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FACULTY OF ELECTRICAL ENGINEERING

PROJECT REPORT

FINAL YEAR REPORT

TECHNICAL VIABILITY OF PARABOLIC DISH CONCENTRATING SOLAR POWER IN MALAYSIA ENVIRONMENT

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TECHNICAL VIABILITY OF PARABOLIC DISH CONCENTRATING SOLAR POWER IN MALAYSIA ENVIRONMENT

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A report submitted in partial fulfillment of the requirement for the Bachelor of Electrical Engineering (Industrial Power) With Honours.

Faculty of Electrical Engineering

UNIVERSITY TEKNIKAL MALAYSIA MELAKA

(JUNE / 2014)

"I hereby declare that I have read through this report entitle "**Technical Viability Of Parabolic Dish Concentrating Solar Power In Malaysia Environment**" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power) With Honours)".

Signature : ……...

Supervisor's Name : Datuk Profesor Dr Ruddin Ab Ghani

Date : ……..

I declare that this report entitle "**Technical Viability Of Parabolic Dish Concentrating Solar Power In Malaysia Environment**" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any degree.

Signature :……

Name : MOHAMAD SAFUWAN BIN ROMLI

Date : 16 JUNE 2014

Dedicated, in thankful appreciation for support, encouragement and understandings

To:

My supervisor Datuk Profesor Dr Ruddin Ab. Ghani;

Puan Hjh Rosnani Bt Hj Affandi;

My beloved father Romli Bin Saad;

My beloved mother Norisah Bt Saidin;

My family member;

My fellow classmate who have been together in four year;

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ABSRACT

Nowadays, the continuous usage of non-renewable such as fossil fuel combustion now and soon will cause of the negative effect in using which cause of global climate change. Another alternative that more reliable and abundant compared to fossil fuel is renewable energy such as solar. Solar Energy (SE) is by far, the most abundant energy source. Solar can be separated into two types that is Photovoltaic (PV) and Concentrating Solar Power (CSP) technology. CSP is a technology which solar radiation is concentrated as much as possible via a parabolic mirror to generate high temperature that then focusing to a receiver that is connected to the Stirling engine, the engine then will produce a mechanical output that then move the generator to generate electricity. However, Malaysia is only focusing to generate electricity using PV while using CSP technology still not be taking into consideration. Malaysia naturally has abundant sunshine and thus solar radiation. However, it is difficult to have a full day with the sky is really clear even in severe drought. The annual average daily solar irradiation for Malaysia has a magnitude of 4.21 – 5.56 $kWhm^{-2}$ and the sunshine duration is more than 2200 hours per years. The purpose of this project identify the potential using of CSP parabolic dish by taking into consideration of using this technology in Malaysia environment, which is by considering of climate change in Malaysia such as wind speed, rapid change of clouds, rain, temperature and relative humidity. There were two methods to analyze the potential of CSP, first by doing field measurement and collecting data from data logger. From the data analyze, the increasing relative humidity that can disturb to the changes ambient temperature and tilted irradiance. Therefore, it can concluded that to there is possible to implement the technology of CSP parabolic dish Stirling engine system in Malaysia.

ABSTRAK

Pada masa kini, penggunaan yang berterusan bahan mentah yang tidak boleh diperbaharui seperti pembakaran bahan api fossil dan arang batu. Ini akan menyebabkan kesan negatif terhadap perubahan iklim global. Salah satu lagi alternatif yang lebih dipercayai dan banyak jika dibandingkan dengan bahan api fosil adalah tenaga boleh diperbaharui adalah seperti solar. Tenaga Solar setakat ini , sumber tenaga yang paling banyak dan tidak akan habis. Pengunaan tenaga solar terbahagi kepada dua jenis iaitu Photovoltaic (PV) dan Penumpuan Kuasa Solar(CSP). CSP adalah teknologi yang radiasi solar tertumpu sebanyak mungkin melalui cermin parabola untuk menjana suhu tinggi yang kemudiannya memberi tumpuan kepada penerima yang disambungkan kepada engin Stirling. Engin ini bersambung kepada keluaran mekanikal yang kemudian bergerak penjana untuk menjana elektrik. Walaubagaimanapun, Malaysia hanya memberi tumpuan untuk menjana elektrik menggunakan PV pada masa sekarang, manakala teknologi CSP masih tidak mengambil kira. Malaysia secara semulajadi menerima cahaya matahari yang banyak. Walaubagaimanapun,, adalah sukar untuk mempunyai hari yang penuh dengan langit adalah benar-benar cerah tanpa awan walaupun dalam kemarau yang teruk. Purata penyinaran suria harian tahunan untuk Malaysia mempunyai magnitud 4,21 sehingga 5,56 $kWhm^{-2}$ dan tempoh cahaya matahari yang menyinar adalah lebih daripada 2200 jam setiap tahun. Tujuan projek ini, adalah untuk mengenal pasti potensi menggunakan daripada CSP dengan mengambil kira menggunakan teknologi ini dalam persekitaran iklim Malaysia, yang mana perubahan iklim di Malaysia adalah seperti kelajuan angin, perubahan kedudukan awan , hujan, suhu dan kelembapan . Terdapat dua kaedah untuk menganalisis potensi CSP, pertama dengan melakukan pengukuran bidang dan mengumpul data dari “data logger”. Dari data yang diperolehi, tahap kelembapan yang bertambah boleh mengganggu kepada perubahan suhu sekitar dan sinaran cahaya solar. Oleh itu, kesimpulan dapat dibuat bahawa teknologi CSP parabola mampu untuk dilakukab di Malaysia tetapi perlu dipertihkatkn lagi tahap tumpuan cahaya matahari di atas cirmin parabola.

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LIST OF ABBREVIATIONS

PV	-	Photovoltaic.
CSP	-	Concentrating Solar Power
SE	-	Solar Energy
SREP	-	Small Renewable Energy Program
FIT	-	Malaysia Feed-in-Tariff
HP	-	Horse-Power
LFR	-	Linear Fresnel Reflector
DNI	-	Direct Normal Irradiance
PSM	-	Projek Sarjana Muda
MMD	-	Malaysian Meteorological Department
PCU	-	Power Concentrating Unit
D	-	Diameter
d	-	Depth
f	-	Focal Point
UTeM	-	Universiti Teknikal Malaysia Melaka

CHAPTER 1

INTRODUCTION

1.0 Overview

This chapter describes the research background, problem statement, project objectives, scope of the study, expected project outcome and project outline.

1.1 Research Background

Nowadays, with oil dominate over 40% of all worldwide energy, with the current continuous usage of non-renewable such as fossil fuel combustion now and soon will cause of the negative effect in using which cause of global climate change. In addition of increasing of oil price have made many countries to find another alternative that more reliable, cheaper and abundant of energy with environmentally friendly and ecological hazards associated with its production. The energy with environmental friendly is hydro, wind, geothermal and solar, as for solar it can be separated into two types that is Photovoltaic (PV) and Concentrating Solar Power (CSP) technology.

Concentrating Solar Power (CSP) is also one of 'green energy' or renewable energy technology that has a brighter future as the main source in generating electricity because the technology is abundant, clean and environment friendly. In addition no fossil fuel is used in this technology. Concentrating Solar Power (CSP) is a technology which solar radiation is concentrated as much as possible via a parabolic mirror to generate high temperature that then

focusing to a receiver that is connected to the Stirling engine, the engine then will produce a mechanical output that then move the generator to generate electricity.

The continuous development of Concentrating Solar Power (CSP) technologies have led to increases the ability to concentrate and harness solar energy for electricity production. There exist many techniques for effective concentration solar energy to produce solar thermal power such as Concentrating Solar Power (CSP). The amount of energy collected from concentration solar system depends on the amount of solar radiation in which concentrate to parabolic dish. As the position of the sun changes throughout day and throughout the year, it is necessary for the CSP system been adjusted so that it is always aimed at the Sun and as the result, will acquire the maximum solar radiation been focused to the parabolic dish receiver. Although, depends the configuration of the system, the most efficient system requires tracking the sun either in one or two axes, but in this project the position of sun been done by adjusting the position of parabolic dish mirror focal point to the brightest point and by installing using sighting rod in the middle of concentrator which functioning for orienting the dish toward the sun. When the concentrator receives the solar radiation on a parabolic dish surface it then will reflected the solar radiation to the focal point, where all the energy is concentrated, thus contribute to operating the Stirling-Engine system.

This study will be focuses on investigating the aspect of using different dimension of parabolic dish concentrator that will affect to solar radiation concentrated depending on the wet climate in Melaka. There are two difference type of parabolic dish which involved in this study, which are 11inches and 25inches in diameter. The 11 inch dish is having depth of 2.5 inch and focal point of 16inch. While the 25 inch dish is having depth of 3.6 inch and focal point of 2.1 inch length. The reflective material for these two dishes is the 11 inch dish is been coated aluminum as reflector and crystal clear acrylic parabolic mirror for 25 inch dish. The study will involve one month of data measurement and analysis.

1.2 Project Motivation

The main issue that motivated to explore this renewable source is that the world has a problem with the reduction of non-renewable energy such as oil and gases to generate electrical energy. Demand of renewable energy has become an important issue for global electricity generation. Specific high tendency towards renewable energy such as solar energy, as it does not diminish with use over time. With the use of renewable energy will reduce greenhouse gas emissions that harm the environment. Environmental issues and rising energy demand has increased interest in the use of renewable energy, especially in the use of solar energy in Melaka, Malaysia.

1.3 Problem Statement

In recent year, Malaysia only focusing on renewable energy such as solar PV, Biomass, Biogas and Mini Hydro generate electricity but even so the usage of Concentrating Solar Power (CSP) still not been given emphasis by government and investor. This is proven by the existence of Malaysia's production facilities on a large scale three leading Photovoltaic (PV) modules manufactures: SunPower, Q-Cells and First Solar [1].

Malaysia is a maritime country near the equator, so Malaysia will have naturally abundant solar radiation but it extremely rare to have a full day with a completely clear sky even in periods of severe drought. This due to Malaysia climate condition such as wind speed, a cloudy sky, rainfall and relative humidity, it usually considers CSP system not suitable be used in Malaysia, especially in Melaka environment but there no analysis had been done regarding the effect of climate condition on CSP system.

1.4 Objective of This Project

The objectives of this project are:

i. To identify the potential of using two sizes of parabolic dish Stirling engine beta-type in Melaka environment.
ii. To study the effect of environment factor in performing of Concentrating Solar Power (CSP) in Malaysia environment.
iii. To measure the temperature that can be produce at the parabolic dish receiver by using two type of parabolic dish concentrator.

This study will base on the technical viability of the possibility in using CSP technology as one alternative to generate electricity by using renewable energy by considering Melaka environment.

1.5 Scope of This Project

The scope of this project will be covering the case study through the literature review, journal finding and field measurement. This project will focus on three major scopes that are:

i. This study will be limited on measurement the temperature that can be concentrating to the parabolic receiver by two different type of parabolic dish concentrator as testing equipment.
ii. This research is by implementing the parabolic dish concentrator with Melaka environment for one month.
iii. This research is by analyzing the effectiveness of temperature that can be concentrated to receiver by considering environment changes in Melaka.

1.6 Expected Project Outcome

The expected project outcome in this study is to have an analysis related to the potential of using CSP technology by considering the Melaka environment such as solar radiation, ambient temperature, relative humidity, rainfall and wind speed complete this study. The result will appear in the form of table and graphs for further discussion. Hopefully this study can be used as reference for further study related to performing CSP in Malaysia.

1.7 Report outlines

The report consists of five chapters.

Chapter 1: Introduction

This chapter provides reader the overview of the research background, project motivation, problem statement, objectives, scopes and the expected project outcome of this project.

Chapter 2: Literature Review

This Chapter shows a review on the literature related to sustainable energy, solar energy, and CSP parabolic dish system. This chapter also reflects relevant previous researchers working related on a CSP parabolic dish system and the performance of parabolic concentrator under environment condition.

Chapter 3: Methodology

This chapter presents the methodology of the study that been used to achieve the objective and description of the flow chart of project activities. Two type of concentrator parabolic dish will be used of this study and the analysis be done from the field data measurement and data enquire from Data Logger system.

Chapter 4: Result and Discussion

This chapter shows all the data that have been recorded for one month in Melaka, that been shows in table and graphical display. The data that have been measure and enquire from Data Logger will be analyzed based on environment conditions that disturb the performance of reflective parabolic dish to receiver or focal point.

Chapter 5: Conclusion and Recommendation

This chapter consists of conclusions based on the entire work and results. This is followed by recommendations and suggestions for the work of future research.