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To cite this article: Matius Sau 2021 *IOP Conf. Ser.: Mater. Sci. Eng.* **1088** 012093

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Solar-generator hybrid plant as an electric energy solution on fisherman boats

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Abstract. The use of new and renewable energy in various fields is currently increasing. This can be seen in the utilization of solar energy, wind energy, geothermal energy, water energy and so on in various sectors of life and industrial sectors. However, good service is needed so that it works optimally, because it requires a system that can work simultaneously or alternately known as a hybrid system. This study aims to utilize solar energy and generators that work in a hybrid manner in serving the load on fishing boats. The experimental method used in the solar energy hybrid system and generator on fishing boats is by means of testing on loads that work simultaneously and alternately. The results showed that the supply of electrical energy from solar energy was 100 Wp, from a generator of 600 watts. At the same time working together it is able to serve a lighting load of 60 Watts and 2 Freezers each of 100 Watts continuously and when working alternately the solar panels are able to serve a load of 60 watts while the generator set is 260 watts. When the generator works alone, it requires a large enough fuel and is able to serve all the loads on the ship, it is different when the solar panel works alone, it can only serve the lighting load but there is no fuel cost. The combination of electrical energy supply from Generator and Solar Energy is carried out alternately by utilizing solar energy as the lighting load during fishing conditions while the electrical energy from the generator is used when running the ship as well as a backup. Thus the use of fuel for generators can be minimized and the operational costs of fishermen are reduced

1. Introduction

The use of new and renewable energy in various fields is currently increasing. This can be seen in the utilization of solar energy, wind energy, geothermal energy, water energy and so on in various sectors of life and industrial sectors. However, good service is needed so that it works optimally, because it requires a system that can work simultaneously or alternately known as a hybrid system. Previous research, has been carried out is the design of a solar power plant hybrid system with diesel power generation as an energy-efficient alternative [6], Testing of solar-diesel hybrid power plant battery charging systems [2], Model Design of Solar-Diesel Hybrid Power System With Homer Pro [1] and Utilization of a Solar Generator / Diesel Hybrid System [3].

In fishing boats, generally using a generator as a source of electrical energy to drive the boat, cooling fish and lighting. This requires a lot of fuel costs so that the income of fishermen is reduced Under these conditions, this research developed a hybrid system of a Solar Power Generation with a Generator on a



fishing boat as a solution to reduce fishermen's operating costs. This study aims to utilize solar energy and generators that work in a hybrid manner in serving the load on fishing boats. The experimental method used in the solar energy hybrid system and generator on fishing boats is by means of testing on loads that work simultaneously and alternately.

2. Hybrid PLTS – Generator / Diesel (PLTD) [1,2,3,6]

The term Hybrid is defined as the use of 2 or more power plants with different energy sources, generally used for captive generators, so that a synergy that provides economic and technical benefits means the reliability of the supply system. The main purpose of a hybrid system is basically to try to combine two or more energy sources (generating systems) so that they can cover each other's weaknesses and can achieve supply reliability and economic efficiency on certain load profiles. Type load (Load profile) is an important keyword in a hybrid system. For each different load profile, a hybrid system with a certain composition is needed, so that the optimum system can be achieved. Therefore, system design and sizing systems play an important role in achieving the target of a hybrid system.

For example, a relatively constant load profile for 24 hours can be supplied efficiently and economically by the generator (with the appropriate capacity), but the load profile where electricity usage during the day differs greatly compared to nighttime, will make the generator use not optimum. Hybrid PV-Generator [4] combination will reduce the generator operating hours (for example from 24 hours per day to only 4 hours per day at peak load only) so that O & M costs can be more efficient, while PLTS is used to supply base loads, so no initial investment is needed big.

Thus Hybrid PV-Generator will be able to save O & M costs, reduce inefficiency in the use of generators, and at the same time avoid the need for large initial investments.

Hybrid system modeling can be expressed in the form of a centralized AC and DC relationship as shown in Figure 1

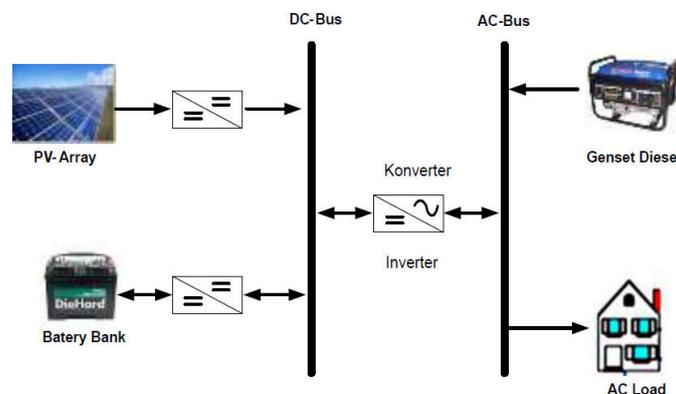


Figure 1. Centralized AC and DC coupled hybrid generating systems (Centralized AC and DC coupled Hybrid Power Systems)

3. Research Methods

The steps taken to utilize the solar energy hybrid system and generator on fishing boats are:

The first stage, namely

- a. Survey of energy needs in fishing boats such as
 - Power capacity on the boat before connecting with Solar Energy
 - Conditions for load requirements on the boat
- b. Calculate the total electric load capacity of the fishing boat

The second stage, namely:

- a. Calculating the electrical load requirements when working with a hybrid system
 - Preparation of components for solar power generation and hybrid systems
 - Perform system installation
- b. Analyze electrical power needs

The third stage, namely

- a. Test the hybrid system to determine whether the system is working or not
- b. Evaluating the system to determine whether the system condition is normal or not

4. Result and Discussion



Figure 2. Forms of Fishing Boat [5]

4.1 Conditions Before the Hybrid system

Based on the survey that has been conducted, it is found that the Power Generation on the Fishing Boat is 1 x 600 Watt which is used to serve all loads on the fishing boat.

The load on the fishing boat is divided into:

- a. The load for lighting in the boat is 60 Watts

Table 1. Lighting load on fishing boats

No.	Components	Amount	Total
1	Inner lighting lamp	2 pieces @ 20 W	40 Watt
2	Lights on the front of the boat	1 piece @10 W	10 Watt
3	Rear Boat Lights	1 piece @ 10 W	10 Watt
Total Load			60 Watt

- b. The load for the fish cooler is 2 pieces (freezer), each 100 watts, a total of 200 Watts
- c. Boat Drive Load (electric motor) 500 Watts
- d. The total required load on the fishing boat in the pre-hybrid condition with solar power generation is:

Table 2. Types of Loads on Fishing Boats

No.	Components	Total Load
1	Lamp load	60 W
2	Cooling Load	200 W
3	Boat drive load (electric Motor)	500 W
Amount		760 W

Based on the survey results, it is known that the capacity of the generator on the boat is 1 x 600 Watt, while the total load calculated is 760 Watt. This happens because the work system of the load on the fishing boat takes turns, as in table 3 below:

Table 3. Load Work System On Fishing Boats

No	Load name	Description		
		Fishermen go fishing	Fishermen while catching fish	Fishermen come home to catch fish
1	Lamp	On	On	On
2	Electric motor	On	Off	On
3	Freezer	Off	On	Off

Total Load	560 Watt	260 Watt	560 Watt
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Based on Table 3 above, it shows that the use of electric power in fishing boats is quite large both when going to sea and when returning from the sea. Likewise, when catching fish in the sea. This condition requires fuel (BBM) large enough to drive the generator because it has to operate from going to sea to returning from the sea.

4.2 Conditions with Hybrid Systems

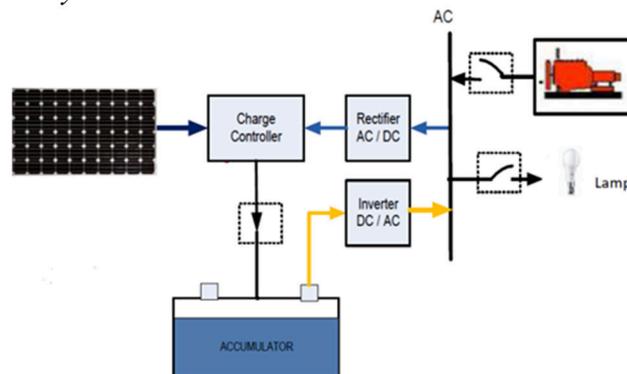


Figure 3. Series of Solar Power Generator Hybrid System With Generator

4.3 Hybrid system load calculation

Based on the results of a survey on the use of electric loads on boats, an electrical system is carried out using an electric load using a PLTS hybrid system with a generator. This system can work alternately and in parallel. This depends on load requirements. Based on table 3, it can be seen that the use of a generator to serve the load works continuously as long as the fishing boat starts to operate. Thus, the fuel used is large enough to serve the load on the boat. The capacity of the solar power plant (PLTS) installed on the fishing boat is:

- Solar panels with a capacity of 2 x 100 Wp
- Accumulator with a capacity of 100 Ah
- SCC 20 Ampere
- Inverter with a capacity of 500 Watts

The use of solar panels with a capacity of 100 Wp is limited by the number, because the ship area is only 300 x 100 cm, the use of solar panels can only be 2 panels with a size of 119x54 cm per solar panel size [8]. Based on [7] the maximum sun exposure in Indonesia in one day is only 3 hours, it can be determined that solar panels can supply electricity:

$$\text{Total} = 3 \text{ hours} \times (2 \text{ pieces} \times 100\text{Wp}) = 600 \text{ watt}$$

The work system for using electrical energy in fishing boats using PLTS and Generator can be seen in table 4.

Table 4. Testing Results of the PLTS hybrid system with a generator on a fishing boat

No	Load Name	Load capacity	Description		
			Fishermen go fishing	Fishermen while catching fish	Fishermen come home to catch fish
1	Lamp	60 W	On	On	On
2	Electric motor	500 W	On	Off	On
3	Freezer	200 W	Off	On	On
Total Load			560 Watt	260 Watt	760 Watt

4.4 In table 4 it can be explained that:

- a. When fishermen go to sea to catch fish, the work load is the electric motor to drive the boat and lighting on the fishing boat. The total load is 560 Watts. In this condition, the lighting load is served by the Accumulator which has been filled by the PLTS during the day while the electric motor to drive the boat is served by a generator.
- b. When fishermen catch fish, the generator does not work (off) so that the lighting load and the fish cooler are served by an accumulator that has been filled by the PLTS.
- c. For an overall load of 760 Watt, when fishermen return to the beach, they are served by a hybrid system, which is supplied from PLTS and Generator.

The use of solar energy and generators that work either alternately or jointly (parallel) on a fishing boat is very helpful for fishermen, especially in operational costs. Thus the welfare of fishermen will increase. Utilization of solar energy in fishing boats can be said to be able to serve the existing load when the loads are operated alternately so that the existing generator is prepared only as a backup. Utilization of solar energy in fishing boats can be said to be able to serve the existing load when the loads are operated alternately so that the existing generator is only prepared as a backup, when the solar panel fills the accumulator for 3 hours. Therefore, it can generate power of 600 Watt. It is capable of serving lighting loads and electric motor loads of 560 watts without cooling. However, the cooler is operated when the electric motor is not working.

5. Conclusion

The results showed that the supply of electrical energy from solar energy was 100 Wp, from a generator of 600 watts. At the same time working together it is able to serve a lighting load of 60 Watts and 2 Freezers each of 100 Watts continuously and when working alternately the solar panels are able to serve a load of 60 watts while the generator set is 260 watts. When the generator works alone, it requires a large enough fuel and is able to serve all the loads on the ship, it is different when the solar panel works alone, it can only serve the lighting load but there is no fuel cost. The combination of electrical energy supply from Generator and Solar Energy is carried out alternately by utilizing solar energy as the lighting load during fishing conditions while the electrical energy from the generator is used when running the ship as well as a backup. Thus the use of fuel for generators can be minimized and the operational costs of fishermen are reduced.

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