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RISK MANAGEMENT OF OCCUPATIONAL SAFETY AND HEALTH IN KRI DOCKING PROJECT USING HAZARD IDENTIFICATION, RISK ASSESSMENT AND RISK CONTROL (HIRARC) METHOD CASE STUDY: PT. PAL INDONESIA

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ABSTRACT

The Republic of Indonesia warship (KRI) is one of the elements of the Integrated Fleet Weapon System, which has an important function in carrying out existing tasks in the defense sector. So that KRI readiness is needed optimally to support the operation to be carried out successfully. One way that is used to prepare the KRI is to carry out routine maintenance through the docking process. But in its implementation, there are still accidents experienced by workers. This research was conducted using the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method. HIRARC is a method of hazard identification, risk assessment, and risk control measures. This method is considered more precise and more accurate where the dangers that arise in the docking process are explained from each work activity. This method also provides appropriate control measures for each hazard. Based on the results of this HIRARC analysis, in each work activity docking based on Risk Ranking will be sorted according to the level of Risk Matrix and will be discussed further against high risk and implemented controls. Then the recommendations produced to minimize workplace accidents in the docking process are by elimination, Administration Control and Use of PPE (Personal Protective Equipment).

Keywords: *HIRARC Method, Docking, PT. PAL Indonesia.*

1. INTRODUCTION

The Unitary State of the Republic of Indonesia is a country known as the largest archipelagic country with an area of almost two-thirds of the Southeast Asian region. This vast territory of Indonesian waters requires the Indonesian government to build a strong sea power to maintain the territorial integrity of the Unitary Republic of Indonesia. This is intended to safeguard various potential threats that will occur in Indonesian waters. Reliable defense strength in the maritime field is the core of defense preparedness for Indonesian Armed Forces in general and the Indonesian Navy in particular. The Indonesian Navy is required to always be prepared to maintain security throughout the archipelago.

The Republic of Indonesia Warship (KRI) is one of the elements of the Integrated Fleet Weapon System that has an important function in carrying out existing tasks in the defense sector. So that KRI readiness is needed optimally to support operations so that it can be implemented

successfully. One of the efforts of the maintenance itself is to carry out docking, in which all vessels are very necessary to carry out periodic docking so that they are ready to carry out their duties.

The docking process carried out by KRI is a very complex maintenance process with various methods. However, in this process, there were also many activities carried out both from the docking crew and ship crews, thus giving rise to the many risks faced in each activity. Therefore, we need Risk Management of Occupational Safety and Health (OSH) in order to minimize the loss of both personnel and material resulting from the docking process.

PT. PAL Indonesia as one of the strategic industries that produce the main tools of the Indonesian defense system, especially for the navy, its existence certainly has an important and strategic role in supporting the development of the national marine industry. In the future PT. PAL Indonesia will continue to improve its ability to play a role in Driving Synergy to Global Maritime Access. The important role of PT. PAL Indonesia will bring the Indonesian maritime industry to fulfill the maritime market globally. At present the design capabilities and quality of PT. PAL Indonesia has been recognized by the international market.

As a shipyard company with more than three decades of experience, PT. PAL Indonesia is one of the domestic shipping industries that has the potential and a project work with high economic and strategic national values, one of which is the Republic of Indonesia Warship (KRI). The biggest challenge in the production process of PT. PAL Indonesia is currently managing and reducing risks in every business situation. The complexity of the docking process confronts PT. PAL Indonesia with a variety of risks that can cause the failure of the objectives to be achieved, such as the occurrence of work accidents that can result in personal or material losses.

The fact of the accident at PT. PAL Indonesia that ever happened was personnel who fell from the top of the KRI who were carrying out the docking process due to slipping so that the victim suffered injuries and fractures, there were also personnel who suffered injuries to the skin because it was sprayed by sand in the sand blasting process and other accidents while carrying out the work. Whereas the events that almost caused danger included personnel who were almost hit by broken rope, there were also personnel who were almost crushed by the material transported by the crane, and several other events. Therefore Risk Management of Occupational Safety and Health (OSH) needs to be applied to the company.

The current OSH conditions in PT. PAL especially in the Division of Maintenance and Repair is under the responsibility of the Environmental Health Work Safety Bureau. Basically, it is good enough and well accommodated by making rules regarding procedures for working by using PPE (Personal Protective Equipment) in accordance with existing SOP (Standard Operating Procedure), but in its implementation, there are often employees or ship escorts (KRI) who do not heed the

rules for using PPE expected. So that sometimes gives a lot of problems related to work safety.

Because the docking process has different risks of workplace accidents and potential sources of danger, it is necessary to control workplace accidents and potential sources of danger using the HIRARC method. This method can be used to analyze potential hazards from work activities and provide a risk assessment of a job. The HIRARC method provides recommendations that can be used to prevent potential work accidents. So that the implementation of the docking process can run safely and smoothly without any loss of personnel or material resulting from the docking process.

This study has the purpose of identifying potential hazards that exist during docking activities. Risk assessment (assessing the level of danger) of the potential hazards present in the docking process. Look for ways / methods that are appropriate to overcome the potential hazards that exist (risk control) during docking activities.

The benefit of this research is that it can be used as an illustration of potential hazards and risk assessment in the docking process. In addition, this study can also be used to determine the level of success of controls that have been carried out by the company and know the root causes, so that appropriate control measures can be taken by increasing awareness of workers in the use of Personal Protective Equipment (PPE) in the hope that workers are safer and more careful careful at work. And as a reference for Occupational Safety and Health (OSH) for each KRI that will carry out docking.

2. MATERIAL / METHODOLOGY

2.1. Docking Project

Docking is a process that is carried out to move the ship from water or sea to the dock with docking assistance facilities. BKI (Bureau of Indonesian Classification) has determined periods for repairs of ships over dock, a ship docking process seen from several aspects such as the age of the ship, the type of material used for the ship's body and the needs of the ship itself. In docking the ship, it must be done with care and preparation that is very mature because of the specific and different specifications of the ship shape.

There are several facilities or types of boat docking, including:

a. Graving Dock/Dry Dock.
b. Floating Dock.
c. Slipway Dock.
d. Synchrolift Dock.

2.2. Occupational Safety and Health (OSH)

According to (Suma'mur, 1995) understanding of workplace accidents is an event that can damage a plan that has been made or planned in advance. Work safety is prioritized in working to avoid accidents. Accidents can be interpreted as an unwanted and unexpected event, which can cause a disaster or loss. Occupational health and safety is needed in industrial activities, every industrial activity always contains hazards and occupational safety

and health risks, these hazards and risks will have consequences, if the OSH is not managed properly, it will cause losses. These losses are in the form of company assets from the lightest to the destruction, the field of workers from the lowest disability / sickness to fatalities, while the environmental field from mild pollution to disasters.

2.3. Risk Management

Risk is something that is often inherent in the activity. Whatever activities we do must have potential risks. Correct risk management can help the company avoid the maximum costs incurred, besides that, it can maintain the calmness of workers in doing work. Risk analysis can help management to decide whether the risks faced by the company will be avoided or taken. Often this can be caused by information systems that are still weak so the company has difficulty knowing how much loss will be experienced. On one side of the planning or preventive action against one weak risk can bring a disaster, on the other hand, excessive warning to avoid risk will bring loss of various opportunities, so it involves an accurate risk assessment that will maximize company profits, therefore risk management needs to be done properly and correctly.

2.4. Possibility of an Event

This value is based on the possibility of an event occurring. Assess the possibility based on work experience, analysis or measurement. Probability levels range from "most likely" to "inconceivable". As can be seen in Table 1.

Table 1. Possible Values (Likelihood) (Source: (Department of Occupational Safety and Health, 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 is not unusual*	4
Conceivable	*Might be occur sometime in the future*	3
Remote	*Has not been known to occur after many years*	2
Inconceivable	*Is practically impossible and has never occurred*	1

2.5. Danger Severity

Severity can be divided into five categories. The severity is based on increasing severity for individual health, environment, or property, as can be seen in Table 2. The severity of an accident in the

company can be retrieved data to be processed and then used as a reference for making security policy in terms of the use of personal PPE, to minimize numbers accidents in an agency.

Table 2. Value of Severity (Saverity)
(Source: (Department of Occupational Safety and Health, 2008))

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

2.6. Risk Assessment

Risks can be presented in various ways to communicate the results of the analysis to make decisions about risk control. For risk analysis that uses probability and severity in qualitative methods, presenting results in a risk matrix is a very effective way of communicating risk distribution across factories and regions in the workplace. Risks can be calculated using the following formula:

L x S = *Relative Risk*

Explanation:
L = *Likelihood*
S = *Severity*

Risk assessment, as can be seen in Table 3.

Table 3. Risk Assessment Matrix
(Source: (Department of Occupational Safety and Health, 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

2.7. Risk Control

Control of hazards in the work environment is actions taken to minimize or eliminate the risk of workplace accidents through elimination, substitution,

engineering control, warning system, administrative control and personal protective equipment.

a. Elimination.
   The top hierarchy is eliminated where the danger must be eliminated when the manufacturing process is made. The aim is to eliminate the possibility of human error in running a system due to a lack of design. Danger elimination is the most effective method so that it does not rely solely on worker behavior in avoiding risks, but the elimination of real harm is not always practical and economical.
b. Substitution.
   This control method aims to replace materials, processes, operations or equipment from dangerous ones to be more harmless. With this control will reduce the danger and risk through system redesign.
c. Engineering Control.
   This control is aimed at separating danger from workers and to prevent human error. This control is installed in an engine or equipment system unit.
d. Warning System.
   Danger control is carried out by giving warnings, instructions, signs, labels that will make people aware of the dangers in that location. It is very important for everyone to know and pay attention to the warning signs that are on the job site so that they can anticipate the danger that will affect them. Applications in the industrial world for this type of control include alarm systems, smoke detectors, warning signs.
e. Administrative Control.
   Hazard control by making modifications to the interaction of workers with the work environment, such as work rotation, training, development of work standards (SOP), shift work, and housekeeping.
f. Personal Protective Equipment.
   Personal protective equipment is designed to protect themselves from hazards in the work environment and pollutants, so that they are always safe and healthy.

2.8. Hazard Identification, Risk Assessment and Risk Control (HIRARC).

The purpose of this guideline is to provide a systematic and objective approach to assessing hazards and associated risks, which will provide an objective measure of hazard identification and provide methods for controlling risk. (Department of Occupational Safety and Health, 2008).

The HIRARC method is mostly carried out by industry players to carry out risk mapping. HIRARC is now known as a hazard identification method, the risk assessment and risk control that are usually used are considered to be more precise and more accurate where the dangers that arise are explained from each work activity. This method also provides appropriate control measures for each potential hazard.

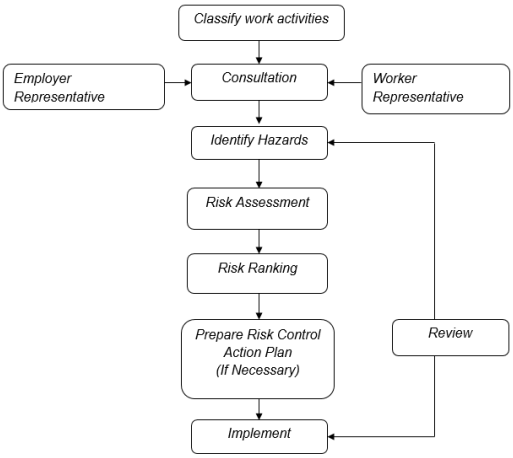

Figure 1. Flowchart of HIRARC Process (Source: (Department of Occupational Safety and Health, 2008))

2.9. Research Flow Chart

The author makes a research design as outlined in the research flow chart shown in Figure 2 below:

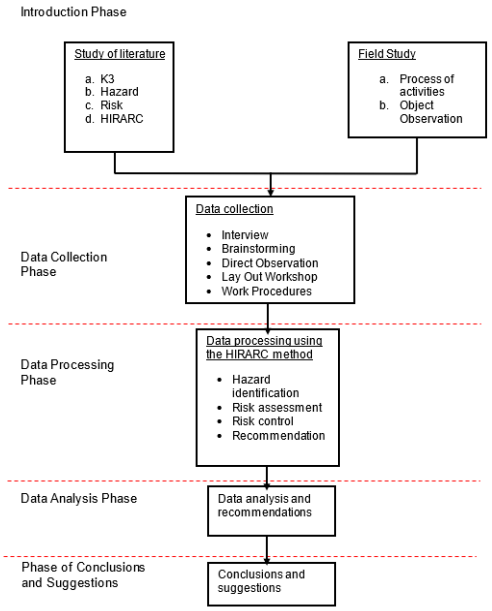

Figure 2. Research Flow Chart

3. DATA ANALYSIS AND DISCUSSION

In this section, we will explain about data collection and processing and data analysis carried out based on the established research methodology. Data collection is carried out in the Maintenance and Repair Division of PT. PAL Indonesia uses primary data, namely data from direct observation, interview results, and questionnaires. After data collection and processing, the next step is to analyze the data obtained.

3.1. Data Collection

At this stage data collection from PT. PAL Indonesia is carried out which will support this research. Data collected in the form of primary and secondary data. The primary data collected is in the form of hazard identification data on ship docking processes, interviews, and the results of the questionnaires. As for secondary data obtained in the form of supporting docking process equipment, and other documents that support research.

3.2. Data Processing

At the stage of data processing, the steps of completion are carried out using the HIRARC method, namely the stage of mapping / classifying the type of work, risk identification and analysis of the causes of risk in the procedure of implementing docking. In the final stage of data processing, recommendations / controls will be carried out on the risks.

3.3. Mapping Phase of Docking Procedure

During the docking procedure, the mapping / classification of work types is divided into three stages, namely the docking preparation stage, the stage of implementation of the work and the completion stage of the dosing process.

From each stage of the docking procedure above, there are various kinds of work processes that have a variety of risks, it requires a more detailed explanation of each of these jobs so that potential risks can be monitored. Furthermore, risk mitigation will be held at each stage of the docking work.

a. Docking Preparation Phase.
   Stage Preparation Docking is a preliminary stage or a preparatory process before the process of docking of a vessel / Pertamina. The stages of this process include:
   1) Ship arrival at the dock.
   2) Docking process.

b. Work Implementation Phase (construction, machinery, electricity and others).
   Work Implementation Stage is the core stage in the docking process. The stages of this process include:
   1) Check plate thickness & other damage to hull / construction.
   2) Cleaning of the hull (*Scrapping*).
   3) Sandblasting Process.
   4) Re-plate (plate thickness less than 70%).
   5) Treatment and cleaning of tanks.
   6) Hull treatment and painting, anchor chain, propeller and steering system.

c. The docking job completion phase.
   The docking job completion stage is the final step in the docking process. The stages of this process include:
   1) Installation of cathodic protection.
   2) The process of undocking.
   3) The process of completing work.
   4) Trial Stage / Sea Trial.

3.4. Hazard Identification of Docking Process

After mapping the docking process, the next step is to carry out the hazard identification in each docking process. In identifying hazards, primary and secondary data are needed, the primary data are obtained from the expert interview / dock while the secondary data is obtained from the data of the incident that occurred before during the docking process.

Hazard identification is performed at all stages of docking process, identification results at each stage include:

a. Hazard Identification of Docking Preparation Stage.
b. Hazard Identification of Work Implementation Stage.
c. Hazard Identification of Docking Work Settlement Stage.

After implementation of risk assessment the next step will be conducted risk assessment in the order of the highest risk level, with the result:

Table 4. Ranking Risk Matrix
(Source: Data Processing Results)

No	*Hazard*	Score	*Risk Matrix*
1	Hazardous gas and limited oxygen causes unconsciousness during the cleaning process of the tank	16	*Substantial*
2	The fire sparks of the replanting process pose a fire hazard	16	*Substantial*
3	The work process at height causes the danger of falling	16	*Substantial*
4	Smooth floors cause slippery when preparing a floating dock	12	*Moderate*
5	Rusty flooring causes injuries to be scratched when preparing a floating dock	12	*Moderate*
6	The limited work space causes the head to bend at the time of preparing the pads of the hull	12	*Moderate*
7	The scattered plates cause punctured injuries	12	*Moderate*
8	The porous stairs caused scratched wounds	12	*Moderate*
9	Stairs that are too upright cause danger of falling	12	*Moderate*
10	Lots of dust causes shortness of breath during the sandblasting process	12	*Moderate*
11	Pressurized sand during sandblasting causes serious injury to the skin and other organs	12	*Moderate*
12	Electric shock causes burns in the welding process	12	*Moderate*
13	Engine trials cause a risk of leakage in the propeller shaft	12	*Moderate*
14	The chipped cable causes electric shock	9	*Tolerable*
15	Scratched corrosion material cause wound infection	9	*Tolerable*
16	*Insufficient scaffolding causes workers to fall*	9	*Tolerable*
17	Sharp oysters cause scratches wounds	8	*Tolerable*
18	Rusty liners cause pinched hands	6	*Tolerable*
19	A broken rope can cause bruising	6	*Tolerable*
20	Ultrasonic wave radiation causes damage tissue structure	6	*Tolerable*
21	Material fall when carrying heavy loads causes pinched wounds	6	*Tolerable*
22	Feet pinched because of daydreaming while watching the dampra	4	*Trivial*

From the results of ranking above, there are 4 types of risks, namely Substantial Risk, Moderate Risk, Tolerable Risk and Trivial Risk. The type of risk that requires control measures and risk reduction before the work begins is the risk of fainting due to limited oxygen during the tank cleaning process, a fire hazard caused by fire sparks from the re-plating process and the danger of falling in the work process at height.

3.5. Discussion

After data collection and processing, the next step is to analyze the data obtained. The analysis in question is the analysis of the results of data processing shown in the Risk Matrix Ranking Table,

where 3 types of hazards are obtained that have a large level of risk (Substantial Risk).

3.6. Identify the Causes of Risk

Identification of the causes of risk arising is focused on the type of risk that is substantially risky or a large risk that requires risk reduction before the work is carried out. Identification of causes is done using a causal diagram or called a Fishbone diagram. With Fishbone diagrams will be found the main causes and derivative causes that form a causal relationship.

3.6.1 Dangerous Gases and Limited Oxygen

Identification of the causes of risk of dangerous gases and limited oxygen causes fainting / weakness.

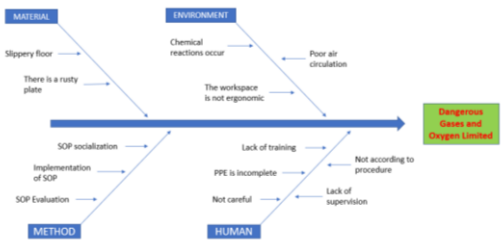

Figure 3. Fishbone diagram of Dangerous Gas and Limited Oxygen

Factors that cause the emergence of dangerous gases and limited oxygen resulting in fainting / weakness in the cleaning process include:

a. Human.

In this case, human beings are workers / workers who carry out their duties as tank cleaners. Having a variety of risks in the process of implementation and there are some shortcomings resulting in the risk of weakness / fainting caused by harmful gases and limited oxygen. Some disadvantages that need to be considered include:

1) Not according to procedure.
2) Lack of supervision.
3) Lack of training.
4) PPE is incomplete.
5) Not careful.

b. Environment.

In this case the environment is a very supportive factor in the tank cleaning process. When the environment does not support the cleaning activities will be very difficult to implement, even tend to provide the worst possibility, namely in the form of a work accident. Things that need to be considered include:

1) Chemical reactions occur.
2) Poor air circulation.
3) The workspace is not ergonomic.

c. Method.

The method in this case is the provisions made as a reference and needed to carry out each activity. The things needed in the process of applying the method are by:

1) SOP socialization.
2) Implementation of SOP.
3) SOP Evaluation.

d. Material.

In this case the material in question is an object / item that has an

impact on the possibilities of the risk of an emerging hazard, including:

1) Slippery floor.
2) There is a rusty plate.

3.6.2. Fire sparks

Identifying the risk causes of fire sparks from the replating process causes fire hazards.

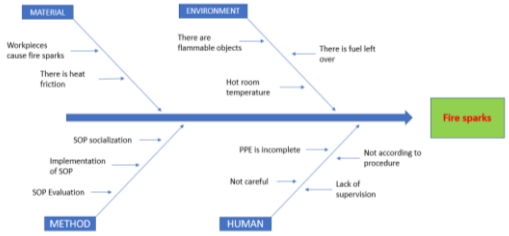

Figure 4. Fishbone Diagram of Fire Spark

Factors that cause the appearance of fire sparks in the welding process that result in fire hazards include:

a. Human.

In this case the human being is a guardian / worker who carries out the task as an observer. Having various kinds of risks in the process of implementation and there are some shortcomings resulting in the risk of fire hazards caused by fire sparks during the welding process. Some disadvantages that need to be considered include:

1) Not according to procedure.
2) Lack of supervision.
3) PPE is incomplete.
4) Not careful.

b. Environment.

In this case the environment in question is a situation that is directly related to the welding process.

1) There are flammable objects.
2) There is fuel left over.
3) Hot room temperature.

c. Method.

The method in this case is the provisions made as a reference and needed to carry out each activity. The things needed in the process of applying the method are by:

1) SOP socialization.
2) Implementation of SOP.
3) SOP Evaluation.

d. Material.

Material in this case is an object that is directly related to the welding process and has the potential to pose a risk of fire hazard, these things include:

1) Workpieces cause fire sparks.
2) There is heat friction.

3.6.3. Work Process at Altitude

Identifying the causes of the risk of work processes at height causes the danger of falling.

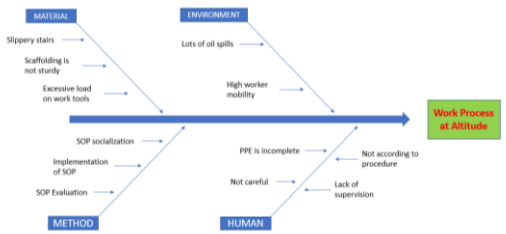

Figure 5. Fishbone Diagram of Work Process at Altitude

Factors that cause the emergence of hazards in the work process at altitude which results in the danger of falling include:

a. Human.

   In this case the human being is a guardian / worker who carries out work at a high place. Having a variety of risks in the process of implementation and there are some shortcomings that result in the risk of falling. Some disadvantages that need to be considered include:

   1) Not according to procedure.
   2) Lack of supervision.
   3) PPE is incomplete.
   4) Not careful.

b. Environment.

   1) Lots of oil spills.
   2) High worker mobility.

c. Method.

   The method in this case is the provisions made as a reference and needed to carry out each activity. The things needed in the process of applying the method are by:

   1) SOP socialization.
   2) Implementation of SOP.
   3) SOP Evaluation.

d. Material.

   Material in this case is supporting equipment used by workers to reach the workplace.

   1) Slippery stairs.
   2) Scaffolding is not sturdy.
   3) Excessive load on work tools.

3.7. Risk Control Analysis

Risk control is carried out on 3 risks that are substantially risky, these risks are:

3.7.1. Dangerous Gases and Oxygen Limited

Risk control with hazardous gas and limited oxygen hazard causes fainting / weakness during the tank cleaning process.

Risk control on this hazard is carried out in the following ways:

a. Elimination.

   1) Avoid using equipment that can cause potential friction or fire sparks.
   2) Avoid working on tanks that have not been declared free of toxic gases.

b. Administrative Controls.

   1) Carry out gas detection against tanks that are completely free of harmful gases.
   2) Carry out blowing on the tank at least 8 hours before starting work.
   3) Prepare a suction blower and press with different main hole to provide air circulation, so avoid the lack of oxygen for workers.
   4) Upayakan work in groups, so that there is someone who monitors if something unexpected happens.
   5) Prepare a fire extinguisher.
   6) Prepare a garbage bag to take and remove dirt.

c. Personal Protective Equipment.

Workers must always pay attention to the security factor of personnel by using personal protective equipment including:

1) Safety gloves, function for hand protective equipment while working which can result in hand injury from unknown sharp objects, because of contamination from chemicals, etc.
2) Safety shoes, serves to prevent fatal accidents that hit the feet due to being hit by goods or slip.
3) Safety helmet, functions as a head protector from objects that can directly hit the head.
4) Using a gas respirator, serves as a filter of dust, smoke, steam and harmful gases in the tank.

3.7.2. Fire sparks

Risk control with hazard fire sparks from the re-plating process creates a fire hazard.

Risk control in this hazard is carried out in the following ways:

a. Elimination.
   1) Avoid using flammable work equipment.
   2) Clean oil or oil spills before starting work.
b. Administrative Controls.
   1) Carry out recapitulation of plate thickness data from the results of ultrasonic tests.
   2) Prepare welding equipment with regard to security aspects.
   3) Prepare the fire team around the welding area (helper, hydrant hose, lighter extinguisher, etc.).
c. Personal Protective Equipment.
   Workers must always pay attention to personnel safety factors by using personal protective equipment such as gloves, helmets and shoes.
   1) Safety gloves, function for hand protective equipment when working from sharp objects, heat, chemicals, etc.
   2) Safety shoes, serves to prevent fatal accidents that hit the feet because of being hit by sharp or heavy objects, hot objects, chemical liquids etc.
   3) Safety helmet, functions as a head protector from objects that can directly hit the head.

3.7.3. Work Process at Altitude

Risk control with hazard work processes at height causes the danger of falling.

Risk control in this hazard is carried out in the following ways:

a. Elimination.
   1) Avoid using work equipment that is porous.
   2) Avoid working in a hurry (must be careful and alert).
b. Administrative Controls.
   1) Prepare equipment that suits your needs with regard to

ergonomic factors (long pole, ordinary brush, roll brush, breathing water, etc.).

2) Prepare scaffolding to reach a high place.
3) Prepare a scaffold to carry out work at height.

c. Personal Protective Equipment.

1) Workers must pay attention to personnel safety factors during the process of working at height by using personal protective equipment, namely headgear so that the head does not hit the hull of the ship.
2) Workers use safety gloves that function for hand protectors when working from sharp objects, heat, chemicals, etc.
3) Workers use safety shoes that function to prevent fatal accidents that hit the feet due to sharp or heavy objects, hot objects, chemical liquids etc.
4) Workers use flashlights or the lighting of lights if needed.
5) Setting up a safety belt for personal safety while working at heights.

3.8. Recommendation

a. Before the docking work begins, a briefing should always be held first to determine the readiness of personnel and work material.

b. During the tank cleaning process, it is expected that workers pay attention to the work environment and pay attention to existing procedures so that dangerous gases can be avoided and limited oxygen can be anticipated by carrying out blowing in certain rooms which are carried out by work processes so that air ventilation can work properly.

c. In the re-plating process, maximum supervision is carried out to minimize accidents by providing assistance to workers who are directly related to the welding process, so that early fire spark can occur which can lead to fire hazards with adequate equipment (hydrant hose, lighter extinguisher, etc.)

d. In the work process at height, each person should use adequate personal protective equipment and in accordance with the SOP.

4. CONCLUSION

Based on the results of the data and analysis of the data that has been carried out, the following conclusions can be obtained:

a. Based on hazard identification and risk assessment using the HIRARC method, accidents that have a high risk in the KRI docking process are as follows:

Table 5. High Risk Ranking Results

No	*Hazard*	Score	*Risk Matrix*
1	Harmful gas and limited oxygen cause fainting /	16	*Substantial*

	weakness during the tank cleaning process		
2	Fire sparks from the re-plating process pose a fire hazard	16	*Substantial*
3	The work process at height causes the danger of falling	16	*Substantial*

b. From the process of implementing docking, there are 3 risks that are categorized as high, so that the risk mitigation needs to be carried out so that the docking can run successfully without an accident which means both personnel and material.

The actions carried out by workers under the monitoring of the Environmental Health Work Safety Bureau are as follows:

a. During the tank cleaning process, it is expected that workers pay attention to the work environment and pay attention to existing procedures so that dangerous gases can be avoided and limited oxygen can be anticipated by carrying out blowing in certain rooms which are carried out by work processes so that air ventilation can work properly.

b. In the re-plating process, maximum supervision is carried out to minimize accidents by providing assistance to workers who are directly related to the welding process, so that early fire spark can occur which can lead to fire hazards with adequate equipment (hydrant hose, lighter extinguisher, etc.)

c. In the work process at height, each person should use adequate personal protective equipment and in accordance with the SOP.

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