UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STUDY THE POTENTIAL OF SUBMERGE PICO HYDRO GENERATION SYSTEM IN WATER PIPELINE

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology
(Industrial Power) with Honour

by

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FACULTY OF ENGINEERING TECHNOLOGY
2015

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **STUDY THE POTENTIAL OF SUBMERGE PICO HYDRO GENERATION SYSTEM IN WATER PIPELINE**

SESI PENGAJIAN: **2015/16 Semester 1**

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I hereby, declared this report entitled “study the potential of submerge Pico hydro generation system in water pipeline
” is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Jabatan Teknologi Kejuruteraan Elektrik) (Hons.). The member of the supervisory is as follow:

…….

(Mr Mohd Firdaus bin Mohd Ab.Halim Project Supervisor)

ABSTRAK

Objektif utama laporan ini adalah untuk membangunkan dan mengkaji jenis submersible Pico hidro yang dipasang di saluran paip air. Semasa melakukan ujian terhadap experiment ini kadar air, tekanan air, perbezaan saiz paip air, menggunakan turbine generator lebih dari satu dan kedudukan pico hydro dipasang di dalam paip di ambil kira sebagai pembolehubah. Kesemua pembolehubah tersebut di ambil kira adalah utuk mencari keadaan yang terbaik dan sesuai untuk dipasarkan. Data yang di ambil dari projek ini adalah voltage, arus, dan kuasa. Selepas itu analisis dilaukan terhadap kadar air dengan arus dan voltan. Projek ini juga mengkaji, potensi submerges pico hydro dengan menggunakan motor kipas penyejuk berkada terus (DC) sebagai generater utuk menjana elektrik.

ABSTRACT

The primary objective of this report is to develop and study the submersible type of Pico hydro mounted in a water pipeline. The testing and experiment for this project involve manipulating variable such as flow rate of water and pressure of water, different size of water pipeline, using turbine generator more than one and different condition that the turbine is installed. The entire variable is to study the best condition that suitable to be installed. The data is taken from this project is voltage, current, and power. Next the analysis will be performing on relationship between rate of water with current and voltage. This project also to cover the possibility of submerges Pico hydro using DC cooling fan motor to generate electricity.

DEDICATIONS

To my beloved parents

ACKNOWLEDGMENTS

Alhamdulillah,

This project is finally complete after dedicating all my effort on completing this project. First of all, I would like to express my thankfulness to Allah S.W.T because has given me all the strength and competed hope to keep up continuously until this report and project.

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LIST OF SYMBOLS AND ABBREVIATIONS

p	=	Power
P_{in}	=	Input power
p_{out}	=	Output power
H	=	Effective head (meter)
n	=	Rate of rotation
Q	=	Water flow rate
G	=	Gravity
η	=	Efficiency
N_s	=	Specific speed
AC	=	Alternating current
DC	=	Direct current
V	=	Water velocity inside pipe
Q	=	Flow rate of water inside pipe
D	=	Pipe inside diameter
gpm	=	Gallon per minute
Ft/sec	=	Feet per second

CHAPTER 1
INTRODUCTION

This chapter will cover the purpose of this project, introduction and problem statement. From that, the conclusion will be drawn based on the activities mentioned. The objectives and scope of the project are also will be explained briefly through this chapter. Objectives and scope are very important towards this project because it will give guidance through the whole process.

1.1 Introduction and Background study

The importance of electricity reliability grows simultaneously with the demand from consumers. The consumers come from many part of the country which is not necessarily near town or city. It also can come from remote area that is far away from the generation plant. To overcome this problem, the remote area can use renewable energy such as wind, hydro, sunlight, and waves. In peninsular Malaysia the common renewable energy source is using hydro and sunlight as a main energy to generate electricity.

The aim of hydropower generation is to generate a clean energy electricity which is one of the most valuable and desired resource. There are many types of hydropower generation with different amount power produced.

Table 1.1: Type of hydropower classification by generating capacity.

Classification	Power Output
Large	>100MW
Medium	10-100MW
Small	1-10MW
Mini	100kW-MW
Micro	5-100kW
Pico	<5kW

Pico hydro is a term used for hydroelectric power generation of under 5 kW. It is useful in minor remote communities that need only a small amount of electricity. Pico hydro system usually found in higher land region. Their small generating capacity makes them suitable for isolated off grid location to provide power to small rural communities. Pico hydro is typically run of river, although small storage tanks may be required to hold a small amount of water to ensure that, even at time of. For this project is to develop and study the potential of Pico-hydro generation system. The generator is submersible type it consist of three generators with different position in the water pipeline. This project also will use single pipeline with different size of diameter for investigate effect size of diameter of the pipeline towards of the voltage of Pico hydro generator. In addition, the different flow rate of the water or pressure of water will be used to observe the voltage that will be generate at Pico hydro generator. The measurement and data will be recorded in order to investigate the generation system performance.

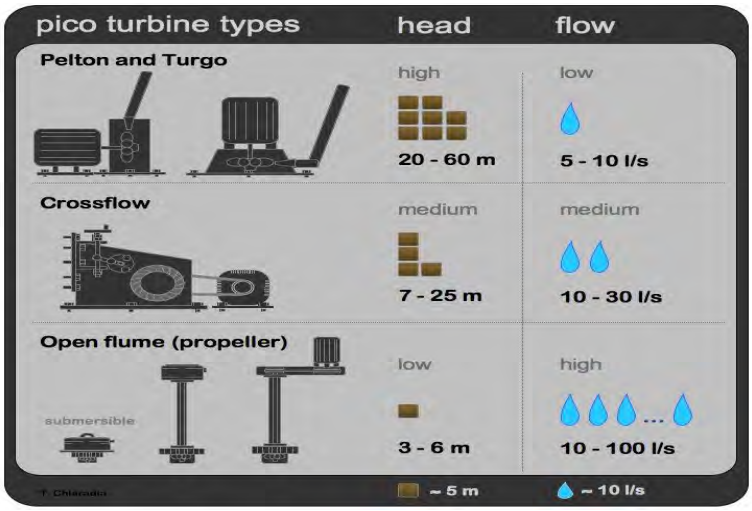

Figure 1.1: shows the different type of Pico hydro in market industry.(source: https://energypedia.info/wiki/Pico_Hydro_Power)

Figure 1.1 shows the different types of pico turbine. At the figure, each turbine design is depend on head and flow rate of water. If head of the turbine is beggest, so the water flow require is low, than if the head is lower, the water flow must be high.

1.2 **Problem statement**

Nowadays the renewable energy is very important because the first energy such as petroleum and coal maybe not enough to support the consumer. Therefore, the first energy is replace with renewable energy to generate electricity.in Malaysia the renewable energy widely used is hydropower generation to generate clean electricity. However this renewable energy is depend on the geography condition. The submersible type Pico hydro is installed in water pipeline and the amount of water flow must be enough to spin the turbine. The piping system is used to carry water to the turbine, the size of the water piping effect the rotation of turbine. For this project purpose is too manipulated of the water flow in different size of the pipeline and different condition of turbine located in the pipeline.

1.3 Objective of the project

1. To study the submersible Pico hydro in water pipeline using dc cooling fan
2. To develop submersible Pico hydro system and testing the system
3. To analyse the potential of the submersible Pico hydro

1.4 Scope of the Project

The main goal of this thesis is to figure out the output coming from direct Pico hydro generator by using voltmeter and clamp meter to measure voltage and current and to study the output characteristic. Other than that this project is using the different size of water pipeline and the turbine will mounted in a water pipeline. The turbine also will be use more than one and will install with different condition. Base on this project the final data will collected and do the analysis base on characteristic of output voltage vs. flow rate of water, output current vs. flow rate of water, output power vs. flow rate of water. The summary for this scope be like this:

1. To study the submersible Pico hydro and water flow with different size water pipe in single piping.
2. To develop the generator by using extra turbine generator
3. To investigate the Pico hydro generator to produce electricity by testing different rate of water Using water pump. The data will be record is voltage, current, and water flow per second.

CHAPTER 2
LITERATURE REVIEW

This chapter will discuss the information, principle and theory about hydro power generation that undergo in this thesis.

2.1 Theory and basic principle

The earliest reference to the use of the energy of falling water is found in the work of the Greek poet Antipater in the 4th century BC. The first founder use water as a energy to move turbine is Romans were using waterwheels to control the water flow. (History of Hydroelectric power).

In 19th century the water wheel technology is improve and become first water wheel used to generate electricity. in 1882 the USA began generating the electricity on the fox river Appleton. Since that time the contribution of hydroelectric power to world use of electricity has risen steadily and today hydroelectricity is the principal source of electric power in some 30 countries and provides about 20% of the world's annual electrical output. This statement was agreed with Anderson et al, 1999.

The very first hydro-plants were relatively small schemes, however, subsequent developments were around very large schemes and today most of the hydroelectric power is produced from very large hydro-plant associated with dams, which were major capital projects. Large dams are still being built today, however the majority are located in the developing world, where between 1980 and 1986 the absolute increase in hydro generation was almost twice that of the industrialized world (Anderson et al, 1999).

The hydroelectric plants work by converting the kinetic energy from water falling into electric energy. This is achieved from water powering a turbine, and using the rotation movement to transfer energy through a shaft to an electric generator.

Figure 2.1: Early hydro turbine design
Source: (http://ffden-2.phys.uaf.edu/104_spring2004.web.dir/Todd_Robyn/Page6.htm)

2.2 **Water turbines**

According to Fariz, & Masjuri turbine is the main part which the water flow towards the turbine will be make the turbine spin than the generator can generate electricity. An example, if use the generator has 3000 rpm to generate electricity, than the turbine must at least 1000 rpm to spin the generator. Usually the type of turbine and generator used base on a few factor depend on the head, water flow, type the location want to install. Turbine of the generator can classification as two types, first, impulse turbine, and second reaction turbine. The impulse turbine normally use for high head and medium head with low water flow. The reaction turbine is use when low head and ultra-low head sites with high flow water only.

2.2.1 **Impulse turbine**

This turbine is axial flow and it is declared as impulse turbines because the occurrence of a direct driver or impulse on the blades which creates by the water. The operation of impulse turbine is, the design at the outlet pipe at near the turbine is installed a nozzle. When the water flow through the nozzle, the pressure can change from low pressure to high pressure to inject the turbine in open air.(Farizz, & Masjuri) The figure 2.2 shows the types of impulse turbine of Pico hydro.

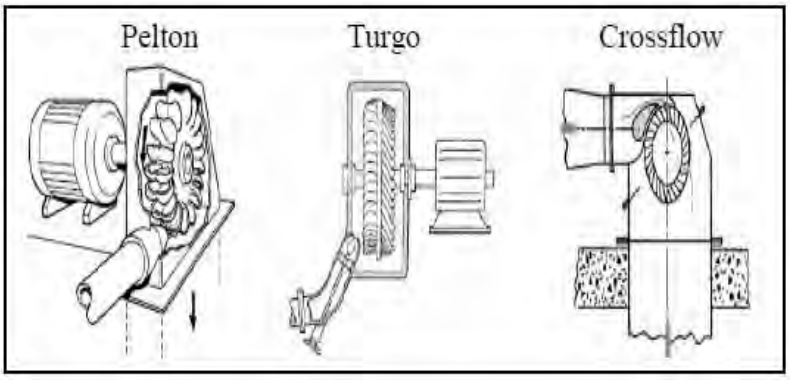

Figure 2.2: various type of impulse turbine for Pico hydro (Farriz & Masjuri)

2.2.1.1 **Pelton Turbine**

The Pelton turbine is an example of a pure impulse turbine and is named after its inventor, L.A. Pelton (1829-1908) who, in 1880 is patented and improved this form of impulse wheel.

This turbine usually uses in application where small flow rate has at a high head, typically more than 250 m. (Farriz, & Masjuri). Like in figure 2.3, the nozzle at the outlet of water with the nozzle is installed in parallel with the turbine. This installation can give more momentum to rotate the turbine.

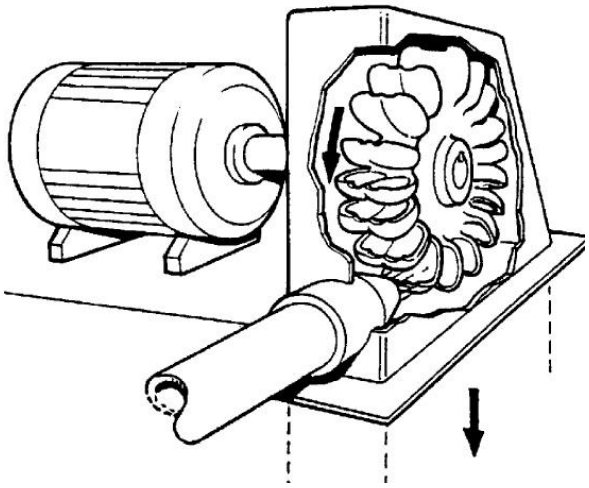

Figure 2.3: Pelton Wheel Turbine (Oliver Paish, 2002).

2.2.1.2 **Turgo turbine**

The impulse wheel is usually used in a medium head turbine. it is causes the water jet is directly in jet the water in half side of the turbine and discharge half another side like in figure 2.4.

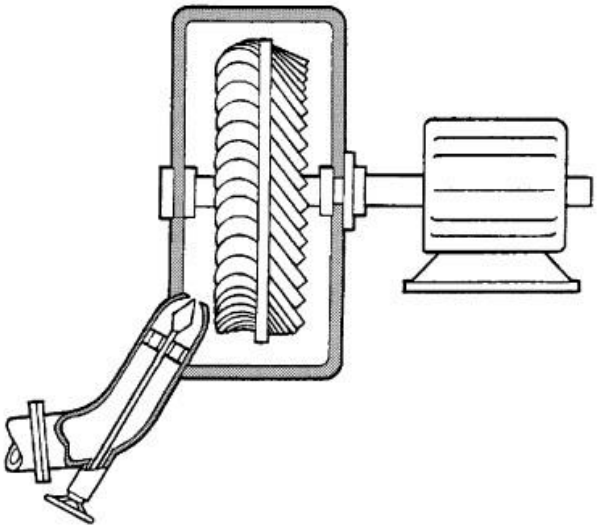

Figure 2.4: Turgo Wheel Turbine (Oliver Paish, 2002)

2.2.1.3 **Crossflow Turbine**

The cross flow turbine installed with the water outlet to the turbine is operate with the partial air admission and the runner partly immersed in water even though it is declared in the family of impulse turbine. (Farriz,& Masjuri). The Figure 2.5 shows the cross flow turbine operation.

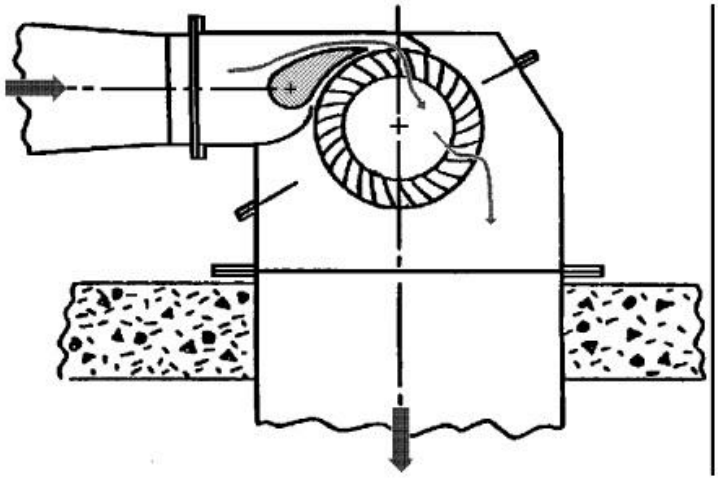

Figure 2.5: cross flow turbine (Oliver Paish, 2002)

2.2.2 **Reaction Turbine**

Refer to Farriz and Masjuri the reaction turbine is radial flow where it used for low head and high flow rate of water. Usually this turbine installed in submerges in water and is enclosed in pressure casing or volute. The reaction turbine have are 2 types.

1. Francis
2. Kaplan