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Hybrid Electric Power Plant Using Wind Turbine Savonius Helix and Solar Cell as an Alternative Power Source in the Lightning Tower at Flashing Lights

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Abstract

Electrical Energy is a very important need, but the electrical energy we use today still comes from conventional power plants that have negative threats such as pollution and fossil fuel reserves that are decreasing. To overcome this, by utilizing alternative energy that is environmentally friendly, one of them is wind energy and solar energy. Hybrid power plants use savonius helix wind turbines and solar cells are made to minimize the use of conventional energy. This tool utilizes wind and solar energy as the main media of electricity generation. The wind turbine which is made is a type of helix savonius vertical turbine that has a large torque, can rotate with low wind speed with a turbine size 80 cm high, diameter 25 cm which is connected to the generator and mounted on mechanical construction with a height of 200 cm and mounted control panel and solar cell with a capacity of 20 WP. This study aims to develop the potential of alternative energy as a power generation medium and be used as a source of flashing lights in the Indorama Engineering Polytechnic lightning tower tower. Savonius helix wind turbines that are designed require a minimum wind speed of 2.45 m / s for the start of the turbine rotation. Generating from the generator produces a maximum voltage of 18.64 V with a generator rotation of 304 rpm when not loaded and when loaded produces a maximum spin voltage of 281.3 rpm, 11.73 V voltage and 0.038 W power with a wind speed of 5 m/s. From the results of testing this hybrid power plant can be used for flashing lights on the lightning rod tower of the Indorama Polytechnic Engineering campus with a duration of 12 hours per day.

Keywords: hybrid power plant, savonius helix, solar cell, flashing lights.

I. INTRODUCTION

Electrical Energy is a very important requirement both now and in the future. The electrical energy we use today still comes from conventional power plants. Conventional generation for now is not impossible that will pose many threats such as increasing pollution and decreasing fossil material reserves [1]. One way to develop plants that do not damage the environment is by utilizing alternative energy. The energy includes solar energy and wind energy. In 2014 the Central Statistics Agency of Purwakarta Regency (BPSKP) recorded the

Largest average wind speed in Purwakarta, namely 4.17 m/s and an average temperature of 25°C [2]. Wind turbine and solar cell technology are effective solutions to eliminate dependence on the use of conventional energy sources. Savonius type wind turbines are one of the Vertical Axis Wind Turbine wind turbines that are easy to spin in low wind speed conditions. Savonius wind turbines have good self starting so they are able to rotate the rotor even though the wind speed is low, besides that the torque produced is relatively high [3]. Solar cell is a component that can convert sunlight energy into electrical energy using the principle of photovoltaic effects. Where both are power plants that require alternative energy, so it is environmentally friendly. The two generators can be combined or commonly referred to as Hybrid power plants which are alternative energy that can be applied even in remote areas.

II. METHODE

This research in principle will try to develop a savonius type wind turbine design and combine it with a solar cell so that it becomes a hybrid for later use as a source of flashing lights in the Indorama Engineering Polytechnic campus tower lightning [9]. This research is focused on the utilization of *hybrid* power plants to be used as a source of flashing lights.

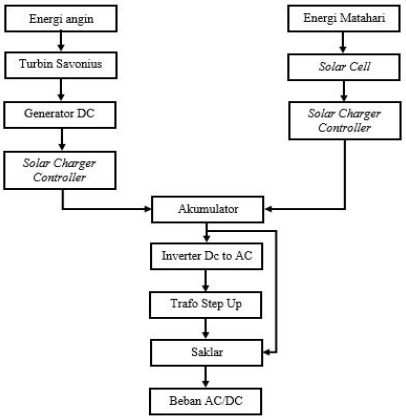

Figure 1. Diagram System

III. RESULT AND DISCUSSION

Tests carried out to determine the reliability of the results of manufacturing that has been done. Tests carried out include testing minimum wind speed, wind turbine generator output and field testing.

Testing for Minimum Wind Speed

This test is conducted to determine whether the turbine that has been made can be used or not. In addition, testing is also carried out to determine the minimum wind speed limit for rotating the start of the turbine.

Test	No Load	Load
	Wind Speed (m/s)	Wind Speed (m/s)
1	2,1	2,4
2	2,3	2,5
3	2,3	2,4
4	2,3	2,4
5	2,2	2,5
6	2,3	2,4
7	2,4	2,5
8	2,1	2,3
9	2,4	2,6
10	2,2	2,4
Avg	2,14	2,45

Table I. Minimal Graph of Wind Speed

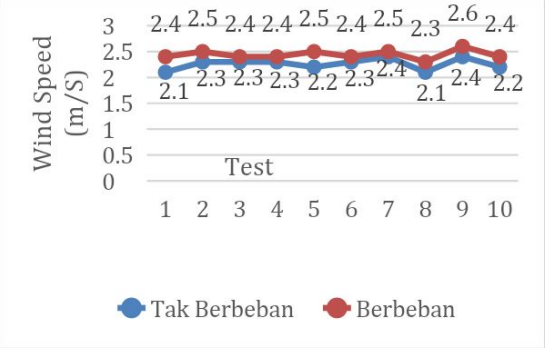

Figure 2. Minimal Graph of Wind Speed

Testing Turbine Generator Output

Testing the turbine generator output is done to find out how many revolutions, voltages, currents and electric power generated by the generator against wind speed.

Wind Speed (m / s)	Voltage (V)	Current (mA)	Power (mW)
2,1	1.08	0.2	0.216
2.5	2.18	0.3	0.654
2,9	3.95	0.4	.158
3.5	6.31	0.7	4,417
3,7	6.8	0.8	5.44
3,9	7.51	0.8	6,008
4	9.64	1.5	14.46
4,4	10.03	1.7	17,051
4,8	11.02	2.5	27.55
5	11.73	3,3	38,709

Table II. Output Generator

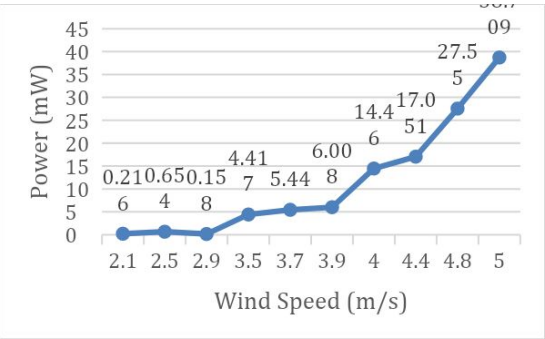

Figure 3. Graph of *Output* Generator

Field Testing

This test aims to determine the performance of *hybrid* power plants for *charging* and *discharging* accumulators with flashing lights. Tests carried out for 24 hours by checking the screen of the solar charger controller to determine the value of the accumulator voltage and capacity per 3 hours.

Figure. 4. Installation of wind turbine and solar cells in the lightning tower

Second check	Hour	Accumulator Voltage (Vdc)	*charging*	*Discharging*
1	6:00 p.m.	12.6		℘
2	9 p.m.	12.3		℘
3	0:00	12		℘
4	3 a.m.	11.5		℘
5	6:00	11.3	℘	℘
6	9:00	11.5	℘	
7	12:00 p.m.	13.5	℘	
8	3:00 p.m.	14.1	℘	
9	6:00 p.m.	12.6		℘

Table III. Actually of Output Generator

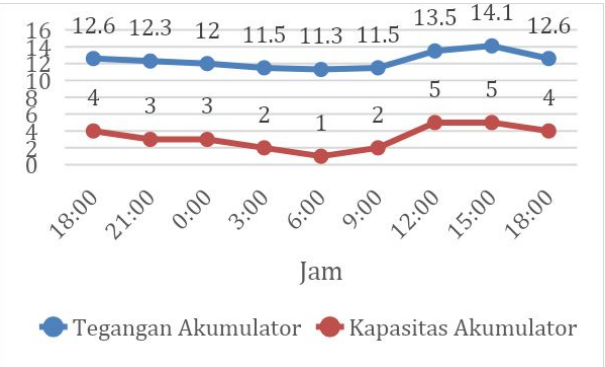

Figure 5. Graph of *Output* Generator

IV. CONCLUSION

Based on the test results, the wind speed results required for the initial start of the turbine are equal to 2.14 m/s when unloaded and 2.45 m/s when loaded. As for the output, the maximum rotation produced is no load of 304 rpm and a voltage of 18.64 V, when the maximum rotation is 281.3 rpm, 11.73 V, 0.003 A, 0.038 W power with a wind speed of 5 m/s. In testing with the same wind speed, the output in the form of rotation and the resulting voltage, no-load produces a greater rotation and output voltage, than the load. From the test results above, hybrid power plants using savonius helix wind turbines and solar cells can be used as a source of blinking lights in the lightning rod with a duration of 12 hours of use and charging a full accumulator during the day with a duration of testing of 5 hours per day.

V. ACKNOWLEDGMENT

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