

Occupational Safety and Health Evaluation Using the Hazard Identification Risk Assessment and Risk Control (HIRARC) Method Based on Ergonomics

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| Submitted: August 10, 2025 | Revised: August 17, 2025 | Accepted: October 09, 2025 |

| Published: March 04, 2026 |

ABSTRACT

PT. XYZ is a medium-sized shipbuilding company engaged in ship repair, maintenance, and new shipbuilding services. The company faces a high potential for workplace accidents in Workshop Area 01, Shelter 05, and the Jetty Area. This study aims to analyze and evaluate workplace hazard potential using the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method, based on ergonomic principles. The research methodology employed a quantitative and qualitative approach through observation, interviews, and the distribution of questionnaires to 78 workers. The novelty of this study lies in the integration of ergonomic principles into the HIRARC analysis to assess and control workplace accident risks. The analysis results identified 15 categories of potential hazards, with details as follows: 5 low-risk, 8 moderate-risk, and 2 high-risk hazards. High-risk hazards were identified in grinding and plate-cutting activities, which require immediate control measures. Control measures were implemented through the use of personal protective equipment (PPE), technical engineering, administrative measures, and worker education. This study concludes that the integration of ergonomics into HIRARC effectively helps companies identify and reduce workplace accident risks while improving workplace safety and comfort.

Keywords: evaluation of occupational health and safety, Hazard Identification Risk Assessment and Risk Control (HIRARC), ergonomic principles.

INTRODUCTION

PT. XYZ is a private national *shipyard* company located in Batam, Riau Islands, Indonesia, capable of providing new ship construction and *repair* services to customers. The company operates in the fields of ship *repair*, *maintenance*, and *construction*, employing skilled workers with expertise in ship construction, maintenance, and *repair*. Its operations are closely associated with workplace risks, particularly in terms of the level of hazard associated with such work [1], [2].

Based on workplace accident data at PT. XYZ from 2024 to 2025, workplace accidents were found to have one of the causes being improper body posture while performing high-risk tasks, which did not align with ergonomic principles [3]. From September 2024 to February 2025, there were 10 workplace accidents, one of which occurred in *the fabrication area of Workshop 01 KSSI*. The accident happened during the cutting process of *the engine bed framing in the transom hull area*, where the employee's left hand was injured by *a multicutter*. The workplace accident occurred due to poor ergonomic posture during the cutting of *the engine bed framing*, which involved *overhead cutting*, resulting in the left hand of the worker being struck. Additionally, the work area was narrow, limiting movement during the cutting process on *the engine bed framing in the transom hull area* [4]. Other recurring incidents include inadequate lighting in the work area, abnormal work positions forcing workers to bend over while performing their tasks, and an inefficient work system that negatively impacts employee performance [5].

RESEARCH METHODS

The research methods used by the author are quantitative and qualitative approaches. The purpose of this methodology is to ensure that the research conducted is measurable, systematic, and relevant to the issues in the field. The objects of this study are the workforce, work processes, and potential hazards found in *Workshop Area 01, Shelter Area 05, and the Jetty*

Area. This research is based on the *Hazard Identification Risk Assessment and Risk Control* (HIRARC) method, which is grounded in ergonomic principles.

According to *the International Labour Organization* (ILO), *Occupational Safety and Health* (OSH) aims to achieve and maintain the highest possible level of physical, mental, and social well-being for all workers in all types of work. OSH also serves to prevent work-related health issues, protect workers from workplace risks, and ensure that work is compatible with workers' physiological and psychological conditions. This principle aligns with national regulations outlined in Law No. 1 of 1970 on Occupational Safety, which mandates that every workplace implement preventive measures and protections to safeguard workers from workplace accidents[6].

The HIRARC method itself is an approach used to identify potential hazards, analyze and assess risk levels, and determine appropriate hazard control measures in the workplace. According to research [7], effective implementation of occupational safety and health (OSH) requires integration between planning, implementation, and evaluation to reduce the risk of workplace accidents. HIRARC encompasses three main stages: hazard identification, risk assessment, and risk control [8]. Research by [9] also indicates that the HAZOP method can help systematically identify potential hazards, enabling targeted improvement recommendations to be designed.

In the context of ergonomics, this approach is used to adapt working conditions to the capabilities and limitations of workers to create a safe, comfortable, and efficient work environment. Ergonomics is a multidisciplinary science aimed at optimizing human work systems by considering health and safety. There are 12 principles of ergonomics that can be used as guidelines in work evaluation, including: working in a normal posture, reducing excessive force, working at an appropriate height, and maintaining a comfortable work environment [3].

Data collection in this study was conducted through direct observation, in-depth interviews with workers, and documentation of work activities in the field. Additionally, a closed-ended questionnaire was used to assess potential hazards from the workers' perspective. The questionnaire was designed based on HIRARC indicators and ergonomic principles, then analyzed using the Slovin formula and tested for validity and reliability using SPSS Statistics software.

RESULTS AND DISCUSSION

Data collection and processing to implement the ergonomics-based *Hazard Identification Risk Assessment and Risk Control* (HIRARC) method [10]. The researcher conducted direct observations in *Workshop Area 01*, *Shelter Area 05*, and *Jetty Area* with guidance from the company. Several potential hazards were identified in the company areas to be observed.

The study also used a closed questionnaire with worker contributions to identify hazards in predetermined areas, namely *Workshop Area 01*, *Shelter Area 05*, and *Jetty Area*, to analyze potential hazards and risk control. The questionnaire was compiled from *Hazard Identification Risk Assessment and Risk Control* (HIRARC) and observations were conducted.

The closed-ended questionnaire used the Slovin formula to determine the sample size of 78 workers in *Workshop Area 01*, *Shelter Area 05*, and *Jetty Area*. The closed-ended questionnaire included 20 hazard identification factors derived from *the Hazard Identification Risk Assessment and Risk Control* (HIRARC) framework.

$$n = N / (1 + (N \times e^2))$$

Explanation : n = Sample Data

N = Population Size

e/alpha= Mean Error

Therefore: N = 78

$$= 78 / (1 + (78 \times 0.2^2))$$

$$= 78 / (1 + 10.8)$$

= 78 / 11.8

= 67 Respondents

The validity and reliability tests aim to determine whether the criteria used are valid and reliable. The tests were conducted using the SPSS Statistics application. Based on the validity test of 20 questions or criteria from the questionnaire that were responded to offline in Workshop Area 01, Shelter Area 05, and Jetty Area. The results show that all 20 questions are valid, and the data is valid based on the R table, where the R table has a significant value of 0.1 and the questionnaire was administered to 78 worker respondents. The following are the results of the validity and reliability tests.

Table 1. Results of Validity and Reliability Tests

No	Questionnaire Question	R Table	Calculated r	Description
1	Tripped	0.185	309	Valid
2	Fell	0.1852	352	Valid
3	Slipped	0.1852	265	Valid
4	Electrocution	0.1852	239	Valid
5	Exposed to welding sparks	0.1852	409	Valid
6	Eye injury	0.1852	362	Valid
7	Exposure to dust and debris	0.1852	230	Valid
8	May fall when the road is uneven	0.1852	244	Valid
9	Can be struck by <i>scaffolding planks</i>	0.1852	301	Valid
10	Can be pinched by <i>scaffolding planks</i>	0.1852	423	Valid
11	Can be struck by <i>scaffolding planks</i>	0.1852	231	Valid
12	Can be hit by a grinder	0.1852	433	Valid
13	<i>Grinding</i> sparks may come into contact with the eyes	0.1852	408	Valid
14	Inhaled dust	0.1852	284	Valid
15	Exposed to <i>a multi-cutter machine</i>	0.1852	0.192	Valid
16	Hand cut by sharp <i>plate</i>	0.1852	281	Valid
17	May fall	0.1852	228	Valid
18	May be hit by beams	0.185	383	Valid
19	Hands can be pinched	0.1852	0.186	Valid
20	Hand can be pinched by binding wire	0.1852	25	Valid

Hazard Identification Risk Assessment and Risk Control (HIRARC) conducts a risk assessment to determine the level of risk or Risk Rating Number (RRN) using the formula:

$$RRN = \text{Likelihood} \times \text{Severity}$$

Table 2. HIRARC Welding

Hazard Identification Risk Assessment and Risk Control (Hirarc)							
Location		Workshop Area 01					
Work		Welding					
Job Description Based on ergonomic principles	Potential Hazards	Potential Risks	Assessment Risk			Risk Level	Recommendations
			L	C	L x C		
1. Preparation of <i>welding</i> cables	1. Tripping						Using <i>a cable rack</i> or <i>cable hanger</i> to organize and arrange cables that are crossed or hanging loosely tidy
	2. Falling	Injuries or wounds on body parts	3	2	6	M	Place warning <i>signs</i> in the work area that are easy to understand
	3. Slipping						
2. Welding	1. Electric shock	Electrical shock	3	2	6	M	Use complete PPE (Personal Protective Equipment), especially <i>welding cups, welding aprons, welding gloves, and safety shoes</i> in accordance with company <i>standards</i>
	2. Exposure to welding sparks	Clothing becomes punctured and skin is exposed					Pay attention to body position and posture when welding in the work area
	3. Eye injuries	Eye <i>injury</i>					Provide training and education to workers on a regular basis

Note:

The position during welding affects the worker's body position and posture, potentially causing lower back pain, unstable body position leading to fatigue, and impacting work comfort. Therefore, apply the first principle of ergonomics: work in a normal position and posture to reduce the impact of abnormal postures and positions during work. Implement risk control measures by providing personal protective equipment (PPE) and conducting regular training and education for workers, which falls under administrative risk control.



Performing welding work without considering the work area, as well as safe and comfortable body positions and postures



Performing welding work while paying attention to body position and posture, ensuring a safe work location.

Hazard Identification Risk Assessment and Risk Control (Hirarc)							
Location		Workshop Area 01					
Work		Welding					
Job Description Based on ergonomic principles	Potential Hazards	Potential Risks	Assessment Risk			Risk Level	Recommendations
			L	C	L x C		
	Performing welding work without paying attention to the safety of the work area during welding activities		Performing work while paying attention to the work area with the assistance of a scissor lift to facilitate work and adjust body position and posture				
3. Finishing/Cleaning of Welds	1. Exposure to dust or debris	Exposure to eyes and respiratory issues	2	2	4	L	Wear complete PPE (Personal Protective Equipment), especially goggles and masks in accordance with company standards
	2. Slipping	Injuries or wounds to body parts					Cleaning or removing weld spatter and clearing the work area of unused materials Performing body stretches to reduce the impact of fatigue

Note:

The position and posture of the body are difficult to reach when cleaning welding spatter due to the close proximity of the aluminum plates, which affects the worker's posture, often causing them to bend over during finishing or cleaning after welding work. Therefore, it is necessary to apply the first principle of ergonomics, which is to work in a normal body position and posture, and control risks by eliminating hazards such as welding spatter and unused materials. Additionally, the ninth principle of ergonomics should be applied, which allows for movement and stretching.

Table 3. HIRARC for Moving Plank Scaffolding

Hazard Identification, Risk Assessment, And Risk Control (Hirarc)							
Location		Workshop Area 1					
Work		Moving Plank Scaffolding					
Job description based on ergonomic principles	Potential Hazards	Potential Risks	Risk Assessment			Risk Level	Recommendations
			L	C	L x C		
1. Preparation of trolley transport equipment	1. Risk of falling when the road is uneven	Injury or wounds to body parts	3	1	3	L	Provide clear and easily visible signage or instructions for the trolley to follow.

Hazard Identification, Risk Assessment, And Risk Control (Hirarc)

Location		Workshop Area 1			
Work		Moving Plank Scaffolding			
Job description based on ergonomic principles	Potential Hazards	Potential Risks	Risk Assessment	Risk Level	Recommendations

When using trolley-type transport equipment based on ergonomic principles, there are still several issues that do not align with ergonomic principles, including: uneven road conditions that are difficult to navigate or unclear areas that can be traversed, necessitating the application of the 11th ergonomic principle by creating clear and understandable signs and controls that fall under administrative risk control measures.

2. Lifting of scaffolding planks	1. Risk of being struck by <i>scaffolding planks</i> 2. Can be pinched by <i>plank scaffolding</i>	Injuries or wounds to body parts Minor injuries and possible abrasions	3	2	6	M	Involving multiple scaffolding personnel in lifting the scaffolding plank to minimize excessive movement. Use complete personal protective equipment (PPE) in accordance with the occupational safety and health standards provided by the company. Provide regular training and education to workers.
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Difficult-to-reach areas, excessive movement, and high temperatures that affect workers' physical endurance. Therefore, apply the second principle of ergonomics to reduce excessive movement and implement administrative risk control by providing training and education, as well as providing PPE (Personal Protective Equipment) in accordance with company standards.



Performing tasks independently and requiring excessive movements, which affect workers' physical endurance.



Performing work by organizing scaffolding planks with the involvement of multiple personnel to reduce excessive movements



Securing scaffolding planks without using safe gloves



Securing scaffolding planks using safe gloves and performing the task with other scaffolding personnel

Hazard Identification, Risk Assessment, And Risk Control (Hirarc)							
Location		Workshop Area 1					
Work		Moving Plank Scaffolding					
Job description based on ergonomic principles	Potential Hazards	Potential Risks	Risk Assessment			Risk Level	Recommendations
3. Placing scaffolding planks in their designated locations	1. Risk of being struck by scaffolding planks	Minor injuries and sprains	3	2	6	M	Involving multiple scaffolding personnel in lifting the scaffolding plank to minimize excessive movement Use complete personal protective equipment (PPE) in accordance with the company's established safety standards Perform substitution or replacement of the scaffolding plank placement process with the assistance of lifting equipment such as a forklift
	2. Can be pinched by scaffolding planks	Minor injuries and possible cuts					

Note:

The area where the scaffolding planks are placed is still not neatly arranged, resulting in excessive movement when picking up the planks. Therefore, the second principle of ergonomics should be applied to reduce excessive movement and control risks by substituting or replacing the work process with the assistance of lifting equipment such as forklifts and providing PPE (Personal Protective Equipment) in accordance with company standards.

Table 4. HIRARC Grinding

Hazard Identification, Risk Assessment, And Risk Control (Hirarc)							
Location		Shelter Area 05					
Work		Grinding					
Job Description Based on ergonomic principles	Potential Hazards	Potential Risks	Assessment Risk			Risk Level	Recommendations
			L	C	L x C		
1. Prepare work tools such as power cables, grinding machines, and others	1. Tripping						Using a cable rack or cable hanger to organize and arrange cables that are crossed or hanging loosely tidy Place warning signs in the work area that are easy to understand
	2. Falling	Injuries or wounds to body parts	3	2	6	M	
	3. Slipping						

Note:

Hazard Identification, Risk Assessment, And Risk Control (Hirarc)

Location		Shelter Area 05					
Work		Grinding					
Job Description Based on ergonomic principles	Potential Hazards	Potential Risks	Assessment Risk			Risk Level	Recommendations
			L	C	L x C		
Cables were found in an unorganized and messy condition, which could pose potential hazards. Therefore, apply the 11th principle of ergonomics by using clear instructions and controls, and implement risk control measures administratively. Additionally, apply risk control measures through engineering by creating cable racks or cable hangers to organize and arrange cables that are crossing or hanging.							
2. <i>Grinding</i>	1. Electric shock	Minor injuries and can result in death (<i>fatality</i>)	3	3	9	H	Use an inspected grinder and ensure that the cables are not damaged or frayed.
	2. May be exposed to <i>the grinder</i>	May sustain minor or severe injuries					Ensure that the <i>grinder</i> handle is used and that <i>the safety guard</i> is properly installed when operating the grinder
	3. Grinder sparks may hit the eyes	May cause eye injury or even blindness					Use complete personal protective equipment (PPE), especially a face shield, safety goggles, gloves, and other items as per company standards Provide training and education to workers on a regular basis Pay attention to body position and posture when grinding in the work area

Note:

The position during grinding activities affects body position and posture because the distance between plates to be ground is close, so it is necessary to apply the first principle of ergonomics, which is to work in a normal position and posture, and implement administrative risk control by conducting inspections and checks on equipment, as well as providing training and education to workers, and implementing risk control through engineering measures by providing handles on grinding tools and ensuring the use of grinding safety guards on such tools.



Performing *grinding* activities while a standing position can be very tiring and ineffective for performing the task.



Performing *grinding* activities with body positions and postures adapted to the task and using handles for safety

Hazard Identification, Risk Assessment, And Risk Control (Hirarc)						
Location		Shelter Area 05				
Work		Grinding				
Job Description Based on ergonomic principles	Potential Hazards	Potential Risks	Assessment Risk			Risk Level
			L	C	L x C	Recommendations
	Unsafe <i>machine grinding</i> due to the absence of <i>safety guards</i> and <i>handles</i>		Grinding machines equipped with <i>safety guards</i> and handles are safe to use.			company <i>standard</i>
			3. Cleaning the workplace / <i>Housekeeping</i>	1. Inhaled dust	Disrupts the 3 respiratory system	

Note:

Clean the work area and move unused materials to designated areas. This requires applying the 10th principle of ergonomics, which is maintaining a comfortable environment, and the 11th principle of ergonomics, which is using understandable instructions and controls. This also falls under risk control, specifically administrative control.

Table 5. HIRARC Cutting Plate

Hazard Identification, Risk Assessment, And Risk Control (Hirarc)							
Location		Shelter Area 05					
Work		Cutting Plate					
Job Description Based on ergonomic principles	Potential Hazards	Potential Risk	Assessment Risk			Risk Level	
			L	C	L x C	Recommendation	
1. Prepare work tools such as <i>power cables, multicutters</i> , and others	1. Tripping	Injuries or wounds to body parts	3	2	6	M	
	2. Falling						
	3. Slipping						
						Using a <i>cable rack</i> or <i>cable hanger</i> to organize and arrange cables that are crossed or hanging untidily. Place warning <i>signs</i> in the work area that are easy to understand.	
2. <i>Grinding</i>	1. Electric shock	Minor injuries and can	3	3	9	H	Before using a <i>multicutter</i> or <i>air cutter</i> , ensure that the equipment has been

Note:

Cables found in disorganized and messy conditions that could pose potential hazards. Therefore, apply the 11th principle of ergonomics by using clear instructions and controls, and implement risk control measures administratively. Additionally, apply risk control measures through engineering by creating *cable racks* or *cable hangers* to organize and arrange cables that are crossing or hanging.

Hazard Identification, Risk Assessment, And Risk Control (Hirarc)

Location		Shelter Area 05				
Work		Cutting Plate				
Job Description Based on ergonomic principles	Potential Hazards	Potential Risk	Assessment Risk		Risk Level	Recommendation
			L	C		
		result in death (<i>fatality</i>)				inspected and is in good working condition.
	2. Risk of being hit by grinding debris	May result in minor or severe injuries				Before cutting with a <i>multicutter machine</i> , ensure that the <i>cutting disk</i> is not worn out to ensure safe use. If it is not suitable for use, replace it immediately.
	3. Grinding sparks may hit the eyes	Eye injuries, including blindness				Ensure that the <i>multicutter machine handle</i> is used during cutting, except in narrow areas where the <i>machine</i> should be replaced with a safer <i>air cutter</i> Provide regular training and education to workers Use a chisel when cutting small materials for added safety Inspect the work area before starting work, paying attention to the cutting position and minimizing excessive movement when cutting <i>plates</i> . Use complete personal protective equipment (PPE) in accordance with the company's occupational safety and health <i>standards</i> .

Note:

The position during plate cutting activities affects body position and posture, so it is necessary to apply the first principle of ergonomics, which is to work in a normal position and posture, and the fifth principle of ergonomics, which is to reduce excessive movements and implement administrative risk control by inspecting and checking tools and conducting training and education for workers. and implementing risk control in engineering design by providing handles on the tools and ensuring the use of *safety* guards on the *multicutter* or *air cutter* machines, as well as creating chucks for small materials to be cut. Most importantly, substitute or replace work processes in areas with high risk during *plate* cutting by replacing the *multicutter machine* with a safer *air cutter machine* and using complete personal protective equipment (PPE) in accordance with the company's occupational safety and health *standards*.

Hazard Identification, Risk Assessment, And Risk Control (Hirarc)					
Location	Shelter Area 05				
Work	Cutting Plate				
Job Description Based on ergonomic principles	Potential Hazards	Potential Risk	Assessment Risk Level		Recommendation
			L	C	L x C
	The multicutter discs are not suitable for use due to being worn out and extremely dangerous if used.				
					Perform grinding activities with proper body position and posture, and use handles for added safety.
	Cutting aluminum plates with a multicutter machine without using a handle is a highly dangerous action				
					Cutting aluminum plates using a multicutter machine equipped with a handle is a safe practice.
	Observe the narrow work area and avoid cutting in extremely narrow areas.				
					Observe the work area and cut in areas that are sufficiently open and easy to access.
3. Final cleaning stage of the plate cuts	1. Hand injured by sharp edges	Hand punctured and may cause injury	3	2	6 M
					Use complete PPE (Personal Protective Equipment), especially gloves and other items in accordance with company standards Maintain a comfortable and clean environment by always performing housekeeping Clean or remove aluminum plate pieces and clear the work area of unused materials Perform body stretches to reduce fatigue

Note:

To maintain a comfortable environment while performing work activities, it is necessary to apply the 10th principle of ergonomics, which is to maintain a comfortable environment and control risks by eliminating hazards such as unused aluminum plate material from cutting by immediately placing them in the designated area. Additionally, apply the 9th principle of ergonomics, which allows for movement and stretching of the body to reduce fatigue, and providing complete

Hazard Identification, Risk Assessment, And Risk Control (Hirarc)					
Location		Shelter Area 05			
Work		Cutting Plate			
Job Description Based on ergonomic principles	Potential Hazards	Potential Risk	Assessment Risk L C L x C		Risk Level Recommendation
personal protective equipment (PPE) in accordance with <i>the</i> occupational safety and health standards provided by the company.					

Table 6. HIRARC Undocking

Hazard Identification, Risk Assessment, And Risk Control (Hirarc)							
Location		Jetty Area					
Work		Undocking Preparation Work					
Work description based on ergonomic principles	Potential Hazards	Potential Risks	Risk Assessment			Risk Level	Recommendations
			L	C	L x C		
1. Block collection	1. May fall	Scratches , sprains, and minor injuries	3	1	3	L	Providing road <i>signs</i> or instructions that can be easily seen and understood by <i>trolley</i> transport vehicles
	2. Can be struck by a beam	Minor injuries and being struck by heavy loads	2	2	4		Perform the task together to reduce excessive movement
2. Proper placement of blocks	1. Hands can get pinched	Hands can injured and bruised	2	3	6	M	Involving several scaffolding personnel in lifting <i>the scaffolding plank</i> to reduce excessive movement By providing sufficient working space and not interfering with work activities
							Providing regular training and education to workers Using complete personal protective equipment (PPE) in accordance with the company's established safety standards

Notes:

Unorganized work areas caused by improperly arranged blocks during block collection can affect workplace safety, and besides safety, it will also affect the work location as it will disrupt the

Hazard Identification, Risk Assessment, And Risk Control (Hirarc)								
Location	Jetty Area							
Work	Undocking Preparation Work							
Work description based on ergonomic principles	Potential Hazards	Potential Risks	Risk Assessment			Risk Level	Recommendations	
			L	C	L x C			
<p>work process. Therefore, it is necessary to apply the 8th principle of ergonomics, which is to allow freedom of movement by providing a work area with sufficient space to support worker activities and involving several personnel in lifting beams to reduce excessive movement, which is included in the 5th principle of ergonomics, as well as implementing administrative risk control by providing training and education to workers and providing complete PPE () (Personal Protective Equipment) in accordance with <i>the</i> occupational safety and health <i>standards</i> provided by the company.</p>								
	Performing <i>undocking</i> activities independently is not recommended because the beams being lifted are quite heavy and numerous							Performing ship <i>undocking</i> activities with other personnel
	Remaining <i>undocking</i> beams are not neatly arranged on pallets							Remaining blocks from the ship <i>undocking</i> process can be neatly arranged on <i>pallets</i> and placed in the designated area.
3. Securing the beams on the pallet	Hands can be get pinched by the binding wire	Hands may be injured and bruised	2	2	4	L	<p>designated locations</p> <p>Use complete PPE (Personal Protective Equipment), especially gloves and other items in accordance with company <i>standards</i></p> <p>Performing substitution or replacement of the process of placing blocks that have been <i>palletized</i> with the assistance of handling equipment such as <i>forklifts</i></p> <p>Using tools such as screwdrivers to secure the beams on <i>the pallet</i></p>	

Note:

Hazard Identification, Risk Assessment, And Risk Control (Hirarc)					
Location			Jetty Area		
Work			Undocking Preparation Work		
Work description based on ergonomic principles	Potential Hazards	Potential Risks	Risk Assessment		Recommendations
			L	C L x C	
The beams to be secured are not suitable because they are larger than the hands, posing a potential hazard during securing. Therefore, the force applied during work should be minimized to prevent workplace accidents. This can be achieved by using tools like screwdrivers, which aligns with the second principle of ergonomics: reducing excessive force and implementing <i>substitution</i> by replacing the beam placement process on <i>pallets</i> with using <i>forklifts</i> , as well as providing complete PPE (Personal Protective Equipment) in accordance with company <i>standards</i> .					

Based on the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) data, the values obtained are then compiled into a table showing that the potential hazards fall into the criteria for potential hazards with low, medium, or high risk levels.

Table 7. Risk Level Assessment

No	Area	Job	Level		
			Low	Medium	High
1	WORKSHOP AREA 01	Welding	1	2	0
		Moving			
		Plank scaffolding	1	2	0
2	SHELTER AREA 05	Grinding	1	1	1
		Cutting plate	0	2	1
3	Jetty Area	Preparation for undocking process	2	1	0
Total work description			5	8	2

During work processes in Workshop Area 01, Shelter Area 05, and Jetty Area at PT. XYZ, there are 15 potential accident points based on the analysis results, namely 5 points at the Low level, 8 points at the Medium level, and 2 points at the High level. At the Low level, these points are categorized in the green column (L = Low risk), at the Medium level in the yellow column (M = Medium risk), and at the High level in the orange column (H = High risk). The potential hazards at the Low and Medium levels are still tolerable but require regular control and monitoring by the Occupational Safety and Health (OSH) personnel.

At the High level, there are three points, namely grinding and plate cutting, which require improvement within 24 hours as a control measure, because the risks that may arise are unacceptable and require further control. The OSH impacts can be controlled by increasing workers' awareness and vigilance regarding workplace safety and health, as well as monitoring the use of PPE (Personal Protective Equipment) such as helmets, safety shoes, safety goggles, and others.

Noise and temperature measurements in Workshop Area 01, Shelter Area 05, and Jetty Area indicate that noise levels are at 62.4 dBA. In accordance with [11], the permissible noise level limits are 85 dBA/7 hours, 88 dBA/4 hours, 91 dBA/2 hours, and 94 dBA/1 hour, given the working hours at PT. XYZ, which are 7 hours per day, the noise levels in Workshop Area 01, Shelter Area 05, and Jetty Area are within safe limits.

The temperatures obtained from the measurements indicate that in Workshop Area 01, Shelter Area 05, and Jetty Area, the temperatures range from 30.4°C and 31°C. The temperature range for work activities is 28.0°C to 31.1°C. This temperature is still in line with occupational health and safety standards that ensure worker performance and comfort [11]-[13].

To reinforce the measurement results, interviews were conducted with 78 workers. The results of the interview responses indicating "Yes" for each question are presented in Table 6 below:

Table 8. Potential Hazards from Observations

	Potential Hazards	Number
Observation Results	Dust Exposure	7
	MSDs	7
	Temperature	78
	Noise	50
	Transportation	30

Based on the observations conducted at the existing work sites in Workshop Area 01, Shelter Area 05, and Jetty Area, through interviews with 78 workers, the potential hazards experienced by workers during their work activities can be seen in Table 6, with complaints regarding dust exposure, MSDs, temperature, noise, and transportation that can disrupt work activities at the work site.

The results of hazard identification in Workshop Area 01, Shelter Area 05, and Jetty Area based on Hazard Identification Risk Assessment and Risk Control (HIRARC) and observations made by researchers are summarized below:

Table 9. Summary of Hazard Identification

No	Summary Of Hazard Identification Potential Hazard	Source
1	Tripping	HIRARC
2	Fell	HIRARC
3	Slipped	HIRARC
4	Electrocution	HIRARC
5	Exposed to welding sparks	HIRARC
6	Eye injury	HIRARC
7	Exposure to dust and debris	HIRARC
8	Prone to falling when the road is uneven	HIRARC
9	Can be hit by scaffolding planks	HIRARC
10	Can be pinched by scaffolding planks	HIRARC
11	Can be struck by scaffolding planks	HIRARC
12	Can be hit by a grinder	HIRARC
13	Grinding sparks may come into contact with the eyes	HIRARC
14	Inhaled dust	HIRARC
15	Exposure to a multi-cutter machine	HIRARC
16	Hand cut by sharp plate	HIRARC
17	Can fall	HIRARC
18	Can be hit by a beam	HIRARC
19	Hands can be pinched by binding wire	HIRARC
20	Hands can get caught in binding wire	HIRARC
21	Dust exposure	Observation
22	MSDs	Observation
23	Temperature	Observation
24	Noise	Observation
25	Transport	Observation

Hazard control is carried out based on a control hierarchy consisting of elimination, substitution, engineering, administration, and provision of PPE (Personal Protective Equipment) [14]. Meanwhile, based on the study [15], [16] a *risk matrix* categorized as *low* indicates a low potential hazard and is not yet a top priority for control. A *risk matrix* categorized as *medium* indicates a moderate potential hazard and requires monitoring to determine whether the potential hazard requires control. Meanwhile, a *risk matrix* categorized as *high* indicates a high potential hazard and is the primary focus of control by the company.

Table 10. Risk Control

No	Potential Hazard	Impact	Risk Matrix	Risk Control
1	Tripping	Minor injury or wound	Medium	Using a cable rack or cable hanger to organize and arrange cables that are crossing or hanging loosely (Engineering)
	Falling Slipping			Place warning signs in the work area that are easy to understand (Administration). Using complete personal protective equipment (PPE), especially <i>welding cups, welding aprons, welding gloves, and safety shoes in accordance with company standards</i> company (Personal Protective Equipment).
2	Electrical shock	Electrical shock	Medium	Pay attention to body position and posture during welding processes at the work site, including ergonomic principle no. 01: working in a normal posture (<i>Substitution</i>).
	Exposed to welding sparks	Clothing becomes torn or damaged		Providing training and education to workers on a regular basis (Administration).
3	Eye injuries	Eye injury	Low	Use complete personal protective equipment (PPE), especially goggles and masks in accordance with <i>company standards</i> (Personal Protective Equipment)
	Exposure to dust or particles	Eye exposure and respiratory issues		Cleaning or removing <i>weld spatter</i> and cleaning the work area from unused material (<i>Elimination</i>) Provide clear and easily visible signage indicating areas that are passable or impassable for <i>trolley</i> transport equipment, in accordance with ergonomic principle no. 11 (Administration)
4	Slipping	Injuries or wounds to body parts	Low	Involving multiple scaffolding personnel in lifting scaffolding planks to reduce excessive movement (<i>Substitution</i>)
	Can fall when walking on uneven surfaces	Injuries or wounds to body parts		Use complete personal protective equipment (PPE) in accordance with the company's established occupational safety and health <i>standards</i> (PPE) Provide training and education to workers on a regular basis (Administration)
5	Can be struck by scaffolding planks	Injuries or wounds to body parts	Medium	Involves multiple <i>scaffolding</i> personnel in lifting <i>the scaffolding planks</i> to minimize excessive movement (<i>Substitution</i>)
	Can be pinched by scaffolding planks	Minor injuries and abrasions		
6	Can be struck by scaffolding planks	Minor injuries and possible sprains	Medium	

No	Potential Hazard	Impact	Risk Matrix	Risk Control
7	Can be pinched by scaffolding planks	Minor injuries and possible abrasions	Medium	Use complete personal protective equipment (PPE) in accordance with the company's established occupational safety and health <i>standards</i> (PPE) Performing <i>substitution</i> or replacing the process of placing <i>scaffolding planks</i> with the assistance of lifting equipment such as <i>forklifts</i> (<i>Substitution</i>)
	Tripping	Injury or minor injury		Using <i>cable racks</i> or <i>cable hangers</i> to organize and arrange cables that are crossing or hanging loosely (Engineering)
	Falling			Place warning <i>signs</i> in the work area that are easy to understand (Administration)
	Slipping			
8	Electrical shock	Minor injuries and may cause death (Fatality)	Height	Use a <i>grinder</i> that has been inspected and ensure that the cables used are not damaged or frayed (Administrative)
	Can be struck by the grinder	May sustain minor or severe injuries		Ensure that the grinder handle is used and that <i>the safety guard</i> is properly installed when using it (Engineering) Use complete personal protective equipment (PPE), especially a <i>face shield</i> , safety goggles, gloves, and other items as per company standards (Personal Protective Equipment)
	Grinding sparks may hit the eyes	Eye injuries, including blindness		Provide training and education to workers on a regular basis (Administration) Ensure proper body position and posture during <i>grinding</i> activities in the work area (<i>Substitution</i>)
9	Inhaled dust	Irritates the respiratory tract	Low	Use complete PPE (Personal Protective Equipment), especially masks that meet company standards (Personal Protective Equipment) Maintain a comfortable and clean environment by always performing housekeeping (elimination) Provide warning signs in the work area that are easy to understand (Administration)
10	Tripping Falling	Injury or minor injury	Medium	Use <i>cable racks</i> or <i>cable hangers</i> to organize and arrange cables that are crossed or hanging untidily (Engineering)

No	Potential Hazard	Impact	Risk Matrix	Risk Control
	Slipping			<p>Provide warning signs in the work area that are easy to understand (Administration)</p> <p>Before using a <i>multi-cutter machine</i> or <i>air cutter</i>, ensure that the equipment has been inspected and is safe for use (Administration)</p> <p>Before cutting with a <i>multi-cutter machine</i>, ensure <i>the cutting disk</i> is not worn out to ensure safety during use, and if it is not suitable for use, replace it immediately (<i>Elimination</i>)</p> <p>Ensure that <i>the multicutter machine handle</i> is used during cutting, except in narrow areas where <i>the machine</i> should be <i>substituted</i> with a safer <i>air cutter</i> (Engineering)</p>
11	Hit by a multi-cutter machine	Suffered lacerations or severe injuries	Height	<p>Provide training and education to workers on a regular basis (Administration)</p> <p>Use a chisel when cutting small materials for safety (<i>Substitution</i>)</p> <p>Inspect the work area before starting work, paying attention to the cutting position and minimizing excessive movement during <i>plate</i> cutting (<i>Substitution</i>)</p> <p>Use complete personal protective equipment (PPE) in accordance with the company's established occupational safety and health <i>standards</i> (PPE)</p> <p>Use complete PPE (Personal Protective Equipment), especially hand protection () and gloves, in accordance with company <i>standards</i> (Personal Protective Equipment)</p>
12	Hand cut by sharp plate	Hand punctured and may cause injury	Medium	<p>Maintain a comfortable and clean work environment by consistently performing <i>housekeeping</i> (<i>elimination</i>)</p> <p>Clean or eliminate <i>aluminum plate</i> pieces and clean the work area of any remaining material that is no longer needed (<i>elimination</i>)</p> <p>Perform body stretches to reduce fatigue, following ergonomic principle no. 9, which allows for movement and stretching (Elimination)</p>
13	Risk of falling	Scratches, sprains, and minor injuries	Low	<p><i>Display</i> a warning sign in the work area that is easy to understand (Administration)</p>

No	Potential Hazard	Impact	Risk Matrix	Risk Control
	Can be struck by a beam	Minor injuries and being struck by heavy loads		Perform the task together to reduce excessive movement (<i>Substitution</i>)
14	Hands may be pinched	Hands may be injured and bruised	Medium	Involve several personnel in lifting beams to reduce excessive movement (<i>Substitution</i>) By providing sufficient working space and not interfering with work activities (<i>Substitution</i>) Providing regular training and education to workers (Administration) Using complete personal protective equipment (PPE) in accordance with the company's established occupational safety and health standards (PPE) Using complete PPE (Personal Protective Equipment), especially gloves and other items in accordance with company standards (Personal Protective Equipment)
15	Hands can get caught in wire ties	Hands may be injured and bruised	Low	Perform <i>substitution</i> or replacement of the process of placing blocks on pallets using lifting equipment such as <i>forklifts</i> (<i>Substitution</i>) Use tools such as screwdrivers to secure the blocks on the pallet (Engineering Modification)

CONCLUSION

Based on the analysis using the Hazard Identification Risk Assessment and Risk Control (HIRARC) method at PT. XYZ in 2025, it can be concluded that potential hazards occurring during work in Workshop Area 01, Shelter Area 05, and Jetty Area have been identified through the distribution of closed-ended questionnaires offline to workers, resulting in 20 valid and reliable potential hazards. Furthermore, the risk levels and evaluation results in the three areas are categorized into three categories: Low (5 points), Medium (9 points), and High (3 points). To control risks and reduce or eliminate the identified hazards in Workshop Area 01, Shelter Area 05, and Jetty Area, several control measures were implemented, including the use of complete Personal Protective Equipment (PPE) in accordance with company standards, the use of work tools that have undergone inspection as part of administrative control, cable management using cable hangers or cable racks as technical engineering control, and the application of 12 ergonomic principles as an additional effort in risk control.

ACKNOWLEDGEMENT

The authors express their sincere appreciation and gratitude to all parties who have provided support, guidance, and contributions to the completion of this research. Special thanks are also extended to all respondents for their participation, as well as to the institution that facilitated the implementation of this study.

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