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Analysis of Solar Radiation Against Solar Panel 50 WP

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ABSTRACT

Solar cell technology is a technology that converts solar energy into electrical energy. This study discusses the radiation of polycrystalline solar cells with a maximum output power of 50 WP. The aim of this study was to determine the effect of light intensity on the yield of electrical energy. The research method is measuring the intensity of the sun using a lux meter and electric current generated from solar panels. From the results of measuring the intensity of the sun for 4 weeks using a 50 Wp cell at 08.00 WIB the average weather is sunny. At 08.00 WIB, the intensity of the sun is 398.05 Wp/m, the voltage is 16.45 volts and the current is 0.73 amperes. The brighter the sun and as long as it is not covered by clouds, the increase in the intensity of the sun at its peak at 14.00 WIB has an intensity of 540.18 W/m, the voltage value is 18.425 Volts and the current value is 0.81 Ampere. The change in value is getting smaller at 17.00 WIB the intensity is 384.75 W/m and for the voltage is 15.7 V and the current is 0.59 A. This is because at that time the average weather was very sunny, and the sun was not covered by clouds.

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1. INTRODUCTION

In today's technological developments, we can't deny almost all electrical energy needs and utilization of sourced butane energy conversion from solar energy, which supports the development of life on this earth every day is often found issues of social inequality and governance an environment that requires support the need for a better and more efficient life. For forming a solar power generation system or converting heat irradiation to light more efficient and more efficiently solar energy is bigger and more friendly to the environment. So it is necessary to make efforts to reduce dependence on energy sources in the earth and government, through innovation and the right thinking for energy sources the use of sunlight, including the development of alternative energy that meets the requirements for alternative energy in the future that is easy, cheap, available in abundance, flexible and in use is friendly to the environment.

Solar energy is the main source of energy for processes that occur on Earth. Solar energy is very helpful in various physical and biological processes on Earth. Radiation is a process of propagation of energy (heat) in the form of electromagnetic waves without the need for an intermediate substance. Solar energy can reach the

Earth's surface using radiation (radiation), because between the Earth and the Sun there is a vacuum (no intermediate substance), while electromagnetic waves are a waveform that propagates in the form of electric and magnetic field components, so it can propagate at very high speeds and without the need for an intermediate substance or medium. Of all the energy released by the sun that reaches Earth through the propagation process, it is then absorbed by the Earth. This absorbed energy will cause the temperature of the Earth to rise.

Renewable energy has a very important role in meeting energy needs considering that the source is very abundant. This is because the use of fuel for conventional power plants in the long term will deplete the dwindling resources of oil, gas and coal and can also cause environmental pollution. One of the efforts that have been developed is the Solar Power Plant (PLTS). PLTS or better known as solar cells (photovoltaic cells) will be more in demand because they can be used for various relevant purposes and in various places such as offices, factories, housing, and others. In Indonesia, which is a tropical area, the potential for solar energy is very large with an average daily insolation of 4.5-4.8 KWh/m²/day. However, the electrical energy produced by solar cells is strongly influenced by the intensity of sunlight received by the system. For the utilization of electrical energy to be used optimally, it is necessary to have a hybrid system with PLN electricity grids.

2. METHODS

According to several researchers who have found out about solar panels as follows following:

1. The solar panel is a device that can convert sunlight into energy electricity. Sunlight is the source renewable energy that can be utilized as a new power plant. Technology solar panels have the potential to be applied in Indonesia, which has a tropical climate. The main problem with solar energy is panel-generated power instability because it is very dependent on the intensity of received sun. Light intensity the sun received by the solar panel can maximized by installing panels the sun with the right angle of inclination so that the output power will be obtained maximum. In this research, with the method of testing the effect of angle the slope of the panel by taking the angle theta (θ) based on the perpendicular angle of the plane panel by using angle 0º - 80º (10 intervals). Effect of output power based on the change in inclination angle panel is directly proportional to its size the intensity of light received by the panel plane. The optimal angle of the solar panel in the morning is when the panel tilt angle is 40º, 10.00 – 14.00 i.e. at an angle of 0º and in the afternoon 16.00 i.e. an angle of 50º, the power obtained by optimal angle of 40º i.e. power of 10.2watt and has a light intensity of 37.8kLux.
2. This paper investigates the simulation performance 5 kWrooftop solar PV system with cell crystal sun. During this research, the module glass-enclosed crystal solar with efficiency 15% with a power temperature coefficient of -0.47 %/°C is selected. PV system mounted on angle of inclination close to latitude simulated using a PV Watt tool from National Renewable Energy Laboratory (NREL). Results show a 5 kW . PV system produce an annual energy of 7658 kWh with a capacity factor of 17.5%. Score energy costs for the resulting output as well estimated to be around Rs. 34457. This study helps to understand how cells crystal solar work under any weather conditions Coimbatore location in India.
3. Solar power plants (PLTS) are development of solar energy technology affordable, not exhausted, and clean will provide long-term benefits great, at this time there are many who use solar panels as independent power generator without having to fully dependent on PLN, each year the demand for electrical energy in the world will experience growth. Utilization solar energy as a power generator has been done a lot using solar panels. Installed solar panels so far it is still static (no following the movement of the sun), based on In this condition, the solar panels cannot maximum light capture, Limitations on static solar panels This can be overcome by testing with Solar Panels with Dynamic Rotation (can follow the direction of movement of the sun). Current and voltage gain on solar panels more effective, namely by obtaining an average value The average output power produced is 34.93 W.
4. The loading of the interconnection system is always changing at any time. Changes in load cause fluctuations in generator output voltage changes and changes in generator excitation current. To produce a constant generator output voltage, a generator output voltage regulation is needed. The voltage regulation is done by adjusting the excitation current. Excitation current is a DC power supply system as a reinforcement in a generator or as a field generator so that a generator can produce electrical energy with a large generator output voltage depending on the magnitude of the excitation current. In this study using a DC power supply as the exciter current with varying values. This is done to determine the characteristics of the generator to changes in the value of a given excitation current. The highest reactive power of the RL load is achieved at an excitation current setting of 3.5 amperes with a reactive power value of 661.4 var. Meanwhile, in the R-C load the reactive power produced is lower than the R-L load, which is 616.93 var. This study concludes that the generator voltage is strongly influenced by the size of the excitation current given. The greater the excitation current, the greater the generator output voltage. This is directly proportional to the generator

output voltage and the given excitation current. In addition, under R-L and R-C loading, the reactive power produced will also increase.

A. Brief Theory

Energy is also called energy which means is an ability that is used to do a business or work. Whereas, According to the Law of Conservation of Energy, energy is cannot be created or destroyed, but can changed shape. There are several meanings According to experts, energy is first, Arif Alfatah and Muji Lestari stated that energy is something that an object requires in order to it can do some work. Second,According to Campbell, Reece and Mitchell stated that energy is an ability that used to rearrange a material. And third, the Big Indonesian Dictionary states that energy is a force that is needed to carry out various process activities.

Energy is divided into two categories, namely energy potential and kinetic energy. However, apart from energy potential and kinetic energy, there is also energy Others are mechanical, electrical, electromagnetic, chemical, thermal, nuclear, wind, and etc. Then, from some of that energy must be changed so that it can be used by humans in everyday life.

An energy source is a source that comes from from nature, plants, microscopic objects, garbage organic or from fossil fuels that have been millions of years old that will be used as an energy producer. Here's the energy grouped based on the source, namely as follows following :

1. Conventional Energy Conventional Energy or also called energy not Renewable energy is an energy that does not can be renewed or regenerated the source is only available on earth with limited amount. In addition to sources the energy is quickly depleted on earth, then also harmful to living things because will have an impact on polluting air, water, and land that affect decline in health. Non-renewable energy can also be coal, natural gas, uranium, and petroleum, as well as Another source of energy is fossil fuels.

2. Renewable Energy Renewable energy is a renewable energy that the source is obtained from nature in the earth with an unlimited number or will run out naturally. Energy renewable energy also does not cause pollution, friendly to the environment and creatures other life, and is considered as energy purest on earth like the sun, wind, river, waves, plants and so on.

B. Potential Alternative Energy Sources

The average energy source used as fuel for power generation in Indonesia which is a source of energy obtained from fossils non-renewable and will not last long. And now, the use of energy sources from fossil fuels will gradually deplete if continue to be used. For that, remember the energy crisis that occurred in Indonesia, development and application of energy sources renewable energy is a useful solution for reduce dependence on usage fossil fuels as the main source of electricity generation. Here are various renewable energy sources are as follows:

1. Solar energy is an energy originating from the sun that is emitted to the earth every minute which can meet the energy needs of all humans in one year, if the radiation is captured correctly. Although the location of the sun is very far from the earth, which is about 149 million kilometers. Then, there is also a tool that is used to convert sunlight into electrical energy directly, namely photovoltaic cells.
2. Wind power is an energy that comes from the blowing of the wind followed by the energy of motion used to do a business. Wind power can also be converted into electrical energy by using wind turbines.
3. Biomass is an energy that comes from from wood, food crops, and animal waste as well as plants. This energy is also renewable because all things are organic like wood and food crops will always be grow and there will always be animal waste and plant.

C. Solar Power Plant (PLTS)

PLTS is a power plant that use sunlight in the form of solar radiation solar photons which will then be converted into electrical energy through solar cells (photovoltaic). Solar cells (photovoltaic) alone is a thin layer made of pure silicon (Si) semiconductors and materials other semiconductors. The sunshine utilized by this PLTS will produce DC electricity that can be converted into AC electricity if needed. And this PLTS will stay generate electricity even when the weather is cloudy as long as there is light.

Figure 1. Application of Solar Cells Into Solar Panels

Basically, PLTS is an electricity generator that can be designed to meet electricity needs in small to large quantities, using either a stand-alone system or a hybrid system and either using the decentralized method (one house with one generator) and the centralized method. (electricity distributed by wired network). PLTS is a renewable energy source, where sunlight is an inexhaustible source of energy. In addition, PLTS is an environmentally friendly power plant because it does not use rotating components, does not have an impact on pollution (air, water, and sea), and does not emit emissions in the form of exhaust gases or waste.

Solar cells or photovoltaic cells come from the English "photovoltaic". Photovoltaic word comes from two words "photo" comes from the Greek word "phos" which means light; and the word "volt" is the name of the unit of measurement of electric current taken from the name of the inventor Alessandro Volta (1745-1827), as a pioneer in studying electrical technology. So literally "photovoltaic" means Light-Electricity, and that's what Solar Cells do, namely converting light energy into electricity, its inventor Edmond Becquerel and his friends in the 18th century.

How do solar cells work? When a semiconductor material such as silicon is stored under sunlight, the silicon material will release a small amount of electricity which is known as the photoelectric effect. What is meant by the photoelectric effect is the release of electrons from the metal surface caused by the collision of light. This effect is the basic physical process of photovoltaic converting light energy into electricity. Sunlight consists of particles called "photons" which have a number of energies whose magnitude depends on the wavelength of a "solar spectrum". When a photon strikes a solar cell, the light will be reflected or absorbed or it may only be transmitted. The absorbed light generates electricity. At the time of the collision the energy contained by the photons is transferred to the electrons contained in the solar cell atoms which are semi-conducting materials. With the energy obtained from photons, electrons break away from the normal bonds of semi-conducting materials and become electric currents that flow in existing electrical circuits. By releasing from the bond, the electron causes the formation of a hole or "hole".

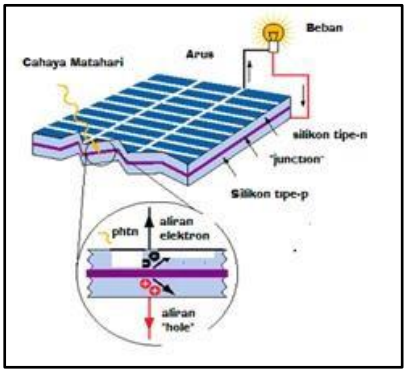

Figure 2. Solar Cells Convert Solar Energy into Electricity

What is a solar module? To get the power, and the desired electrical voltage, solar cells are connected in series and parallel then laminated and framed and called Solar Modules. Generally, solar modules have a working voltage system of 12 Volt and 24 Volt, and have a power that varies from 10 Wp to 300 Wp.

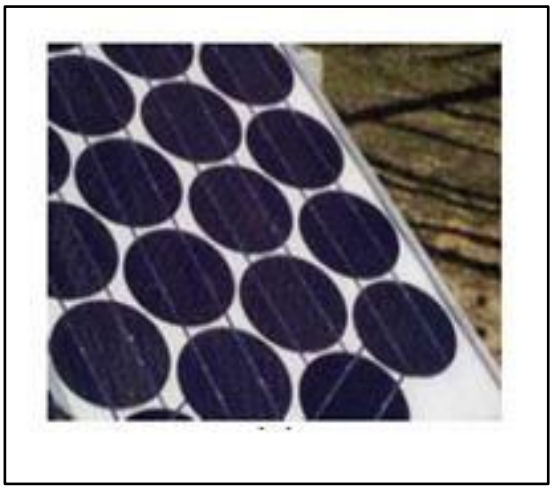

Figure 3. Solar Module

The performance of the solar module is described by the characteristics of the I-V Curve, or Electric Current (I) versus Voltage (V) curve as shown in Figure 3 below. The solar module will produce maximum electric current if there is no resistance component (R) in the circuit, in other words we will short the positive pole and negative pole. The maximum current is commonly referred to as the Short Circuit Current (Isc) which occurs when the Solar Module Voltage is equal to zero (V=0). On the other hand, the maximum voltage is generated when the circuit is not connected. This voltage is referred to as the Open Voltage (Voc), in this condition the resistance R is very large and no current flows at all because the electrical circuit is not connected or in an open condition. From the two extreme load resistance conditions, and the conditions in between are depicted as shown in Curve IV below, Electric Current (I) is shown on the Y axis with units of Ampere, while Voltage (V) is shown as X axis with units of Volts. As shown in the figure, the short circuit current (Isc) occurs when the voltage is equal to zero, and the open voltage (Voc) occurs when the electric current is equal to zero. The amount of electrical power from the solar module is located at all points along the curve in Watts. Watt is obtained by multiplying the voltage and electric current (Watt = Volt x Ampere). At the point Isc the resulting power is zero because the voltage is equal to zero. Similarly, at the point Voc electric power is equal to zero because the electric current is equal to zero. The maximum power generated occurs at the "knee" of the curve. In the picture below, it can be seen that the maximum power occurs when the voltage reaches 17 volts and the electric current is 2.5 amperes, therefore the maximum power produced is 17 volts multiplied by 2.5 amperes is 42.5 watts. Maximum power is generally referred to as peak power with the notation mp, so the electric current at the maximum position is written as Imp and voltage as Vmp.

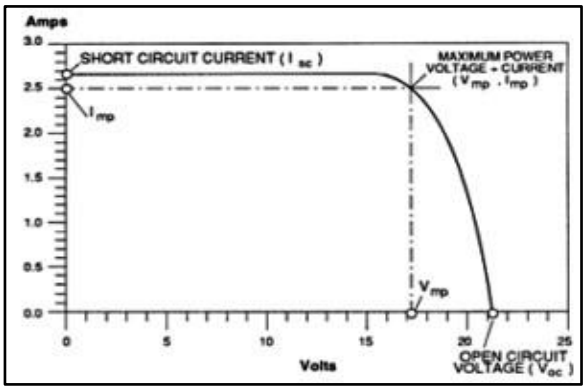

Figure 4. Current-Voltage (I-V) Curve of the Solar Module

The current-voltage curve of each solar module product must be made under standard conditions of sunlight intensity and solar module temperature, because the power output of this solar module is highly

dependent on the intensity of sunlight and the temperature of the solar module. The influence of the intensity of sunlight on the power output of the solar module is getting bigger, the intensity of sunlight falling on the surface of the solar module will be the greater the electric current generated, in other words the intensity of sunlight is directly proportional to the output of electric current. While the temperature of the solar module will be inversely proportional to the output voltage generated, so the greater the temperature of the solar module, the voltage will decrease. The standard I-V curve of a solar module is made under conditions of 1000 W/m2 Light Intensity and 25 0C Solar Module Temperature.

The method used in the implementation of this research is a follow-up study, which begins with the identification and characterization of solar cells, followed by a series of analyzes to find the variables in this study, mainly data from:

1. Tracker Solar Cell single panel design construction.
2. Performance test by measuring the Solar Cell Tracker system.
3. Measurement of the output voltage (V) and current (I) from the Solar Cell to the optimal value of solar radiation.

D . Research Steps

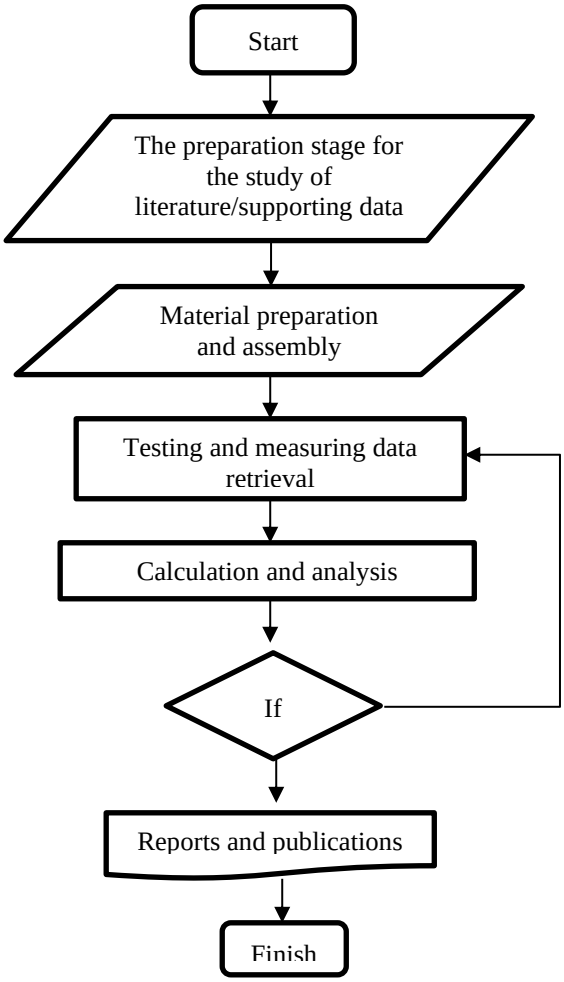

Figure 5. Research Flowchart

E. Data Collection

This research begins with measuring the intensity of sunlight on the surface area of the solar cell, at the time of measuring the intensity of sunlight, the output voltage and electric current are also measured. The measurement data provides an illustration of the correlation of the intensity of sunlight to the output power produced by the solar cell as well as information about the highest capability that can be produced by the solar cell. 50 Wp Solar Cell is used as data material from the measurement results.

3. RESULTS AND DISCUSSION

From the results of the average measurement of solar intensity for 2 days, for 7 hours, the measurement results can be seen in the following table.

Table 1. Observation Results of Solar Cell 50 Wp Day First

Time (hour:minute)	Radiation (W/m^2)	T. Panel (^oC)	V Cell Solar (Volts)	I Cell Solar (ampere)
09:00	1041	44,2	19,99	1,92
09:40	1014	42,1	17,88	1,85
10:00	1061	41,1	16,85	1,60
10:40	1142	41,4	19,61	1,88
11:00	1175	44·1	19,14	1,83
11:40	1041	44,2	19,91	1,87
12:00	1016	40,2	19,99	1,92
12:40	1155	45,3	18,87	1,84
13:00	1062	45,1	19,99	1,92
13:40	1051	43,1	17,88	1,85
14:00	1046	42,5	16,85	1,60
14:40	1027	41,4	19,61	1,88
15:00	1032	41,7	19,14	1,83
15:40	1028	41,6	19,91	1,87
16:00	1026	38,8	18,71	1,82

The polycrystalline type solar panel test data was carried out for 7 hours with an average solar radiation of 1061 W/m, this shows that radiation tends to decrease because the weather is cloudy and wind gusts occur, with an average voltage of 17.76 Volts and a current of 1.8 A.

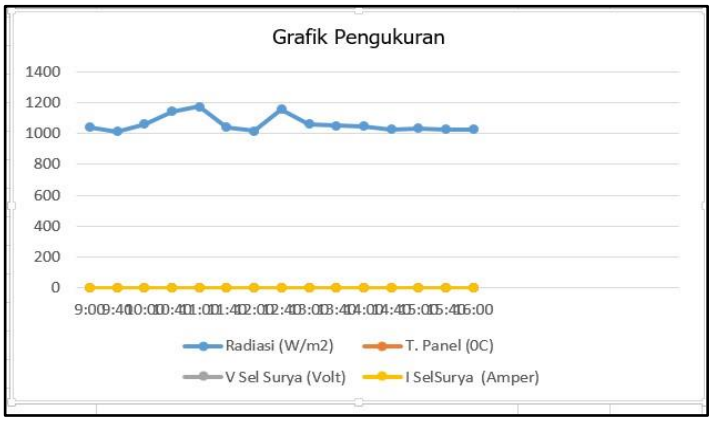

Figure 6. Graph of Observations on the First Day

Table 2. Observation Results of Solar Cell 50 Wp Day Second

Time (hour:minute)	Radiation (W/m^2)	T. Panel (^oC)	V Cell Solar (Volts)	I Cell Solar (ampere)
09:00	1063	41,1	16,85	1,60
09:40	1143	41,4	19,61	1,88
10:00	1176	44·1	19,14	1,83
10:40	1042	44,2	19,91	1,87
11:00	1042	42,5	16,85	1,60
11:40	1027	41,4	19,61	1,88
12:00	1034	41,7	19,14	1,83
12:40	1107	43,2	19,85	1,62
13:00	1150	45,3	18,87	1,84
13:40	1051	44,3	19,51	1,89
14:00	1052	43,1	17,88	1,85
14:40	1031	41,7	19,14	1,83
15:00	1034	38,3	19,09	1,82
15:40	1115	38,3	18,87	1,84
16:00	1062	39,1	19,99	1,92

The test data for polycrystalline solar panels were carried out for 7 hours with an average solar radiation of 1075 W/m, this indicates that radiation tends to decrease because the weather is cloudy and wind gusts occur, with an average voltage of 18.97 Volts and a current of 1.8 A.

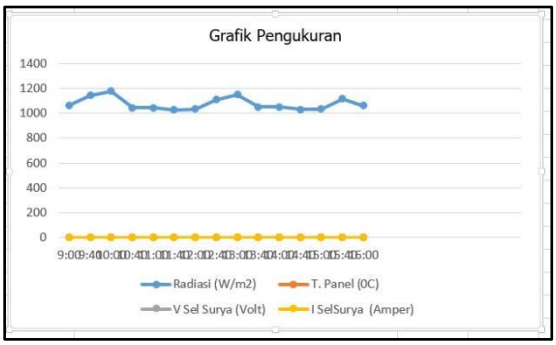

Figure 7. Graph of Observations on Day Two

4. CONCLUSION

From the results of the average measurement of solar intensity for 2 days, the intensity of the 50 Wp solar cell is obtained. The solar intensity at 09.00 WIB is the average sunny weather at 09.00 WIB is 1041Wp/m. the voltage is 19.99 V and the current is 1.92 A. The brighter the sun and as long as it is not covered by clouds, the value of the intensity of the sun is greater. The change in value is getting smaller where at 16.00 WIB the intensity is 1026 W/m and for the voltage is 18.71 V and the current is 1.82 A. This is because at that time the average weather is very sunny, and the sun is not covered by clouds. The average for the measurement of the first day of solar radiation is 1061 W/m, with cloudy weather and an average temperature of 17.76 Volts and a current of 1.8 A. The second day of solar radiation is 1075 W/m, with cloudy weather and an average temperature of 18 .97 Volts and a current of 1.8 A.

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