Analysis Of Occupational Health And Safety (Ohs) Risk In The 50 Kg Tube Welding Assembly Process At Pt Pindad Using The Hirarc (Hazard Identification Risk Assessment And Risk Control) Method

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Abstract — PT Pindad is a company engaged in the manufacturing industry, which involves the production process as well as a lot of critical operational work, this raises concerns regarding the continuity of the activity process, where it is possible to cause work accidents ranging from minor to major, which causes serious injuries and even death. The purpose of this study is to identify the hazards and risks that occur and also provide suggestions for improving the occupational safety and health management system at PT Pindad. An analysis has been carried out based on the problems encountered using a fishbone diagram. Therefore, the HIRARC method was chosen as a support for solving existing problems at PT Pindad. This research uses a qualitative descriptive research method. Identification was carried out on 23 activities, and after carrying out a risk assessment based on HIRARC, 3 risks were found and the causes of events that gave rise to high risk factors were identified, namely, welding process activities, operator or worker position activities in welding, and material refining activities. The proposed design of OHS risk control is given by referring to five risk control hierarchies: elimination, substitution, engineering, administration, and personal protective equipment.

Keywords— HIRARC, OHS, Work Accident

I. INTRODUCTION

PT Pindad is a company engaged in the manufacturing, service, and trade of defense and security products and industrial products. This raises concerns regarding the continuity of the activity process, which is likely to cause work accidents ranging from minor to major. The following is work accident data at PT Pindad recorded by the OHSE division.

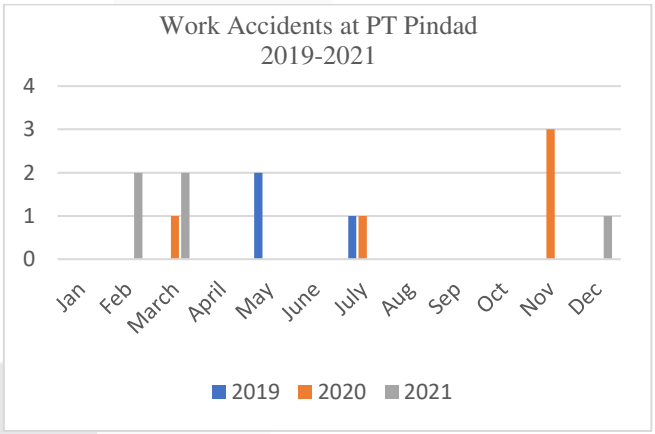

FIGURE 1.
Work Accidents at PT Pindad 2019-2021

From the picture above, it can be seen that the working conditions at PT Pindad are considered quite dangerous because there are still unwanted work accidents. The number of work accidents in 2019–2021 continues to increase, therefore, it is very necessary to make efforts to better prevent work accidents so that the work safety of workers in companies can be improved. For that, we need a method that can meet these requirements.

The method chosen in this research is HIRARC (Identification, Risk Assessment, and Risk Controls). HIRARC is a series of processes to identify potential hazards that can occur in activities, whether routine or not, within the company and then carry out a risk assessment of these hazards. Therefore, this research will identify any potential hazards that occur at PT Pindad. Once identified, how to

control the hazard will be determined by referring to the control hierarchy.

II. LITERATURE REVIEW

A. Occupational Health and Safety (OHS)

Occupational Health and Safety is an effort to create a healthy and safe work environment in order to reduce the possibility of work accidents or work-related illnesses due to negligence and a lack of productivity at work. According to the Health Law of the Republic of Indonesia No. 9 of 1960, Chapter I, Article II, Occupational Health is a health condition that aims to make working people obtain the highest degree of health, both physically, spiritually, and socially, with efforts to prevent and treat diseases or health problems caused by work and the work environment, as well as diseases in general.

B. Work Accident

A work accident is an event that is unwanted, not expected, and causes human and property casualties (Putri & Lestari, 2023;Ardan, 2015). Work accidents can occur at work and can also occur when you have finished work but are still in the work environment. Accidents at work occur because of two things: an Unsafe act (unsafe behavior) and an unsafe condition (conditions that are not safe). According to (Pisceliya & Mindayani, 2018;Heinrich 2017), 88% of accidents are caused by unsafe actions.

C. Hazard

A hazard is an event or circumstance that has the potential to result in damage, injury, or even death. Hazards can appear in a range of settings, such as the workplace, the outside world, or daily life. Physical hazards like fire, explosion, or auto accidents are one type of hazard, as are non-physical ones like chemical, biological, radiation, psychological, or ergonomic risks.

D. Risk

Risk is the potential for loss, harm, or other unfavorable outcomes as a result of specific behaviors, occurrences, or circumstances. Risk is associated with uncertainty and can be related to a variety of facets of life, including safety, money, the environment, business, and health. A systematic strategy and risk analysis techniques can be used to recognize, quantify, and manage risks. The goal of risk management is to decrease or eliminate undesirable risks and raise the possibility that a project or activity will succeed or produce the desired results.

E. HIRARC

Hazard Identification, Risk Assessment, and Risk Control (HIRARC) is a method for preventing or minimizing work accidents. HIRARC is a method that starts with determining the type of work activity, which is then identified as the source of the hazard so that the risks are identified. Then a risk assessment and risk control will be carried out to reduce exposure to hazards found in each type of work. Purnama, (2015). HIRARC is an effort to prevent and reduce the potential for work accidents, avoid and minimize risks that occur appropriately by avoiding and minimizing the risk of work accidents, and control them in the context of carrying out activity processes so that the process becomes safe. Figure 2 below explains the process of using HIRARC.

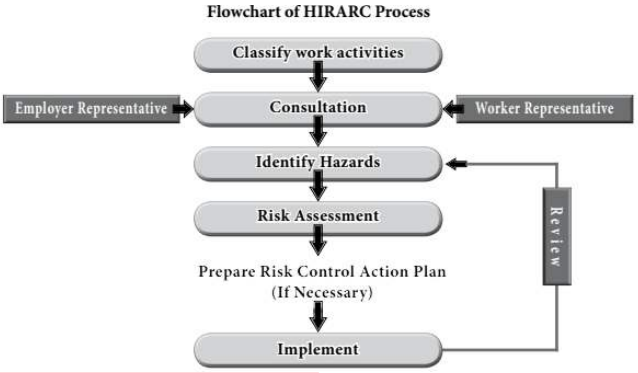

FIGURE 2.
Flowchart of HIRARC Process
(Source: DOSH, 2008)

Risk assessment aims to determine the level of risk by taking into account the possibility of its occurrence and the magnitude of its consequences. The assessment in the risk assessment is Likelihood and Severity. The following is a table of severity, likelihood, and risk matrix from the standard OHSE division of PT Pindad:

TABLE 1.
Severity Criteria

Clasification Level	Criteria	Explanation
1	Very Low	Occupational accidents with minor injuries without the need for medical assistance
2	Low	Work accidents with major injuries require the help of a company doctor
3	Medium	Occupational accidents with major injuries require specialist medical assistance without hospitalization
4	High	Occupational accidents with severe injuries require the help of specialist doctors and require hospitalization
5	Very High	Occupational accidents with very serious injuries and deaths

TABLE 2.
Likelihood Criteria

Level	Criteria	Explanation
1	Rarely	(0-1 times/month) 0-20%
2	Abnormal Condition	(2-10 times/month) 20-40%

3	Often	(11-20 times/month) 40-60%
4	Very Often	(20-40 times/month) 60-80%
5	Continously	80-100%

TABLE 3.
Risk Matrix

Likely to Happen (Frequency) Risk – Environmental Impacts					
Likelihood	**Severity**				
	1	2	3	4	5
1	I	I	I	I	L
2	L	L	L	L	M
3	L	L	M	M	H
4	M	M	H	H	H
5	H	H	H	H	H

Note:
I= Ignore
L= Low
M= Medium
H= High

III. METHOD

A. Conseptual Model

By adhering to this framework, researchers may make sure that the problem-solving procedure is carried out in a methodical way and that the outcomes can be used to influence improved decisions and actions in order to address the current difficulties. The conceptual model in this study can be seen in the following figure:

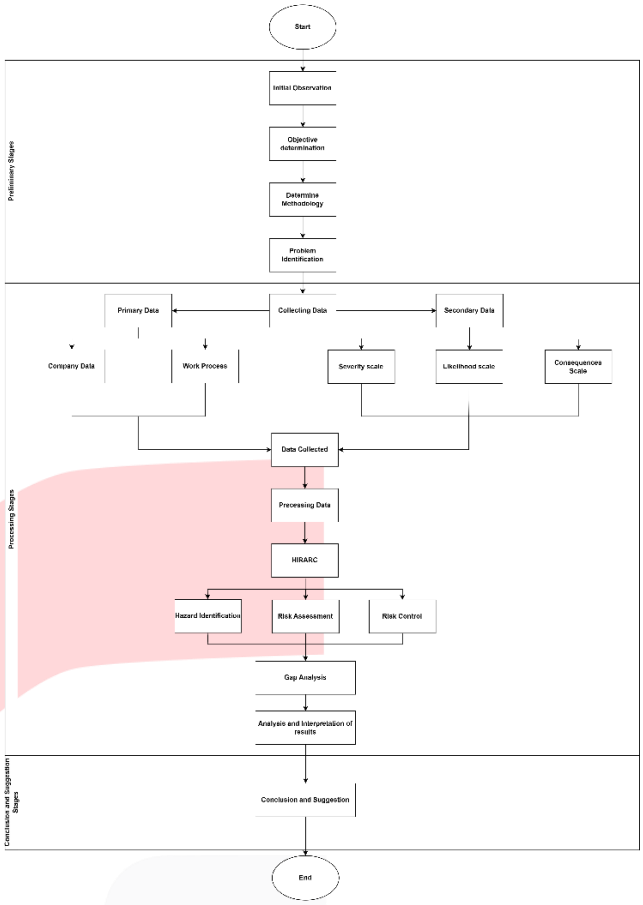

FIGURE 3.
Conseptual Model Flowchart

In this study, there are inputs, including the current conditions of PT Pindad in the implementation of Occupational Safety and Health according to ISO 45001:2018. The first input is to identify potential hazards at PT Pindad using HIRARC. The result of this stage is risk control. The controls made by HIRARC will be referenced later in ISO 45001:2018.

IV. RESULT AND DISCUSSION

Data processing was performed on this research, namely the identification of hazards (hazard identification), risk assessment (risk assessment), and risk control. As for improvement proposals for company management.

A. Hazard Identification

Hazard identification is an effort carried out systematically to identify potential hazards in work activities. Potential hazards that can be identified are useful for being more cautious when doing something, being alert, and taking steps to prevent accidents.

TABLE 4.
Hazard Identification

Activity	Potential Hazard	Potential Risk	Consequens
Prepare the material to be welded	Material	Pierced by sharp material	Scratches on limbs
Welding process	Smoke when welding	Exposure to vapors or gases	Respiratory system disorders,

			respiratory tract infections and lung diseases
Welding process position	Being in the wrong position when doing welding	Overstretching from squatting for too long	Lower extremity or back injuries
Material refinement process	Sparks during material refining	Hit by a spark	Burns, serious injuries
Material refinement process	An irregular cable near grinding process	Electric shock, fire	Burns, serious injuries to death

B. Risk Assessment

The objective of risk assessment is to determine the pote ntial value of work accidents. The level of risk is determined based on the probability of occurrence (likelihood) and the s everity that can be caused (severity). The results of the risk a ssessment are shown in the following table:

TABLE 5.
Risk Assessment

Activity	Potential Hazard	Consequens	S	L	V	Risk Level
Prepare the material to be welded	Material	Scratches on limbs	1	2	2	Ignore
Welding process	Smoke when welding	Respiratory system disorders, respiratory tract infections and lung diseases	4	5	20	High
Welding process position	Being in the wrong position when doing welding	Lower extremity or back injuries	5	1	5	High
Material refinement process	Sparks during material refining	Burns, serious injuries	4	1	4	Medium
Material refinement process	An irregular cable near grinding process	Burns, serious injuries to death	5	1	5	High

There were 23 work process activities that resulted in work accidents, and out of those 23 activities, three activities were found to have a high-risk value.

C. Gap Analysis

Based on the results of controlling using HIRARC, the requirements that must be implemented by the company will be fulfilled, especially in the assembly welding process, because the process has a high level of risk and can cause great potential hazards.

TABLE 6.
Gap Analysis

Actual Condition	Requirement ISO 45001:2018	Gap	Proposed
Has carried out risk control from the danger of exposure to gas, smoke, or dust in the welding process by installing a blower.	6.1.2 (Hazard Identification and Risk Assessment) 8.1.2 (Eliminating Hazards and Reducing Risks) 8.1.3 (Change management)	There are still complaints about respiratory problems due to gas, smoke, and dust from welding.	Based on the Gap, there is a need for changes or modifications to the workplace.
Unsuitable Workplace and does the welding process outside of the workplace	6.1.2 (Hazard Identification and Risk Assessment) 8.1.2 (Eliminating Hazards and Reducing Risks) 8.1.3 (Change management)	Complaints of experiencing pain in the back due to activities such as bending and squatting for too long.	Based on this gap, it is necessary to change or modify the workplace and OHS management system.
Cables of the machine or equipment have not been properly arranged.	6.1.2 (Hazard Identification and Risk Assessment) 8.1.2 (Eliminating Hazards and Reducing Risks)	The cables of the machine or equipment have not been properly arranged. Where there are still cables laid on the road where operators or other workers	Based on this Gap, Proposed infrastructure improvement plans, procedures about awareness and

	7.3 (Awareness) 7.4 (Communication)	pass by and the cables are near the workplace.	communication

D. Risk Control

Risk control is applied to all dangers discovered through the process of identifying hazards and taking into account the risk assessment to establish priorities and management methods. In this control, researchers only control three activities that have a high-risk value. Table provides the following example of a risk control outcome:

TABLE 7.
Risk Control

Activity	Potential Hazard	Consequens	Proposed Control	Hirarchy of Control
Welding process	Smoke when welding	Respiratory system disorders, respiratory tract infections and lung diseases	Make repairs or modifications to the workplace by adding Local Exhaust Ventilation	Re-engineering
Welding process position	Being in the wrong position when doing welding	Lower extremity or back injuries	Making improvements to the workplace to be more ergonomic and conducting a Rapid Entire Body Assessment	Re-engineering and Administrative
Material refinement process	An irregular cable near grinding process	Burns, serious injuries to death	Make improvements to infrastructure, create awareness and communication procedures	Re-engineering and Administrative

V. CONCLUSION

Identification was carried out on 23 activities, and after carrying out a risk assessment based on HIRARC, 3 risks were found and the causes of events that gave rise to high risk factors, namely, welding process activities, operator or worker position activities in welding, and material refining activities.

In the welding process activities, namely the risk of exposure to gas, smoke, and dust due to welding a 50 kg cylinder, there is a serious threat to the health and safety of the welding operator and other workers in the vicinity. Long-term exposure to these harmful substances can cause breathing problems, skin irritation, and even more serious health effects. Proposed re-engineering control of welding process activities by implementing local exhaust ventilation (LEV) at each welding workplace.

In the activity of the position of the operator or worker in welding, namely the risk of workers experiencing low back pain due to the occurrence of a position when doing work that is not in accordance with the provisions or is not ergonomic, where workers have a working time of 12 hours with a break of 1 hour and 30 minutes from 06.00 am to 18.00 pm. Proposed re-engineering and administrative controls on operator position activities when performing welding by redesigning the welding workplace to meet ergonomic requirements and worker comfort when welding is required and in the form of routine Rapid Entire Body Assessment (REBA) measurements.

In material refining activities, the risk occurs due to inadequate infrastructure facilities; there are also unsafe actions and unsafe conditions carried out by operators or workers when refining materials. Proposed administrative controls on material refining activities by establishing competency, training, and awareness procedures as well as communication procedures.

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