BACHELOR THESIS & COLLOQIUM – ME234841

IMPLEMENTATION OF HIRARC METHODOLOGY FOR OCCUPATIONAL SAFETY AND HEALTH IN THE SHIP RECYCLING SHIPYARD ENVIRONMENT

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If in the future there is any inconsistency with this statement, then I am willing to accept sanctions in accordance with the applicable provisions at the Sepuluh November Institute of Technology.

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ABSTRAK

IMPLEMENTASI METODOLOGI HIRARC UNTUK KESELAMATAN DAN KESEHATAN KERJA DI LINGKUNGAN GALANGAN KAPAL DAUR ULANG

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Abstrak

Galangan kapal daur ulang merupakan lingkungan industri yang potensial menghadirkan risiko keselamatan dan kesehatan kerja yang tinggi. Untuk mengatasi tantangan ini, metodologi HIRARC (Hazard Identification, Risk Assessment, and Risk Control) diimplementasikan sebagai pendekatan sistematis untuk mengidentifikasi, menilai, dan mengendalikan bahaya serta risiko yang ada. Studi ini membahas aplikasi HIRARC dalam konteks galangan kapal daur ulang, dengan fokus pada tiga tahapan utama: identifikasi bahaya potensial yang meliputi risiko fisik, kimia, dan biologis; penilaian risiko yang melibatkan estimasi tingkat risiko berdasarkan probabilitas dan dampaknya; serta pengendalian risiko melalui strategi pencegahan dan mitigasi yang tepat. Metodologi HIRARC memberikan kerangka kerja yang komprehensif untuk mengelola keselamatan dan kesehatan kerja di lingkungan yang kompleks ini. Potensi bahaya dengan tingkat risiko tinggi sebanyak 17 (21,2%), tingkat sedang 36 (46,2%), dan tingkat rendah 24 (32,7%). Potensi bahaya ini disebabkan oleh kurangnya pemahaman dan pelatihan mengenai K3 pada pekerja. Dengan mengidentifikasi bahaya secara dini, mengevaluasi risiko secara obyektif, dan menerapkan langkah-langkah pengendalian yang sesuai, galangan kapal daur ulang dapat meningkatkan kondisi kerja dan mengurangi potensi cedera serta dampak negatif bagi kesehatan pekerja. Dengan demikian, hasil dari penelitian ini memberikan kontribusi penting dalam pengembangan kebijakan keselamatan dan kesehatan kerja yang efektif di galangan kapal daur ulang serta sektor industri serupa.

Kata kunci: Daur Ulang Kapal, Identifikasi bahaya, Metode HIRARC, Potensi Risiko, Pengendalian Risiko

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ABSTRACT

IMPLEMENTATION OF HIRARC METHODOLOGY FOR OCCUPATIONAL SAFETY AND HEALTH IN THE SHIP RECYCLING SHIPYARD ENVIRONMENT

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Abstract

Recycling shipyards are industrial environments that potentially present high occupational safety and health risks. To address this challenge, the HIRARC (Hazard Identification, Risk Assessment, and Risk Control) methodology was implemented as a systematic approach to identify, assess, and control hazards and risks. This study discusses the application of HIRARC in the context of a recycling shipyard, focusing on three main stages: identification of potential hazards that include physical, chemical, and biological risks; risk assessment that involves estimating the level of risk based on its probability and impact; and risk control through appropriate prevention and mitigation strategies. The HIRARC methodology provides a comprehensive framework for managing occupational safety and health in this complex environment. Based on the Hazard Identification carried out in the ship recycle work area, there are 77 potential hazards. Potential hazards with a high risk level are 17 (21.2%), moderate level 36 (46.2%), and low level 24 (32.7%). This potential hazard is caused by the lack of understanding and training on OHS for workers. By identifying hazards early, evaluating risks objectively, and implementing appropriate control measures, recycled shipyards can improve working conditions and reduce potential injuries and negative impacts to workers' health. As such, the results from this study make an important contribution to the development of effective occupational safety and health policies in recycled shipyards and similar industry sectors.

Key Words: Hazard identification, HIRARC Method, Potential Risk, Risk Control, Ship Recycle

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Praise be to God Almighty for all His grace and gifts so that the author can complete the thesis entitled “IMPLEMENTATION OF HIRARC METHODOLOGY FOR OCCUPATIONAL HEALTH AND SAFETY IN THE SHIP RECYCLING SHIPYARD ENVIRONMENT”. This thesis is prepared to fulfill one of the requirements to obtain a Bachelor of Engineering degree at Department of Marine Engineering, Faculty of Marine Technology, Institut Teknologi Sepuluh Nopember.

In the process of preparing this thesis, the author received a lot of help, guidance, and support from various parties. Therefore, the author would like to express her deepest gratitude to :

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The author hopes that this research can be useful in the Indonesian maritime world. The author realizes that this research is far from perfect. Therefore, any reasonable input and criticism is welcome with the aim of future research progress.

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LIST OF ABBREVATIONS

OHS / K3 : Occupational Health and Safety

HIRARC : Hazard Identification Risk Assessment Risk Control

HKC : Hong Kong Convention

SRFP : Ship Recycling Facility Plan

PPE : Personal Protective Equipment

CHAPTER 1

INTRODUCTION

1.1 Research Background

Indonesia is a developing country that has a great opportunity to become the largest maritime industry center in the world, given its strategic geographical location and abundant marine resources. The maritime industry, as one of the vital sectors, not only plays a role in supporting the economy and trade, but also contributes significantly to job creation and infrastructure development. In this context, the utilization of proceeds or parts of the ship recycling process is needed to promote sustainable economic growth.

However, in Indonesia, it is still rare to find shipyard companies that specifically focus on ship recycling, so this research is expected to be a reference for business actors in the shipyard sector, especially those related to ship recycling. With the increasing number of old ships that are not fit for operation, the ship recycling process is a very relevant solution.

On the other hand, the ship recycling process also brings significant risks to the work area, which can impact the safety and health of workers. Therefore, it is important to conduct an in-depth analysis of the possible risks in this process, as well as apply an appropriate methodology, such as HIRARC (Hazard Identification, Risk Assessment, and Risk Control), to identify and control the hazards. This research aims to explore and provide recommendations that can improve occupational safety in the recycling shipyard environment in Indonesia.

Figure 1 Graph of Work Accidents and Deaths 2001-2021

Source : hsepedia.com

The table above explains the data from the National Occupational Safety and Health (OHS) Month and BPJS TK. For 2018-2021, no data related to occupational deaths was found, so if we consider an annual increase of around 2%, it can be assumed that the number of deaths ranges from 3,000 to 4,500 per year (HSEpedia,n.d, 2022). From the data found, there are indeed some data that need to be verified and raise some questions. One of them is the significant increase in the number of work accidents in Indonesia which increased dramatically in 2020. As quoted from the official BPJS Employment

website, it is explained that JKK provides protection for the risk of accidents that occur in the work relationship.

The findings of this research make a valuable addition to the existing body of knowledge on Occupational Health and Safety (OHS) within the maritime sector. They have the potential to pave the way for the development of improved safety techniques and protocols, ultimately leading to a reduction in work-related accidents. Specifically, when it comes to ship recycling, certain factors emerge as the primary drivers behind ensuring occupational safety. The potential dangers associated with coming into contact with dangerous substances, the possibility of encountering sparks, and the risk of being hit by materials all contribute to the greatest likelihood of occupational safety disruptions. One of the major hazards in ship recycling is the potential exposure to dangerous substances. The primary safety concerns revolve around the risks associated with coming into contact with hazardous materials, being exposed to sparks, and being hit by materials while performing primary cutting tasks. (Fariya, 2017).

1.2 Problem Statement

The problem formulation is an important basis for understanding the challenges and needs for improving working conditions in the maritime environment. The following are important problems in this research:

1. What are the potential hazards in the fabrication area of the ship recycle process?
2. How to assess the probability of hazard occurrence using the HIRARC method?
3. What are the recommendations and strategies that can be done to achieve a safer and healthier work environment?

1.3 Research Purpose

The research objectives about the implementation of the HIRARC Method to analyze occupational safety and health. health (K3) can be formulated as follows:

1. Identify the causes of hazards in the fabrication area of the ship recycle process.
2. Evaluate the chances of work accidents using the HIRARC method
3. Propose recommendations and strategies that can be applied to improve the effectiveness of OHS implementation using the HIRARC method.

1.4 The Scope of Research

The focus of this research is to implement the HIRARC method to determine opportunities for OHS risks in the ship recycling fabrication area.

1.5 Benefits of Research

The benefits of research on the application of HIRARC method for OHS analysis in the fabrication area, include:

1. Provide an evaluation of OHS in the fabrication area
2. Prevent and reduce the occurrence of work accidents in the fabrication area
3. Open up development opportunities for better OHS

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction of Ship Recycle

Ship Recycle is a ship dismantling activity carried out to retrieve the remaining plates, equipment, and other materials that can still be reused. The traditional ship recycle process is still widely available in Indonesia. Tanjung Jati Village, Kamal Sub-District, Bangkalan, Madura is one of the ship recycle places that is still managed traditionally until now.

The types of ships that are dismantled are cargo ships, barges, LCTs, tankers, and dredgers with an age exceeding 25 years from the start of production and experiencing a decrease in performance so that they do not meet the requirements of seaworthiness. This recycling process begins with the incoming ship being pulled to the shore because the ship's tank is clean when the ship arrives, then cutting can be done. The cutting of the ship is divided into 2, namely the main cutting carried out on the beach by cutting the upper ship structure with the help of a crane and the second cutting is carried out on land. The part that is cut on land is the structure of the ship that is submerged in water. The next process is the collection of the remnants of the cutting results, the parts that are reused are collected and then sent to the factory that has worked together.

Indonesia has ship recycling facilities which are differentiated based on the number, type and size of ships operating in Indonesia. There are categories of recycling facilities in industrial areas, namely small ship recycling facilities under 5,000 dwt, large ship recycling facilities up to 30,000 dwt, and medium facilities between 5,000 dwt and 10,000 dwt (Sunaryo & Tjitrosoemarto, 2022).

2.2 Related Studies

2.2.1 (Mulana, 2021). **OCCUPATIONAL HEALTH AND SAFETY RISK ASSESSMENT OF SHIPYARD USING HIRARC METHOD: Institut Teknologi Sepuluh Nopember.**

2.3 Regulation Ship Recycle

In running a ship recycle business, a regulation is needed to keep it environmentally friendly, including:

2.3.1 Based Convention

United Nations of Environmental Program (UNEP) through Technical Guidelines for Full and Partial Environmentally Friendly Management of Ship Demolition in 2003 made a ship recycle shipyard modeling arrangement (UNEP, 2003), as follows:

a. There is a division of the work area for ship dismantling into smaller elements
b. Hazardous substances must be removed especially the main work areas that are prone to contaminants and toxins.
c. There is a temporary storage area for scrap steel
d. Have a safe storage area for hazardous substances.

e. Scrap material and material still in process must be separated areas
f. There is equipment for cleaning hazardous substances

In Bangladesh there are new regulations that require ships to be scrapped to have a certificate from the exporter stating that the ship is free from toxic substances (Rabbi & Rahman, 2017). If Indonesia also implements the same regulations, it will help reduce environmental pollution and create an environmentally friendly ship recycling process.

2.3.2 Hong Kong Convention

The Hongkong Convention has the main objective is to ensure that the implementation phase of ship recycle for ships after they have reached their operational life does not pose a risk to human health and the environment. The conference produced regulations for all ship recycle operators to reduce the risk of accidents.

The regulations issued through Hong Kong 25 regulations and 7 annexes, said the main rules for the country as the initial stage in making ship recycle business which has 4 points, namely:

a. Guidelines for the Development of the Inventory of hazardous materials
b. Guidelines for the Development of the Development of the Ship Recycle Plan
c. Guidelines for the Safe and Environmentally Sound Ship Recycling
d. Guidelines for the Authorizing of Ship Recycling Facilities

Specifically, the four technical guidelines for implementing the Hong Kong Convention can be simplified as follows:

a. Hazardous material recording and planning
b. Providing Ship Recycle Plan for ships that will be scrapped
c. Business actors are able to develop a Ship Recycling Facility Plan
d. Ships that will be recycled must have a clear identity and the shipyard has a construction and operational license.

An addition to the facility requirements is to develop and implement a Ship Recycling Facility Plan. This document is a record made by the entrepreneur or the authority of the business. The contents of this document are in the form of processes, procedures, facilities, and the application of shipyards that are friendly to worker safety as well as the environment. There are mandatory items in this document:

a. Education and training for worker safety
b. Human and environmental protection
c. Having clear rules and responsibilities for each personnel
d. Response to emergency conditions
e. Located in an area that has legal force and provisions from the authorities
f. Application of applicable procedures at the shipyard and owned facilities

The HKC launched in May 2009, aims to ensure that ships being recycle do not pose unnecessary risks to human health and safety. The convention is critical to documenting hazardous materials, developing ship recycling plans, certifying recycling facilities, and conducting ship recycling in a safe and environmentally friendly manner. (Hiremath et al.,

2016). The Hong Kong Convention requires that every ship recycling site must be able to demonstrate compliance with the SRFP (Ship Recycling Facility Plan) (Jamaluddin et al., 2022). SRFPs must fully understand all relevant legal and regulatory requirements and demonstrate a strong commitment to worker health and safety and environmental protection. SRFP covers four main aspects: Facilities Management, Facilities Operations and Occupational Health and Safety (OHS), and Environmental Protection. Due to limitations, environmental protection assessment was not considered in this study.

2.3.3 International Maritime Organization (IMO)

The International Maritime Organization (IMO) is a specialized agency of the United Nations responsible for regulating shipping. Founded in 1948 and headquartered in London, IMO's main mission is to ensure the safety and security of international shipping and prevent marine pollution from ships. IMO conventions and regulations are developed through a collaborative process involving member countries, industry stakeholders and experts. The organization plays an important role in setting global standards for maritime safety, security and environmental protection.

There are many types of hazardous materials recycled on ships. According to the IMO Guidelines on Ship Recycling, these hazardous materials must be inventoried. Some of these materials and their impacts on the environment and human health include metals and fuel oil, ship hulls and ballast water, paints and coatings, as well as asbestos and PCBs. (Fariya, 2017).

2.3.4 International Labor Organization (ILO)

The regulation aims to guide shipbreakers and rightsholders to realize the application of the standards applied by the ILO in terms of occupational safety and health of the working environment. A healthy and safe working environment must be consistently maintained to the fullest extent possible in accordance with ILO Convention No. 155 of 1988 on Occupational Health and Safety (Lestari & Effendi, 2005). This is very important and shipbreaking businesses should start paying attention to it.

Adverse consequences arise from workplace accidents, encompassing health problems, safety concerns, exhaustion, injuries, fatalities, and material damages (Siregar et al., 2023). These incidents extend beyond physical harm, causing significant disruptions to work operations and diminishing overall productivity and efficiency. Financially, the implications can be severe, entailing medical costs, compensation claims, and potential legal liabilities. Furthermore, the psychological impact on employees can dampen morale and job satisfaction, potentially leading to increased turnover rates and fostering a negative work atmosphere. To mitigate these risks, it is imperative for companies to establish robust safety protocols, invest in employee training, and cultivate a proactive risk management culture. Through these measures, companies can fortify workplace safety, minimize the occurrence of accidents, and foster a healthier and more productive work environment.

2.4 Basic Theory

This chapter will explain the theory and other reference sources used as a reference in processing data and solving problems in this study.

2.4.1 Occupational Health and Safety (OHS)

According to OHSAS 18001:2007, Occupational Safety and Health (OHS) encompasses all elements and circumstances that possess the capacity to impact the well-being and safety of employees and other individuals within a work environment, including contractors, suppliers, visitors, and guests (OHSAS 18001, 2007). Furthermore, Law Number 23 of 1992, specifically Article 23, addresses the same matter. To attain maximum work efficiency, it is imperative to establish Occupational Health and Safety (OHS) measures, encompassing the delivery of healthcare services and initiatives to avert work-related illnesses (Yahya, 2020). The term OHS pertains to the safety and well-being of employees within their work environment.

The environment encompasses various aspects, which consist of:

1. Health

Ensuring workers work in a healthy environment, free from hazards and have adequate facilities to maintain their health.

2. Safety

Ensuring workers work in a safe environment, free from the risk of accidents, and have effective protection systems in place to prevent accidents.

Occupational Health and Safety (OHS) refers to efforts to protect the health and safety of employees in the workplace. It includes the identification, evaluation, and control of risks to hazards in the work environment that could result in injury, illness, or death. The goal is to create a safe and healthy work environment for all workers.

2.4.2 OHS Management System

An OHS Management System is a system designed to manage and control occupational safety and health risks within an organization. The system involves several stages, including:

1. Hazard Identification: Identifying all potential hazards that may occur during the work process.
2. Risk Assessment: Assessing the risk level of each identified hazard.
3. Risk Control: Controlling the risks that have been identified and assessed.
4. Monitoring and Evaluation: Monitoring and evaluating the implementation of the OHS management system.

An OHS Management System is a structured approach to managing Occupational Health and Safety in an organization. Based on the OHSAS 18001:2017 standard (which has now been replaced by ISO 45001), an OHS management system includes a set of procedures, policies and practices designed to identify, reduce and manage OHS risks. OHSAS 18001 outlines a risk control hierarchy consisting of five levels for managing occupational health and safety hazards. These levels include elimination, substitution, engineering controls, administrative controls, and personal protective equipment (Asih et al., 2021). The aim is to ensure regulatory compliance, improve employee well-being, and reduce workplace incidents and accidents.

2.4.3 OHS Regulations

OHS regulations are rules imposed by the government to implement an OHS management system in an organization. In Indonesia, OHS implementation is governed by several regulations, including:

1. Law No. 13 Year 2003: The Law on Manpower, which stipulates the obligation of companies to implement an OHS management system.
2. SMK3 PP No. 50 Year 2012: Government Regulation on the Implementation of Occupational Safety and Health Management Systems, which stipulates the obligation of companies to implement OHS management systems based on international standards such as OHSAS 18001:2017.
3. SMK3: Occupational Safety and Health Management System, which is the implementation of these regulations.

In line with the directives, the implementation of Occupational Health and Safety (OHS) is intended to protect company assets, the environment, the community, and employees. The application of an OHS Management System within a company should adhere to the following stages: Article 6 serves as a foundational framework for the industrial sector, particularly in maritime industries, for risk management. This process includes: establishing occupational health and safety (OHS) policies, planning OHS measures, implementing the OHS plan, monitoring and evaluating OHS performance, and reviewing and improving the performance of the OHS management system (Winarni, 2024).

OHS regulations aim to regulate the procedures, standards, and obligations to prevent work accidents, protect employee health, and create a safe and healthy working environment. The application of these concepts and principles is essential in maintaining the safety, health and well-being of employees in various types of industries, including in the context of ship recycling.

2.4.4 Hazard

Danger is a situation that causes losses and creates negative risks. To recognize the presence of danger, identification is required by identifying conditions or situations that can cause injury, damage or death. In the shipbuilding industry, materials such as glass wool boards, glass wool felt, glass wool pipes, and glass fiber products are commonly utilized. However, during ship recycling, there is a need for enhanced methods to address the toxicity and recycling processes associated with glass fiber waste (Du et al., 2018).

2.4.5 Risk

Risk is the possibility of danger or loss occurring. Risks can come from various sources such as unsafe work environments, use of inappropriate tools, and work practices that do not comply with safety standards. Determining risk can be done through a process of identification, evaluation and risk control to reduce the possibility and impact of undesirable events. The risks encountered in the shipping industry can include maritime accidents, environmental pollution, financial losses, health and safety hazards, as well as compliance issues with international regulations and standards (Mutia, 2023).

In ship recycling operations, the primary safety concerns are exposure to hazardous materials, risk of fire sparks, and the danger of being struck by falling materials. The most significant probability of safety incidents in ship recycling is associated with exposure to hazardous materials. The severe safety impacts include exposure to hazardous substances, fire sparks, and being struck by materials during primary cutting operations (Fariya, 2017). Risk control measures provide a solution for managing all identified hazards by evaluating the level of risk. This assessment helps in setting priorities and determining the appropriate control strategies (Pramadi et al., 2020).

2.4.6 Accidents

An accident is an event that results in unwanted and unplanned injury, damage, or loss. Accidents occur due to many factors ranging from environmental conditions, human error, and equipment failure. Accident management can be an effort to prevent accidents by ensuring a safe work environment, providing job training to employees and industry players, as well as establishing effective emergency procedures.

2.4.7 Safety Culture

Safety culture can include attitudes, values and behavior related to safety in the workplace. Safety awareness includes risk, commitment to safe work practices, open communication about Health and safety, and active participation in safety efforts. A good safety culture in the work environment will create an environment where safety is a priority. There are four existing conditions in the ship recycling industry in Indonesia. The ship cutting industry is not well-recognized in the country, resulting in insufficient attention and support from the government for its development (Fariya, 2017).

A study found that the perception of accident risk influences work motivation by 25%. This finding aligns with Sigayan's view (cited in Adab, 2013), which states that employee perception is a key factor affecting work motivation. Additionally, the research indicates that 75% of work motivation is influenced by factors other than the perception of accident risk (Umama & Nurfitria, 2018).

2.5 Model (HIRARC)

The HIRARC model is a model for analyzing Occupational Safety and Health (K3) risks in a systematic approach to identifying potential hazards, evaluating related risks, and developing control strategies to reduce the risks that occur. This model contains identification, risk assessment, risk matrix and risk control stages. This model aims to facilitate the implementation of safety controls and prevent risks.

2.5.1 Procedure HIRARC

This procedure is a series of steps or procedures used to implement the HIRARC method. One of the requirements for implementing OHSAS 18001:2007 is the inclusion of HIRARC. Clause 4.3.1 in OHSAS 18001:2007 requires organizations/companies intending to implement OHSAS 18001:2007 based OHSAS 18001:2007 to conduct an HIRARC assessment in their company (Yahya, 2020). This procedure involves the process of identifying potential hazards that may occur, identification stage, risk assessment, risk matrix, and risk control.

2.5.2 Hazard Identification

Hazard identification is the first stage in the HIRARC method. A hazard refers to anything that could potentially cause harm, whether it's related to human injury, health problems, property damage, environmental damage, or a combination of these factors (DOSH Malaysia, 2008). Hazard identification involves recognizing unwanted events that could trigger a hazard and understanding the processes through which these events might happen.

This stage involves the process of identifying possible hazards. Hazard identification involves documenting all potential hazards that have a chance of occurring, such as hazardous materials, fire, and falling material. The process of recognizing potential hazards can be carried out in the work environment or in certain activities. Hazards can come from chemicals, equipment, work processes, or environmental conditions and many more.

Tabel 1 Hazard Value

Source : (DOSH Malaysia, 2008)

	Severity (S)				
Likelihood (L)	1	2	3	4	5
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

Table C

High
Medium
Low

2.5.3 Risk Assessment

Risk assessment is the second stage in the HIRARC method. Risk refers to the chance of a hazardous event occurring within a given timeframe or under certain conditions, along with the potential severity of harm or damage to people, property, the environment, or a combination of these. Risk assessment is the process of evaluating these potential risks to safety and health that arise from workplace hazards (DOSH Malaysia, 2008).

It involves the process of assessing the risk level of each identified hazard. A systematic evaluation of the risk associated with each identified hazard is assigned a value depending on its severity or hazardousness. Risk assessment involves analyzing the likelihood of an adverse event occurring and its impact on employees, equipment or the environment. Risk assessment involves measuring the severity and likelihood of occurrence of hazards, as well as their impact on worker safety and the environment. (DOSH Malaysia, 2008)

Risk can be calculated using the following formula:

L x S = Relative Risk

L = Likelihood

S = Severity

Tabel 2 Likelihood Level

Source : (DOSH Malaysia, 2008)

LIKELIHOOD (L)	EXAMPLE	RATING
Most likely	The most likely result of the hazard / event being realized	5
Possible	Has a good chance of occurring and is not unusual	4
Conceivable	Might be occur at sometime in future	3
Remote	Has not been known to occur after many years	2
Inconceivable	Is practically impossible and has never occurred	1

Tabel 3 Severity Level

Source : (DOSH Malaysia, 2008)

SEVERITY (S)	EXAMPLE	RATING
Catastrophic	Numerous fatalities, irrecoverable property damage and productivity	5
Fatal	Approximately one single fatality major property damage if hazard is realized	4
Serious	Non-fatal injury, permanent disability	3
Minor	Disabling but not permanent injury	2
Negligible	Minor abrasions, bruises, cuts, first aid type injury	1

2.5.4 Risk Matriks

A risk matrix is a table used to describe and assess risks based on their likelihood of occurring and the level of impact if they do occur. It describes each identified hazard, the level of risk, and the actions to be taken to control the risk. This risk matrix helps in identifying and controlling possible risks. The risk matrix helps in classifying risks into categories that require different control measures.

Tabel 4 Likelihood Level and Description

Source : AS/NZS 4360 ; 1999

Level	Descriptor	Detail description
5	Almost certain	Occur once a day
4	Likely	Occur once a week
3	Possible	Occur once a month
2	Unlikely	Occur once a year
1	Rare	Occur only in exceptional circumstances or never happened

Tabel 5 Severity Level and Description

Source : AS/NZS 4360 ; 1999

Level	Descriptor	Detail description
1	Insignificant	No injuries, low financial loss (< Rp. 1 M)
2	Minor	First aid treatment, on-site release immediately contained, medium financial loss (<RP. 10 M)
3	Moderate	Medical treatment required, on-site release contained, high financial loss (< Rp. 100 M)
4	Major	Extensive injuries, loss of production capability, off-site release with no detrimental effects, major financial loss (< Rp. 1 B)
5	Catastrophic	Death, toxic release off-site with detrimental effect, huge financial loss (> Rp. 1 B)

2.5.5 Risk Control

Risk control is the final stage in the HIRARC model that involves controlling processes that have been identified and assessed. Risk control contains measures or strategies that are implemented to reduce or control risk, so that tolerable risk is achieved or maintained at an acceptable level. Risk control may involve changing work processes, implementing safety equipment, training employees, or setting up a safer work environment, as well as effective communication systems.

The next step is to implement risk control measures. In Occupational Health and Safety (OHS), the goal of risk control is to reduce or eliminate the risk of accidents, illnesses, and injuries that could affect workers or individuals involved in work activities. Below is a table that illustrates the severity levels of hazards to help prioritize preventive actions (Giovanni et al., 2023).

Tabel 6 Risk Priority

Source : (DOSH Malaysia, 2008)

RISK	DESCRIPTION	ACTION
15 - 25	HIGH	A HIGH risk requires **immediate** action to control the hazard as detailed in the hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.
5 - 12	MEDIUM	A MEDIUM risk requires a planned approach to controlling the hazard and applies temporary measure if required. Actions taken must be documented on the risk assessment form including date for completion.
1 - 4	LOW	A risk identified as LOW may be considered as acceptable and further reduction may not be necessary. However, if the risk can be resolved quickly and efficiently, control measures should be implemented and recorded.

After assessing the severity level of a hazard and determining its extent, the following preventive measures can be implemented:

a. Elimination
   It can mean reducing hazardous work, tools, processes, machinery or materials to protect workers. For example, removing part of the process from an activity

b. Substitution

Hazardous work can be replaced by controlling new hazards that come along later. Protection of workers is also necessary. A safe way would be a good choice as a substitute.

c. Engineering Control

There are various effective methods for managing workplace hazards. Redesign focuses on altering jobs and processes to improve safety; for example, redesigning containers to make them easier to handle can lessen the risk of injury. Isolation involves separating hazards from workers when elimination or substitution is not possible. An instance of this is using an insulated, air-conditioned control room to protect operators from toxic chemicals. Automation helps minimize human exposure to dangerous tasks by employing machines or robots; for instance, robots controlled by computers can perform spot welding in car manufacturing. It is important, though, to ensure that safety measures are in place to protect workers from any robotic hazards. Barriers can prevent hazards from reaching workers, such as using special curtains to avoid eye injuries from welding arc radiation or proper guarding to shield workers from moving parts. Absorption methods, such as using baffles to reduce noise or lockout systems to control energy sources during maintenance, help to keep hazards away from workers. Finally, Dilution involves lowering the concentration of hazardous substances, such as through ventilation systems that reduce toxic gases before they reach operators.

d. Administrative Control

Safe work procedures involve implementing standardized safety practices that workers must follow, with employers responsible for ensuring adherence. These procedures should be reviewed and updated regularly in consultation with employees. Supervision and training play a critical role; initial training on safe practices and refresher courses should be provided, and adequate supervision is necessary to help workers identify potential hazards and assess work procedures. Job rotations and other strategies can minimize workers' exposure to hazards. For example, rotating tasks that involve repetitive movements can help prevent cumulative trauma injuries, and scheduling noisy operations during off-hours can reduce exposure. Effective housekeeping, repair, and maintenance programs are also crucial. Regular cleaning, waste disposal, and spill management, along with maintaining tools and machinery, can prevent injuries. Hygiene practices are essential to minimize the risk of workers absorbing toxic materials or transferring contaminants to their families. Street clothes should be stored separately from work clothes, eating areas must be kept away from toxic hazards, and eating in toxic work areas should be prohibited. Workers should, where applicable, shower and change clothes at the end of their shifts to ensure cleanliness.

e. Personal Protective Equipment (PPE)

PPE and specialized clothing are employed when other safety measures are not feasible or when additional protection is required. It is essential for workers to receive comprehensive training on how to properly use and maintain this equipment. Both employers and employees must be fully aware of the limitations and capabilities of the PPE. Employers bear the responsibility of enforcing the use

of PPE whenever it is necessary to safeguard workers. Additionally, regular inspections and maintenance of the equipment are vital to ensure it is in good working condition. Failing to do so could result in defective PPE, which might provide a misleading sense of safety and ultimately jeopardize worker health and safety.

2.6 Existing safety guard

Existing Safety Guard is a safety protection system that already exists in the ship recycling industry. This system involves a variety of safety equipment, such as body armor, helmets, gloves, and so on. This system is built to protect workers from risks that may occur during the ship recycling process, such as exposure to hazardous materials, fire, and being crushed by materials. This Existing Safety Guard includes OHS system, which consists of:

a. Physical security systems such as safety fences, machine guards, or ventilation cover systems.
b. Use of PPE (Personal Protective Equipment) that is appropriate and properly worn by employees.
c. Clear and easily recognizable warning systems and safety signs.
d. Safety procedures established and followed by all members of the work team.

Identifying the Existing Condition involves assessing the current state of a sample or situation. This process includes analyzing and evaluating the sample to understand its present condition. To determine the current state, several methods can be employed: conducting direct interviews, using questionnaires, observing existing systems, and then performing a thorough evaluation and analysis (Jamaluddin et al., 2022).

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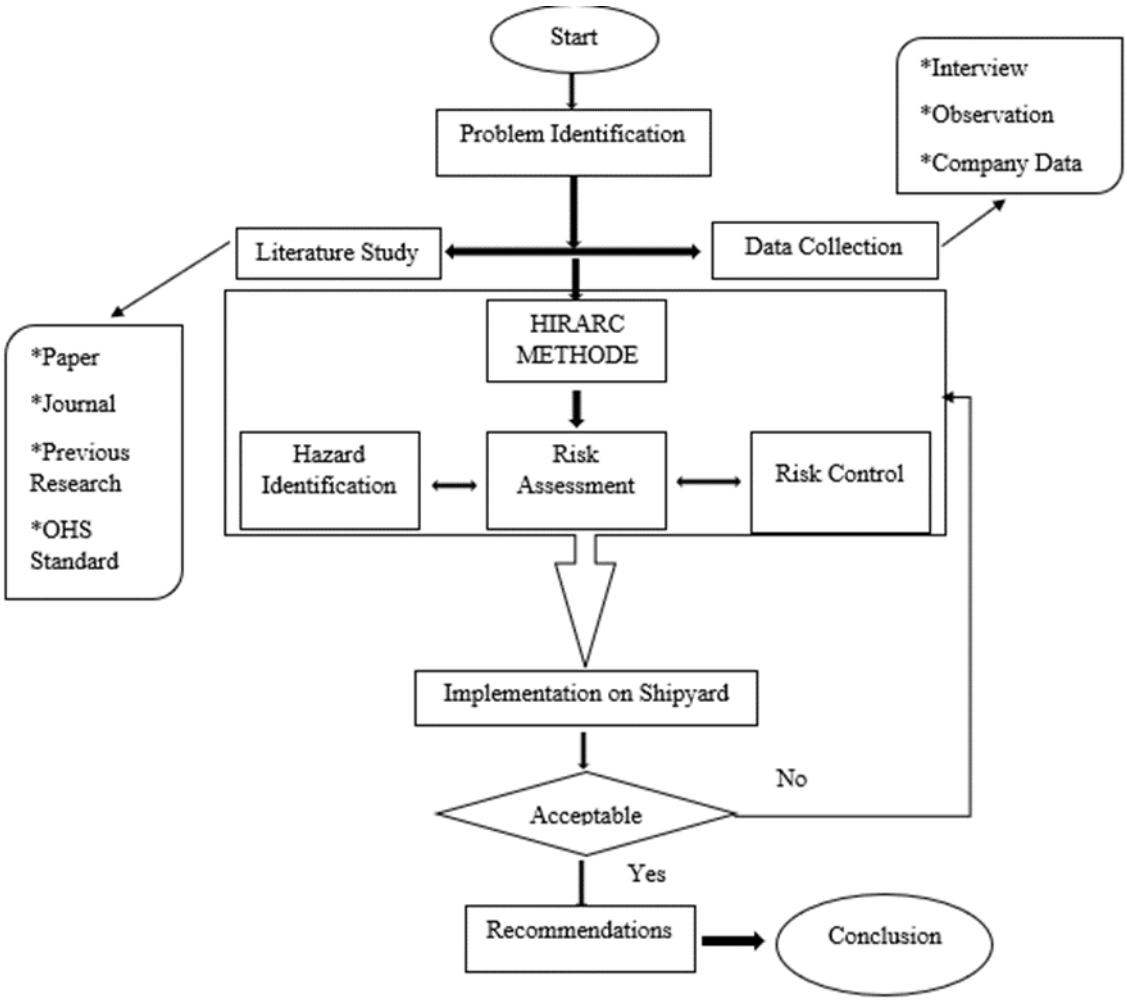
CHAPTER 3

METHODOLOGY

3.1 Method of Research

This research process is designed to provide a deeper understanding of the implementation of HIRARC in analyzing occupational safety and health in the ship recycling industry. The method used in this research is descriptive. The research data sources were collected from primary data and secondary data. Data collection techniques through observation, interviews and documentation, data analysis techniques using triangulation techniques. This data is collected at shipyards in Madura, then the author will further analyze it at the Digital Marine Technology and Maintenance Center (DMOM) Department of Marine Technology FTK-ITS.

3.2 Research Flow Chart



3.3 Problem Identification

The process of identifying specific problems and thesis objectives was carried out. The problems that occur in the implementation of the fabrication process in ship recycling

will be compared with the conditions in accordance with the requirements in the OHS Standard. This research is conducted to develop better safety methods and practices and reduce work accidents in the Company, especially the Madura area.

3.4 Research Study

This stage has the aim of obtaining information and data that will be reinforced by basic theories and guidelines related to the research, In this information collection is carried out subjectively and objectively.

3.4.1 Literature Study

The author gets basic theories from reliable sources such as journals, books, papers, OHS Standards, and previous research related to this research. Based on the study that has been carried out, we will obtain theories and guidelines to support data processing in this study. The study conducted by the author relates to the basis of occupational health and safety (OHS), standardization or regulations applied, and methods in the assessment of the HIRARC method.

3.4.2 Data Collecting

Data is obtained by making direct observations which aim to find out the actual conditions that exist in the field. In addition, the author strengthens the validity of the data by conducting interviews with related parties in the implementation of the ship recycle process in the fabrication area in order to find out previous, current and future plans. The data is also supported by data from the company where this research was conducted.

3.5 HIRARC Analysis

The data and information that has been obtained will be analyzed using the HIRARC method. Where in this analysis process is divided into 3 steps:

3.5.1 Hazard Identification

This stage is carried out by conducting field observations in the fabrication area to identify hazards and possible hazards that will occur. The data will be analyzed to determine the severity of the risk.

Tabel 7 Hazard Identification

No	Location	Hazard	Possible Harm (s)

3.5.2 Risk Assessment

Tabel 8 Risk Assessment

Risk Assessment				Risk Level
Consequence	L	S	R	

3.5.3 Determining Risk Control

This stage contains recommendations for risks that have been obtained based on risk assessment. In this risk control there are 5 hierarchical levels.

Tabel 9 Risk Control

No	Risk Control				
	Elimination	Substitution	Engineering Controls	Administrative Controls	PPE

3.5 Implementation on Shipyard

In this implementation, an assessment of the results of risks to OHS with the HIRARC method is carried out. If it meets the predetermined requirements, the next stage will be carried out, namely providing recommendations.

3.5 Recommendations Arrangements

The preparation of this recommendation is very necessary to prevent the occurrence of OHS risks in the company and make it easier to handle if the risk occurs according to probability analysis. This recommendation is compiled based on existing conditions.

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CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

The HIRARC method to analyze OHS in the ship recycle fabrication area. This research place to be studied is on the coast in the Kamal area, Bangkalan, Madura. The type of business is a ship recycling business and is managed individually. This business process is carried out in Borongan (group) and for safety is borne by each individual. During the observation conducted by the author, there were many potential hazards in the fabrication area coupled with workers who did not wear Personal Protection Equipment (PPE).

4.2 Data Analysis

This analysis data contains data and information used in the research which will then be processed with the HIRARC Method.

4.2.1 Fabrication Area Condition

In the conditions in the fabrication area of the ship recycle process located in Tanjung Jati Village, Bangkalan, Madura, it is ± 500 m from Kamal Harbor, Madura and ± 50 m from residential housing. The ship recycle process uses a beacing process by leaning the ship on the coast. The division of areas in this process can be explained in the figure below:

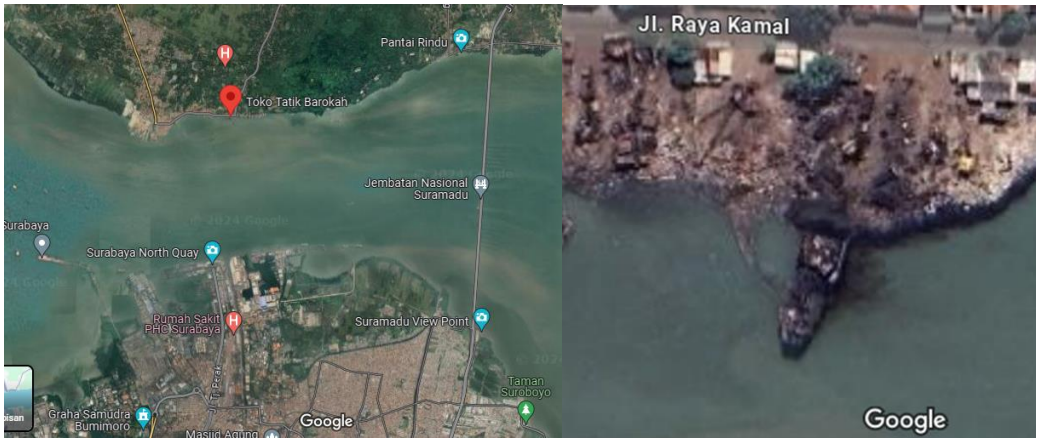

Figure 2 Location of Research

Source : Google Maps

Information :

Land Area : 50 x 100 m^2

Main Ship Cutting : 20 x25 m^2

Secondary Ship Cutting : 15 x 60 m^2

Material Selection : 10 x 10 m^2

Ship Cutting Tools Storage : 12 x 20 m^2

Hazardous Material Storage : 7.5 x 15 m^2

Worker Rest Area : 5 x 5 m^2

Canteen : 3x3 m^2

4.2.2 Tools and Equipment

Crawler Crane : 2 Link Belt LS 78 (piece)

Pump : 2 (piece)

Drum : 4 (piece)

Plastic/Tarp :2 (piece)

Headlamp : 5 (piece)

Handyman Equipment : 5 (piece)

Handy Talky : 5 (piece)

Gas cylinders : 30 (piece)

Oxygen cylinders : 30 (piece)

Rope : 8 (piece)

Hose : 25 (piece)

Regulator : 25 (piece)

4.2.3 Undergoing Activity

The work carried out in ship repair work is part of the work to make the process easier. The division of labor can be categorized as follows:

1. Supervisors (2 Persons)
   In charge of supervising work operations. Supervision includes the process of cutting, welding, and so on.
2. Helper (2 Persons)
   In charge of preparing the tools and checking the condition of the equipment during and after use. This helper is also in charge of tidying up, and carrying out tool repairs in case of damage.
3. Cutting (23 persons)
   In charge of cutting ship parts, the cutting is divided into 2 (cutting on the ship and cutting on land). The equipment is distributed using boats and cranes.
4. Porters (12 Persons)
   In charge of collecting plates or equipment resulting from cutting that will be transported to the truck. The work stage of the crane operator will lift the cutting

results from the ship to the ground crane. Furthermore, it will be cut again into smaller parts. These pieces will be combined by porters and lifted to the truck using a crane, in the truck body there is already a person in charge of arranging the pieces so that they are neat.

5. Driver (2 Persons)
   Tasked with delivering the results of this ship recycle to the destination companies, ranging from East Java to Central Java.
6. Crane Operator
   In charge of operating the crane during the cutting process or during the process of carrying or moving heavy equipment. There is 1 worker if there is work that requires faster time, usually hiring a crane and operator.

4.3 HIRARC Model

The principles of risk evaluation and access restriction to confined areas, as outlined in Government Regulation No. 50 of 2012, reflect an approach consistent with the risk management principles established in ISO 45001:2018. A comprehensive risk evaluation for confined areas is a crucial step in ensuring of workers, in alignment with the risk management requirements set forth by ISO 45001:2018. This risk evaluation process involves a thorough analysis of the specific characteristics of confined areas, following risk management principles that include hazard identification, risk assessment, and the development of effective control measures. These measures are designed to systematically reduce risks, ensuring that workers can operate safely in potentially hazardous areas (Nainggolan & Hendra, 2023).

The HIRARC model was carried out based on the ship recycle activity located at Jl. Kamal, Bangkalan, Madura. The identified area is divided into several areas:

1. Fabrication Area
2. Around the Fabrication Area
3. Warehouse

4.3.1 Hazard Identification (HI)

Identifying potential hazards in a ship recycling area can be done systematically and structurally to ensure workplace safety. The first step is to conduct a thorough inspection of the work area to identify potential risks, such as hazardous materials, unsafe physical conditions, and equipment that may be in disrepair. Additionally, identifying potential ignition sources, such as open flames, metal sparks, or poorly maintained electrical equipment, is crucial as these can trigger fires or explosions in environments with flammable materials. Furthermore, it is important to involve the workforce in the risk identification process, as they have direct insights into potential hazards that may not be apparent to supervisors. Workers can provide valuable information about field conditions and potential hazards that may not be detected during formal inspections. Preventing fire ignition is structured based on the HIRARC established by the company, and managing fire impact is structured based on event tree analysis conducted beforehand (Anggraeni et al., 2017). With a careful and integrated approach, both hazards and ignition sources can be

identified and managed more effectively, thereby minimize the risk of accidents and ensuring safety in ship recycling environment.

4.3.2 Risk Assessment (RA)

In a risk assessment, you can find out more details about the causes and consequences of a potential hazard. It is important to know the causes of danger and its impact on workers and the environment to determine the level of danger so that prevention and treatment can be carried out if an incident that results in a work accident occurs.

This step is carried out to assess the probability and level of risk associated with each identified hazard. The process follows the guidelines set out by Australian Standards/New Zealand Risk Management Standards (AS/NZS 3260: 2004), a standard developed in Australia and New Zealand (Australian Standards/New Zealand Standards 4360, 2004). According to this standard, risk assessment is based on two main parameters: the probability or likelihood of a hazard occurring and the potential impact or severity of its consequences. By evaluating these parameters, organizations can systematically determine the level of risk and implement appropriate control measures to mitigate it (Giovanni et al., 2023).

4.3.3 Risk Control (RC)

In K3, the aim of risk control is to prevent or reduce the possibility of accidents, illnesses and injuries that could befall workers or individuals involved in work activities. The HIRARC method for risk control includes several strategies: elimination, which involves eliminating the hazard completely; substitution, which replaces a hazard with a less harmful hazard; engineering controls, which involve modifying equipment or systems to reduce risk; administrative controls, which include changes to work practices or procedures to reduce risks; and personal protective equipment (PPE), which provides individual protection to workers. (Giovanni et al., 2023)**.**

4.4 Implementation of HIRARC Method

The results of the data processing are presented in the appendix, which includes detailed information and a comprehensive analysis related to the study's findings. The appendix contains tables, graphs, and supporting documents that provide a complete overview of the analyzed data, including the analytical methods used and the interpretation of the results. By referring to the appendix, readers can gain a deeper understanding of the research outcomes and evaluate the data in greater detail as needed. Implementation of the HIRARC method in the area that will be made into an object is as follows:

4.4.1 Fabrication Area

In the fabrication area there are potential hazards that come from the equipment used, the ship recycle process, worker behavior, and the unorganized fabrication area.

Figure 3 Fabrication Area

At this location, there are ship cutting facilities where the structure of the ship, after undergoing the initial cutting or dismantling stage, is further processed. Here, the components of the ship that have been separated from the main structure are intensively processed for the purposes of recycling or reuse. This process involves various technical activities, such as further cutting, welding, and assembly, to prepare the resulting materials for reuse in other industries or for sale as secondary raw materials. The area is equipped with advanced equipment and technology to ensure the efficiency of the fabrication process and compliance with stringent safety and environmental standards.

4.4.2 Around Fabrication Area

In this environment, there are potential hazards surrounding the ship recycling process. These conditions include infrastructure, geographical location, facilities used, and awareness of workers. By knowing the potential hazards and possibilities that occur in the environment in analyzing the hazards in the area around the ship recycling process.

Figure 4 Around Fabrication Area

4.4.3 Warehouse

Conceptually, fire prevention can be achieved through the use of the fire tree approach developed by the National Fire Protection Association (NFPA) as outlined in NFPA 550 standards. This prevention strategy can be implemented through two primary approaches: preventing fire ignition and managing the impact of a fire. The prevention of fire ignition is based on the HIRARC framework established by company. On the other side, managing

the impact of a fire relies on the event tree analysis conducted previously. This approach ensures that both the prevention of potential fire sources and the effective management of fire consequences are addressed systematically (Anggraeni et al., 2017).

Figure 5 Warehouse Area

4.5 HIRARC Evaluation

Based on the Hazard Identification carried out in the ship recycle work area, there are 77 potential hazards. Potential hazards with a high risk level are 17 (21,2%), moderate level 36 (46,2%), and low level 24 (32,7%). This potential hazard is caused by the lack of understanding and training on OHS for workers. The following is data that shows the potential dangers that have been identified in the object of this research

Tabel 10 Area Vs Risk Result of HIRARC Method

AREA / RISK	FABRIKASI	AROUND SHIP RECYCLE AREA	WAREHOUSE
LOW RISK	17	0	7
HIGH RISK	11	2	4
MODERATE RISK	24	4	8
TOTAL	52	6	19

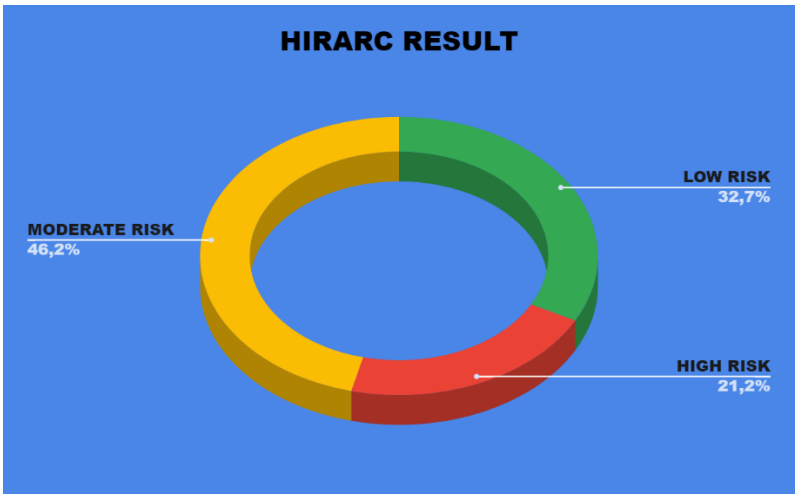

Figure 6 Determine of HIRARC Result

Based on the 3 locations analyzed, starting from the fabrication area, around ship recycling, and warehouse area. There are 77 potential hazards identified that come from a lack of individual awareness of safety at work, a lack of safety training for workers who carry out ship recycling activities, and the tools used. The following is the total data of potential hazards found in the 3 areas of this research object:

Tabel 11 Risk Vs Area Result HIRARC Method

RISK / AREA	High	Moderate	Low
FABRICATION AREA	17	11	24
AROUND SHIP RECYCLE AREA	2	4	0
WAREHOUSE AREA	7	4	8
TOTAL	26	19	32

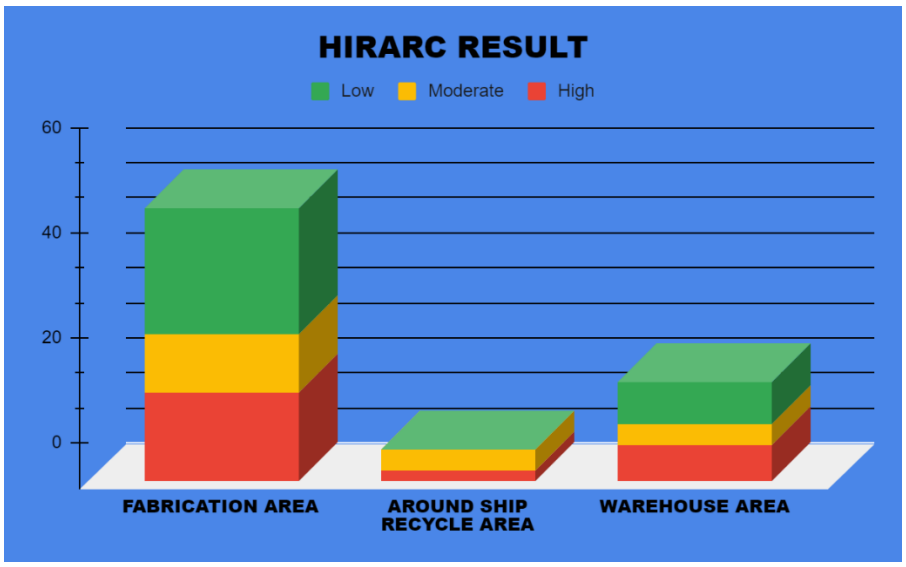

Figure 7 Determine of HIRARC Result in Each Area

Based on the data displayed above, it shows that there are 17 potential hazards in the fabrication area at a high level, 11 potential hazards at a medium level, and 24 potential hazards at a low level. Based on the data obtained, the fabrication area has the most potential hazards at a low level with a total of 24 potential hazards. Meanwhile, the behavior of workers who do not comply with work safety standards and ignore the use of PPE is the root cause of the 17 potential hazards, causing high potential hazards. In addition, the fabrication area should not be mixed with other activities so as not to pose a hazard to workers passing through the area around the ship recycling area.

There are a total of 6 hazards around ship recycling with 2 potential hazards at a high level, 4 potential hazards at a medium level, and at a low level there are 0 potential hazards. there are 2 potential danger levels at the highest level, which are caused by the remaining results from recycled ship materials which can pollute the beach and pose a potential danger to workers because there are some workers who do not wear safety shoes, which creates the potential for their feet to be scratched or punctured by sharp material left over from the ship. The ship recycling process means that if the waste material is not cleaned it can cause wounds and infections.

There are a total of 19 potential hazards in the warehouse area, with 7 high level potential hazards, 4 moderate level hazards, and 8 low level potential hazards. Based on this data, it proves that this area has quite high potential hazards. because in this warehouse area there is storage of gas material which can cause potential fires, besides that the area near the warehouse is used as a gathering place for workers during breaks. Workers who take breaks have a habit of smoking and this will trigger a fire if there is a leak in the gas cylinder.

It can be seen what is the cause of this potential danger due to workers carrying out ship recycling, conditioning and structuring work areas starting from cutting, welding, transporting materials resulting from ship dismantling, and workers' lack of understanding regarding work safety. In this case, companies or business actors also have an important role in maintaining safety and health of workers and the environment.

OSHA has consistently emphasized the need for mandatory training to ensure safer working environments, focusing on several key areas. First, there must be adequate training provided to workers to ensure they are well-informed about safety protocols and equipped to handle potential hazards effectively (Neşer et al., 2008). This training should cover all relevant aspects of their job roles and safety procedures. Second, it is crucial for workers to use the correct personal protective equipment (PPE) tailored to their specific job risks. Proper use and maintenance of PPE are essential to provide effective protection against workplace hazards. Third, compliance with fire protection measures is mandatory; workers must be trained to adhere to established fire safety protocols and be aware of the proper procedures to follow in case of a fire. Lastly, there must be well-organized emergency response teams in place, including those responsible for firefighting, rescue operations, first aid, pollution control, and other critical services. These teams need to be properly trained and prepared to respond to emergencies promptly and effectively. By addressing these areas, OSHA aims to enhance workplace safety and ensure that all employees are adequately protected and prepared for any potential emergencies.

Based on the research results obtained to strengthen risk and safety management strategies, an evaluation of HIRARC was carried out as a framework for identifying, assessing and controlling risks that exist in the work environment. There is an integration aspect in the HIRARC evaluation. The company can create a safer and healthier work environment, and reduce the risk of accidents that can harm workers and the company itself.

For the benefit of all parties, it is very important to maintain a healthy and safe working environment. as effectively as possible, in accordance with ILO Convention No. 155 of 1988 on Occupational Health and Safety (Lestari & Effendi, 2005). The following are policy aspects that companies can implement to reduce the risk of work accidents :

1. **Training OHS**

OHS training is key component in efforts to reduce identified risks. By providing appropriate training to the entire workforce, including an in-depth understanding of specific risks and how to manage them, companies can increase awareness and compliance with established safety practices.

This training will be one of the crucial steps in implementing HIRARC, where this training aims to increase workers' awareness of the dangers that exist in the work environment and ways to control these risks. Through effective training, workers are expected to be able to recognize potential dangers and implement established safety procedures, thereby reducing the possibility of accidents.

2. **Monthly Safety Report**

Monthly safety reports are an important tool for monitoring and evaluating the effectiveness of the HIRARC strategy that has been implemented. Through regular analysis of safety events, management can identify new risk trends, correct detected weaknesses, and plan continuous improvements to achieve a safer work environment that is more responsive to changing conditions.

Preparation of monthly safety reports is also an integral part of the HIRARC evaluation, which functions to monitor and evaluate implementation of the workplace safety program. This monthly safety report includes data analysis of accidents, incidents, and preventive actions that have been taken, as well as recommendations for future improvements. With systematic reports, companies can evaluate the effectiveness of the risk control measures that have been implemented.

3. **Create Standard Operational Procedures**

Creating clear and detailed SOPs is an important step in HIRARC, because SOPs serve as a guide for workers in carrying out their duties safely. A good SOP should include steps to identify hazards, conduct risk assessments, and establish controls necessary to reduce or eliminate those risks. With SOPs, companies can ensure that all workers follow the same procedures, thereby increasing consistency and effectiveness in risk management. SOPs not only outline practical steps to prevent risk events, but also organize emergency responses and integrate safety practices into daily operational routines.

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CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

Based on the research results obtained, the author found the following conclusions:

1. Based on the results of hazard identification conducted in the ship recycling area, a total of 77 potential hazards were found spread across three locations, namely fabrication, around the ship recycling area, and warehouse. Of these, 17 potential hazards (21.2%) are at a high risk level, 36 potential hazards (46.2%) are at a medium risk level, and 24 potential hazards (32.7%) are at a low risk level. These potential hazards are caused by workers' lack of awareness of work safety and inadequate facilities.
2. There is a chance of an accident occurring in the following three areas:
   a. Fabrication Area: Has the most potential hazards with 52 total hazards, of which 17 are high hazards. This is caused by worker behavior that does not comply with safety standards and lack of use of Personal Protective Equipment (PPE).
   b. Area Around Ship Recycle: There are 6 potential hazards, with 2 of them at a high risk level. This danger is largely caused by residual materials that can pollute the environment and the risk of injury due to a lack of proper protection for workers.
   c. Warehouse Area: There are 19 potential hazards, with 7 of them at a high risk level. Storage of gas materials that have the potential to cause fires and workers' smoking behavior in these areas increases safety risks.
3. Overall, a lack of understanding and training regarding work safety is the main factor contributing to the high potential for danger in the field of ship recycling. Therefore, it is important for companies to increase workers' awareness and knowledge regarding work safety.

5.2 Research Obstacles

The research carried out by the author has been completed optimally, but not without existing limitations. The following are the limitations of the author in conducting research:

1. Researchers focus on ship recycling objects related to OHS in the ship recycling area, so that researchers have the challenge of learning new things related to safety, potential hazards, assessing the severity of a risk or danger, and risk control to prevent or reduce harm from occurring.
2. Researchers experience limitations in obtaining information data and some documentation needed to strengthen research results. This may affect the depth of analysis and generalization of findings.

5.3 Recommendations

Based on the conclusions obtained, the researcher provides the following suggestions:

1. Companies can increase supervision over the implementation of safety procedures and use of PPE. It is recommended that companies increase the frequency and quality of OHS training for all workers, with a focus on best practices in hazard identification and risk control. More interactive and simulation-based training can improve workers' understanding and skills. Companies need to develop and update SOPs regularly to include the latest procedures that comply with good safety practices. Involving workers in the SOP preparation process can increase compliance and effectiveness. Companies need to carry out environmental awareness campaigns regarding the impact of recycled ship waste materials, as well as the potential pollution that can be caused. This may include programs that involve workers in cleanup and waste management activities.
2. It is recommended to separate the fabrication area from other activities to reduce the risk of accidents. Good work space arrangement can help minimize potential dangers to workers who pass through the area.
3. Further research is recommended to collect more comprehensive data regarding work incidents and accidents in the ship recycling area. The use of technology such as sensors and risk management software can help in real-time data collection and analysis. Further research can be carried out to explore more deeply the factors that influence work safety in the ship recycle industry, as well as to develop more effective risk control models. Further efforts are needed to improve access to relevant data and documentation so that future research can be more in-depth and accurate.(Mulana, 2021)

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APPENDIX

AUTHOR BIODATA

The author, Putri Lia Agustina, was born in Blitar on August 17, 2001. The author studied high school at SMAN 01 TALUN and graduated in 2020. In 2020, the author was enrolled in the double degree program of the Department of Marine Engineering, Faculty of Marine Technology, Institut Teknologi Sepuluh Nopember and Hoschule Wismar with NRP 5019201026

In the Department of Marine Systems Engineering, the author was active in several seminar activities organized by the Department, the Association of Marine Systems Engineering Students (HIMASISKAL) and was active as secretary of the Internal Relations division. The author also conducts Practical Work activities as a form of adding experience to the company PT. Samudera Marine Indonesia and PT. Indonesian Classification Bureau. The author has a strong and deep desire for a career in the maritime industry, such as logistics, shipping, and surveyor companies. The author hopes that after graduating from the Department of Marine Engineering, he can have a career in one of the companies mentioned above.

Putri Lia Agustina

Puttrilia17@gmail.com

Formulir Responden Identifikasi Bahaya di Area Fabrikasi pada Daur Ulang Kapal

I. Pengantar :

Terima kasih atas partisipasi Anda dalam mengisi formulir ini. Data yang Anda berikan akan digunakan untuk keperluan penelitian dalam rangka menyelesaikan tesis akhir.

II. Informasi Responden

Nama :

Jabatan :

Lama Bekerja :

III. Identifikasi Bahaya

1. Kondisi Area Kerja

Apakah area fabrikasi bersih dan teratur

☐ Ya

☐ Tidak

Apakah terdapat material atau alat yang menghalangi jalur evakuasi?

☐ Ya

☐ Tidak

Apakah pencahayaan di area kerja cukup baik?

☐ Ya

☐ Tidak

2. Peralatan dan Alat

Apakah peralatan yang digunakan dalam kondisi baik dan terawat?

☐ Ya

☐ Tidak

Apakah alat pelindung diri (APD) seperti helm, kacamata, dan sarung tangan tersedia dan digunakan dengan benar?

☐ Ya

☐ Tidak

Apakah ada potensi bahaya terkait penggunaan peralatan berat, seperti crane atau mesin pemotong?

☐ Ya

☐ Tidak

Jika ya, jelaskan:

3. Bahan dan Material

Apakah bahan kimia atau bahan berbahaya disimpan dengan benar dan sesuai prosedur?

☐ Ya

☐ Tidak

Apakah ada risiko terkait penyimpanan atau penanganan bahan bakar dan oli?

☐ Ya

☐ Tidak

Jika ya, jelaskan:

4. Kesehatan dan Keselamatan:

Apakah ada bahaya terkait paparan terhadap gas berbahaya atau debu?

☐ Ya

☐ Tidak

Jika ya, jelaskan:

Apakah prosedur darurat dan evakuasi sudah disosialisasikan kepada semua pekerja?

- ☐ Ya
- ☐ Tidak

Apakah ada risiko terjadinya kebakaran atau ledakan di area fabrikasi?

- ☐ Ya
- ☐ Tidak

5. Pengawasan dan Pelatihan

Apakah pekerja mendapatkan pelatihan yang memadai mengenai keselamatan kerja dan penggunaan alat?

- ☐ Ya
- ☐ Tidak

Apakah ada pengawasan rutin untuk memastikan kepatuhan terhadap prosedur keselamatan?

- ☐ Ya
- ☐ Tidak

IV. Tindakan Pengendalian dan Rekomendasi

1. Tindakan pengendalian apa yang sudah diterapkan untuk mengurangi risiko yang teridentifikasi?

2. Rekomendasi tambahan untuk meningkatkan keselamatan di area fabrikasi:

V. Penutup

Apakah ada hal lain yang perlu diperhatikan terkait keselamatan di area fabrikasi?

( )

Formulir Survei Frekuensi Bahaya di Area Fabrikasi pada Daur Ulang Kapal

I. Pengantar :

Terima kasih atas partisipasi Anda dalam mengisi formulir ini. Data yang Anda berikan akan digunakan untuk keperluan penelitian dalam rangka menyelesaikan tesis akhir.

II. Informasi Responden

Nama :

Jabatan :

Lama Bekerja :

III. Tabel Index Frekuensi

Tingkat	Keterangan
5	Terdapat ≥ 1 kejadian dalam sehari
4	Terdapat ≥ 1 kejadian dalam seminggu
3	Terdapat ≥ 1 kejadian dalam sebulan
2	Terdapat ≥ 1 kejadian dalam setahun
1	Terdapat < 1 kejadian dalam setahun

IV. Tabel Tingkat Keparahan

Tingkat	Keterangan
1	Tidak terjadi cedera, kerugian finansial sedikit (< 1 juta)
2	Cedera ringan, kerugian finansial sedang (< 10 juta)
3	Cedera sedang, perlu penanganan media, kerugian finansial besar (< 100 juta)
4	Cedera berat ≥ 1 orang, kerugian besar, gangguan produksi (< 1 M)
5	Fatal ≥ 1 orang, kerugian sangat besar dan dampak sangat luas, terhentinya seluruh kegiatan (> 1M)

V. Identifikasi Bahaya Area Fabrikasi

Berikut adalah beberapa bahaya yang mungkin terjadi di sekitar area fabrikasi pada daur ulang kapal. Silakan berikan tanda centang (√) jika terjadi

No	Bahaya	√
1	Kecelakaan kerja akibat peralatan yang tidak lengkap atau rusak	
2	Kecelakaan kerja akibat kurangnya pelatihan atau pengalaman	
3	Kecelakaan kerja akibat lingkungan kerja yang tidak aman	
4	Kecelakaan kerja akibat tertindas atau terjepit	
5	Kecelakaan kerja akibat jatuh atau terjatuh	
6	Kecelakaan kerja akibat kurangnya perawatan peralatan	
7	Kecelakaan kerja akibat kurangnya pengawasan	
8	Kecelakaan kerja akibat sengatan listrik	
9	Kecelakaan kerja akibat kurangnya kesadaran keselamatan	
10	Kecelakaan kerja akibat area kerja berantakan	

Lain - lain (silahkan jelaskan) :

VI. Silakan Nilai Frekuensi Bahaya yang Terjadi Berdasarkan Skala di Atas :

No	Bahaya	Frekuensi
1	Kecelakaan kerja akibat peralatan yang tidak lengkap atau rusak	
2	Kecelakaan kerja akibat kurangnya pelatihan atau pengalaman	
3	Kecelakaan kerja akibat lingkungan kerja yang tidak aman	
4	Kecelakaan kerja akibat tertindas atau terjepit	
5	Kecelakaan kerja akibat jatuh atau terjatuh	
6	Kecelakaan kerja akibat kurangnya perawatan peralatan	
7	Kecelakaan kerja akibat kurangnya pengawasan	
8	Kecelakaan kerja akibat sengatan listrik	

9	Kecelakaan kerja akibat kurangnya kesadaran keselamatan	
10	Kecelakaan kerja akibat area kerja berantakan	

VII. **Silakan Nilai Tingkat Bahaya yang Terjadi Berdasarkan Skala di Atas :**

No	Bahaya	Keparahan
1	Kecelakaan kerja akibat peralatan yang tidak lengkap atau rusak	
2	Kecelakaan kerja akibat kurangnya pelatihan atau pengalaman	
3	Kecelakaan kerja akibat lingkungan kerja yang tidak aman	
4	Kecelakaan kerja akibat tertindas atau terjepit	
5	Kecelakaan kerja akibat jatuh atau terjatuh	
6	Kecelakaan kerja akibat kurangnya perawatan peralatan	
7	Kecelakaan kerja akibat kurangnya pengawasan	
8	Kecelakaan kerja akibat sengatan listrik	
9	Kecelakaan kerja akibat kurangnya kesadaran keselamatan	
10	Kecelakaan kerja akibat area kerja berantakan	

Formulir Responden Identifikasi Bahaya di Sekitar Area Fabrikasi pada Daur Ulang Kapal

I. Pengantar :

Terima kasih atas partisipasi Anda dalam mengisi formulir ini. Data yang Anda berikan akan digunakan untuk keperluan penelitian dalam rangka menyelesaikan tesis akhir.

II. Informasi Responden

Nama :

Jabatan :

Lama Bekerja :

III. Identifikasi Bahaya

1. Kondisi Area Kerja

Apakah area sekitar fabrikasi bersih dan teratur

☐ Ya
☐ Tidak

Apakah terdapat material atau alat yang menghalangi jalur evakuasi?

☐ Ya
☐ Tidak

Apakah pencahayaan di area kerja cukup baik?

☐ Ya
☐ Tidak

2. Peralatan dan Alat

Apakah peralatan yang digunakan dalam kondisi baik dan terawat?

☐ Ya
☐ Tidak

Apakah alat pelindung diri (APD) seperti helm, kacamata, dan sarung tangan tersedia dan digunakan dengan benar?

☐ Ya
☐ Tidak

3. Kesehatan dan Keselamatan:

Apakah ada bahaya terkait paparan terhadap gas berbahaya atau debu?

☐ Ya
☐ Tidak

Jika ya, jelaskan:

Apakah prosedur darurat dan evakuasi sudah disosialisasikan kepada semua pekerja?

☐ Ya
☐ Tidak

Apakah ada risiko terjadinya kebakaran atau ledakan di area sekitar fabrikasi?

☐ Ya
☐ Tidak

4. Pengawasan dan Pelatihan

Apakah pekerja mendapatkan pelatihan yang memadai mengenai keselamatan kerja dan penggunaan alat?

☐ Ya
☐ Tidak

Apakah ada pengawasan rutin untuk memastikan kepatuhan terhadap prosedur keselamatan?

☐ Ya
☐ Tidak

IV. Tindakan Pengendalian dan Rekomendasi

1. Tindakan pengendalian apa yang sudah diterapkan untuk mengurangi risiko yang teridentifikasi?

2. Rekomendasi tambahan untuk meningkatkan keselamatan di sekitar area fabrikasi:

V. Penutup

Apakah ada hal lain yang perlu diperhatikan terkait keselamatan di sekitar area fabrikasi?

( )

Formulir Survei Frekuensi Bahaya di Sekitar Area Fabrikasi pada Daur Ulang Kapal

I. Pengantar :

Terima kasih atas partisipasi Anda dalam mengisi formulir ini. Data yang Anda berikan akan digunakan untuk keperluan penelitian dalam rangka menyelesaikan tesis akhir.

II. Informasi Responden

Nama :

Jabatan :

Lama Bekerja :

III. Tabel Index Frekuensi

Tingkat	Keterangan
5	Terdapat ≥ 1 kejadian dalam sehari
4	Terdapat ≥ 1 kejadian dalam seminggu
3	Terdapat ≥ 1 kejadian dalam sebulan
2	Terdapat ≥ 1 kejadian dalam setahun
1	Terdapat < 1 kejadian dalam setahun

IV. Tabel Tingkat Keparahan

Tingkat	Keterangan
1	Tidak terjadi cedera, kerugian finansial sedikit (< 1 juta)
2	Cedera ringan, kerugian finansial sedang (< 10 juta)
3	Cedera sedang, perlu penanganan media, kerugian finansial besar (< 100 juta)
4	Cedera berat ≥ 1 orang, kerugian besar, gangguan produksi (< 1 M)
5	Fatal ≥ 1 orang, kerugian sangat besar dan dampak sangat luas, terhentinya seluruh kegiatan (> 1M)

V. Identifikasi Bahaya Area Fabrikasi

Berikut adalah beberapa bahaya yang mungkin terjadi di sekitar area fabrikasi pada daur ulang kapal. Silakan berikan tanda centang (√) jika terjadi

No	Bahaya	√
1	Kecelakaan kerja akibat jatuh atau terjatuh	
2	Kecelakaan kerja akibat terlindas atau terjepit	
3	Kecelakaan kerja akibat peralatan yang tidak lengkap atau rusak	
4	Kebakaran atau ledakan akibat bahan kimia yang tidak terkontrol	
5	Pencemaran lingkungan akibat limbah yang tidak terkontrol	
6	Kecelakaan kerja akibat kurangnya pelatihan atau pengalaman	
7	Kecelakaan kerja akibat lingkungan kerja yang tidak aman	
8	Kecelakaan kerja akibat kurangnya perawatan peralatan	
9	Kecelakaan kerja akibat kurangnya pengawasan	
10	Kecelakaan kerja akibat area kerja berantakan	

Lain - lain (silahkan jelaskan) :

VI. Silakan Nilai Frekuensi Bahaya yang Terjadi Berdasarkan Skala di Atas :

No	Bahaya	Frekuensi
1	Kecelakaan kerja akibat jatuh atau terjatuh	
2	Kecelakaan kerja akibat terlindas atau terjepit	
3	Kecelakaan kerja akibat peralatan yang tidak lengkap atau rusak	
4	Kebakaran atau ledakan akibat bahan kimia yang tidak terkontrol	
5	Pencemaran lingkungan akibat limbah yang tidak terkontrol	
6	Kecelakaan kerja akibat kurangnya pelatihan atau pengalaman	
7	Kecelakaan kerja akibat lingkungan kerja yang tidak aman	
8	Kecelakaan kerja akibat kurangnya perawatan peralatan	

9	Kecelakaan kerja akibat kurangnya pengawasan	
10	Kecelakaan kerja akibat area kerja berantakan	

VII. **Silakan Nilai Tingkat Bahaya yang Terjadi Berdasarkan Skala di Atas :**

No	Bahaya	Keparahan
1	Kecelakaan kerja akibat jatuh atau terjatuh	
2	Kecelakaan kerja akibat terlindas atau terjepit	
3	Kecelakaan kerja akibat peralatan yang tidak lengkap atau rusak	
4	Kebakaran atau ledakan akibat bahan kimia yang tidak terkontrol	
5	Pencemaran lingkungan akibat limbah yang tidak terkontrol	
6	Kecelakaan kerja akibat kurangnya pelatihan atau pengalaman	
7	Kecelakaan kerja akibat lingkungan kerja yang tidak aman	
8	Kecelakaan kerja akibat kurangnya perawatan peralatan	
9	Kecelakaan kerja akibat kurangnya pengawasan	
10	Kecelakaan kerja akibat area kerja berantakan	

Formulir Responden Identifikasi Bahaya di Area Gudang pada Daur Ulang Kapal

I. Pengantar :

Terima kasih atas partisipasi Anda dalam mengisi formulir ini. Data yang Anda berikan akan digunakan untuk keperluan penelitian dalam rangka menyelesaikan tesis akhir.

II. Informasi Responden

Nama :

Jabatan :

Lama Bekerja :

III. Identifikasi Bahaya

1. Kondisi Area Kerja

Apakah area gudang bersih dan teratur?

☐ Ya

☐ Tidak

Apakah terdapat material atau alat yang menghalangi jalur evakuasi?

☐ Ya

☐ Tidak

Apakah pencahayaan di area kerja cukup baik?

☐ Ya

☐ Tidak

2. Peralatan dan Alat

Apakah peralatan yang digunakan dalam kondisi baik dan terawat?

☐ Ya

☐ Tidak

Apakah alat pelindung diri (APD) seperti helm, kacamata, dan sarung tangan tersedia dan digunakan dengan benar?

☐ Ya

☐ Tidak

3. Bahan dan Material

Apakah bahan kimia atau bahan berbahaya disimpan dengan benar dan sesuai prosedur?

☐ Ya

☐ Tidak

Apakah ada risiko terkait penyimpanan atau penanganan bahan bakar dan oli?

☐ Ya

☐ Tidak

Jika ya, jelaskan:

4. Kesehatan dan Keselamatan:

Apakah ada bahaya terkait paparan terhadap gas berbahaya atau debu?

☐ Ya

☐ Tidak

Jika ya, jelaskan:

Apakah prosedur darurat dan evakuasi sudah disosialisasikan kepada semua pekerja?

☐ Ya

☐ Tidak

Apakah ada risiko terjadinya kebakaran atau ledakan di area fabrikasi?

☐ Ya

☐ Tidak

IV. Tindakan Pengendalian dan Rekomendasi

1. Tindakan pengendalian apa yang sudah diterapkan untuk mengurangi risiko yang teridentifikasi?

2. Rekomendasi tambahan untuk meningkatkan keselamatan di area fabrikasi:

V. Penutup

Apakah ada hal lain yang perlu diperhatikan terkait keselamatan di area fabrikasi?

( )

Formulir Survei Frekuensi Bahaya di Area Gudang pada Daur Ulang Kapal

I. Pengantar :

Terima kasih atas partisipasi Anda dalam mengisi formulir ini. Data yang Anda berikan akan digunakan untuk keperluan penelitian dalam rangka menyelesaikan tesis akhir.

II. Informasi Responden

Nama :

Jabatan :

Lama Bekerja :

III. Tabel Index Frekuensi

Tingkat	Keterangan
5	Terdapat ≥ 1 kejadian dalam sehari
4	Terdapat ≥ 1 kejadian dalam seminggu
3	Terdapat ≥ 1 kejadian dalam sebulan
2	Terdapat ≥ 1 kejadian dalam setahun
1	Terdapat < 1 kejadian dalam setahun

IV. Tabel Tingkat Keparahan

Tingkat	Keterangan
1	Tidak terjadi cedera, kerugian finansial sedikit (< 1 juta)
2	Cedera ringan, kerugian finansial sedang (< 10 juta)
3	Cedera sedang, perlu penanganan media, kerugian finansial besar (< 100 juta)
4	Cedera berat ≥ 1 orang, kerugian besar, gangguan produksi (< 1 M)
5	Fatal ≥ 1 orang, kerugian sangat besar dan dampak sangat luas, terhentinya seluruh kegiatan (> 1M)

V. Identifikasi Bahaya Area Fabrikasi

Berikut adalah beberapa bahaya yang mungkin terjadi di sekitar area fabrikasi pada daur ulang kapal. Silakan berikan tanda centang (√) jika terjadi

No	Bahaya	√
1	Kebakaran atau ledakan akibat bahan kimia yang tidak terkontrol	
2	Kebakaran atau ledakan akibat peralatan listrik yang tidak terkontrol	
3	Kebakaran atau ledakan akibat material yang mudah terbakar	
4	Kecelakaan terjatuhan benda atau alat	
5	Kecelakaan kerja akibat kurangnya pelatihan atau pengalaman	
6	Kecelakaan kerja akibat kurangnya pengawasan	
7	Kecelakaan akibat alat yang tidak tertata	
8	Kecelakaan fatal karena kebakaran	
9	Kecelakaan pada saat menata barang	
10	Kecelakaan karena kurangnya peralatan APD	

Lain - lain (silahkan jelaskan) :

VI. Silakan Nilai Frekuensi Bahaya yang Terjadi Berdasarkan Skala di Atas :

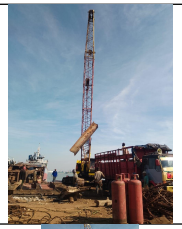
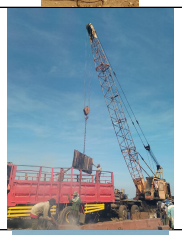
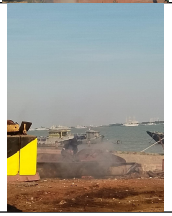
No	Bahaya	Frekuensi
1	Kebakaran atau ledakan akibat bahan kimia yang tidak terkontrol	
2	Kebakaran atau ledakan akibat peralatan listrik yang tidak terkontrol	
3	Kebakaran atau ledakan akibat material yang mudah terbakar	
4	Kecelakaan terjatuhan benda atau alat	
5	Kecelakaan kerja akibat kurangnya pelatihan atau pengalaman	
6	Kecelakaan kerja akibat kurangnya pengawasan	
7	Kecelakaan akibat alat yang tidak tertata	
8	Kecelakaan fatal karena kebakaran	
9	Kecelakaan pada saat menata barang	

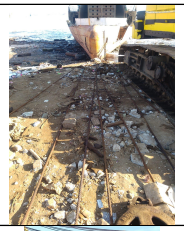
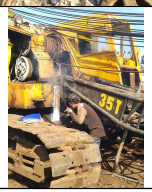
10	Kecelakaan karena kurangnya peralatan APD	

VII. **Silakan Nilai Tingkat Bahaya yang Terjadi Berdasarkan Skala di Atas :**

No	Bahaya	Keparahan
1	Kebakaran atau ledakan akibat bahan kimia yang tidak terkontrol	
2	Kebakaran atau ledakan akibat peralatan listrik yang tidak terkontrol	
3	Kebakaran atau ledakan akibat material yang mudah terbakar	
4	Kecelakaan terjatuhan benda atau alat	
5	Kecelakaan kerja akibat kurangnya pelatihan atau pengalaman	
6	Kecelakaan kerja akibat kurangnya pengawasan	
7	Kecelakaan akibat alat yang tidak tertata	
8	Kecelakaan fatal karena kebakaran	
9	Kecelakaan pada saat menata barang	
10	Kecelakaan karena kurangnya peralatan APD	

FABRICATION AREA

No	Location	Hazard	Possible Harm (s)	Risk Assessment					Existing Safetyguard	Risk Control				
				Consequence	L	S	R	Risk Level		Elimination	Substitution	Engineering Control	Administrative Controls	PPE
1		Unorganized materials	Workers could be trip	no injury	1	1	1	Low		Eliminate unused objects		Provide special areas for storage of cables that are still in use, such as enclosures or Cabinets equipped with leak sensors.		
		There is a leak in the cable to distribute gas	There is a fire or explosion	Serious Injurity	4	4	16	High	Not Available				Training and hazard intelligence for occupational safety	
				Fatality	4	4	16	High						
				lost asset	4	4	16	High						
				pollution	4	1	4	Low	Not Avalable					Wear face mask
		There is sharp material		no injury	4	1	4	Low	Not Available	Dispose of leftovers from the ship recycling process properly				Using Safety Shoes and gloves
		A gas leak occurred	Damages breathing and triggers fires	catastrophic	3	5	15	High	Not Available		Provide special areas for storage of cables that are still in use, such as enclosures or Cabinets equipped with leak sensors.	Leak Sensor	Safe work procedures by not smoking near this area	
				Fatality	3	4	12	Moderate						
				serious Injurity	3	3	9	Moderate						
				respiratory injurity	3	1	3	Low						Using face mask
2		Crane movement transfer	Crusing, amputation	Fatality	3	4	12	Moderate	Not Available		Organize a special area for crane activities and training of safety workers			
				serious Injurity	3	3	9	Moderate				communication tools for coordinating crane operations		
				minor injurity	3	2	6	Moderate						Wear PPE
		Falling object or materials	Head injuries, concussions, or fatalities	Fatality	4	4	16	High					Organize a special area for crane activities and training of safety workers	
				serious Injurity	4	3	12	Moderate						
				minor injurity	4	2	8	Moderate						Wear safety helmet
3		Ropes placed in the fabrication area	There was a entanglement that entangled the worker	no injury	1	1	1	Low	Not Available	Move the rope to a place where workers cannot reach it				Wear safety helmet and safety shoes
		Untidy rope	Slip, trip and fall	no injury	1	1	1	Low						
4		Falling material	Head injury, concussion, or other injury	Fatality	4	4	16	High	Not Available			Redesign by re-mapping the plate transfer location to make it safer	Safe work procedures by implementing work safety standards	Wear safety helmet and safety shoes
				serious Injurity	4	3	12	Moderate	Not available					
				minor injurity	4	2	8	Moderate						
		The crane rope broke	head injury, death	Fatality	2	4	8	Moderate	Not Available				Conduct regular checks on crane ropes and ensure they are secure before use.	
				serious Injurity	2	3	6	Moderate						
				minor injurity	2	2	4	Low						
5		Air Pollution	Respiratory and lung problems	respiratory injurity	2	1	2	Low	Not Available					Wear mask and safety equipment
				serious Injurity	2	3	6	Moderate						
				minor injurity	2	2	4	Low						
		Cutting smoke	Irritating to eyes	blindness	2	3	6	Moderate						
				pollution	2	1	2	Low						
				minor injurity	2	2	4	Low						
		Noise	Damages hearing	minor injurity	2	2	4	Low	Not Available					Use Ear plugs

6		Slip	Sprains and minor injuries	minor injurity	1	2	2	**Low**	Not Available				Implement safety standards	Wear PPE
7		Sparks	Burns and irritates eyes	serious Injurity	5	3	15	**High**	Not Available			Isolate by doing work in a separate place		Wear welding glasses
				minor injurity	5	2	10	**Moderate**						
		Welding gas	Triggers fires, explosions and material damage	catastrophic	3	5	15	**High**	Workers smoke while welding			Provide a special covered area for welding and workers wear face coverings and welding goggles.		
				Fatality	3	4	12	**Moderate**	workers do not use safety equipment for welding					
				serious Injurity	3	3	9	**Moderate**						
				minor injurity	3	2	6	**Moderate**						
8		Sparks	Burns, irritates eyes, starts fires	Fatality	5	4	20	**High**	worker wearing welding glasses					
				serious Injurity	5	3	15	**High**						
				minor injurity	5	2	10	**Moderate**	workers wear PPE					
		Cutting smoke	Impairs breathing	respiratory injurity	2	3	6	**Moderate**	workers wear masks					
				serious Injurity	2	3	6	**Moderate**						
				minor injurity	2	2	4	**Low**						
		Sharp edge of the material	Causes scratches	no injurity	5	1	5	**Moderate**	The workers wear safety shoes and gloves					
9		Ship structure materials	Physical injury, permanent disability, and death	Fatality	4	4	16	**High**	No training for safety plans				Organize work training and make safety paln for ship top structure cutting	Wear a helmet, safety shoes and gloves
				serious Injurity	4	3	12	**Moderate**	Workers use PPE				Implement safety procedures	
				minor injurity	4	2	8	**Moderate**						
		Noise	Hearing reduction	serious Injurity	2	3	6	**Moderate**	None of the workers wore earplugs					Wear Ear plugs
				minor injurity	2	2	4	**Low**						
		Slip	Injuries, wounds, and paralysis	serious Injurity	1	3	3	**Low**	Workers wear safety shoes	Make sure there is no liquid in the area		Make sure there is no liquid in the area		
				minor injurity	1	2	2	**Low**						

AROUND FABRICATION AREA

No	Location	Hazard	Possible Harm (s)	Risk Assessment					Exsisting Safety Guard	Risk Control				
				Consequence	L	S	R	Risk Level		Elimination	Substitution	Engineering Control	Administrative Controls	PPE
1		Remaining sharp material	Causes wounds due to scratches or punctures.	Tetanus irritation	5	4	20	High	Not Available				Implement a cleaning program	Wear safety shoes
				Serious injury	5	3	15	High						
				Minor injury	5	2	10	Moderate	There is a first aid kit	Dispose of leftovers from the ship recycling process properly				
2		Oil spill	Polluting the beach	Pollution	5	1	5	Moderate	There is oil storage				Implement an oil spill cleanup program	
3		Wood material chips	Causes wounds due to scratches or punctures.	No injury	5	1	5	Moderate	Not Available	Throwing wood chips into the trash			Provide trash cans	Using Safety Shoes
4		Plastic waste	Polluting the environment	Pollution	5	1	5	Moderate	Not Available			Provide trash cans		

WAREHOUSE AREA

No	Location	Hazard	Possible Harm (s)	Risk Assessment					Exsisting Safety Guard	Risk Control				
				Consequence	L	S	R	Risk Level		Elimination	Substitution	Engineering Control	Administrative Controls	PPE
1		Pile of wood material	Stumble	no injury	1	1	1	Low	Not Available	Move to a place far from the fabrication area				Wear Safety Shoes
2		Gas leak	Fire	Lost of asset	4	4	16	High	There are workers smoking near the tube		Move to a place far from the fabrication area and not close to heat and ignition sources	Provide fire extinguishers	Conduct training and awareness on the causes of fires	Provide fire extinguishers
				Fatality	4	4	16	High						
				serious injurity	4	3	12	Moderate	The tube is placed near where workers gather during breaks					
			Poisoning	Fatality	1	4	4	Low	-					-
				serious injurity	1	3	3	Low						
				minor injurity	1	2	2	Low						
			Explode	Lost of asset	4	4	16	High	There are workers smoking near the tube			Install gas leak detectors	Conduct training and awareness on the causes of fires	
				Fatality	4	4	16	High						
				serious injurity	4	3	12	Moderate						
3		oxygen gas leak during welding	Fire	Lost of asset	3	4	12	Moderate	Not Available		Move to a place far from the fabrication area and not exposed to heat or fire sources	Provide fire extinguishers		
				Fatality	3	4	12	Moderate						
				serious injurity	3	3	9	Moderate						
			Poison	Fatality	1	4	4	Low						
				serious injurity	1	3	3	Low						
				minor injurity	1	2	2	Low						
			Explode	Lost of asset	3	4	12	Moderate				Install gas leak detectors		
				Fatality	3	4	12	Moderate						
				serious injurity	3	3	9	Moderate						