THE ANALYSIS OF ELECTRICAL SYSTEM REQUIREMENT OF JAVA COASTAL

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WORD COUNT 4313
TIME SUBMITTED 02-MAY-2023 02:57AM
PAPER ID 99286913

THE ANALYSIS OF ELECTRICAL SYSTEM REQUIREMENT OF JAVA COASTAL FISHING VESSELS

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SUMMARY

Traditional ships are dependent on diesel which functions not only as a propulsion, but also to supply power to the tools they use. This causes a decrease in the profits obtained by fishermen considering that the price of diesel fuel is increasingly expensive. This problem is also supported by the availability of diesel which is one of the non-renewable fossil fuels on earth which is getting thinner. The design and calculation of electrical power to supply tools that can make fishermen more effective in catching fish where the electrical energy obtained comes from solar energy and is assisted by a portable generator as an emergency supply. The innovation of using solar energy as an effort to reduce the use of solar which will indirectly save fishermen's expenses. The 3GT fishing boat use 4 solar panels with 450Wp specifications. This fishing boat design is equipped with radar, AIS, and navigation lights.

1. INTRODUCTION

Sea transportation is one of the technological sectors that continues to develop [1]. This can be seen through the functions and uses of sea transportation itself, especially for fishermen on the Java Coast where boats are the primary infrastructure for their daily livelihood needs. Ship is a category of marine transportation that uses diesel fuel. Solar is one of the preparations that are sourced from fossil energy, where fossil energy is energy that is unrenewable resources which means it cannot be renewed and one day it will definitely run out [2].

Based on the identification of data on several energy sub-sectors, such as oil and gas, renewable energy and electricity, the trend of investment realization in the energy sector throughout the 2010-2017 period tends to be below the target. Based on the calculation and analysis of the potential and challenges of investment in the fossil energy sector according to the RUEN, several important things need to be considered, one of which is to meet the RUEN target in the fossil energy sector, it is projected that Indonesia requires investment of more than USD 500 billion until 2050. the upstream oil and gas sector fails to meet, then the government has the potential to spend more than USD 400 billion by 2050 [3]

With the limited availability of fossil energy, especially diesel fuel, this is what demands fishermen as consumers to use diesel as well and efficiently as possible to conduct research to reduce ship fuel that was previously unrenewable to renewable material. This is done so that if at any time the diesel fuel runs out, the fishermen as consumers will have no trouble because there are other fuels to replace diesel.

On the other hand, solar energy is energy obtained by converting solar thermal energy (the sun) through certain equipment into other forms of power. In addition, solar energy is categorized as energy that is currently being actively developed by the Government of Indonesia, where Indonesia as a tropical country has great solar energy potential [4].

From the two problem topics above, the author aims to conduct an analysis by replacing the role of diesel which was previously the main fuel for ships into the role of solar energy through solar panels. The advantage of using solar panels is that apart from being an innovation from the development of renewable technology, this solar panel can also ease the operational needs of fishermen, improve fishermen's welfare because it can save on ship fuel costs, this technology is also environmentally friendly, and reduces dependence on fuel.

In this study, the electric power requirements of fishing boats will be designed and analyzed with the specifications of the boat as a small fishing fleet. This study will discuss the design and calculation of electrical power to supply tools that can make fishermen more effective in catching fish where the electrical energy obtained comes from solar energy and is assisted by a portable generator as an emergency supply.

The basic concept of this research is the need for the suitability of solar panels that replace the role of diesel as the main fuel for fishing boats. The solar panels are designed in such a way with the addition of several components and supporting sensors such as PLTS Solar module 450 Wp, Off grid inverter 5000W, 12V 120Ah battery, ESP 32, DC voltage sensor control system, PZEM-004T Sensor, ACS712 Sensor, Portable Generator, Fish Finder Garmin 585 plus, AIS class B Xinuo XF11069B plus promarine VHF AIS antenna, Furuno 1623 radar, navigation light, ceiling light, bilge pump 1100GPH, etc.

2. METHOD

A. Solar Energy

Solar energy can be converted directly into other forms of energy by three separate processes, namely the heliochemical process, the helioelectrical process and the heliothermal process. Meanwhile, the conversion of solar energy into electricity is a helioelectrical process. This process can take place if photovoltaic or solar cells are used. Photovoltaic is a device used to convert or

convert solar energy into direct electrical energy, which is made of semi-conductor material [5].

In its utilization, solar panels require several other components, namely solar charge control and batteries. Solar Charge Control (SCC) or also known as Battery Controller Unit (BCU) is an electronic device that functions to control the voltage and current from the solar cell to the battery and from the battery to the load. A battery that functions as a storage for power generated by solar cells [6].

B. Solar Charge Controller

The main controller of the solar charge functions to maintain the amount of charge coming from the solar PV module that flows into the battery bank to prevent the battery from being overcharged. It performs three basic functions: (i) It limits and regulates the voltage from the solar panels to avoid overcharging the battery. (ii) While the dc load is in use, the controller does not let the battery discharge. (iii) Allows use of different dc loads [7].

Figure 2.1 Solar Charge Controller (SCC) **[8]**

C. Sensor PZEM-004T

PZEM-004T is a sensor that can be used to measure rms voltage, rms current and active power that can be connected via Arduino or other opensource platforms. The physical dimensions of the PZEM-004T board are 3.1 × 7.4 cm. The PZEM-004t module is bundled with a 3mm diameter current transformer coil which can be used to measure a maximum current of 100A [9].

Figure 2. 2 Sensor PZEM-004T **[10]**

D. Sensor ACS712

ACS712 is a packaged IC which is useful as a current sensor replacing a current transformer which is relatively large in terms of size. In principle, the ACS712 is the same as other hall effect sensors, namely by utilizing the magnetic field around the current and then converting it to a linear voltage with changes in current [11].

Figure 2. 3 Sensor ACS712 **[12]**

E. Generator Set

Genset (generator set) is a device that functions to generate electrical power. Referred to as a generator set with the understanding is a set of equipment combined from two different devices, namely the engine and generator or alternator. The engine as a player device while the generator or alternator as a generating device. In a generator set system, the drive or engine greatly influences the generator's working system. Because a stable generator rotation can make the generator output a maximum [13].

Figure 2. 4 Generator Set 1 Phase **[14]**

F. Battery VRLA

The type of battery used in this study is a battery with a voltage of 12 Volts and 120 Ah. The battery was chosen because it has a high number of hours of charging and discharging [15]. The batteries analyzed in this study have the specifications shown in Table 2.1 as follows:

Table 2.1 Battery Specifications

Parameter	Description
Capacity	12 V 120 Ah
Long	405 mm
Wide	170 mm
Tall	235 mm
Heavy	33 kg

3. RESULT AND DISCUSSION

3.1 SYSTEM CONCEPT

This 3 GT fishing boat used a DC power source as the main supply to suppled almost all the equipment used by fishermen. Using batteries as a medium for stored power generated by solar panels so that it could be used even at night when fishermen went to sea.

The load supplied by the DC electric current source is divided into 2 types, namely crucial loads and non-critical loads. The crucial load is the electrical load that had to be lit continuously when the fishing vessel is operated, these tools are the bilge pump, radar, AIS, and navigation lights which are further divided into mashhead lights, green side lights, side red lights, and side lights. side. stern light.

Non-crucial loads are electrical loads that do not have to be always on and can be turned on/off according to the needs of fishermen, these tools are lighting lamps and fish finder.

The working principle of the electrical system on this 3 GT fishing boat is that all DC loads would be connected to the battery as the main supplied, when in an emergency the battery cannot supplied the load because the battery capacity runs out or there is a problem with the battery, the supply voltage for the DC load would transferred to the adapter while disconnecting the battery to the load with the help of a relay. However, not all DC loads would be transferred to the adapter, only crucial loads would turned on in an emergency.

The AC power source itself is basically only used to supply cool storage and later to supplied an adapter during an emergency which comes from a portable generator when the ship is operated or from a shore connection when the ship is in port.

3.2 SYSTEM DESIGN

This 3 GT fishing boat system had 2 power supplies, namely AC (Alternating Current) and DC (Direct Current). The DC source is obtained from 4 x 450 Wp solar panels which will be stored in a 24 Vdc battery / battery used to supply loads that do require DC current. While the AC source is obtained from a portable generator with a voltage of 220 Vac and can also be obtained from the Shore Connection at the port.

Loads connected to the supply are divided into 2, namely crucial loads and non-crucial loads. Crucial loads are tools that are important and shold be always on when fishing boats are operated, these tools are navigation lights, radar, AIS, and bilge pumps. Meanwhile, non-crucial loads are loads that are considered less important so that they can be turned on or off according to the user's wishes, these tools are lighting lamps and fish finder as well as cool storage. Figure 3.1 shows a load block diagram supplied by a DC current source from the battery.

The DC current source generated by solar panels is used as the main supply for almost all the tools used in this 3 gt fishing boat so that dependence on fossil energy sources can be reduced. The power generated by the solar panels will be processed first in the control battrycharger before being stored in a battery with a voltage of 24 volts and then connected to a DC load. Figure 3.2 shows a load block diagram supplied by an AC current source from a portable generator and shore connection.

The AC current source is used as an emergency supply and turn on the 220 V AC load. The AC current source comes from a portable generator that can generate 220 V AC voltage which is used to turn on cool storage which is useful for cooling fish caught by fishermen and supplying an adapter that can be used in an emergency as a DC current supply at crucial loads so that important tools can still be used when fishermen are looking for fish. This 3 gt fishing boat is also equipped with a shore connection as a 220 V AC current supply when the ship rests in port. Figure 3.3 shows a block diagram of the crucial loads that can be supplied by the adapter.

Although the main supply in a 3 gt fishing boat is the battery/battery, in an emergency such as when a problem occurs in the solar panel system or when the battery or battery capacity runs out, the DC load supply can be taken over by the adapter. However, not all loads will be covered by the adapter, only crucial loads that should be always on when the fisherman is operated

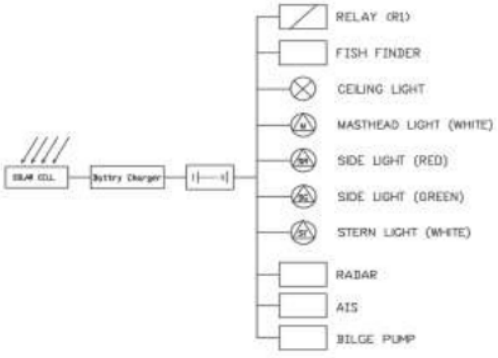


Figure 3. 1 DC Source to Load Block Diagram

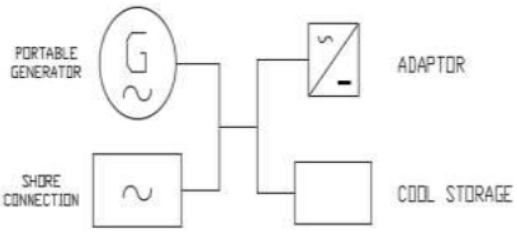


Figure 3. 2 AC Source to Load Block Diagram

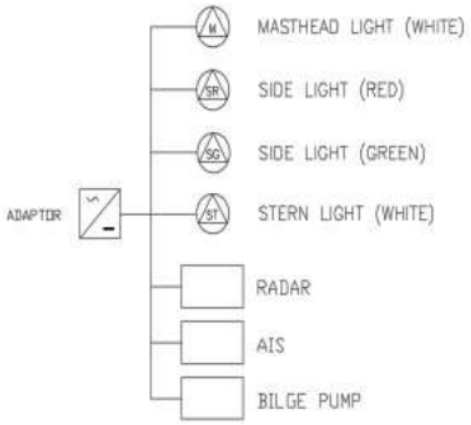
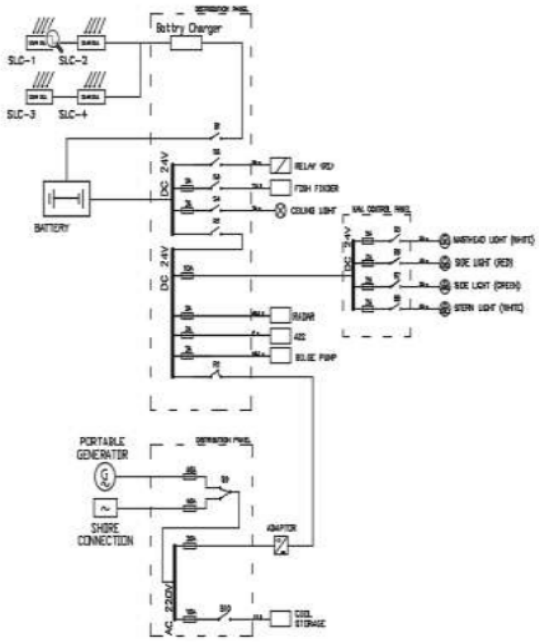


Figure 3. 3 Block Diagram from Adapter to Load



No.	SYMBOL	DESCRIPTION
1		SOLAR PANEL 450 WP
2		BATERAI / AKI
3		SHORE CONNECTION
4		PORTABLE GENERATOR
5		ADAPTOR 220 Vac TO 24 Vdc
6		FUSE WITH AMPERE CAPACITY
7		LAMPU PENERANGAN 20W
8		MASTHEAD LIGHT 25W
9		SIDE LIGHT RED 25 W
10		SIDE LIGHT GREEN 25 W
11		STERN LIGHT 25 W
12		SPST SWITCH
13		SPDT SWITCH
14		KONTAK NO RELAY
15		KOTAK NC RELAY

Figure 3. 4 Description Symbol Design One Line Overall System Diagram

3.3 SHIP BODY DESIGN

In this research, several stages of work have been carried out, namely the design of the ship's hull, the calculation of the analysis of electricity needs, the assembly of ship components and their installation, then testing and analysis of the ship's electrical power.

This boat has been designed with a capacity of 2-3 people, 9.46 meters long and 1.25 meters wide and can go at a speed of 12-15 knots. This vessel has been designed for a cruising radius of 50 miles, for operations in the coastal areas of Java where the southern coast of Java has extreme currents and waves. This fishing vessel has a fish capacity of 50 kg and is equipped with cool storage that can maintain the freshness of the caught fish.

The design of this ship has a total length (Loa) of 9.46 meters which is the overall length of the ship measured from the end of the rear of the ship to the end of the forehand of the hull, the length of the waterline (Lwl) is 8.05 meters measured from the intersection the height of the stern with the waterline at draft up to the intersection of the height of the bow with the waterline, the width of the ship (B) 1.25 meters, the height of the main deck of the ship (H) with a height of 0.84 meters measured in the midship plane from above keel (keel) to the top of the deck on the side of the ship. Then the ship's draft height (T) is 0.35 meters measured from the top of the keel to the waterline. From these specifications the design of this fishing boat is included in the type of 3GT fishing boat.

Determination of the specifications of solar panels as a source of ship electrical energy

Determination of solar panel specifications is very necessary as a basic design for determining energy that can be used as driving energy. The solar panels used are mono-crystalline types with a capacity of 450 Wp. The specifications of the solar panels used are as follows:

Table 3.2 Solar Panel Specification

Maximum Power (Pmax)	:	450WP
Maximum Power Current (Imp)	:	13.15A
Maximum Power Volatge (Vmp)	:	34,20V
Maximum Circuit Voltage (Voc)	:	41.04V
Short Circuit Current (Isc)	:	13.95A
Maximum System Voltage	:	1000V
Operating Temperature	:	-40°C to +85°C
Dimensions	:	1900 x 1134 x 35mm

Determination of fish finder specifications as a tool for fishermen to find fish

Determination of fish finder specifications is very necessary as a useful tool to help fishermen in finding the location of the fish. The fish finder used is the Garmin 585 Plus type.
Physical dimensions: 6.93" x 7.48" x 2.60" (17.6 cm x 19.0 cm x 6.6 mm)
Power consumption: 7.6 watts
Current : 0.32 A
Voltage range: 10 - 36 VDC

Determination of AIS specifications as ship traffic communication

AIS is needed as a useful tool to convey data via VHF Data Link (VDL) to send and receive information automatically to other ships. The AIS used is the AIS class B Xinuo XF1069.
Physical dimensions: 6.93" x 7.48" x 2.60" (17.6 cm x 19.0 cm x 6.6 mm)
Power consumption: 7.6 watts
Current : 0.32 A
Voltage range: 10 - 36 VDC

Determination of Radar specifications as a ship navigation tool

Radar is one of the navigations in the ship that serves to provide information related to the distance of the ship to the mainland, other ships, and possible obstacles that will be faced in order to avoid a collision. The radar used is the Furuno 1623 Radar Silver LCD Small Ship which is equipped with an antenna.
Power Supply : 12-24 VDC
Current consumption: 3.2-1.4 A

Other supporting equipment, among others:

1. Ship Navigation Lights (mast light / M, side light (red) / SR, side light (green) / SG stern light / ST)
   - Voltage : 24 V
   - Power : 25 W
   - Current : 1.05 A

2. Ceiling Lights
   - Voltage : 24 VDC
   - Power : 15 W
   - Current : 0.625 A

3. Bilge Pump 12V 24V DC 1100GPH Submersible Pump Submersible Pump 4100L/hour
   - Voltage : 24 V
   - Current : 1.8 A

4. Cool Storage
   - Length : 3 meters
   - Width : 0.8 meters
   - Height : 0.5 meters
   - Power : 100 Watt
   - Fish capacity: 50kg

Table 3.3 Equipment Current and Voltage Specifications

Tool's name	Voltage (Volt)	Ampere/ hour (Ah)	Power (Watt)
Fish Finder	24	0,32	7,6
Bilge Pump	24	1,8	43,2
Radar	24	1,4	33,6
AIS	24	0,08	2
Lighting	24	0,625	15
Masthed Light (white)	24	1,05	25
Side Light (red)	24	1,05	25
Side Light (green)	24	1,05	25
Stern Light (white)	24	1,05	25
TOTAL			201.4

From the exposure of the tools above, the power used in one hour is 201.4 Watt. And if the fishing boat operates for 12 hours then:
Power in 1 hour x operating time
201.4 watts x 12 Hours = 2416.8 Watts or 2,417 Kw

To find out how much battery capacity is used then:
Battery capacity = 2416.8 watts / 24volt = 100.7 Ah
Because in this study the voltage used is 24 VDC, the batteries must be connected in series so that the batteries used in this fishing boat are 2 from 12 Volt batteries with a capacity of 100.7 Ah.

If you use a portable generator with the same load, you will spend as much diesel as :

S = 0.2 x P x T
= 0,2 x 2,417 x 12
= 5,8 liter

The description
- K = 0.2 (Factor of determination of diesel consumption per kilowatt per hour)
- P = Generator power
- T = Time

When compared to fishing boats that use a solar panel system that is designed in a hybrid way with the use of a portable generator with fishing boats that use a full portable generator system, it can be said that these fishing boats are much more efficient than fishing boats. which uses a fully portable generator system.

4. CONCLUSION

The location of Indonesia which is on the equator with a tropical climate makes Indonesia have sunlight available throughout the year, this point makes the use of solar panels have enormous potential. Especially in the mode of transportation of ships which have advantages where the sun's rays are not blocked by anything, in contrast to land buildings.

The design of this 3 GT fishing boat is equipped with supporting equipment that is able to make fishermen effective in catching fish and keeping them fresh on the way to the mainland, these tools are bilge pump, fish finder and cool storage.

The design of this fishing boat is also equipped with radar, AIS, and navigation lights in the form of a masthead light, 2 side lights on the right and left of the ship, and a stern light so that it is deemed to have met the standards for operating on the high seas.

This 3 gt fishing boat system has 2 power supplies, namely AC (Alternating Current) power and DC (Direct Current) power where DC electric power is the main supply and for AC power sources it is only used to turn on cool storage and in an emergency. just. Equipped with a shore connection so that when you lean back you can use the resources available on land.

Based on the analysis carried out in this study, the ship use 4 solar panels with 450Wp specifications. The electrical power generated by the solar panels will be stored in a battery with a capacity of 120 Ah and used to supply loads with a total power of 201.4 watts as long as this fishing boat operates for approximately 12 hours.

If you compare this fishing boat that uses a solar panel system designed in a hybrid manner with the use of a portable generator with a fishing boat that uses a full portable generator system, it can be said that this fishing boat is much more efficient than fishing boats that use a full portable generator system. This fishing boat is able to save 5,8 liters of diesel which is replaced with free energy obtained from solar panels installed on the roof of the fishing boat.

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