Analysis of The Utilization of Solar Panels as Pump Crusters Automatically in Fish Pond Farming

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Abstract— The purpose of making this final task is to apply the solar power system as a source of electrical energy to move the water pump automatically in fish ponds. This system works automatically with the Water Level Control tool sensor (WLC), so that if the water level drops or rises then the water pump will automatically work. On this automated system use the Smart Relay SR2B121BD and the ZelioSoft 2 application.
Data retrieval carried out at 10.00 -14.00 WIB, obtained data pumps 1 and 2 for a height of 1 cm for 30 minutes and a height of 2 cm for 70 minutes. The amount of discharge the pump produces 1 and 2 ranges from 37 L/M to 45 L/M.
Pump 1 Test results obtained an average efficiency of 7.68%, with the highest efficiency of 11.03% and the lowest efficiency of 5.26%, while the average pump efficiency of 2, 7.05% with the highest efficiency of 10.66% and the lowest efficiency of 5.41%. The average efficiency of the solar panels is 11.20% with the highest efficiency of 14.60% and the lowest efficiency of 7.29%.

Keywords— solar panels, Water Level Control, Pumps

I. INTRODUCTION

The existing solar energy potential can be utilized to meet the needs of electricity by the community, moreover, its availability is very large for a long period of time and is environmentally friendly. Existing sunlight is converted into electrical energy by *a solarcell*. *Solar cell* is an elementemiconductor that can convert solar energy into electrical energy with *a photovoltaic* principle.

The management process in fish farming activities has several problems that occur, one of which is related to the condition of the water level in the pond. Usually the water level changes due to heavy rainfall, or a long drought. Water levels that are too deep or too shallow can interfere with fish activities in the pond. High rainfall can increase the water level even to overflow and cause fish to escape from the pond, while during drought, water supply is needed so that fish farming activities are not disturbed, therefore pump assistance is needed to increase or decrease the amount of water in the pond. Electricity needs as a pump drive in fish ponds can be supplied using *solar cells.* The selection of *solar cells* as providers of electricity needs is an application of efforts to utilize renewable energy so that it does not depend on electricity sources from PLN. The solar water pump is equipped with an automatic system with the concept of *water level control* so that the pump can turn on when needed to fill or reduce water in the pond.

II. METHODS

The methods used in writing this Final Project include the method of designing the solar power plant system, designing tool storage, and automated systems.

2.1 Solar Power Plant System Design

2.1.1 Solar Panels

Figure 1. *Polycristalline* Solar Panels

The solar panels used in this final project total 4 pieces of *sunlite polycrystalline* type 156P-50 solar panels have dimensions of 545 x 675 x 25 mm.

2.1.2 *Solar Charge Controller*

Figure 2. *Solar Charge Controller*

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Solar charge controller is an equipment used to regulate the amount of charging current in the battery to avoid *overcharging* and regulate the consumption current from the battery so that *fulldischarge* and overload do not occur . *The solar charge controller* has one input and twooutputs which each have positive and negative terminals.

2.1.3 Battery

Figure 3 Battery

Batteries are a means of storing electrical energy in the form of chemical energy. In this final project, the battery used is ROCKET type ESFT 50-
12 totaling 2 pieces, each of which has a capacity of 50 Ah. The voltage requirement in the final project is 24V so that the two batteries with a voltage of 12V each are assembled in series so that they can produce a voltage of 24V.

2.2. Tool Storage Design

2.2.1 *Box* Panel

1. Measuring the display of measuring instruments to be installed on the *panel box*
2. Sketching the size of the measuring instrument on the door of the panel *box*
3. Punching holes in the door of the *panel box* according to the size sketch that has been made using cut burrs
4. Smoothing the surface of the cut using a miser
5. Installing measuring instruments on the holes that have been made.

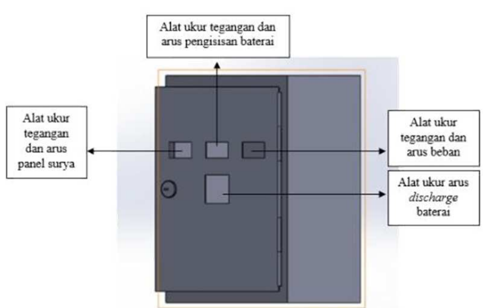

Figure 4. Panel*Box*

2.2.2 Battery *Box*

1. Measuring battery dimensions
2. Make *the battery box* design according to the dimensions of the battery
3. Preparing the tools and materials to be used
4. Cutting iron L profile 28 cm long
5. It holds together a 6 mm (25x30 cm) iron plate, with a 28 cm L profile iron as in figure 3.5.

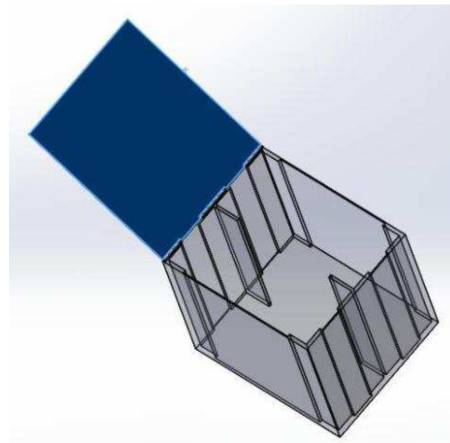

Figure 5. Battery *Box* Frame

6. Cutting 2 mm iron plate for battery *box* blanket part according to size
7. Bending the cut 2 mm iron plate according to design needs
8. Incorporating *the battery box* blanket with the battery *box* frame
9. Installing hinges using two keeling nails using ripet pliers
10. Installing the battery box door

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2.3. Automatic System Design

2.3.1. Program Smart Relay

1. Installing the Zelio Soft 2 application
2. Open the Zelio Soft 2 app

Figure 6. Application Initial View Zelio Soft 2

3. Choosing the type of *smart relay* according to what is used in the final project, namely SR2B121BD

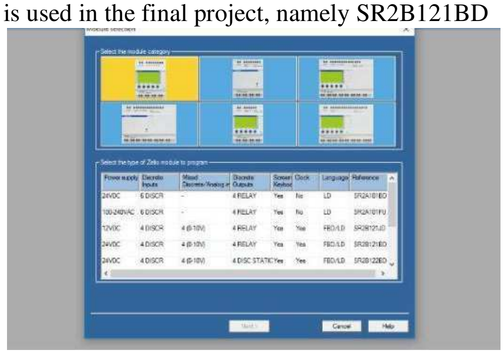

Figure 7. Selecting the Type of Smart Relay Used on the Zelio Soft

Drawing a *waterlevel control* sensor system to turn the pump on/off automatically

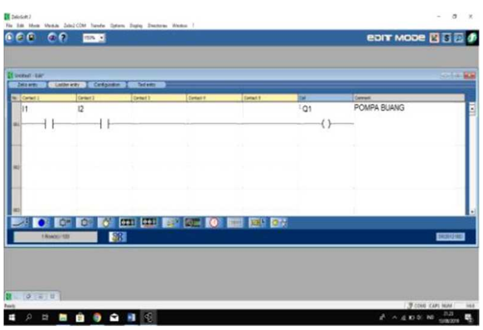

Figure 8. Drawing the Control System

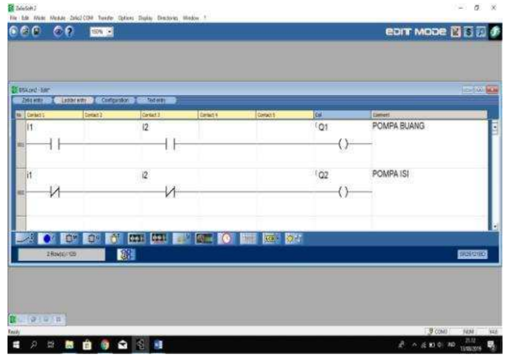

Figure 9. Sensor Ladder Diagram WLC as Pump Drive

2.4. Design of Electrical Installations

2.4.1.Electrical Installation Steps The implementation of electrical installations is as follows:

1. Setting up the tools to be used
2. Creating a drawing of the electrical installation to be installed, shown in figure 3.10

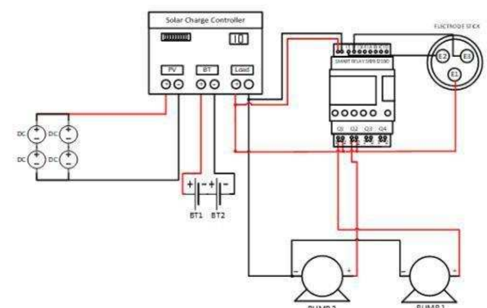

Figure 10. Paired Electrical Installations

3. Placing solar panel modules on the roof
4. Installing *a solar charge controller* and *smart relay* on the *box panel*
5. Connecting solar panel modules on solar *charge controller terminals* complete with ammeter measuring instruments and voltmeters as current and voltage gauges from solar panels
6. Assemble the batteries in series then connected the *solarcharge terminal controller* complete with ammeter and voltmeter to measure the voltage and *charge/discharge* current of the battery
7. Connecting *a smart relay* on the load terminal of *the solar chargecontroller*
8. Installing and connecting *the water levelcontrol* lower limit sensor rod with a positive source of 24VDC
9. Connecting two other *waterlevel control* rods with a smart relay input terminal
10. Installing the pump buffer

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11. Connecting the pump at the output terminal of *the smart relay* according to figure 3.16 complete with ammeter measuring instruments and voltmeters for measuring current and voltage at load
12. Installing the pump on the pump buffer that has been created
13. Installing pipes according to the needs on both pumps
14. Spruce cable installation using cable sheathing
15. Turning on the MCB PLC, and connecting the USB data cable from the laptop/PC to the PLC
16. Transferring the program to a PLC

III. RESULTS AND DISCUSSION

3.1 Testing

The testing process is one of the processes that aims to test the solar panels to drive the pump with *water level control* sensors and measure the solar panel power, pump power, and pump uptime at any change in water level. The water level is simulated at a height of 1 cm and 2 cm to obtain panel power and pump power.

3.1.1.Equipment used

1. Installation of solar power plant as an automatic pump drive with *water level sensorcontrol*
2. Solarimeter
3. Stopwatch
4. Stationery

3.1.2.Measured parameters

1. Light intensity
2. The current and voltage generated by solar panels
3. Battery *charge/discharge* current and voltage
4. Current and voltage at load
5. Time of filling/disposal of water in fish ponds

3.1.3.Operation Steps

2. Menyiapkan system instalasi solar power plant and its automation system
3. Ensuring the condition of the measuring instrument to be used under normal conditions
4. Setting the *water level control* sensor in conditions that require water up to 1 cm high
5. Pressing the ON button to activate the load
6. Record 5 predefined parameters at the beginning of the load ON periodically at 10 minutes later, until the load is automatically on the OFF condition
7. Setting *the water level control* sensor in conditions of excess water of 1 cm
8. Pressing the ON button to activate the load
9. Record 5 predefined parameters at the beginning of the load ON periodically at 10 minutes later, until the load is automatically on the OFF condition
10. Setting *the water level control* sensor in conditions of 2 cm lack of water
11. Pressing the ON button to activate the load
12. Record 5 predefined parameters at the beginning of the load ON periodically at 10 minutes later, until the load is automatically on the OFF condition
13. Setting *the water level control* sensor in conditions of excess water of 2 cm
14. Pressing the ON button to activate the load
15. Record 5 predefined parameters at the beginning of the load ON periodically at 10 minutes later, until the load is automatically on the OFF condition

3.2. Test and Analysis Data

The solar power generation system as a source of electricity generation in fish farming ponds is used as a pump drive automatically with a *water level sensor (water levelcontrol).* The tool was tested on 7, 10, 14 and 15 August 2019 with conditions of changes in water levels of 1 cm and 2 cm so that the following data were obtained.

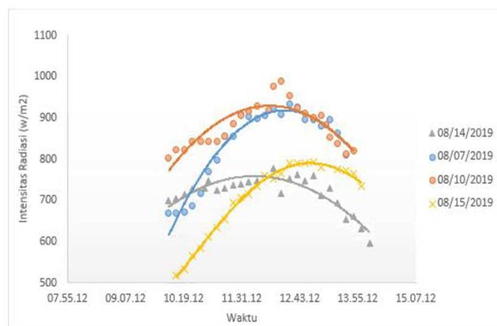

Figure 11. Intensity Change Graph Light Radiation against time

Solar panel testing in generating electricity tested on August 8,10,14 and 15, 2019 produced a graph of changes in the intensity of sunlight radiation against changes in time as shown in figure 4.1. From 4 tests of solar light radiation intensity, the results are obtained the more noon, the value of the intensity of sunlight radiation increases until a certain value then decreases. In the test on August 7, 2019, the value of the intensity of sunlight radiation at 10.00 WIB was 670 $_{m2}$, the greater the intensity of the solar radiation the greater it became to a maximum of 12.30 WIB of 934 $_{m2}$, then dropped until 14.48 WIB of 792 $_{m2}$. In the test on August 10, 2019, the value of the intensity of sunlight radiation at 10.00 WIB was 803 W / m^2, the greater the intensity of sunlight radiation the greater until the maximum at 12.20 WIB of 989 $_{m2}$, then dropped until 14.51 WIB of 806 $_{m2}$. In the test on August 14, 2019, the intensity value of sunlight radiation at 10.00 WIB was 699 $_{m2}$, it increased until 12.00 WIB by 763 $_{m2}$, then dropped until

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14.11 WIB by 586 W / m^2. In the test on August 15, 2019, the intensity value of sunlight radiation at 10.00 WIB was 517 m2, it increased until 13.00 WIB by 792 m2, then dropped until 14.04 WIB by 745 m2.

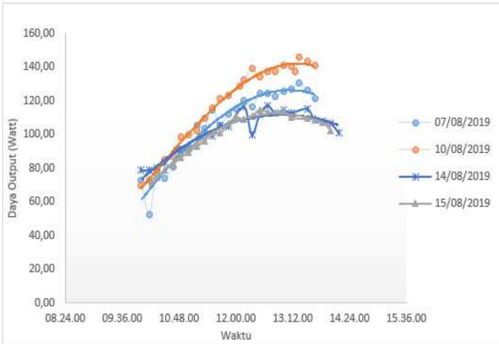

Figure 12. Power Change Graph
Solar Panel Output against time

Tests conducted on August 7, 10, 14 and 15, 2019 produced a graph of the change in the output power of solar panels and pumps against the change in time as shown in figure 4.8. The solar panel output power on August 7, 2019 at 10.00 WIB was 72.93 Watts, then rose to the maximum value at 13.20 WIB of 130.38 Watts, then dropped to the test at 14.48 WIB of 121.31 Watts. The tests on August 10, 14, and 15 had the same characteristics as the tests on August 7, 2019 where the power from the beginning of the test continued to increase, then was at the maximum point of output power, then decreased until the end of the test.

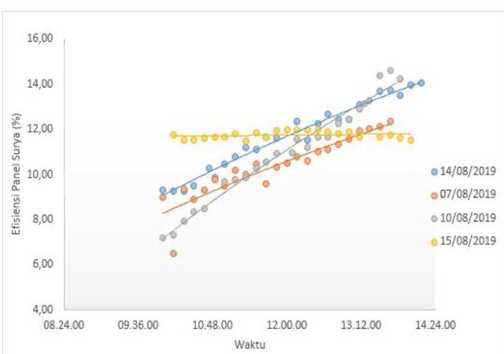

Figure 13. Efficiency Change Graph
Solar Panels against time

Solar panel generation tests conducted on August 7, 10, 14 and 15, 2019 produced a graph of changes in solar panel efficiency to changes in time as shown in figure 4.9. In the test on August 7, 2019, results were obtained where efficiency increased from 9% to 12.7%. In the test on August 10, 2019, the results were obtained, the efficiency increased from 7.19% to 14.6. In the test on August 14, 2019, results were obtained where efficiency increased from 9.03% to 14.04%. In the test on August 15, 2019, the efficiency of solar panels was relatively constant in the range of 11% to 12% despite a slight increase or decrease. Changes in the efficiency of solar panels can be caused by several factors, one of which is the position of the sun towards the solar panel

IV. CONCLUSION

Based on the results of data collection and analysis that has been carried out, the following conclusions were obtained.

a. Solar panels installed as power plants produce different power according to weather conditions and precisely the irradiation of the sun that hits the solar panels. The largest power generated by solar panels was obtained on August 10, 2019, namely at 13.30 WIB with a voltage of 28.7 Volts and a current of 5.08 Amperes so that a power of 145.80 Watts was produced. The smallest power produced by solar panels was obtained on August 10, 2019 at 10.00 WIB with a voltage of 25.4 Volts and a current of 2.75 Amperes so that a power of 69.82 Watts was generated

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b. The efficiency produced by solar panels in an average-loaded condition of 11.20% with the smallest efficiency was obtained on August 10, 2019 at 10.00 WIB which was 7.29% and the largest efficiency was obtained on August 10, 2019 at 13.40 WIB which was 14.60%.

c. Pumps ON and OFF according to the condition of the water level in the pond. The average discharge produced by pump 1 is 0.662 L/S, and the average discharge produced by pump 2 is 0.658 L/S.

The greatest efficiency in the pump produced by pump 1 obtained on August 10, 2019 was 11.03%, and the smallest efficiency of the pump was produced by pump 2 obtained on August 14, 2019 of 5.26%.

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