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|  | *METEOR STIP MARUNDA* |
| pISSN: 1979 – 4746  eISSN : 2685 - 4775 | ***Maritime Institute of Jakarta*** |

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| **Optimizing Lifeboat Maintenance at KM. Binaiya with *Fishbone Analysis***  1Ni Kadek Evayuni Adi Riswana, 2Anugrah NurPrasetyo, 3Anak AgungIstri Sri Wahyuni, 4Maulidiah Rahmawati  *-spacing-*  *1Politeknik Pelayaran Surabaya*  *2Politekik Pelayaran Surabaya*  *3Politeknik Pelayaran Surabaya*  *-spacing-*  *evayuni122@gmail.com* |
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***Abstract***

*The purpose of the study was to determine how the maintenance of lifeboats on board ships was carried out and what factors caused the failure of launching lifeboats on KM. Binaiya refers to SOLAS 1974 (Safety of Life at Sea) and SOP (Standard Operating Procedure). This study uses a qualitative research method. Primary data was obtained by conducting observations and interviews while on board the ship. Based on the results of the study, it can be concluded that the implementation of lifeboat maintenance is not in accordance with the SOP (Standard Operating Procedure) and the cause of the failure of launching lifeboats is because the lifeboats are rusty and corroded, this is influenced by personnel factors, material factors, method factors, environmental factors. Some of the efforts made are to carry out safety meetings and training for the ship's crew, the mate responsible for safety directly controls the implementation of lifeboat maintenance, optimizes and improves lifeboat maintenance, increases the role of the deck crew in assisting the 3rd mate, carries out lifeboat maintenance in accordance with the ship's SOP, makes plans and repairs by considering the scale.*

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| ***Keywords:*** *Optimization, Lifeboat Maintenance, Fishbone Analysis* |

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# INTRODUCTION > T.N Roman 11 Bold

Shipping safety is a fundamental aspect in the maritime industry world which has the goal of protecting human life, cargo, and the environment as awhole.In the Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 20 of 2015 Article 1 paragraph 1 concerning Shipping Safety Standards, it is explained that shipping safety is a condition for the fulfillment of safety requirements related to transportation in waters, ports, and maritime environments. Based on these regulations, all *crew* must implement applicable regulations in order to meet material requirements, especially the equipment of auxiliary equipment as a means of ensuring safety on board. Government regulations have been made in such a way, but various ship accidents still occur frequently. There are many accidents at sea that should still be able to be rescued but fail to be carried out because the safety equipment needed on board is inadequate and cannot function properly when used.

According to SOLAS 1974 (*International Convention for the Safety of Life at Sea) CHAPTER III*, safety equipment on board consists of *lifeboats, rescue boats, infatable liferafts, lifebuoys,* and *life* jackets. One of the safety tools that plays a very important role when there is a danger on board a ship that can accommodate the capacity of many people is the lifeboat. *A lifeboat* or lifeboat is a small boat that has a propulsion motor, functions to assist and provide assistance to the ship's *crew* and passengers at sea when the ship is in an emergency such as a fire, collision, or search and rescue of people falling into the sea.

In general, on passenger ships, partially *enlcosed space* lifeboats are used because they have a large capacity,  *partially enlcosed space*  lifeboats that have met the requirements with an aggregate capacity of not less than 50% of the total number of people on board are requirements that must be met by passenger ships based on SOLAS 1974 *Chapter III Regulation* 21.

SOLAS 1974 *Chapter III Regulation* 11 explains that lifeboats must be close to the service and accommodation rooms, located on the right or left side of the hull and some are located at the stern of the ship. Many lifeboat materials are made of metal or wood but along with technological advances in the maritime field, lifeboats are made of *fiberglass*, where the material is strong, lightweight and resistant to any conditions or weather. However, this does not mean that the lifeboat does not require optimal maintenance, many things from the lifeboat part need special attention and require good maintenance in accordance with the applicable maintenance procedure standards.

Maintenance is a series of activities that must be carried out on all main components and supporting components in the lifeboat to keep all parts of the lifeboat in good condition and can operate optimally according to their function.

Based on the Regulation of the Crew Service (PDAK) of PT Pelni article 13 regarding the duties and responsibilities of Mualim III, namely the maintenance of safety equipment on board such as lifeboats, lifeboats, *life jackets* and *inflatable life rafts* in accordance with PMS (*Plan Maintenance System*) regulations) on board. Lifeboat maintenance is very important if at some point the ship is in an emergency and requires evacuation actions of people on board, the lifeboat will play a very important role in this situation, if maintenance is not carried out and has not received special attention, it will result in a malfunction in the operation of the lifeboat launch which results in endangering the entire *crew* and the people on board. This often happens, lifeboat maintenance is neglected and underestimated, so that when the lifeboat is needed it cannot be operated optimally.

The researcher has experience related to problems on board the ship for 12 months, on October 22, 2023 when an *abandon ship drill was carried out*  at Waingapu Port, the lifeboats could not be lowered because the supporting equipment for  *launching*  the lifeboats was *in trouble*, it was found that the wheels or *rollers* on the lifeboats did not move at all because they were squeezed by the block of the goddesses or *block davits* which has rusted and rusted, as well as many supporting components for *launching* lifeboats, have been corroded and fragile, making the process  *of launching* lifeboats hampered and taking a long time to lower the lifeboats. The lack of optimal maintenance on the lifeboats on board causes this to happen, so that it has an impact on the replacement of goods that are no longer suitable for use and have not received attention.

Based on the experience that has been experienced on board while carrying out sea practices, a research entitled Optimizing the Maintenance of Lifeboats in KM. Binaiya with Fishbone Analysis is interesting to do.

# METHOD > T.N Roman 11 Bold

The research method used is qualitative research. Sugiyono, (2021) stated that qualitative research is research by describing the situation factually using rational analysis techniques used as a guideline to focus research based on the actual conditionsA.

The type and source of data used is primary data obtained from original sources such as respondents and direct observations, secondary data can be in the form of documents and manuals on board. The data collection technique was carried out by collecting observation, interview and documentation data. Observation was carried out by directly observing the implementation of maintenance and checking of lifeboats on board and participating in the implementation of lifeboat *launches*. Interviews were conducted with several *crews*, namely Captain, Mualim I, Mualim III and Bosun. Documentation data was obtained in the form of photos, documents and manuals or literature on board that can support the accuracy of this research problem.

The data analysis technique used was *fishbone analysis* in the form of a diagram of fish bones, the snout of the head facing to the right as *an effect* and the bones of fish as *the cause* or causes of the problem topic. In this process, it can be categorized into several *causes*, namely *personal* factors, *material* factors, *method* factors and *environmental* factors. This research was carried out on the KM ship. Binaiya with *a passanger ship* type with *IMO number* 903216, the call sign YEVZ was made in 1994. This ship has a length of 99.8 meters, a width of 18 meters, a *gross tonnage* of 6,022 tons and a maximum draft of 4.20 meters***.***

# RESULTS AND DISCUSSION > T.N Romans 11 Bold

**Results**

**Data Analysis**

In the data analysis, *a fishbone analysis diagram*  in the form of a fish bone diagram was used to make it easier for researchers to find the factors that caused the failure of the lifeboat launch in KM. Binaiya, the supporting data used in compiling *the fishbone analysis* diagram comes from observation and interview data that has been obtained while carrying out research on the ship. The failure of the lifeboat launch occurred because many of the supporting components of the lifeboat launch were rusty and porous, this was found when directly observing the supporting components of the lifeboat *launch* such as *davit blocks, safety pins, wire falls, floating blocks* and retaining pens, there must even be one that needs to be changed. There are 4 factors that are obtained in influencing this, namely:

A diagram of a diagram

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Fig 1. Fishbone *Analysis Diagram*

The following is a detailed explanation of the influencing factors, namely:

1. Humans (*Staff*)

The *personal* factor is a factor that comes from a human or person involved in the process of the event. This factor refers to the *crew of*  the ship as an operator who is directly related to the maintenance and operation of the lifeboat at the time of the incident.

Table 1. Personnel Factor

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Statement | Yes | Not |
| 1. | *The crew deck* carries out routine and continuous maintenance of the lifeboat. |  | ✔ |
| 2. | The supervision and coordination between officers, bosun and *crew decks* in carrying out maintenance has gone well. |  | ✔ |

Based on the results of observations and interviews, the discipline of the ship's *crew* in the implementation of lifeboat maintenance on board is very important, especially in Mualim III who has responsibility for the condition of the lifeboats on board. Discipline in carrying out responsibilities regarding lifeboat maintenance can be seen from the condition of the lifeboat that is poorly maintained, there are many supporting components for *launching* lifeboats that have been corroded and porous. Coordination between the mualim is not established, mualim II is the head of daily work who takes care of all parts of *the deck*, if you have seen signs of corrosion on the launching components of the lifeboat, it can be coordinated with mualim III to immediately carry out maintenance but this has not been done. Then, the lack of supervision by mualim I on the performance of Maulim III to conduct weekly and monthly inspections. Mualim I has not carried out direct supervision to check the condition of *the safety equipment* on board, especially the lifeboats, whether they are in accordance with reports and conditions in the field.

1. Material

Material factors are factors derived from the material or object being studied. This refers to the lifeboats and supporting components for *launching* lifeboats on board.

Table 2. Material Factors

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Statement | Yes | Not |
| 1. | Damage to the lifeboat *launch* support components can affect the lifeboat *launch* failure . | ✔ |  |
| 2. | The large number of lifeboats can affect the maximum maintenance of lifeboats and supporting components for *launching* lifeboats. | ✔ |  |

One of the causes of lifeboat launching failure is damage to lifeboat *launching* supporting components such as goddesses or *davits blocks* that are rusty and porous, besides that *safety pins*, *floating blocks*, *wire falls*, and anchors as supporting components can also affect the smooth *launch* lifeboat. The condition of the goddesses was curved and cropos so that they squeezed the wheels or *rollers* on the lifeboats, finally the lifeboat got stuck and could not be lowered. The large number of lifeboats in KM. Binaiya is 8 lifeboats and each lifeboat of course has its own goddesses and has other supporting components for *launching* lifeboats. This can also affect suboptimal maintenance because with a large number of lifeboats and a relatively fast corrosion process with inadequate maintenance working hours, it can make lifeboat materials and goddesses less maintenance.

1. Method

The *method* factor is a factor derived from the procedure, process or way of working carried out in the maintenance of a lifeboat.

Table 3. Method Factor

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Statement | Yes | Not |
| 1. | The implementation of lifeboat maintenance is carried out in accordance with the SOPs on board. |  | ✔ |
| 2. | SOPs for the maintenance of lifeboats are important to be carried out regularly and continuously. | ✔ |  |

Based on the results of interviews and observations in the field, the implementation of lifeboat maintenance has not been carried out in accordance with the ship's SOPs. The responsibility for the maintenance of the lifeboat lies with the mualim III assisted by the bosun, and  *the daily deck crew*. The implementation of lifeboat maintenance includes weekly maintenance such as cleaning the hull of the lifeboat, applying *grease* to *the wire falls* and *roll reep* inspection of the goddess-goddess block, props, hand pumps and rigging equipment. The application  *of oil seal winch*, *ball* and *roller bearings* on the brake equipment must be in good and optimal condition. Monthly maintenance includes periodic inspection of *phyrotechnic* equipment, draining of *water supply* and replacement. Then periodic inspections such as *phyrotechnic conditions*, *drinking water*, *hand fire extinguisher* and inspection of the *canopy* contained in the type of lifeboat on the KM ship. Binaiya is *a partially enclosed space*, so inspections of the *canopy* must be carried out periodically to ensure there are no leaks or tears. The maintenance of lifeboats has not been carried out sequentially and regularly while many lifeboats require special care and attention, even though there are standard regulations on board but the implementation in the field has not been carried out properly.

1. Environment

Environmental factors are environmental factors that can affect the lifeboats and supporting components of launching lifeboats directly.

Table 4. Environmental Factors

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Statement | Yes | Not |
| 1. | Corrosion and porosity in the support components of lifeboat launches are affected by extreme weather. | ✔ |  |
| 2. | Corrosion and corrosion in the supporting components of the lifeboat launch are affected by seawater. | ✔ |  |

In the observations that have been made, environmental factors greatly affect the condition of the supporting components of the launching lifeboat. All supporting components of the lifeboat descent are made of iron, if the iron is outdoors, exposed to direct sunlight, hit by erratic weather and even exposed to seawater containing chloride ions continuously, causing the iron to quickly corrode. Seawater contains chloride ions called sodium chloride (NaCl), these ions will increase their conductivity, accelerating the electrochemical reaction between iron and the environment so that corrosion occurs faster. If the condition of *the block davit* and other supporting components of  *the lifeboat launch* is left in a dirty, dusty condition and exposed to seawater continuously, corrosion will occur quickly.

Discussion

1. **The implementation of lifeboat maintenance carried out at KM. Stuttgart**

The results of the research that have been carried out have found that the condition of lifeboat goddess number 5 has been damaged and porous, other supporting components such as *wire falls, floating blocks, safety pins* and retaining pens have also been rusted. Based on the data on board, the following is a table of maintenance of lifeboats in KM. Binaiya :

Table 5. Lifeboat Maintenance Table

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PT. INDONESIAN NATIONAL SHIPPING (Persero)**  **SAFETY MANAGEMENT** | | | | | | | | |  | | | |
| **INSPECTION AND MAINTENANCE**  **LIFEBOATS, RESCUE BOATS AND THEIR EQUIPMENT**  (SOLAS Chapter III – Reg 20) | | | | | | | | | | | | | |
| **Ship Name**  **MILES. BINAIYA** | **Skipper**  **CAPT. ANSAR HAMJA** | | | | **K.K.M**  **KHAIRUL** | | | | | **OCTOBER 2023 PEL. MAKASSAR** | | | |
| **LIFEBOAT/RESCUE BOAT** | **1** | **2** | **3** | **4** | | **5** | **6** | **7** | **8** | | **9** | **10** | **11** | | **12** |
| **Equipment** | **A = Maintained , B = Unmaintained , C = Less , D = Damaged/Expired** | | | | | | | | | | | | |
| Deck/Lifeboat Squad Field |  |  |  |  | |  |  |  |  | |  |  |  | |  |
| 1. Lifeboat (hull) section  Inside and outside | A | A | B | B | | B | A | B | B | |  |  |  | |  |
| 2. Goddess | A | B | B | B | | D | A | B | B | |  |  |  | |  |
| 3. Blocks on the goddesses | A | B | B | B | | D | B | B | B | |  |  |  | |  |
| 4. Wire rope/lifeboat bar | B | A | A | B | | D | A | B | B | |  |  |  | |  |
| 5. Wire rope/bar lashing | B | A | B | B | | B | B | B | B | |  |  |  | |  |
| 6. Realize front/back block | A | B | B | B | | B | B | B | B | |  |  |  | |  |
| 7. Prop, hand pump | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 8. Portable class abs | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 9. Freshwater Tank | C | C | C | C | | C | C | C | C | |  |  |  | |  |
| 10. Seats are rescued | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 11. Manual/Emergency Steering | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 12. Lifeboat paddle | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 13. Block & Strap Prapat | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 14. Hand Pump | A | A | A | A | | A | A | A | A | |  |  |  | |  |
|  |  |  |  |  | |  |  |  |  | |  |  |  | |  |
| Engine/lifeboat squad field |  |  |  |  | |  |  |  |  | |  |  |  | |  |
| 1. Brake lining | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 2. Lifeboat Motor | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 3. Fuel & oil lubrication | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 4. Battery | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 5. Battery charges | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 6. Tools for engine lifeboat | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 7. Solar cell | B | B | B | B | | B | B | B | B | |  |  |  | |  |
| 8. Goddess LO tank | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 9. Lifeboat ankle | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 10. Star Charge | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 11. LO Filter | A | A | A | A | | A | A | A | A | |  |  |  | |  |
| 12. FO Filter | A | A | A | A | | A | A | A | A | |  |  |  | |  |

Information:

A = Maintained

B = Unmaintained

C = Less

D = Broken / *Expired*

The table above is a table of monthly lifeboats inspections based on *SOLAS Chapter III Regulation* 20, the inspection was carried out in October 2023, KM. Binaiya has 8 lifeboats, 4 in the right hull with even lifeboat numbers and 4 lifeboats in the left hull with odd number lifeboats. Judging from the information of the goddesses and the blocks of lifeboats number 1 and 6 predicate A = maintained, lifeboats number 2, 3, 4, 7, 8 predicate B = unmaintained, and lifeboat number 5 predicate D = damaged. As well as many supporting components for *launching* lifeboats such as *wire rope*, *wire lashing*, and *release block,* with the predicate B which means not maintained and lifeboat number 5 with the predicate D = damaged.

The following is the SOP (*Standard Operating Procedure*) on the KM ship. Binaiya, which must be carried out by mualim III in the maintenance of the lifeboat. It is stated in Part Two of Article 6 regarding the Maintenance of Lifeboats and Their Equipment:

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Fig 2. SOP (Standard Operating Procedure) KM. Stuttgart

Source : Personal Documents (2023)

Referring to the SOP above, the results of the realization of the implementation of lifeboat maintenance for lifeboats  *and support launching*  lifeboats on board the ship are as follows:

Table 6. Realization of Lifeboat Maintenance According to SOP on board

|  |  |  |  |
| --- | --- | --- | --- |
| **Maintenance Type** | **Routine** | **Infrequently** | **Never** |
| Lifeboat motors inspected and tested (every Saturday) | ✔ |  |  |
| *The hull* and inside of the lifeboat are cleaned (every 1 week) |  |  | ✔ |
| Check and clean *proofs*, hand pumps, and rigging equipment (every 1 week) |  |  | ✔ |
| Goddess blocks, seals, *release gear, wire reeps, roll reeps* are greased (every 1 week) |  |  | ✔ |
| Check lifeboat ropes, rope ladder ladders, lifeboat covers (every 1 week) |  | ✔ |  |
| *Brake Lining, oil seal winch, ball and roller bearings* on brake equipment checked (every 1 week) |  |  | ✔ |
| Inspection of all equipment, including *pyrotechnics* (every 2 months) |  | ✔ |  |
| The *water supply tank*  is drained and replaced new (every 1 month) |  |  | ✔ |
| Inspection of completeness and validity period of *food ration*, *pyrotechnic*, *drinking water* (periodically) | ✔ |  |  |
| Checking the condition and validity period *of the Hand Fire Extinguisher* (periodically) |  | ✔ |  |
| Check the *Canopy* (periodically) |  | ✔ |  |
| Request an item if there is damage, shortage, or expiration |  | ✔ |  |

Based on the table above, it can be concluded that the implementation of lifeboat maintenance has not been in accordance with the SOPs on the ship, namely on  *the hull* of the lifeboat, *proof*, hand pump, rope, dewi, *release gear*, *wire reep*, *roll reep*, *brake lining*, *oil seal winch*, *ball* and *roller bearing* In the brake device, *water supply* tank, this results in many lifeboats being rusted and porous so that  *the failure*  of the lifeboat launching occurs and cannot function optimally.

1. **The factors causing the failure of launching the lifeboat in KM. Stuttgart**

Based on the problems that the researcher found on board the ship and the results of observations and interviews that have been conducted, it was found that damage to *the davit blocks, safety pins, wire falls, floating blocks* and retaining pens was influenced by several factors that caused the failure of the lifeboat launch in KM. Binaiya. Overall, the factors that will be explained below, are related to each other so that they can create dangerous conditions, and ultimately result in the failure  *of the lifeboat* launch.

The following is a description of the factors that affect the failure  *of the*  lifeboat launch at KM. Binaiya :

1. Lack of discipline of the crew in maintaining the lifeboat.
2. Lack of supervision and coordination
3. Damage to  *lifeboat* launching components
4. The large number of lifeboats on board
5. The implementation of lifeboat maintenance is not in accordance with the SOP on board
6. Extreme weather and sea water
7. **Efforts to increase maintenance must be made to prevent lifeboat launching failures in KM. Binaiya.**

Based on the results of observations that have been carried out during the research and interviews obtained from several informants. To ensure shipping safety and prevent the recurrence of lifeboat launch failures, it is necessary to make efforts involving all related parties. Here are some explanations of the efforts made to improve the maintenance of lifeboats to prevent lifeboat launch failures:

1. Conducting *safety meetings* and training for crew members
2. The mualim, who is responsible for safety , directly controls the implementation of lifeboat maintenance.
3. Optimize and improve lifeboat maintenance.
4. Increasing the role of *the crew deck* in helping Mualim III
5. Carry out lifeboat maintenance in accordance with the SOP (*Standard Operating Procedure* ) on board

Carry out planning and improvements with priority scales in mind.

# CONCLUSION > T.N Roman 11 Bold

Researchers have made direct observations in the implementation of suboptimal lifeboat maintenance . Based on the results of the research that has been conducted and the discussion on "Optimizing the Maintenance of Lifeboats in KM. Binaiya with *Fishbone Analysis*" then the researcher can draw several conclusions as follows:

1. The implementation of lifeboat maintenance at KM. Binaiya has not been implemented according to the SOP (*Standard Operating Procedure* ). So that it failed to *launch* a lifeboat.
2. The failure of *launching* the KM lifeboat. Binaiya was caused by damage to the lifeboat's *launching* support components such as *block davits, wire falls, floating blocks, safety pins* and retaining pens that were rusted and cropos so that the lifeboat could not be *launched*. This is influenced by *the personal* factor of the  *ship's crew* discipline in carrying out lifeboat maintenance. Material factors include damage to the *launching components*  of the lifeboat and the large number of lifeboats on board. The factors *that led* to the implementation of lifeboat maintenance were not in accordance with the ship's SOPs. Environmental factors are influenced by the weather and seawater content resulting in rapid corrosion.
3. The efforts made are to conduct *a safety meeting* at the beginning of the voyage and training for all  *ship crews* regarding the maintenance and operation of the lifeboats and mualim who is responsible for safety and direct control in supervising the maintenance of the lifeboats. To prevent damage to the supporting components of the lifeboat launch, namely optimizing maintenance and increasing the role of the *crew deck* in helping mualim III carry out the maintenance of the lifeboat. In addition, the maintenance of lifeboats is carried out in accordance with SOPs. Weather has an effect in this case, therefore the planning and inspection of the lifeboat is done by considering the priority scale to achieve optimal results***.***

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