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Safety System of Back Current to KWH Meter on Solar Power Inverter On-Grid System

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Abstract**—** *On-Grid inverter is a DC to AC inverter system sourced from solar power or other DC sources, which is integrated with the PLN AC power network. In the on-grid inverter system, some customers have used PLN's export and import (exim) KWH meters. In the KWH meter exim, if the grid inverter has excess power or there is no load, then the electrical energy will be sent to the customer meter as a deposit for the kwh meter. But for some customer meters that have not used KWH exim, especially digital and prepaid meters, excess power on the grid inverter solar cell will be calculated as a load, so that if there is no load, the use of the KWH meter will increase according to the energy generated by the grid inverter. This can happen because the current transformer on the KWH meter is partially polarized, so that the KWH meter cannot distinguish the direction of the current flow. To overcome this, it is necessary to make a tool to anticipate backflow to the customer's meter. The method used is by comparing the current in the load compared to the current on the KWH meter and the current on the Grid Inverter. If the current value at the load is less than the current value on the PLN meter, the grid inverter will automatically be disconnected.*

Keywords**—** *On-Grid inverter, Solar power, KWH meter, Back current.*

I. INTRODUCTION

The production and utilization of solar energy electricity generated from rooftop solar installations in Indonesia is still very limited. Although it has become a global trend, rooftop solar has not been widely known by the people of Indonesia. This Off-Grid system makes it possible to store solar power in batteries for use when the power grid is off or when it is not on the grid. The hybrid system provides power to offset grid power whenever the sun shines while simultaneously sending excess power to the grid for credit for later use. The On-Grid system is a solar cell system that only produces power when the utility power grid (PLN) is available. This system must be connected to the grid in order to function. This system can send the excess power generated back to the grid when the solar cells produce excess power so there is a surplus for later use. The On-Grid system is the simplest and most cost-effective system for installing solar panel energy compared to the Off-Grid system, but it does not provide backup power during grid outages [1]–[4].

In the on-grid inverter system, some customers have used PLN's export and import (exim) KWH meters. In the KWH meter exim, if the grid inverter has excess power or there is no load, then the electrical energy will be sent to the customer meter as a deposit for the kwh meter. But for some customer meters that have not used KWH exim, especially digital and prepaid meters, excess power on the grid inverter solar cell will be calculated as a load, so that if there is no load, the use of the KWH meter will increase according to the energy generated by the grid inverter. This can happen because the current transformer on the KWH meter is partially polarized [5], so that the KWH meter cannot distinguish the direction of the current flow [6]–[9]. To overcome this, it is necessary to make a tool to anticipate backflow to the customer's meter. The method used is by comparing the current in the load compared to the current on the KWH meter and the current on the Grid Inverter. If the current value at the load is less than the current value on the PLN meter, the grid inverter will automatically be disconnected.

II. METHOD

A. On-Grid and Off-Grid Systems

On-Grid

The On-Grid system is a photovoltaic system that only produces power when the utility power grid is available. This system must be connected to the grid in order to function. This system can send the excess power generated back to the grid when the solar cells produce excess power so there is a surplus for later use. The On-Grid system is the simplest and most cost-effective system for installing solar panel energy compared to the Off-Grid system, but this system does not provide backup power during grid outages.

Factors to consider when installing an On-Grid solar panel system:

1. Locations that have 24-hour access to utility power
2. Urban and surrounding locations, are ideal installation locations
3. The location of homes, business buildings, government offices and other service buildings interested in efficiency and reduction of monthly electricity costs
4. Locations that already have or will have an SLO certificate for installed connections
5. Locations where the EXIM kWh meter (Export-Import) has been installed or which will and are currently in the process of arranging the EXIM kWh meter installation

Off-Grid

This Off-Grid system makes it possible to store solar power in batteries for use when the power grid is off or when it is not on the grid. The hybrid system provides power to offset grid power whenever the sun shines while simultaneously sending excess power to the grid for credit for later use. This Off-Grid system cannot be expected to provide power for all electrical loads used because the cost and volume of the battery will be prohibitive. Off-Grid systems

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require more specialized equipment which is more expensive and more complicated to install.

Consideration factors that need to be considered for installing the PV mini-grid system off-grid:

1. Locations that do not have a PLN connection
2. Locations that do not have a PLN connection, but plan to have a power connection in the next 5-10 years
3. Locations that have a PLN connection, but are not functioning 24 hours. So it requires backup power when the power goes out
4. Locations that use generators or other power generation systems, and want power assistance from solar energy
5. Remote, remote locations, outermost islands and islands, borders, forest interiors, high seas, and other extreme locations, which do not have an independent power source

Research Scheme

This testing stage is based on the research scheme in Figure 1. The source of electrical energy from this study is from the PLN electricity source and the source of electrical energy from solar panels or photovoltaic (PV). Solar panels are devices that can convert solar energy into electrical energy.

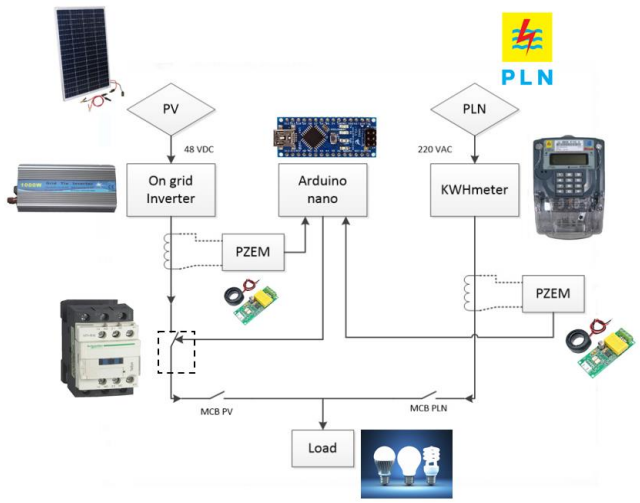

Fig. 1. Research Scheme

III. Results and Analysis

The voltage on the PLN system used is a voltage of 220V or a single-phase voltage system. This PLN voltage will go through a digital KWH meter. The voltage from the solar panel system in the form of a DC voltage of 48V will be converted into an AC voltage of 220V through an inverter. The solar panels used are as shown in Figure 2.

The first test is to do a test to see the output or output of PLN and solar panels. The results of testing the output of PLN and solar panels are shown in Figure 3. The output of the solar panels seen is after the on-grid inverter system. So that the output voltage that is read is the AC voltage value. The output results show that the voltage and current from PLN and solar panels are close to the same value, namely 228 V and 1.13 A. The output results also show the frequency value of the solar panel system is the same as PLN. Figure 3 also shows the load supplied to the solar panel system because it shows a power value of 239.3 W in the solar panel system.

Fig. 2. Solar Panel

Fig. 3. The output of PLN and solar panel

The next test is testing the On-grid solar panel inverter system. When the load is on, the on-grid inverter system from the solar panel will supply the load in full (Full Load). The results of the full load on-grid inverter system research are shown in Figure 4. The load is fully on (full load) and fully supplied with the solar panel system and the PLN system is off (OFF).

Fig. 4. Full Load System

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As for the no-load or no-load system, the on-grid solar panel inverter system does not supply the load, but the on-grid solar panel inverter system will provide electricity from the solar panels to PLN. It can be seen in Figure 5 that when the load goes out, the electrical energy from the solar panels will be supplied to PLN. The system transfer from solar panels or PLN to this load is detected by the PZEM sensor so that the PZEM sensor will send data to the Arduino uno. Then Arduino will give a command to the contactor.

Fig. 5. No Load System

IV. CONCLUSION

The method used is by comparing the current in the load compared to the current on the KWH meter and the current on the Grid Inverter. If the current value at the load is less than the current value on the PLN meter, the grid inverter will automatically be disconnected.

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