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Management of Major Engine Maintenance and Repair Strategy at KM Thalia to Improve Ship Operational Efficiency

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Abstract
Maintenance and repair of the ship's main engine is a crucial aspect in ensuring that ship operations remain optimal and efficient. This study aims to analyze the maintenance and repair methods of the main engine in KM Thalia and the impact that can arise due to errors in its maintenance. This study uses a qualitative approach with primary data obtained through direct observation and interviews with the ship's crew. The results of the study show that effective maintenance methods include preventive, predictive, corrective, and breakdown maintenance. Errors in maintenance can lead to machine failure, increased operating costs, and significant safety risks. By implementing the right maintenance strategy, the life of the engine can be extended and the performance of the vessel remains optimal. This study emphasizes the importance of a maintenance management system based on international safety standards to improve ship operational efficiency.

Keywords: Ship maintenance, main engine repair, operational efficiency, safety management.

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INTRODUCTION

In reality, the ship has a main propulsion diesel engine and auxiliary aircraft installed as a support for the ship in its operations. Ships have diesel engines as the main mover that is used to rotate the ship's propellers so that the ship can sail from one port to another. Most commercial vessels in operation today use diesel engines as their main propulsion. The advantage of fuel economy caused the diesel engine to be widely used on various types of ships, so it occupies the first place among ship engines. These things can be achieved if supported by a good and smooth ship engine in its operation. The smooth operation of the ship certainly cannot be separated from the engine or ship propulsion aircraft which must be supported by a good work and maintenance system. The availability of sufficient spare parts on board also plays a big role in the smooth maintenance and repair so that the condition of the ship's engine will be created that has more operational value. Diesel engines according to how they work are divided into two types, namely four-stroke diesel engines and two-stroke diesel engines. A four-stroke diesel engine is an engine with a two-turn crankshaft step or four times the stroke work step produces one time of effort and a two-stroke diesel engine is an engine with a one-turn crankshaft step or two times the stroke work step produces one time of effort. The diesel engine that is often used on my boat for the main drive engine is a two-stroke diesel engine.

Ships are one of the means of sea transportation that may be familiar to most people. Moreover, the fact is that Indonesia is an archipelagic country with 2/3 of its territory in the form of waters. Since ancient times, our ancestors have used ships as one of the means of transportation to sail the sea, including in the era of the Indonesian kingdom ships were used to travel by kings to conquer and expand their territory.

Nowadays in the world of shipping and shipping, ships are widely used as commercial fleets (commercial ships), combat fleets (warships), and transportation and tourism fleets (passenger ships). Ships are one of the means of transportation that plays a role because of their large size, for example the Supertanker Ship which is a tanker transporting liquid cargo with a carrying capacity of up to thousands of tons per voyage.

Based on this background, the author can determine the problems that will be discussed in this Applied Scientific Paper, namely:

1. How to Maintain and Repair the Main Engine on KM Ships. Thalia?
2. What is the impact if there is an error in maintenance on the KM ship. Thalia
3. How to Maintain and Repair the Main Engine on KM Ships. Thalia?

LITERATURE REVIEW

Maintenance is a maintenance activity that is carried out to prevent unexpected damages and find conditions or circumstances that cause production facilities to be damaged when used in the production process. (Drs. Harsono, 1984 : 147)

According to Sofjan Assauri (2008:134) Maintenance is an activity to maintain or maintain factory facilities/equipment and carry out repairs or

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adjustments/replacements as needed so that there is a satisfactory production operation condition in accordance with what is planned.

According to Wati (2009:45) Maintenance is all technical and administrative actions carried out to keep the condition of the machine/equipment good and can perform all its functions properly, efficiently, and economically in accordance with a high level of safety.

According to Kurniawan (2013:2) repair is the activity of maintenance, repair, replacement, cleaning, adjustment, and inspection of the object being treated. Treatment activities have many criteria for activities that are interrelated with each other. These activities must be managed in such a way, so that it can become a system that is able to achieve the desired targets.

According to Ansori and Mustajib (2013:3), the repair process in general aims to focus on preventive measures to reduce or even avoid damage to equipment by ensuring the level of reliability and readiness and minimizing maintenance costs.

The main engine of a ship, also called the main propulsion engine (MPU) or main engine, is the engine that moves the ship by converting mechanical power into propulsion for the ship's propellers. The main engine is an important part of the ship that includes the internal combustion motor. In a deep combustion motor, fuel is burned directly in a gas pressure cylinder resulting from fuel combustion. The process of burning fuel inside the engine cylinders generates heat, which is then used to drive the propellers. The propeller rotation is measured in RPM (*Revolution per minute*). The main engine is an engine installation in the ship that is used to move / rotate the propeller shaft so that the ship can move.

According to Peter Boy (2009:21). The main propulsion engine is also called the main engine or the maritime language Main Engine which moves a ship in its operation to carry cargo from port to port to port, both solid, liquid, gas and human goods. A diesel engine is an engine with a reciprocating working system on the pistons. The heat and pressure generated from the cylinder with internal combustion are converted to mechanical energy by the reciprocating motion of the piston power. The reciprocating movement of the piston is converted into rotary energy by the crankshaft with the movement of the cylinder crank consisting of a connecting rod and a crank connected to the piston power. The combustion process that occurs in the cylinder liner of the main engine produces a heat source. The heat source causes the temperature of the main engine to increase, therefore a cooler is needed that can lower the temperature of the main engine. The cooling required is closed cooling in this case freshwater cooler.

According to Jusak Johan Handoyo, (2015: 34), in the book Diesel engines that drive the main propulsion of ships. states that a diesel engine is an aircraft that converts direct heat potential energy into mechanical energy, or also called a Combustion Engine System in which the ship's engine operates in a cycle to produce propulsion power.

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Definition of Ship According to the Law (Number 17 of 2008 Article 1 paragraph 38), a ship is a water vehicle with a certain shape and type, which is driven by wind power, mechanical power, other energy, pulled or towed, including vehicles with dynamic carrying capacity, vehicles below the water surface, as well as floating devices and floating buildings that do not move.

Vessel or ship according to the Great Indonesian Dictionary, a ship is a vehicle that transports passengers and goods at sea (rivers and so on). Ships can be interpreted as means of transportation used to sail, both national ships and foreign ships operated by national shipping companies or foreign companies and various types of cargo transported, including humans, animals, goods, and plants. According to (Capt. R.P. Suryono, 2005).

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A ship is a large structure designed to sail on water, and is used for the transportation of goods, passengers, or other activities in the waters. Ships typically have a waterproof hull and are equipped with a propulsion system, such as an engine or sail. (Carlton, J. 2012). In a military context, a ship is a war vehicle used by the navy for various purposes, such as naval defense, patrol, or assault. Warships can have specialized weapons, defense systems, and operational capabilities. (Till, G., & Hooton, E. R. 2013).

RESEARCH METHODS

This research is a qualitative type of research. The place and time of this Applied Scientific Work research is when the author conducts research and sailing practice (Prala) at the company PT. Citra Niaga Mandiri on the KM. THALIA for 12 (1 year), starting from May 12, 2023 to June 15, 2024.
The data sources used by the author consist of:

a. Primary data
   Primary data is data obtained directly and the ship by way holds a direct interview with the Engineer and the Head of the Engine Room about the maintenance and repair of the main engine on the KM Ship. Thalia, in this case, the author obtained primary data based on the instruction manual book and direct observations when maintaining and repairing the ship's main engine.
b. Secondary Data
   Secondary data is complementary data to primary data obtained from literature sources such as literature,
   lectures and data from companies and other matters related to this practice.

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The data collection used in this study is a field research method, which is research conducted by conducting a direct review of the object being studied. Data and information are collected through:

1) Observation, making observations directly on board the ship where the author makes direct observations when maintaining and repairing the ship's main engine.
2) Interviews, namely holding questions and answers directly with officers at the time of holding direct observations when maintaining and repairing the ship's main engine, and directions and instructions by lecturers and supervisors in the POLIMARIM AMI Makassar environment.

RESULTS AND DISCUSSION

PT. Citra Niaga Mandiri is a commercial shipping company. Its birth was more motivated by the determination and fighting spirit of its founder in providing services, especially in the field of national shipping. Like other companies and the Indonesian nation, PT. Citra Niaga Mandiri has experienced ups and downs together. Even so, KM. THALIA as a national shipping company, always supports government programs in the economic sector and will always be ready to assist the government in maintaining national defense and security. PT. Citra Niaga Mandiri is expected to be able to develop and make a positive contribution to the country.

KM THALIA is located in Indonesia which operates in the Parepare Nunukan area. The ship is on its way to Nunukan and will return to Parepare on a passenger voyage, the KM Thalia Ship (IMO 8813556, MMSI 525024013) is a Passenger/Ro-Ro Cargo Ship built in 1989 (35 years old) and currently sailing under the Indonesian flag.

Maintenance is an activity or activity that needs to be carried out on all objects, both non-technical including management and human resources so that they can function properly, as well as engineering including a material or moving object or immovable object, so that the material can be used and function properly and always meets the requirements of international standards (not individual standards or local company standards).

Maintenance can also be interpreted as activities that are necessary to maintain management and materials to a certain level of conditions. For example, management on board that can manage the maintenance of machinery on board with all its equipment must be able to work continuously and is expected to be able to be used and function properly for a long period of time according to its use. To get the expected results, of course, it is necessary to carry out good maintenance and repairs, with a safety management system based on international law (International Safety Management Code).

In the object of this research, the focus is on the ship main engine or *Marine Engine* as the driving force of the ship in KM. Thalia.

The maintenance and repair of the ship's aircraft carrier aims to keep the ship in good condition in all weather and places, as well as to prevent

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heavier damage to the ship.

The functional structure of a shipping company expressly assigns the responsibility of "Maintenance and Repair of Ship Engines" to the Fleet Manager in order for the ship to be declared fit for operation and sailing. The Fleet Manager is responsible for:

1) Maintaining ships to keep them seaworthy
2) Fully equipped crew and certificated
3) Ready to sail and receive cargo
4) Creating a maintenance strategy to be implemented on board
5) Planning budgets for maintenance and maintenance and working with ship management (Skipper, Chief Officer, Chief Engineer and Second Enguineer)

In SOLAS 1974/1978 Chapter II Part C, D, E, it is clearly stated that all ships of IMO Countries must carry out "Maintenance and Repair of Ship Engines".

Types of Ship Repair Maintenance Management

The following types of maintenance on ship engines, including:

1) Breakdown Maintenance
   This maintenance is done after your boat's engine is damaged, or in other words, damaged first and then repaired. This is certainly not a good thing, because it will increase the cost of repairing and maintaining the ship later.
2) Preventive Maintenance
   Preventive maintenance is maintenance that is carried out in a structured manner.
3) In general, maintenance is carried out periodically, where a number of activities such as inspection and repair, replacement, cleaning, lubrication, adjustment, and equalization are carried out to make them the same.
4) Predictive Maintenance
   This type of maintenance is carried out by the owner by predicting the age of the ship's engine part. In this maintenance, the engine parts will be replaced before they are damaged. To find out the age of the engine on a ship, diagnostics are usually used as an analysis material. If the part is old enough, it will immediately replace it with a new engine to avoid bad things that may happen in the future. Predictive Maintenance is carried out by analyzing the trend of damage to certain components to prevent more severe damage in the future.
5) *Corrective Maintenance*

   Corrective Maintenance is carried out when there is damage or problems that interfere with the operation of the machine is not optimal but not until Shut Down/Break Down occurs.

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Impact That Generated If there is an error in maintenance on the KM ship. Thalia.

The consequences that will be caused if there is a machine maintenance error are not carried out properly, namely:

1) Ship collisions, due to sudden, uncontrolled engine failure, and so on.
2) The ship sank, the loss of the ship including the crew and all the cargo, collisions, the rupture of the sea chest, the fire in the engine room, etc.
3) The ship shakes, due to improper maintenance and repair of the Crankshaft, which can damage other salty parts.
4) The ship vibrates, one of the propeller blades has run aground or hits a hard beam, it can also damage the ship's engine or electrical installation.
5) The ship is idle, due to unplanned damage and repairs and insufficient spare parts.
6) Overrun of ship operating costs, due to continuous losses that are difficult to predict.
7) The Bureau of Classification does not recommend ships for sailing, as the machinery on the ship does not meet the Class.
8) Trading business partners do not recommend chartering such vessels.
9) Insurance will charge the company a greater cost, the ship as a whole does not carry out maintenance and repairs properly (Low Performance)

Another impact that can be detrimental is the company's loss to pay *manpower* or operators due to damaged engines so that the work that had to be done by the ship to produce operational activities becomes unproductive or idle until the ship's engine returns to normal.

Not only that, operational needs such as the use of electricity, gas and other materials needed can incur large costs for repairing damaged engines. If all these losses are accumulated, of course the value is very large. Meanwhile, in terms of *planning*, losses that occur due to damaged or disrupted engines will experience delays in ship operations and cause losses due to cargo not being able to be loaded or departed quickly, resulting in delays in the delivery of goods, to schedules that are not according to the target.

If the goods are delivered late, usually the company will be charged a late fine, and even if you want the delivery to take place quickly, the company must use a faster delivery service / fast delivery, but of course the costs that must be incurred are more expensive. Another cost that must be incurred is if you have to replace spare parts because there is damage to several components due to infrequent maintenance. Replacing engine spare parts is of course not cheap so *that maintenance costs* are high. If you see a very long effect due to damage or disruption of the engine, maintenance is a must-have condition that must be done. That is the reason why various types of engine maintenance must be done.

Maintenance and Repair of Main Engines on KM Ships. Thalia

There are several benefits that will be obtained and obtained if you

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carry out these types of ship engine maintenance, including:

1) Optimizing the use of materials according to their benefits and functions or in other words streamlining the benefits of machines.
2) It can prevent sudden heavy damage (breakdown) and also prevent a decrease in efficiency. This will certainly be very useful to avoid engine shutdown in the middle of the sea.
3) Making work more effective because the operational system runs smoothly. So there will no longer be an increase in the ship's working time because the engine is down.
4) Maintain and extend the life of the ship.
5) Reduce the number of repairs that are often too high.
6) Especially if you have to replace an engine which is very expensive and even the ordering process takes a long time and the type of machine is sometimes not available.

As for the Parts That Need to Be Maintained on the Ship Engine

There are several parts of a boat's engine that you need to take care of because of their very important functions. These parts include:

1) The hull and propeller of the ship, by cleaning them regularly. If it is damaged, then you should replace it immediately.
2) The main engine, by performing maintenance by adjusting the engine before you use it and lubricating the engine using oil.
3) compressor, by keeping it clean and turning it off when not in use.
4) Air system, by cleaning regularly or replacing its components if anything is damaged.
5) Electrical system, by checking and calibrating it regularly, especially before you use it.

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CONCLUSION AND SUGGESTION

Conclusion

1) The maintenance and repair of the ship's aircraft carrier aims to keep the ship in good condition in all weather and places, as well as to prevent heavier damage to the ship.
2) In the maintenance and repair of ships to obtain orderly operation of the ship, as well as to improve the safety of the crew, cargo and equipment.
3) Another impact that can be detrimental if you do not carry out good ship maintenance and repair is the company's loss to pay *manpower* or operators due to damaged engines so that the work that previously had to be sailed by the ship to produce operational activities becomes unproductive or idle until the ship's engine returns to normal

Suggestions

1) It is recommended that the responsible and tasked crew always carry out maintenance and repairs in accordance with the PMS that has been determined or monitor the journal and prepare the spare parts needed so that if there is maintenance and repair of spare parts and other needs can be available.
2) Increase the awareness of the crew on the importance of ship repair to obtain regular ship operation, as well as improve the safety of the crew, cargo and equipment.
3) The crew who are responsible and tasked not to neglect and carry out routine maintenance and repairs of the ship to ensure that the operation of the ship can be smooth and smooth and not constrained during sailing.

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