

TRIP OCCURRENCE OF THE MAIN STEAM BOILER AT SS. TANGGUH BATUR

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Abstract

Main boiler is the main machinery that functions to produce pressurized steam used as a driving force for the main engine on the ship. On November 17, 2023 on the SS. Tangguh Batur, the main boiler experienced a combustion process failure, causing main boiler No. 1 to stop operating. The purpose of this study is to determine the causes and effects of combustion failure on the main boiler and its countermeasures. The research method used is descriptive qualitative. Data collection techniques through observation, documentation, interviews, and literature study. The data analysis technique in this research is 5 why's analysis. The conclusion of this research shows that the trip in the operation of the main boiler is caused by the low duty compressor No. 1 which stops operating, the closed main gas valve on the main boiler, and the FO piston valve on the burner No. 1 main boiler which is not open.

Keywords: Descriptive qualitative, Main boiler, Steam, Trip, 5 Why's analysis.

INTRODUCTION

LNG ships are specially designed to load LNG or natural gas that has been cooled to a temperature of around -162°C , so that it turns into a liquid and can be more easily and economically transported over long distances. The main propulsion engine that drives the LNG ship is the main steam turbine. Steam turbines include external combustion engines, because the steam needed to drive the turbine is produced by the main boiler (Prasetyo, 2020).

The main boiler is the main machinery on the ship that functions to produce pressurized steam over one atmosphere with its working principle of heating water in the main boiler pipe using a mixed media of fuel (liquid and / or gas) and air in the furnace (main boiler combustion chamber).

The main boiler combustion process can use a combination of liquid fuel (fuel oil) and natural gas fuel (BOG) simultaneously called dual mode firing. Disruption of the combustion process can be caused by several factors, namely: interference with the burner, interference with the valves, interference with the security system, interference with the electrical system, interference with the main boiler water filling system.

In reality, the main boiler can experience disturbances, such as what happened at SS. Tangguh Batur on November 17, 2023, on a voyage from Malaysia to Korea. There was a combustion disturbance, during operation, the failure of combustion in the main boiler had an impact on reducing the main boiler pressure.

LITERATURE REVIEW

Analysis

Analysis is an attempt to observe in detail something or object by describing the components that form it or its constituents for further study (Simatupang, 2020). The data analysis process

includes organizing data, dividing it into small parts, synthesizing, arranging patterns, choosing what is important and what to study, and making conclusions to inform others (Sugiyono, 2022).

Main steam boiler or main boiler

Main boiler is the main plane with water in its pipes that is heated to produce steam with a pressure of more than one atmosphere or one bar and high temperature (Wardana *et al.*, 2020). As the main aircraft that drives the main steam turbine is clearly a mainstay for a tanker, it must of course be maintained in its condition and capabilities so as to improve the function of all safety equipment that must complement the main boiler aircraft (Prasetyo, 2018). However, to run the boiler with high efficiency, significant energy consumption is required, especially when heating the feed water into steam at the initial stage (Kristanto, 2022).

Control system of the main boiler

The main boiler system is controlled by two main control systems, namely the burner management system (BMS) which regulates the operation of combustion with liquid fuel and combustion with gaseous fuel in stages in sequences such as replacement of combustion in the burner, adding or reducing the number of burners. While the automatic boiler control (ABC) functions to regulate the flow of combustion fuel to the burner such as liquid fuel flow and gas fuel flow.

RESEARCH METHOD

Research methods include all the approaches used to conduct research, namely all the techniques used by researchers when investigating research questions (Sundari, 2024). Researchers use descriptive qualitative research methodology as the method of this research. The qualitative research method involves a research approach that centers on understanding phenomena through perception, and the results of data analysis on the object of research in the form of descriptive analysis (Sahir, 2021).

In qualitative research, data is usually collected in the form of words, activities, documents, writings, photographs, and statistics. One of the benefits of data is its ability to make decisions or solve problems more quickly and more clearly about a situation or problem (Rijali, 2021). Researchers use data collection techniques with observation, interviews, documentation and literature study. Research instruments are used to collect data relevant to the research focus such as researchers as instruments, interview instruments and documentation instruments.

The data analysis method used is the root cause analysis (RCA) method. Root cause analysis is a method used to determine the failure of a system or machine. This method aims to identify the causes of problems that actually occur in an event, so that the root cause of the problem can be known. In addition, this method is also to create and implement solutions in order to prevent the occurrence of the same problem (Haq *et al.*, 2020).

RESULTS AND DISCUSSION

In the context of this research, it is important to select a context description that is relevant, clear, and supports the understanding of the research being conducted. The research was conducted during the sea practice program from 27 March 2023 to 24 December 2023, over a period of 9 (nine) months. The discussion of research results is a process in which researchers interpret and review the results of data analysis thoroughly, in response to the formulation of research

problems. In this discussion, researchers describe the results obtained based on observations, interviews, and literature studies.

In the findings of this problem, and based on the research experience during sea practice on board the SS. Tangguh Batur on November 17, 2023 while at sea from Malaysia to Korea. There was a disturbance in the main boiler control system resulting in a trip in the machinery.

1. Factors that cause trips in the operation of the main boiler on board SS. Tangguh Batur.

a. Low duty compressor No. 1 factor that stops operating

After observations, interviews and literature studies, it was found that the set point on the inlet guide vanes (IGV) on the low duty compressor No. 1 exceeded the limit which caused an alarm and then the main boiler failed during combustion.

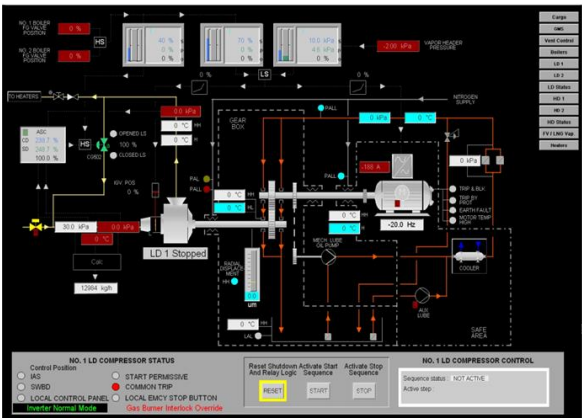


Figure 1. Low duty compressor No. in engine control monitor

Due to this incident, the gas engineer made a report to the office in accordance with the direction of the chief engineer so that it could be immediately repaired during the drydock which will be carried out after Incheon Port. This must be reported immediately because the machine is an important machine and it is time for the sensor on the inlet guide vanes to be calibrated by the maker.

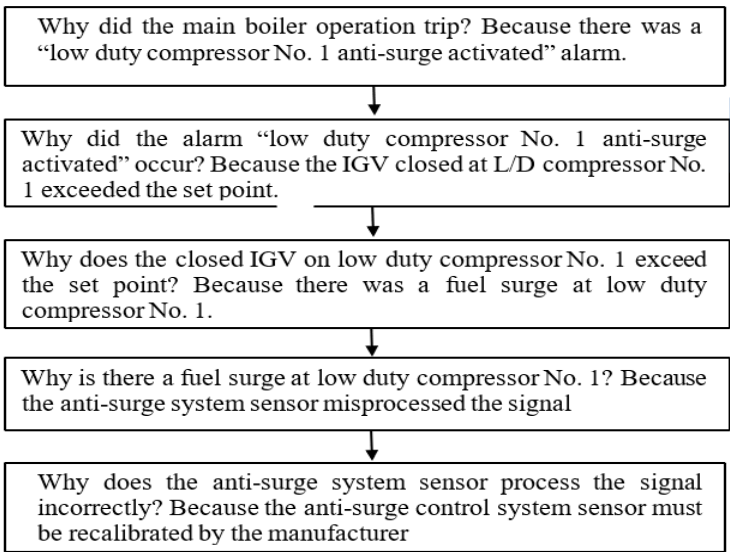


Figure 2. Analysis of 5 whys low duty compressor No. 1 stopped operating

b. Factor FO piston valve on burner No. 1 main boiler that is not open

At the time of the trip on the No. 1 main boiler, it was discovered that the No. 1 main boiler burner valve was not open. The FO backup system should activate and automatically operate the main boiler again.



Figure 3. Main boiler FO piston valve

Due to the absence of fuel flow for combustion in the main boiler, the machinery was tripped. After Engineer 2 checked the valve, it turned out that the limit switch on the valve did not touch the upper limit of the open indicator on the limit switch. For the time being, Engineer 2 operated the limit switch to touch the upper limit of the sensor manually.

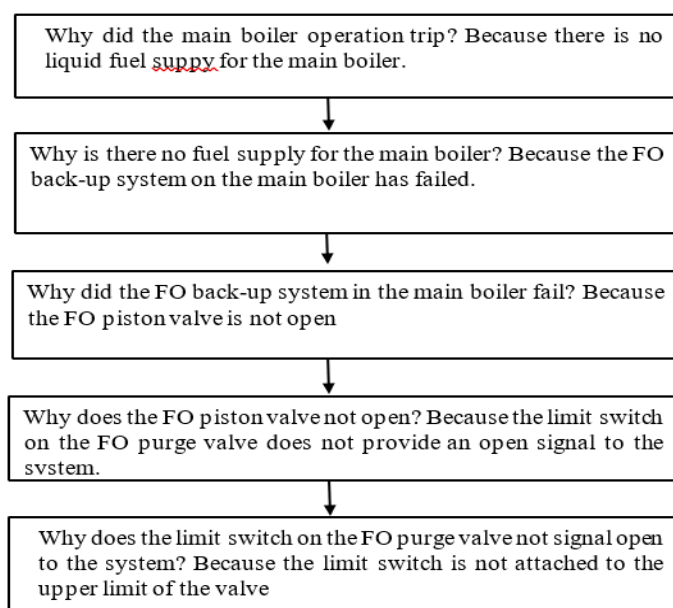


Figure 4. Analysis of 5 why's FO piston valve on burner No. 1 main boiler that does not open

c. Closed main gas valve on main boiler

After Engineer 2 made an observation, it was found that the main gas valve could not be operated automatically from the engine room control because the solenoid valve on the valve was closed so it had to be opened manually. Then chief engineer in the engine room control confirmed that the main gas valve was open.

As a result of the low duty compressor No. 1 that stops operating is the fuel gas that goes to the main steam boiler to be stopped, resulting in the main gas valve in the fuel gas system closed, resulting in gas combustion failure in the main boiler.

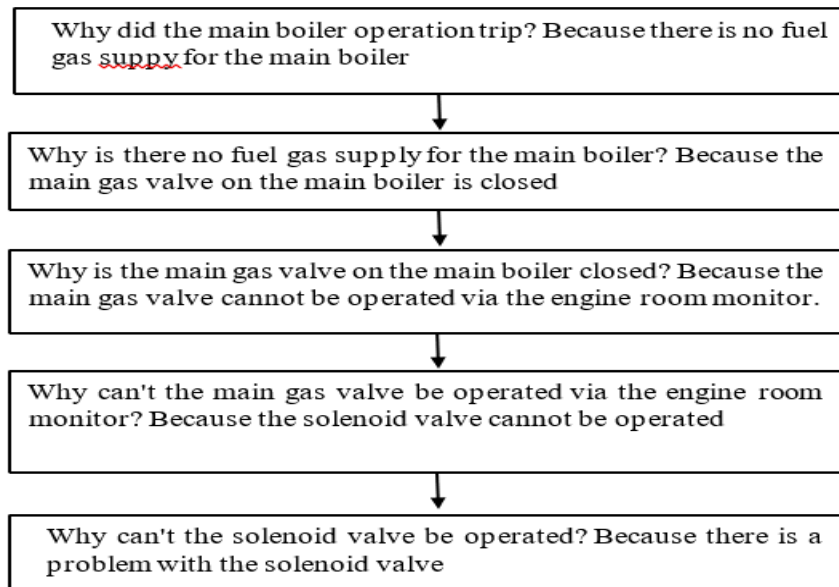


Figure 5. Analysis the 5 why's of the closed main gas valve on the main boiler

2. The impact of the trip on the operation of the main boiler on board SS. Tangguh Batur

a. Ship operational disruption

This disruption is very influential in shipboard operations, because a continuous supply of pressurized steam is very important for propulsion and systems on the ship.

b. Main boiler No. 2 becomes overburdened

When main boiler No. 1 trips, the production of pressurized steam used for machinery on board remains the same, especially for machinery that plays an important role in ship operational activities such as steam turbine generators (turbo generators), main boiler water filling pumps (main feed water pumps) and main steam turbines (main turbines). So that the load received by main boiler No. 2 remains the same as if both main boilers are operating.

c. Increased emissions

Incomplete combustion tends to result in higher levels of harmful flue gases or combustion residuals to be released into the surrounding environment. These emissions can include pollutants such as carbon monoxide (CO), nitrogen oxides (NO_x), and particulate matter that contribute to air pollution and potentially impact air quality standards.

3. Efforts to prevent tripping in the operation of the main boiler on board SS. Tangguh Batur.

a. Calibrating the anti-surge sensor on low duty compressor No. 1

Calibration of the anti-surge sensor on low duty compressor No. 1 is carried out during drydock as well as maintenance on the compressor. This is done so that events that can cause a trip in the operation of the main boiler are not repeated. From the results of calibration and maintenance carried out during drydock, low duty compressor No. 1 can return to normal operation to transfer fuel gas for combustion in the main boiler.

b. Perform repair and maintenance on FO piston valve

Maintenance that can be carried out by the ship's crew is cleaning the outside of the valve which is dirty due to fuel dripping from the valve. Meanwhile, during drydock, the FO piston valve can be disassembled by the service engineer to repair the damaged parts of the valve and check the limit switch control system to show that the valve is operating normally.

c. Performing repair and maintenance on the main gas valve

Valves such as the main gas valve can only be repaired and maintained during drydock because the system connected to this valve must be isolated such as tank cargo and main boilers on board. The service engineer in charge will disassemble and check the valve, it is found that the part on the main gas valve is not working properly to be replaced is the valve needle. After all the parts are done, one of the Engineer will check and ensure that the valve can work according to its function.

CONCLUSION

Based on the findings and results of the research that has been carried out, the researcher can conclude about the trip in the operation of the main boiler on board SS. Tangguh Batur is the main cause of the control system located at low duty compressor No. 1, liquid fuel piston FO valve No. 1 and main gas valve main boiler. This resulted in disruption of vessel operations, overloading of the No. 2 main boiler and increased emissions. Repair and maintenance while in drydock can prevent the studied incident from recurring.

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