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Tandatangan :……..
Nama Penyelia Utama: Dr. Chew Boon Cheong
Tarikh : 31st May 2014

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RENEWABLE ENERGY ADOPTION FOR ENERGY COMPLEMENTARY: APPLICATION OF OFFSHORE WIND TURBINES IN MALAYSIA

NURFARAHIN BT. SALLEH

Laporan ini dikemukakan sebagai memenuhi sebahagian daripada syarat penganugerahan Ijazah Sarjana Muda Pengurusan Teknologi (Inovasi Teknologi)

Fakulti Pengurusan Teknologi dan Teknousahawan
Universiti Teknikal Malaysia Melaka

JUNE 2014

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ABSTRAK

Pada masa kini, kadar kepenggunaan elektrik di dunia telah sampai di tahap yang membimbangkan di mana kadar permintaan tenaga untuk menjana elektrik telah melebihi kadar bekalan tenaga untuk menjana elektrik. Kadar bekalan tenaga tersebut adalah seperti tenaga bahan api yang meliputi arang batu, petroleum, dan gas asli. Kesemuanya boleh digunakan untuk menjana tenaga elektrik. Oleh yang demikian, apabila penduduk bumi terlampau bergantung dengan sumber bahan api tersebut, maka untuk jangka masa akan datang ianya mungkin tidak mencukupi untuk menampung permintaan yang semakin meningkat untuk menjana tenaga elektrik di dunia. Oleh itu, sumber tenaga yang boleh diperbaharui boleh memberikan sumber tenaga yang bersih dan selamat kepada bumi dan masyarakat. Ia juga jauh lebih bermanfaat daripada sumber tenaga tradisional dari beberapa aspek seperti kos memperolehi sumber tenaga, mengekal dan mengendalikan stesen menjana kuasa elektrik berpusat dan mengatasi masalah pencemaran udara. Turbin angin luar pesisir merupakan salah satu tenaga boleh diperbaharui. Turbin ini direka sesuai dengan ciri-ciri bahan api tertentu di mana sebelum ini bahan api digunakan untuk menghidupkan turbin bagi menjana tenaga elektrik. Justeru itu, ciri-ciri yang paling penting dalam sebuah lading angin adalah kelajuan angin dan penggunaan teknologi turbin angin luar pesisir. Kedua-dua ciri tersebut memberi kesan untuk menghasilkan penjanaan kuasa elektrik yang besar (Persatuan Tenaga Angin Eropah, 2009). Dalam kajian ini, Labuan, Sabah telah dipilih sebagai lokasi untuk memasang turbin angin luar pesisir kerana kelebihan geografi Laut China Selatan. Teknologi ini dijangka menyediakan tenaga kuasa besar untuk menjana elektrik dan kurang kesan pencemaran terhadap alam sekitar. Ia juga memberi

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kemampanan yang tinggi kerana terletak di kawasan angin yang kuat di mana ciri-ciri persekitarannya tidak terhalang oleh bangunan-bangunan dan struktur muka bumi yang sesuai. Kajian ini menggunakan kaedah kualitatif bagi pengumpulan dan menganalisa data. Kajian ini membuktikan bahawa penggunaan turbin angin luar pesisir di Laut China Selatan, Sabah boleh menjadi sumber tenaga alternatif kepada penggunaan sumber tenaga tradisional untuk menjana elektrik. Kesimpulannya, turbin angin luar pesisir mungkin menjadi salah satu sumber tenaga utama di Sabah di masa akan datang. Oleh itu , penggunaan turbin angin luar pesisir untuk penduduk di Sabah memberi banyak manfaat kepada mereka dan juga menyokong matlamat kerajaan Malaysia untuk menjadi lebih berdaya saing dalam penjanaan tenaga boleh diperbaharui di samping mengekalkan pertumbuhan ekonomi negara.

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ABSTRACT

Nowadays, the world electricity requirements are increasing at alarming rate and the power demand has been running ahead of supply. It is widely recognized that the fossil fuels such as coal, petroleum and natural gas are presently being used for electricity. Therefore, in future it may not be sufficient to keep pace with ever increasing demand of the electrical energy of the world. The renewable energy can provide clean sources of energy which is reliable and secure to society. It is also far more economical than traditional energy resources, especially the costs of acquiring, maintaining, and operating centralized power stations and remediating their pollution can be avoided. Offshore wind turbine is one of the renewable energy. The turbines are designed to suit the particular fuel characteristics whereby before this a fuel used to turn a turbine, which drives a generator and feeds the grid. The single most important characteristics of a wind farm site is the wind speed and in the new millennium, the technology adoption of the offshore wind turbine is focus on the most effective ways to make very large turbines (European Wind Energy Association, 2009). In this case study Labuan, Sabah has been selected as the location to install the offshore wind turbines because of the geographical advantage of South China Sea. The technology is expected to provide the great power energy with least environment impact and high sustainability as it is located at the strong wind area where there are no terrain features, buildings or other obstruction to slow it down. The research used qualitative methods for both data collection and data analysis. This study proved that the application of offshore wind turbines in the South China Sea, Sabah conveys the energy complementary to fossil fuels and results the acceptance of Sabah residential towards the installation of offshore wind turbines. As a conclusion, the

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offshore wind turbines might become one of the main energy sources in Sabah. Thus, the application of offshore wind turbines to Sabah residential develops a lot of benefits to them and support Malaysian government goals which leading Malaysia to be more competitive in renewable energy generation while sustaining national economic growth.

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CHAPTER 1

INTRODUCTION

1.0 Introduction

In this modern era, Malaysian government started focus on encourage the entire industries sector begin to adopt green environmental and one of the alternative ways will be implement the renewable-based electricity generation module in the industries. According to International Energy Agency (2010), the prospects for renewable-based electricity generation hinge critically on government policies to encourage their development. Thus, the Malaysian government will be the sectors that make sure all the electricity generations from renewable are well-planned. The main objective will be reconciling the characteristics of the new technologies with the need to maintain supply reliability.

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The wind power which includes onshore and offshore wind farms has created expectations among policy makers and the industry alike that these technologies will make a major contribution in meeting growing electricity need. The onshore wind adoptions are wind farms that installed on land and the offshore wind adoptions are wind farms installed off the coast.

Wind power uses the spinning turbines of industrial-scale windmills to convert wind into electricity. Wind turbines capture the wind energy with two or three propeller-like blades, which are mounted on a rotor to generate electricity. The turbines sit high atop towers, taking advantage of the stronger and less turbulent wind at 100 feet (30 meters) or more above ground. The modern large wind turbines generally have three blades and sit atop towers ranging from 150 feet tall for onshore turbines to 300 feet tall for offshore turbines. These high turbines are designed to take advantage of stronger winds above ground level.

Furthermore, a blade acts much like an airplane wing. When the wind blows, a pocket of low-pressure air forms on the downwind side of the blade and pulls the blade toward it. Thus, causing the rotor to turn which is called lift. The force of the lift is actually stronger than the wind force against the front side of the blade which is called drag. The combination of lift and drag causes the rotor to spin like a propeller and the turning shaft spins a generator to make electricity.

The purpose of offshore wind turbines adoption emphasizes in this research is because it complements to the fossil energy in powering electrical grid. Zuhairuse et al. (2009), state Malaysia has been considering wind energy as one of the alternative source of power generation and Chiang et al. (2003), state a study is conducted to gauge the potential of offshore wind energy in Malaysia.

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The study shows that highest potential of wind energy is located in the East coast of Peninsular Malaysia with an annual vector resultant wind speed of 4.1m/s. The offshore characteristics were reportedly stronger than that of the coast with wind speed more than 5m/s during the northeast monsoon (September to March) but, low for the rest of the year. Hence, the offshore wind turbines adoption needs the areas of strong wind blows. Labuan Island at the South China Sea could be selected for this research.

1.1 Research Questions

Economy, social, environment and energy security are closely interlinked. Within these decades, the world is facing the challenge of securing affordable energy to fuel economic growth and satisfy the energy needs for the growing population. According to Seeram (2012), in 1973, 87% of the world energy supply was carbon based fossil fuels. Thirty four years later, in 2007, 81 % of the world energy supply is still dependent mainly on carbon-based fossil-fuel. The world has made improvement towards less carbon-based fossil fuel energy by 6%, but the world energy supply is still dependent mainly on carbon-based fossil energy.

One of the renewable energy is wind energy with offshore wind turbines adoption. The offshore wind turbines can reduce the use of fossil fuels and it used as the new source of electricity in future. European Wind Energy Association (2009) explains high availability is crucial for the economics of any wind farm. This depends primarily on system reliability and adequate maintenance capability, with both being achieved within as capital and operational costs.

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The key advantages of an offshore wind farm are minimal of maintenance required and maximum of access feasibility. By referring to this research, the research questions are stated as below:

a) What are the factors contribute to offshore wind turbines adoption?
b) How does Malaysia National Petroleum Corporation (PETRONAS) adopt the offshore wind turbines adoption in Labuan Island, Sabah at the South China Sea?
c) What the innovation solutions are in order to enhance offshore wind turbines adoption in Labuan Island, Sabah?

1.2 Research Objectives

The primary objective of this research is to investigate the way of Malaysia National Petroleum Corporation (PETRONAS) enhance the factors involving in adoption of offshore wind turbines adoption in Malaysia.
The objectives of this research are stated as below:

a) To identify factors contribute the offshore wind turbines adoption.
b) To investigate the ways PETRONAS adopt offshore wind turbines in Labuan Island, Sabah at the South China Sea.
c) To propose the innovative solutions to enhance offshore wind turbines adoption in Malaysia.

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1.3 Scope

Labuan Island, Sabah has been selected as the location to install the offshore wind turbines because the geographical advantage of the South China Sea. The location situated in the South China Sea has the most promising site. Although, the wind in Malaysia is generally light, variable and uncertainty wind patterns but it still acceptable. Normally the wind will changes causes by the four seasons, it can be distinguished as southwest monsoon, northeast monsoon and the two shorter monsoon transitions.

The southwest monsoon usually starts in the second half of May or early June and ends in September. Prevailing winds are generally from the southwest with a speed of light, below 15 knots. Meanwhile, northeast monsoon usually starts in early November and ends in March. During this season, the prevailing winds are from the east or northeast with speeds between 10 and 20 knots. East coast states of Peninsular Malaysia as well as the South China Sea are more affected by these winds which can reach speeds of 30 knots or more during a strong surge of cold air from the north. Moreover, in the period from April to November, when typhoons, the winds frequently develop in the western Pacific and moving westward across Philippines, southwest winds in the northwest coast of Sabah and Sarawak became more powerful and can reach 20 knots or more.

As a country surrounded by the sea, the effect of the sea breeze and land breeze on the wind patterns are great especially during days with clear skies. There are high possibility that the wind can reach several tens of kilometers into the rural areas if the situation fulfill the condition of sunshine afternoon and the sea breeze speeds is between 10 and 15 knots. In clear night, the reverse process occurs and land breezes with weak speeds develop in coastal areas.

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30 respondents are mainly divided into two groups. First category is by interviewing 25 executives in Malaysia National Petroleum Corporation (PETRONAS). PETRONAS has been selected for the expert opinions because the researcher believed that they can provide many information regarding to the renewable energy sources as they are pioneering in managing energy consumption in Malaysia. This group of respondents is also the group that involving in renewable energy developments in future. PETRONAS is chosen as the location for collecting the primary data because of this company has the expertise in offshore oil exploration and this expertise and experience could be extended for the adoption of offshore wind turbine project. Second category is the residents in Labuan which are involving 5 social responses. Thus, the researcher can get opinion from the expert about the offshore wind turbines adoption and understand more about the social in Labuan Island, Sabah.

1.4 Limitation

Two limitations are identified in this research. Firstly, the case study is to investigate how the offshore wind turbines can be adopted at the South China Sea of Labuan Island. Secondly, researcher assumed that all respondents have provided honest and correct answers.

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