

PLTS Design for Medium Industry Needs

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ABSTRACT

Energy is a basic need of every human being. The current energy needs are mostly met by energy sourced from fossil fuels such as oil, coal and natural gas. However, the current supply of energy is decreasing. If not immediately addressed, the possibility of an energy crisis is unavoidable. Alternative energy is one of the right solutions in fulfilling electrical energy sourced from fossil fuels because it is considered renewable and environmentally friendly energy. One alternative that can be applied to this problem is the use of solar cell technology. In this study, a PLTS plan will be made for the needs of small industries. The design of this PLTS is done by making an ideal design with the specifications of the equipment on the market. The results of the design show that the components of the PV mini-grid system in medium-sized industries are one SMA Sunny boy 20000TL inverter, and 100 solar panels with a capacity of 200 Wp.

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1. INTRODUCTION

Energy needs are increasingly becoming the basic needs of every human being. Man require an increase in the amount of energy for industrial, commercial, domestic, agricultural, and use of transportation. Needs energy electricity already Becomes part important for human life. All activities man started from activity house ladder up to you activity industry very depend will energy electricity. The more tall amount population, sothe more big also needs will energy electricityfor Fulfill his needs.

The current energy needs, mostly fulfilled by fossil fuel energy such as oil, coal and natural gas. However, the current supply of energy is decreasing. If not soon handled, the possibility of an energy crisis is unavoidable. For that innovation about alternative energy, especially from unlimited resources, it is very needed as technology develops, to meet energy needs Public in time which will come. And wrong one alternative which can appliedis innovation regarding cell technology Sun.

Cell Sun is a device which change energy ray sun Becomes energy electricity with process effect *photovoltaic*. Energy Sun *photovoltaic* is technology technology which used for utilise energy sun into direct current with a semiconductor device which normal our say as panel Sun (*sollarcell*) (Purwoto ,2018:1).

Cell Sun is device which could change energy light sun Becomeselectrical energy by following the photovoltaic principle. Solar cells are an energy technology that direct. Electrical energy can be created without the help of moving fluids such as steam or gas. Solar cells also do not require mechanical movement like *Rankine cycle* or *Brayton cycle*. Panel Solar Cell there is a number of type that is:

- a. Cell Sun silicone monocrystal

Cell Sun silicone Monocrystal Cell Sun this formed from ingredient base monocrystal. Is the most efficient panel which generated with technology latest & produces the most electric power per unit area high (Hidayat, 2015: 2).

- b. Cell Sun silicone polycrystal
Making cell Sun silicone as source current constant, no as simple making silicone for semiconductor material. by quantitative solar cell polycrystal occupy the place second. Efficiency located Among 10-15% more low from cell monocrystal.
- c. A-silicon (a-Si) solar cells A-silicon solar cells
arrangement the atom no order, that solar cell this on basic more productive, where absorption of a-silicon to light is almost 40 times more good from silicone crystal . Profit cell Sun a- silicone among others: Power absorption big, area band height, Need ingredient more a little, and Possibility method making could automatically. The downside is the efficiency still low, consequence prisoner inside big and current photo which caused very small.

The solar panel also consists of various parts as following:

- a. *Cover Glass*
Cover Glass is component which protects solar panels from the input of dirt or water that can interfere with the performance of the solar panel. Materials that used consist from ingredient clear or normal use glass or mica.
- b. Adhesive Transparent
Adhesive which working for glue electronic device. Transparent adhesive is used on layer in on anti reflective and in lower glass protector or cover from panel Sun
- c. Layer *antireflective*
Layer *antireflective* (layer anti-reflection) is a thin layer with an optical *refractive index* which located in Among semiconductor and air which working as deflector direction light to semi-conductor so that could catch light more many.
- d. Material Semiconductor
Semiconductor is component main on panel Sun. function alone is as absorbent light from ray sun. semiconductor arranged from combined two material semiconductor that is p-type and n-type
- e. *Back Contacts*.
Back contact is the part of the back protector of the solar panel which acts as a conductor. ingredient from back contact alone made of from metal.
- f. frame Outside
The outer frame of the solar panel is made of high strength aluminum and strong to direct impact

Solar Chargers Controller

Solar charger controller electronic circuit which serves to control the DC current that will injected to battery and take from battery towards the load. in addition to the above function has a function Another is as a current limiter so that it doesn't happen overcharging and overvoltage which will injected from panel Sun

Inverter

Inverter is device electronics power which has a function as a modifier or converter voltage from voltage DC to Voltage AIR CONDITIONING.

Accumulator (battery)

The accumulator (battery) which is often referred to as battery is converter energy chemical Becomes electrical energy with direct voltage (DC). battery also commonly referred to as electrochemical influence to substance chemical the reagent, so that called as a secondary element. For old calculations use battery could use equality 1

$$T = \frac{C}{I} \dots \dots \dots \text{equation 1.}$$

Information

T : Charge Time (Hours)

C : Battery Capacity (Ah)

I : Current Average (A)

For look for Time which needed in charging battery (t) is comparison from battery capacity (C) and the average current of the *solar charger controller* (A).

2. RESEARCH METHOD

Method which used in design analysis The series is carried out in several stages, including: (a). Determination of the solar panels used, (b). Determination component the regulator will used, (c). From aspect use component, also considered aspect economical and condition which there is on the market, so that in the search for components is not difficult.; (d). From aspect aesthetics, design tool so that could made in such a way that it is neat, attractive and safe in its use; (f). Choose component which Graduated qualifications and in accordance with system requirements. design PLTS this conducted by making ideal designs by compiling equipment specifications on the market.

In this design, the solar panels available in the market are used, and already certified to facilitate the selection of equipment. solar panels used is panel Sun brand Shinyoku with power 300 WP. In lower this isspecification the solar panels.

Brand	: Shinyoku (Polycrystalline)
Max. Power (Pmax)	: 300W
Max. Power Voltage (vmp)	: 36.2 V
Max. Power Current (imp)	: 8.28 A
Open Circuit Voltage (Vocs)	: 43.4 V
Short Circuit Current (isc)	: 9.27 A
Nominal Operating Cell Temp (NOTC)	: 45±2 °C
Max. System Voltage	: 1000V
Max Series Fuse	: 16A
Weights:	: 20.65 kg
Dimension	: 1956 x 992 x 40 mm



Image 1. Panel Sun Shinyoku polycrystalline 300 WP

Inverter In planning this, used inverter which already there is in market, and already certified for easy equipment selection. Inverter used is a SMA brand inverter with a power of 20 kW. Below is the inverter specification the.

Brand : SMA

INPUT

Max. DC Power : 20440 W
 MPP voltage range /
 rated input voltage : 380 V to 800 V /600 V
 Min. input voltage /start input : 150 V / 188 VMax
 voltage
 Max. input Current input A /
 Input B : 33 A / 33 A

OUTPUT

Rated power (at 230 V, 50 Hz) : 20000 W
 Max. air conditioning apparent : 20000 VA
 power
 Max. efficiency / European : 98.4 % / 98.0 %
 Efficiency



Figure 2. Inverter SMA Sunny Tripower 20000 W.

Make design seat Panel Sun

Below is a preliminary design drawing of the truss for placing as many as 6 sheets of solar panels. In the design of this framework, the main components used are: iron elbow sized 50x50x4mm which used as frames panel Sun, and also hollow iron measuring 40x60x2mm which is used as the legs of the frame the. These components are then assembled using nut and bolt connection . Figures 3 (a) and (b) show the frame of the solar panel when the solar panel is not installed and after it is installed. Figure 3(c) shows dimensions of the solar panel frame from the side view. Figure 3(d) shows the dimensions long and wide panel frame sun from looks on.

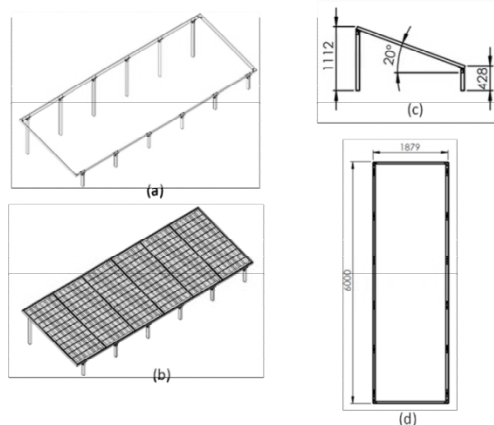


Figure 3. Design seat panel Sun

3. RESULTS AND DISCUSSIONS

Based on specification data tool and data use load then can be calculated needs burden per day like following :

Burden	Power (W)	Quantity (Pcs)	Total Power (W)	Length of Use (h)	Energy consumption (Wh)
Lamp	40	20	800	12	9600
LED Bulb	20	15	400	12	4800
air conditioning	1200	5	6000	9	54000
Sanyo Pump	250	2	500	6	3000
Machine A	900	2	1800	8	14400
Machine B	1200	1	1200	8	9600
Machine C	1500	1	1500	8	12000
Total			22700	107.4 KWh	

Use burden which planned in this study is 60% for PLTS planning, because so that the investment costs are not too large, the design is only limited to reduce total burden electricity.

Capacity PV Module

To determine the desired solar module capacity, it is necessary to determine the appropriate load really desired, which is 60% of the total load used, it can be calculated as follows:

$$\begin{aligned} \text{Load} &= 60\% \times \text{total burden} \\ &= 60\% \times 107.4 \text{ KWh} \\ &= 64.44 \text{ KWh.} \end{aligned}$$

If burden already is known, so need calculated how many large PV area which used, so could calculated as following:

$$P_{\text{max}} = \frac{W}{G_{\text{av}} \times \text{TCF} \times X}$$

In accordance with applicable regulations, solar panels have a significant reduction in power capacity generated if exceed from standard temperature optimal panel Sun the work. If panel Sun If it works above a temperature of 25 C, it will decrease 0.5% for every change in temperature. Temperature highest 29,82 C and lowest 25,32 C on month january, so increase Becomes 4.5°C. so countable with equality (1) as following:

$$\begin{aligned} P \text{ moment increase } 4.5 \text{ C} &= 0.5\% / ^\circ\text{C} \times P \text{ MPP} \times \text{increment C} \\ &= 0.5\% / ^\circ\text{C} \times 200 \text{ W} \times 4.5 \text{ C} \\ &= 4.5 \text{ W} \end{aligned}$$

Output power moment temperature go on Becomes 29,82 C could calculated with equality (2) and (3) become P MPP moment go on temperature C = PMPP - _ When temperature C go on:

$$\begin{aligned} 29,82 \text{ C} &= 200 \text{ W} - 4.5 \text{ W} \\ &= 195.5 \text{ W} \end{aligned}$$

$$\text{TCF} = \frac{195.5}{200} \times 100 = 0.97$$

The calculation results

Based on the calculations carried out, the results of the calculation of the lowest solar radiation, the highest solar radiation, average radiation and E yield are as follows:

Solar Radiation Lowest (kWh)	Solar Radiation Highest (kWh)	Solar Radiation Average (kWh)	□ (kWh/year)
64.44	112.37	87.98	32.113

Performance Ratio (PR)

Performance Ratio (PR) is a measure of the quality of a system seen from the annual energy consumed generated. If the system has a PR value of 70-90 %, then the system cansaid to be worthy. The following is the calculation to find the value of the *performance ratio* of the PLTS systemthis:

$$PR = \frac{E \text{ yield}}{E \text{ ideal}}$$

$$E \text{ ideal} = P \text{ array_STC} \times H \text{ tilt}$$

$$H \text{ tilt} = _ \square 365$$

$$= 5,175 \text{ h} \times 1000\text{W/m}^2 \times 365 \text{ days}$$

$$= 1888,9 \text{ kWh/m}^2$$

$$\square \square = \square \square \square \square \square \square \square \square \square \square \square \square$$

$$\square \square = 200 \square \square 100 \square \square 1888,9 \text{ h/year.}$$

$$= 37,777.4 / _ _$$

So PR:

$$PR = \frac{E \text{ yield}}{E \text{ ideal}}$$

$$PR = \frac{32,113 \text{ kWh/year}}{37,777.4 \text{ Wh/year}}$$

$$= 0.85$$

$$0.85 \%$$

4. CONCLUSION

Design and build of a Solar Power Plant (PLTS) at Allianz Ecopark Ancol in the area *Learning Farm* conducted with system *On grids*, system this chosen for reduce usagelctricity from PLN. With power output which generated on radiation Lowest 64.44 kWh, radiation the highest is 112.37 kWh, and the average radiation is 87.98 kWh. So design this on-grid PLTS could awaken 60 % from load capacity namely at 64.44 kWh of power.

Of the 100 solar panels used, there are 4 strings with 25 solar panels installed simultaneously series and 2 panels in parallel. Number of arrays attached 2 then connected to the SMA Sunny Boy 20000TL inverter. Sunny Boy High School inverter 20000TL later connected to panel and forwarded the load and network PLN. The components of the PV mini-grid system in medium-sized industries are one SMA Sunny boy 20000TL inverter, and 100 solar panels with capacity 200Wp

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