DESIGN AND CONSTRUCT OF
TIDAL STREAM POWER GENERATION MODEL

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4 BEKC

MAY 2009

"I hereby declare that I have read through this report entitle Tidal Power Generation and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Control, Instrumentation and Automation.)"

Signature : .....

Supervisor's Name : EN HIDAYAT B ZAINUDDIN.

Date : 15 May 2009

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A report submitted in partial fulfillment of the requirements for the degree of Bachelor in Electrical Engineering
(Control, Instrumentation and Automation)

Faculty of Electrical Engineering
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

May 2009

I declare that this report entitle Tidal Power Generation 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 other degree.

Signature : .....
Name : MOHD SARIZA BIN ABDUL GANI
Date : 15 May 2009

Dedicated to my family,
especially to my beloved mother and father

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ABSTRACT

The Tidal Power Generation Project is one of future technologies that can be applied in Malaysia. This is due to the fact that Malaysia is located between the South China Sea and Hindi Sea. This kind of technology can replace the current technologies that we use right now. This project is conducted to design and construct a small scale Tidal Stream Power Generation. When the tidal phenomena happen, the turbine blades will rotate and generates the electricity using generator and the electricity store inside the capacitor. This process happens continuously as long as there is tidal stream present until the electricity is stored in full capacity. After that, the stored electricity can be used when it is needed. Thus, model design of this project is important for further research in this field in the future.

ABSTRAK

Projek Penjanaan Kuasa Aliran Air adalah salah satu teknologi di masa hadapan yang boleh diaplikasikan di dalam Malaysia. Ini kerana Malaysia terletek di antara Perairan Laut China Selatan dan Perairan Lautan Hindi. Teknologi ini juga boleh menggantikan teknologi yang sedia ada. Projek ini dilaksanakan untuk menkaji dan merekabentuk sebuah model yang mewakili Loji Penjanaan Kuasa Aliran Air. Apabila berlakunya keadaan pasang surut, bilah turbin akan berputar dan disebabkan proses tersebut, penjanaan kuasa elektrik akan terhasil. Proses ini akan berterusan selagi wujudnya keadaan pasang surut sehinggalah kapasitor mencapai tahap tepu. Selepas itu, tenaga elektrik tersebut boleh digunakan. Oleh itu, reka bentuk model bagi projek ini adalah penting untuk penyelidikan lanjut dalam bidang ini pada masa akan datang.

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CHAPTER 1

INTRODUCTION

1.1 Project Background and Problem Statement

In Malaysia, the population is over 24 million with growth rate of 1.8% and a median age of 24 years. Malaysia's economy continued its strong growth in 2004, with real Gross Domestic Product (GDP) expending by 7% up from 5% in year 2003. A third of the economy is driven by industry, 60% by services and about 7% by agriculture [1-2]. Industry sector needs more electricity every day and increasing each year to fulfill the world demands.

There are many renewable energy resources in Malaysia such as solar, hydro and wave energy. All of this renewable energy is free, continuously and produces no greenhouse gases or other waste. It needs no fuel and not expensive to do maintenance works.

The purpose of this project is to use tidal energy as an alternative energy in the future. The idea is to utilize the nature of tidal stream in Malaysia for electrical generation. Most tides can be predicted and it does not need a large environmental impact. Thus, this renewable energy is not being wasted and can be used in full potential in future.

1.2 Project Objectives

Based on the problem stated above, there are several objectives to be achieved upon completion of this project:

1 To study the tidal stream phenomena at a river, estuary and coast.
2 To design and develop a modal that can be representing tidal stream phenomena.
3 To design and develop a Tidal Power System that might suitably use at river, estuary and coast in Malaysia.
4 To study the performance of Tidal Stream Power System at selected river, estuary and coast.
5 To propose a design concept of Tidal Power Generation to be implemented in Malaysia.

1.3 Project Scope

The main focus for this project is to extract the tide stream potential energy to spin the turbine to generate electricity. Then the dynamo generates Direct Current (DC) to charge the capacitor or directly generate electricity to the load. For this project, it will use the reaction type of turbine inside the aquarium tank and the expected output power is around 1 to 2 Watts (W). Finally, this project is proposed to be implemented at estuary of a river or under main bridge.

1.4 Project Methodology

In order to reach the goal of this project, several methods have been carried out and arranged and there are:

1.4.1 Information Gathering

All the information gathers from internet such as journals and thesis and other document about renewable energy, definition of tidal, types of tidal, performance of tidal and tidal turbine

1.4.2 Designing Process

The designing section will be carried out after enough resources obtained. This involves designing two models. The first model is for the demonstration and the second model is a portable model that used in selected areas as a proof that this system is functional in real world. The designing process also includes simple electrical circuit design, aside from hardware design. The materials that will be used for this project will also need to be studied to make sure this project stays low cost.

1.4.3 Testing and Recording

The next step is testing the system using a portable model in selected areas to make sure it can work in real time situation. The result and observation is recorded to make sure that the system can be applied and function as expected.

1.4.4 Redesign and Conclusion

If the system does not work as required, then redesign should be carried out to identify and overcome the problems that occur in the pervious system. This process will contribute greatly to the perfection of the development system and to make able to future research of this technology.

Figure 1.1 shows about the flow chart for Project Methodology starting from literature study until system analysis. After that if the result is unsatisfied, back to construction or design section.

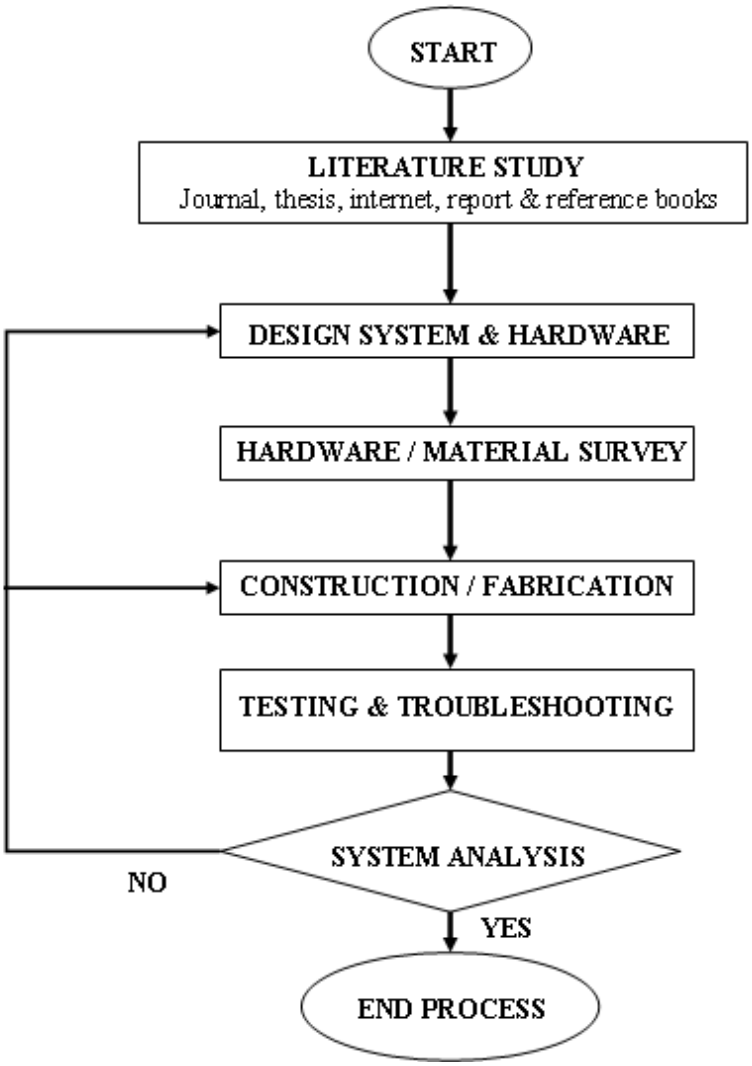


Figure 1.1: Flow Chart for Project Methodology.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review involves works of obtaining the information or data analyzing through related works that have been done. This includes all related thesis, documents and paper works form individuals or companies involved in developing or researching the technology. For that, some materials have been used as references to assists in carrying out this project.

The renewable energy is the energy generated from natural resources and it naturally replenished such as sunlight from light of the sun, tides, wind and rains. From these energies, the new and safe technologies are produced like solar power, hydroelectric, biomass, geothermal, hydrogen, wind and more. There are many renewable technologies that had discovered and keep improving every time. Each of this energy has there own potential but not all these energies can use in every where [7 - 14]. Figure 3.1 shown about renewable energies system.

There are two definitions about the tidal which are tidal wave and tidal stream. The first definition is tidal wave is a type of hydropower that uses the movement of water caused by tidal currents or the rise and fall of sea levels due to the tides. The second one is the flowing water in the river and ocean can be called as tidal phenomena or more accurate as tidal stream. Although not widely used yet, tidal power has potential for future electricity generation. It is a type of renewable energy that is more predictable

than solar power and wind energy. Tidal power has great potential for future electricity and power generation because of the massive size of our oceans [6 - 8].

(a)

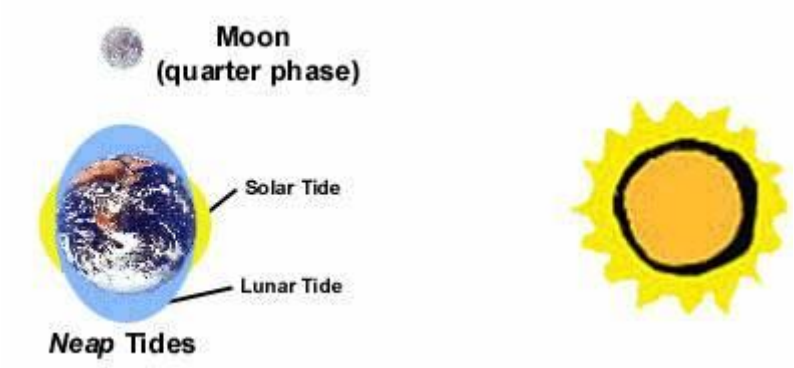
(b)

Figure 2.1: Renewable Energies: (a) The Wind Farm (b) Solar Cell Power Generation

2.2 Tidal Phenomena

References [3 - 4] describe the tidal wave phenomena around The Earth. This section discusses about two types of tidal which are the Spring Tides (which called the High Tides) and the Neap Tides (which called the Low Tides). There are two high tides and two low tides around The Earth at any instant. One high tide is on the longitude closest to The Moon and the other on the longitude furthest from The Moon. The low tides are on the longitudes at 90 to the longitudes where the high tides are situated. On any given longitude the interval between high tides is approximately 12 hours 25 minutes. The different in high between a high tide and low tide called the Tidal Range. The mid-ocean tidal range is typically about 0.5 to 1.0 meters but is somewhat larger on the continental shelves. For both tides, the Figure 2.1 shows when the Spring Tide and Neap Tide happen between the Moon and the Sun.

(a)



(b)

Figure 2.2: Actual tide at ocean for (a) The Spring Tide and (b) The Neap Tide

For the tidal stream phenomena, it uses the movement of flowing water form the areas of upstream to downstream. The simple explanation is the movement of flowing water from Point A to Point B. It more similarly to hydroelectric but the hydroelectric needs built the dam holds a specific amount of water to convert the potential energy to kinetic energy [7 - 11]. But in tidal stream concept, it uses the movement of flowing water to generate electricity by rotation of turbines. So, this type of tidal stream can be found at the river and an estuary.

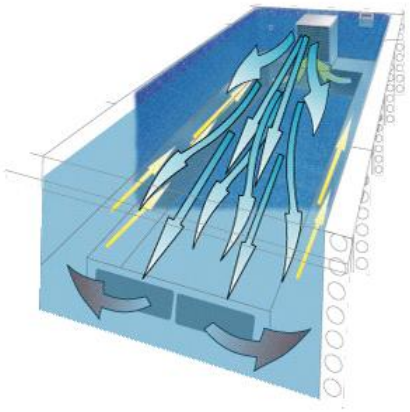


Figure 2.3: Model movement of the actual tide stream

2.3 Tidal Technology

References [5 - 6] are mainly about the implementation of this tidal technology in Western Countries and the focus more in tidal at the sea. It is stated in the report that this type of technology requires high level of expertise or specialty and involves very costly maintenance. It is a new technology that requires the equipments and the specialty for this technology are expensive if we compare the current technology. However, Malaysia is a country that has entire source for the development of tidal system whether for stream or sea. This statement can be described as follows:

a) Malaysia has high tidal range from 2 meter to 4 meter.

Traditionally, tidal amplitude in the candidate site ought to be more than 5 meter. With the development of the low head turbines, this requirement seems not to be so restricted. Some 2 meter or 3 meter tidal range areas also can be harnessed [1 - 6]. Surely, the higher the tidal range is the better use of this energy can be made. To prove this statement, the records of actual tides in Malaysia are at Pelabuhan Klang is given at Figure 2.4.

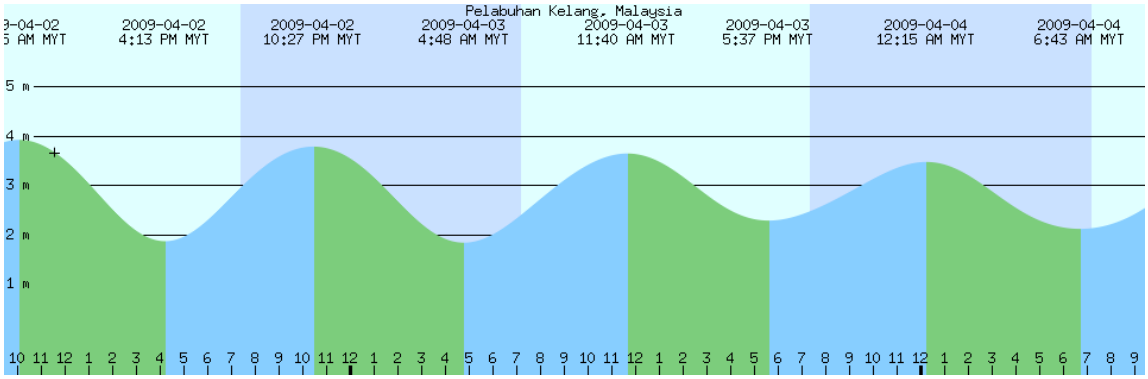


Figure 2.4: The record of actual stream tide at Pelabuhan Klang, Selangor [15 - 16].

b) Malaysia is country outside area of active volcanic belt.

The project site should not be chosen in a zone where the geological hazards happen frequently, or rather, it must avoid of the active volcanic belt, the potential earthquake centre, the active fault and etc. In addition, the site foundation should be hard enough to be able to support a great barrage. A soft sandy basement is always unfavorable for a traditional exploitation candidate.

The technology that use for tidal at sea or tidal wave is more likes wind technology. By doing the construction work which is the plant concrete bar at sea bed and the only difference is the turbine is fully sink inside the sea water or the flow of water. But for this project, the focus is more to the tidal stream at the river where it can generate electricity at any river which have flowing water.

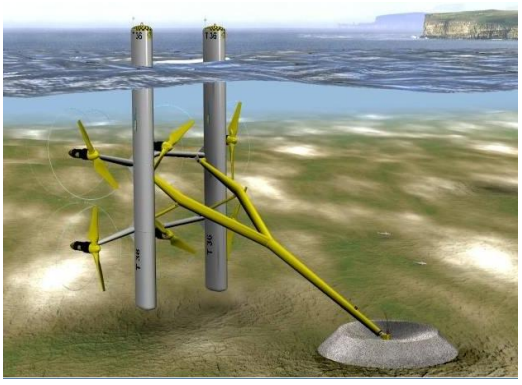


Figure 2.5: Tidal Stream Technology use at river [17].

2.4 Water Turbine

References [7 – 8] are about the water turbine types that normally used in tidal technology either for tidal stream and tidal wave. Normally there are two types of turbine that used in hydro and there are The Impulse Turbine and The Reaction Turbine. The Reaction Turbine are acted on by water, which changes pressure as it moves through the turbine and gives up its energy.

They must be encased to contain the water pressure, or they must be fully submerged in the water flow. The Impulse Turbine changes the velocity of a water jet. The jet impinges on the turbine's curved blades which change the direction of the flow. The resulting change in momentum (impulse) causes a force on the turbine blades. Since the turbine is spinning, the force acts through a distance (work) and the diverted water flow is left with diminished energy. Prior to hitting the turbine blades, the water's pressure (potential energy) is converted to kinetic energy by a nozzle and focused on the turbine. No pressure change occurs at the turbine blades, and the turbine doesn't require housing for operation. The Impulse Turbines are most often used in very high head applications and for The Reaction Turbines are used in low and medium head applications. So the best choice is to use The Reaction Turbine type and Figure 2.4 illustrates the type of turbine.

Figure 2.4: The Reaction Turbine