10th Eco-Energy and Materials
Science and Engineering
Symposium

Energy Technology, Environmental
and Social Impact, Nanotechnology
and Material Technology, Energy
Economic and Management, Nuclear
Technology, New Technology and
Other topics related to energy field.

On December 5-8, 2012
Sunee grand hotel,
Ubon-ratchathani

Organized by

Co-organized by
PREFACE:
Message from the President of
Rajamangala University of Technology Thanyaburi

Rajamangala University of Technology Thanyaburi (RMUTT), in conjunction with Kyoto University, is pleased to host the 10th Eco-Energy and Materials Science and Engineering Symposium (10th EMSES). This international conference is not only giving an opportunity for Thai and foreign researchers to present and discuss their research works and update their expertise but also to initially stimulate the development of research works on eco-energy and materials science and engineering. Our program consists of six research tasks: (1) Energy Technology, (2) Environmental and Social Impact, (3) Nanotechnology and Materials Science, (4) Energy Economics and Management, (5) New Energy Technology and (6) Nuclear Technology.

I would like to take this opportunity to express our sincere gratitude to our two distinguished Plenary Speakers for kindly accepting our invitation. I deeply appreciate the very strong support given by Kyoto University. Thanks to the tireless works of the Organizing Committee, the Technical Program Committee, the invited speakers and paper and poster contributors, and excellent program been assembled to cover a broad spectrum of interesting topic.

We warmly welcome you to the 10th EMSES on December 5-8, 2012, Ubon Ratchathani, Thailand.

Numyoot SONGTHANAPITAK, Ph.D.
President of Rajamangala University of Technology Thanyaburi
and Conference Chairman of 10th EMSES 2012
PREFACE:
Message from the Director of
Institute of Advanced Energy, Kyoto University

It is my great pleasure to have the 10th Eco-Energy and Materials Science and Engineering Symposium (EMSES) with Rajamangala University of Technology Thanyaburi (RMUTT) under the long-term collaboration between RMUTT and Kyoto University. The 1st EMSES was held in 2001 in Thailand and the symposium has been expanded in its scientific contents as well as the academic network. I believe that the 10th EMSES gives a good opportunity to all participants to exchange their knowledge and idea to realize eco-friendly energy system in society. I would like to express my welcome to all participants and sincere thanks to the 10th EMSES organizing committee and all supporting organizations to make us having this symposium.
I hope that the symposium will be successful and lead to further progress in energy science and technology and also in friendships of participants.

G. Ogata
Professor Yukio Ogata, Ph.D.
Director of Institute of Advanced Energy, Kyoto University
PREFACE:
Message from the Former Dean of
Graduate School of Energy Science, Kyoto University
Program Leader,
Global COE “Energy Science in the Age of Global Warming”

I want to express my hearty welcome to all participants of Eco-Energy and Materials Science and Engineering Symposium (10th EMSES). This symposium is aiming the realization of importance of energy and materials technology through the academic, science and technology network among the world communities. The symposium gives an opportunity for researchers to discuss their research works and also to initially stimulate the development of research works on eco-energy and materials science and engineering. Once the cooperation among researchers has been created, the further cooperation work will be developed.

I would like also extend my sincere thanks to all who made the meeting possible, including the 10th EMSES organizers, the SEE forum committee members, and the Japanese Government, JSPS, for their kind support. I am looking forward to seeing you in Ubon Ratchathani, Thailand.

Professor Takeshi YAO, Ph.D.
Former Dean of Graduate School of Energy Science, Kyoto University
and Program Leader, Global COE “Energy Science in the Age of Global Warming”
Message from the Chairperson of 10th EMSES Organizing Committee

Rajamangala University of Technology Thanyaburi (RMUTT), in conjunction with Kyoto University, is pleased to host the 10th Eco-Energy and Materials Science and Engineering Symposium (10thEMSES).

RMUTT has a major mission on encouraging and supporting all areas of research. One of the key reasons is to assist in developing capability in science and technology in order to cope with recent rapid change in this field. We have jointly set up an academic symposium on the 10thEMSES with the perception on the significance of exchanging knowledge and research experiences between researcher in the field of energy, materials technology and environmental science. This symposium is not only giving an opportunity for Thai and foreign researcher to present and discussion their research works and update their expertise but also to initially stimulate the development of research works on eco-energy and materials science and engineering. Once the cooperation among researchers has been created, the closer future cooperation incorporate with joint-research works will be developed. Thus, to support the aforesaid role, the symposium working committee would like to invite you to participate in this academic symposium.

I would like to express our sincere thanks to the organizing committee, participants and contributors for your kind corporation to this symposium. I wish this symposium proceeding will be a useful reference for future scientific research development.

Sommai PIVSA-ART, Ph.D.
Dean of Faculty of Engineering, RMUTT
Director of CoE on Sustainable Energy System (Thai-Japan)
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  Deachrat JAITHAWIN                   RMUTT, Thailand
Sunee Grand Hotel Map
Sunee Grand Hotel
### Conference Program of 10th Eco-Energy and Materials Science and Engineering

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<td>Registration</td>
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<td>EMSES committee meeting</td>
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<tr>
<td>07:00-09:00 am</td>
<td>Registration</td>
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<td>09:00-09:40 am</td>
<td>Opening Ceremony at Taptim Siam 4 Hall</td>
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<td></td>
<td>Assoc. Prof. Dr. Numyoot Songthanapitak, President of RMUTT, Thailand and Chairperson of 10th EMSES conference</td>
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<td>Prof. Dr. Kiyoshi Yoshikawa, Vice President of Kyoto University, Japan Co-Chairperson of 10th EMSES conference</td>
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<tr>
<td>09:45-10:45 am</td>
<td><strong>Keynote Speaker I:</strong> Japan Power Generation Mix and Energy Security after Fukushima Nuclear Accident, presented by Professor Dr. Keiichi N. Ishihara, Graduate School of Energy Science, Kyoto University, Japan</td>
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<td>10:45-11:00 am</td>
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<td><strong>Keynote Speaker II:</strong> Vertical Motions in Greater Bangkok Area after the 2004 Sumatra-Andaman Earthquake from GPS Observations and Its Prediction based on the Geophysical Modelling, presented by Professor Dr. Chailemchon Satirapod, Chulalongkorn University, Thailand</td>
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<td>Chair</td>
<td>Prof. Dr. Padungsak Ratthanacho</td>
<td>Assoc. Prof. Dr. Wisanu Pecharapa</td>
<td>Assoc. Prof. Dr. Seiichi Kawahara</td>
<td>Prof. Dr. DaeHee Park</td>
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<tr>
<td>Co-Chair</td>
<td>Dr. Wirachai Roynarin</td>
<td>Dr.Sorapong Pavasupree</td>
<td>Asst Prof. Dr. Warunee Arinyawiriyan</td>
<td>Asst. Prof. Dr. Jakree Sritonchant</td>
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<td>Chair</td>
<td>Assoc. Prof. Dr. Vijit Kinnares</td>
<td>Prof. Dr. Narongrit Sombotsomboon</td>
<td>Prof. Dr. Hideaki Ohgaki</td>
<td>Prof. Dr. Susumu Yoshikawa</td>
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<td>Co-Chair</td>
<td>Dr. Boonyang Plangklang</td>
<td>Dr. Supakij Suttiruengwong</td>
<td>Dr.Nithiwatthan Choosakul</td>
<td>Dr. Surawut Chuangchote</td>
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<td>05:00-06:30 pm</td>
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<td>Co-Chair</td>
<td>Dr. Sorapong Pavasupree and Dr. Sumonnan Niamlang</td>
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### Conference Program of 10th Eco-Energy and Materials Science and Engineering

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<td>Prof. Dr. Takeshi Yao</td>
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<td>Assoc. Prof. Dr. Thawatch Kerdchuen</td>
<td>Dr. Leong Yew Wei</td>
<td>Dr. Supaporn Tomsorn</td>
<td>Asst. Prof. Dr. Sonchait Hiranarom</td>
<td>Dr. Nathabhat Phankong</td>
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<td>Dr. Leong Yew Wei</td>
<td>Dr. Supaporn Tomson</td>
<td>Asst. Prof. Dr. Sonchait Hiranarom</td>
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<td>Prof. Dr. Jun Li</td>
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<td>Chair</td>
<td>Dr. Arthit Sode-Yome</td>
<td>Assoc. Prof. Dr. Kawee Srikulkit</td>
<td>Assoc. Prof. Dr. Yuji Aso</td>
<td>Dr. Sarocha Charoenvai</td>
<td>Dr. Narongchai O-Charoen</td>
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<tr>
<td>Co-Chair</td>
<td>Asst.Prof.Dr. Boonrit Prasartkeaw</td>
<td>Assoc. Prof. Dr. Yuji Aso</td>
<td>Assoc. Prof. Dr. Yuji Aso</td>
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<td>Assoc. Prof. Dr. Natha Kuptashien</td>
<td>Assoc. Prof. Dr. Sommai Pivsa-art</td>
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<td>Prof. Dr. Chul-Su Kim</td>
<td>Prof. Dr. Yuichi Anada</td>
<td>Prof. Dr. Keiichi N. Ishihara</td>
<td>Assoc. Prof. Dr. Natha Kuptashien</td>
<td>Assoc. Prof. Dr. Sommai Pivsa-art</td>
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<tr>
<td>Co-Chair</td>
<td>Dr. Winai Chanpeng</td>
<td>Assist. Prof. Dr. Kazushi Yamada</td>
<td>Asst. Prof. Dr. Sommai Pivsa-art</td>
<td>Dr. Boonyang Plangklang</td>
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</tbody>
</table>
Water Waste Treatment Stand Alone Photovoltaic System

O. Sadmai and S. Hiranvarodom
1Department of Electrical Engineering, Faculty of Engineering,
Rajamangala University of Technology Thanyaburi, Klong 6, Thanyaburi, Pathumthani 12110
E-mail: ong-art.s@en.rmutt.ac.th

Abstract—This paper presents the design and installation of Stand Alone PV System for water waste treatment photovoltaic system which has been installed at The Rajamangala University of Technology Thanyaburi (RMUTT), Prathumthani province in Thailand. This paper consists of the computer program simulation [1] and discussion for many components such as PV panel and Battery which mainly equipment in this system. The main objective is to be constructed water waste treatment solar energy which has been installed at The Big Pond near Department of Civil Engineering. The water waste treatment has been continuously operated for 2 month ago and it operates under in case of selected load for save battery lifetime. While it works on 2.7kWh/day of load demand. The project shows that it can be run by itself under rainy day, cloudy day and clearness day.

Keywords—Stand Alone PV System, Water Waste Treatment Design, Education, RMUTT

1. INTRODUCTION

The solar energy is very well done for produce of electrical energy because it is free and none pollution. The stand alone PV system has been selected for this project and design by HOMER program to calculation optimal system with PV and battery to support 300W DC motor of water waste treatment solar energy.

The Rajamangala University of Technology Thanyaburi (RMUTT) is located in Thailand at 14.04 latitude and 100.72 longitude, the annual average solar radiation about 5.58 Wh/m²/day [1], the temperature is very high between 25 – 35 degree Celsius [2] This paper proposes a study and design of stand alone PV system to provide the electrical energy for a 300W 24V DC motor in a water waste treatment solar energy.

2. THE SIMULATION AND DISCUSSION

The simulation program is called “HOMER” is to be selected to analyze useful data which can be shown in the system. From the figure 1, it shows a model of a stand alone PV system which configuration of PV sizing by 80W, 160W, 240W, 320W, 400W and 480W respectively and battery is to be 130Ah for 2 to 5 string.

Figure 1. The simulation system used in this work.

From the figure 2, it shows the monthly radiation per day. The system has maximum daily radiation on December and minimum on June. However, in this site (Prathumthani Province in Thailand) can be used average 5.58 kWh/day for calculate design by hand.

3. STAND ALONE PV SYSTEM CONFIGURATION

From the figure 3, it shows block diagram of the stand alone PV system. Mainly PV panel are convert solar radiation to DC voltage which supply to two 300W DC motor and charge current to two battery bank of 24 system voltage. The battery is a key element of the system and it impress the voltage to the whole system. The propeller has been established to a DC motor and operates by PLC programe with a single command at infront of control box. The water waste treatment solar energy has been operated by 2 case in (4)

From table 1 shows specification of 80W mono crystalline silicon that has been selected for this project.

Table 1 specification of PV panel

<table>
<thead>
<tr>
<th>Mono Crystalline Silicon 80W</th>
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<tbody>
<tr>
<td>Voltage at maximum power</td>
</tr>
<tr>
<td>Current at maximum power</td>
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<tr>
<td>Open Voltage</td>
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<tr>
<td>Short Circuit Current</td>
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</table>
3.1 BATTERY

The battery 130Ah 12V was selected and it is mainly heart of the system because it is a mainly power which is supplied to dc motor. Accordingly, the photovoltaic system in this work can not be charged the battery that is insufficient current for running a motor during the day.

3.2 PLC

It is a control device which has been controlled two dc motor. It works by writing a program ladder into CPU with in a PLC after that it can be run by it self or remote area mode and it supplied by battery.

3.3 300W DC MOTOR

300 W dc motor is a mainly loads of the system because it has been driven a propeller to hit a water in big pond. It has 24VDC and 12.5A. There are two 300W dc motor which has been installed at both side, right hand and left hand.

![Figure 3. Block diagram of this system](image)

4. LOAD PROFILE

In this system, it can be studied in 2 case of load demand. The first case, the machine is working all time of the day time by static load as 300W dc motor (8 hours) without night time load. The second, the machine is to be run and stop it every five minutes, as can be seen in figure 4, 5 represents of load profile in this work.

![Figure 4. Load Profile for Case 1](image)

![Figure 5. Load Profile for Case 2](image)

4. RESULTING OF SIMULATION

The result of simulation shows that the monthly average electric production. The peak average power (kW) is indicated on October and lower average power is indicated on June.

![Figure 6. Monthly Average Electric Production](image)

![Figure 7. DC primary load VS PV Power](image)

As can be seen in the figure 7 shows that dc primary load and versus PV power for the example at 600W dc
load a PV power can be supplied around 40W.

Figure 8. DC primary load VS Battery input Power

Figure 8 shows that DC primary load versus battery input power. At battery input power is to be Zero, DC input power is more than 200W to 900W respectively.

5. INSTALLATION

Figure 9. Controlled box of the motor in this system

Figure 10. Controlled box of the motor in this system

As can be seen in the figure 10 represents the controlling of the DC motor in this system and charge regulator, pilot lamp, PLC controller. The figure 11 represents PV installation in a propeller water waste treatment machine. There are two 80W mono crystalline silicon which have been installed in the top of the machine.

Figure 11. PV array and construction of system

From the figure 12 shows a typical of water waste treatment machine (WWTM). The controlled box is to be installed in the middle of the WWTM

Figure 12. The propeller water waste treatment No.1

Figure 13. The propeller water waste treatment No.2
Figure 14 shows clearly that Stand alone PV system, while working and running both source with PV array supply to the load and charging current or only charging current into battery if the motor not working at day time.

In this work, stand alone PV system has treat for under voltage of the battery or PV array cannot be insufficient charge current into battery. Table 1. Optimal PV and Battery required of the system. It represents that the optimal stand alone PV system must be able to handle the maximum load which has been selected 800Wh/day is 3 PV panel of 80W mono crystalline silicon and 2 battery of 130Ah 12V. Otherwise, water waste treatment solar energy has been installed in the big pond where nearly on Department of Civil Engineering.

The amount of PV array and No. of Battery by program is indicated by Table 2 and manual calculation which using 2 PV panel and 2 Battery for this work under this reason the construction very small and cannot be upload anything on the machine. The machine have been installed for 2 month, the machine has been completed to normally operating at the big pond.

Table 1. The optimal PV and Battery in this system.[6]

<table>
<thead>
<tr>
<th>Load Profile</th>
<th>No. PV array</th>
<th>No. of Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1600 Wh/day</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>800 Wh/day</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 2. The configuration of WWTM in actual installation

<table>
<thead>
<tr>
<th>Load Profile</th>
<th>No. PV array</th>
<th>No. of Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1600 Wh/day</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>800 Wh/day</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

As can be seen Table 3. Shows PV production which it can be produced from the system. The 160W PV system is indicated at 30W and mean output power 0.754kWh/day. In additional, total energy production is indicated at 275kWh/year. The PV production was collected to 1 year of simulation. It is able to state that mean output wattage was 0.03kW.

Table 3. PV production

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated capacity</td>
<td>0.160</td>
<td>kW</td>
</tr>
<tr>
<td>Mean output</td>
<td>0.03</td>
<td>kW</td>
</tr>
<tr>
<td>Mean output</td>
<td>0.754</td>
<td>kWh/d</td>
</tr>
<tr>
<td>Capacity factor</td>
<td>19.6</td>
<td>%</td>
</tr>
<tr>
<td>Total production</td>
<td>275</td>
<td>kWh/yr</td>
</tr>
</tbody>
</table>

6. CONCLUSION

Water waste treatment solar energy has power consumption around 5.4kWh/day or 1.971kWh/year. The system can be supplied power 275kWh/year. Energy of DC motor is 5.3kWh/day. Computer software was used to simulation and compare power between by hand and simulation and it is working very well at the big pond. After installation this machine for 2 month found that it can be run correctly as same as supply by DC source.

7. ACKNOWLEDGEMENT

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8. REFERENCES

[3] Faculty of Electrical Engineering Department, Rajamangala University of Technology Thanyaburi http://www.rmutt.ac.th