The Impact of Solar Panel Temperature to Solar Home System (SHS) Output Voltage

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Abstract. Solar energy can be used for alternative energy by the solar panel to produce electrical energy. The use of solar energy on the solar panel to produce electricity is affected by the weather and the radiating duration and then will impact the temperature of the solar panel. The result of the research revealed that the temperature changes that impacted the output voltage from the solar panel will affect output voltage from the solar panel and the output voltage from the solar panel will change when generated even though the measured temperature is almost equal.

Keywords: solar energy, solar panel, temperature, voltage

1. Introduction

The need for electricity in Unilak is increasing every month to supply nine faculties with twenty study programs for the bachelor degree (S1) and two study programs for the master degree (S2). One faculty that is mostly contributed to consuming the electricity is the Faculty of Engineering which consists of three study program which are Architectural Engineering, Electrical Engineering, and Civil Engineering. This will cause the increasing of electrical finance that is given to the electrical supplier, so as needed the development of renewable energy such as the use of solar energy.

The utilization of solar energy can make use of the solar panel (solar cell) that will directly convert the light energy into electricity, so it can supply the entire Faculty of Engineering. Designing a Solar Home System (SHS) needs the accurate calculation to consider the ideal and proper utilization of photo Voltaic (PV) system. To think of solar insulation resource that is volatile, also system configuration of PV which are dynamic and not rigid. Therefore, the accurate calculation is needed to obtain the best system configuration in the design, so that the purpose of the design is fulfilled.

2. Theory and Hypotheses

Application and utilization on various PV systems in Indonesia had been occupied since the early of the 1980s [1], [2]. The research on the system application worthiness had been started from pilot Project Solar Village (cooperating with TÜV Rheinland, Germany) since the early of 1980s, then continued with Pilot Project Village Electrification & Pumping System (cooperating with NEDO, Japan) on Kenteng, Yogyakarta in 1987 [2]. In 1990, after succeeding the application of Solar Home
System (SHS) in Sukatani village, West Jawa. It was started the dissemination of system for village lighting through Banpres Project by installing 3,445 units SHS in 15 Provinces of Indonesia [2]–[4].

Since then, the PV system is well known by the society. In 1998, by the launch of Million Housing Project: 50 MWp Photovoltaic Rural Electrification, then begin the era of PV systems commercial [5]. Many countries, including South Vietnam, Brazil, Spain, China, Laos, Sri Lanka, India, Thailand, and Indonesia, have active photovoltaic programs, largely aimed at providing power to rural communities [6]. The largest markets for small solar home systems are India (450,000 systems planned), China (150,000), Thailand (150,000), Kenya (120,000), Morocco (80,000), Mexico (80,000) and South Africa (50,000) [6].

SHS is independent Solar Power Electric Generation system. It becomes a practical and flexible solution for electrical supply to fulfill electrical needs on domestic installation. This electrical energy can be used for household appliances, lighting, computer, etc. Not only this system can be used in the urban area, but also in the remote area that still not connected by PT. PLN electrical grid.

SHS usually consists of one or more PV module [7], [8]. While, the Solar Charge Controller (SCC) distributes electric current control to protect the battery and electrical failure [9]. The battery are used to store the energy for night activity [10] or when the sun is replaced by the moon. The inverter is used to convert Direct Current (DC) to Alternating Current (AC) with the output voltage that is compatible with the system used (example 220V) [11].

3. Research Methods

The research method for this research as follows:

3.1. Type of Research

This research was the beginning to start research on solar energy. It was because the Faculty of Engineering had not had the solar panel that would be used as converter media to convert solar energy into electricity. The step was to utilize potential solar radiation that was produced by utilizing the rooftop of the Faculty of Engineering. The calculation was done by measuring the space for placing the solar panel on the rooftop towards the output voltage that was produced by the solar panel.

3.2. Data Source

It was primary data from the solar energy around the Faculty of Engineering, Universitas Lancang Kuning - Pekanbaru.

3.3. Data Collection Technique

The data collection can be collected by observing the result of solar energy that was converted by the solar panel.

4. Result and discussion

The system is built with 2 (two) set of solar Home System that apart from each other. The first system is two unit of the mono-crystalline solar panel holding capacity of 200 WP that is placed facing east, and 2 (two) unit of the solar panel holding capacity 200 WP facing west. While the second system uses the solar cell from poly-crystalline that consist of 2 (two) unit of the solar panel holding capacity of 150 WP that is placed facing east, and 2 (two) unit of the solar panel holding capacity of 150 WP facing west. Therefore the total energy that can be generated is 1,400 WP.

The other installation is placed in the energy conversion room which is on the first floor under the solar panel. The energy is connected with NYY-HY cable sized 4 x 6 mm² for 4 x 200 WP Mono-Crystalline. While for the 4 x 150 WP Poly-Crystalline uses NYM-HY sized 4 x 2,5 mm². These cables directly connected to the solar power electric generator direct circuit system, as seen in the Figure 1. While to control electricity that is received by solar panel, is used Solar Charge Controller
(SCC) type Maximum Power Point Tracking (MPPT) which holding capacity of 30 A and 40 A, also type pulse width modulation (PWM) which holding capacity of 20 A and 30 A, that is used to control electricity that is produced by solar panel. Then this energy is saved in 4 (four) unit of batteries 12 V DC, that each of the batteries holding the capacity of 75 Ah. There is two type of battery used, they are type Maintenance Free (MF) and Hybrid.

To observe the impact of solar panel temperature after receiving solar energy, then in this research is done the measuring activity starting from 6th of June 2018 until 10th of June 2018 from 07.00 to 18.00 WIB and the result is provided in table 1.

Table 1. Solar panel temperature measuring results

| Measuring Date & Time | Solar Panel Type | Capacity | Temperature (°C) | Voltage(Volt) |
|-----------------------|------------------|----------|-----------------|--------------|
|                       |                  | Max      | Min  | Average | Max  | Min  | Average | Max  |
| 6th of June 2018 (07.00 s/d 18.00 WIB) East | Polycrystalline | 150 WP | 69,6 | 28,9 | 51   | 15,363 | 20,11  |
| 7th of June 2018 (07.00 s/d 18.00 WIB) East | Polycrystalline | 150 WP | 73,7 | 26,4 | 50,2 | 14,201 | 19,68  |
| 9th of June 2018 (07.00 s/d 18.00 WIB) West | Mono-crystalline | 200 WP | 89,9 | 25,9 | 59,9 | 30,227 | 40,33  |
| 10th of June 2018 (07.00 s/d 18.00 WIB) East | Mono-crystalline | 200 WP | 89,5 | 24,7 | 60,1 | 14,832 | 17,66  |

In the form of the chart, it can be seen the relation between solar panel temperature by type polycrystalline holding the capacity of 150 WP to the output voltage that is produced as seen in Figure 2 and 3 with different measuring date and time, but at that time the measured temperature is almost equal. In table 1 is seen that the temperature on the 7th of June 2018 was 50,2 °C, then the output voltage that is produced decreased by 1,435 Volt.
Figure 2. The relation of solar panel temperature to the output voltage 150 WP West

Figure 3. The relation of solar panel temperature to the output voltage 150 WP East

The relation of solar panel temperature to the output that is produced type *mono-crystalline* holding the capacity of 200 WP as seen in Figure 4 and 5, the measured temperature is almost equal in the different measuring date and time as seen in table 1.

Figure 4. The relation of solar panel temperature to the output voltage 200 WP West
Figure 5. The relation of solar panel temperature to the output voltage 200 WP East

In figure 4, the chart shows the measuring on 9th of June 2018, there is differentiation on the evolution that is produced when compared to the measuring on 10th of June 2018 as seen in figure 5. It is because of the measuring on 10th of June 2018, SPEG had been loaded and the decreasing voltage output happened in the solar panel in the difference of 15,395 Volt.

5. Conclusion

The result of the research revealed that temperature changes will impact to output voltage of the solar panel, wherein this research the temperature of the solar panel is decreasing, then the produced output voltage will also reducing in difference of 1,435 Volt and the output voltage of solar panel will change when charged, even though the measured temperature in the different measuring date is almost equal indifference of 15,395 Volt.

6. References

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