Generation of Wind Power In Perlis, Northern Malaysia

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***Abstract*—In recent years, wind energy is one of the fastest developing renewable energy sources technologies across the globe. Wind energy conversion given a serious consideration in Malaysia since it is located in the equatorial region. Wind energy generation in Malaysia is very much depends on the availability of the wind sources that varies with specific location. This paper present analysis of wind speed by using Weilbull distribution function and describes the performance on the Horizontal axis Wind Turbine (HAWT). The wind speed data and output voltage from the wind turbine is recorded per hour for a 24 hour by using Davis Vantage Pro2 Weather station and Electrocoder. A few calculations has been done to get output power from the wind to shows potentialities of wind energy weather it can be develop in Perlis.**

Keywords-component; Weilbull; Horizontal axis wind turbine(HAWT)

I. INTRODUCTION

In recent years, considerable importance has been placed on the rational use of energy resources [1]. Nowadays, wind analysis given remarkable information to researches involved in renewable energy studies. Renewable energy resources that occur naturally and repeatedly in the environmentally where it can be harnessed for human benefit [2]. The renewable energy resources include solar, wind, wave, geothermal and biomass.

Wind power is a renewable energy source that has developed rapidly since the end of the 1970s. Wind turbines produce clean energy, don't need any fuel transport that can hazardous to the environment. The sun, the wind and running water are all renewable energy sources, in contrast to coal, oil and gas, which depend on fossil fuels from mines or oil and gas fields. Modern wind turbines are efficient, reliable and produce power at reasonable cost. This has been achieved by an energy policy that has created a market for renewable energy and by research development. The technology in the wind turbines has developed in several ways. The control systems have become cheaper and more advanced, new profiles for the rotor blades can extract more power from the wind, and new power electronic equipment makes it possible to use variable speed and to optimize the capacity of the turbines

[3]. In this few decades wind power generation has developed from alternative energy source to a new fast-growing industry which no longer needs subsidies and manufactures wind turbines that produce power at competitive cost.

Data of wind speed is needed to asses the potential wind. The wind speed is random variable and variation wind speed over a period of time is represented by probability density function. Wind speed frequency distribution has been presented by various probability density functions that are Weilbull, Rayleigh and gamma [4]. However, in recent years Weilbull distribution has been one of the most commonly used accepted, recommended distribution to determine potential of wind energy [5].

There were a lot of researches being done in the area of wind speed characteristics in the past and it's potential as renewable energy sources in worldwide. Asian countries including Malaysia have the potential to develop wind energy. Analysis of the wind power generation in Malaysia was done by Azami Zaharim et all [6] that investigates a comparative assessment between three statistical distributions that is weibull, Lognormal and Gamma. The result shows Weilbull distribution seems to satisfy fit the wind speed about 2.0 to 2.6 m/s and 2.0 to 3.0 m/s in the year 2005 and 2006 respectively. This paper presents the potential of wind power generation in Perlis, through Weilbull distribution function method and principle work of horizontal wind turbine for 24 hour on 14th March in a year 2011.

II. METHODOLOGY

A. Wind turbine

Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for a specific task such as pumping water or a generator that can convert mechanical power into electricity for homes used and many more. When the wind flows past the turbine's rotor blades, the blades turn and convert the wind energy into kinetic energy. The relationship between the kinetic energy is determined by equation 1 th at is:

$$\textit{Kinetic energy} = 0.5\ mV^2 \qquad (1)$$

Where m is mass of the air in kilograms and V is velocity in meters per second.

This energy spins the rotor inside a generator where the kinetic energy is converted into electricity energy. Once the wind energy is converted into electricity, the electricity flows

This work has been supported in part by Kementerian Pengajian Tinggi Malaysia under Fundamental Research Grant.

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through cables in the turbine, down the turbine tower to connect with the output from the other wind turbine before entering local electricity network.

There are several different concept of wind turbine. Wind turbines are separated by two types that are Horizontal Wind Turbine (HAWT) and Vertical Axis Wind Turbine (VAWT). For this paper, the stress is put on HAWT. HAWT have the main rotor shaft and electrical generator at the top of the tower, and must be pointed into the wind.

Figure 1 show WindPower wind turbine that has been installed at Electrical Energy and Electronic (EEIS).

Figure 1: WindPower wind turbine

B. Site and data description

The wind speed and air density data for this study is obtained by using Davis vantage pro2 Weather station that successfully installed at Electrical Energy and Electronic (EEIS) located in Kangar, Perlis. The function of weather station used to record solar radiation, temperature, wind speeds, wind directions, rain falls, pressure and humidity. The wind speed and direction were captured by a Davis cup anemometer and vane installed at the top of 10 meters height from the ground level that is a same height with WindPower wind turbine. Wind speeds taken every 1 minute were averaged over 1 hour and stored in computer that is connected to receiver. At the end of the each day, the data was manually saved to a computer.

Voltage measurements were carried out by the Electrocoder with normal DC voltage that connected to the WindPower wind turbine. The Electrocoder will record the data every minute up to seven days. The data will be manually downloaded to the computer once a week to ensure that it can continue recording the voltage data. The data from weather station and Electrocorder will be synchronizing due to data recorded for both in every minute.

Figure 2: Weather station

C. Weilbull distribution

Wind speed frequency distribution has been represented by various probability density functions such as gamma, lognormal, three parameter beta, Rayleigh and Weibull distributions. The weilbull distribution is the most commonly used statistical distribution for describing wind speed data. Weibull distribution is a good match with the experimental data. The idea is that only annual or monthly average wind speeds are sufficient to predict the complete frequency distribution of the year or month [7]. The Weilbull function is defined as:

$$f(v) = \frac{k}{c}\left(\frac{v}{c}\right)^{k-1} e^{-(\frac{v}{c})^k} \tag{2}$$

Where :

f (v) = probability function
v = wind speed (m/s)
k = shape parameter
c = scale parameter

Wind power density it is important to determine the site potentiality to install wind turbine. The following expression is measurement of power density in the wind:

$$P = \frac{1}{2}\rho v^3 \tag{3}$$

Where ρ is an air density at standard atmosphere (kg/m^2)

III. RESULT AND DATA ANALYSIS

According to [8] several methods have been proposed to estimate Weibull parameters that are graphic method, maximum likehood method, moment method and power density method. In this paper, the stress is put on the power density method to represent wind speed data. Figure 3 describes the daily wind speed from the previous data collected in year 2005 until 2009 for the whole year. The highest total daily average of wind speed is 3.500 m/s was recorded on 15th January 2005. On 28th until 30th July 2007 there is no wind speed data were recorded but the wind speed is start to increase back after that. From the graph, it can be said that wind speed in Perlis is low. The best time to harness wind energy when northern monsoon season that is start form November until March. However, the light wind speed in other month still can generate power at certain location.

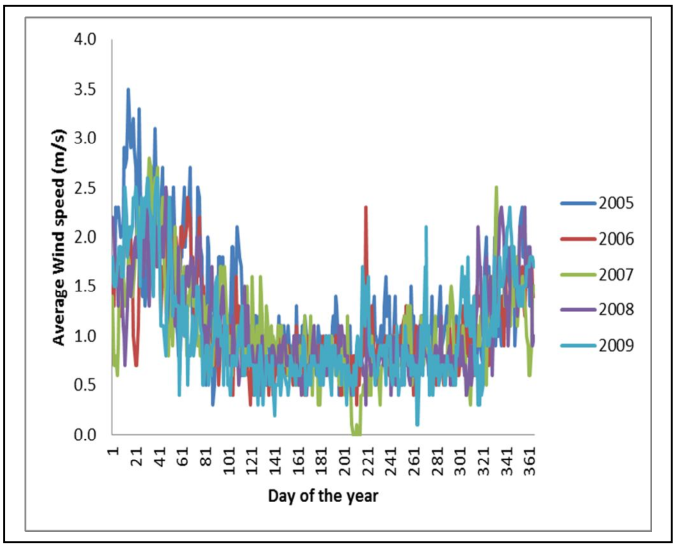

Figure 3. Total of wind speed collected from year 2005 to 2009

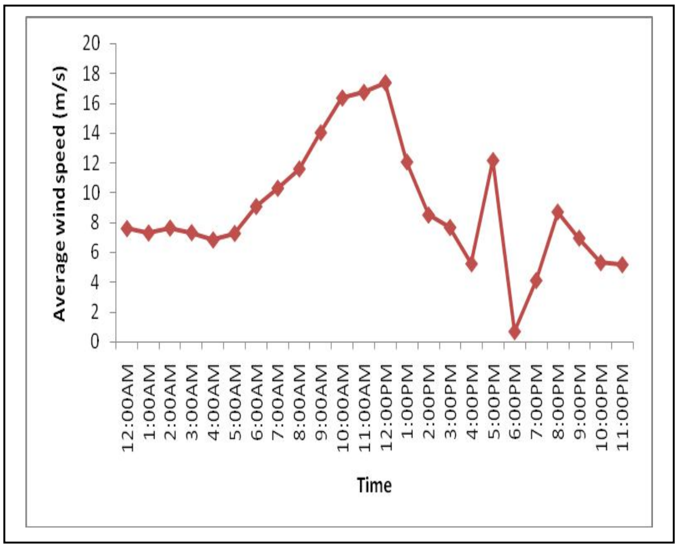

Figure 4. Wind speed on 14th March 2011

For this research the data of wind speed was take and analyzed during 24 hour on 14th March 2011. From figure 4 the maximum of wind speed was record on 12.00PM is 17.333 m/s while the lowest one is 0.633 m/s of wind speed occurs on 6.00PM. The average wind speed on that day is 8.983 m/s.

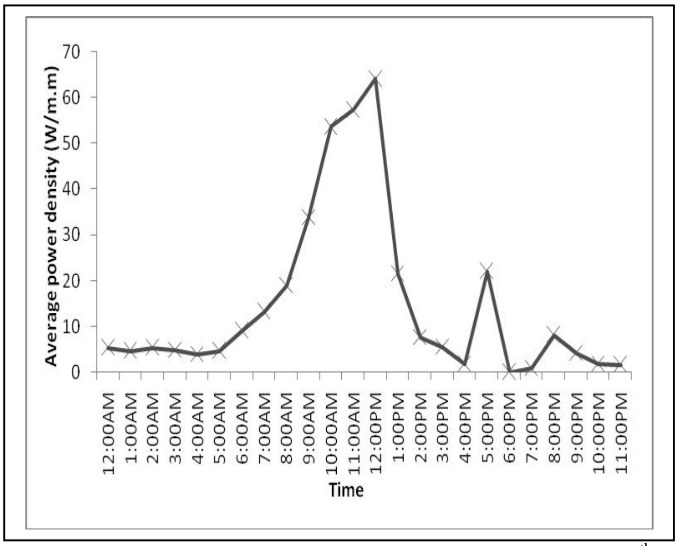

Figure 5. Average of power density from the wind on 14th March 2011.

Figure 5 show average power density in the same day of wind speed data. The highest power density is 64.206 w/m^2.

To see the performance of wind turbine, the average value of output voltage were recorded by using Electrocorder. Figure 6, show an average of output voltage from Windpower wind turbine. The maximum voltage is 71.5 occur on 12.00PM. The batteries used to configured this system is 12Vdc. So that, the batteries will be charge when the Windpower wind turbine generate more than 12Vdc.

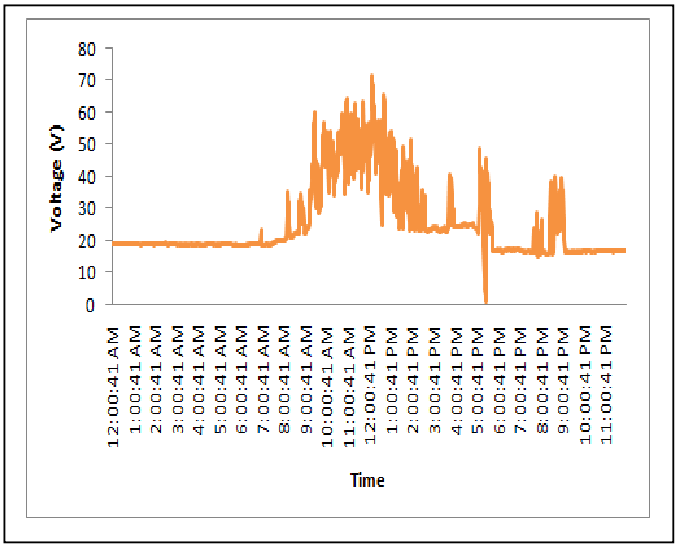

Figure 6. Output voltage from Windpower wind turbine

IV. CONCLUSION

This paper investigates, a potentiality of wind energy as renewable energy in Perlis by implemented Weilbull distribution method and see performance of Windpower wind turbine. The installation of Davis Pro2 Weather Staion and Electrocorder has improved the recording data as research purpose. From the result, it can conclude that Perlis has a strong potential of developing wind energy as one of its resources of renewable energy. However, it is important to choose a suitable type of wind turbine and suitable location as Perlis has low wind speed. For the future research, some recomendation of wind turbine is needed to improve recorded data of output voltage.

ACKNOWLEDGMENT

The authors gratefully acknowledge the contributions and cooperation from researcher of center of exelent (COE), Universiti Malaysia Perlis (UniMAP) for their work on the original version of this document.

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