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2 Journal of Engineering Design and Technology 159 LOGIC Journal of Engineering Design and Technology Vol. 21 No.3 November 2021; p. 159 - 164 SOLAR POWER SYSTEM DESIGN APPLICATIONS FOR POOL WATER PUMP OPERATION AT TOURIST ACCOMODATION 1,2,3,4) Mechanical Engineering Department, Bali State Polytechnic, Bukit Jimbaran, Badung, Indonesia 5) Agricultural and BioSystem Engineering Department, Udayana University, Bukit Jimbaran, Badung, Indonesia Correponding email 1) : igabwirajati@pnb.ac.id I 16 Gusti Agung Bagus Wirajati 1), I Dewa Made Cipta Santosa 2), I Bagus Aditya Jaya Pramana3), I Putu Gede Suka Haryasa4), Ida Ayu Gede Bintang Madrini 5) Abstract. Utilization of solar energy in Indonesia has begun to bloom. This is due to the fact that Indonesia is located at the equator where the sun is exposed all year round and is a very environmentally friendly energy. Based on this, solar energy is used as an option to meet electricity needs by using a photovoltaic (PV) system. The use of a photovoltaic system as a power provider to operate a pool water pump at a villa in Bali is an example 16 of the application of a photovoltaic system. In this study, A Seri and Parallel photovoltaic arrays were used with a panel system that was integrated with PLN electricity. The angle of inclination and direction of placement chosen in this study is 15° with facing north, which refers to research that, has been done previously. PV designs and a series of control panels that can be accessed via the internet will be described as well.The aim in this research is investigate how photovoltaic design used as a solar power plant which applied to the module can be runing the pool water pump in the villa or tourist accommodation. Keywords: photovoltaic, design modul, water pump 1. INTRODUCTION Energy is one of the main needs in human life. The use of solar energy in Indonesia has very good prospects, considering that geographically as a tropical country, across the equator, the potential for solar energy is quite good. Utilization of Solar Energy through photovoltaic conversion has been widely applied, among others, the application of individual systems and hybrid systems, namely a system of combining conventional energy sources with renewable energy sources [1]-[4]. There is no denying that solar energy is a promising and clean energy sources, because

there is no defilement produced during the energy alteration process, and the energy sources are highly available on earth very much. Therefore many simple module designs were introduced to utilize solar energy. [5]-[12]. Wirajati, el.al.[13]-[14] conduct research about experimental a Building Integrated Photovoltaic (PV) and showing result that photovoltaic is very eligible to be implemented in the building in Bali-Indonesia area as the tropical country, how ever need to be improvement in term of investment cost. In addition, Santosa et al. [15] stated that photovoltaic from building application devices energy sources are very good for the future, since energy efficiency already improved to achieve 3 a net zero energy building. In this study, a photovoltaic panels array with Seri and Parallel connection are used to generate electricity stored in the battery. A hardware device was built which would later be connected to the telecommunication network 3 in order to be able to monitor the performance of PLTS remotely using phone application. 2. METHODS This research was conducted in one of the villas located in the village of Ubud, Gianyar Regency, Bali Province. The solar power system which is installed to operate the pool pump at the villa can be seen in Figure 1. 12 p-ISSN : 1412-114X e-ISSN : 2580-5649 http://ojs2.pnb.ac.id/index.php/LOGIC

 2.1 Working Principle of System Design A solar module (photovoltaic) is a number of solar cells that are arranged in series and parallel, to increase the voltage and current generated so that it is sufficient for the use of the load power supply system. To get the maximum output of electrical energy, the surface of the proposed system must eternally into teh sun. Figure 2 shows an application of the proposed solar system design as a driving force for a pool water pump in one of the villas in Bali. Application of solar power in villas or tourism accommodations 11 with the integration of solar power with the PLN electricity network source. Photovoltaic circuits use a combination of series and parallel circuits. The current and voltage coming out of the solar panel is controlled by SCC (solar charge control) for the needs of the battery charging

system and direct current (DC) supply. Then direct current (DC) from the battery is converted into alternating current (AC) with an inverter that is adjusted to the voltage from PLN. In combination with PLN, 19 an ATS (Automatic Transfer Switch) system is used which is specially designed for solar power applications, where when the battery charging is below 30% or the voltage drops below 10 V, the electricity supply will automatically switch to PLN without pause. This transfer switch is made very smooth so that operations such as air conditioning, pool pumps and refrigerators are not disturbed at all. So with the combined management of this system, it is clear that the measurement of electricity consumption from PLN and solar power is clearly separated when the utility is operational. PLN's electricity consumption will be significantly reduced and the proportion of solar power can be increased frequently with optimization developments and lower investment costs for solar installations Figure 1. Research area on the villa 2.2 Design and Built System Flowchart Figure 4 representative as a research flowchart. The research was carried out in the period from May to August 2021 The system is designed to operate the pool pump in the villa which is 12 m2 area and depth of 1.5 m. The main component was assembly. The main components refer to all components asembled on the control panel. After the system design and main components are completed, then proceed with the installation of the system on the villa. Commisioning test and data retrieval are also proceed as well on the next day. Table 1. Specification of PV Array Variable Value Maximum power Pmax (WP) 160 Voltage at Pmax (V) 17.8 Current at Pmax (A) 8.99 Open circuit voltage (V) 21.8 Short circuit current (A) 9.53 Panel size (mm) 1480 x 670 x 30 Weight (kg) Cell type 11.2 Mono-crystalline silicon

 Figure 2. The Design of a Solar Power Pump for Pool Water Pumps in the Villa Figure 3 System installation process Figure 4. Research flowchart. PV ARRAY BATTERY PUMP CONTROL PANEL KWH PLN System Design Main Component Assembly System installation System testing

Data retrieval START END

LOGIC 6 Jurnal Rancang Bangun dan Teknologi Vol. 21 No. 3 November 2021 2 Journal of Engineering Design and Technology 162 3. RESULTS AND DISCUSSION 3.1 System Block Diagram Block diagram description: a. Solar Panel The main components of the system that can produce DC electrical energy called solar panels. 20 Solar panels are made of semiconductor materials (usually silicon) which when exposed to sunlight can produce an electric current. The specification of PV array: peak power (Pmax) : 160W, max power voltage (Vmp) : 17.8V, max power current (Imp) : 8.99A, open-circuit voltage(Voc) : 21.8V, short-circuit current (Isc) : 9.53A, power tolerance : +-3%, dimension(mm) : 1480x670x30mm, connector: MC4 plug type, cell BB : 12. b. Battery The battery or battery is a store of electrical energy when the sun is not there. The specification of battery: Battery dry deep cycle solar panel, voltage : 12v, capacity : 100ah, dimension : 330(l) x 171(w) x 214(h) mm, terminal size : t11 c. Controller In the controller has been assembled various equipment such as tracer solar charge controller real MPPT 40A auto 12/24V, contactor, delay timer relay + socket base 220VAC 60s, energy meter monitor LCD display with CT / Coil 0-100A, low voltage disconnect 13 MCB DC 63A 440v 63 Ampere 2P mini circuit breaker, relay LY2N 220V 10A LY2N 220V 10A BM5, exhaust fan 120x120x38 220VAC. It"s a device that regulates the charging of electric current from the solar panel to the battery and vice versa. When the remaining battery charge is 20% to 30%, the regulator will decide with the load. The battery regulator also regulates the overcharging of the battery and the overvoltage of the solar panels. The benefits of this tool are also to avoid full discharge and overloading and monitor battery temperature. Overvoltage and charging can reduce battery life. This controller is equipped with diode protection which prevents DC current from the battery from entering the solar panel again. There is one tool added to the controller called eBox wifi. It 1 is a kind of serial server which can make solar controller and inverter be with wifi communication function, and carry out wireless monitoring, parameter settings, and etc. for the system only by cooperating with mobile

phone APP d. Inverter Inverter is a device that converts DC current to AC according to the needs of the electrical equipment used. This tool converts DC current from solar panels into AC current for the needs of loads that us e AC current. The specification of inverter: 14 power inverter pure sine wave DC 12V to AC 220V 2000 watt. Figure 5. System Block Diagram According to the Figure 5, the proposed model can be operated as follows: when sunshine, photovoltaic capture the radiation it produced. This pv's array is a union of various very little and flimsy solar cells arranged in series, parallel or mixed that can produce large currents and voltages as well. How the module work is that if sunlight hits the panel then there is a transfer of an electron from N to P in the panel, and electrical energy can be generated from the terminal output on the panel. The panel will produce varying electrical energy and it depends on the number of solar cells on the panel. The result of this panel is in the form of direct current (DC) electricity whose output voltage depends on how many solar cells are installed in the panel and the amount of sunshine that flashes on the panel. The outturn from this panel can be used properly for equipment that requires a DC voltage source with a small current usage. To be able to use it at night, the electrical energy obtained from the panel must be stored in the battery But 5 the output from the panel cannot be directly saved to the battery. A regulator circuit is needed that contains a series of automatic battery chargers. The purpose of this regulator is to arrange the outturn voltage of the panel and the setting current entering the battery automatically. In addition, another function of the regulator is to make the current connecting or un-connecting from the panel into the battery automatically. It also requires disconnecting the current flow from the battery when a short circuit or overload comes about. Solar panels can be used directly PV ARRAY CONTROLLER INVERTER LOAD BATERAY

 without the addition of regulator circuits or batteries, but this is not carried out because it can burden the performance of the

panel (due to excessive load) so that serious damage can be avoided. Furthermore, this regulator is also useful to save from the case of an overload from the panel and the panel free from damage. The connection between the storage battery and the charge is involved in parallel to the load. if the battery is fully charged. To protect the battery from the overload or short circuit, the battery should be passed through the protection circuit before connected. If the desired electrical output is alternating electricity (AC), the system that produces direct current (DC) must be connected to the device first called inverter. The inverter can convert electric current (DC) into alternating electric current (AC) directly. After the DC current is converted into AC current in the inverter, the AC current can be directly used to provide electrical and electronic equipment that requires alternating current. The output voltage and power connected to the load should match the capabilities of the inverter used and the size of the storage system used. 4. CONCLUSION A PV-powered water pump has been developed to experimentally investigate the potential use of PV power supply system for pool water pump. Based on the research that has been done, it can be concluded that the concept of a PV design system installed in one of the villas can actually operate a pool pump. The provision of alternative energy sources such as solar energy through the use of photovoltaic is a promising prospect for further development, considering that the primary use of oil and natural gas is still the main energy source. In addition to being environmentally friendly, energy sources from the sun do not require special periodic maintenance, which will further reduce production costs. 5. ACKNOWLEDGEMENT This research was supported by the Directorate of Sumber Daya, DIKTI, Ministry of Education, Culture and Research and Technology, Indonesian Government, Grant No. 249/E4.1/AK.04.PT/2021 and 40/PL8/PG/2021 for the in cash contribution. The author also would like to thank the Department of Mechanical Engineering - Bali State Polytechnic for the moral support that has been shown by helping the smooth running of this research so that it can be completed. The author is very grateful to colleagues and students who have helped in the completion of this research. 6. REFERENCES [1] A. N. Celik and N. Acikgoz, “Modelling and Experimental Verification of

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