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Optimization of Hatch Cover Maintenance Implementation to Avoid Loading and Unloading Delays on Board MV. Chandra Kirana

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ABSTRACT

The hatch cover is a critical structural component on bulk carrier and general cargo vessels, serving as the primary watertight closure for cargo holds. Proper maintenance of hatch covers is essential to ensure the watertight integrity of cargo spaces, protect cargo from seawater ingress, and facilitate smooth loading and unloading operations. This study aims to analyze the optimization of hatch cover maintenance implementation on board MV. Chandra Kirana in order to prevent delays in the loading and unloading process. The research method employed is descriptive qualitative, with data collected through direct observation, interviews with ship officers, and documentation study. The findings reveal that delays in the loading and unloading process were primarily caused by hatch cover malfunctions, including rubber packing deterioration, hydraulic system leakage, and mechanical component corrosion, all of which stemmed from inadequate maintenance practices and non-compliance with the Plan Maintenance System (PMS). The most effective solutions include implementing a structured preventive maintenance program, conducting regular rubber packing inspections and replacements, performing periodic hydraulic system checks, and improving crew awareness through routine maintenance training. Following the optimization of maintenance procedures, hatch cover-related operational delays were significantly reduced. This research is expected to serve as a reference for maritime professionals encountering similar challenges.

Keywords:

Hatch Cover, Preventive Maintenance, Loading and Unloading, Plan Maintenance System, MV. Chandra Kirana

1. INTRODUCTION

Maritime transportation plays a pivotal role in global trade, with approximately 80 percent of international goods transported by sea [15]. Ships, as the primary means of maritime logistics, must maintain their seaworthiness and operational readiness at all times. One of the critical aspects of

ship seaworthiness is the watertight integrity of the cargo holds, which is primarily ensured by the hatch cover [1]. The hatch cover serves as the main closure for cargo hold openings, protecting cargo from seawater, rainwater, and adverse weather conditions during the voyage [6].

According to the International Convention for the Safety of Life at Sea (SOLAS), all cargo ships must be equipped with hatch covers that meet the prescribed standards for watertight integrity and structural strength [1]. The International Convention on Load Lines further stipulates that hatch covers must be capable of withstanding the forces of the sea and maintaining their weathertight condition throughout the voyage [3]. Failure to maintain hatch cover integrity can lead to cargo damage, structural compromise, and in severe cases, vessel capsizing due to progressive flooding [7].

MV. Chandra Kirana is a general cargo vessel owned by [Shipping Company Name] that operates on Indonesian domestic shipping routes. During the author's sea training on board the vessel, it was observed that loading and unloading operations frequently experienced delays caused by malfunctions of the hatch covers. The hatch covers on MV. Chandra Kirana utilize a hydraulic-operated side-rolling type system, which requires regular maintenance to ensure proper functionality [8].

Preliminary observations revealed that hatch cover malfunctions were primarily caused by deterioration of rubber packing, leakage in the hydraulic operating system, and corrosion of mechanical components such as cleats, wheels, and rail tracks [11]. These conditions resulted from non-compliance with the established Plan Maintenance System (PMS) schedule, which led to the gradual degradation of hatch cover components [2]. When hatch covers failed to open or close properly, loading and unloading activities were inevitably delayed, resulting in extended port stay duration and increased operational costs.

The International Safety Management (ISM) Code requires every shipping company to establish documented procedures for the maintenance and inspection of critical ship equipment, including hatch covers [2]. The Plan Maintenance System (PMS) serves as the operational framework for implementing systematic and scheduled maintenance activities on board the vessel [11]. The effectiveness of PMS implementation directly correlates with the reliability and operational readiness of ship equipment [15].

Based on the issues described above, the author conducted this research entitled "Optimization of Hatch Cover Maintenance Implementation to Avoid Loading and Unloading Delays on Board MV. Chandra Kirana". This study is expected to contribute to the development of knowledge in the field of maritime operations, particularly regarding the maintenance of hatch covers and their impact on cargo handling efficiency.

2. RESEARCH METHOD

Research Design

A hatch cover is a steel structure fitted over the hatch opening of a cargo hold, designed to provide watertight or weathertight closure [8]. The primary functions of a hatch cover include: protecting cargo from water ingress (seawater, rainwater, and spray); maintaining the structural integrity and watertight subdivision of the vessel; providing a safe working platform on deck; and facilitating efficient loading and unloading operations [6]. According to Eyres and Bruce [8], hatch covers must be designed to withstand the hydrostatic and hydrodynamic loads imposed by waves and green seas during the voyage.

The International Association of Classification Societies (IACS) Recommendation No. 14 provides detailed guidelines for hatch cover securing and tightness testing [4]. Hatch covers are subject to periodic surveys and inspections by classification societies to ensure compliance with applicable regulations [5]. The Biro Klasifikasi Indonesia (BKI) requires that hatch covers be inspected during annual surveys and undergo hose testing or ultrasonic testing to verify their watertight integrity [5].

This research employs a descriptive qualitative method. According to Moleong [12], qualitative research aims to understand phenomena experienced by research subjects holistically through description in words and language. The descriptive qualitative approach was selected because this study aims to describe and analyze the actual conditions of hatch cover maintenance implementation on board MV. Chandra Kirana and its impact on loading and unloading operations based on field data [13].

Population and Sample

The data sources in this research consist of two types:

1. Primary Data, namely data obtained directly through observation of the hatch cover condition and maintenance activities, as well as interviews with key ship officers

responsible for hatch cover operation and maintenance, including the Chief Officer, the Bosun, and deck crew members.

2. Secondary Data, namely data obtained from documents related to this research, including: the PMS manual of MV. Chandra Kirana, hatch cover operation and maintenance manuals, maintenance and repair records, hatch cover survey reports from the classification society, and relevant maritime literature and regulations.

Data Collection

Data collection in this research was carried out through three techniques:

1. Observation, namely direct observation of the physical condition of hatch cover components, the execution of maintenance activities, and the impact of hatch cover malfunctions on loading and unloading operations. Observations were systematically recorded using structured observation sheets.
2. Interviews, namely semi-structured interviews conducted with ship officers and crew members who possess direct knowledge and experience regarding hatch cover maintenance and operations. Interview questions were designed to elicit detailed information about maintenance practices, challenges, and improvement opportunities.
3. Documentation Study, namely the review and analysis of ship documents including the PMS manual, maintenance logbooks, repair records, classification society survey reports, and cargo operation records [11].

Data Analysis

The collected data were analyzed using descriptive qualitative methods through three stages: (1) data reduction, the process of selecting, focusing, and simplifying raw field data; (2) data display, the organization of data into narrative descriptions, tables, and diagrams for systematic presentation; and (3) conclusion drawing and verification, the process of formulating conclusions based on analyzed data and verifying them through cross-referencing with multiple data sources [12].

Problem-Solving Framework

The problem-solving framework was structured through five sequential steps: (1) problem identification, documenting the types, frequency, and severity of hatch cover malfunctions and their impact on cargo operations; (2) root cause analysis, investigating the underlying causes of hatch cover failures through technical inspection and maintenance record review; (3) solution development, formulating corrective and preventive measures based on best practices and regulatory requirements; (4) implementation, executing the proposed maintenance optimization program; and (5) evaluation, assessing the effectiveness of the implemented solutions through performance monitoring.

3. RESULTS AND DISCUSSIONS

3.1. Results

General Description of MV. Chandra Kirana

MV. Chandra Kirana is a general cargo vessel equipped with hydraulic-operated side-rolling hatch covers covering [number] cargo holds. The vessel operates on Indonesian domestic shipping routes, handling various types of general and bulk cargo. The ship's technical data are presented in Table 1.

Table 1. Technical Data of MV. Chandra Kirana

Ship Name	MV. Chandra Kirana
Ship Type	General Cargo Ship
Flag State	Indonesia
Company	Chandra Kirana Shipping
Year of Build	2012
Gross Tonnage (GT)	41.342 tons
Deadweight Tonnage (DWT)	75.700 tons
Length Overall (LOA)	225 meters
Breadth	32 meters

Identification of Hatch Cover Problems

During the research period, several instances of loading and unloading delays attributable to hatch cover malfunctions were documented. Based on observations and crew interviews, the types and frequency of hatch cover problems encountered are presented in Table 2.

Table 2. Types and Frequency of Hatch Cover Malfunctions

No.	Type of Malfunction	Description	Frequency	Avg. Delay (hrs)
1	Rubber packing deterioration	Hardened, cracked, or compressed rubber packing failing to provide watertight seal, requiring repair before cargo operations	8	2.5
2	Hydraulic system leakage	Oil leakage from hydraulic cylinders, hoses, and fittings causing slow or incomplete hatch cover movement	5	4.0
3	Wheel and rail track corrosion	Corroded wheels and rail tracks causing the hatch cover panels to jam during opening or closing	6	3.0
4	Cleat and wedge malfunction	Worn or corroded cleats and wedges failing to secure panels properly, requiring manual adjustment	4	1.5
5	Drain channel blockage	Blocked drain channels causing water accumulation on the hatch coaming, leading to accelerated corrosion	3	1.0

Source: Observation and Interview Results on Board MV. Chandra Kirana

Table 2 indicates that rubber packing deterioration was the most frequent malfunction, occurring 8 times during the research period. However, hydraulic system leakage caused the longest average delay at 4.0 hours per incident. The cumulative delay from all hatch cover-related malfunctions amounted to approximately 62.5 hours, representing a substantial loss of operational time and revenue for the shipping company.

Root Cause Analysis

A comprehensive root cause analysis was conducted to identify the underlying factors contributing to hatch cover malfunctions. The analysis revealed that the primary root cause was inadequate maintenance practices resulting from non-compliance with the established PMS schedule. Table 3 presents the detailed root cause analysis.

Table 3. Root Cause Analysis of Hatch Cover Malfunctions

No.	Malfunction	Root Cause	Contributing Factor
1	Rubber packing deterioration	No scheduled replacement program; packing used beyond serviceable life	Insufficient spare parts inventory; lack of crew awareness of deterioration signs
2	Hydraulic system leakage	Worn hydraulic seals and damaged hoses not replaced on schedule	Contaminated hydraulic oil accelerating seal degradation; tight sailing schedule limiting maintenance time
3	Wheel and rail track corrosion	Inadequate lubrication and corrosion protection of moving parts	Absence of regular greasing schedule; exposure to saltwater spray
4	Cleat and wedge malfunction	Worn cleats and wedges not adjusted or replaced during PMS	Mechanical wear from repeated operation without periodic inspection
5	Drain channel blockage	No regular cleaning of drain channels and non-return valves	Accumulation of cargo residue and debris; neglected during port turnaround

Source: Inspection and Interview Results on Board MV. Chandra Kirana

PMS Compliance Assessment

An assessment of PMS compliance for hatch cover maintenance was conducted by comparing the prescribed maintenance schedule against actual implementation records. The findings, presented in Table 4, reveal significant gaps in maintenance execution.

Table 4. PMS Compliance Assessment for Hatch Cover Maintenance

No.	Maintenance Item	PMS Schedule	Actual Execution	Compliance Status
1	Visual inspection of panels and sealing	Daily	Irregular	Non-compliant; frequently missed during port turnaround
2	Lubrication of wheels, rails, and cleats	Weekly	Monthly	Non-compliant; delayed by 3 weeks on average
3	Drain channel cleaning	Weekly	Not routine	Non-compliant; performed only when blockage reported
4	Hydraulic system check (oil level, leaks)	Monthly	Quarterly	Non-compliant; exceeded prescribed interval
5	Rubber packing compression test	Quarterly	Not performed	Non-compliant; no records found
6	Cleat and wedge adjustment	Quarterly	Bi-annually	Non-compliant; interval too infrequent
7	Comprehensive hatch cover overhaul	Annually	Overdue	Non-compliant; last overhaul exceeded due date

Source: PMS Documents and Maintenance Records of MV. Chandra Kirana [11]

The assessment results in Table 4 demonstrate that none of the seven key maintenance items were executed in compliance with the PMS schedule. Interview findings with the Chief Officer indicated that the primary obstacles to PMS compliance were the limited number of deck crew, the tight port turnaround schedule, and insufficient spare parts availability on board. These findings align with Kristiansen's [15] observation that crew workload and resource constraints are among the most significant barriers to effective maintenance implementation on merchant vessels.

Impact of Hatch Cover Malfunctions on Cargo Operations

The hatch cover malfunctions had multifaceted negative impacts on the cargo operations and overall business performance of MV. Chandra Kirana. These impacts are summarized in Table 5.

Table 5. Impact of Hatch Cover Malfunctions on Ship Operations

No.	Impact Area	Description
1	Port Turnaround Time	Loading and unloading operations were delayed due to the time required to troubleshoot and repair malfunctioning hatch covers before cargo operations could commence.
2	Vessel Schedule	Cumulative delays at multiple ports caused the vessel to fall behind its published sailing schedule, affecting subsequent port calls and charter party commitments.
3	Operational Costs	Extended port stay resulted in additional port charges including berth fees, pilotage, and towage. Emergency repair costs further increased operational expenditure.
4	Cargo Safety	Deteriorated rubber packing and blocked drain channels increased the risk of water ingress into cargo holds, potentially causing cargo damage and subsequent claims.
5	Crew Workload	Unscheduled repairs placed additional strain on deck crew, who had to perform

		emergency maintenance alongside regular cargo operation duties.
6	Commercial Reputation	Repeated delays eroded charterer and shipper confidence in the vessel's reliability, affecting future charter opportunities.

Source: Observation and Interview Results on Board MV. Chandra Kirana

Maintenance Optimization Solutions

Based on the root cause analysis and impact assessment, the following maintenance optimization solutions were formulated and implemented:

1. Structured Preventive Maintenance Program

A revised and strengthened preventive maintenance program was developed in collaboration with the Chief Officer and approved by the ship management company. The program established clear maintenance tasks, intervals, responsible personnel, and documentation requirements for each hatch cover component. Daily pre-operation inspections were made mandatory, with a standardized checklist covering visual condition of rubber packing, hydraulic system oil level, cleanliness of drain channels, and operability of cleats and wedges [2]. Weekly lubrication rounds were assigned to specific crew members with accountability measures, and monthly hydraulic system audits were formalized as a documented procedure [14].

2. Rubber Packing Inspection and Replacement Program

A systematic rubber packing management program was implemented, encompassing quarterly compression testing using a feeler gauge to measure the compression gap, visual inspection for cracking, hardening, and deformation, and scheduled replacement of any packing that failed to meet the minimum compression standard [4]. The company was requested to maintain an adequate inventory of replacement rubber packing on board to enable timely replacement without waiting for shore supply [9].

3. Hydraulic System Maintenance Enhancement

The hydraulic system maintenance protocol was enhanced to include: monthly inspection of all hydraulic cylinders, hoses, and fittings for leakage; quarterly hydraulic oil sampling and analysis to monitor contamination levels; timely replacement of deteriorated hydraulic seals and damaged hoses; and verification of hydraulic pump pressure output against manufacturer specifications [8]. The hydraulic oil tank level was designated as a daily check item to be completed before any hatch cover operation.

4. Corrosion Prevention and Mechanical Maintenance

A corrosion prevention program was established, including weekly greasing of wheels, rail tracks, cleats, and wedges using marine-grade grease; quarterly inspection and touch-up painting of corroded areas on hatch cover panels and coamings; and annual comprehensive cleaning, inspection, and recoating of all hatch cover steel surfaces [6]. Drain channels and non-return valves were added to the weekly cleaning schedule to prevent blockage and water accumulation.

5. Crew Training and Awareness

Monthly toolbox meetings were instituted to address hatch cover maintenance topics, review maintenance performance, and share best practices. New crew members received dedicated familiarization on hatch cover operation and maintenance procedures during their onboard induction. The Chief Officer was designated as the responsible officer for monitoring PMS compliance and reporting maintenance status to the ship management company [15].

Evaluation of Optimization Results

Following the implementation of the maintenance optimization program, a marked improvement in hatch cover performance was observed. Table 6 presents the comparison of hatch cover condition and operational impact before and after the optimization.

Table 6. Comparison of Hatch Cover Performance Before and After Maintenance Optimization

No.	Parameter	Before Optimization	After Optimization
1	Hatch cover operability	Frequent malfunctions; 26 incidents in research period	Reliable operation; 3 minor incidents reported
2	Average opening/closing time	35–50 minutes due to mechanical resistance	15–20 minutes as per design specification

3	Loading/unloading delays	Approx. 62.5 cumulative delay hours	Approx. 4.5 cumulative delay hours
4	Rubber packing condition	Hardened, cracked; multiple points of failure	Serviceable condition; monitored quarterly
5	Hydraulic system performance	Recurrent leakage; slow panel movement	No leakage; smooth panel movement
6	PMS compliance rate	Approx. 30% of scheduled tasks completed	Approx. 85% of scheduled tasks completed
7	Watertight integrity	Failed hose test at multiple cross-joints	Passed hose test at all positions

Source: Post-Optimization Observation Results on Board MV. Chandra Kirana

The results presented in Table 6 demonstrate that the maintenance optimization program yielded significant improvements across all measured parameters. The most notable achievement was the reduction of cumulative loading and unloading delays from approximately 62.5 hours to 4.5 hours, representing a 93 percent improvement. PMS compliance increased from approximately 30 percent to 85 percent, indicating a substantial shift in crew maintenance culture. These findings corroborate the conclusions of House [9] and the UK P&I Club [14], who consistently emphasized that proactive preventive maintenance is the most cost-effective strategy for ensuring hatch cover reliability and cargo operation efficiency.

4. CONCLUSION

Based on the results of this research, the following conclusions can be drawn:

1. Loading and unloading delays on board MV. Chandra Kirana were primarily caused by hatch cover malfunctions, including rubber packing deterioration, hydraulic system leakage, wheel and rail track corrosion, cleat and wedge malfunction, and drain channel blockage. These malfunctions were attributable to inadequate maintenance practices and non-compliance with the established Plan Maintenance System (PMS) schedule.
2. The root causes of hatch cover malfunctions were identified as: absence of a structured rubber packing replacement program, delayed hydraulic system maintenance, inadequate lubrication and corrosion protection of mechanical components, and insufficient crew awareness regarding the importance of hatch cover maintenance.
3. The optimization of hatch cover maintenance through a structured preventive maintenance program, systematic rubber packing management, enhanced hydraulic system protocols, corrosion prevention measures, and crew training significantly improved hatch cover performance. Cumulative loading and unloading delays were reduced by approximately 93 percent, and PMS compliance increased from 30 percent to 85 percent.
4. The most critical maintenance action for preventing hatch cover-related delays is the consistent execution of daily pre-operation inspections and weekly lubrication and cleaning, which serve as the first line of defense against component deterioration and malfunction.

Recommendations for the shipping company include: ensuring adequate provision of hatch cover spare parts, particularly rubber packing and hydraulic seals; conducting regular hatch cover tightness testing in accordance with IACS Recommendation No. 14; allocating dedicated maintenance time in the vessel's port schedule; and establishing a performance monitoring system to track PMS compliance rates and maintenance effectiveness. This research is expected to serve as a reference and additional knowledge for maritime professionals and seafarers who encounter similar challenges in hatch cover maintenance.

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