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Analysis of Effectiveness and Efficiency of Daihatsu De-18 Diesel Generator Maintenance Implementation Time on The Ship MV CSSC Gladstone

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Abstract

Diesel generator engine maintenance on ships is an important activity to maintain the performance and operational reliability of ships. The effectiveness and efficiency of maintenance implementation time has a direct impact on the availability of generators to meet maximum electricity needs in various operational conditions. This study aims to analyze the effectiveness and efficiency of diesel generator engine maintenance time on board the MV CSSC Gladstone. Maintenance time data was obtained from ship maintenance records and analyzed to gain a better understanding of the maintenance process. The results showed that effective and efficient maintenance time plays an important role in maintaining smooth ship operations and minimizing generator downtime. Suggestions put forward include planning regular maintenance schedules, continuous monitoring and evaluation, utilizing monitoring technology, regular training for maintenance personnel, and collaboration with manufacturers or experts in the field of maintenance. By considering these suggestions, it is expected that ships can improve the effectiveness and efficiency of maintenance time and maintain their overall operational performance and reliability.

***Keywords**: Maintenance, diesel engine, generator*

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1. Introduction

International shipping is one of the important sectors in global trade. Along with the growing need for transportation of goods and passengers between countries, this sector is growing rapidly and refers to ship travel involving more than one country, either for commercial purposes, tourism, or other activities involving the transportation of goods. Ships have been a very important means of transportation since ancient times. Its role in connecting various regions in the world, both for trade, exploration, and inter-island travel, is very large, but ships in supporting international shipping require adequate operational requirements, such as navigation equipment, machinery, safety equipment, loading and unloading equipment and so on, which generally use electric current as a source of motion.

Diesel generator engines are very important for a ship where the generator engine produces electricity, these are the things needed for ship movement, lighting and other activities that require electricity on the ship, therefore diesel generator engines need regular and planned maintenance so that ship operations are not hampered by unstable electricity sources. Therefore, it is necessary to have a planned maintenance system (PMS) on diesel generator engines to avoid running hours that exceed working hours. According to Henri Londong Allo (2022) Planned maintenance system (PMS) on ships is mandatory according to the International Safety Management Code (ISM Code). An effective planned maintenance system not only helps meet the safety and environmental objectives stated in the ISM Code, but is also an investment in asset protection and optimization of its management. The planned maintenance system simplifies the planning, documentation and implementation of maintenance and survey work on board ships by considering the spare parts used for maintenance tasks.

Several previous studies related to diesel generator engine maintenance, Alfiat Aras

Nursalam (2023) entitled Maintenance Analysis of High and Low Pressure on Fuel Pump Auxiliary Engine on the AHTS Pelangi Escort 2 Ship. The results of the study showed that a malfunctioning injector would not only affect the server exhaust gas temperature but could also reduce engine power. Therefore, good and routine maintenance according to the ship's manual working hours will prevent this problem. In the research of Yudantama (2024) entitled Diesel Generator Performance Optimization Strategy on the Mv. Kartini Samudra ship. It is stated that to run the rotor rotation function, the Diesel Generator engine must always be in good condition and ready to use at any time, and operate with maximum efficiency. To keep the diesel generator engine in good and optimal condition, the PMS (Plan Maintenance System) plays a very important role in the performance of the diesel generator engine.

When the author carried out sea practice, the diesel engine used by the author on the ship with the Daihatsu DE-18 engine type. uses diesel fuel to generate power. Diesel engines are known to be more efficient in terms of fuel consumption and longer durability than gasoline engines. The capacity and power of this engine have a fairly large capacity, with the D-18 type referring to the engine's ability to generate the power needed to drive the generator. This engine is generally used for industrial purposes, ships, or in other applications that require a backup or main power source. In the capacity negotiations on the generator that will later be used to meet the electricity needs on the ship, so the analysis made in determining the amount of power needed and variations when using it in operational conditions, namely maneuvering, anchoring, sailing and other conditions. These things are the reasons behind knowing the minimum and maximum power required. From several quotes that I have read and encouraged by the maintenance of diesel generator engines on the fuel system, specifically on the injector. As the author experienced on May 20, 2023 during a trip from Norfolk, United States to Shanghai, China. The maintenance of the injector was faster than it should have been 1500 hours, because there were several factors that influenced this to happen, so that the performance of the diesel generator engine decreased and resulted in the ship's operations not running smoothly. Therefore, quick action was taken to carry out maintenance on the injector to avoid unwanted things.

Effectiveness is the ability to achieve predetermined goals or objectives. In this context, an action or effort is considered effective if it succeeds in producing the desired results, even though the way the resources used are not always optimal. According to Astuti (2019), namely the achievement of planned goals in accordance with the budgeted costs, the time set and the specified personnel. Effectiveness is said to be successful in terms of whether or not the targets that have been set are achieved. Efficiency is the ability to achieve desired results by using resources such as time, energy and money, or materials) as economically and optimally as possible. In this case, efficiency focuses on the use of minimal resources to achieve the same goals or even better results. According to Syam (2020), namely the measure of the success of an activity which is assessed based on the amount of resources used to achieve the desired results. An activity can be said to be efficient if there is an improvement in the process, for example becoming faster or cheaper

Ship Maintenance is an activity of maintaining and repairing a ship carried out by the owner or company of the ship or other parties, either during or outside the operational period of the ship, in order to maintain the seaworthiness and maintain the health of the ship so that it can operate optimally. Ship owners currently use a system called the Planned Maintenance System (Suprapto, 2020) in scheduling ship maintenance. Planned Maintenance System is organized or planned maintenance and is carried out with forethought, control and recording according to a predetermined plan. Therefore, the maintenance program to be carried out must be dynamic and require active supervision and control from the maintenance department through information from historical records or equipment. The concept of a planned maintenance system is intended to overcome problems faced when the ship is operating by carrying out maintenance activities. Communication can be improved with information that can provide complete data for making a decision. The important data in maintenance activities include maintenance reports, inspection reports, repair reports and others. Planned maintenance consists of several implementations (DNV, 2021). The implementation of planned maintenance on ships is categorized into two types: routine maintenance and periodic maintenance. Both of these must be carried out properly, accurately, and in accordance with

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the established procedures. The primary objective of planned maintenance is to minimize the risk of damage to the ship. This system is based on several regulations, including external regulations such as the ISM Code and the Indonesian Classification Bureau, as well as internal company regulations and instructions from the equipment manuals.

Planned maintenance consists of three main types of implementation. First, preventive maintenance or routine maintenance focuses on preventing severe damage before it occurs. This principle must be ingrained in everyone responsible for ship maintenance. The goal of preventive maintenance is to continuously monitor the condition of equipment within acceptable limits and to detect potential damage at an early stage, allowing for scheduled maintenance. Second, periodic maintenance is a subset of preventive maintenance that follows a fixed schedule based on calendar time or running hours. This type of maintenance refers to the instructions provided in the equipment manual. It involves scheduled servicing after specific time intervals, such as every 24 hours, 500 hours, 1000 hours, 2000 hours, and so on, ensuring that equipment remains in optimal condition. Lastly, corrective maintenance is carried out only after damage has occurred. This approach involves running the equipment continuously without maintenance until a failure happens, at which point repairs are conducted. While some shipowners may opt for corrective maintenance to reduce short-term costs, it can lead to significantly higher expenses in the long run due to unexpected breakdowns and emergency repairs. Therefore, prioritizing preventive and periodic maintenance is essential to ensure the longevity and reliability of the ship's machinery. In the maritime industry, the reliability and efficiency of ship equipment are crucial to ensuring smooth sailing operations. One of the most critical components supporting a vessel's operation is the diesel generator, which serves as the primary power source for various onboard systems. Therefore, the maintenance of diesel generators must be carried out optimally to keep the ship running smoothly and prevent failures that could lead to delays or severe damage to the ship's electrical system.

MV CSSC Gladstone is one of the vessels that utilizes the Daihatsu DE-18 Diesel Generator as its power source. To ensure this generator operates at peak performance, it is essential to analyze the effectiveness and efficiency of its maintenance implementation time. Maintenance effectiveness refers to how well the maintenance procedures prevent failures and sustain generator performance, while efficiency relates to the optimal use of time during maintenance to minimize disruptions to the ship's operational schedule. This study aims to analyze the effectiveness and efficiency of the Daihatsu DE-18 diesel generator maintenance time on MV CSSC Gladstone. The analysis includes evaluating maintenance procedures, assessing the time required for each maintenance stage, and understanding its impact on generator performance and overall ship operations. By conducting this study, valuable recommendations can be made to improve the quality of diesel generator maintenance, ensuring the seamless operation of the vessel.

2. Method

The place and time of this proposal research, namely when the author carried out sea practice on the ship for 12 months, starting on January 3, 2023 to January 9, 2024, on the MV. CSSC GLADSTONE ship.

The data and information needed for this thesis were collected through:

1. Field Research Method

The field research method, or field research, is a research approach that is carried out at a location where the phenomenon being studied occurs naturally. This involves collecting data directly from the source, such as observation, interviews, or direct participation. This method allows researchers to gain an in-depth understanding of the social, cultural, or environmental context in which the phenomenon occurs. The study carried out using a method of procuring a direct review of the data or objects to be studied. Data and information will be collected by:

a. Observation, conducting a direct survey at the location of the object. In this proposal, it is the place where the researcher conducts sea practice on the ship.

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b. Interviews, procuring questions and answers directly asked by researchers at the location of the object to be studied with the officers on the ship and lecturers at the Makassar Maritime Polytechnic, regarding the efficiency of diesel engine maintenance generators on board.
2. Literature review (Liberary Research) is a study that requires reading books and literature that must be studied to obtain a theoretical basis that will be used in discussing the problem being studied.
3. Descriptive subjective method

The descriptive subjective method is an approach to research that tries to understand or explain phenomena based on the subjective perspective of the individuals or groups involved. This approach often involves collecting qualitative data such as interviews, observations, or content analysis to gain a deep understanding of how individuals or groups experience and perceive the phenomenon. The author examines the data that has been obtained from the results of observations or direct observations of the research object.

C. Types and Sources of Data

The types of data that will be used are classified into two types, namely (Sugiyono, 2013 'Alfabeta, 2010):

1. Data Type

a. Qualitative Data

Qualitative data is a type of data that cannot be measured numerically, but describes the characteristics or qualities of a phenomenon. This usually consists of descriptions, narratives, or subjective interpretations of observations or experiences. The data obtained in the form of variables in the form of information about the discussion either verbally or in writing.

2. Data Sources

The sources used by researchers in this study are:

a. Primary data, namely data generated from direct surveys. Data from this study were obtained using the survey method, namely by direct observation and recording of the efficiency of the time for implementing diesel generator engine maintenance on ships. This study aims to analyze the causes and methods of maintaining diesel generator engines so that they do not experience damage.

b. Secondary data, namely data that is not generated by researchers directly, but rather data collection through one or more people who are not researchers themselves, this data is usually in the form of books, documents on ships or internet references related to the object of the study.

3. Results and Discussion

The problems faced are related to the analysis of the effectiveness and efficiency of the implementation time of the maintenance of the Daihatsu D-18 diesel generator engine at mv.cssc gladstone, based on the author's real experience during the sea practice period (prala). During operation, it was found that the exhaust gas generator no. 2 experienced an increase in temperature. This temperature increase was apparently triggered by damage to the injector. When the injector does not work optimally, the process of spraying or atomizing fuel into the cylinder will be disrupted, so that the combustion process cannot take place optimally. This is a serious problem because it will affect the performance of the auxiliary engine. running optimally. This assumption is based on the hypothesis that the work plan application was not run so that the injector was not maintained according to the schedule determined by the work plan application. The author estimates that this may be the main cause of the damage to the injector.

Based on the results of direct observation and in-depth analysis during the implementation of sea practice, this initial assumption was not proven. The author found that in the work plan application at the time of the incident date it was not yet time for maintenance and was reinforced with evidence of running hours data. The author attaches data on the work plan application. In the previous chapter, the author suspected that the problem that occurred in the auxiliary engine no. 2, namely the occurrence of faster damage to the injector before the PMS, was caused by the application of the work plan maintenance system which was not.

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AE 2	2916		Aux. engine No.2			0
item	*interval*		*next date PMS*	*done*	*date*	*due*
Fuel Injektor Valve Cylinder No 1	1500	hrs	**2023/5/29**	**3000**	**2023/03/29**	4500
Fuel Injektor Valve Cylinder No 2	1500	hrs	**2023/5/29**	**3000**	**2023/03/29**	4500
Fuel Injektor Valve Cylinder No 3	1500	hrs	**2023/5/29**	**3000**	**2023/03/29**	4500
Fuel Injektor Valve Cylinder No 4	1500	hrs	**2023/5/29**	**3000**	**2023/03/29**	4500
Fuel Injektor Valve Cylinder No 5	1500	hrs	**2023/5/29**	**3000**	**2023/03/29**	4500
Fuel Injektor Valve Cylinder No 6	1500	hrs	**2023/5/29**	**3000**	**2023/03/29**	4500

Source: MarineTraffic. (2023).

The data entered by the author is in accordance with the work plan application and auxiliary engine running hours data no. 2, which in this case concerns fuel injector valve maintenance, showing that further maintenance was carried out on May 29, 2023. This indicates that the plan maintenance system has been carried out properly and planned. The second alleged problem that the author gave was the dirty diesel generator fuel. After further analysis and checking, the second alleged problem was correct so that it was continued in the discussion chapter.According to the author's experience on the ship, injector damage earlier than the PMS date specified in the work plan application can occur due to dirty fuel entering the fuel injector valve, causing the nozzle tip to become clogged and causing the fuel to drip or in other words the fogging process is not optimal.

1. Problem Handling

At the time of the incident, where the author who was taking the temperature in the engine room to be entered into the log book saw the exhaust temperature increase and reported it to the third engineer as the one responsible for the generator. Then the third engineer reported to the chief engineer that there had been an increase in exhaust gas in generator no. 2 cylinder no. 6 so that the chief engineer ordered the third engineer to turn on generator no. 1 then parallel it then the third engineer stopped generator no. 2 to avoid serious damage to generator no. 2 which is precisely in cylinder no. 6.

2. Solution

After the chief engineer identified an increase in exhaust gas temperature in the generator injector in cylinder no. 6, the action was taken to stop generator no. 2 and parallel it to generator no. 1 so that the ship's operation continued. then the chief engineer conducted a safety meeting with the engine crew to discuss the next steps so that the chief engineer decided to order the third engineer to replace the injector first because the spare parts on the injector were still available so that the injector was replaced on generator no. 2 cylinder no. 6.

3. Problem Solving

After maintenance was carried out on the injector on cylinder no. 6 by conducting a press test. After the injector was tested, it was found that the pressure of the injector had decreased to 25 Mpa while for the injector pressure in accordance with the manual book procedure on the Mv.Cssc Gladstone ship, namely the old or used injector 32-33 and for the new injector pressure with pressure 34-35.

4. Conclusion

Based on what has been conveyed in the previous chapter, the author concludes that the implementation of PMS (planned maintenance system) on board the MV. CSSC GLADSTONE has been carried out well and in accordance with the procedures and schedules on board.The work plan application is very helpful for engineers on board because it can provide information about the implementation of maintenance on a component or auxiliary machine. The exhaust gas on generator no.2 cylinder no.6 experienced an increase in temperature due to damage to the injector due to dirty fuel, so the process of spraying or atomizing fuel into the cylinder will be disrupted, in this case the fuel drips, so that the combustion process cannot take place optimally.

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