Design Analysis of Solar Powered Systems Full Flexible 10 WP Capacity

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Abstract

The need for electricity is good for the industry, offices, and public and individuals are greatly increased. However, the increase in demand for electricity is not accompanied by the additional power supply. Based on these problems, chosen solar energy as an alternative energy to generate electric power. A tool that is used here is the solar cell because it can directly convert solar radiation into electrical energy (photovoltaic process). So that solar energy can be used at night, then during the day, the electrical energy generated is stored before a battery which is controlled by the regulator. Regulator output is directly connected to the inverter from the DC to AC. The test results of solar modules (photovoltaic) indicated that the results of the average power output reached 7.6 Watt, and the currents were 0.4 A. This is because the photovoltaic follows the direction of movement of the sun and always located at the photovoltaic to remain facing the sun. Therefore, it will still be able to capture the radiant sun to the fullest

Keywords: *Solar Cell; Design Analysis; Photovoltaic System; Electric Power.*

1. Introduction

Energy is the ability to do the job. Energy is the power that can be used to perform various processes of activity including mechanical energy, heat, and others. Therefore, almost all disputes in this world, stems from the struggle for energy resources. There is some natural energy as a clean, non-polluting, secure and unlimited alternative energy known as renewable energy (Akhmad, 2011). New and renewable energy sources in the future will increasingly have a very important role in meeting energy needs. This is because the use of fossil fuels for conventional power plants over a long period of time will deplete petroleum, gas and coal resources whose reserves are increasingly depleted (Anggara etc, 2014). In Indonesia located in this tropical region. Actually has a considerable advantage of receiving sustained sunlight throughout the year. Unfortunately the energy seems to be left wasted for natural purposes only (Hasan, 2012). In addition solar energy can be utilized with the help of other equipment, that is by changing the radiation of the sun of another form. There are two kinds of ways to convert solar radiation into other energy, that is through solar cell and collector (Karmiathi, 2012). There is no doubt that solar energy is one of the most environmentally friendly and promising sources of energy in the future, since no pollution is generated during the energy conversion process, and also its energy source is widely available in nature (Rahayuningtyas, etc, 2014). Therefore, the application of Solar Power (PLTS) technology to utilize the available solar energy potentials in those locations is the right solution (Subandi, etc 2015). PLTS or better known as solar cells (Photovoltaic cells) will be more desirable because it can be used for various relevant purposes and in various places such as offices, factories, housing, and others. So it is deemed necessary to be studied further, in order to obtain a comprehensive technical study (Ubaidillah, etc 2012). In this study will analyze the design of solar power plant system design capacity of 10 WP on the laboratory scale. With the aim of research to calculate the characteristics of solar power plants by using Solar Cell 10 WP and calculate the maximum power generated by the solar power generated. So it can be analyzed the performance of the design of solar power generation system for 10 WP capacity.

2. Research Methods

The method used in circuit analysis design is done several stages, including:

(A). Determination of solar panels used, so that in its use there is no damage to the solar panel itself.

(B). Determination of the regulator component to be used, so that in the application there is no error of use that result in less good or can damage the solar panels and electrical equipment installed later.

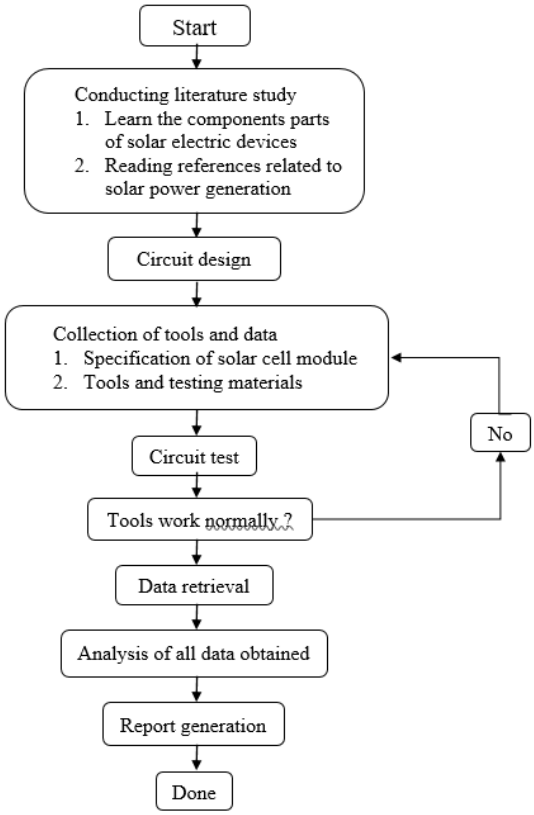
(C). In terms of the use of components, also considered economic terms and conditions in the market, so that in the search component is not experiencing difficulties.

(D). In terms of aesthetics, design tools to be made in such a way that neat, attractive and safe in its use.

(E). Selecting components that pass the qualifications and according to system requirements, such as BCR and inverter (if there is AC load). The methodology used in the design of 10 WP solar power generation analysis can be described in the form of a systematic flowchart such as Figure 1.

3. Results and Discussion

The first step in this research is to study the literature and design of related systems regarding solar cell *power system*



as shown in Figure 2.

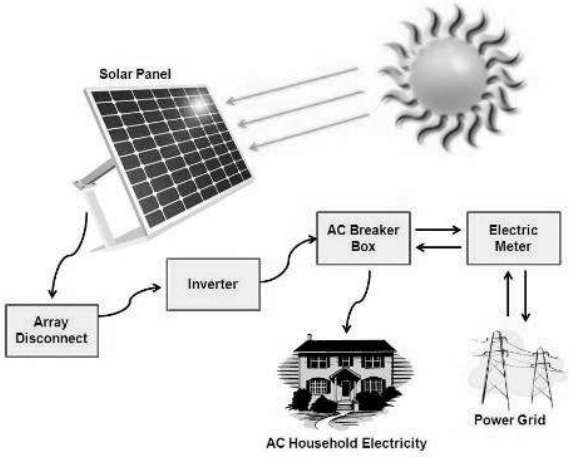


Figure 1. Diagram of the research flow

Figure 2. Installation of 10 WP solar cell

Based on Figure 2, the PLTS block diagram is designed, the working principle of the Solar Power Generation (PLTS) created is as follows: the sun is shining, the radiation produced from the sunlight is then captured by the photovoltaic solar panel. This solar panel is a combination of several solar cells of very small size and thin both in series, parallel or mix (series and parallel), so it becomes a large solar panel and can produce large currents and voltages. The working principle of solar panels is that if sunlight is on solar panels, the electrons in the solar cell will move from N to P, so that at the output terminal of the solar panel will generate electrical energy. The amount of electrical energy generated by solar panels varies depending on the number of solar cells combined in the solar panel. The output of this solar panel is a large direct current (DC) electric current. The outlet voltage depends on the number of solar cells installed in the solar panel and the amount of sunlight that illuminates the solar panel (Bansai, 1990). The output from these solar panels can already be used directly to loads requiring a DC voltage source with a small current consumption. In order for the resulting electric energy to be used in conditions such as at night (the condition when solar panels are not exposed to sunlight), the output of this solar panel must be connected to a storage medium, in this case Is the battery. But this is not directly linked from the solar panel to the battery, but must be connected to the regulator circuit, where in the circuit there is a charging circuit Automatic charger (Automatic charger). The function of this regulator is to regulate the output voltage of the solar panel and adjust the incoming current to the battery automatically. In addition, the Regulator works to connect and disconnect the current from the Solar Panel to Battery automatically and also serves to disconnect the flow from the load battery when there is a short circuit or excessive load. The type of regulator designed here is a type of modification or a combination of series and parallel. Solar panels can actually be directly used without a regulator or battery set, but this is not done because it can overload the performance of the panel (due to excessive load) so there will be no fatal damage to the solar panel. In addition, this regulator also serves to secure from the overload of solar panels so that solar panels are not easily damaged (Widodo et al. 2010). The connection of the battery to the load is connected directly to the parallel load. If the battery is fully charged. To protect the batteries due to overload or short charge in the load, then before the batteries are connected directly must pass through the protection circuit. Where the function is clear enough, namely to protect or protect the battery due to excessive load (over load) or short circuit at the load. If it is desired that the output of electricity from this PLTS in the form of alternating current electricity (AC) then the PLTS can already discharge the direct current (DC) power must be connected to an electronic circuit / electronic module called Inverter DC-AC. Where Inverter DC-AC function to convert electric current direction (DC) become electric current back and forth (AC). Once the electric current is converted to alternating electric current, the output of this inverter which has the form of alternating current can be directly used to supply electrical equipment and electronics that require alternating current. The magnitude of the voltage and output power that can be connected to the load must be in accordance with the ability of the inverter used and the size of the storage system used (the amount of ampere hour (AH) or the amperage of the battery). In this research, we tested the effect of solar angle on the output of solar cell. It aims to find out how big the influence of the angle of the sun comes and also how big the influence of the angle can be ignored. The way of testing is done as Figure 3.

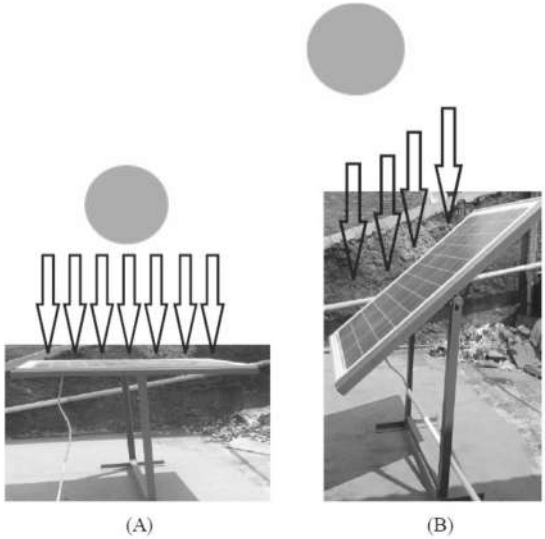


Figure 3 : Testing the influence of the direction of the sun angle to the output of the solar cell (A) the direction of ray perpendicular (B) the direction of the rays to form a certain angle.

The installation of a solar cell panel in a position perpendicular to the direction of sunlight as Fig. 3A is done to find out the maximum output, while to know the effect of sunlight direction on the output panel is done by changing the direction of solar cell panel every 10□ to reach Angle 45□ to the coming sun angle as Fig. 3B. From these steps can be known the influence of the direction of sunlight on the output of solar cell panels. Data collection of sun position / angle is required. It aims to know how big the shift angle of the sun at a certain time interval. This data retrieval is done from 9:00 to 16:00. Test results can be seen in Table 1. Using the data in Table 1 above can be made graph of the relationship between open circuit voltage with time, as in Figure 4.

Table 1. Results of stress, current and power testing for various angular positions of solar cells

NO	Hour	Straight Position			Angle Shape Position		
		Voltage (Voc)	Current (A)	Output Power (W)	Voltage (Voc)	Current (A)	Output Power (W)
1	8.00	4.08	0.2	3.306	4.14	0.28	4.706
2	9.00	4.18	0.21	3.568	4	0.514	8.306
3	10.00	3.86	0.362	5.65	3.76	0.61	9.162
4	11.00	3.9	0.416	6.522	3.64	0.61	8.826
5	12.00	3.8	0.394	5.988	3.66	0.61	8.874
6	13.00	3.6	0.416	5.936	3.66	0.61	8.874
7	14.00	3.8	0.194	2.948	3.86	0.574	8.896
8	15.00	4.14	0.17	2.856	4	0.41	6.626
9	16.00	4.04	0.166	2.712	2.16	0.27	4.566
Rata - rata		3.934	0.28	4.382	3.654	0.498	7.648

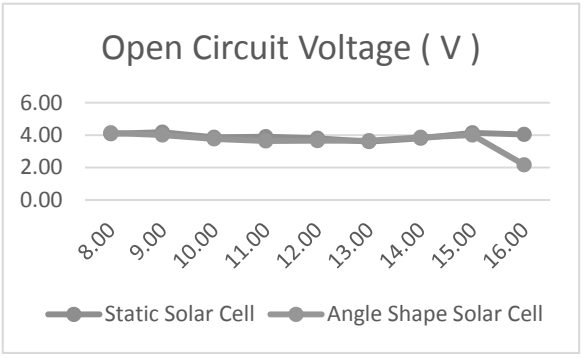


Figure 4. Graph of the relationship between the open circuit voltage to the time on the solar cell.

Based on Figure 4. explains that the average measurement value of open circuit voltage in the solar module angular position position of 3.654 V and obtained the average value of short circuit voltage when the solar module upright position (horizontal) of 3.934 V. Differences in open circuit voltage results (Voc) obtained because the solar module always positioned perpendicular to the sun so that the results obtained will be larger than the solar module with the position to form an angle. Furthermore, to know the comparison of short-circuit current to time can be seen in Figure 5.

Figure 5 illustrates that the current generated by the solar module that forms an angle greater than the current generated by the solar module in the horizontal position has a static property, this occurs because the irradiation captured by the solar module on the position of forming a larger angle so that The current captured in the position to form a larger angle because the greater the irradiation value the greater the irradiation value. From the measurement result data, it is obtained the measurement value of the average short circuit current in the solar module in the position of forming an angle of 0.498 A and obtained the average value of short circuit current when the solar module is perpendicular (horizontal) of 0.28 A. For Knowing further about the magnitude of the ratio of the output power to the time in the solar cell, can be seen in Figure 6.

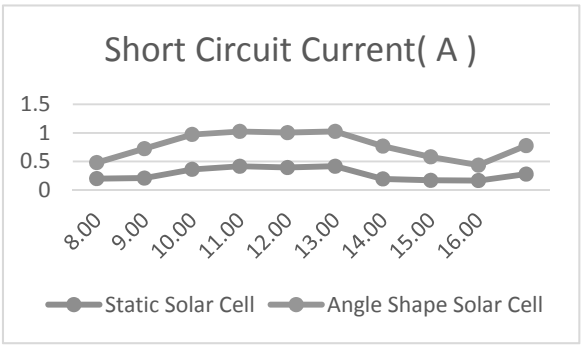


Figure 5. Graph of the comparison between short-circuit current to time on solar cell.

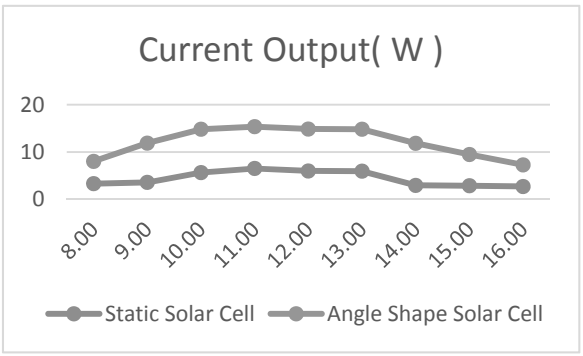


Figure 6. Graph of the comparison between the output power of time on the solar cell.

From the open circuit voltage (Voc) and the short circuit (Isc) obtained at the time of testing the resulting output power by multiplying the fill factor (FF) in the sury module so that the graph of the ratio of output power at the angle position with the solar module at position perpendicular. The average output power generated at the moment of the solar module positioning an angle of 7,648 W and obtained the average output power value when the solar module position is perpendicular (horizontal) of 4,382 W.

4. Conclusion

From the results of design analysis of solar power generation system with 10 WP solar panels can be obtained the following conclusion:

(A). Characteristic of the Design that is, the position of the angle of the solar module when following the direction of the movement of the sun produces an average open circuit voltage (Voc) of 3.654 V and the average current of short circuit (Ioc) 0.498 A and the horizontal position creates an average voltage Average The open circuit (Voc) is 3,934 V while the average current short-circuit (IOC) 0.28 A

(B) The position of the slope angle of the solar module when following the direction of the movement of the sun produces Output Power (Pout) of 7,648 W and the position perpendicular (horizontal) produces Output Power (Pout) 4.382 W.

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