APPLICATION OF X BAND AND S BAND RADAR ON THE SHIP MV BULK CARRIER TO DETECT OBJECTS UNDER THE SURFACE OF THE SEA FOR SHIPPING SAFETY

Muhammad Ismail Chandra[1] , Dety Sutralinda[2] , Antony Dumanik[3]

[1] *Merchant Marine Polytechnic Surabaya, Jl. Gunung Anyar Lor No.1, Gunung. Anyar, District. Gunung. Anyar , Surabaya 60187, Indonesia*

ABSTRACT
Radio Detection And Ranging or often called RADAR is an electromagnetic wave system used to detect, measure, and find out objects and bad weather within a certain range as long as RADAR can reach it. The purpose of the study was to determine the cause of RADAR in MV. Bulk Carrier cannot detect an object below the surface of the water and To find out the benefits of optimizing X Band and S Band RADAR on MV ships. dear Bulk Carrier This type of research is qualitative descriptive research. This research was carried out on March 16, 2023 at PT. L… P… L… at MV Bulk Carrier The results of the study obtained that X band and S band radars have different capabilities in detecting objects below sea level. X band radars have a shorter detection range but higher resolution, making them more suitable for detecting small objects. S band radars have a longer detection range but lower resolution, making them more suitable for detecting large objects. The use of X band and S band radars on the MV Bulk Carrier is quite effective in detecting objects below sea level, such as corals, obstacles, and submarines. However, there are some obstacles faced, such as interference from sea waves and bad weather. The application of X band and S band radars on the MV Bulk Carrier ship can improve shipping safety by detecting objects below sea level. However, efforts need to be made to optimize its use to make it more effective.

KEYWORDS: X band radar, S band radar, subsurface object detection, shipping safety.

1. INTRODUCTION.

In the world of transportation, especially in the world of sea transportation, often when sailing in a channel or in the open sea where movement is not limited, the ship where I practice really needs navigation equipment in the hope that it can help while sailing for shipping safety. As far as I know, as a cadet at the Surabaya Shipping Polytechnic, the ship has several navigation tools used by the watch captain or other deck *officers* to assist in carrying out bridge watch duties such as GPS, ECDIS, AIS, and also including RADAR and ARPA.

RADAR plays a big role when a ship is sailing, especially in narrow shipping lanes with the aim of determining whether or not there are dangers around the ship. *Radio Detection And Ranging* or often called RADAR is an electromagnetic wave system that is used to detect, measure and identify objects and bad weather within a certain range as long as RADAR can reach it.

RADAR can detect nearby objects by emitting (Transmitter) radio waves and when the emitted radio waves hit an object, the waves will automatically reflect on the RADAR *Receiver* . After receiving these waves, RADAR will show where the object is and what objects have been detected, not only that but can detect the distance of the object and find out whether the object is moving or not.

There are 2 types of RADAR on board ships, namely X Band RADAR which has a frequency range of around 8.0 – 12.0 GHz and a wavelength of 2.5 – 3.75 cm in the RADAR has different wave propagation ranges to suit its use in detecting distant and close targets around the ship so that the ship can avoid existing dangers.

In accordance with the STWC 1978 provisions in section AI/12 of the STCW Code, however, even though it has been tested and officially has regulations that require every ship to have a RADAR on board, there are still times when electronic items experience *errors* , which is from my experience.

The incident that I experienced when sailing in the waters of *the Makassar Strait* , in fact the waters were safe, but considering the meteorological location of these waters is close to the island of Kalimantan which still has lots of forests and swamps plus coal mining which is increasingly widespread and resulting in land clearing and trees and swamp plants being carried away. to the sea.

The case that occurred when I was passing through these waters in the evening and raining where the RADAR was already in the active position and in accordance with *the Master Night Order* , we who were on the bridge during the watch felt that there was a hard object that hit/collided the ship MV. Bulk Carrier After carrying out an inspection It turned out that there was a log accompanied by swamp plants (Nipah plants) around it that had been hit by the ship's bulbous, causing the front of the ship to be damaged and scratched.

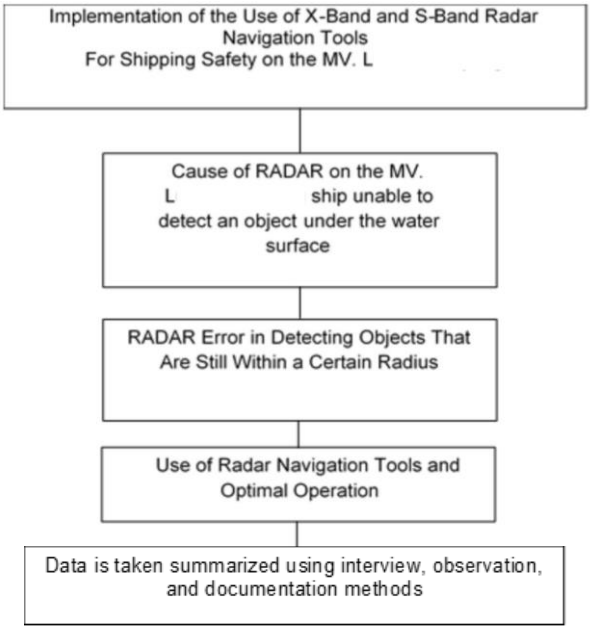
This incident forces us who are on guard duty to be alert to all objects around us and optimize all navigation equipment on the ship to support safety when the ship is sailing. From the description of the incident above, the author will discuss the title "Implementation of X Band and S Band Radar Onboard an MV . Bulk Carrier Dear To Detect Objects Below Sea Surface For Safety Voyage **”**.

2. MATERIALS/METHODOLOGY; EXPERIMENTAL PROCEDURE.

Research Framework

This writing has a framework that shows the flow and steps of writing such as the framework below:

Figure 1. Research Framework



Source: Personal

2.1. Types of research

This research was written using qualitative research methods. Qualitative research is descriptive and often uses analysis. In qualitative research, the emphasis is on process and meaning (subject perspective). The theoretical basis is used as a guide to ensure that the research focus is in accordance with the facts in the field, and also provides a general description of the research setting and discussion of research findings.

2.2. Research Location and Time

To obtain data related to the problems discussed in this paper, the author carried out research during marine practice (PRALA) precisely from March 4 2023 to August 7 2023 at the company PT. L… P… L… on one of the MV Bulk Carrier ships.

2.3. Data Sources and Data Collection Techniques

Data sources are anything that can provide information about related research. The data used in this research uses two types of data sources, namely primary data and secondary data.

According to Sugiyono (2018:456) Primary data is a data source that directly provides data to data collectors. Data is collected by the researcher himself directly from the first source or place where the research object is carried out. Researchers used the results of interviews obtained from informants regarding the research topic as primary data. According to Sugiyono (2018:456) secondary data is a data source that does not directly provide data to data collectors, for example through other people or through documents. In this research, the secondary data sources are in accordance with the Employment Law, books, journals, articles related to research topics regarding internal control systems for payroll systems and procedures in an effort to support labor cost efficiency.

study , the research informants were crew members on commercial ships used as a place to carry out maritime practices (PRALA). Data collection techniques used include interview techniques , observation techniques and documentation techniques.

An interview is a question and answer session with someone who needs to be asked for information or an opinion about something where the interviewer (*Interviewer*) asks questions to the interviewee (*interviewee*). This is done to evaluate the capabilities of the ship's crew in certain situations. Observation is a condition where direct observations are carried out by researchers in order to be better able to understand the context of the data in the entire social situation so that a holistic (comprehensive) view can be obtained (Sugiyono, 2020: 109). This technique is used in dealing with emergencies on board ships carried out by the ship's crew. Documentation is a method used to obtain data and information in the form of books, archives, documents, written numbers and images in the form of reports and information that can support research (Sugiyono, 2018:476). This technique is used to support or as evidence related to institutions and administration as well as in dealing with emergencies on ships and so on.

2.4. Data analysis technique

The presentation of this thesis writing can use descriptive analysis methods. Descriptive means describing in detail events in the field and putting them in written form starting from the emergence of a problem, until finding a solution to the problem.

Qualitative means collecting data that is narrative, descriptive and contains intensive field notes. The data that has been obtained is processed according to the theories and methods that have been determined from the start before carrying out data collection. The data that has been processed is then analyzed

according to the scientific discipline used. Based on the results of this analysis, discussions were then carried out until everything was finished, then questions related to the research could be confirmed and concluded through this research.

3. RESULTS AND DISCUSSION.

3.1 Overview and Location of Research

In this thesis the author will describe a general description of the research object according to the title, namely " Application of X Band and S Band Radar Onboard an MV . Bulk Carrier Dear To Detect Objects Below Sea Surface For Safety Voyage ". So, with a general description of this research, readers can understand and understand what happened when the author conducted research on the MV. Bulk Carrier which is owned by PT. L… P… L… .

The following is *the Ship Particular* MV. Dear Bulk Carrier :

Ship Particular

Ship Name	: Bulk Carrier DEAR
Vessel Type	: *Cargo*
Vessel Specific Type	: *Bulk Carrier*
IMO	: 9******
MMSI	: 5********
Call Sign	: Y****
DWT	: 82133
Year Built	: 20**
Managing Company	: N/A
Flag	: ID
Engine Type	: Kawasaki Heavy Industries l Motor l 6s60me-c8
GT	: 43361
KW	: N/A
Length	: 229 AD
Width	: 32 M

Figure 2. MV. Bulk Carrier Dear

Source: Personal Documents

3.2 Research result

A. Data Presentation

In presenting this data, it will be described using the results of observations and interview results which can be explained as follows.

a. Observation Results

1) On Tuesday, April 12 2023, at 16.45 WITA, when the ship sailed to Adang Bay to load, it was already in *Makassar Strait* . The ship experienced problems where the ship hit or collided with logs and palm trees and caused vibrations that were felt up to the bridge. This incident was very detrimental and worrying because it was feared that there would be a leak or fatal damage that would endanger the ship's cargo and crew, but at that time there was no leak or major damage to the front of the ship and the ship had almost arrived at its destination. Optimal and effective use of navigation tools must always be implemented to avoid fatal errors occurring in the future , due to the use of less effective navigation tools.
2) When the ship sailed towards *Adang Bay* , on April 12 2023, precisely at *Makassar Strait* at 16.45 the ship experienced a collision or hit a log and palm tree which caused vibrations that could be felt on the bridge, where the distance from the bow to the bridge at the stern was very far. up to 200 meters more. At that time the target was visible on *the Radar* but it only blinked or was not clear enough (appearing to disappear and disappearing) and the officer on duty only predicted that it was only a small object that was under the surface of the water but could still rise to the surface of the water (the object only floated and did not sink fully).
3) At that time the 2nd Officer who was still on the bridge and *the cadet* who was on guard duty went straight to the bow on the orders of *the Chief Officer* who was on the bridge to check whether there was a leak or not and what impact the incident had. Where at that time the ship was empty or had just finished unloading at PLTU Tanjung Wangi, and would be loading at Adang Bay. When inspected it turned out that the front of the ship had scratches and damage that was not too fatal which resulted in a leak, however, to minimize the occurrence of leaks, the 2nd captain informed the C/O to contact the bosun and bring a wrench to open *the Forecastle Ballast Tank Manhole* and enter to Check the condition of the inner plate if the impact occurred, whether it was damaged or not, fortunately there was no damage that caused the plate to be dented inward due to the impact. After carrying out careful and thorough observations and confirmation via radio with the bridge or C/O the ship was declared safe and only suffered minor damage and was still normal, where the vibrations felt from front to back occurred because the ship was empty and had no cargo, the dimensions of the hatch were Big and high are the main factors for continued vibrations. However, the lack of optimization of navigation tools, especially radar, can be detrimental to the ship's *crew* , cargo and company if a leak occurs on the ship.

Figure 3. MV. Bulk Carrier Dear

Source: Personal Documents

b. Interview result

From the results of interviews with respondent 1 (*Chief Officer*), respondent 2 (*Second Officer*), and respondent 3 (*Third Officer*), the author found that optimization of radar navigation tools still needs to be improved to minimize and avoid collisions, especially with relatively small objects and not only focuses on ships and *buoys* only.

1) The results of the interview with respondent 1, stated that the reason why ships can hit logs causing vibrations to the bridge is because the predicted C/O of wood or nipa palm plants is small and is only considered harmless marine debris, because our ship itself has large dimensions and is not will be affected but there will be prediction errors and less optimization of the use of navigation tools and circumnavigation.
2) The results of the interview with respondent 2, stated that the cause of the ship experiencing this incident was because the use and setting of the radar was not appropriate for the water conditions, the weather, and in the conditions of the evening or near night, where the radar should have been used more optimally and was able to detect the movement of objects. certain things which are actually difficult to detect, such as in this case where the object is floating and going up and down on the surface of the sea water, so that if it is detected by radar, the officer on duty can know that there is an object in front of the ship and can confirm it through direct observation whether the object is whether it is dangerous or not and what actions need to be taken, whether to avoid it or go through it safely.
3) The results of the interview with respondent 3 stated that the reason the ship experienced this incident was due to lack of preparation when carrying out guard duty and it was only considered a normal problem or radar *error* , so this incident occurred. However, less than optimal use of navigation tools also has an impact at that time, so the use of navigation tools must be optimized to avoid undesirable events.

B. Data analysis

The use of navigation tools in the world of shipping plays a very important role in having a positive impact on shipping safety and security, especially radar which is always used on any shipping route and anywhere.

However, there are several obstacles in using and optimizing radar on ships, therefore to help optimize it by providing procedures and SOPs for operating or maintaining radar on ships.

a. Many officers when carrying out guard duty still neglect to turn off and on the radar and do not follow the appropriate procedures, do not change the radar display to the zero position and still apply objects on the target and *range.* When they want to turn off the radar, they immediately turn it off without changing it to *range* 6 NM uses x-band and s-band radar, which means the radar navigation tool does not work optimally when it is turned on again and is long-term.
b. *False echo* radar interference occurs where more than one shadow of an object appears, in the radar layer where *the false echo* consists of:
    1) *Multiple echo* radar interference where the image of the target is split or biased into 2 with the same bearing, due to the strong *echo reflection power* and *the gain* being too large.
    2) *Indirect echo* radar interference where the image of a target in the opposite direction from the target is caused by reflections from the ship itself.
    3) *Side echo* radar interference, which causes false images that are influenced by strong side lobes.
c. When carrying out the watch handover, the author saw that the officer on watch often gave information about the surrounding situation and neglected to check the ship's position on ECDIS, AIS, especially on the x-band radar and s-band radar to carry out *performance tests* and did not *record it* in the *radar log book.* which is only done once, which can be 5-10 days before writing on the platform. This is very important because from this it can be seen and monitored that the operation of the radar is working optimally or requires repair, so that officers are aware of the deterioration in the condition of the radar they are operating.

Table 1. Data analysis

NO	Question	Resource Person's Answer
1.	What causes RADAR on MV ships? Bulk Carrier unfortunately, can't detect objects below the water surface?	Speaker 1 The reason the radar on the ship could not detect this object was due to an error in identifying it and the ship was empty Interviewee 2 So the radar at that time was not set to relative, so if the object was large and moving it would have a tail in the opposite direction to our ship Interviewee 3 This may be due to lack of preparation when carrying out observations and less than optimal use of radar
2.	How to optimize the use of X-Band and S-Band RADAR on MV ships. Bulk Carrier darling?	Speaker 1 Can see and ensure that when carrying out guard duty and operate correctly and as effectively as possible as well as more thorough observation Interviewee 2 Follow procedures and follow the radar manual correctly so that errors and accidents can be minimized Interviewee 3 Can be further improved in knowledge, use and operation of navigation tools and ensure more thoroughness

3.3 Discussion

Based on the results of observations and interviews with several *crew*, what the author obtained while carrying out practices on board the ship and produced supporting statements, namely:

1. Radar is an electronic navigation tool that is very influential and very helpful in the world of shipping, which is useful for determining and detecting the position of targets or ships from time to time on a regular basis. To determine the position of the target to be observed, you can use a stand or distance and setting is also very important to ensure that the target or object is moving or not. When operating the radar position at *head up* , so that the radar functions effectively and efficiently, it is not difficult to determine the position of the ship or objects in front of the ship, it is also very helpful when making observations to avoid whether or not there is a danger of collision. Then by looking at *the layers crt* or *Catode Ray Tube* which is shown on the radar layer which shows the strength of the reflection received, which will produce dots that show the surrounding conditions of bad weather, rain or existing objects and the denser the object, the clearer it will be shown on the x-radar screen band and s-band. Even

though the signal obtained is relatively small, it can be strengthened with radar, which is very helpful in the shipping process and ship operations safely and efficiently to get to the destination safely .

4. CONCLUSION.

Based on conclusions from facts and research on the application of x-band and s-band radar on board the MV. Bulk Carrier. To detect objects below sea level for shipping safety, researchers can draw the following conclusions:

1. The factors that cause x-band radar and s-band radar are not optimal and cannot detect objects below sea level, according to discussions and interviews with sources who knew at the time of the incident, it is known that the operation of radar navigation equipment must be careful and can operate and adjust x band radar and s band radar in every situation and be less careful about what dangers await when taking something that is considered normal for granted .
2. The lack of effective operation and use of the x band radar and s band radar navigation tools, which should be operated and observed while on guard duty and should not underestimate something that is observed, should always be ready and must understand in every situation what should be done and the use of the x-radar. and s-band which should be able to avoid unwanted events.

On this occasion, the researcher will provide several suggestions that may be useful and helpful to other people, other researchers, and also readers. The suggestions are as follows:

1. It is best when carrying out guard duty to at least check the operation of the x-band radar and s-band radar which should be checked and also the surrounding situation, optimizing the use of x-band radar and s-band radar must be carried out to find out what objects are ahead and around the ship to avoid objects or ships that have a risk of colliding with the ship.
2. Always carry out and carry out safety and prevention measures related to collisions with ships and other objects of a wild or unknown nature which should be avoided, and of course increasing the operation and optimization of x-band radar and s-band radar navigation equipment for ship crews and of course The application of rules must be optimized again, so that you don't just use *feeling* and *instinct* which always underestimates something and considers it normal.

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