizing of PV and the battery bank. Then, a comparison between them including the pros and cons for each system will be presented.

The sizing for PV and batteries bank is implemented by creating GUI based on MATLAB 2021 a. The selection of PV will be relied on minimum area needed to cover the load. There are various famous PV manufacturers. While the batteries selection will be relied on minimum total cost given for the same load demand. the batteries selection will be from lead-acid type which is used frequently in PV application.

Key words: Renewable energy recourses (RES), Battery Energy Storage System (BESS), Photovoltaic, Battery Sizing, Smart grid.

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