Photovoltaic System for a Board of The Faculty Map in a Thai University

Somchai Hiranvarodom
Department of Electrical Engineering, Faculty of Engineering, Rajamangala University of Technology Thanyaburi
Klong 6, Thanyaburi, Pathumthani 12110, Thailand, Tel. +66 2549 3420, Fax. +66 2549 3422 E-Mail: hiranvarodom@hotmail.com

Abstract: This paper presents the design of a stand-alone Photovoltaic (PV) system to supply an electric power for a board of the faculty map. This system has been installed at the Faculty of Engineering in Rajamangala University of Technology Thanyaburi (former name was Rajamangala Institute of Technology-RIT), Klong 6, Thanyaburi district, Pathumthani province of Thailand. The purpose of this work is to study and analysis of the performance of the PV system that to be installed at the Rajamangala University of Technology Thanyaburi (RMUTT). The design of control circuit was experimentally done in this work. Protection of the battery from damage from deep discharge and overcharge by a controller was also considered. In addition, microcontroller program for controlling the operation of LED (light emitting diode) lamps was developed to show the way from starting place to another department or another building that someone who wants to go within the Faculty of Engineering. Users are able to know the amount of space in meters between the starting place and destination from reading on display segment. During the night time, an operation period of time for the fluorescent lamp between 19.00-22.00 hours was controlled. The system performance of the system including the life cycle cost analysis of the system and measuring data of solar energy at the design location are addressed.
Key Words: PV system, life cycle cost analysis.

1 Introduction

RMUTT is located about 50 kilometers far from Bangkok. The main reason for installing is to demonstrate the application of a PV stand-alone power system that is able to be used in the university or other places, not just in rural areas. To give the basic knowledge and concept of PV system to many students who have been studying at the university, especially engineering students, are important. This is because most of students come from many provinces of Thailand. Whenever they graduate from the university and back to their home town, they could bring the concept of PV system to inform some people who live in the rural areas to consider for installation. The another objective is to study and analysis of the performance of a PV power system that concerned with the period of time for operating during the night must be controlled by an electronic device which is called "regulator". Accordingly, a 150 W_p of PV system was designed by programme computer using visual basic.

2 System Components

2.1 Photovoltaic module

There are 2 PV modules which have been installed and are connected in parallel. The PV module # BP275U was selected and its characteristics can be shown as follows:

Rated power	75 watts@ 25°C
Voltage @ max. power	17.0 volts
Current @ max. power	4.45 amps
Short circuit current	4.75 amps
Open circuit voltage	24.1 volts
Warranted minimum	65 watts
Maximum system voltage	600 volts
Temperature coefficient of I_{sc}	(0.065±0.015) %/°C
Temperature coefficient of V_{oc}	-(80±10) mV/°C
Temperature coefficient of power	-(0.5±0.05) %/°C
NOCT	47±2°C
Dimension	53.7 cm×120.9 cm×5 cm
Weight	7.7 Kg

the PV modules have been mounted on the roof of the system structure which can be shown in Fig.2.

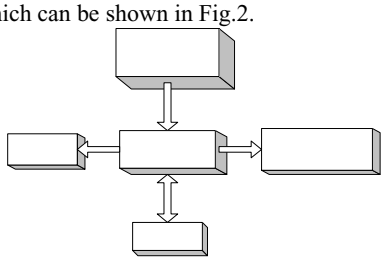

Fig.1 Block diagram of PV system for a board of the faculty map

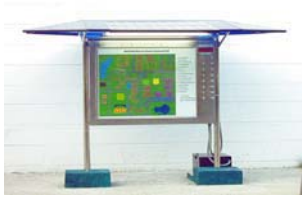

Fig.2 Front view of a PV power system for a board of the faculty map at the design location within the faculty of engineering, (RMUTT) during daytime

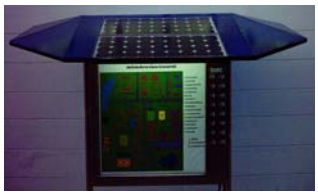

Fig.3 Front view of a PV power system for a board of the aculty map during night time

2.2 Regulator or Controller

Normally, the operating voltage of this system is about 12 volts. A solar charging controller with 20 A rated from BP solar

company has been used in this work.

2.3 Battery

Rated ampere-hour and an operating nominal voltage are 100 Ah and 12 volts respectively. This type of battery is designed for deep cycle and low self discharge as needed.

2.4 Microcontroller

1) There are 16 switches (16 points of destination) to push for selecting location where user wants to go.

2) Use LED to show the way from starting place to another department or another building that someone who wants to go within the Faculty of Engineering on a board of the faculty map. Users are able to know the amount of space in meters between the starting place and destination from reading on display segment.

3) There is a display segment.

4) Control the period of time for an operating of a fluorescent lamp.

2.5 Lamp

A circuit of 36 watts fluorescent lamp is mounted under the roof of the structure or under the PV modules. it is controlled by program from microcontroller.

3 Testing

As mentioned early, there are 16 buildings or destinations that users who are able to select to go to there.

- all department buildings concluded are 13.
- building of office of the dean is 1.
- central buildings for research and study are 2.

The results for testing can be seen from Tab.1.

Tab.1 some details from testing showing load current in ampere, display segment and no. of LED operated

Building	No. of LED operated	Distance (m)	Load current (A)	
Computer Eng.	9	60	1.6	2.8*
Electrical Eng.	12	70	1.6	2.8*
Central Bld. 1	13	80	1.6	2.8*
High voltage Bld.	12	90	1.6	2.8*
Civil Eng.	15	120	1.6	2.8*
Central Bld. 2	17	120	1.6	2.8*
Survey Eng.	18	150	1.6	2.8*
Electronics Eng.	21	180	1.6	2.8*
Water resource Bld.	21	180	1.6	2.8*
Dean's office Bld.	27	220	1.8	3.0*
Transport Bld.	26	230	1.8	3.0*
Plastic Eng.	29	240	1.8	3.0*
Mechanical Eng.	37	300	1.8	3.0*
Textile Eng.	39	340	1.9	3.1*
Industrial Eng.	41	360	2.0	3.2*
Chemical Eng.	46	430	2.0	3.2*
* the figures that include load current of Fluorescent lamp				

4 Life Cycle Cost Analysis

The life cycle cost analysis (LCCA). It is based on the key assumptions (year 2004). In addition, the cost of installation and operation and maintenance were estimated by multiplying the capital cost of PV arrays with 0.2 (20%) and 0.02 (2%) respectively.

- Total life cycle cost (LCC) is about 147, 913 baht.
- Annual LCC is 10,773 baht/year.
- Cost of electricity is about 1.34 baht/Wh.

This is based on the period of analysis in 20 years.

Tab.2. average value of each operational parameter that to be measured between March and April at the design location (RMUTT)

	Time (hours)				
	10.00	13.00	16.00	19.00	22.00
Battery voltage (V)	13	13.4	13.3	12.8	12.7
Generaged current (A)	5.5	8.0	4.2	0.0	0.0
State of charge (%)	96	100	100	98	95
Lamp operated	-	-	-	on	Off

5 Conclusions

This project work is one of the projects for PV system applications in RMUTT. It has been very useful for people who want to know the direction to access building or destination within the faculty of engineering including all of students who come from outside area. This project will also be expanded more wide scale for the university map soon. However, microcontroller programming for the next project should be more developed to reduce command of program shortly.

Acknowledgments

I would like to many thank to my colleagues and some students who help me to install and record data are gratefully acknowledged.

Reffernces

[1] S. Hiranvarodom. A Comparative Analysis of Photovoltaic Street Lighting Systems Installed in Thailand, Proceeding of 3rd World Conference on Photovoltaic Energy Conversion, Osaka International Congress Center 'Grand Cube', Osaka, Japan, May 2003, 11-18: 2478-2481.