

---

# Analysis of Occupational Safety and Health using The HAZOP Method on PT. ABC 3 Kg LPG Gas Cylinder Maintenance Workshop Employees

\*Aminatus Suhra<sup>a</sup>, Emon Rifa'i<sup>b</sup>

<sup>a</sup> Universitas KH. Bahaudin Mudhary Madura, Sumenep, Indonesia

<sup>b</sup> Universitas KH. Bahaudin Mudhary Madura, Sumenep, Indonesia

---

## ABSTRACT

Every company activity is inseparable from the risk of danger, therefore companies need to make efforts to minimize the consequences that could be detrimental. To minimize this, risk management activities are needed. In risk management, we must know what potential dangers may occur in the activity and the level of risk posed so that we can take appropriate preventive and control measures. Potential hazard analysis was carried out at the 3kg LPG gas cylinder maintenance workshop at PT. A B C. Due to the production process activities carried out by the workers, the workers still lack the self-awareness to wear personal protective equipment and there are less ergonomic working postures. Analysis using the HAZOP Worksheet method. The results of data processing show that sources of danger that can or have the potential to cause work accidents are worker attitudes, work environment conditions, falling materials, noise and sand particles. It is known that there are ergonomic risks in the work of the 3KG LPG gas cylinder maintenance workshop. The risks experienced include musculoskeletal disorders and fatigue that appears in the waist, arms, wrists, calves and ankles, as well as the neck. General steps that can be implemented to reduce potential hazards and risks are to require and emphasize all workers to use Personal Protective Equipment and provide workers with the tools they need, such as ergonomic tables and chairs. By implementing this, it can reduce work-related accidents.

**Keywords :** Hazard, Work Accident, HAZOP.

---

## Article History

Received 02 September 23

Received in revised form 16 October 23

Accepted 09 December 23

---

## 1. Introduction

Every work environment always has a risk of work accidents. The magnitude of a work accident depends on the type of industry, technology and risk control in the work environment. The implementation of work safety and health is very important because it is an effort to minimize work accidents that occur in the company, and is an effort to protect for workers so that when working at the workplace the workers will always feel safe and comfortable (Myrtanti & Suardika, 2022). Along with the presence of very sophisticated technology, it can cause huge side effects if we cannot control or operate the tool and can cause losses when using it. Carrying out work activities certainly has risks and dangers, if these potential dangers are not controlled it will cause fatigue, illness, work-related injuries and can even result in serious accidents (Ditya et al., 2021). Therefore, companies must provide facilities and a safe working environment to create comfort while working. Apart from that, companies must guarantee occupational safety and health for workers. One of them is by paying attention to Occupational Safety and Health (K3) conditions.

Occupational Safety and Health (K3) is a topic that cannot be separated in the labor system which is directly related to human resources. K3 is not only important in the social security and welfare of workers, but can have an impact on the success of a company's productivity. Occupational safety

and health issues are not solely the responsibility of the government but are the responsibility of all parties, especially workers and company owners. Every company hopes to increase or produce high productivity, quality products that cannot be separated from the role of human resources (HR), therefore the company will always try and optimize (HR) so that the company's goals can be achieved (Muhammad Nur, 2017)

A good company is a company that can maintain the work safety and health of its employees by making rules and programs regarding (K3) which must be implemented by all employees and company leaders (Triadi et al., 2022). One of the reasons why so many workers die due to work accidents (380 thousand workers (13.7%) out of 2.78 million) is due to the lack of awareness among agencies and employees regarding the importance of implementing Occupational Safety and Health (K3) in the workplace (Rismawati et al., 2016). Therefore, the K3 program is really needed by employees so that employees feel safe and comfortable while working. For this reason, companies must be stricter and firmer so that employees can comply with the rules for implementing K3 itself.

Operators in the 3kg LPG gas cylinder maintenance workshop work one working day (approximately 8 hours) to ensure that gas cylinder maintenance is carried out efficiently, with working hours reaching 8 hours per day. Operators in the 3kg LPG gas cylinder maintenance workshop play an important role in ensuring The gas cylinder is in good condition and ready for use by consumers.

---

\* Corresponding author.

E-mail address: [aminatussuhra@unibamadura.ac.id](mailto:aminatussuhra@unibamadura.ac.id)

PT. ABC is a 3kg LPG gas cylinder maintenance workshop company. This research was conducted at PT. ABC, where there are still quite a number of work accidents, both minor and serious accidents. When repairing LPG gas cylinders, the important things that must be considered are the welding process, painting, Open/Close Valve process, gas purging, hand guard, Shoot Blasting process, and Hydros Test. Incorrect processes result in material/product damage and can cause work-related accidents that can claim lives. Such as welding which can cause the eyes to easily hurt/tired when welding tubes if you don't wear protective glasses and during the painting process if you are not skilled in that field it will be fatal because paint that can enter the body can cause death, as well as the Open/Close Valve process if Not concentrating will cause your hands to get pinched and this can have fatal consequences, of course. Because this process is very important in the operation of repairing 3KG LPG gas cylinders. Therefore, it is necessary to have adequate planning and supervision to reduce the risk of damage to equipment and products, as well as the risk of occupational health and safety hazards during the process.

The object of this research is to identify or determine the potential for a hazard and analyze operational processes using the Hazard and Operability study (HAZOP) method. The Hazard and Operability study (HAZOP) method aims to survey framework procedures efficiently and to decide whether deviations from a process can cause an unwanted work accident.

Efforts need to be made to improve occupational safety and health in LPG gas cylinder maintenance workshops, such as by adjusting work posture, reducing workload, and providing training on work ergonomics. Therefore, researchers carry out occupational safety and health analyzes to identify potential hazards and risks and determine appropriate preventive measures. The HAZOP (Hazard and Operability Study) method is a method that can be used to identify potential dangers and risks in work processes.

## 2. Literature Review

In general, occupational health and safety is an effort to protect against all potential dangers. It is hoped that the workforce around the workplace will always be safe and healthy and the production process will run safely and efficiently. The aim of Occupational Safety and Health is to build a safe, comfortable and healthy environment. So that a healthy workforce can be created that is protected from work-related accidents and can increase work productivity and company efficiency. Efforts to implement K3 are to protect workers from production equipment so that their safety is always guaranteed, as well as protecting people around the work environment so they remain healthy (Rasyidi, 2021). In Law No. 1 of 1970 concerning Work Safety, by imposing strict sanctions on employees who commit violations, namely penalties (a 10% penalty system and postponement of promotion) the aim is that every employee is able to be more careful and follow procedures (Kartikasari, 2020).

Hazard and Operability (HAZOP) is a hazard analysis technique used in preparing to determine safety in a system for the presence of potential hazards. The purpose of HAZOP itself is to determine whether a deviation process is leading to an undesirable event (Sabrina & Widharto, 2018). Using the HAZOP method can provide parameters regarding the level of danger that can be prioritized as well as proposed improvements to parts of a process that experience deviations. from the design determined by the company, the HAZOP method is a qualitative method that is easy to learn, systematic and obtains thorough results (Mochamad, 2020).

Parameter yang menjadi standar metode HAZOP diantaranya :

### 1. Likelihood

Is the risk opportunity for danger or consequences to occur on items or

components with an existing safety system.

Table 1. Likelihood Criteria

Level	Criteria	Likelihood	
		Description	
		Qualitative	Quantitative
1.	Rarely happening	Can be thought of but not only during extreme circumstances.	Less than 1 time per 10 years.
2.	Likely to happen	It hasn't happened yet but could appear/happen at some time	Occurs once per 10 years.
3.	Possible	It should happen and may have happened/ appeared here or elsewhere	1 time per 5 years to 1 time per year.
4.	Most likely	Can occur easily, may appear in most circumstances	More than 1 time per year to 1 time per month.
5.	Almost certainly	Frequently occurring, expected to appear in the most frequently occurring circumstances	More than 1 time per month.

Source : UNSW Health and Safety (2008)

The Likelihood Criteria is one of the criteria used in examining risk. The Likelihood criterion used is frequency in quantitative calculations based on company data or records over a certain period of time. In the table above, the Likelihood criteria have levels from 1 to 5, and there are five criteria, namely: level 1 has rare criteria, level 2 has low probability criteria, level 3 has possible criteria, level 4 has high probability criteria, and level 5 has criteria almost certain.

### 2. Consequences

This is a level that shows the severity of the injury experienced by the worker which is defined qualitatively as well as the work days lost due to the injury.

Table 2. Consequence Criteria

Level	Description	Consequences	
		Severity of Injury	Working days
1.	Not significant	The incident did not cause harm or injury to humans	Does not cause lost work days
2.	Small	Causes minor injuries, minor losses and does not have a serious impact on business continuity	Can still work on the same day/shift
3.	Currently	Serious injury and hospitalized, does not cause permanent disability, moderate financial loss	Lost work days under 3 days

4.	Heavy	Causing serious injury and permanent disability and large financial losses as well as having a serious impact on business continuity	Missed work days of 3 days or more
5.	Disaster	Resulting in deaths and severe losses, it can even stop the business forever.	Lost days of work forever.

Source: UNSW Health and Safety (2008)

The Consequences (saverity) criteria used are the consequences that the worker will receive which are defined qualitatively and taking into account lost working days as in the table above. The Conquences criteria are also the same as the Likelihood criteria which have a scale of 1 to 5.

3. Risk Level

Risk Level or risk obtained from the result of multiplying the Likelihood value with the Consequences value will later be used as a recommendation for improvement in accordance with existing problems. The risk value itself can be done using the Risk Matrix.

TINGKAT BAHAYA (RISK LEVEL)						
KEMUNGKINAN (LIKELIHOOD)	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
SKALA	1	2	3	4	5	
	KESERiusAN (SEVERITY/ CONSEQUENCES)					

Gambar 1. Risk Matrix Source : UNSW Healt and Safety (2008)

Risk matrix is a matrix that describes the product of probability (Likelihood) and seriousness (Consequences), where Likelihood and Consequences have a scale level of 1 to 5 according to tables 1 and 2. The level of danger which is the result of multiplication is depicted in 4 colors. which indicates the level of risk, namely: 1) yellow warrants mean low risk, 2) blue means medium risk, 3) red means high risk, 4) purple means extreme risk. From the risk matrix above, risk scores and priorities can then be calculated for taking corrective action. To calculate the risk score is as follows:

$$\text{Risk score} = \text{likelihood} \times \text{Consequences} \dots\dots\dots (1)$$

An example of calculating the first risk score is that the likelihood value is 3 and the consequences value is 2, so the calculation is as follows: Risk score = 3 x 2 = 6 (Located in blue, so it is classified as "Medium")

Table 3. Risk Matrix Description

E- Extreme Risk	Activities should not be carried out or carried out until the risk has been reduced. If it is not possible to reduce risks with limited resources, then the work cannot be carried out.
T – High Risk	Activities should not be carried out or carried out until the risk has been reduced. It is necessary to consider the resources allocated to reduce risk. If work is still ongoing, then action must be taken immediately.
S – Medium Risk	Actions are needed to reduce risks, but the costs of necessary prevention must be carefully considered and limited.
R – Low Risk	Risk is acceptable, additional controls are not required. Monitoring is necessary to ensure that controls are maintained and implemented properly and correctly.

3. Methodology

This research was carried out at the PT 3kg LPG gas cylinder maintenance workshop. A B C. The research objects used in this research were 7 operational stations in the 3KG LPG gas cylinder maintenance workshop including open valve work stations, valve inspection, shootblasting stations, tube painting, company logo painting, tube welding, and adding blanching plates.

The types of data in this research are primary data and secondary data. Primary data was obtained by researchers through direct observation, interviews with questions and answers about complaints felt by workers, such as MSDs, occupational hazards, hazard findings, risks, sources of hazards, and others. Secondary data in this research was obtained by collecting data obtained through other sources such as books, journals and reports, previous research, archives and company documents. Which could support the preparation of this research.

In analyzing and identifying Hazard sources using the HAZOP Worksheet and Risk Assessment. Starting from (1) knowing the sequence of processes in the production process of printing the company logo on the tube, painting the tube, shootblasting, closing & opening the valve, checking the valve, welding and adding a blancer plate, repairing the handguard & footring. (2) Identifying potential dangers in the work area by observing any deviations that occur that can cause work accidents by direct field observation. (3) Complete the criteria in the HAZOP worksheet as in Table 1 and Table 2. (4) Classify the hazards found (source of hazard and frequency of hazard findings). (5) Describe deviations that occur during the operating process. (6) Describe the cause of the deviation. (7) Describe what can result from these deviations (consequences). (8) Determine the action or temporary measures that can be taken.

#### 4. Results and Discussions

Data is taken by conducting direct research at the business premises such as interviews, taking photos. Before the research, the researcher provided an explanation to the workers regarding the purpose and method of collecting data, where the workers observed in this research were assigned to do normal work (based on the work they usually do). The data used in this research includes occupational hazards and poor posture while working.

Results of research observations on 3kg LPG gas cylinder maintenance workshop workers at PT. ABC there are several dangers. These dangers include the canister hitting your feet when unloading and loading the canister, your hand getting caught when opening or installing the valve on the canister, back pain when painting the company logo, and you can inhale too much gas when purging gas, standing for too long when repairing hand guards and foot rings can result in fatigue and lack of concentration, eyes exposed to sand particles during the shoot blasting process, eyes exposed to welding flame sparks when welding tubes and adding plates to tubes. Then, the discovery of these hazards can cause dangerous risks that threaten the safety of gas cylinder maintenance workshop workers, such as shortness of breath, serious injuries, minor injuries, eye pain, fatigue, lack of concentration, back pain, pinched hands, even fires and equipment damage which result in risks in the form of material loss.

After identifying hazards and risks, the next step is to determine the source of the hazards from the identified hazards and risks. This identification of the source of danger was carried out to find out the cause of the finding of danger in the work of the 3kg LPG gas cylinder maintenance workshop. In carrying out the identification, researchers collected data by observing and interviewing 3kg LPG gas cylinder maintenance workshop workers.

Hazard and risk identification is carried out to find out the findings of dangers and risks that exist in the 3KG LPG gas cylinder maintenance workshop work carried out by K3 management. This identification was carried out by means of field observations and interviews with the resource person, namely one of the health workers. We describe the results in the hazard and risk identification table below.

Table 4. Hazard and risk identification

No.	Process	Hazard Findings	Risk	Hazard Source
1	Tube painting	Noise	Hearing disorders	Material
		Not wearing personal protective equipment	Respiratory disorders	Material
		Standing too long	Muscle ache	Worker attitude
2	Company logo painting	Head hit the tube	Dizziness, Head injury	Material
		Bending over too long	Pain in the back	Worker attitude
		Standing too long	fatigue, pain in the legs	Worker attitude
		Noise	Hearing disorders	Material
3	Welding and adding plates to tubes	Not wearing personal protective equipment	burns, eye infections	Material

4	Shootblasting	Wrong position	back, neck, hand pain	Worker attitude
		Not wearing personal protective equipment	inhale dust	dust
		Sand particles	eyes hit by sand particles	sand particles
		Heavy load	hand injury	Material
5	Handguard and footing repairs	Leg crushed by tube	leg injury, serious injury	Worker attitude
		Hands are pinched	hand injury, serious injury	Material
		Wrong position	fatigue, muscle aches	Worker attitude
		Noise	Hearing disorders	Material
6	Open and close valve	Heavy load	tube fall	Material
		Hands are pinched	serious injuries, broken bones	Material
		Head hit the machine	head injury	Material
		Standing too long	fatigue	Worker attitude
7	Check valve	The tube fell off	wounds, leg injuries	Material
		Hands are pinched	hand injury, hand bruise	Material
		Noise	Hearing disorders	Material

The likelihood and consequences assessment scale used in this research is a standard provided by the company. The likelihood criteria are the criteria used to calculate the possibility of an accident risk based on the frequency per unit of time (day, month, year). Consequences criteria are risk impact criteria which are classified based on the severity of the impact of risk events that may occur.

In carrying out a hazard and risk analysis in the 3kg LPG gas cylinder maintenance workshop work, a risk level assessment is carried out by multiplying the Likelihood value with the Consequences value. Then the results of the risk assessment can be in the form of a Risk Matrix. In the Risk Matrix table we can find out the level of danger risk.

$$R = C \times L \dots\dots\dots (2)$$

Information :

**R** = The resulting risk level value (*risk level*)

**C** = Consequences value

**L** = Likelihood value

To assess the likelihood and value of consequences, researchers used interviews with respondents. The respondents that the researchers took were workers in the 3kg LPG gas cylinder maintenance workshop at PT. A B C. The researcher took 7 respondents, then the data from interviews and field study findings on hazards and risks were entered into the HAZOP Worksheet for risk level assessment as shown in the following table:

Table 5. Hazop Worksheet

No	Proses	Temuan Hazard	Risiko	Sumber Hazard	L	C	R	Risk Level
1	Pengecatan Tabung	kebisangan	Gangguan pendengaran	Material	4	1	4	Sedang
		tidak memakai APD	Gangguan Pernafasan	Material	2	2	4	Rendah
		terlalu lama berdiri	Nyeri oto	Sikap Pekerja	2	1	2	Rendah
2	Pengecatan logo perusahaan	kepala terbentur tabung	Pusing, cedera kepala	Material	3	2	6	Sedang
		terlalu lama membungkuk	Nyeri pada punggung	Sikap Pekerja	5	2	10	Tinggi
		terlalu lama berdiri	kelelahan, nyeri pada kaki	Sikap Pekerja	2	1	2	Rendah
3	Pengelasan & penambahan plat	kebisangan	Gangguan pendengaran	Material	4	1	4	Sedang
		tidak memakai APD	Luka bakar, Mata infeksi	Material	2	2	4	Rendah
		Salah posisi	Nyeri punggung, leher, tangan	Sikap Pekerja	2	3	6	Sedang
4	shootblasting	tidak memakai APD	Menghirp debu	debu	2	2	4	Rendah
		Partikel pasir	Mata terkena partikel pasir	partikel pasir	5	2	10	Tinggi
		Beban berat	Cedera tangan	Material	3	2	6	Sedang
5	Perbaikan Handguard & Footring	Kaki tertimpa tabung	Cedera kaki, luka berat	Sikap Pekerja	3	2	6	Sedang
		Tangan terjepit	Cedera tangan, luka berat	Material	4	2	8	Tinggi
		Posisi Salah	kelelahan, nyeri otot	Sikap Pekerja	2	3	6	Sedang
6	Open & Close valve	kebisangan	Gangguan pendengaran	Material	4	1	4	Sedang
		Beban berat	Kejutahan tabung	Material	3	2	6	Sedang
		Tangan terjepit	Luka berat , patah tulang	Material	2	4	8	Tinggi
7	Pemeriksaan valve	kepala terbentur mesin	Cedera kepala	Material	3	2	6	Sedang
		terlalu lama berdiri	Kelelahan	Sikap Pekerja	2	1	2	Rendah
		Tabung jatuh	Luka, cedera kaki	Material	2	2	4	Rendah
7	Pemeriksaan valve	Tangan terjepit	cedera tangan, memar tangan	Material	3	3	9	Tinggi
		Bising	Gangguan pendengaran	Material	4	1	4	Sedang

Then, from the results of the risk assessment in table 5, it can be differentiated based on the risk level ranking as follows.

Table 6. Low Risk Level Hazard Findings

No	Proses	Temuan Hazard	Risiko	Sumber Hazard	L	C	R	Risk Level
1	Pengecatan Tabung	tidak memakai APD	Gangguan Pernafasan	Material	2	2	4	Rendah
		terlalu lama berdiri	Nyeri oto	Sikap Pekerja	2	1	2	Rendah
2	Pengecatan logo perusahaan	terlalu lama berdiri	kelelahan, nyeri pada kaki	Sikap Pekerja	2	1	2	Rendah
3	Pengelasan & penambahan plat	tidak memakai APD	Luka bakar, Mata infeksi	Material	2	2	4	Rendah
4	shootblasting	tidak memakai APD	Menghirp debu	debu	2	2	4	Rendah
5	Open & Close valve	terlalu lama berdiri	Kelelahan	Sikap Pekerja	2	1	2	Rendah
		Tabung jatuh	Luka, cedera kaki	Material	2	2	4	Rendah

Based on the HAZOP worksheet, there are several hazards or dangers that are categorized as low level risk, including:

- In tube painting work, there are hazards or dangers if workers do not wear personal protective equipment in accordance with company regulations, workers could be at risk of respiratory problems due to inhaling too much thinner or residual gas coming out of the tube, and if workers stand for too long while operating, will cause fatigue, pain in the leg muscles.
- When painting a company logo, if you look at it from the wrong position due to standing for too long and doing repetitive work, there is a risk of losing concentration and causing fatigue and pain in the legs.
- In welding work and adding plates to tubes, there is a danger that if you don't wear the right PPE, it can cause burns and eye irritation because welding sparks that can hit the eyes will cause eye irritation.
- In shootblasting work, if workers do not wear PPE there is a risk of inhaling dust and causing respiratory problems, dust produced from machines which causes shortness of breath and so on.
- In open valve & close valve work, if workers often stand for too long there is a risk of fatigue and loss of concentration, and then the tube can fall due to loss of concentration and cause injuries and leg injuries.

Table 7. Medium Risk Level Hazard Findings

No	Proses	Temuan Hazard	Risiko	Sumber Hazard	L	C	R	Risk Level
1	Pengecatan Tabung	kebisangan	Gangguan pendengaran	Material	4	1	4	Sedang
2	Pengecatan logo perusahaan	kepala terbentur tabung	Pusing, cedera kepala	Material	3	2	6	Sedang
		kebisangan	Gangguan pendengaran	Material	4	1	4	Sedang
3	Pengelasan & penambahan plat	Salah posisi	Nyeri punggung, leher, tangan	Sikap Pekerja	2	3	6	Sedang
4	shootblasting	Beban berat	Cedera tangan	Material	3	2	6	Sedang
		Kaki tertimpa tabung	Cedera kaki, luka berat	Sikap Pekerja	3	2	6	Sedang
5	Perbaikan Handguard & Footring	Posisi Salah	kelelahan, nyeri otot	Sikap Pekerja	2	3	6	Sedang
		kebisangan	Gangguan pendengaran	Material	4	1	4	Sedang
		Beban berat	Kejutahan tabung	Material	3	2	6	Sedang
6	Open & Close valve	kepala terbentur mesin	Cedera kepala	Material	3	2	6	Sedang
7	Pemeriksaan valve	Bising	Gangguan pendengaran	Material	4	1	4	Sedang

Based on the HAZOP worksheet, there are several Hazards that are categorized as low level risk, including:

- During the process of painting tubes, a source of hazard was found, namely noise caused by tubes and machines that were operating and could cause hearing problems for workers.
- In the process of painting the company logo, a hazard was discovered where the head could hit and cause the risk of dizziness and head injury which was caused by the material on the tube, and also caused hearing loss due to noise caused by the material.
- In the process of welding and adding plates to the tubes, there is a risk or hazard in which there is pain in the back due to bending too much, this is caused by the source of the hazard being human negligence or work attitude.
- In the shootblasting process, there is a danger where the tube falls on the person, which risks leg injuries and serious injuries, because the work is repeated for too long so the load is too heavy and causes injury to the hands and loss of concentration.
- In the process of repairing handguards and footrings, there were hazards found, namely that workers experienced fatigue and muscle pain due to the worker's position being in the wrong position, and there was noise which was at risk of hearing loss caused by the material and they could be crushed by the tube due to very heavy and repetitive loads.
- In the open & close valve process where workers are careless or tired which results in their heads hitting the machine, with the risk of head injury, this is caused by human and material negligence.
- During the valve inspection process, there is a danger or danger of noise causing the risk of hearing loss, this is caused by the material.

Table 8. High Risk Level Hazard Findings

No	Proses	Temuan Hazard	Risiko	Sumber Hazard	L	C	R	Risk Level
1	Pengecatan logo	terlalu lama membungkuk	Nyeri pada punggung	Sikap Pekerja	5	2	10	Tinggi
2	shootblasting	Partikel pasir	Mata terkena partikel pasir	partikel pasir	5	2	10	Tinggi
3	Perbaikan Handguard & Footring	Tangan terjepit	Cedera tangan, luka berat	Material	4	2	8	Tinggi
4	Open & Close valve	Tangan terjepit	Luka berat , patah tulang	Material	2	4	8	Tinggi
5	Pemeriksaan valve	Tangan terjepit	cedera tangan, memar tangan	Material	3	3	9	Tinggi

Based on the HAZOP worksheet in table 8, there are several Hazards or dangers that are categorized as High level risk, including:

- In the LPG gas cylinder maintenance workshop, there is a process of painting company logos on the cylinders which is a source of danger which comes from the work attitude, namely bending too long because these workers do their work often bending for too long and repeatedly, which can lead to the risk of back pain.
- In shoot blasting work, where the aim of this work is to remove rust from the tube and there is a hazard found, namely sand particles, with the risk that if the worker does not wear complete personal protective equipment or is not skilled in this matter, the sand particles can come into direct contact with the eyes.
- In the LPG gas cylinder maintenance workshop, there are repairs to handguards & footrings which are aimed at repairing the head and bottom ring of the cylinder which are dented. This work carries the danger of hands being trapped by machines which causes the risk of hand injuries and serious injuries. This is caused by materials and human negligence.
- In open & close valve work, there is a source of danger that comes from the material with the risk of hands being pinched by

machines which can result in serious hand injuries and broken bones.

5. During the valve inspection work, there was a finding of a pinched hand hazard which poses a risk of hand injury and bruises on the hands caused by materials and human negligence during work.

Recommendations for improving the HAZOP method :

1. Recommendations for work accident improvements
  - a. Providing K3 training on personal protective equipment which will be held by management. Workers who cannot attend training will be subject to sanctions.
  - b. Create a worksheet on the use of personal protective equipment in the work area so that workers can immediately read what potential dangers they will experience if they do not use personal protective equipment.
  - c. Create a visual display regarding the use of Personal Protective Equipment in work areas that have the potential for work accidents and create a Standard Operating Procedure (SOP) for the use of Personal Protective Equipment. This visual display will be installed in several places to encourage workers to always use PPE properly.
2. Recommendations for improving work attitudes, workers are given training on good and natural work attitudes from ergonomic experts or K3 experts.
3. Recommendations for improving working environment conditions. Many materials that are piled too high are not arranged neatly and regularly, resulting in tubes falling, resulting in potential work accidents caused by materials that are not organized and well arranged, which are caused by materials that are not organized and well arranged. To overcome this, recommendations for improvement are given, namely creating procedures for arranging and arranging raw materials or other materials in a neat and clean manner so as to reduce the risk of potential accidents that could occur. Apart from that, management should further emphasize the regulations made, so that the production process can run well and the level of work safety is higher.
4. Recommendations for controlling sources of noise hazards include providing complete personal protective equipment such as ear plugs, so that workers are not too disturbed by noise caused by materials and machines.
5. The recommendation for danger or danger of equipment/material falling on officers is by providing work SOPs and officers must focus on carrying out their work.
6. The recommendation for controlling pinched hands is to provide training in the use of personal protective equipment and officers must concentrate in carrying out their work.
7. The recommendation for repairing a head hitting a tube while operating is to provide appropriate personal protective equipment, including a helmet, to minimize injury when the tube hits the worker's head.

## 5. Conclusion

There are work postures that are not ergonomic, such as standing and looking down for too long, bending over and lifting weights repeatedly and resulting in injuries at several points such as back and hand injuries and muscle injuries.

From the level of occupational health and safety of PT employees. ABC is in the good category based on employee assessments, indicating that the company has paid attention to and prioritized health and safety, including the use of personal protective equipment. However, judging from the level of awareness of employees, it is in the medium category, this shows that employees are aware of the importance of using personal protective equipment and the importance of maintaining health and safety when carrying out work activities.

Hazard sources that the company has include inhaling too much dust, residual gas, the smell of paint, the smell of burning from the cylinder which can cause shortness of breath. The eyes are exposed to sand particles and welding spatter which causes eye irritation, hands get caught in the machine, and tubes fall.

## REFERENCES

- [1] Ditya, E., Savitri, Y., Lestariningsih, S., & Mindhayani, I. (2021). Analisis Keselamatan Dan Kesehatan Kerja ( K3 ) Dengan Metode Hazard And Operability Study ( HAZOP ) ( Studi Kasus : CV . Bina Karya Utama ). 3(1), 51–61.
- [2] Kartikasari, N. (2020). “Pengaruh Keselamatan Dan Kesehatan Kerja Terhadap Kinerja Karyawan Di Pt. Pln Area Malang.” *Keselamatan Kerja, Kesehatan Kerja, Kinerja Karyawan*, 5(3), 248–253.
- [3] Mochamad, S. (2020). Analisa Risiko K3 Pada Operator Rolling Mill Dengan Pendekatan Hazard And Operability Study (Hazop) (Study Kasus Di Pt. Xyz). *Jiso : Journal of Industrial and Systems Optimization*, 3(2), 63–70. <https://doi.org/10.51804/jiso.v3i2.63-70>
- [4] Muhammad Nur, C. D. O. (2017). *Pengaruh Pelaksanaan Program Keselamatan dan Kesehatan Kerja ( K3 ) terhadap Produktivitas Kerja Karyawan pada PT . Bormindo Nusantara Duri*. 116–125.
- [5] Myrntanti, R. D., & Suardika, I. B. (2022). Pekerja Bagian Produksi Di Industri Pencacah Plastik Dengan Menggunakan Fault Tree Analysis ( FTA ). 7(2), 78–83.
- [6] asyidi, F. P. & M. (2021). Jurnal Ilmiah Wahana Pendidikan. *Jurnal Ilmiah Wahana Pendidikan* <https://jurnal.unibrah.ac.id/index.php/JIWP>, 7(1), 24–28. <https://doi.org/10.5281/zenodo.6301651>
- [7] Rismawati, A. W., Tati, & Achdiani, Y. (2016). Penerapan Keamanan, Kesehatan dan Keselamatan (K3) Kerja pada Pelaksanaan Praktik Membatik di SMK Negeri 3 Tasikmalaya. *Jurnal FamilyEdu*, 2(2), 60–69.
- [8] Sabrina, M. R. W., & Widharto, Y. (2018). Analisis Potensi Bahaya Dengan Metode Hazard and Operability Study Melalui Perangkingan Risk Assessment Studi Kasus: Divisi Spinning Unit 4 Ring Yarn Pt Apac Inti Corpora. *Industrial Engineering Online Journal*, 7(4), 1–7.
- [9] Triadi, A. A. A., Syahrul, Wijana, M., Sutanto, R., & Setyawan, P. (2022). Implementasi Keselamatan Dan Kesehatan Kerja Dengan Pendekatan Ergonomi Di Umkm. *Jurnal Karya Pengabdian*, 4(1), 28–33.