Volume 2, No. 12 December 2024
p-ISSN 3032-3037 | e-ISSN 3031-5786

ADVANCES IN SOCIAL HUMANITIES RESEARCH

EVALUATION OF FIRE ON THERMAL OXIDIZER (TOX) AT XY COMPANY WITH FISHBONE APPROACH

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Abstract

On April 9, 2020, Thermal Oxidizer (TOX) at PT. XY burned. Its function is to control exhaust emissions by burning harmful organic compounds. In this case, the Waste Heat Recovery Unit (WHRU) located above the TOX combustion chamber failed. Gas Turbine Generators (GTG) failed. In this study, the fishbone method is used after conducting data collection techniques to obtain the necessary information and data to achieve the research objectives. The data collection techniques applied include observation, brainstorming, and documentation. Maintenance policies, machine errors, human error, extreme environmental conditions, and inadequate operational procedures are some of the causes. The results of the analysis show that improving workers' operational skills, regular equipment inspections, and improving safety management systems are essential. These results provide practical advice to improve operational safety and prevent similar incidents in the future.

Keywords: Thermal Oxidizer**,** *Waste Heat Recovery Unit* (WHRU), *Gas Turbine Generators* (GTG), *Fishbone Diagram*

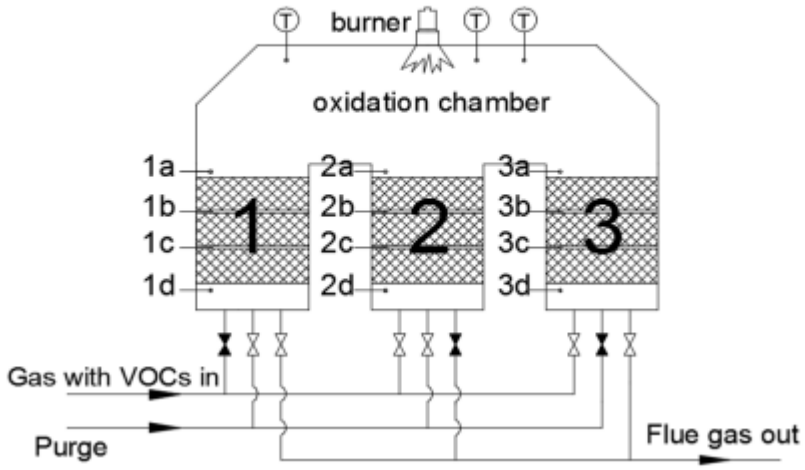
Introduction

PT. XY is an important gas field throughout the country owned by PT. Pertamina EP is managed by the Ministry of Energy and Mineral Resources. The Tambak Lorok PLTU uses the gas produced from this field to provide electricity to the Central Java Province area. Therefore, the resilience and availability of PT. XY should be maximized by avoiding unexpected shutdowns due to damage to the gas purification equipment.

A fire occurred in the *Top Thermal Oxidizer Unit* (TOX) section at PT. XY on Thursday, April 9, 2020, at around 09.31 WIB. The part that burned was the *Waste Heat Recovery Unit* (WHRU), which is located above the *combustion chamber* of the TOX. Inside the WHRU, a number of hot oil coil pipe units made of carbon steel with ASTM A-106 Gr.B specifications and with the design of the Gundih CPP refining facility handles ten production and injection wells in the Gundih Field, consisting of nine production wells and one injection well. The current gas production of the Gundih Field includes gas

supply of 68 MMSCFD, gas sales of 46 MMSCFD (50 BBTUD), and condensate of 460 BCPD.

Thermal oxidizer at PT. XY functions to control exhaust gas emissions by burning volatile *organic compounds* (VOCs) or other harmful gases. This tool is essential for reducing harmful emissions such as hydrocarbons and sulfur compounds, resulting in safer combustion products such as carbon dioxide (CO2) and water vapor (H2O). In addition, *the thermal oxidizer* helps control the smell of exhaust gases, improving its duration. By using *a thermal oxidizer* at PT. XY, the facility can comply with national and international emission and environmental regulations. *The thermal oxidizer* guarantees high combustion efficiency when operating at high temperatures (750–1200 °C), which allows for optimal treatment of hazardous gases. This role is very important to support the operations of PT. XY that is safe and efficient and to maintain environmental sustainability.



TOX Images

The condition of TOX burning at PT. The current XY is very different from the original design of TOX; the input numbers are very different, and the combustion temperature is very high, over 1,600oF (1,144 K). In addition, the WHRU does not work normally, so the stack output temperature is still very high, over 700oF (644 K), and the hot oil temperature at the WHRU outlet is only 330–340oF (438–444 K).

Research Methods

In this study, *the fishbone* method is used after conducting data collection techniques to obtain the necessary information and data to achieve the research objectives. The data collection techniques applied include observation, brainstorming, and documentation (Sabrina & Widharto, 2019). To assess the severity of each incident or potential danger, the researcher conducted an interview (*brainstorming*) with the head of the picking department at PT. XY. Furthermore, the data processing technique is an advanced stage of collecting and identifying the data that has been obtained (Mubarok,

2023). Therefore, data processing and analysis techniques are used to identify the factors that cause accidents with appropriate methods.

Steps to create a diagram *Fishbone* It includes identifying key problems, determining cause categories such as people, processes, machines/technology, environment, and policies, as well as creating branch bones to record specific causes in each category. Furthermore, root cause analysis is carried out to identify the main contributing factors, followed by the development of solutions or actions to address those causes. Once the solution is implemented, an evaluation is carried out to assess the impact (Aulia Alva Space, 2023).

Results and Discussion

Based on this problem, the researcher used the *fishbone identification method*. The preparation of *the fishbone* diagram aims to identify the factors that cause fires that occur in *the Thermal Oxidizer* (TOX) at PT. XY. By identifying these causative factors, the process of finding solutions or preventive measures becomes more efficient. In general, fishbone diagrams are used to illustrate the cause of a problem, which further helps in analyzing the cause-and-effect relationship and choosing the right method to solve the problem at hand.

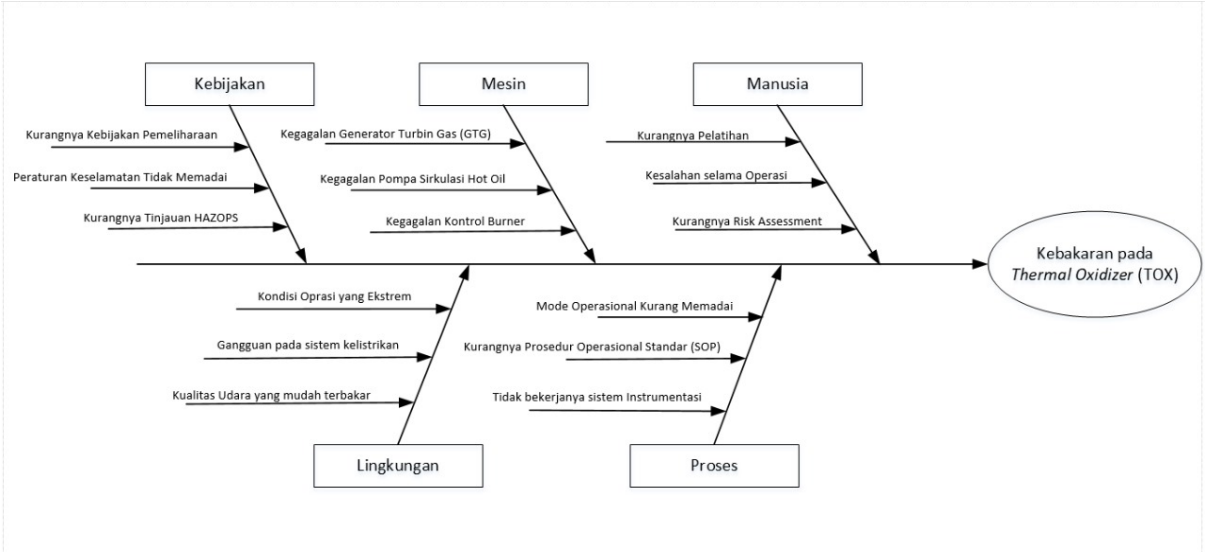


Figure 1

Based on Figure 1, the identification of the factors causing the TOX Fire at PT. XY. The following is an explanation of the factors that cause accidents from each category in the fishbone diagram above, which includes humans, processes, environment, policies and machines:

Policy:

Lack of maintenance policies, inadequate safety regulations, and incomplete HAZOPS reviews have led to vulnerable machine components to damage (Anggraini Agustini, 2022). In addition, failure of gas turbine generators (GTGs), hot oil circulation pumps, and burner controls can increase the risk of fire. Human factors such as lack of

training, errors during operations, and lack of risk assessment also contribute to fire incidents. Extreme operating conditions, disruptions to the electrical system, and flammable air quality exacerbate the situation. The lack of standard operating procedures (SOPs) and the non-functioning of the instrumentation system can exacerbate the problem.

Machine:

Failure of the gas turbine generator (GTG), hot oil circulation pump, and burner control can contribute to system malfunctions that can potentially trigger a fire. When GTG fails, the power supply to critical equipment can be disrupted, resulting in the system not functioning properly. In addition, if the hot oil circulation pump is not operating optimally, the flow of hot oil required to maintain the temperature and pressure of the system becomes inadequate, increasing the risk of overheating. On the other hand, burner controls that don't work properly can cause the burner to stay on even if the surrounding conditions are unsafe, creating a very dangerous situation

Human:

The lack of training for operators contributes to a lack of knowledge and skills in operating equipment safely. This can lead to errors during surgery, which is often caused by a lack of concentration and awareness of the risks involved. In addition, inadequacy in conducting risk assessments indicates weak identification of potential hazards and lack of effective countermeasures, thereby increasing the likelihood of dangerous incidents (Dhimas Pravi Ghossan Soesanto, n.d.).

Milieu:

Extreme operating conditions, such as high temperatures or humidity, can significantly increase the potential risk of fire. Disturbances in the electrical system also have the potential to cause short circuits, which can trigger fires. In addition, the quality of air containing flammable materials increases the risk of fire, especially in the event of sparks or combustion processes. The combination of these factors creates a very dangerous environment and requires special attention in safety management.

Process:

Inadequate operational modes reflect deficiencies in proper operational standards and procedures. In the absence of clear standard operating procedures (SOPs), operators do not have adequate guidance for operating machines safely, increasing the risk of errors. Additionally, malfunctioning instrumentation systems result in a lack of early detection of potential hazards, which can worsen the situation in the event of an incident. Therefore, it is important to strengthen operational standards and ensure that instrumentation systems are functioning properly to improve safety in the workplace.

Conclusion

Fire at *Thermal Oxidizer* (TOX) at PT. XY on April 9, 2020 was caused by the failure of the hot oil circulation pump system and its *Gas Turbine Generators* (GTG), which caused overheating of the coil tubes in the *Waste Heat Recovery Unit* (WHRU), as well as burner control problems without an effective shutdown interlock. The lack of risk assessment and maintenance of the instrumentation system also contributes, coupled with uncontrolled environmental factors. These findings emphasize the need for an evaluation of safety management systems and improved procedures to prevent similar incidents in the future.

To prevent similar fires at PT. XY, it is necessary to carry out equipment re-inspection, HAZOPS upgrade for hot oil system, and in-depth inspection of *hot oil coil tubes*. In addition, analysis of affected equipment failures, determination of the cause of "trip" in GTG, and improvement of operational procedures and worker skills in process safety are also essential.

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