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RISK MANAGEMENT ANALYSIS WITH FAULT THREE ANALYSIS (FTA) METHOD COMPRESSOR SYSTEM PACKED DRINKING WATER PT. SWABINA GATRA

Rizky Adi Kurniawan1*, Akhmad Wasiur Rizqi2, Hidayat3

Universitas Muhammadiyah Gresik
E-mail:rizkyadi270595@gmail.com[1],akhmad_wasiur@umg.ac.id2,hidayat@umg.ac.id3

ABSTRACT

Occupational safety and health is now starting to be important for the wider community in Indonesia, especially for employees and industrial workers, considering the growing economy and industry as well as general development, the greater the potential for harm caused. Actually this problem can be overcome by applying existing methods such as Fault Three Analysis (FTA). The purpose of this research is to carry out risk management on work equipment system failures as an effort to control work accidents at PT. Swabina Gatra The design of this research is descriptive. Hazard identification in this research uses the (HIRARC) method then the hazard result with the highest value is used as the Top Event in the Fault Three Analysis (FTA) method. The implementation stage of this method is to identify the potential and overcome hazards in the Compressor System Unit for Bottled Drinking Water PT. Swabina Gatra. The results showed that there were 7 cut-sets or causes of failure in the compressor system. The cut-set results obtained by the prevention stage which are enforced are the provision of Earth-Leakage Circuit Breakers (ELCB) on the electric panel compressor system, Perform periodic pressure vessel calibration tests no later than once every 5 years, Work in accordance with SOPs or work instructions that have been set by the Company , and conduct periodic inspections or inspections and schedule repairs and maintenance.

Keywords : Risk Management, Compressor System, FTA Method

PRELIMINARY

Occupational safety and health is now important for the wider community in Indonesia, especially employees and industrial workers, given the growing development of the economy and industry as well as its general development. In addition, the purpose of K3 is not only to provide protection for workers and other people in the workplace to ensure their safety, but also to control risks to equipment, assets, and production sources so that they can be used safely and efficiently to avoid accidents and damage. occupational illness. (Banten Province Manpower and Transmigration Office, 2022)

According to Suma'mur (2001, p.104), work safety is a series of efforts to create a safe and peaceful work atmosphere for employees who work in the company concerned. According to Suma'mur, occupational safety is a specialization of work safety science and its practice which by conducting an assessment of the factors causing accidents in the work environment and the company through measurements, the results of which are used as the basis for corrective actions to the environment and if necessary prevention, so that workers and the community around a company are protected from work-related hazards and it is possible to experience the highest degree of health. (Dr. Suma'mur. P.KM.MSC, 1996)

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In an effort to improve the quality of production and modernize equipment in the production process, it will provide a large possibility of the emergence of an influence on the workforce. The existence of technology accompanied by new modern equipment in the company, besides bringing convenience in production also has a high level of accident risk. Therefore, it requires high precision and vigilance in operating it. Errors in the operation of equipment and inadequate workforce skills can cause a very large possibility of danger in the form of work accidents, fires, explosions, environmental pollution and disease.

Based on the International Labor Organization (ILO) September 2021, every day, people die from work accidents or occupational diseases. Each year, at least 1.9 million people die and 90 million Disability-Adjusted Life Years (DALYs) are estimated to be caused by exposure to 19 major occupational risk factors. In addition there are about 360 million non-fatal work accidents every year (resulting in more than 4 days of absence from work).

A work accident is an unexpected and unplanned event that can disrupt the continuity of the company's production process, injure people, damage the environment, or company property and assets (Triswandana, 2020). Work accidents will cause very negative things, namely, in the form of economic losses and can also cause human suffering or the workforce concerned. From this incident, it is necessary to protect the workers. Therefore, the work environment is designed to be conducive for workers to carry out activities in a comfortable and safe atmosphere in various ways, one of which is by identifying hazards and assessing risks.

Hazard Identification and Risk Assessment of the work environment in the workplace has been regulated in Government Regulation no. 50 of 2012 concerning Occupational Health and Safety Management System (SMK3). Article 9 paragraph 3 letter b. This regulation was made to protect workers from various kinds of risks that might cause work accidents (Ministry of Manpower of the Republic of Indonesia, 2022). Various factors can lead to an accident, one of which is caused by equipment.

Efforts to improve the quality and production of PT. Swabina Gatra has modernized production equipment, one of which is the compressor system. The new Compressor System is used for maintenance, operation procedures and has a higher pressure compared to the old system. Therefore, to anticipate the occurrence of accidents caused by the compressor system, then conduct a risk management analysis on system failure using the Fault Three Analysis (FTA) method. FTA is a graphical model of branches in a system that can lead to a possibility of unwanted failure (Djamal & Azizi, 2015). The purpose of risk management is the failure of work equipment systems as an effort to control work accidents at PT. Swabina Gatra. After performing the Fault Three Analysis method using the TopEvent FTA application, then carrying out the control stages. This research is expected to be able to identify hazards and analyze risks, conduct risk assessment analysis on the production activities of bottled drinking water at PT. Swabina Gatra with the Fault Tree Analysis method, and recommending the results of the Risk Assessment as an evaluation and planning material for the production of Bottled Drinking Water at PT. Swabina Gatra. and Recommending the results of the Risk Assessment as an evaluation and planning material for the production of bottled drinking water at PT. Swabina Gatra. and Recommending the results of the Risk Assessment as an evaluation and planning material for the production of Bottled Drinking Water at PT. Swabina Gatra.

Method*Hazard Identification, Risk Assessment, and Risk Control (HIRARC)*

The HIRARC method is an approach that begins with determining the type of work activity to further identify the source of the hazard so that the risk is obtained then risk assessment and risk control are carried out to reduce the hazard in each type of work activity (Trisaid, 2020). The HIRARC method consists of three processes, namely Hazard Identification, Risk Assessment, and Risk Control.

Hazard Identification is the first step in the method *HIRARC.*Hazard identification is carried out by examining each work area in the form of:

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Hazard identification with the aim of identifying all the hazards that exist in a job (Giananta, 2020).

After identifying the hazards, the next step in the HIRARC method is a risk assessment. Risk assessment is carried out by considering the possibility of occurrence of the event (likelihood/probability) and the impact of the event (consequence/severity) (Afredo & Tarigan, 2021). Risk Assessment aims to identify the value of the potential risk of work accidents (Dwisetiono & Fairussihan, 2022). In risk assessment, it is usually inseparable from the standards used, one of which is the AS/NZS 4360 standard.

After assessing the likelihood and consequence, the risk level is then determined. Risk assessment can be done by looking at the probability and impact matrix (Saputro & Lombardo, 2021).

Fault Tree Analysis (FTA)

*Fault Tree Analysis*is a model of analysis of design, procedures, and errors in human factors (Budiono, 2003). Fault Tree Analysis can be used to predict and prevent accidents or an investigation tool after an accident (Geotsch, 1996).

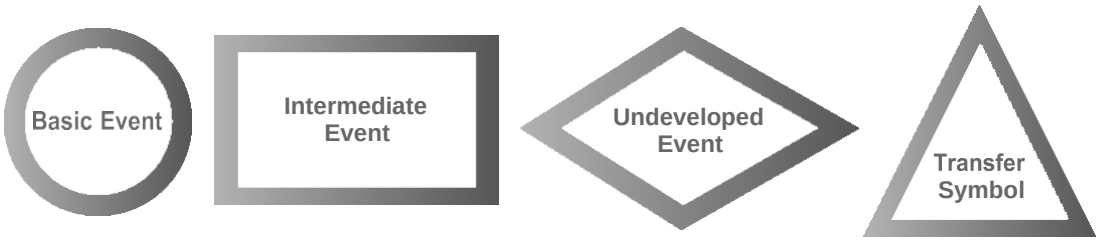
Fault Tree Analysis has several stages: (Satriyo & Puspitasari, 2017)

1. Determine the top/main event
2. Set FTA limits
3. Examine the system to understand how the various elements relate to each other and the top event
4. Create a fault tree, starting at the very top and working your way down
5. Fault tree analysis to identify ways to eliminate events that lead to failure
6. Prepare a corrective action plan to prevent failure.

Application of FTA Techniques

In its application, the FTA technique used qualitatively has 2 (two) basic types of notation: events and logic gates. Event notation consists of 4 symbols, including: (Dr. Antonius Alijoyo, Bobby Wijaya, & Intan Jacob, 2021)

1. Circle (basic event) – is a symbol that states the cause of the risk. In other words the circle symbol represents the root / source cause of a risk event where this symbol does not require further analysis.
2. Square (intermediate event) – is a symbol of events that still require further analysis, usually after this symbol will be followed by logic gates to describe the next event.
3. 4 Diamonds (undeveloped event) – is a symbol that states that the event cannot be analyzed further due to insufficient data or information.
4. Triangle (transfer symbol) – is a symbol of events that still require



follow-up analysis, apart from the main risk event in the analysis being worked on.

Image 1. Event Notation.

Logic gate notation consists of 3 symbols, including:

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1. AND Gate – a risk event can occur if all the input events under it occur.
2. OR Gate – a risk event can occur if one or more of the input events below occur.
3. Voting OR Gate – an event can occur if the number of events that occur matches the required conditions. In the example image below, an event can occur if there are at least 2 causes that must occur. If the Voting OR Gate contains 1/3, then at least 1 cause must occur.

Figure 2. Gate Notation.

RESEARCH METHODS

Activity Plan

This research was conducted using the field method and the library method. The field method includes direct observation of the company by observing the Compressor System Unit for Bottled Drinking Water (AMDK) PT. Swabina Gatra and direct interviews with related parties. While the literature study method includes collecting information in the form of theories needed to support research writing through various reference books from both the campus library and from other libraries that describe the results of data processing carried out using the Hazard Identification, Risk Control, And Risk Assessment (HIRARC) and Failure Three Analysis (FTA)

The first step in this research is to identify problems at PT. Swabina Gatra by going directly to the field (field studies) accompanied by a literature study, namely reading literature related to the research topic. then proceed with the collection of information in the form of interviews with the company. Furthermore, the identification results are processed using the Hazard Identification, Risk Control, And Risk Assessment (HIRARC) method to determine the Top Event.

The next step is to process data using the Fault Three Analysis (FTA) method. The first step in data processing is the identification of hazards and determining the Top Events obtained using the HIRARC method in the Compressor System Unit for Bottled Drinking Water PT. Swabina Gatra. Then create a fault tree, the results of the fault tree are calculated using the TopEvent FTA application.

The next step is to control risk by proposing solutions that can be taken by the company in minimizing the risk of work accidents. Furthermore, concluded the results of the research that has been done.

Research sites

The research was conducted at PT. Swabina Gatra with a location on Jl. RA. Kartini No. 21 A, Kebomas District, Gresik Regency, East Java 61124 on the Compressor System Unit for Bottled Drinking Water (AMDK).

Data Types and Sources

In supporting the implementation of this research, it takes some data to analyze the problems faced. The data is obtained through:

1. Literature study is a method of collecting data and collecting information in the form of theories needed to support research writing in the compressor system unit of bottled drinking water PT. Swabina Gatra through various reference books both from the campus library and from other libraries
2. Field Study is a method of collecting data by conducting a direct survey to the factory location which aims to identify problems. Data collection techniques used are interviews and observations at PT. Swabina Gatra.

Methodology

The flow chart of the methodology used in problem solving in this study is as follows:

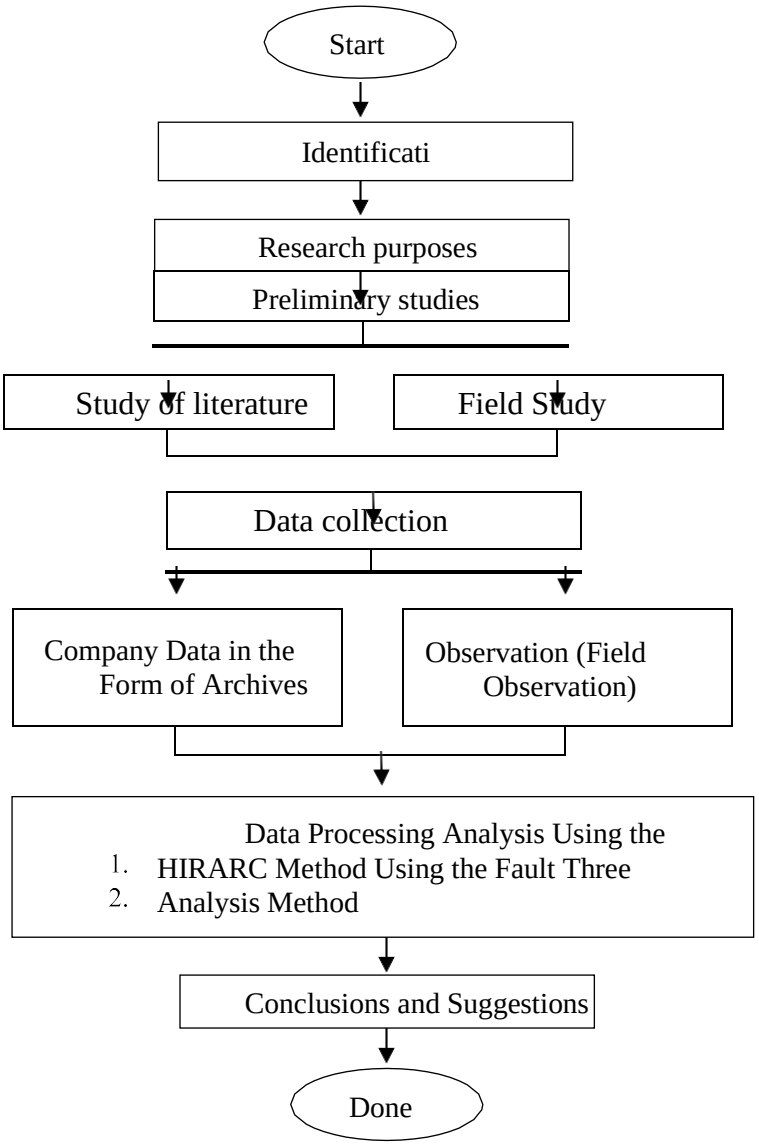

Figure 3. Research Methodology Flowchart.

RESULTS AND DISCUSSION

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The results and discussion will be presented on the results of the analysis using the Hazard Identification, Risk Control, And Risk Assessment (HIRARC) and Fault Three Analysis (FTA) methods, starting from identifying problems and determining Top Events to carrying out prevention stages in the Drinking Water Unit Copressor System. Packaged at PT. Swabina Gatra.

Determining the Top/Main Event

From the results obtained through the HIRARC method, it can be seen from Table 1 with the highest level of risk which is used as the Top Event or the top event of the System Compressor Unit for Bottled Drinking Water at PT. Swabina Gatra.

Activity Name : System Copressor			
Potential Hazards from Activities/Activities	Risk Assessment		Level of risk
	Possibility	Severity	
1. Air supply hose leak to main tank	*Unlikely*	*Moderate*	M (Medium Risk)
2. Disconnected air supply pipe			
3. Compressor short circuit	*Rare*	*Moderate*	M (Medium Risk)
4. Explode	*Rare*	*Moderate*	M (Medium Risk)
	Rare	*Catastropic*	H (High Risk)

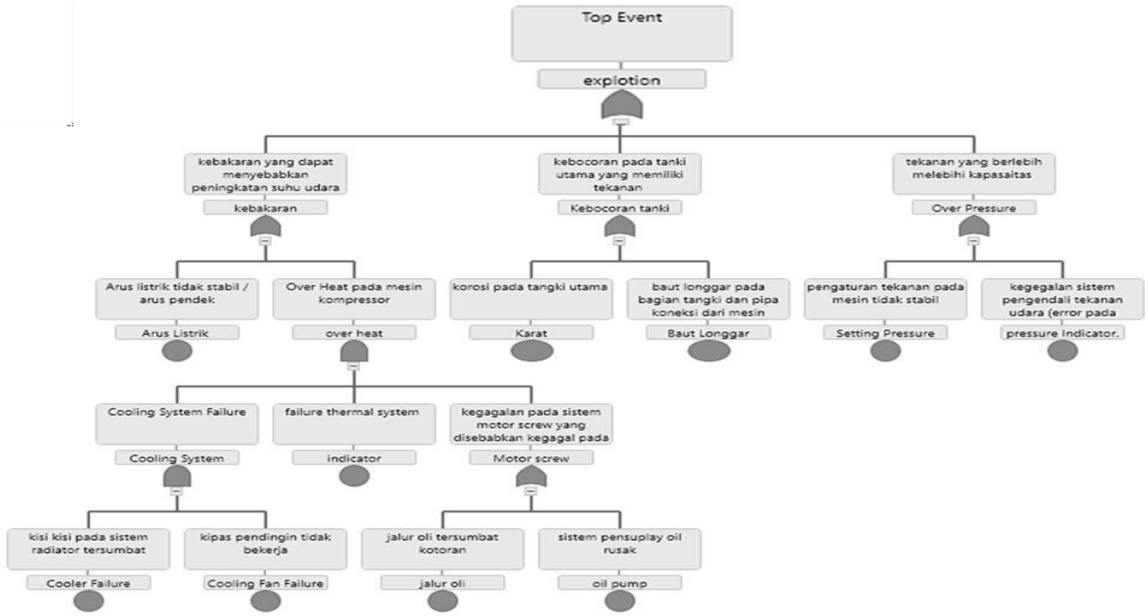
Table 1. HIRARC standard AS/NZS 4360

From the results obtained through the Hazard Identification, Risk Control, And Risk Assessment (HIRARC) method, what is used as a Top Event is the potential danger caused by the compressor system activity of the Packaged Drinking Water unit, namely exploding.

Making a Fault Tree

FTA is a system analysis method using a top-down approach that starts from the top-level event that has been defined first and then looks for the causal events and or their combination to the most basic events (Wahyu & Fathoni, 2018). The following is the function tree of the System Compressor Unit for Bottled Drinking Water (AMDK) using the TopEvent FTA application:

Figure 4. Fault Tree.



Determine Minimum Cut-set/basic event

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In this study, the minimum cut-set is a collection of causes of failure or a combination of them which, if they occur, can lead to the emergence of process malfunctions. Based on the results of the fault tree using the TopEvent FTA application in Figure 4, the minimum cut-set on the System Compressor is as follows:

Explotion Compressor - Minimal Cut Sets				
No	Minimum Cut Set	Order	Unavailability	Contribution
1.	Electric Current / short circuit	1	1	0.2
2.	Rust/corrosion	1	1	0.2
3.	Loose Bolt	1	1	0.2
4.	*Pressure Settings* /pressure setting	1	1	0.2
5.	*pressure indicators.*	1	1	0.2
6.	*Cooler Failure.Cooling Fan failure.indicator*.oil line	4	1	2
7.	*Cooler Failure.Cooling Fan failure.indicator*.oil pump	4	1	2

Table 2. Explotion Compressor - Minimal Cut Sets

There are 7 cut-sets for the occurrence of Top Events / top explosion events in the Packaged Drinking Water Compressor Unit (AMDK) system, which are caused by unstable electric currents / short circuits, corrosion occurs in the main air storage tank, loose bolts on the main tank, setting pressure on the engine, damage to the Pressure Indicator, damage caused by several series of systems (Cooler Failure. Cooling Fan Failure. indicator. oil line), and damage to several systems (Cooler Failure. Cooling Fan Failure. indicator. oil). pumps).

Repair And Prevention Analysis

Proposed improvements are given based on the root problems obtained (minimum cut-set) through Fault Three Analysis in table 2 above can show a description of the root problems and proposed improvements as follows:

Explosion Compressor		
No	Minimum Cut Set	Proposed Repair and Prevention
1.	Electric Current / short circuit	Provision of Earth-Leakage Circuit Breaker (ELCB) on the electrical panel of the compressor system.
2.	Rust/corrosion	Perform periodic pressure vessel calibration tests no later than once every 5 years in accordance with Ministerial Regulation 37 of 2016.
3.	Loose Bolt	Conduct periodic inspections or inspections.
4.	*Pressure Settings* /Settings pressure	Work according to the SOP or work instructions has been determined by the Company.
5.	*pressure indicators.*	Perform periodic pressure vessel calibration tests no later than once every 5 years in accordance with Ministerial Regulation 37 of 2016.
6.	*Cooler Failure.Cooling Fan Failure.indicator*.oil line	Conduct periodic inspections or inspections and schedule repairs and maintenance.
7.	*Cooler Failure.Cooling Fan Failure.indicator*.oil pump	Conduct periodic inspections or inspections and schedule repairs and maintenance.

Table 3. Repair and Prevention.

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CONCLUSION

Based on the results of research conducted on the Compressor System Unit for Bottled Drinking Water PT. Swabina Gatra by using the Fault Three Analysis (FTA) method, it can be concluded that the highest level of risk that will be used as a Top Event in the FTA method obtained from the HIRARC method is to explode in the compressor system (Explotion Compressor) so that it is focused on analyzing the causes of the explosion in the system. FTA method.

In the results obtained from the fault tree of the FTA method, there are 7 cut-sets or causes of failure in the compressor system, namely due to unstable electric current/short circuit, corrosion in the main air storage tank, loose bolts on the main tank, pressure settings on the engine. , damage to the Pressure Indicator, damage to several systems (Cooler Failure.Cooling Fan Failure.indicator.oil line), and damage to several systems (Cooler Failure.Cooling Fan Failure.indicator.oil pump).

Based on the results of the cut-set obtained, the prevention stage that is enforced is the provision of Earth-Leakage Circuit Breakers (ELCB) on the electric panel compressor system, conducting periodic pressure vessel calibration tests no later than every 5 years, working in accordance with SOPs or work instructions that have been set by the Company, and conduct periodic inspections or inspections and schedule repairs and maintenance.

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