UNIVERSITY TEKNIKAL MALAYSIA MELAKA

MODELING OF HYDRO WIND TURBINE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Process)

by

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BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Modeling of Hydro Wind Turbine**

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the Degree in Bachelor of Manufacturing Engineering (Manufacturing Process). The member of the supervisory committee is as follow:

……

Supervisor

ABSTRAK

Sumber tenaga boleh diperbaharui adalah sumber tenaga alam yang tidak habis-habisan Kini, manusia menggunakan tenaga angin dan tenaga hydro untuk menghasilkan elektrik. Batteri hanya mempunyai jangka penggunan yang singkat dan tidak dapat membekalkan penjanan kuasa bagi jangka masa panjang di tempat yang terpencil. Penyelesaian yang dicadangkan untuk menyelesaikan masalah ini adalah dengan mengembangkan turbin yang dikendalikan oleh tenaga angin dan hydro. Objektif bagi projek ini adalah untuk mereka satu turbin hydro angin dan menyiasat pendahuluan operasi bagi turbin hydro angin yang telah direka. Tinjauan pustaka dibuat terhadap turbin angin dan hydro untuk mendapatkan pemahaman yang lebih baik terhadap konsep dan prinsip asas bagi turbin angin and hydro yang telah ada. Tiga konsep rekaan bagi model turbin hydro angin telah dilakarkan dan konsep yang terbaik telah dipilih melalui cara pemilihan konsep Pugh. Konsep yang telah dipilih dikembangkan menjadi rekaan teliti dengan mengunakan perisian CATIA dan bahan yang sesuai untuk memfabrikasikan model turbin hydro angin telah dipilih. Proses pembuatan yang telah digunakan untuk memfabrikasikan model turbin hydro angin adalah kimpalan MIG, “bending” and “riveting”. Turbin hydro angin ini telah dikaji dan data yang terkumpul dianalisakan. Keseluruhan penemuan dalam projek ini disimpulkan dan cadangan pembaikan bagi turbin hydro angin model disarankan pada akhir projek.

ABSTRACT

Renewable energy sources are the natural resources that are inexhaustible. Today, people use wind energy and hydro power to make electricity. Battery has the limitation of short usage lifetime and cannot provide long term power generation in isolated places. In this project, the proposed solution to solve the problem is by developing a turbine operated by wind and hydro power. The objectives of this project are to design and investigate preliminary operation of hydro wind turbine designed. Literature review is done on the wind and hydro turbine to gain a better understanding of the concept and fundamental of existing wind and hydro turbine. Three concepts of design for the hydro wind turbine model are sketched and the best concept is selected through the Pugh concept selection method. The detail design of the selected concept is generated using CATIA software and the suitable materials are chose based on light weight property. The main manufacturing processes used to fabricate the hydro wind turbine model are MIG welding, bending and riveting. The hydro wind turbine is tested and the data gained is analyzed. The overall findings are concluded and recommendation of improvement for the hydro wind turbine designed is suggested at the end of project.

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First and foremost, I would like to express my deepest sense of gratitude and appreciation to my respected project supervisor, Associate Professor Ir. Sivarao A/L Subramonian, for his support, useful guidance, encouragement, valuable advice and constructive comments during the time this final year project was being developed. And not forget to my examiner and panel, Mr Mohd Fairuz Bin Dimin@Mohd Amin and Mr. Ammar Bin Abd Rahman respectively. Thank you for the guidance.

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Last but not the least, a special note of thanks is also dedicated to my classmate, Ow Yong Chia Hau in helping me to fabricate the hydro wind turbine model. Without his helping, the model will not fabricate successfully.

DEDICATION

Dedicated to my supportive father and mother, who sacrificed so much for his children. I would like to extend my heartiest thanks to my beloved family. They are understanding, supportive, loving and caring especially for the period during development of this project. Special appreciation to all of you.

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LIST OF ABBREVIATIONS

AC	-	Alternating Current
AWS	-	Average Wind Speed
CAD	-	Computer Aided Design
DC	-	Direct Current
DG	-	Distributed Generators
HTGS	-	Hydro Turbine Generating Sets
IG	-	Induction Generator
MHPP	-	Micro Hydro Power Plant
MIG	-	Metal Inert Gas
MPT	-	Maximum Power Tracking
MWPT	-	Micro Wind Power Turbine
NDE-HS	-	Nonlinear Differential Equations for Hydraulic System
PMSG	-	Permanent Magnet Synchronous Generator
PVC	-	Polyvinyl Chloride
RPM	-	Revolution Per Minute
SCIG	-	Squirrel Cage Induction Generator
SPS	-	Sim Power System
THD	-	Total Harmonic Distortion
TSP	-	Transient Stability Program
VFC	-	Voltage and Frequency Controller

CHAPTER 1
INTRODUCTION

This chapter describes about the background of the project and briefly explains about the problem statement for this project. Then, the goals and scope of the project are identified. Finally, the proposed solution is briefly discussed.

1.1 Background

Renewable energy sources are the natural resources that are inexhaustible. Renewable energy sources have attracted attention world-wide due to soaring prices of fossil fuels. Renewable energy sources are considered to be important in improving the security of energy supplies by decreasing the dependency on fossil fuels and in reducing the emissions of greenhouse gases. Importantly, renewable energy produces virtually no greenhouse gas emissions. This can protect earth from pollution. Examples of renewable energy are wind, hydropower, solar, geothermal and biomass.

Wind is simply air in motion caused by the uneven heating of the earth‟s surface by radiant energy from the sun. Today, people use wind energy to make electricity. Wind power has been used for pumping water, milling grain and driving other mechanical devices start from thousand years ago. Nowadays wind farm commonly employs groups of wind turbine, located either on land, near-shore and off-shore, to harness wind energy for mass production of electricity. A wind turbine is a device fitted with blades which converts kinetic energy of the wind into rotational motion to turn an electrical generator and produce electricity. Wind power is commonly used in many countries including Germany, Denmark, Spain and United.

Hydropower is energy that comes from the force of moving water. The force of moving water can be extremely powerful. Hydropower is called a renewable energy source because the water on the earth is continuously replenished by precipitation. Hydro energy uses water to create power. Hydropower converts the energy in flowing water into electricity. Most hydroelectric power comes from the potential energy of dammed water driving a water turbine and generator. The quantity of electricity generated is determined by the volume of water flow and the amount of "head". “Head” is the height from turbines in the power plant to the water surface created by the dam. The greater the flow and head, the more electricity produced.

1.2 Problem Statement

The light of alert sign board that located at the dangerous and isolated area like sea is operated by using battery at night. But battery has the limitation of short usage lifetime and cannot provide a long term power generation. Furthermore, the replacement of new battery in this isolated place is trouble and inconvenience.

1.3 Objective

The objectives of this project are to:

i. Design a hydro wind turbine.
ii. Develop a hydro wind turbine model.
iii. Investigate the preliminary operation.

1.4 Scope

This project focus on prototype a turbine that operated by wind and hydro power. The maximum dimension of the hydro wind turbine is 50mm length, 30mm width and 40mm height.

1.5 Proposed Solution

The problem can be solved by develop a turbine that operated by wind and hydro power. This hydro wind turbine can provide a long term power generation and is no need of doing any battery replacement when usage life time is over.

CHAPTER 2
LITERATURE REVIEW

This chapter contains of literature review on the types, development and application of wind turbine, hydro turbine and wind hydro turbine.

2.1 Wind Turbine

Wind turbines used to generate electricity come in a wide variety of sizes. Large wind turbines, which are usually installed in clusters called windfarms, can generate large amounts of electricity. Large wind turbines may even produce hundreds of megawatts of electricity, enough to power hundreds of homes. Small wind turbines which are generally defined as producing no more than 100 kW of electricity, are designed to be installed at homes, farms and small businesses either as a source of backup electricity, or to offset use of utility power and reduce electricity bills.

Wind turbines produce electricity by using the natural power of the wind to drive a generator. The wind is a clean and sustainable fuel source, it does not create emissions and it will never run out as it is constantly replenished by energy from the sun. In many ways, wind turbines are the natural evolution of traditional windmills, but now typically have three blades, which rotate around a horizontal hub at the top of a steel tower. Most wind turbines start generating electricity at wind speeds of around 3-4 metres per second (m/s), (8 miles per hour); generate maximum „rated" power at around 15 m/s (30mph); and shut down to prevent storm damage at 25 m/s or above (50mph).

Patel, D. *et al*. (2010) have analyzed the impact of wind turbine generators on network resonance and harmonic distortion. First, a representative study system is devised where the impact of different elements of power system on system resonance frequencies is analyzed. Then the influence of system background harmonics on harmonic distortion is shown for the study system as well as for one of the actual Hydro One distribution feeder systems. It is shown that several scenarios are possible when these resonant frequencies align with harmonic frequencies that are likely to be injected by other power electronic based system equipment including distributed generators (DGs), thus causing unacceptable total harmonic distortion. Results for the study system further shows that the addition of a specific number of SCIG‟s may cause an unacceptable value of THD due to network resonance.

2.1.1 Types of Wind Turbine

There are two basic types of wind turbine which are horizontal axis wind turbines and vertical axis wind turbines. Figure 2.1 shows the two basic types of wind turbines. Horizontal axis turbines need to be aimed directly at the wind. Because of this, they come with a tailvane that will continuously point them in the direction of the wind. Vertical axis turbines work whatever direction the wind is blowing, but require a lot more ground space to support their guy wires than horizontal axis wind turbines. (Clarke, 2003).

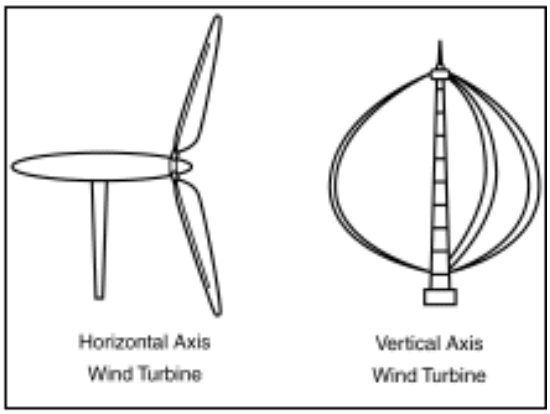

Figure 2.1: Two basic wind turbines, horizontal axis and vertical axis (Clarke, 2003).

2.1.2 Components of Wind Energy Systems

There are four basic components of typical wind energy system which are including rotor, gearbox, enclosure and tail vane. Figure 2.2 shows the basic components of a typical wind energy system. A rotor is consisted of blades with aerodynamic surfaces. When the wind blows over the blades, the rotor turns, causing the generator or alternator in the turbine to rotate and produce electricity. Gearbox is matched to the rotor speed to that of the generator or alternator. The smallest turbines which are under 10 kW usually do not require a gearbox. The function of enclosure or nacelle is to protect the gearbox, generator and other components of the turbine from the elements. A tailvane or yaw system is used to align the turbine with the wind. Horizontal axis wind turbine is mounted on a tower and vertical axis turbines are usually built on the ground. (Clarke, 2003).

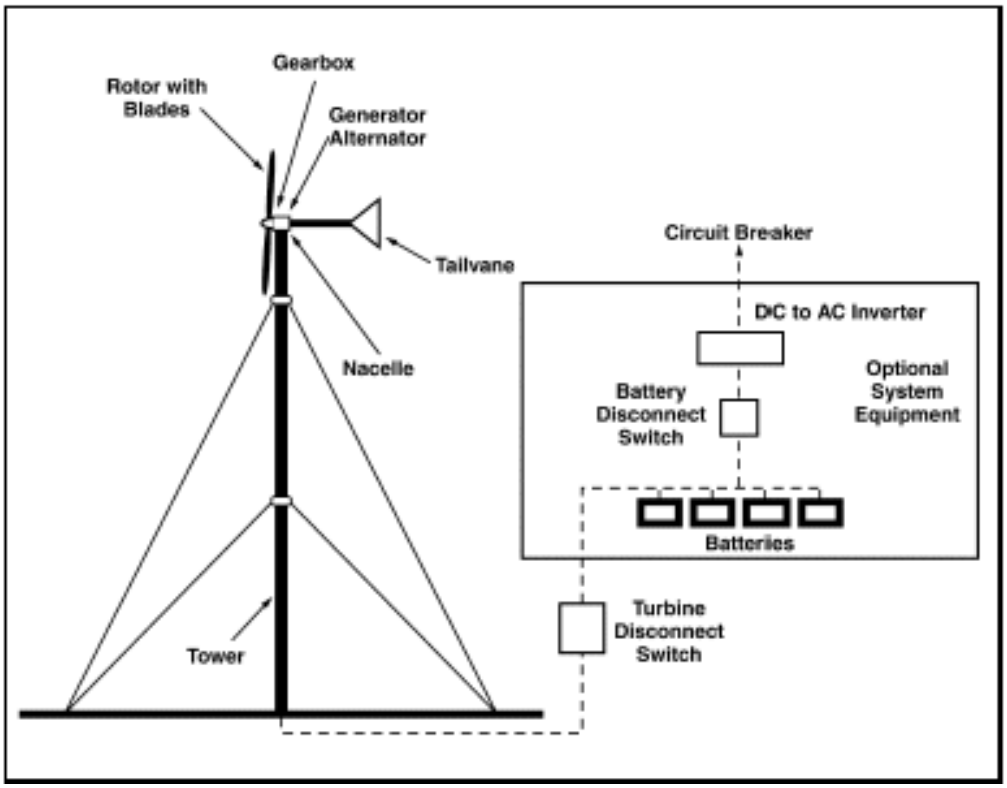

Figure 2.2: Components of a wind energy system (Clarke, 2003).

2.1.3 Current Wind Turbines

Today‟s wind turbines use blades to capture the wind‟s kinetic energy. Wind turbines work because they slow down the speed of the wind. When the wind blows, it pushes against the blades of the wind turbine, making them spin. They power a generator to produce electricity. Most wind turbines have the same basic parts which are blades, shafts, gears, a generator, and a cable. Some turbines do not have gearboxes. These parts work together to convert the wind‟s energy into electricity. (National Energy Education Development Project, 2010).

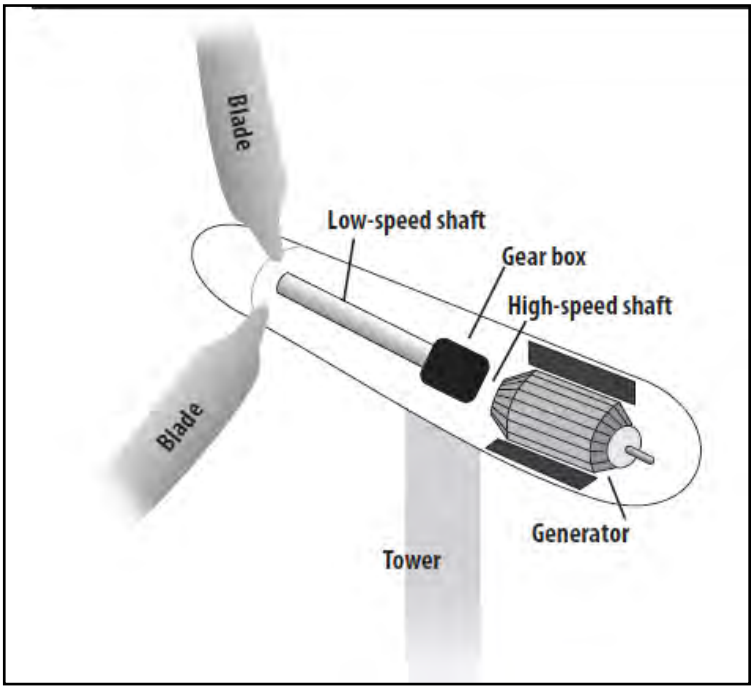

Figure 2.3: Wind turbine diagram (National Energy Education Development Project, 2010).

The wind blows and pushes against the blades on top of the tower, making them spin. The turbine blades are connected to a low-speed drive shaft. When the blades spin, the shaft turns. The shaft is connected to a gearbox. The gears in the gearbox increase the speed of the spinning motion on a high-speed drive shaft. The high-speed drive shaft is connected to a generator. As the shaft turns inside the generator, it produces electricity. The electricity is sent through a cable down the turbine tower to a transmission line.