CHAPTER I
INTRODUCTION

1.1. Background

Indonesia has projected to reach a 100% electrification ratio at the end of 2019. By December 2017, the ratio has touched 95.4% [1]. This is a serious plan to expand electricity until it reaches a remote area. The government has many power generators to generate electricity, and each place would be made an effort to build its own plant generator, according to its potential power, each place could be used transmission line to transmitted electricity to all area.

The government and independent corporations had been installed power plant that expanse to all national zone. By December 2017, Indonesia has produced 60,000 MW of electricity that generates by 13 power plants. It included 49,7 % Steam Power Plant (PLTU); 16,7 % Combined Cycle Power Plant (PLTGU); 10,3 % Diesel Power Plant (PLTD); 8,5 % Hydro Power Plant (PLTA); 7,3 % Gas Power Plant (PLTG); 3,9 % Gas Engine Power Plant (PLTMG); and only 3,6 % for renewable energy power plant. This renewable energy consisted of geothermal in the top is 81, 8 %; mini-hydro in 11,8 %, micro-hydro in 3 %, and other renewable energy in only 0,12% [1]. For comparison of the data, it would conclude that Indonesia has much focus on fossil energy. It has the lowest cost to generate renewable energy, especially the unmentioned power plant on that data, namely the pico-hydropower plant [2].

However, it has several challenges problems to build power generation or transmitted electricity to the remote area. Besides, the areas were far from a near power plant, and the most challenging problem is hard to access and high-cost facilities. An engineer proposed some solution for this problem, specifically using the own potential energy to each remote area. Often should be exploited the renewable energy potential in that place. One of the renewable energy resources that have high potential and uses a minimum device is pico-hydropower.

Hydropower itself is a power derived from the energy of falling water or fast running water. It is a kind of renewable energy that has a high potential to use. For 75,000 MW potential in Indonesia, only exploited 9% from a large or small scale [2]. There were mini-hydropower/micro-hydropower and pico-hydropower; they were differentiated by maximum energy capacity to be generated.

Micro-hydropower could be produced energy from 5 kW to 100 kW, and below 5kW, it called pico-hydropower [3] [4]. Pico-hydropower could be powered by two fluorescent light bulb and one television for 50 houses [5]. Besides, this kind of hydropower uses the smallest discharged to produce energy than other types of hydropower.

Despite, the location of Indonesia is between 6° 04' 30'' North latitude and 11° 0' 36'' South latitude and between 94° 58' 21'' and 141° 01' 10'' East latitude and lies on equator line located at 0° latitude line. In term of geographic position, Indonesia located in Southeastern Asia, it has boundaries as follows: North – Malaysia, Singapore, Vietnam, Philippines, Thailand, Palau, and the South China Sea; South – Australia, Timor Leste, and the Indian Ocean; West – Indian Ocean; East – Papua New Guinea and the Pacific Ocean. It has a total area of 1,913,578.68 km 2 and consist of 17,504 islands. This tropical country is hot and humid but more moderate in highlands. The weather in Indonesia is significantly affected by rainfall. There are two seasons in Indonesia, which are the dry season and the rainy season. The rainy season lasts from November to March, with the high moisture level and the cold Northwesterly wind, while the dry season will occur from April to October [6]. Due to the advantages of geographical position, the pico-hydropower plant can develop extensively in Indonesia and could be an alternative solution in increasing its electrification ratio in a remote area.

For extracting hydropower, it commonly uses a Francis turbine. This kind of turbine is the most type of hydraulic turbine used frequently in medium-scale hydroelectric plants. This type of turbine can be used as low as 2 meters and as high as 300 meters for heads. Besides, over the remote area, commonly, there was a river as a water resource for living. It only needs 5 meters cubic per second discharge to rotate the pico-hydro turbine to generate hydropower [7].

There was two Francis turbine in the dynamic fluid laboratory. Both turbines are differentiated by the diameter of the runner 8 and 10 cm. However, their characteristics are unknown. So, it is important to determine the characteristics of this turbomachinery.

1.2. Statement of Problem

What characteristics of a blower act as a turbine with head and discharge of parameter and different runner diameter 8 and 10 cm?

1.3. Objective

The objective of this project is:

a. Obtain the characteristics of francis turbine with 8 and 10 cm diameter of runner in pico scale between
   1. Discharge and rotational speed
   2. Torque and rotational speed
   3. Mechanic power and rotational speed
   4. eficiency and rotational speed

b. Obtain the characteristics of francis turbine with 8 and 10 cm diameter of runner in pico scale for future selecting as a reference.

1.4. Benefit

This project has the benefit of being a reference for selecting Francis turbine in pico scale.

1.5. Limitation of Problem

From the problems to be solved over, the limitation problem is needed, explicitly:

a. This project uses Pico Hydro-Powerplant in Limau Manih, Padang.
b. The variation of runner to each francis turbine is 8 cm and 10 cm

1.6. Writing Format

This final report written allows to this format contents:

Chapter I : Introduction, contents a background, statement of problem, aim, benefit, limitation of problem, and writing format.

Chapter II : Literature review, contents of several theories and relevant researches.

Chapter III : Methodology, contains of simulation method for testing Francis turbine.

Chapter IV : Data and discussion, contains of characteristic of turbine as the analysis result for the test.

Chapter V : Result, contains conclusion of the characteristic test of the turbine.