Media Gizi Kesmas
p-ISSN 2301-7392, e-ISSN 2745-8598
10.20473/mgk.v14i1.2025.9-19

ORIGINAL ARTICLE **Open Access**

Analysis of the Company Commitment to Occupational Health and Safety in Confined Space Work at Phosphoric Acid Unit Plant III PT X

Analisis Komitmen Perusahaan terhadap Keselamatan dan Kesehatan Kerja pada Pekerjaan Ruang Terbatas di Unit Asam Fosfat Pabrik III PT X

Revida Nikita Melzanda[1]*, Endang Dwiyanti[2]

[1]Public Health Study Program, Faculty of Public Health, Universitas Airlangga, Surabaya, 60115, Indonesia
[2]Department of Health and Safety Work, Faculty of Public Health, Universitas Airlangga, Surabaya, 60115, Indonesia

Article Info

***Correspondence:**
Revida Nikita Melzanda
revida.nikita.melzanda-2018@fkm.unair.ac.id

Submitted: 19-12-2024
Accepted: 24-02-2025
Published: 30-06-2025

Citation:
Melzanda, R. N., & Dwiyanti, E. (2025). Analysis of the Company Commitment to Occupational Health and Safety in Confined Space Work at Phosphoric Acid Unit Plant III PT X. *Media Gizi Kesmas*, 14(1), 9-19. https://doi.org/10.20473/mgk.v14i1.2025.9-19

ABSTRACT

Background: In 2018, 148 workers died due to work in confined spaces. The highest number of deaths was found in tank, bin, and vat interiors work and among construction laborers. PT X has activities working in confined spaces, one of which is in the Phosphoric Acid Unit Plant III. The work is Cleaning Strainer Line Discharge P-2501 or the activity of cleaning phosphoric acid tanks.

Objectives: To analyze the commitment implemented by the company toward the occupational safety and health of workers in confined spaces in the form of tanks, especially in the Phosphoric Acid Unit Plant III of PT X.

Methods: This research was a descriptive study conducted at PT X Gresik, East Java, Indonesia using an observation method. Data analysis was conducted by comparing the procedures that have been implemented in confined space work at the Phosphoric Acid Unit of Plant III with the work instruction/procedure documents made by PT X.

Results: Based on data from Hazard Identification, Risk Assessment, and Determining Control (HIRADC), it was known that the potential hazards in the cleaning strainer line discharge P-2501 included high-risk work and had the impact of death. The results of gas measurements in the phosphoric acid tank in the Phosphoric Acid Unit of Plant III show that the confined space used for the cleaning strainer line discharge P-2501 activity was stated to be safe to enter and work in because oxygen (O_2) was at a concentration of 20.9%, which is still in accordance with the threshold limit value (TLV) of 19.5%-23.5% and the concentration of phosphoric acid gas (HF) was still below the TLV (0.5 ppm), which is 0.0 ppm.

Conclusion: The implementation and commitment of PT X to occupational safety and health for workers in confined spaces in the form of phosphoric acid tanks in the Phosphoric Acid Unit of Plant III has been carried out properly and in accordance with the work instruction documents created and owned by the company. PT X has also carried out risk control against potential hazards in confined space work in accordance with the risk control hierarchy.

Keywords: Confined space, Employment protection, Hierarchy of control, HIRADC, Safe work

ABSTRAK

Latar Belakang: *Selama 2011-2018 sebanyak 1.030 pekerja meninggal dunia diakibatkan oleh pekerjaan di ruang terbatas. Jumlah kematian paling banyak ditemukan pada pekerjaan di tangki dan saluran pembuangan sebanyak 205 kasus serta pekerjaan konstruksi sebanyak 173 kasus. PT X memiliki aktivitas bekerja di*

ruang terbatas, salah satunya pada Unit Asam Fosfat Pabrik III. Pekerjaan tersebut ialah Cleaning Strainer Line Discharge P-2501 *atau aktivitas membersihkan tangki asam fosfat.*

Tujuan: *Menganalisis komitmen yang diterapkan oleh perusahaan terhadap keselamatan dan kesehatan kerja para pekerja pada pekerjaan di ruang terbatas berupa tangki, khususnya di Unit Asam Fosfat Pabrik III PT X.*

Metode: *Penelitian ini merupakan studi deskriptif yang dilakukan di PT X Gresik, Jawa Timur, Indonesia menggunakan metode observasi. Analisis data dilakukan dengan membandingkan prosedur yang telah diterapkan di pekerjaan ruang terbatas Unit Asam Fosfat Pabrik III dengan dokumen instruksi/prosedur kerja yang dibuat oleh PT X.*

Hasil: *Berdasarkan data pada* Hazard Identification, Risk Assessment, and Determining Control (HIRADC), *diketahui bahwa potensi bahaya pada pekerjaan* cleaning strainer line discharge P-*2501 termasuk risiko tinggi dan memiliki dampak kematian. Hasil pengukuran gas pada tangki asam fosfat di Unit Asam Fosfat Pabrik III diketahui bahwa ruang terbatas yang digunakan untuk aktivitas cleaning strainer line discharge P-2501 dinyatakan aman untuk dimasuki dan dilakukan pekerjaan di dalamnya karena gas Oksigen (O_2) berada pada konsentrasi 20.9%, yaitu masih sesuai dengan Nilai Ambang Batas (NAB) sebesar 19.5%-23.5% dan konsentrasi gas Asam Fosfat (HF) masih berada di bawah NAB (.0.5 ppm), yaitu sebesar 0.0 ppm.*

Kesimpulan: *Implementasi dan komitmen PT X terhadap keselamatan dan kesehatan kerja pada pekerja di ruang terbatas berupa tangki asam fosfat di Unit Asam Fosfat Pabrik III telah dilakukan dengan baik dan sesuai dengan dokumen instruksi kerja yang dibuat dan dimiliki perusahaan. PT X juga telah melakukan pengendalian risiko terhadap potensi bahaya pekerjaan di ruang terbatas sesuai dengan hierarki pengendalian risiko.*

Kata kunci: *Hierarki pengendalian, HIRADC, Kerja aman, Perlindungan kerja, Ruang terbatas*

INTRODUCTION

Every work activity in a company or industry certainly has risks or hazards that can affect the safety and health of its workers. Therefore, companies or industries need to make every effort to foster work protection norms for their workers during their work activities in the workplace. This can be done through the implementation of OHS. OHS or Occupational Safety and Health is all activities to ensure and protect the safety and health of workers through efforts to prevent work accidents and occupational diseases (Minister of Manpower of the Republic of Indonesia, 2018).

One of the jobs in industry that has risks and hazards to the safety and health of its workers is work in confined spaces. A confined space is a room that is large enough and has a configuration such that workers can enter and perform work in it, has limited access in and out and is not designed to be used as a workplace continuously (Minister of Manpower of the Republic of Indonesia, 2023). Some examples of confined spaces commonly located in industry include: water, fuel, or chemical storage tanks; bunkers; tunnels; conventional water wells; sewers, gutters, septic tanks, or waste lines; silos or warehouses storing certain materials; containers; and so on. Work activities carried out in confined spaces in industry generally include maintenance or cleaning, inspection or repair, welding, grinding, cutting, and installation of equipment (Proxsis East, 2017).

Work in confined spaces has high risks and hazards that threaten the safety and health of workers. The risks and hazards that can be encountered when carrying out work activities in confined spaces are the presence of toxic gases, flammable and explosive gases, abnormal oxygen conditions, exposure and pungent odors sourced from chemicals, extreme temperatures, limited lighting, the presence of electrical sources that are not properly isolated, room construction that is insulated or tortuous, slippery room conditions, and the presence of sharp objects. These hazards can lead to falls or slips, impact on tools, electric shock, exposure to very high temperatures, irritation, fainting, and death of workers (Proxsis East, 2017).

Based on data reported by the U.S. Bureau of Labor Statistics, in 2018 as many as 148 workers died due to work in confined spaces. The highest number of deaths was found in confined spaces in the form of tank, bin, and vat interiors. Meanwhile, construction laborers had the largest number of fatal workplace injuries involving confined spaces (U.S. Bureau of Labor Statistics, 2020). Cases of work accidents while working in confined spaces also

occur in Indonesia. In 2019, there were four barge docking workers at Tanjung Semarang Port who were found dead in a manhole suspected of experiencing gas poisoning (Purbaya, 2019). Then in 2021, five workers died while repairing a manhole in a culvert. The five victims allegedly died after inhaling toxic natural gas (Naufal and Sari, 2021).

Work accidents while working in confined spaces were also experienced by employees of PT Riau Prima Energi (RPE) which resulted in the death of a worker and three other employees had to be hospitalized due to respiratory problems. The cause of the victim's death was due to inhalation of Sulfamic acid chemicals. In addition, two workers of PT Gading Sawit Kencana (GSK) in Central Kalimantan also died after falling into the palm kernel tank, suspected of experiencing a lack of oxygen (Mardlotillah, 2020).

Due to the potential risks and hazards that can occur in confined spaces, working in confined spaces requires specific accuracy, skills and expertise. In addition, it is also necessary to have regulations in order to guarantee safety and health protection for workers who carry out work activities in confined spaces, both in the form of laws and regulations, work procedures, as well as control and supervision. Workers carrying out work activities in confined spaces must have a work permit and confined space entry permit before carrying out their work in confined spaces. Confined Space Entry Permit, hereinafter referred to as Entry Permit, is a written document issued by the Management to allow activities and supervise activities in a confined space (Minister of Manpower of the Republic of Indonesia, 2023).

PT X is a state-owned wnterprise (SOE) which is a well-known and complete fertilizer company in Indonesia. The provision of quality fertilizer products, chemical products, and services according to consumer demand is carried out through a production process that is of course done by implementing a management system that guarantees quality, prevents pollution, and has a culture of occupational safety and health (K3). In order for the production process to run smoothly, PT X makes efforts to protect and guarantee safety at work for its workers so that they can work productively, especially in work activities that have high risks. PT X certainly also has work activities in confined spaces, one of which is in the Phosphoric Acid Unit of Plant III. The work is carried out during the activity of Cleaning Strainer Line Discharge P-2501 or the activity of cleaning the phosphoric acid tank.

Based on the findings made during the initial observation through the Hazard Identification, Risk Assessment, and Determining Control (HIRADC) document on work in confined spaces in the Phosphoric Acid Unit of Plant III of PT X states that the work has a high risk. High risk works at PT X include those that deal with hazardous chemicals, such as plant operators, technicians, and workers in the production area. These works involve exposure to toxic chemicals, possible leaks, and the risk of industrial accidents. Therefore, from the HIRADC results obtained and that the work in confined spaces has characteristics that match the high risk work at PT X, the researcher was interested in conducting further research related to work in confined spaces. The purpose of this study was to analyze the commitment applied by the company to occupational safety and health toward workers in confined space work, especially in the Phosphoric Acid Unit of Plant III PT X. It was expected that this research can be useful for related industries to take preventive steps in order to reduce the risks and hazards that can arise from work activities in confined spaces that have the potential to occur to workers who carry out these work activities.

METHODS

This research was a descriptive study conducted at PT X Gresik, East Java, Indonesia in March 2022 using the observation method for data collection. Descriptive studies are research conducted to describe phenomena that occur in a real, actual, and realistic manner to make descriptions and images systematically, factually, and accurately about the facts of the relationship between the phenomena studied (Rukajat, 2018). Data collection was carried out through data analysis and related documents, literature studies, and interviews with one of the workers in the Occupational Safety and Health Department (K3) at PT X whose job is to supervise the work in confined spaces.

The object to be evaluated in this study was related to the company's commitment to occupational safety and health for workers in confined space work in the Phosphoric Acid Unit of Plant III PT X, such as the analysis of Hazard Identification, Risk Assessment, and Determining Control (HIRADC) documents that have been made by PT X. From the HIRADC data that had been obtained, the researcher looked at the scores of the risks and hazards of the work in confined space which had previously been determined by the K3 Department of PT X. The scores were then interpreted through the Likelihood Criteria, Consequence Criteria, and Risk Matrix tables to determine the level of danger of the work in confined space. In addition, data analysis was also conducted by comparing the procedures that have been applied to the work in confined space of the Phosphoric Acid Unit of Plant III, such as the existence of safety permits, gas measurements in confined spaces, the hierarchy of controls carried out, and the availability of other supporting documents or programs as to whether they were in accordance with the work

instruction or procedure documents that have been made by PT X. Number of Ethics Code: 0575/HRECC.FODM//2025.

Table 1. Likelihood Criteria

Level	Criteria	Description
1	Rare	Almost never/very rarely occurs
2	Unlikely	Rarely occurs
3	Possible	May occur occasionally
4	Likely	Frequent occurrence
5	Almost Certain	Very frequent

Table 2. Consequence Criteria

Level	Criteria	Description
1	Insignificant	No injury, financial loss is very small, negligible
2	Minor	There is an injury and requires first aid, minor financial loss
3	Moderate	Injuries requiring medical treatment, financial loss of medium
4	Major	Severe injury requiring immediate hospitalization, major financial loss
5	Catastrophic	Death, huge financial loss

Table 3. Risk Matrix

Description		Consequence				
		Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Likelihood	**Almost Certain**	H	H	E	E	E
	Likely	M	H	H	E	E
	Possible	L	M	H	H	H
	Unlikely	L	L	M	M	H
	Rare	L	L	L	L	M

Description:
L = Low
M = Moderate
H = High
E = Extreme

RESULTS AND DISCUSSION

The most common confined space in PT X is the raw material (chemical) storage tank. One of the work units that have work activities in confined spaces is the Phosphoric Acid Unit at Factory III. In this unit, the work activity in confined spaces carried out is cleaning the raw material storage tank in the form of phosphoric acid or Cleaning Strainer Line Discharge P-2501.

Table 4. Hazard Identification, Risk Assessment, and Determining Control (HIRADC) Work in Confined Space at Phosphoric Acid Unit of Plant III of PT X.

Activity	Hazard	Risk Identification		Inherent Risk				Existing Control
		Description	Consequences	L	C	RF	Cat	
Cleaning Strainer Line Discharge P-2501	Work in a confined space	Ran out of oxygen while working in a 32-inch pipe line	Fatality	2	5	10	H	**Engineering** - Blower installation **Administration** - Safety permit creation - Gas measurement - Installation of warning signs for working in confined spaces **Personal Protective Equipment** - Use of PPE appropriate to the area (gas mask and safety shoes)

Description:
L = Likelihood
C = Consequence
RF = Risk Factor
Cat = Category

Based on the data contained in the Hazard Identification, Risk Assessment, and Determining Control (HIRADC) that has been carried out, it was known that the potential hazards in the P-2501 Cleaning Strainer Line Discharge activity were included in the high risk category and had an impact on fatality or death. In addition to conducting HIRADC, the confined space in the Phosphoric Acid Plant III Unit that will be used to carry out the P-2501 Cleaning Strainer Line Discharge activity was also first measured by the safety inspector. The gases measured in this confined space in the form of phosphoric acid tanks were oxygen (O_2) and phosphoric acid gas (HF). From the results of measurement of these gases that was conducted on November 26, 2021, it was known that the confined space that will be used for the activity of Cleaning Strainer Line Discharge P-2501 in the Phosphoric Acid Unit of Plant III was declared safe for workers to enter and carry out work activities because the concentration of O_2 and HF were below the threshold limit value (TLV).

Table 5. Gas Measurement in Confined Space of Phosphoric Acid Unit of Plant III of PT X.

Gas Type	Threshold Value (TLV)	Measurement Results
O_2	19.5% - 23.5%	20.9%
HF	0.5 ppm	0.0 ppm

Hazards Identification

PT X has workplaces in the form of confined spaces, including pipelines, silos, Hazardous and Toxic Material (B3) storage tanks, raw material storage tanks, side material storage tanks to be reprocessed (waste treatment tanks), and boilers located scattered throughout the factory area. The most common confined space at PT X is in the form of tanks. One of the work units at PT X that has work activities in confined spaces is the Phosphoric Acid Unit at Plant III. In this unit, the activity carried out is cleaning the phosphoric acid raw material storage tank or Cleaning Strainer Line Discharge P-2501.

Hazard identification is a process carried out to determine the overall situation or events in work activities that can potentially cause occupational accidents and occupational diseases that may arise in the workplace. Companies must establish and implement procedures to identify hazards from their work activities, assess risks, and determine the necessary hazard controls. The ability to identify hazards is important to prevent work accidents, so efforts can be made to minimize the level and threat of these hazards to a safer level (Hasibuan *et al.*, 2020).

The hazardidentification stage in the study was carried out by analyzing the Hazard Identification, Risk Assessment, and Determining Control (HIRADC) that had been previously made by the Production Department III B Phosphoric Acid II Section. This hazard identification aims to understand all situations or sources of danger that exist at each stage of work activities that can potentially cause accidents and occupational diseases that may arise in the workplace (Rofiq and Azhar, 2022). The work activity observed was the cleaning of one of the tools in the phosphoric acid raw material storage tank, namely Cleaning Strainer Line Discharge P-2501.

Hazard Identification, Risk Assessment, and Determining Control or commonly abbreviated as HIRADC is a series of processes to identify potential hazards, measure, and evaluate the risks arising from the existence of these hazards and then assess the risks of the hazards that have been identified (Cholil *et al.*, 2020). The results of the risk assessment will later be useful for the main basis for the preparation of OHS goals and targets, as well as hazard control programs by companies or industries in order to prevent, minimize, and even eliminate the level of risk of occupational accidents (zero accident) in the workplace (Ramadhania *et al.*, 2021). Risk assessment was carried out by looking at the guidelines in the Australian Standard/New Zealand Standard for Risk Management (AS/NZS, 2004). The parameters used in the risk assessment consist of Consequence (C), which is the magnitude of the impact of the hazard and Likelihood (L), which is how likely the hazard is to occur. The value of Likelihood and Consequence will later be used to determine the value of the Risk Matrix or Risk Factor (Ramadhan, 2017), by which the scale refers to the standards made by PT X.

Based on the HIRADC that has been carried out before the start of work, the Cleaning Strainer Line Discharge P-2501 activity has a potential hazard, namely running out of oxygen while working in the pipe line 32 inchi. The occurrence of oxygen deprivation while working in a confined space can cause shortness of breath; therefore, it is also mentioned that the consequence of the potential hazard is fatality or death. From the HIRADC data, it was also known that the inherent risk of cleaning activities in confined spaces has a likelihood value of 2, which means that the possibility of potential risks is unlikely, has occurred more than once and the possibility of repetition is rare. Meanwhile, the consequence value was 5, which means that it has the potential impact of fatality or the potential to cause death and the potential impact of permanent total disability due to occupational accidents and occupational diseases.

From the likelihood and consequence values, it was discovered that the risk factor value was 10. From the risk factor value, the Cleaning Strainer Line Discharge P-2501 activity was included in the High Risk category and further action was needed so that the hazard could be minimized to the As Low As Reasonably Practicable (ALARP) level or the hazard was at the lowest possible level, but did not interfere with the work process. Knowing the high risk that potentially arises when carrying out work activities in this limited space, the Production Department III B Phosphoric Acid II Section has carried out hazard control (existing control). Hazard control was conducted based on the hierarchy of control, which includes engineering control, administration control, and the use of personal protective equipment.

The engineering control was carried out by installing a blower to keep the air circulating. The administrative control was carried out by making a safety permit (work permit) and taking gas measurements before carrying out work in a confined space, as well as installing signs warning of work activities in the confined space. Workers who will enter the confined space were also given Personal Protective Equipment (PPE) that must be worn while working in the form of gas masks and safety shoes. In addition to making HIRADC, before the work in the confined space begins the Safety Inspector will first take gas measurements in the confined space of the Phosphoric Acid Plant III Unit which will be used to carry out the Cleaning Strainer Line Discharge P-2501 activity. The gases measured in this confined space in the form of phosphoric acid raw material storage tanks were oxygen (O_2) and phosphoric acid gas (HF).

From the measurement of gases in the phosphoric acid raw material storage tank, it was discovered that the concentration of O_2 had a level of 20.9% with a threshold limit value (TLV) of 19.5%-23.5%, which means that the concentration of oxygen in the phosphoric acid raw material storage tank is still in accordance with the provisions of the TLV according to the Regulation of the Minister of Manpower of the Republic of Indonesia Number 11 of 2023 concerning Occupational Safety and Health in Confined Spaces (Minister of Manpower of the Republic of Indonesia, 2023a). In addition, the measurement also shows that the concentration of HF gas was 0.0 ppm with a TLV of 0.05 ppm, which means that the concentration of phosphoric acid gas in the phosphoric acid raw material storage tank was below the TLV according to the Regulation of the Minister of Manpower of the Republic of Indonesia Number 5 of 2018 concerning Occupational Safety and Health in the Work Environment (Minister of Manpower of the Republic of Indonesia, 2018). That way, the confined space in the form of a phosphoric acid raw material storage tank wass declared feasible and safe for workers to enter and carry out work activities Cleaning Strainer Line Discharge P-2501.

Work Instructions

A work instruction is a set of steps established to perform and complete a job safely and completely. Work instructions are prepared to provide work order guidance for workers when completing a type of work. Work instructions are also formed to complement Standard Operating Procedures (SOP) that have been previously made in a work unit (Al Azhar University Indonesia, 2019).

PT X has a work instruction regarding inspection or monitoring of work in confined spaces for workers who will work in confined spaces. The work instruction aims to provide guidelines or instructions on the steps that must be taken when working in confined spaces in order to prevent accidents and occupational diseases. The work instruction was prepared by the Occupational Safety and Health (OHS) section of PT X's Environment & OHS Department. The key points discussed in the confined space work instruction include the following:

1. Conduct gas tests or gas measurements before workers enter confined spaces. Gas measurements include oxygen levels, flammable gases and vapors, and potentially hazardous air contaminants. Measurements are carried out using calibrated equipment and ensuring that electrical equipment has been tagged and locked, all pipes are emptied, pressure is removed, and blanking/blinding is carried out.
2. Gas measurements inside confined spaces should be tested periodically or at least once per work shift to ensure that the airflow settings can prevent the accumulation of harmful air inside the confined space.
3. If hazardous air is detected during work in the confined space, each worker is required to leave the confined space immediately and an evaluation is conducted to determine how the hazardous air occurred.
4. All workers who will carry out work activities in confined spaces are required to use Personal Protective Equipment (PPE) in accordance with potential work hazards, such as safety hats, gas masks (half mask/full face mask/air line respirator), goggles, safety shoes, alkaline/acid resistant clothing/Chemical Protective Suit for work in sulfuric acid, phosphoric acid, and ammonia tanks. Workers can also use full body harness if access to space is limited using scaffolding with a height of≥2 meters and other PPE according to the potential work hazards faced.
5. If the access/entry/man hole cover is opened, a sign or other temporary barrier must be installed to prevent accidental entry of workers and to protect workers in the confined space from foreign objects entering the room, one of which is by installing a "Watch Out for People Working Inside" sign outside the confined space. In addition to installing signs, it is necessary to provide information boards to place safety permits, job safety analysis (JSA), and other information during the work.
6. All workers who enter the confined space are tagged and recorded and leave their ID cards on the information board, which is removed when the worker leaves.
7. There must be at least one person to supervise at the entrance during confined space work and make direct communication contact with workers inside the confined space.
8. A continuous clean air flow system must be provided while workers are inside, provided that the air flow is directed in such a way that it can reach the area where workers will be performing activities.
9. All workers who will be working in confined spaces must have been educated and have the necessary knowledge and skills to perform work in confined spaces safely, especially regarding potential hazards related to work in confined spaces.
10. It must be ensured that workers in confined spaces are physically fit and do not have a history of: epilepsy; heart disease; headaches, such as migraine or vertigo that can cause disorientation; claustrophobia or other mental disorders; spinal disorders or pain; permanent visual disability; and other diseases that can jeopardize safety and health while working in confined spaces.

Implementations of Occupational Health and Safety

Based on data from related documents, matters regarding Occupational Health and Safety (OHS) implemented in the work of Cleaning Strainer Line Discharge P-2501 in the confined space of Phosphoric Acid Unit of PT X Plant III are as follows:

1. Safety Permit

   A safety permit is a document used to control the risks and potential hazards of work accidents, administrative losses, and to ensure safe work procedures are followed (Febriyani, Mulya and Fuadi, 2020). Safety permit is generally a letter stating that the work object for repair work and/or inspection in hazardous work areas has been inspected and the work is declared safe to do and is equipped with recommended safety equipment and safeguards. A Confined Space Safety Permit must be made before the work begins. In addition to the safety permit, it must also be completed with a job safety analysis (JSA) hat has previously been approved in a JSA meeting.

   Safety permits are filled out by the service

requesting work unit and the work implementation work unit. In the work activity of Cleaning Strainer Line Discharge P-2501 at Phosphoric Acid Unit Plant III, the service requesting unit is the Production Department III B Phosphoric Acid II Section, while the implementation of the work is a contractor appointed by PT X to carry out the work. The validity period of the safety permit is according to the shift or eight working hours. If the work has not been completed, the previous safety permit must be closed, then a new safety permit approval made. Every Safety Inspector in supervising work activities in confined spaces must always carry a STOP card, which is the authority to stop work if there is potential that can cause work accidents.

2. Workplace Preparations

In the activity of Cleaning Strainer Line Discharge P-2501 at Phosphoric Acid Unit Plant III, workplace preparation is carried out by:

a. Check that the watering hoses are fitted and connected.
b. Availability of fire extinguishers.
c. Explosive and flammable materials have been secured.
d. A fire watcher has been appointed.
e. The work area is wetted and/or marked with warning signs and safety lines.
f. All pipes have been emptied, pressure relieved, and blocked and blinded.
g. Pipes have been cleaned and/or purged.
h. The tank was neutralized before workers entered.
i. Artificial ventilation and/or exhaust fans/blowers are available.
j. A manhole man has been appointed.
k. All safety devices have been checked and are ready for use.
l. Breaker removed and Lock Out and Tag Out (LOTO) installed.
m. Communication tools are available.

3. Personnel Preparations

Before working in confined spaces, each worker is required to attach a health certificate from a doctor stating that the worker is in good health and has no history of diseases meaning that they are not allowed to work in confined spaces based on the standards at PT X, namely:

a. Epilepsy.
b. Heart disease or heart problems.
c. Asthma, bronchitis, or shortness of breath with fatigue.
d. Hearing impairment.
e. Headaches such as migraine or vertigo that can cause disorientation.
f. Claustrophobia or other mental disorders.
g. Spinal disorders or pain.
h. Permanent visual disability.
i. Other diseases that can jeopardize safety while working in confined spaces.

Every worker who did work in confined spaces at PT X had previously been given a safety induction by the K3 Department staff and safety briefing by the Safety Inspector and the area owner unit. Safety briefing was conducted on the first day before the work starts and the material presented was about potential hazards and safe working standards in confined spaces. The provision of safety briefing aims to ensure that the workforce on duty can understand and do their work safely in confined spaces, so as to minimize the occurrence of work accidents or even zero.

PT X also conducted job rotation for workers who worked in the tank. The maximum workforce in the tank was 30 minutes, after which the workers left and were replaced by other workers. This was done with the aim that workers can breathe fresh air and to maintain the physical condition of the workforce.

4. Testing before Entering a Confined Space

Before the worker on duty enters the confined space to carry out the activity of Cleaning Strainer Line Discharge P-2501 in the Phosphoric Acid Unit of Plant III, gas measurement is first carried out by the Safety Inspector of the related area. The gases measured in this activity are oxygen (O_2) and phosphoric acid (HF). One of the gas measurement results shows that the confined space in the form of a phosphoric acid raw material storage tank that will be used for the P-2501 Cleaning Strainer Line Discharge activity in the Phosphoric Acid Unit of Plant III was declared safe to enter because O_2 was at a concentration of 20.9%, which is still at a concentration according to the threshold limit value (TLV) of 19.5%-23.5%. Then, the concentration of HF also fell below the TLV (0.5 ppm), which was 0.0 ppm. After measurements are taken and declared safe, the manhole in the confined space would be tagged "SAFE," which means that the tank is allowed to be entered by workers and work activities are carried out in it.

5. Communication Systems

The communication system in confined space work aims to monitor the condition of the main officer when working in the manhole and make it easier to notify the main officer in the event of a factory emergency. The communication system implemented at PT X was manually voiced between the main officer and the middle officer. In addition, each safety partner uses a communication device in the form of a Handy Talky (HT) which is used in the event of an emergency to contact the Area

Safety Inspector and rescue officer.

6. Use of Personal Protective Equipment (PPE)

   Personal Protective Equipment (PPE) used when working in the confined space of the Phosphoric Acid Plant III Unit in the P-2501 Cleaning Strainer Line Discharge activity includes:

   a. Safety helmet
   b. Safety goggles
   c. Leather gloves
   d. Face shield
   e. Rubber shoes
   f. Wearpack
   g. Gas mask

Hierarchy of Control

Risk control is a tool for companies to make decisions in reducing or avoiding the risk of hazards that are potentially faced. The potential risk of harm can be controlled by determining the priority scale in the selection of risk control called the hierarchy of control. The risk control hierarchy is a stage of risk control prevention that has the potential to arise consisting of several levels with a priority scale (Gea, Febrian and Praja, 2023). The risk control hierarchy consists of:

1. Elimination

   Elimination is an effort to control hazards by eliminating the source of the hazard. This stage is the top priority in the risk control hierarchy. Elimination can be done by eliminating dangerous equipment or materials, eliminating an unnecessary process, and changing the construction design to remove hazards (Ramadhan, 2017). In the activity of cleaning strainer line discharge P-2501 confined space work in the Phosphoric Acid Unit at Plant III, risk control in the form of elimination was not carried out because it was not possible to eliminate phosphoric acid, which is a source of danger. This is because phosphoric acid is a raw material for making fertilizer, so it cannot be eliminated or replaced by other materials.

2. Substitution

   Substitution is the second step in the risk control hierarchy if elimination cannot be done. Substitution is an effort to replace hazardous materials with other safer materials. This substitution aims to replace the source of danger which can be in the form of hazardous materials, equipment, components, processes, or substances with other materials or equipment that are safer or lower in risk level (Timothy and Widiawan, 2022). Risk control in the form of substitution was not carried out in the activity of cleaning strainer line discharge P-2501 confined space work in the Phosphoric Acid Unit at Plant III. Phosphoric acid, which is the source of danger in this activity, was not possible to be replaced with other safer materials because phosphoric acid is a raw material for making fertilizers.

3. Engineering Control

   Engineering control is the third stage in the risk control hierarchy. Engineering control is done if elimination and substitution cannot be done. Engineering control is an effort to control risks by making improvements to equipment or workplace design, modifying work tools or work processes, providing protection for machines to minimize hazards. This control aims to separate the risk of hazards from workers and to prevent error (Tarigan and Hutagalung, 2022).

   Engineering control in a confined space or tank is a hazard control effort aimed at sources of danger inside or outside the tank or in the environment around the tank. Hazard control through engineering is installed in a machine or equipment system unit. Control or engineering carried out in the activity of cleaning strainer line discharge P-2501 confined space work in the Phosphoric Acid Unit at Plant III was by installing air ventilation in the form of a blower which serves to minimize the occurrence of hot temperatures while working in the tank.

4. Administrative Control

   Administrative control is the fourth stage in the risk control hierarchy. Administrative control focuses on implementing appropriate regulations, safe work procedures, developing work standards (SOPs) and safety training as risk control measures or reducing hazard levels. Administrative control can also be done by modifying the interaction of workers with the work environment through work rotation, work shifts, and housekeeping (Tarigan and Hutagalung, 2022). Administrative hazard control in confined spaces or tanks is carried out through the creation of administrative regulations that regulate workers to limit their contact time (exposure) with hazard factors or contaminants in confined spaces. Administrative control carried out in the activity of cleaning strainer line discharge P-2501 confined space work in the Phosphoric Acid Unit at Plant III was by making job safety analysis (JSA), safety permits, measuring the gases in the tank before the start of work, and installing warning signs of working in confined spaces.

5. Use of Personal Protective Equipment (PPE)

   Personal Protective Equipment (PPE) is a set of tools used by workers to protect all or part of their bodies from potential hazards or work accidents while carrying out their work activities. Hazard control through the use of

PPE is the last resort in an effort to protect the workforce if engineering control and administrative efforts cannot be carried out properly. The selection and use of PPE is the least effective thing in hazard control, because PPE only serves to reduce the risk of the impact of hazards. The use of PPE in the activity of cleaning strainer line discharge P-2501 confined space work in the Phosphoric Acid Unit at Plant III was by using safety helmets, safety goggles, leather gloves, face shields, rubber shoes (safety shoes), wearpacks, and gas masks.

The strength of this research was that the topic discussed was specific and relevant to the present as work safety issues in confined spaces are still a major concern in various industries. In addition, this research has adopted the latest regulations related to occupational safety and health in confined spaces, thus supporting the relevance and actuality of the discussion. Meanwhile, the shortcoming of this research was the limited primary data obtained. The HIRADC document provided by the company was not focused on confined space work only, but included other high-risk work at PT X. This resulted in data related to the types of activities in the confined space. This caused the data related to the types of activities, risks, and hazards of work in confined spaces at PT X to not provide a real picture of the existing conditions.

CONCLUSION

Based on data on Hazard Identification, Risk Assessment, and Determining Control (HIRADC) that had been conducted by the Production Department III B Phosphoric Acid II Section, work in confined spaces in the form of cleaning strainer line discharge P-2501 was included in high-risk work with the potential danger of running out of oxygen that could cause death (fatality). Therefore, prior to the confined space work for the P-2501 cleaning strainer line discharge activity in the Phosphoric Acid Unit of Plant III, gas measurement by the Safety Inspector of the relevant area was carried out first. The types of gas measured in this work activity were oxygen and phosphoric acid.

From the measurement results, it was known that the tank that would be used for the P-2501 discharge line strainer cleaning work was declared safe to enter and work in because the concentration of both types of gas was below the threshold limit value (TLV) according to existing regulations. Although the measurement results of the two types of gas in the phosphoric acid tank state that it was safe, PT X still carried out risk control of potential hazards that might arise considering that work in confined spaces was included in high-risk work. Hazard control was conducted based on the risk control hierarchy: namely engineering control by installing a blower; administrative control by making JSA, safety permit, gas measurement before work starts, and installing related signs; and the use of PPE by using safety helmet, safety goggles, leather gloves, face shield, rubber shoes (safety shoes), wearpack, and gas mask.

Suggestions that can be given to PT X Gresik, especially in the Production Department III B Phosphoric Acid II Section, are to conduct regular education and training for workers who are tasked with carrying out work activities in confined spaces. Work rotation is also important, especially for workers who often do or have been doing work activities in confined spaces for a long time. In addition, PT X should strive to facilitate workers who work in confined spaces to conduct special and periodic health checks.

Acknowledgement

Praise be to Allah SWT for all His mercy and grace so that this journal could be completed with the title "Analysis of Company Commitment to Occupational Health and Safety in Confined Space Work at Phosphoric Acid Unit Plant III PT X", as one of the academic requirements in order to obtain a Bachelor of Public Health (S.KM.) degree at the Faculty of Public Health, Universitas Airlangga. On this occasion, I would like to thank Mrs. Endang Dwiyanti, Dra., M.Kes., as the supervisor, and PT X Gresik, East Java for allowing me to conduct research and process data to make this journal.

Conflict of Interest and Funding Disclosure

None.

Author Contributions

RNM: writing–original draft, writing–review and editing, conceptualization, data curation, methodology, analysis and interpretation of result; ED: supervision.

REFERENCES

AS/NZS (2004) *Australian Standard/New Zealand Standard for Risk Management (AS/NZS 4360:2004)*. Available at: www.saiglobal.com/shop (Accessed: 2 December 2024).

Cholil, A.A. *et al.* (2020) 'Penerapan Metode HIRADC Sebagai Upaya Pencegahan Risiko Kecelakaan Kerja Pada Divisi Operasi Pembangkit Listrik Tenaga Gas Uap', *Jurnal Bisnis & Manajemen*, 20(2), pp. 41–64. https://doi.org/https://doi.org/10.20961/jbm.v20i2.54633.

Febriyani, D., Mulya, W. and Fuadi, Y. (2020) 'Analisis Penerapan Sistem Safety Permit di Unit PLTU Teluk Balikpapan', *Jurnal Keselamatan, Kesehatan Kerja dan Lindungan Lingkungan*, 6(2), pp. 330–339. https://doi.org/https://doi.org/10.36277/identifikasi.v6i2.133.

Gea, H.V., Febrian, M.R.S. and Praja, N.S. (2023) 'Analisis Keselamatan dan Kesehatan Kerja Menggunakan Metode HIRARC di PT XYZ', *Jurnal Logistics & Supply Chain (LOGIC)*, 02(01), pp. 20–26. https://doi.org/https://doi.org/10.33197/jlscc.v2i1.1006.

Gultom, G.O. and Widajati, N. (2016) 'Hubungan Personal Factor Dengan Safety Behaviour Pekerja Confined Space PT. X', Jurnal Ilmiah Keperawatan, 2(2), pp. 2477–4391.

Hasibuan, A. *et al.* (2020) *Teknik Keselamatan dan Kesehatan Kerja*. Edited by J. Simarmata. Yayasan Kita Menulis.

Mardlotillah, N.I. (2020) 'Manajemen Risiko Keselamatan dan Kesehatan Kerja Area Confined Space', *HIGEIA Journal of Public Health Research and Development*, 4(1), pp. 315–327. https://doi.org/10.15294/higeia.v4iSpecial%201/40911.

Menteri Ketenagakerjaan Republik Indonesia (2018) 'Peraturan Menteri Ketenagakerjaan Republik Indonesia Nomor 5 Tahun 2018 Tentang Keselamatan dan Kesehatan Kerja Lingkungan Kerja'.

Menteri Ketenagakerjaan Republik Indonesia (2023) 'Peraturan Menteri Ketenagakerjaan Republik Indonesia Nomor 11 Tahun 2023 Tentang Keselamatan dan Kesehatan Kerja di Ruang Terbatas'. Available at: https://peraturan.go.id/files/permenaker-no-11-tahun-2023.pdf (Accessed: 10 July 2024).

Naufal, M. and Sari, N. (2021) *Tiga Karyawannya Tewas di Gorong-gorong Cipondoh, Telkom: Murni Kecelakaan Kerja*, *Kompas*. Available at: https://megapolitan.kompas.com/read/2021/10/08/15195731/tiga-karyawannya-tewas-di-gorong-gorong-cipondoh-telkom-murni-kecelakaan?page=all (Accessed: 2 December 2024).

Proxsis East (2017) *Pengetahuan Umum Tentang Ruang Terbatas (Confined Space)*, *Proxsis Group*. Available at: https://surabaya.proxsisgroup.com/pengetahuan-umum-tentang-ruang-terbatas-confined-space/ (Accessed: 2 December 2024).

Purbaya, A.A. (2019) *4 Orang Tewas Saat Perbaiki Kapal Tongkang di Pelabuhan Semarang*, *detikNews*. Available at: https://news.detik.com/berita-jawa-tengah/d-4643075/4-orang-tewas-saat-perbaiki-kapal-tongkang-di-pelabuhan-semarang (Accessed: 2 December 2024).

Ramadhan, F. (2017) 'Analisis Kesehatan dan Keselamatan Kerja (K3) Menggunakan Metode Hazard Identification Risk Assessment and Risk Control (HIRARC)', in *Seminar Nasional Riset Terapan*, pp. 164–169.

Ramadhania, M. *et al.* (2021) 'Analisis Hazard Identification, Risk Assessment, Determining Control (Hiradc) Pada Aktivitas Kerja Di Ud Ridho Abadi Tangerang Selatan Tahun 2020', *Environmental Occupational Health and Safety Journal*, 2(1), pp. 59–68. https://doi.org/https://doi.org/10.24853/eohjs.2.1.59-68.

Rofiq, M.A. and Azhar, A. (2022) 'Hazards Identification and Risk Assessment In Welding Confined Space Ship Reparation PT. X With Job Safety Analysis Method', *BERKALA SAINSTEK*, 10(4), pp. 175–161. https://doi.org/10.19184/bst.v10i4.32669

Rukajat, A. (2018) *Pendekatan Penelitian Kuantitatif: Quantitative Research Approach*. Yogyakarta: Deepublish (CV Budi Utama).

Tarigan, R. and Hutagalung, J. (2022) 'Analisis dan Pengendalian Risiko dengan Metode Hazard Identification, Risk Assessment, dan Risk Control pada Proyek Pembangunan Living Plaza Medan', *Portal: Jurnal Teknik Sipil*, 14(1), pp. 1–9. https://doi.org/http://dx.doi.org/10.30811/portal.v14i1.2333.

Timothy, M. and Widiawan, K. (2022) 'Hazard Identification, Risk Assessment and Risk Control (HIRARC) pada CV Lisa Jaya Mandiri Food', *Jurnal Titra*, 10(2), pp. 641–648.

Universitas Al Azhar Indonesia (2019) *Pedoman Pembuatan Instruksi Kerja (IK)*. Universitas Al Azhar Indonesia.

U.S. Bureau of Labor Statistics (2020) *Fact Sheet | Fatal occupational injuries involving confined spaces | July 2020*. Available at: https://www.bls.gov/iif/factsheets/fatal-occupational-injuries-confined-spaces-2011-19.htm (Accessed: 10 July 2024).