

# ANALYSIS OF OCCUPATIONAL SAFETY AND HEALTH RISK MANAGEMENT ON THE INDONESIAN NAVY SHIP PROJECT USING HAZARD IDENTIFICATION, RISK ASSESSMENT AND RISK CONTROL

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## ABSTRACT

Indonesian Navy ships (KAL) is one element of the Integrated Fleet Weapon System (SSAT), which plays an important role in carrying out tasks in the defense field. So, we need an optimal KAL readiness to support the passage of the operation to be carried out successfully and smoothly. One of the ways used to prepare KAL is to carry out routine maintenance through the docking process. However, in practice there are accidents suffered by workers. This research was conducted using the HIRARC method. HIRARC is a method of hazard identification, risk assessment and risk control measures that are used for this method is considered more appropriate and more accurately where the dangers that arise in the process described docking of any work activity. In this method also provides appropriate control measures for each hazard. Based on the results of the HIRARC analysis, each suction work activity of docking based Risk Ranking will be sorted according to the level of Risk Matrix and will be discussed further against high risks and implemented controls. Then the resulting draft recommendation to minimize workplace accidents in the docking process is by way of elimination, Administration Control and Use of PPE (Personal Protective Equipment).

Keywords: HIRARC method, Docking process, KAL.

## 1. INTRODUCTION

Unitary Republic of Indonesia is a country that is known as an archipelago (archipelagic state) the largest total area occupied almost two-thirds of Southeast Asia. Indonesian waters of this vast bringing the Indonesian government to build a strong sea power to maintain the integrity of the Unitary Republic of Indonesia. It is meant to keep the range of potential threats that would occur in the territorial waters of Indonesia, both a potential threat from within and from outside the region NKAL. Defense force in the field of maritime reliable and fast at the core of defense for military preparedness in general and the Navy in particular.

Indonesian Navy ships (KAL) is one element of the Integrated Fleet Weapon System (SSAT), which plays an important role in carrying out tasks in the defense field. The operation of ship based on the plan that has been prepared by the operating staff of each of the Main Command (Kotama), which includes War Military Operations (OMP) and Military Operations Other Than War (MOOTW). So, we need an optimal KAL

readiness to support the passage of the operation to be carried out successfully and smoothly.

Several attempts were carried out on each Kotama (Main Command) among other operations against KAL carry out routine maintenance, so it can always be optimized readiness. One of the efforts of the treatment itself is to carry out docking, which is where the whole boat is very necessary to implement it periodically so that buoyancy and combat readiness can be guaranteed. The docking process performed by KAL is a very complex process that treatment with a variety of methods. But in this process there are also a lot of activities undertaken by both the crew and the crew ship docking, thus giving rise to the many risks faced in each of the activities.

PT. PAL Indonesia as one of the strategic industries that produce the main tool of defense systems for naval Indonesia in particular, its existence would have an important and strategic role in supporting the development of the national marine industry. With the purposes beginning of its

establishment as a center of excellence of the national maritime industry, PT. PAL Indonesia has proven its reputation as a major force in the development of the national maritime industry. In the efforts to strengthen the foundations for the development of the maritime industry, PT. PAL Indonesia has always worked hard to deliver and disseminate knowledge, technology, and skills to the general public related to the national maritime industry. PT. PAL Indonesia Indonesia is a major step to enter the global field of defense industry. With its position as the primary guide Integrated Fleet Weapon System naval, then in the future PT. PAL Indonesia will continue to improve its ability to be able to play a role in Driving Synergy to the Global Maritime Access. The important role of PT. PAL Indonesia, will bring Indonesia's maritime industry to the fulfillment of the global maritime market. Currently the design capability and quality of PT. PAL Indonesia has recognized the international market.

The biggest challenge in the production process of PT. PAL Indonesia today is to manage and mitigate the risks inherent in any business situation. The complexity of the docking process exposes PT. PAL Indonesia with a variety of risks that could lead to the failure of the objectives to be achieved, such as accidents that could result in losses of men and material. Fact accident occurrence in PT. PAL Indonesia that ever happened was never there personnel who fell from the top of KAL which performs docking process due to slip so that the victim suffered wounds and fractures, there are also personnel who suffered wounds to the skin because of being sprayed by sand in the sandblasting and other accidents at the time carrying out the work. Therefore, risk management safety and health (K3) should be applied to the company. K3 conditions currently existing in PT. PAL especially in Division Maintenance and Repair (Harkan) under the responsibility of the Bureau of Occupational Health Safety Environment (K3LH).

Because in the process of docking at risk of occupational accidents and potential hazards of different it is necessary to control accidents and potential hazards using HIRARC (Hazard Identification, Risk Assessment and Risk Control). This method can be used to analyze the potential hazards of work activities and assesses the risks to a job. HIRARC method provides

recommendations that can be used for the prevention of potential accidents. Thus, in the implementation of the docking process can be run safely and smoothly without any personnel and material losses resulting from the docking process.

## **2. MATERIAL AND METHODS**

### **2.1 Indonesian Navy ships (KAL)**

KAL is one of the main components of the Integrated Fleet Weapon System (SSAT). KAL is the main system appliance and weapons of the Indonesian Navy in maintaining sovereignty The Unitary State of the Republic of Indonesia (NKRI) in the entire territory of Indonesia. KAL has special markings, under the command of a Navy officer manned by a crew which is legally subject to military discipline which has technical and integrated requirements.

Grouping Indonesian Warships in 3 strengths, namely destroyer ships (Striking Forces), Patrol ships (Patrol Forces) and Support Ship (Supporting Forces) which is intended to focus the priorities in the preparation of the ship in accordance reality function of combat on the ground with customized support their respective functions, in particular prioritized on weapons systems, propulsion systems, navigation equipment and operations presence at sea for marine security enforcement (Kasal, Principles of Policy Kasal, Jakarta, 2011).

### **2.2 project Docking**

*docking* process that is done to move the ship out of the water or on the sea to dock with the help of docking facilities. BKI (Indonesian Classification Bureau) and the Shah Bandar has been determining the periods to repair the ship above the dock (docking ships), docking ship seen from all aspects such as the age of the ship, the type of material used for the body/body vessel and the needs of the ship itself. In conducting the ship docking should be done with caution and preparation was done because the specifications of vessel forms a special and different.

### **2.3 Occupational Health and Safety (K3)**

According to Sumakmur (2009) notion of a work accident is an event that can ruin a plan that has been made or planned. Safety takes precedence in work to avoid accidents. Accidents can be defined as an

event that is undesirable and unexpected, that its occurrence can cause a disaster or loss. Occupational safety and health is needed in industrial activities, the things that the background is that any industrial activity always hazards and risks to safety and occupational health hazards and risks will be consequences if K3 is not managed properly, it will cause a loss, Losses in the form of the company's assets from the lightest to the destruction,

#### **2.4 Risk management**

Risk is often inherent in the activity. Any activities that we do certainly have potential risks. Proper risk management can help companies avoid as much as possible the costs incurred, besides that it can be maintained tranquility of workers to do the job. Risk analysis can help management to decide whether the risks faced by the company will be avoided or taken. Often this can be caused due to weak information systems so that companies have difficulty in knowing how losses will be experienced. On one side of the planning or precaution against a weak risk may bring about a catastrophe, on the other hand, excessive warnings to avoid risk will bring the loss of a variety of occasions,

#### **2.5 Hirarc (Hazard Identification Risk Assessment And Risk Control)**

The method used in this study is the HIRARC method is a combination of hazard identification, risk assessment and risk control, a method to prevent or minimize occupational accidents (Nurmawanti et al, 2013). Hirarc is a method that starts from determining the types of work activities that then identified his source of danger so on to get the risk. then will do a risk assessment and risk management to reduce exposure to hazards are on any kind of job.

### **3. RESULTS AND DISCUSSION**

#### **3.1 Data collection**

Data collected in the form of primary and secondary data. The primary data collected in the form of data hazard identification process vessel docking work, interviews and questionnaire results. As for the secondary data in the form of supporting equipment docking process, and other documents that support the writing.

#### **3.2 Data processing**

At this stage of data processing steps HIRARC completion method is phase mapping / classify the type of work, risk identification and analysis of the causes of risk in the implementation of the docking procedure. In the final stages of data processing will be done on / control the risks that exist.

#### **3.3 Phase Mapping docking procedure**

At the docking procedure, mapping / classify the type of work is divided into three (3) stages namely docking preparation stage, the stage of implementation of the work and the completion stage docking process. Of each stage above the docking procedure there are various kinds of work processes that have a variety of risks, it would require a more detailed explanation of each job so that potential risks can be monitored. The next will be held dealing with risks at each stage of the docking job.

- a. Preparation Stage docking.  
Preparation docking preliminary or preparatory process before the implementation process against a ship docking / KAL. The stages in this process include:
  - 1) Acceptance of boats at the dock.
  - 2) Ship docking (docking).
- b. Step Implementation of the work (construction, machinery, electrical and other), Step Work implementation a core stages in the process of docking. The stages in this process include:
  - 1) Examination of the plate thickness and damage to the hull/construction.
  - 2) Cleaning the hull (Scrapping).
  - 3) Sandblasting process.
  - 4) Replate (Plate thickness is less than 70%).
  - 5) Maintenance and cleaning of tanks.
  - 6) Maintenance and painting the hull, anchor chains, propeller and steering systems.
- c. Step completion of the docking job.  
Step completion of the docking job is the final stage in the process of docking. The stages in this process include:



- 1) Installation *cathodic protection*.
- 2) The process of reduction of the ship on the dock (*undocking*).
- 3) The process of completion of work on water.
- 4) Stage Trial / *Trial*.

### 3.4 Hazard identification in the process of docking

After the docking process mapping, then the next step is to carry out the identification of hazard that exists in each of the docking process. In conducting the hazard identification required primary data and secondary data, primary data obtained through interviews expert/dock technician while the secondary data obtained from the data of events that have occurred during the process of docking ship.

Hazard identification process carried out at all stages of docking, the result of identification at each stage include:

a. Hazard Identification Phase Preparation docking.

Hazard identification at this stage is done by taking into account the possibilities of hazards that may arise in any process.

b. Identification *Hazard Step* Work Implementation (construction, machinery, electrical and other),

Hazard identification in the docking phase conducted concerning the possibilities of the dangers that may arise in any process.

c. Identification *Hazard Step* Completion docking.

Hazard identification in the docking phase conducted concerning the possibilities of the dangers that may arise in any process.

Having carried out a risk assessment to be carried out the next steps in the order of ranking risk heaviest level of risk, namely:

**table 4 Risk Ranking Matrix**  
(Source: Data Processing)

| No. | Hazard   | Score | risk Matrix |
|-----|--|-------|-------------|
| 1   | Harmful gases and oxygen-limited cause fainting/limp during the tank cleaning process    | 16    | substantial |
| 2   | Sparks from the replating process create a fire hazard                                   | 16    | substantial |
| 3   | The process of working at height causing a fall hazard                                   | 16    | substantial |
| 4   | Slippery floor causing slipping when setting up the floating dock                        | 12    | moderate    |
| 5   | The floors were rusted scratched causing injury when setting up the floating dock        | 12    | moderate    |
| 6   | Limited working space causes the head to collide when preparing keel bearings            | 12    | moderate    |
| 7   | The plates were strewn cause stick injuries  | 12    | moderate    |
| 8   | Stairs porous cause injury scratched   | 12    | moderate    |
| 9   | Stairs lead to the danger of falling too upright   | 12    | moderate    |
| 10  | Lots of dust causing shortness of breath during the sandblasting process                 | 12    | moderate    |
| 11  | Pressurized sand when the sandblasting cause serious injury to the skin and other organs | 12    | moderate    |
| 12  | Electric shock burns on the welding process  | 12    | moderate    |
| 13  | Experiments machine causing the risk of leakage on the shaft propellers                  | 12    | moderate    |
| 14  | Cable chipped cause electric shock   | 9     | tolerable   |
| 15  | Scratched material corrosion causing wound infections                                    | 9     | tolerable   |
| 16  | scaffolding less robust cause worker falls   | 9     | tolerable   |
| 17  | The oysters were sharply etched causing injury   | 8     | tolerable   |
| 18  | Lier corroded causing pinched hands  | 6     | tolerable   |
| 19  | Slamming rope broke causing bruises  | 6     | tolerable   |
| 20  | Ultrasonic wave radiation causes body tissue structures damaged                          | 6     | tolerable   |
| 21  | Fall of material when carrying a heavy load causing injury pinched                       | 6     | tolerable   |
| 22  | Foot wedged for daydreaming when manning damper  | 4     | trival      |

From the results obtained ranking above 4 types of risks to Substantial Risk, Moderate Risk, and Risk Tolerable Risk trival. The risks that require risk reduction and control measures before starting work is a risk of fainting/limp because of the limitations of oxygen during the process of cleaning the tank, fire hazards caused by sparks from the process of replating and fall hazards in the process of working at height.

After collecting and processing the data, the next stage is to analyze the data obtained. The analysis in question is an analysis of the data processing are shown in Table Risk Ranking Matrix, which gained 3 types of hazard that has great value risk level (Substantial Risk).

### 3.5 Identification of Risk Causes

Identify the cause of the risk is focused on the types of risks that are Substantial Risk or a substantial risk that requires the reduction of risk before the job is done. Identification of the cause of this is done using a causal diagram called fishbone diagrams. With a fishbone diagram will be found the main cause and the cause of hereditary form of causality.

a. Cause of risk with hazard identification of hazardous gases and oxygen-limited cause fainting/limp.

#### Dangerous Gases and Oxygen Limited

The factors that cause the appearance of hazard harmful gases and oxygen-limited resulting in fainting/weakness in the process of cleaning the tank, among others:

- 1) Human.  
In this case the man is workers who carry out duties as tank cleaners. Having a wide variety of risks in the implementation process and several shortcomings are resulting in the risk of weak / fainting caused by noxious gases and oxygen is limited. Some deficiencies that need to be considered include:
  - a) Not following procedures.
  - b) Lack of supervision.
  - c) Lack of training.
  - d) Personal Protective Equipment is incomplete.
  - e) Less caution.
- 2) Environment.  
In this case the environment is a factor that is very supportive in the process of cleaning the tank. When the environment does not support the cleanup activities will be very difficult for implemented, and even tend to give the worst possible in the form of accidents. Things that need to be considered include:
  - a) Chemical reactions occur.
  - b) Air circulation is not good.
  - c) The workspace is not ergonomic.
- 3) Method.  
The method in this case the provisions made as a reference and is required to carry out each activity. Things that are needed in the

process of implementing the method, namely by:

- a) Standard Operating Procedures socialization.
  - b) Application of Standard Operating Procedures.
  - c) Evaluation of Standard Operating Procedures.
- 4) Material.

In this case, the material in question is of objects/items that impact the possibilities of hazards arise, among others:

- a) Slippery floor.
- b) There is a rusty plate.

b. Hazard identification risk causing the sparks of the replating process causing a fire hazard.

The factors that cause the appearance of hazard Sparks on the welding process which resulted in a fire hazard, among others:

- 1) Human.  
In this case the man is workers who carry out tasks as welding. Having a wide variety of risks in the implementation process and several shortcomings are resulting in the risk of fire hazard caused by a spark during the welding process. Some deficiencies that need to be considered include:
  - a) Not following procedures.
  - b) Lack of supervision.
  - c) Personal Protective Equipment is incomplete.
  - d) Lack of caution.
- 2) Environment.  
In this case the environment in question is directly related to the situation of the welding process.
  - a) There is a flammable object.
  - b) There is residual fuel.
  - c) The temperature of the hot room.
- 3) Method.  
The method in this case the provisions made as a reference and is required to carry out each activity. Things that are needed in the

process of implementing the method, namely by:

- a) Sosialisasi Standard Operating Procedures.
  - b) Application of Standard Operating Procedures.
  - c) Evaluation of Standard Operating Procedures.
- 4) Material.

Material in this case is an object that is in direct contact with the welding process and has the potential to pose a fire hazard, such matters include:

- a) The workpiece causes a spark.
- b) There is friction heat.

**c.** Cause of risk with hazard identification process of working at height causing a fall hazard.

The factors that cause the appearance of hazard the process of working at height which resulted in the danger of falling, among others:

- 1) Human.  
In this case the man is workers who carry out work at high altitudes. Having a wide variety of risks in the implementation process and several shortcomings are resulting in the risk of falls. Some deficiencies that need attention among others:
  - a) Not according to the procedure.
  - b) Less supervision.
  - c) PPE is not complete.
  - d) Incautious.
- 2) Environment.
  - a) Many oil spills.
  - b) High labor mobility.
- 3) Method.  
The method in this case the provisions made as a reference and is required to carry out each activity. Things that are needed in the process of implementing the method, namely by:
  - a) Standard Operating Procedures socialization.
  - b) Application of Standard Operating Procedures.

c) Evaluation of Standard Operating Procedures.

4) Material.  
The material in this case is the ancillary equipment used by workers to reach the workplace.

- a) Slippery stairs.
- b) *scaffolding* less robust.
- c) Excessive burden on the working tool.

### Analysis of Risk Management

Risk control carried out on 3 Risk Substantial risk nature, these risks are:

a. Hazard risk control with limited harmful gases and oxygen, causing fainting/limp during the tank cleaning process.

On hazard risk control is done in the following way:

- 1) *Elimination.*
  - a) Avoid using equipment that could pose a potential friction or sparks.
  - b) Avoid working on tanks that have not been declared free of toxic gases.
- 2) *Administrative Controls.*
  - a) Carrying out gas detection to the tank that is free of hazardous gas.
  - b) Implement blowing toward the tank at least 8 hours before starting the job.
  - c) Setting up and press the suction blower depending manhole to provide air circulation, so avoid the lack of oxygen for the workers.
  - d) Strive to work with a group, so there is a monitor in case something undesirable.
  - e) Prepare a fire extinguisher.
  - f) Prepare a garbage bag to collect and remove debris.
- 3) *Personal Protective Equipment.*

Workers should always pay attention to the safety of personnel using personal protective equipment, namely:

a) *safety gloves* (Gloves), serves for protective equipment when working hands that can result in hand injuries from sharp objects are not known, because of contamination from chemicals, etc.

b) *safety shoes* (Shoes), serves to prevent a fatal accident that befell the foot by falling items or slip.

c) *safety helmet* (Helm), serves as the chief protector of items that can be directly on the head.

d) Using a gas respirator, serves as a filter of dust, smoke, fumes and noxious gases in the tank.

b. Control risk hazard sparks from the replating process create a fire hazard.

On hazard risk control is done in the following way:

1) *Elimination.*

a) Avoid using work equipment flammable.

b) Clean up spilled oil or oil before starting the job.

2) *Administrative Controls.*

a) Implement recapitulation of the data plate thickness of ultrasonic test results.

b) Setting up welding equipment with due regard to safety aspects.

c) Set up a team of firefighters around the welding area (Helper, hydrant hose, fire extinguisher, etc.).

3) *Personal Protective Equipment.*

Workers should always pay attention to the safety of personnel using personal protective equipment ie gloves, helmet and shoes.

a) *safety gloves* (Gloves), serves to hand protective equipment when working from sharp objects, heat, chemicals, etc.

b) *safety shoes* (Shoes), serves to prevent a fatal accident that befell foot crushed sharp or heavy

objects, hot objects, chemicals, etc.

c) *safety helmet* (Helm), serves as the chief protector of items that can be directly on the head.

c. Control risk *hazard* the process of working at height causing a fall hazard.

On hazard risk control is done in the following way:

1) *Elimination.*

a) Avoid using porous work equipment.

b) Avoid working in a hurry (to be careful and alert).

2) *Administrative Controls.*

a) Setting up the equipment according to the needs with attention to ergonomics (long pole, regular brush, brush roll, brushing water, etc.).

b) Setting up the scaffolding to reach high places.

c) Setting up scaffolding to carry out work at height.

3) *Personal Protective Equipment.*

a) Workers must take into account the safety of personnel during work at height using personal protective equipment, namely headgear/hood so that the head does not hit the hull / KAL.

b) Workers use safety gloves (gloves), which serve to hand protective equipment when working from sharp objects, heat, chemicals, etc.

c) Workers use safety shoes (shoes) that serve to prevent a fatal accident that befell foot crushed sharp or heavy objects, hot objects, chemicals, etc.

d) Workers use a flashlight or lighting of the lamp, if necessary.

e) Preparing safety bell as individual safety while working at height.



**Recommendation**

- a. Before work begins docking should always hold a briefing beforehand to determine the readiness of personnel and material work.
- b. At the time of the tank cleaning process is expected to workers noticed working environment and pay attention to the existing procedures so that dangerous gases can be avoided as well as the anticipated presence of oxygen is limited by carrying out blowing into the rooms of certain work processes carried out so that the air vents can work well.
- c. In the process of replating improved supervision the maximum to minimize accidents that exist by way of assisting workers who are in direct contact with the welding process, so that it can be anticipated by early onset of sparks that

could result in a fire hazard with the proper equipment (hoses hydrant, fire extinguisher, etc.),

d. In the process of working at height should each personnel using personal protective equipment is adequate and following Standard Operating Procedures,

**4. CONCLUSION**

based on draft copies of data and data analysis has been done, it can be concluded as follows:

- a. Based on hazard identification and risk assessment methods HIRARC, accidents at high risk on KAL docking process is as follows:

**Table 5 High-Risk Ranking Results**

| No. | Hazard  | Score | risk Matrix |
|-----|---|-------|-------------|
| 1   | Harmful gases and oxygen-limited cause fainting/limp during the tank cleaning process | 16    | substantial |
| 2   | Sparks from the replating process create a fire hazard                                | 16    | substantial |
| 3   | The process of working at height causing a fall hazard                                | 16    | substantial |

b. Of the implementation process of docking obtained three (3) risks are categorized as high, then it is necessary countermeasures against the risk that the implementation of the docking went smoothly without any accident which means both personnel and material.

Actions taken by the workers under observation K3LH bureau is as follows:

- 1) At the time of the tank cleaning process is expected to workers noticed working environment and pay attention to the existing procedures so that dangerous gases can be avoided as well as the anticipated presence of oxygen is limited by carrying out *blowing* in certain rooms implemented work processes so that ventilation can work well.
- 2) In the process *replating* maximum supervision implemented to minimize any accidents by assisting workers who are in direct contact with the welding process, so that it can be anticipated early onset of sparks which could result in a fire

hazard with the proper equipment (hydrant hose, fire extinguisher, etc.).

3) In the process of working at height should each personnel using tools adequate personal protective and following the Standard Operating Procedures.

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