

Maintenance of the Lifeboat on Board the MV Jambo X

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Abstract.

Maritime accidents are still dominated by human error and suboptimal maintenance of safety equipment, making lifeboat readiness a crucial aspect of ship safety management. This study aims to analyze the lifeboat maintenance procedures on board the MV. Jambo X and evaluate their compliance with SOLAS and ISM Code provisions. The study used a qualitative descriptive approach with a single case study design. The population was all deck crew involved in lifeboat maintenance, with a purposively selected sample of the Captain, Second Officer, and Boatswain. Data were collected through semi-structured interviews, participant observation, and documentation, then analyzed using the Miles and Huberman model through data reduction, data presentation, and conclusion drawing. The results showed that lifeboat maintenance had been carried out systematically through the Safety Management System and Planned Maintenance System, with most components in good condition and ready for use. However, inconsistencies were found in operational testing and equipment placement due to operational constraints. In conclusion, the lifeboat maintenance system is generally effective and meets standards, but requires improvement in the consistency of implementation and equipment arrangement to strengthen emergency preparedness.

Keywords: *Lifeboat Maintenance, Maritime Safety, Planned Maintenance System, Safety Management System and SOLAS Compliance.*

I. INTRODUCTION

Ship accidents at sea continue to be a major concern in global shipping safety, given that approximately 75–90% of maritime incidents are caused by human error, such as navigational errors, cargo management, and non-compliance with operational procedures, which are exacerbated by technical and natural factors (Emzir, 2021; Rahman & Yusuf, 2023). In Indonesia, ship accident reports for the 2010–2020 period indicate that approximately 80% of cases are related to human negligence, poorly maintained safety equipment, and the effects of extreme weather, thus emphasizing the urgency of more comprehensive safety management, particularly in the maintenance of safety aids, which are the last line of defense in emergencies (Hasrianto, 2023; Center for Maritime Safety Research, 2024). In the global context, the Safety of Life at Sea (SOLAS) framework is continuously updated, including the 2009 SOLAS Amendments to Chapter III and resolution MSC.559(108) 2024, which strengthens the standards for lifeboat maintenance, thorough inspection, functional testing, overhaul, and maintenance of launching and ventilation equipment, while also requiring the role of a Planned Maintenance System (PMS) and maintenance certification by authorities (IMO, 2024; Safety4Sea, 2024).

Specifically, recent studies in Indonesia highlight the role of preventative lifeboat maintenance in ship safety management systems, showing that lifeboat engine and winch failures often arise from inconsistent maintenance programs, minimal documentation, and limited crew training (Farahidi et al., 2023; Wulandari et al., 2024). Analysis of lifeboat engine maintenance on commercial vessels revealed that scheduling conflicts with other maintenance activities and low PMS implementation lead to reduced equipment lifespan and functional readiness in emergencies, while studies of lifeboat winches confirmed that budgetary constraints, management oversight, and safety culture increase the risk of lifeboat launch system failure during ship abandonment (Anwar & Supriyadi, 2023; Maritime Safety Journal, 2026). However, most previous work has focused on specific technical components, such as the engine, davit, or winch, without integrating them into a comprehensive procedural framework linking company instructions, ship SOPs, and actual practice. Consequently, a consistent and measurable systematic overview of lifeboat maintenance procedures has not yet been established (Siwi, 2021; Pratama, 2021).

These discrepancies in findings demonstrate the limitations of the state of the art, which isolates

technical aspects from managerial, regulatory, and safety culture dimensions, even though Article 10 of the ISM Code explicitly requires that all ships and their equipment be maintained in a ready-to-use and optimally functional condition (IMO, 2002; Saatcioglu & Ozturk, 2022). In practice, the gap between regulatory text and field implementation is often evident in weekly visual inspections that are not followed by functional tests, postponed overhauls due to time and cost constraints, and minimal documentation, thus opening up a gap in understanding lifeboat maintenance procedures that are still fragmented and do not systematically map maintenance stages, crew responsibilities, and accountability mechanisms (Anwar & Supriyadi, 2023; Jurnal Keselamatan Pelayaran, 2024). Based on this gap, the problem statement of this research is formulated as follows: what are the lifeboat maintenance procedures implemented on board the MV. Jambo X, taking into account the obligations of the 2009 SOLAS Chapter III amendments, ISM Code Article 10 regulations, as well as operational conditions and characteristics of ship management in the Indonesian maritime context (Farahidi et al., 2023; Wulandari et al., 2024).

This study aims to systematically identify, describe, and analyze the lifeboat maintenance steps on the MV. Jambo X, starting from daily and weekly inspections, monthly and annual checks, to operational tests and overhauls, while evaluating the level of consistency of implementation with SOLAS, MSC.559(108), and ISM Code standards (IMO, 2024; Safety4Sea, 2024). Urgently, this research is important to support the strengthening of maritime risk management in the era of digitalization and globalization of shipping, considering that there are not many works that integrate technical, managerial, and regulatory aspects into a single empirical procedural framework for Indonesian commercial vessels (Maritime Safety Journal, 2026; Farahidi et al., 2023). The novelty of the research lies in the integrative approach of the case study that maps in detail the lifeboat maintenance procedures on the MV. Jambo X, while comparing it with the latest international standards, thus theoretically enriching the study of shipping safety management and ship maintenance systems, and practically providing a basis for improving SOPs, crew training, and evaluating company policies to reduce the risk of safety equipment failure and prevent loss of life in emergency conditions (Wulandari et al., 2024; Optimization of Lifeboat Maintenance, Journal of Applied Marine Safety, 2024).

II. METHOD

This study uses a qualitative descriptive approach with a single case study design to uncover the lifeboat maintenance procedures on board the MV. Jambo X in the context of compliance with SOLAS and the ISM Code, because qualitative methods allow for a holistic, contextual, and in-depth understanding of the phenomenon of safety equipment maintenance through words, language, and field practices (Moleong, 2017; Emzir, 2021), while also being relevant to the focus on processes, organizational dynamics, and subjective interpretations of actors on board (Sugiyono, 2018; Creswell & Poth, 2023).

The study was conducted on board the MV. Jambo X during a sailing practice on the Ketapang–Gilimanuk Port route in 2024–2025, allowing lifeboat maintenance activities to be observed in a real operational context. The population consisted of all deck crew involved in lifeboat maintenance, such as the Captain, Second Officer, Boatswain, and deck officers, selected through purposive sampling with the following criteria: having direct responsibility for lifeboat maintenance, at least one year of experience on the same ship, and willingness to provide information (Creswell, 2013; Reinartz et al., 2022).

As the primary instrument, the study used semi-structured interviews with the Captain, Second Officer, and Boatswain to explore perceptions, policies, practices, and challenges of lifeboat maintenance (Emzir, 2021; Wulandari et al., 2024), supported by participant observation during routine maintenance activities and documentation of daily logs, checklists, company SOPs, inspection reports, and SOLAS Chapter III regulations (Sugiyono, 2018; Yusuf, 2014). These three instruments reinforced each other, thus fulfilling the principle of qualitative data triangulation (Sugiyono, 2018; Creswell & Poth, 2023).

The research procedure began with a preparatory phase, which included obtaining research permits, developing interview guidelines and observation checklists, and adapting the questionnaire to the latest regulations (Sugiyono, 2018; Hartono, 2022). In the field phase, researchers participated in on-site practice for 12 months, observing each lifeboat maintenance session, recording the process, and conducting

interviews according to the operational schedule, while maintaining a participant-observer position to understand the context of the maintenance practice without disrupting normal operations (Yusuf, 2014; Hartono, 2022). The collected data were reviewed periodically to ensure the richness of the information and the consistency of the findings.

Data analysis was conducted following the Miles and Huberman (1992) model, which includes data reduction, data presentation, and conclusion drawing/verification, using a qualitative thematic approach (Sugiyono, 2018; Miles et al., 2020). Data reduction was carried out by filtering, coding, and grouping interview transcripts, observation notes, and documents into main themes such as daily, monthly, and annual procedures, documentation management, and management involvement, then presented in a structured narrative and thematic tables to facilitate pattern identification (Sugiyono, 2018; Miles et al., 2020). Conclusions were linked back to the research problem formulation and objectives to provide a detailed explanation of the execution of care procedures and their consistency with international standards (Miles et al., 2020; Wulandari et al., 2024).

Ethical considerations were implemented by obtaining verbal and written informed consent from all informants, maintaining the confidentiality of informant identities and vessel names when necessary, and ensuring data was used solely for academic purposes (Creswell & Poth, 2023; Emzir, 2021). The research was conducted in accordance with research ethics guidelines at the educational institution and ethical clearance was obtained prior to the fieldwork phase. Data were stored in a structured and secure manner, both digitally and physically, to maintain the confidentiality and integrity of information throughout the research and publication.

III. RESULTS AND DISCUSSION

Data Presentation

1. Observation Results



Fig. 1. Certificate of Inspection of the MV. Jambo X Lifeboat

Source: Ship Documents (2025)

The lifeboat maintenance procedures on the MV. Jambo X follow the international SOLAS (Safety of Life at Sea) standards and IMO guidelines which include routine checks to ensure emergency readiness as follows:

- Routine checks (daily/weekly), namely ensuring that the lifeboat has not suffered any physical damage, the lifeboat body (hull) is clean, and the lashing (fasteners) are installed and the grease is not dry.
- Monthly maintenance, namely carrying out a full functional check, including checking the steering system and fuel equipment, checking that the launching system (davit) is functioning properly.
- Periodic maintenance and drills, namely the lifeboat is lowered into the water and operated/run to ensure operational function readiness.

The following are the data and observation results that researchers have obtained after conducting several observations which will be used as research material:

Observer Name : Najwa Aulia Ramadhani

Date : September 10, 2024

Start Time : 09.00 LT

Finish Time : 10.00 LT

Location : BaliStrait

Table 1. Monthly Maintenance Observation Sheet for Lifeboats

| No | Aspect Observed | Observation Indicators | Observation Results | Compliance | Information |
|-----|--------------------------------------|---|---|------------------------------|--|
| 1. | Position and placement of lifeboats | Lifeboats are positioned according to the ship's design and SOLAS provisions. | The lifeboat is in its designated position | In accordance | Easy and safe access |
| 2. | Condition of the lifeboat hull | There are no cracks, leaks or structural damage | Stomach in good condition | In accordance | - |
| 3. | Lifeboat cover system | The cover can be opened and closed normally | Works fine | In accordance | - |
| 4. | Lifeboat launch rope | Not worn, broken or damaged | Good condition | In accordance | No wear found |
| 5. | Hook and release system | No rust, can work normally | Functioning normally | In accordance | Lubricate regularly every week |
| 6. | System davit | There is no rust or mechanical damage. | Condition suitable for use | In accordance | - |
| 7. | lifeboat engine | The machine can be started and operates normally. | The engine starts and functions properly when run for 10 minutes. | In accordance | - |
| 8. | Engine fuel | The quantity and condition of fuel is sufficient | Fuel available | In accordance | - |
| 9. | Lifeboat engine oil | Oil volume and condition | Oil within normal usage limits | In accordance | Replaced as scheduled |
| 10. | Engine starter system | Starter works during testing | Normal starter | In accordance | - |
| 11. | Safety equipment | Life jackets, paddles, ropes, available and suitable | Life jackets were not in the lifeboat, other equipment was fit for use. | Not quite right | The number is as per the provisions, life jackets are in the passenger compartment storage |
| 12. | Emergency rations and drinking water | Sufficient quantity and not expired | Still worthy | In accordance | Periodic check date |
| 13. | Lowering the lifeboat | The lifeboat was lowered to the waterline | The lifeboat was not lowered | It is not in accordance with | Busy ship operating hours |
| 14. | Maintenance report | Reported on the PMS checklist | PMS is filled routinely at each treatment | In accordance | - |

Source: Researcher Data (2025)

Based on observations of the monthly maintenance of the MV Jambo X lifeboats conducted in September 2024 in the Bali Strait, findings warrant attention. Safety equipment, including life jackets, was not placed in the lifeboats, despite the required number and being stored in the passenger compartment. Furthermore, the procedure for lowering the lifeboats to the waterline was not followed, citing the ship's busy operational schedule. Both findings have the potential to impact the lifeboats' preparedness in an emergency.

| No | Aspect Observed | Observation Indicators | Observation Results | Compliance | Information |
|-----|--------------------------------------|--|---|------------------------------|--|
| | system | testing | | | |
| 11. | Safety equipment | Life jackets, paddles, ropes, available and suitable | Life jackets were not in the lifeboat, other equipment was fit for use. | Not quite right | The number is as per the provisions, life jackets are in the passenger compartment storage |
| 12. | Emergency rations and drinking water | Sufficient quantity and not expired | Still worthy | In accordance | Periodic check date |
| 13. | Lowering the lifeboat | The lifeboat was lowered to the waterline | The lifeboat was not lowered | It is not in accordance with | Busy ship operating hours |
| 14. | Maintenance report | Reported on the PMS checklist | PMS is filled routinely at each treatment | In accordance | - |

Source: Researcher Data (2025)

Based on the results of the Monthly Maintenance observation of lifeboats carried out in January 2025 in the Bali Strait area, it was found that most of the lifeboat components and systems were in good condition and in accordance with applicable provisions, especially regarding the placement of lifeboats, hull conditions, closing systems, launching ropes, hooks and release systems, davit systems, fuel availability, engine oil conditions, emergency rations, and maintenance reporting through the Planned Maintenance System (PMS).



Fig. 3. Body Maintenance Check List

Source: Ship Documents

Figure 3 shows that the main components are stated to be in good condition and do not require replacement or repair of supporting equipment aspects, including hand pumps and other equipment, the inspection results also show good condition with no record of the need for repair or replacement of spare parts. There is no information about damage or non-conformity listed in the remarks column, which indicates that all items inspected have met inspection standards.

Observer Name : Najwa Aulia Ramadhani

Date : April 1, 2025

Start Time : 09.00 LT

Finish Time: 11.30 LT

Location : BaliStrait

Table 3. Monthly Maintenance Observation Sheet for Lifeboats

| No | Aspect Observed | Observation Indicators | Observation Results | Compliance | Information |
|----|-------------------------------------|---|--|---------------|----------------------|
| 1. | Position and placement of lifeboats | Lifeboats are positioned according to the ship's design and SOLAS provisions. | The lifeboat is in its designated position | In accordance | Easy and safe access |
| 2. | Condition of the lifeboat hull | There are no cracks, leaks or structural | Stomach in good condition | In accordance | - |

| No | Aspect Observed | Observation Indicators | Observation Results | Compliance | Information |
|-----|--------------------------------------|--|---|-----------------|--|
| | | damage | | | |
| 3. | Lifeboat cover system | The cover can be opened and closed normally | Works fine | In accordance | - |
| 4. | Lifeboat launch rope | Not worn, broken or damaged | Good condition | In accordance | No wear found |
| 5. | Hook and release system | No rust, can work normally | Functioning normally | In accordance | Lubricate regularly every week |
| 6. | System davit | There is no rust or mechanical damage. | Condition suitable for use | In accordance | |
| 7. | lifeboat engine | The machine can be started and operates normally. | The engine is turned on | In accordance | Engine running while in water |
| 8. | Engine fuel | The quantity and condition of fuel is sufficient | Fuel available | In accordance | - |
| 9. | Lifeboat engine oil | Oil volume and condition | Oil within normal limits | In accordance | Replaced as scheduled |
| 10. | Engine starter system | Starter works during testing | Starter is running | In accordance | There are no problems while running |
| 11. | Safety equipment | Life jackets, paddles, ropes, available and suitable | Life jackets were not in the lifeboat, other equipment was fit for use. | Not quite right | The number is as per the provisions, life jackets are in the passenger compartment storage |
| 12. | Emergency rations and drinking water | Sufficient quantity and not expired | Still worthy | In accordance | Periodic check date |
| 13. | Lowering the lifeboat | The lifeboat was lowered to the waterline | The lifeboat was lowered to the waterline | In accordance | To find out the obstacles due to docking |
| 14. | Maintenance report | Reported on the PMS checklist | PMS is equipped | In accordance | The report is being checked because it will undergo docking. |

Source: Researcher Data (2025)

Based on the results of monthly maintenance observations conducted in April 2025, it was found that functional testing of the lifeboats had been carried out optimally, indicated by the lifeboat engines being successfully started and operating normally while in the water, the starter system functioning smoothly, and the lifeboats being lowered to the waterline. This indicates a significant improvement in the operational readiness of the lifeboats, particularly as part of the ship's preparation for docking.



Fig. 4. Engine Maintenance Check List

Source: Ship Documents

The engine system inspection results showed that the engine was in good general condition, with the volume and quality of engine oil and clutch oil still meeting operational standards. The fuel oil tank and fuel oil pipe showed no leaks or damage, thus deemed safe for use, while the cooling system—consisting of a fresh water cooler, cooling water pump, fresh water pump, and sea water pump—functioned normally without any indication of problems. In the electrical system, the battery was in good condition and ready to use, as were the search light, generator belt, and electrical cables operating normally without damage or wear, and navigation lights such as the compass light were declared to be functioning properly. Overall, no items were found that required repair or component replacement (part exchange).

Interview Results

1. Information obtained from the answers of source 1 (Captain):

Based on an interview with Informant 1, namely Captain Roemi of the MV. Jambo X ship on September 14, 2024 in the ship's Navigation Room, the lifeboat maintenance procedure is carried out in a planned and systematic manner based on the company's Safety Management System (SMS) and SOLAS provisions, with the aim of ensuring the lifeboat is always ready for use in an emergency. Maintenance includes checking the physical condition of the lifeboat, davit, lifeboat engine, and the completeness of safety equipment which is carried out routinely daily and weekly by the deck crew, as well as monthly and annual maintenance supervised by the relevant officers. Each activity is carried out following the company's checklist so that no components are missed and can be properly documented. In addition, the ship implements an integrated recording and reporting system through the Planned Maintenance System (PMS) which is recorded on the date of each inspection activity, and the ship's log book as evidence of the implementation of maintenance according to procedures, and is used as internal evaluation material and supporting documents during inspections by the company, auditors, and surveyors of the relevant authorities.

2. The results of the information obtained from the answers of source 2 (Second Officer):

Based on the results of an interview with Informant 2, namely Second Officer Bambang on the MV. Jambo X ship on August 8, 2024 in the ship's Navigation Room, routine inspections of lifeboats were carried out periodically and structured according to ship safety procedures. The inspection included the physical condition of the lifeboat (hull, lifeboat cover, and safety rope), the launching system (davit) which includes wire, brakes, and release hooks, as well as the lifeboat engine which was checked in terms of fuel, oil, and Starter to ensure reliability in an emergency. In addition, the completeness of safety equipment in the lifeboat, such as life jackets, oars, fire extinguishers, emergency rations, and drinking water, was also checked routinely for quantity and physical condition.

The informant added that lifeboat drills were conducted routinely according to schedule to train the crew in lifeboat lowering procedures, engine operation, and emergency task allocation. Lifeboat maintenance was supervised by the Chief Officer through scheduling, providing direction, and checking maintenance results to ensure compliance with the company's Safety Management System (SMS) and shipping safety regulations. Overall, the interview on August 8, 2024, indicated that routine inspections, drills, and supervision of lifeboat maintenance on the MV. Jambo X had been carried out in a structured and continuous manner, reflecting the strong commitment of management and crew to maintaining the readiness of lifeboats as the primary means of saving lives.

3. The results of the information obtained from the answers of source 3 (boatswain):

Based on the results of an interview with Informant 3, namely Bosun Sugi on board the MV. Jambo X, the lowering of lifeboats is not always carried out during every monthly maintenance activity, but is adjusted to the ship's operational schedule and ongoing conditions. When the ship is in busy operating conditions or situations that do not allow such as limited berthing time or safety considerations, the lowering of lifeboats can be postponed, but the postponement is always officially recorded in the Planned Maintenance System (PMS) as a form of documentation and accountability in accordance with the ship's safety management system. The main obstacles faced in lifeboat maintenance, according to Bosun, are time constraints due to busy operational schedules and unfavorable weather conditions, such as strong winds and high waves, which hinder the implementation of maintenance, especially those involving the lowering of lifeboats. Nevertheless, every maintenance activity carried out or delayed is still well documented to ensure

compliance with maintenance procedures and facilitate future evaluation. From the Bosun's point of view, the maintenance of lifeboats plays a very important role in the safety of the ship and the entire crew, because lifeboats are the main means of saving lives when an emergency occurs at sea, so that negligence in their maintenance can have fatal consequences if the lifeboat fails to function when needed.

Data analysis

1. Source Triangulation

Table 4. Source Triangulation

| No | Focus | Informant 1 | Informant 2 | Informant 3 | Interpretation |
|----|---|--|--|--|---|
| 1. | Lifeboat maintenance procedures | Captain Roemi stated that lifeboat maintenance was carried out in accordance with the company's Safety Management System (SMS) and referred to SOLAS provisions as international safety standards. | Second Bambang stated that routine inspections cover the physical condition of the lifeboats, davits, engines, and safety equipment. The inspections are conducted in accordance with ship safety procedures and applicable operational standards. | Boatswain Sugi stated that maintenance continues to follow established procedures despite operational constraints. | All three informants shared the similarity that lifeboat maintenance is based on a safety management system and maritime safety regulations. Lifeboat maintenance procedures are carried out systematically in accordance with SMS, SOLAS, and PMS. |
| 2. | Routine lifeboat inspection | Captain Roemi stated that the inspection carried out included a physical inspection of the lifeboat, davit system, lifeboat engine, and the completeness of the safety equipment in the lifeboat. | Second Bambang explained in detail the inspection of the hull, lifeboat cover, safety rope, launching system (wire, brake, hook), lifeboat engine, fuel, oil, starter, and safety equipment. | Boatswain Sugi said that maintenance was still carried out in accordance with applicable technical procedures despite the limitations of operational conditions. | Information between informants complements each other, where the Second Officer explains technical details, while the Captain and Bosun emphasize the implementation of procedures in general. |
| 3. | Frequency and implementation of maintenance | Captain Roemi said that treatment is carried out daily, weekly, monthly, and yearly according to the PMS schedule. | Second Bambang stated that inspections are carried out routinely and periodically as part of the ship's safety system. | Boatswain Sugi said that not all activities (such as lowering lifeboats) could always be carried out due to the busy operational conditions of the ship. | There is agreement that maintenance is routine and scheduled, but field implementation is adjusted to the operational conditions of the ship. |
| 4. | Operational testing of lifeboats | Captain Roemi stated the importance of ensuring lifeboats are always ready for use in emergencies through routine maintenance. | Second Bambang explained that there was a drill on using lifeboats, including lowering the lifeboats and operating the engines. | Boatswain Sugi explained that lowering the lifeboats cannot always be done every monthly maintenance. | There is agreement that operational testing is important, but its implementation is flexible according to the condition of the ship. |
| 5. | Maintenance recording and monitoring | Captain Roemi explained that all maintenance | Second Bambang stated that after the maintenance was | Boatswain Sugi stated that if maintenance or | These three statements demonstrate that a |

| No | Focus | Informant 1 | Informant 2 | Informant 3 | Interpretation |
|----|--|--|---|--|--|
| | system | activities recorded in the Planned Maintenance System (PMS), maintenance checklists, and the ship's logbook. This record-keeping is essential for internal evaluations and inspections by the company and surveyors. | are completed, the work results were immediately recorded in the PMS and reported to the duty officer or Chief Officer for verification. | lowering of lifeboats cannot be carried out as scheduled, it will be recorded in the PMS along with the reason for the delay so that it remains well documented. | documentation system is a crucial part of ship safety management. It serves not only as evidence of work but also as a monitoring and evaluation tool to ensure maintenance remains under control despite operational constraints. |
| 6. | Obstacles in lifeboat maintenance | Captain Roemi emphasized that lifeboats are rarely lowered into the water so the percentage of successful use in an emergency is low. | Second Bambang stated that the ship's operational density makes it impossible to carry out intensive maintenance. | Boatswain Sugi stated that the main obstacles were limited operational time for the ship and weather conditions. | The three informants indicated that the constraints were operational and technical in nature but could still be controlled through the maintenance management system. |
| 7. | The importance of lifeboat maintenance | Captain Roemi agreed that lifeboat maintenance was very important to ensure that the lifeboats were always ready to use in an emergency. | Second Bambang agreed that lifeboat maintenance is important to ensure that the lifeboat can function normally and optimally when needed. | Boatswain Sugi agreed that lifeboats are the main tool for saving lives so they must always be ready for use. | All informants had the same perception that lifeboat maintenance plays a vital role in the safety of lives on board ships. |

Source: Processed researcher data (2026)

Based on the results of interview data triangulation, there is consistency and mutual reinforcement between the three informants regarding the implementation of lifeboat maintenance on the MV. Jambo X. Informants 1, 2, and 3 agreed that maintenance was carried out based on the company's Safety Management System (SMS), SOLAS provisions, and was formally recorded in the Planned Maintenance System (PMS) and logbook, so that the safety system runs in a structured and documented manner. The technical aspects of lifeboat inspections including the hull, structure, davit, engine, and completeness of safety equipment also show continuity between policies, supervision by officers, and field practices. Weather constraints and tight operational schedules, which were emphasized more by Informant 3, did not cause contradictions because all activities and delays were recorded as a form of accountability. Thus, the interview data was declared valid and credible because it had fulfilled the principle of source triangulation through comparison of information from various roles in the ship's organization.

2. Engineering Triangulation

Table 5. Triangulation Techniques

| No | Main Theme | Observation and Documentation Results | Interview Results | Conclusion |
|----|---|---|--|---|
| 1. | Implementation of lifeboat maintenance procedures | Direct observations on board the ship revealed that the lifeboats were maintained according to standards. This was evident in the maintenance checklists, lifeboat inspection certificates, and routine maintenance recorded in the | The captain explained that all lifeboat maintenance is carried out in accordance with the company's SMS and SOLAS regulations. | Observation and interview data mutually support the fact that lifeboat maintenance on ships is not carried out haphazardly, but has become a planned work system. |

| No | Main Theme | Observation and Documentation Results | Interview Results | Conclusion |
|----|---|---|--|---|
| | | PMS. Overall, the lifeboats were well-maintained, clean, and ready for use. | Maintenance focuses not only on administration but also includes thorough technical and operational inspections under the supervision of officers. | |
| 2. | Physical condition and suitability of lifeboat components | The observation results showed that the lifeboat hull was in good condition, there were no cracks, the closing system was normal, the launching rope was not worn, the hook and davit were functioning well, and most components were free from rust. | The Second Officer explained that a physical inspection of the lifeboat is a top priority because even minor damage can affect its function in an emergency. The inspection includes the hull, lifeboat cover, safety lines, and launching system. | There was a strong agreement between actual field conditions and the crew's explanations. This indicates that the physical inspection procedures were actually implemented consistently, not simply as a documentation formality. |
| 3. | Lifeboat engine maintenance and readiness | In the September 2024 and April 2025 observations the lifeboat engine was tested and was functioning normally, but in January 2025 the engine and starter were not tested so the actual condition cannot be ascertained. | The Second Officer explained that the engine check must include fuel, oil, and starter so that the engine can be used immediately in an emergency. | While engine maintenance was generally performed, there were inconsistencies at certain times. This suggests that ship operational factors could have influenced the implementation of the full engine test. |
| 4. | Completeness of lifeboat safety equipment | Observations showed that safety equipment was complete and fit for use, but life jackets were not placed in the lifeboats, but were stored in the passenger compartment. | The Second Officer stated that safety equipment must be fully available in the lifeboat to support the evacuation and survival of the crew. | There are differences between ideal conditions according to procedures and actual conditions in the field. This indicates operational adjustments are necessary, but it still has the potential to impact response speed in an emergency. |
| 5. | Implementation of lowering lifeboats and drills | Observations indicate that lifeboats are not always lowered, particularly during busy operational times. However, in April 2025, lifeboats were lowered as part of docking preparations. | The Bosun explained that lifeboat lowering could be delayed if operational or weather conditions prevented it, but it would still be recorded in the PMS. The Second Officer also stated that drills were conducted routinely as scheduled. | Data shows that lifeboat training and deployment remain a priority, yet flexible to field conditions. This demonstrates a balance between safety and the ship's operational demands. |
| 6. | Maintenance recording and documentation system | Observations showed that the PMS checklist was consistently completed and no items requiring repair or | The Captain and Bosun emphasized that every maintenance | There is strong consistency between the documents and field practices. This |

| No | Main Theme | Observation and Documentation Results | Interview Results | Conclusion |
|----|---|--|--|---|
| | | part exchange were found. All maintenance was properly recorded. | activity is recorded in the PMS and logbook as a form of control and proof of compliance with regulations. | demonstrates that the documentation system is operating effectively as a tool for control, evaluation, and safety audit evidence. |
| 7. | Obstacles in implementing lifeboat maintenance | Observations showed several discrepancies such as the failure to lower lifeboats or test engines at certain times due to busy ship operations. | The Bosun explained that the main obstacles stemmed from the ship's busy operational schedule and bad weather factors that limited certain maintenance activities. | Triangulation results indicate that the challenges were not due to negligence, but rather operational factors. However, good time management is still necessary to prevent excessive delays in critical care. |
| 8. | Level of readiness of lifeboats as the main safety tool | Observations indicate that the lifeboats are generally in good working order, with a significant improvement in April 2025 when all functional tests were carried out. | All informants emphasized that lifeboats are the primary means of saving lives and must therefore always be ready for use. | Overall, the lifeboats were well prepared. Despite some minor deficiencies, the maintenance system demonstrated a strong commitment to the safety of life on board. |

Source: Processed researcher data (2026)

In terms of maintenance and readiness of the lifeboat engine, observations indicate that the engine functioned normally during tests in September 2024 and April 2025, but no engine and starter tests were conducted in January 2025, making their actual condition unverifiable. Based on the Second Officer's statement, the engine inspection should have included fuel, oil, and starter checks, thus indicating that general engine maintenance was in place, although there were inconsistencies at certain times due to ship operational factors.

Regarding lifeboat lowering and drills, observations indicate that lifeboat lowering is not always carried out when the operational schedule is busy, but in April 2025 the lifeboat lowering was carried out as part of the docking preparation, while the Bosun explained that lowering can be postponed if operational or weather conditions do not permit, as long as it is still recorded in the PMS. The Second Officer emphasized that drills are still carried out routinely. This shows that the implementation of exercises and lifeboat lowering remains a priority, but is carried out flexibly by considering safety and operational needs.

The main obstacles to lifeboat maintenance, such as delays in lowering lifeboats or testing engines at certain times, were identified through observation and explained by the Bosun as being due to the intensity of ship activities and unfavorable weather conditions. Triangulation results indicated that these obstacles were external, not negligence, but still required improved time management to prevent excessive delays in critical maintenance. Overall, the results of technical triangulation between observation, documentation, and interviews showed high data consistency and indicated that the lifeboat maintenance system on the MV. Jambo X had been running in a structured manner, although there were some minor discrepancies due to operational factors.

IV. DISCUSSION

The discussion in this chapter is based on the results of data analysis regarding the implementation of lifeboat maintenance on board the MV. Jambo X, by examining its compliance with the principles of maritime safety and SOLAS provisions. The study shows that lifeboat maintenance has referred to the company's Safety Management System (SMS), supported by a maintenance checklist and Planned Maintenance System (PMS), so that it runs in a planned, systematic, and continuous manner according to the

principles of preventive maintenance. The division of tasks is also clear, with daily and weekly maintenance carried out by the deck crew, and monthly and annual maintenance supervised by the Chief Officer, which ensures quality control and minimal overlapping of responsibilities.

The observation results revealed that the technical inspection of the lifeboat was carried out routinely and thoroughly, covering the physical condition of the lifeboat, the launching system (davit, wire, brake, hook), the lifeboat engine, and the safety equipment inside, so that the technical readiness of the lifeboat was generally in good condition and ready for use in an emergency. However, in the equipment aspect, partial discrepancies were found, namely that life jackets were not stored in the lifeboat but in the passenger compartment, thus potentially slowing down evacuation in emergency conditions that require quick access. Lifeboat engine maintenance was carried out periodically, although in very busy operational conditions the engine testing was not always optimal, but in general the engine condition was still recorded as good in the PMS.

In terms of the documentation system, all lifeboat maintenance activities are recorded in the PMS, lifeboat maintenance checklist, and log book, which demonstrates the integration between technical and administrative maintenance as a means of monitoring, evaluation, and proof of compliance with procedures. The implementation of lifeboat drills is also carried out routinely to train the crew in lifeboat lowering procedures, engine operation, and task allocation, although they can be delayed due to weather or operational schedules, but the delays are still documented. Overall, the lifeboat maintenance system on the MV. Jambo X has been running well, but needs improvement, especially in the placement of safety equipment to strengthen the principle of emergency preparedness and maximize the level of safety during critical conditions.

V. CONCLUSION

This study shows that the maintenance of lifeboats on board the MV. Jambo X has been carried out in a structured and systematic manner with reference to the company's Safety Management System, SOLAS provisions, and supported by a Planned Maintenance System as a control and documentation tool. In general, the technical condition of the lifeboats, including the hull, davit system, engine, and emergency equipment are in good condition and ready for use. Daily, weekly, and monthly routine maintenance activities have been carried out consistently, supported by a clear division of tasks and officer supervision. However, several discrepancies were found, such as the failure to place life jackets in the lifeboats and the suboptimal implementation of lifeboat lowering and engine testing at certain times due to the ship's busy operations. This indicates a gap between ideal procedures and field practices, although overall lifeboat readiness remains in the good category.

This study has limitations due to its use of a single case study approach, which makes the results difficult to generalize to all ships with varying operational characteristics. It also relies on observational conditions influenced by ship schedules and weather factors. Therefore, further research is recommended to use a comparative approach across multiple vessels and integrate quantitative methods to more objectively measure maintenance effectiveness. Practically, the results of this study provide important implications for shipping companies to improve the consistency of drill implementation, ensure the completeness of safety equipment is installed according to standards, and strengthen time management to avoid delays in critical maintenance. Furthermore, improved crew training and oversight of PMS implementation are also needed to minimize the risk of lifeboat failure during emergencies.

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