Development of the Concept Design of Rooftop Solar Power Plant Practice Tool

Stieven N. Rumokoy*1, I Gede Para Atmaja[2], Maureen Langie[3], Josephin Sundah[4]
[1,2,3,4]Manado State of Polytechnic, Electrical Engineering
E-mail: ***1rumokoy@polimdo.ac.id**, [2]igedeatmaja69@gmail.com,
[3]mauren.langie@elektro.polomdo.ac.id, [4]josephinsundah2017@gmail.com

Abstract

Solar energy source as an alternative to gain electrical energy continues to grow. One of the utilization systems is to use the solar panels on the roof top of the house. The Household-scale of Solar System Power Plant has been widely used. This case requires skilled workers for the installation of this system.

This study aims to develop a household-scale of Solar System Power Plant practice tool into a complete system. The research method starts with a literature study and then continues with the design system. The results obtained are a household-scale Solar System Power Plant tool design that can describe a complete system of the electrical energy distribution. The concept of a practical tool that previously only focused on the mechanical installation of solar panels but now become more complete with the addition of an electrical energy distribution system.

Keywords *— Solar Energy, Solar Panel, Renewable Energy*

1. INTRODUCTION

Solar energy is one of potential energy to be developed in Indonesia, considering that Indonesia is a country where located in the tropics area [1][2][3][4]. Tropical areas receive more sun irradiation than sub-tropical areas. In addition, the conditions of sunlight in the tropics are more stable in terms of irradiation time throughout the year compared to subtropical areas where the solar irradiation time is relatively more fluctuating. Due to technological developments, the use of solar energy in Indonesia continues to expand. One of the uses of solar energy is converting it to electrical energy by using solar panels [5]. The utilization of solar panels in its application can be used massively in solar power plants or by utilizing household scales that can be installed on the roof top of the house. In terms of installation, solar power plants can be installed in a system that is synchronized with main grid (on-grid system) [6][7][8] or in a system that is not connected to a main grid (off-grid system/stand-alone system).

In the utilization of solar panels as a converter of solar energy into electrical energy, the solar panels can be installed on the roofs of houses/buildings, often referred to as rooftop solar power plants. The rooftop solar power plant is one of the future power generation technologies that are environmentally friendly and can be a saving solution to the current high electricity tariffs [9][10]. The utilization of solar panels mounted on the roof of the house has been widely used as an alternative to electrical energy to support energy needs either for use alone or connected to a large system of electricity grids.

To answer the needs of workers who have competence in the field of installing solar panels, especially utilization on roofs of houses/buildings, an adequate learning/training system is required. The learning system must be able to answer the required competence needs [11][12]. One of the supporters of the learning process that can support the achievement of the desired competence is by making practical tools [13][14]. The practical tools used for the learning process must be designed according to the needs. This practice tool needs to be made to describe the actual conditions. In this article, the development of a practical tool design that can be used as a learning support media has been made so that practitioners can gain competence in installing a solar power system on the roof of a house/buildings.

2. RESEARCH METHOD

The design for developing practical tools is intended to complete a system of electrical energy generation. The initial design of the practical tool, which only consisted of a solar panel installation system, was then designed with a complete system for the electrical energy distribution system.

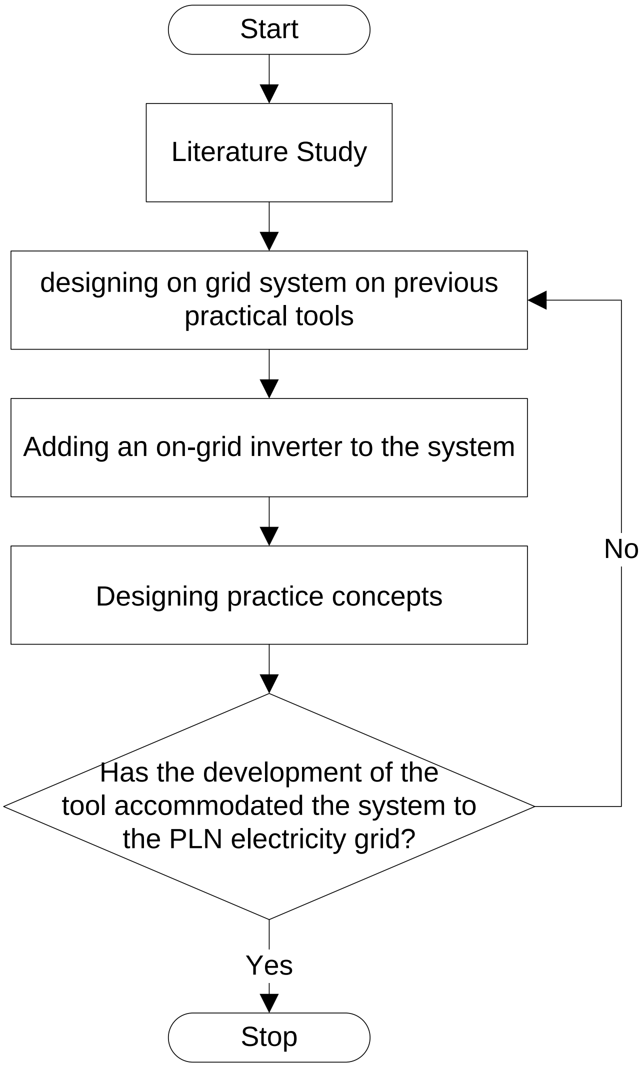

Figure 1. Research Flowchart

The steps of this research started with the literature study. The literature study was conducted to obtain initial information about the need for the right system to develop the designed practice tool. The next step was system design. The system design was an practical tools of On-grid system. In the on-grid system, an inverter has been added as a component of equipment that can distribute electrical energy which gain from the conversion of solar energy.

3. RESEARCH RESULTS AND DISCUSSION

3.1. Practical Tool Development Design Details

The practical tool design was a solar power plant generator practice tool on a household scale. The design of this practice tool was a development of a previously designed practice tool [13]. The development of this practical tool design was deemed necessary to complete a system for generating electrical energy to a distribution system for electrical energy.

3.1.1. Pre-Development Tools Detail

The previously design is a practical tool of solar panel design which installed on a prototype of a roof. The design of this practical tool aims to make the trainee competent in how to install solar panels on a roof top. This practice tool was designed in such a way as to resemble the actual condition of the roof. The concept design can be seen in Figure 2.

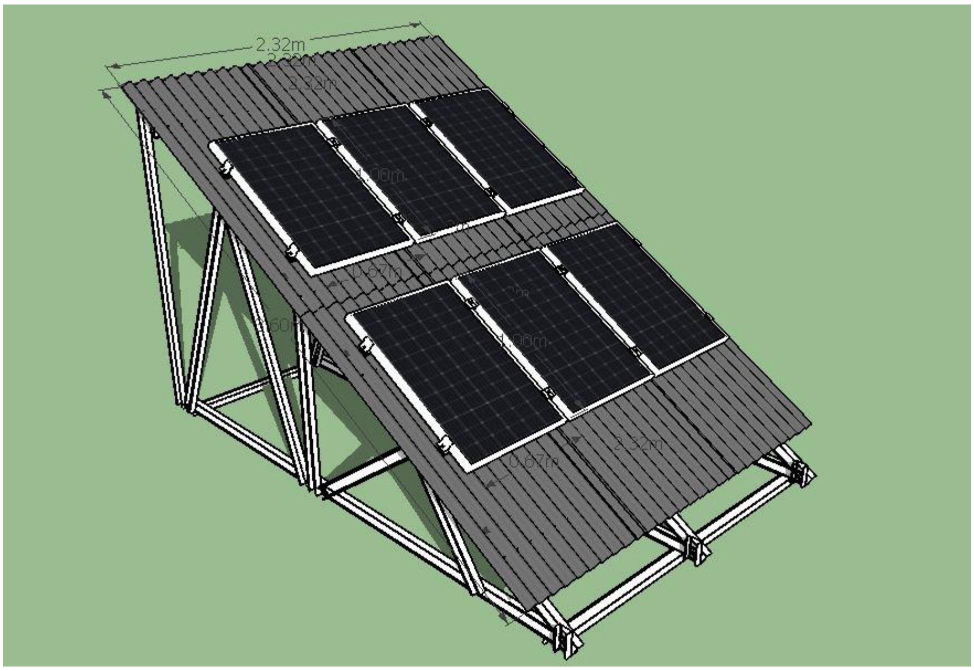

Figure 2. Pre-Development Practical Tool Design

3.1.2. Post-Development Tools Detail

The development of the designed tools focuses on the completeness of the system on the side of electrical energy distribution. The added systems is an inverter to bridge the energy obtained to synchronized with the AC power grid system. The inverter used is an inverter that can accommodate an on-grid system. The basic On-Grid Solar Power Plant system only consists of Solar Panels and Inverter components. Through the inverter, the solar energy converted into electrical energy is arranged so that the inverter can supply electrical energy into a main power grid. In the design of this tool, the number of solar panels used is six pieces with an output voltage of 24 V. The inverter used is an inverter with a capacity of 2kW. The development design of the practice tool can be seen in Figure 3.

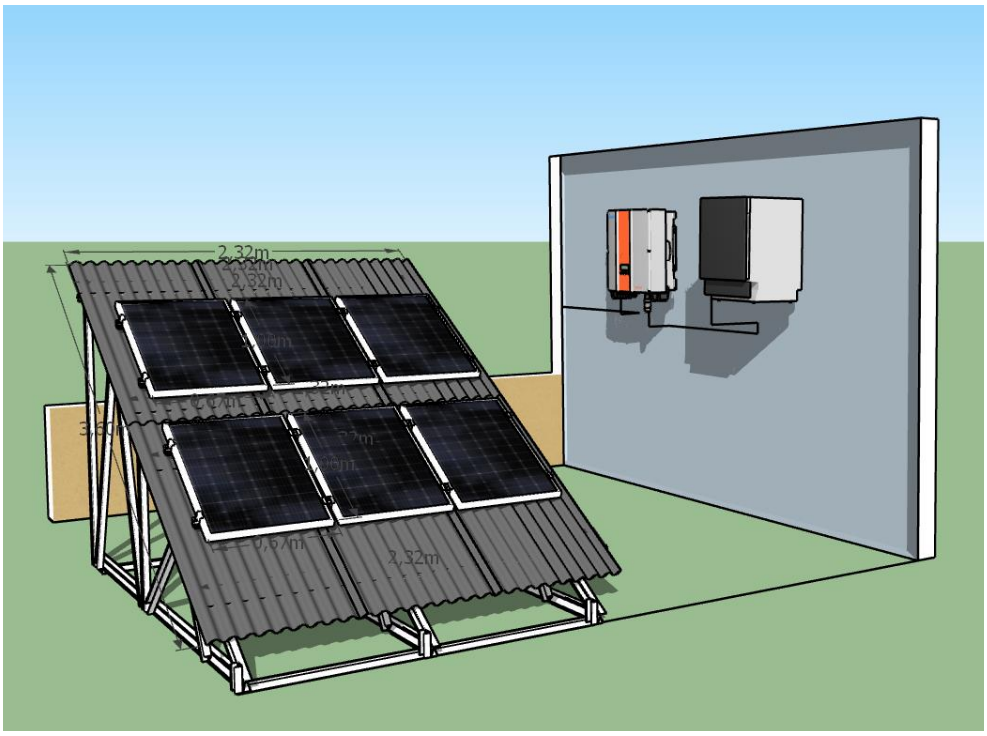

Figure 3. Post-Development Practical Tool Design

3.2. Practical Tool Usage

The usage of this practical tool is divided into three steps of work. The work steps are installing rails and solar panels, the DC side wiring connection system, and the AC side wiring connection system, respectively. With this concept, the trainee will be trained with the proper way. The trainee will be able to understand how to install and operate a household-scale solar power plant.

3.2.1. Rail and Solar Panel Installation

This step is where the trainee installs rail construction to mount the solar panels as if they were on the roof of a house. At this stage, trainee will more practice on the mechanical system installation. The accuracy of Installation to be considered because it relates to the precision and tightness of installing the solar panels.

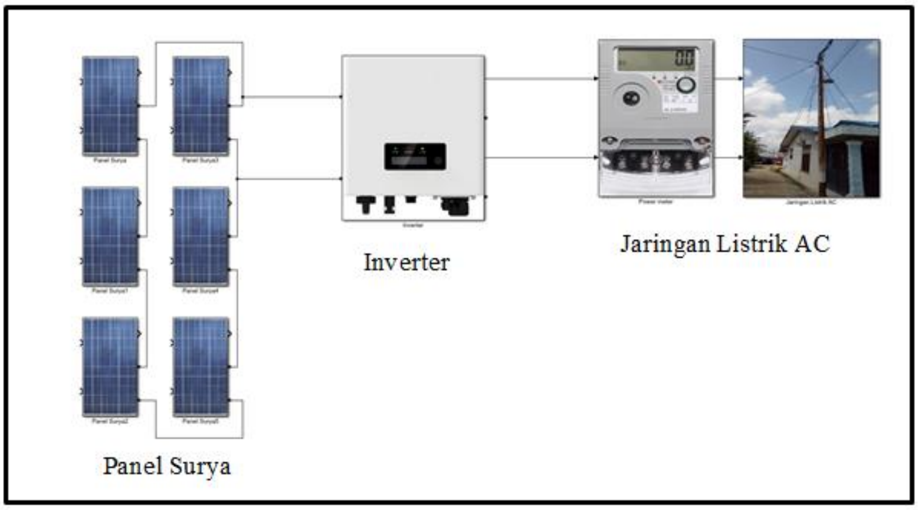

Figure 4. Post-Development Practical Tool Design Diagram

3.2.2. DC Side Wiring Connection System

The connection system on the DC side is the Connection System on the solar panel side. Practitioners will be trained to connect the solar panel connectors in series or parallel. In this practical tool, the connection between solar panels is made in series to achieve a sufficient voltage. The required voltage is adjusted to the input voltage range value on the inverter. The input voltage value that goes into the inverter must meet the minimum input voltage requirements for the inverter to work.

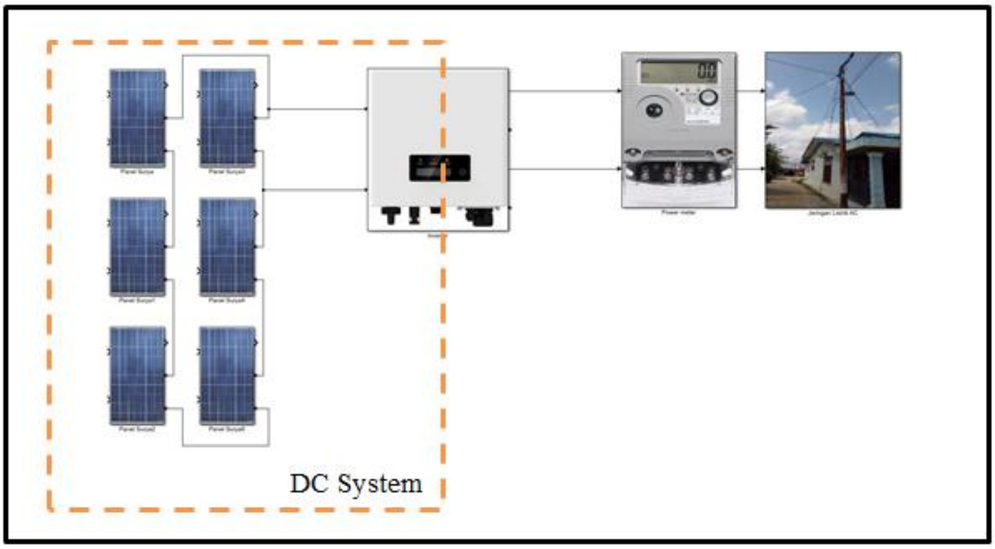

Figure 5. Connection diagram on DC side

3.2.3. AC Side Wiring Connection System

The connection system on the AC side is a wiring system between the inverter and the AC power grid. The connection system is relatively simple because it only connects two cables. The wiring safety must be considered because the system used on this side is 220 V AC.

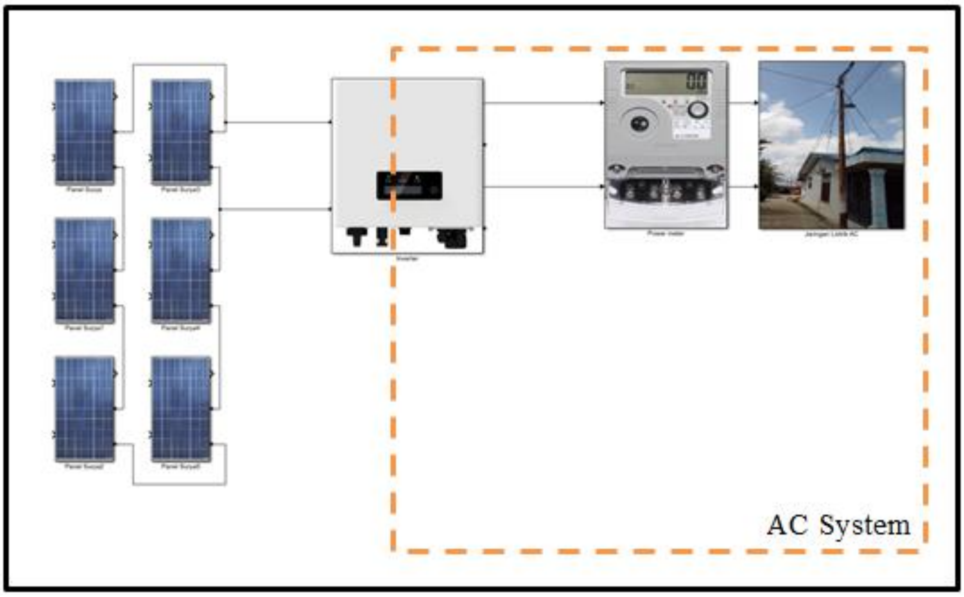

Figure 6. Connection diagram on AC side

4. CONCLUSION

The designed concept of the practical tool has accommodated the the practical installation of AC side system for the utilization of solar power generation. The previously concept of a practical tool is only focused on the mechanical installation of solar panels, but now become complete with the addition of an electrical energy distribution system. Through this design concept, a practical tool system can be built to support the competency oon installation of solar power plants on a household scale.

5. SUGGESTED

For the next practice tool development, the design system can be made with various types of solar panel dimensions. Differences in the type and or dimensions of the solar panel can add to the diversity of knowledge of trainee in the competence of tool installation.

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