Use of Floating Photovoltaics to Increase Solar Stability

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***Abstract*—Commonly installed solar panels have several deficiencies. One of the common problems is its fluctuating output caused by its high temperature and low amount of sun irradiation. This fluctuation can be minimized using a better cooling system. In this study, the cooling system tested is water cooling. We float a solar panel above the water to decrease its temperature. When the solar panel's temperature decreases, its output will be more stable. The experiment is conducted at Universitas Indonesia's lake during noon.**

Keyword—Floating PV, PV Efficiency

I. INTRODUCTION

The 21st century is a time when technology plays a significant role in our everyday lives, especially in our capability to be productive. Modern lives cannot be separated from electricity. About 92.8% of 225 million residents in Indonesia have access to electricity in their homes. Electricity in Indonesia grows rapidly each year. For comparison, each person consumes approximately 450 kWh annually in 2004, and the number increases significantly to 900 kWh in 2014; the increase in electricity consumption is 100% [1].

A power system is based on the equilibrium between demand and supply. As the demand of electricity rises, the supply increases. Most of the supply comes from coal power plants, accounting for 58.3% in 2017 and targeted to be reduced to only 54.4% in 2025 (DJK ESDM, 2018). With its dependence on coal power plants until 2025, Indonesia secures an easy and reliable energy source but has big problems in terms of health and the environment [2](Munawer, 2018).

Solar panels are being developed each year and used in various forms of implementation. However, these devices have shortcomings, such as output stability; as usage increases, the heat accumulates, leading to fluctuating output. As the solar panel generation rise in popularity, With the brink of the solar renewable system, an increasing number of people develop and use the technology on many scales; however, with its low efficiency, tuning up the system performance cannot give the best result of one system.

In this paper, we will discuss on how to increase the efficiency of solar panels by using a variable amount of reflectors that are mounted on a floating system. The experiment was held at Teksas Lake, Universitas Indonesia. Section II will elaborate on the methodology used. Section III will present the experiment setup, the system output data, and the comparison with existing usage. Section IV will discuss the conclusion and further improvements of the method

II. MATERIALS AND METHODS

A. *Components of the system*

This study aimed to determine the installation that performs best in terms of output stability. To compare between conventional and floating installation, we install these panels as close as possible to each other so that they have similar solar irradiance but varied cooling method.

Data were obtained in the noon when the sun is shining at its peak. The experiment was carried out in Teksas Lake, one of Universitas Indonesia lake.

We conduct the experiment by using 50Wp Mysolar Monocrystalline PV panel. Each experiment is carried out using two panels that should have the same number of sun irradiance. Table 1 shows the specification of the PV panel used, and Figure 1 provides the I–V characteristics of the panel.

TABLE 1 Specification of Mysolar 50 Wp

Electrical Characteristics	MY50S-12
Pmax	50W
Vmp	18.1V
Imp	2.78A
Voc	22.2V
Isc	2.96A
Temp Coeff. Voc	−(0,4 ± 0.05)%/ °C
Temp Coeff. Isc	(0,065 ± 0.02)%/ °C
Temp Coeff. Power	−(0,5 ± 0.05)%/ °C
NOCT	47 ± 2°C
Operating temperature	−40°C to 85°C
Max system voltage	1000VDC
Power tolerance	+ 3%
Cells	Monocrystalline
No. of cells	36 (4x9)
Dimension	530mm
Wight	4.2kg

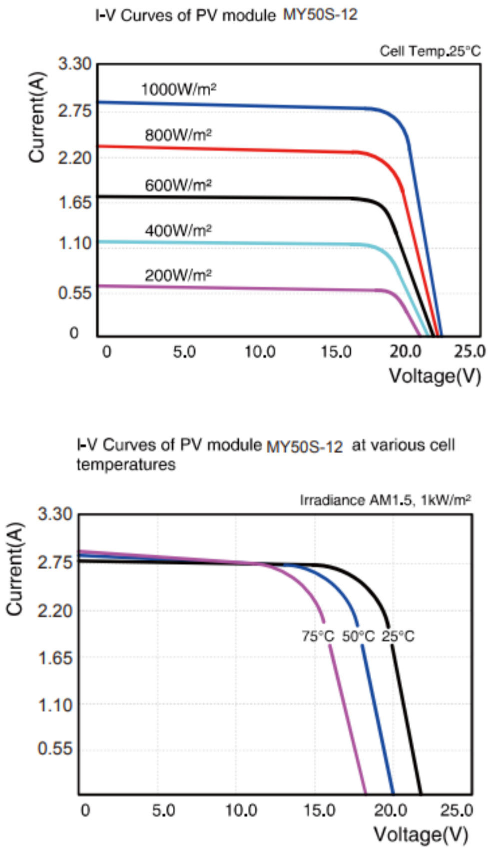

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Fig. 1. I–V charactristics of Mysolar 50Wp

Two data loggers manufactured by APPA are used to log the data. The variable that is being measured is current flowing from the panel toward the load.

A 12 V PWM solar charge controller is used and connected to SLA battery as a system load to obtain stable output voltage. The controller can provide stable output voltage for the system and is thus selected to be connected to the panels.

Fig. 2. Location site

B. *Configuration*

In this experiment, two solar panels are connected in parallel to the PWM solar charge controller. One of the panels is installed conventionally in the jetty, and the other one is installed floating on water near the jetty.

The assembly and installation of the two panels are made as close as possible to minimize errors. A rubber tire is used as buoy to float the panel. A PVC pipe is used as a frame, in which the panel is attached to the tire.

Current flowing toward the load from the panels are measured and recorded using current data logger.

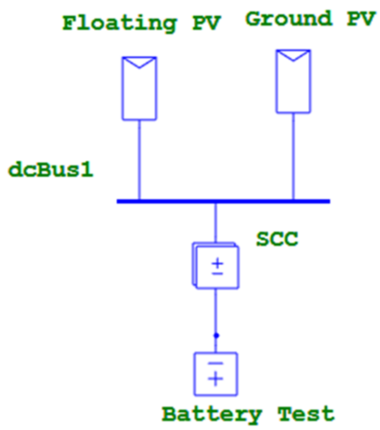

Fig. 3. System configuration

III. Results and Discussion

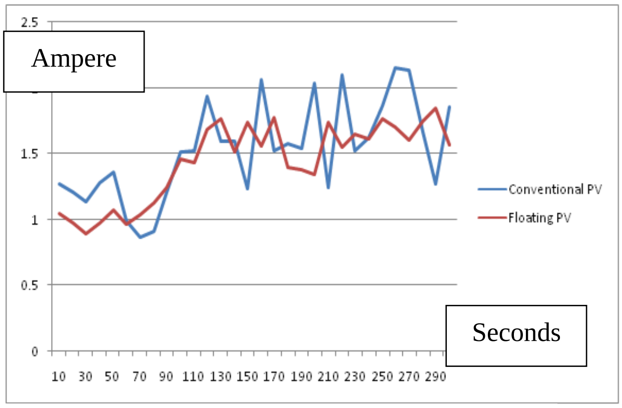

Fig. 4. Data collected

Based on the experiment, we have a total of 30 data for each PV. These data are tested at the same time and are placed side by side during the test, with one of them floating above the lake.

Figure 1 indicates the current that flows toward the load during 13.00–13.05. The Y axis indicates the amount of current in ampere, and the X axis indicates the time in seconds. The conventional PV averages to 1.56 A, while the floating PV averages to 1.45 A. The maximum current that flows from the conventional PV and from the floating PV is 2.149 and 1.84 A, respectively. The temperatures of the conventional PV are 50 °C at the start and 54 °C at end of the test. The temperatures of the floating PV are 47 °C at the start of the test and 48 °C at the end.

Based on these data, conventional PV transfer has higher amount of power toward the load than the floating PV; however, the graph shows that the conventional PV fluctuates more. In addition, the conventional PV has a tendency to peak more, but it would fall down a couple of seconds later. This phenomenon leads to massive power drop for a moment, which is problematic when implemented to a more complex and bigger system. Heat at the PV causes it to overheat.

The floating PV may produce a slightly smaller amount of power but is more stable. The current rarely drops down because the temperature at the PV is more stable, ranging from 47 °C to 48 °C as the water at the lake works as a natural cooling system. Floating PV has a lot of benefits when implemented at bigger systems because it is more reliable than the conventional PV.

IV. Conclusions

PV usage can be optimized with the natural characteristics of water that use floating PV as its platform. In this research, floating PV using tires as platform can deliver power more stable than the ground platform. This finding can "enhance the output of one system.

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