

Analyze New Method Based On Surya Energy

*Zuraidah Taro¹, Hamdani², Solly Aryza³, Siti Anisa⁴, Maharani Putri⁵

Staff Lecture Faculty Engineering University Pembangunan Pancabudi Gatot Subroto Street km 4,5 Medan,
North Sumatera Indonesia

Corresponding Author: Zuraidah Taro

Abstract: *The Working Principle Of Solar Cells Is Very Simple. Solar Cells Are An Energy Conversion Tool That Transforms Solar Energy For Electrical Energy. Energy From Sunshine Accommodated Then Converted into Electrical Energy. Such Energy Can Be Used For Running Various Kinds Of Electronic Devices Starting From Lighting Lights, Moving Motor, And Many More Others. The following article is the effort that must be done to make solar energy as an alternative energy in overcoming the needs of household electricity in the village of Pardamean Dusun Gunung Tua Kec.Pahae Jae Kab. North Tapanuli North Prov.Sumatera Far Inside With Difficult Access And Unspoiled Electricity PLN.*

Keywords: *Solar Cells, Electricity Needs, Unprecedented Electricity PLN*

Date of Submission: 19-08-2017

Date of acceptance: 08-09-2017

I. Introduction.

Indonesian independence enters its 72nd years. But there are still villages in North Sumatra that have not enjoyed the flow of electricity. But it does not turn off the activities of citizens. They use electricity with solar power. Previously citizens just use lighting teplon lights or lamp strongkeng (By using kerosene) as lighting at night. With the solar power, now dozens of residents can light the night with electric lights, can listen to music and watching television.

Indonesia as a tropical countries have high solar energy potential with average daily (insolation) radiation of 4.5 kWh / m² / day (Solarex, 1996). This potential can be utilized as an inexpensive and available alternative energy source throughout the year. In addition, Indonesia's geographical condition, which consists of thousands of islands, still causes many remote areas that have not reached PLN's electricity. Therefore, the application of Solar Power (PLTS) technology to utilize the available solar energy potential in those locations is the right solution. The application of solar power technology to remote area electricity needs can be done with a variety of solar power generation systems, such as hybrid power plants that is a combination of solar energy sources with other energy sources, the most common is the integration of solar energy with the energy of diesel engines or sources Micro-hydro energy. The other solar system is the "Solar Home System" (SHS), which consists of solar module panels, batteries, controllers and lights, these systems are installed in individual homes with photovoltaic modules installed over the roof of the house. The system typically has a photovoltaic module with a power capacity of 50 Wp which on average daily solar radiation of 4.5 Kwh / m² will produce approximately 125 s / d 130 watt-hours of energy. Implementation constraints SHS is a price that is still relatively expensive for the community is remote and poor. Therefore there needs to be a guide in designing, calculating and selecting the necessary components so that the society can afford to pay and can enjoy electricity like his brother who already enjoys electricity, at least for the needs of lighting.

II. Literature Review.

2.1. Photovoltaic.

Solar cells or also often called photovoltaics is a device capable of converting direct sunlight into electricity. Solar cells can be put as the main actors to maximize the enormous potential energy of sunlight to the earth, although besides used to generate electricity, energy from the sun can also be optimized thermal energy through the solar thermal system.

Solar cells can be analogous to devices with two terminals or connections, where when dark conditions or insufficient light work like diodes, and when exposed to sunlight can produce voltage. When irradiated, generally a commercial solar cell produces a dc voltage of 0.5 to 1 volt, and short-circuit currents in milliamperes scale per cm². The magnitude of the voltage and current is not sufficient for many applications, so generally, a number of solar cells are arranged in series forming solar modules. One solar module typically consists of 28-36 solar cells, and the total produces a dc voltage of 12 V under standard irradiation conditions. The solar module can be combined in parallel or series to increase the total voltage and output current according to the power required for a particular application. The picture below shows the illustration of the solar module.

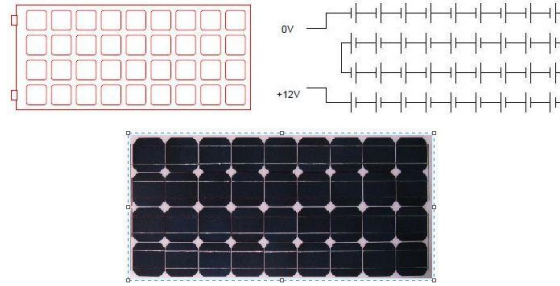


Fig 1. Illustration of solar module.

2.2. Structure of Solar Cells.

By the development of science and technology, the types of solar cell technology are growing with various innovations. There are so-called first-generation solar cells, two, three and four, with different cellular structures or parts. In this paper, we will discuss the structure and workings of typical solar cells on the market today that are silicon-based solar cells that also generally include the structure and workings of first-generation solar cells (silicon solar cells) and the second (thin film).

2.3. Antireflective Layers

Light reflection must be minimized in order to optimize the light absorbed by the semiconductor. Therefore, solar cells are usually coated by an anti-reflection coating. This anti-reflection material is a thin layer of material with a large optical refractive index between the semiconductor and the air causing the light to be deflected toward the semiconductor to minimize reflected light.

III. Energy Storage Accommodation Capacity.

An ES system can be integrated at the system level or the feeder level. For system-level integration, ES is deployed to provide grid support applications for the substation and downstream feeders. As for the feeder-level deployment, ES systems are sized to support local secondary loads and to mitigate integration concerns of local DG units. In this case, ES is located at the secondary circuit supplied by an MV/LV service transformer. The grid-related issues observed due to ES integration differ when compared for system and feeder-level deployments. Therefore, ES accommodation capacity needs to be defined and calculated separately for the system-level and feeder-level deployments.

2.4. System-level ES Integration

At the system-level, ES integrational challenges primarily manifest into system protection issues. During a fault condition, the current contribution from ES system may interfere with the overcurrent protection of the distribution grid. This section details two primary protection-related concerns resulting from ES integration: sympathetic tripping and relay insensitivity.

2.4.1. Sympathetic Tripping

The concept of sympathetic tripping is explained using Fig 2. The distribution circuit is comprised of two feeders each protected by an overcurrent relay. Consider that a fault occurs on Feeder 2. Under fault conditions, if the ES system remains in the circuit, it inadvertently feeds the fault current through the relay at the substation (R1). When a large-scale ES of considerable size is deployed, the fault current contribution from ES can go above the relay pickup current setting of the overcurrent relay at the substation causing an unwanted tripping of Feeder 1. This condition is defined as sympathetic tripping.

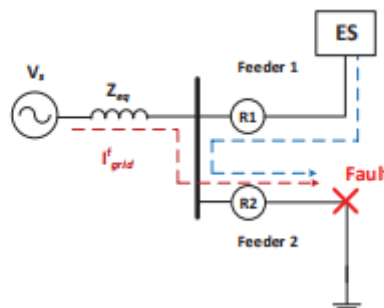


Fig2. Discharging of Energy Storage

3.1.2 Relay Insensitivity

The fault current injections by ES into the distribution system may cause a reduction in the fault current seen by an upstream protection device. Consequently, the reach of the upstream protective devices is reduced. The extent of reach reduction depends upon ES capacity, ES location, fault impedance, and feeder impedance. The ES system inverter design also influences its fault current contribution.

3.1.3. Feeder-level ES Integration In this case,

ES system is integrated at the secondary distribution feeder supplied by an MV/LV service transformer (Fig. 3). At feeder-level, ES integration can primarily result in operational issues such as violations of thermal current ratings and overvoltage limits of the secondary distribution circuit. 1) Thermal Current Rating Violation While charging, ES acts as a load and may result in violations of service wire's thermal current ratings. Therefore, before integrating ES at the secondary feeder, it is important to determine the accommodation limit for thermal current constraints. The analysis is equivalent to determining the maximum load a distribution asset can carry without causing a thermal current rating violation (Fig. 3).

3.1.4. Voltage Limit Violation

While discharging, an ES acts as a local generation and may result in overvoltages in the secondary buses. The maximum allowable range of voltage at any bus is 5% of the rated voltage, i.e., 1.05 per-unit, as specified by ANSI C84.1. When ES is deployed at the feeder ends of lightly loaded weak secondary circuits, an overvoltage may result due to ES discharging. Similarly, if ES is set to charge while the circuit is heavily loaded, an undervoltage may occur. However, for a realistic case study, it is assumed that when the load is high, ES will typically not be programmed to charge. If one needs to consider the undervoltage condition, the same approach as proposed for overvoltage case can be applied.

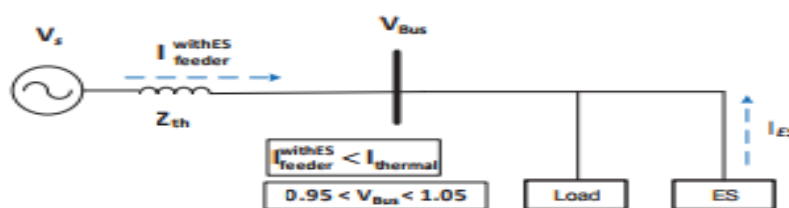


Fig 3. Feeder Level Integration.

IV. Solar Cell Energy Storage System

which is big enough in Indonesia application is P system as well as home lighting system individually (Solar Home System) and abbreviated SHS. The selection of this scheme in its application in the countryside is based on a consideration of the following factors:

- A. The pattern of settlements between houses in the village is quite widespread
- B. It is difficult to get land or sea transportation
- C. Doesn't requires integration with other plants.
- D. Modular, and easy to develop
- E. Small capacity making it easy to install
- F. Affordable prices
- G. Solar radiation as an adequate source of energy
- H. Not dependent on BBM

SHS is one of the applications of PLTS system for rural electrification as home lighting system individually or decentralized with relatively small installed power which is about 48-55 Wp. The amount of authority of 50 Wp per household is expected to meet the needs of lighting, information (TV and Radio) and communications (Radio communication). The main components of SHS consist of:

1. Photovoltaic module as a power supply that generates electrical energy from the input of a certain amount of solar energy
2. Battery as storage and energy conditioner
3. Battery voltage regulator (BCR) as an over size device, guard system reliability
4. Loads of Electric such as TL (DC) lamps, switches, radio, television, and others.



Fig 4. Implementation of Solar Home System on Vilages.

The design is done to determine the size of photovoltaic cells and batteries for solar energy systems with a maximum capacity of 1000 Watt. The design steps are as follows:

2.5. Determine Total Load Flow in Ampere-Jam (Ah).

Ampere-hours of equipment are calculated in DC ampere-hour/day. The charge current can determine by dividing the wattage rating of various loaded devices with simple PV system operating voltage.

$$I_{tot} \text{ load DC} = \text{Watt} / V_{op} \times \text{hours spent a day} \dots\dots\dots(1)$$

$$I_{tot} \text{ beban AC} = (\text{Watt} / V_{op} \times \text{jam wear day}) / 0.85 \dots\dots\dots(2)$$

$$I_{tot} \text{ beban} = I_{tot} \text{ load DC} + I_{tot} \text{ AC load} \dots\dots\dots(3)$$

5.2 System Loss and Security Factors

For PLTS systems with 1000 Watt power down, a 20% factor must add to loading as a substitute for system losses and security factors. Therefore the ampere-hour load specified in step 3.1 is multiplied by 1.20 so that:

$$\text{Total load} + \text{Loss \& Safety Factor} = I_{tot} \text{ load} \times 1.20 \dots\dots\dots(4)$$

2.6. Determining the worst Equivalent Sun Hours (ESH) hours

The equivalent sun time of a place is determined based on the solar insolation map of the world released by Solarex (Solarex, 1996). Based on the world solar insolation map obtained: ESH for Sulawesi Region = 4.5

2.7. Determining the Need for the Total Flow of Solar Panels

The required total solar panel current is determined by dividing 'Total load + Loss and safety factor' with ESH.

$$I_{tot} \text{ panel} = (I_{tot} \text{ load} \times 1,20) / \text{ESH} \dots\dots\dots(4)$$

2.8. Determining Battery Capacity for Recommended Reserve Time

Photovoltaic solar electrical systems are equipped with storage batteries (Aki) to provide energy at the load when operating at night or in less sunlight. Recommended backup time capacity varies by the latitude of the area where solar panel installation is shown in Table 1. (Source: Solarex, 1996: Discover The Newest World Power, Frederick Court, Maryland USA). Based on insolation map of the world (Solarex, 1996), the location of Indonesia is located at 10o LS - 10o LU. This means that the reserve time for all parts of Indonesia, including Central Sulawesi, is the same, i.e., 5-6 days.

Table 1. A relationship between the installation location and the timing of Solarex's photovoltaic module back up.

Latitude of mounting location	Times
0° – 30° (North or South)	5 – 6 days
30° – 50° (North or South)	10 – 12 days
50° – 60° (North or South)	15 days
Latitude of mounting location	Storage time
0° – 30° (North or South)	5 – 6 days
30° – 50° (North or South)	10 – 12 days
50° – 60° (North or South)	15 days
Latitude of mounting location	Storage time
0° – 30° (North or South)	5 – 6 days
30° – 50° (North or South)	10 – 12 days
50° – 60° (North or South)	15 days

V. Conclusions

Based on the above description, it can be concluded that in the village of Pardamean Dusun Gunung Tua Kec.Pahae Jae Kab. North Tapanuli North Prov.Sumatera feasible to use solar energy as a source of electrical energy to meet household electrical needs as lighting at night and for other purposes.

References.

- [1] Prosedur Perancangan Sistem Pembangkit Listrik Tenaga Surya Untuk Perumahan /Solar Home System (Muhammad Bachtiar) Jurnal SMARTek, Vol. 4, No. 3, Agustus 2006: 176 - 182
- [2] Alamanda, D., 1997, Prospek PLTS di Indonesia, ELEKTRO INDONESIA, Edisi ke Sepuluh.
- [3] Penerapan Teknologi PLTS Sebagai Solusi Untuk Membuka Keterisolasian Wilayah Pedalaman Dan Terpencil, BERITA BPPT, 2 Maret 2004
- [4] Messenger, R., and Ventre, J., Photovoltaic Systems Engineering, CRC Press, Boca Raton USA.
- [5] Mulyadi, Rahmad, 1995, Buku Panduan Pembangkit Listrik Tenaga Surya, Direktorat Teknologi Energi UPT-LSDE, BPPT.
- [6] Patel, Mukund. R., 1999, Wind and Solar Power Systems, CRC Press, Boca Raton, Florida, USA.
- [7] PT. LEN Industri, Buku Petunjuk Instalasi, Pengoperasian, & Pemeliharaan Pembangkit Listrik Tenaga Surya (SHS 50 Watt peak).
- [8] Solarex, 1993, Everything You Always wanted to know about Solar Power, Villawood Sydney, N.S.W. Australia.

Zuraidah Taro. "Analyze New Method Based On Surya Energy ." IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE), vol. 12, no. 4, 2017, pp. 54–58.