Analysis of Collision Hazard Prevention With Operating Radar Ncd – 453 Type On MV Amrta Jaya 1

Slamet Prasetyo Sutrisno¹, Siti Nurlaili Tri Wahyuni² and David Ardiansyah³

Abstract
The navigation system is the key to the safety of the ship in carrying out the voyage. RADAR will be very useful during bad weather, foggy conditions and sailing at night, especially when navigational instructions such as beacons, buoys, hills or buildings cannot be visually observed. So prospective ship officers must understand and understand to use RADAR navigation tools. To find out the target position and reduce the accident rate in the shipping lane, the role of RADAR in supporting shipping safety is needed.

This study aims to analyze the prevention of collision hazards by using the Maneuvering Board in the operation of the Binocular RADAR at MV AMRTA JAYA 1. The type of research used in this study is quantitative research. In this case the data collection techniques used are documentation and observation. Documentation is in the form of searching for information in the form of books and documents, while observation is in the form of an approach to the object of research.

From the results of research conducted, it can be seen that the method used to calculate the RADAR Plotting Sheet can be done by theoretical methods with formulas and scale methods with mathematical logic. The two methods can be used with the same results but with different time efficiency. The use of muvering boards and RADAR Plotting Sheet calculations can help identify the presence or absence of a collision hazard, and help estimate the closest distance, time taken, course and speed of the target ship.

Keywords: Operation, Binocular RADAR, Maneuvering Board, Collusion

1. Introduction
The maritime sector is one sector that contributes greatly to the economy in Indonesia. Many companies provide services in the field of shipping, especially in the provision of sea transportation in the form of ships. Many ships are chosen as a means of distributing goods in large quantities, with various carrying capacities, ships are the choice for the distribution of goods both imported and exported. Shipping companies in addition to providing goods distribution services by ship also provide agency services for ships from other companies, one of which is PT Admiral Lines. PT Admiral Lines is a shipping company that has been established since 1966 and has been operating for 56 years. During its operation, PT Admiral Lines has served various industries to transport cargo and has become a trusted partner for cooperation with foreign companies such as ARPENI, DAIHATSU, SUZUKI, KLTL, NYK LINES, TOYOTA, and TFSI. Mostly for business cooperation, PT Admiral Lines has business partners from companies from Japan because PT Admiral Lines has been distributing a lot of goods to Japan for a long time. By implementing professional, customer-oriented, proactive and accountable business operations. PT Admiral Lines is located in Central Jakarta, precisely at Jalan Gunung Sahari No.79-80, Central Jakarta, operating from Monday to Friday from eight in the morning to four
in the afternoon.

PT Admiral Lines is owned by the Indonesian Navy Foundation and a member of the Indonesian National Shipowners Association (INSA). The company has obtained the ISM Code Compliance Document certificate and ISO 9001 Quality Management Certificate in 2015. PT Admiral Lines has several services in the shipping sector. The services provided by PT Admiral Lines are shipping agencies, accounting authorities, and General Cargo ships. These three services have been operating for more than 53 years, of course, it is not a short time to build a company.

The MV Amrta Jaya 1 ship is one of the ships belonging to PT Admiral Lines with the Indonesian-flagged General Cargo type, MV Amrta Jaya 1 made on April 12, 1984. The shape of the construction and equipment of the ship is still quite lagging, starting from the type of crane, shape accommodation, to navigation equipment on the bridge. With a fairly old age the ship is still feasible to operate.

By standard, the completeness of the navigation tools on the MV Amrta Jaya 1 is sufficient, although the age of the navigation tools is still quite old and requires careful maintenance to keep it durable and in good condition. Most of the navigation tools used are built-in navigation tools from the beginning of shipbuilding. Many of the navigation tools on the bridge come from and are made by Japan, which incidentally is the same as the country of origin of the MV Amrta Jaya 1 ship.

The navigation equipment used is still fully analog, unlike today's ships, which are all connected and connected, making it easier to find information through only one navigational device. Radio Detection And Ranging (RADAR) with the new model is connected with Automatic RADAR Plotting Aid (ARPA) which is able to calculate and estimate the threat of collision hazards easily. So that splash hazards can be avoided in accordance with the Regulations for Prevention of Collision Hazards at Sea (P2TL). The author is more focused on the description of the Binocular RADAR type NCD – 453 which will be the core of this research.

RADAR on MV Amrta Jaya 1 has a type and type that is very interesting to learn more about, the Japanese-made RADAR has been used since the beginning of the MV Amrta Jaya 1 ship produced with the type of RADAR Binoculars type NCD – 453 is a challenge for navigators to operate it to prevent collision hazard.

RADAR Binoculars type NCD – 453 is one type of RADAR with a fairly old age of manufacture, this RADAR has distinctive physical characteristics starting from its size which is quite large and its operation is still simple with analog buttons, and the RADAR screen is covered with binoculars. chimney-shaped. RADAR Binoculars type NCD – 453 has considerable consequences in its use, with the age of the RADAR which is fairly old and its use is still manual. The RADAR cannot provide information about:

a. Time to reach the Closest Point of Approach (TCPA)

b. Closest Point of Approach (CPA)

c. Object’s Bow
d. Object Speed
e. Aspect

This is a deficiency in the binocular RADAR model in the MV Amrta Jaya 1, because there can be a potential collision hazard, if not accompanied by good observations of the officers on duty, measures to prevent collision hazards have been regulated in the Regulations for Preventing Collisions at Sea (P2TL). Before that, it is necessary to find out how to solve these problems optimally, so the author gives the title to this research "AN ANALYSIS OF COLLISION HAZARDS PREVENTION WITH OPERATING RADAR TYPE OF NCD – 453 ON MV AMRTA JAYA 1."
2. Research Method
This study uses quantitative methods that focus on the calculation process of CPA, TCPA, object bow, object speed, and aspect. Sampling during sea practice, samples were taken based on the passing action carried out by the ship on January 5, 2022 at 19.30 LT, which was carried out from the data collected, namely the bearing of the object with the observer ship, the distance of the object with the observer ship, and the position of the object with the ship. The data collection tool used is the Binocular RADAR type NCD – 453. After the data is collected, data analysis is carried out using a maneuver board using two techniques, namely the large triangle technique and the small triangle technique in order to make comparisons of accuracy, comparison of the calculation process, and can a cross checking process is carried out to avoid calculation errors.

3. Results and Discussion
a. Overview of Research Objects
MV Amrta Jaya 1 has tools that are used to assist the duties and performance of officers in carrying out navigation activities, ships have different specifications and types of navigation tools depending on the period of manufacture and the place of manufacture. RADAR Binoculars type NCD – 453 is functionally the same as RADAR in general, serves to determine an object that is around the ship along with the distance of the object to the RADAR antenna, but in appearance RADAR Binoculars type NCD – 453 has a characteristic that is the presence of binoculars on the RADAR screen.

Table 1. Specifications of Binocular Radar Type NCD – 453 on the MV Amrta Jaya 1 ship

<table>
<thead>
<tr>
<th>TYPE AND TYPE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maker</td>
<td>Japan Radio Co.Ltd</td>
</tr>
<tr>
<td>Design Serial Number</td>
<td>R79003</td>
</tr>
<tr>
<td>Date design</td>
<td>February 23, 1979</td>
</tr>
<tr>
<td>Date assembly</td>
<td>March 1984</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DISPLAY UNIT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>NCD – 453</td>
</tr>
<tr>
<td>Serial Number</td>
<td>LK21990</td>
</tr>
</tbody>
</table>


b. Research Results
1) Data Presentation
The data was taken from the results of observations when the ship sailed on January 5, 2022, observations were made using the Binocular RADAR type NCD – 453 as a navigational aid, the data obtained were, among others.

Table 2. Data from the observation of the target ship with RADAR Binoculars type NCD – 453

<table>
<thead>
<tr>
<th>Observation data</th>
<th>Bearing data</th>
<th>Distance data</th>
<th>True bow data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target ship 1 (19.30 LT)</td>
<td>340 °</td>
<td>6.55 miles</td>
<td></td>
</tr>
<tr>
<td>Target ship 2 (19.42 LT)</td>
<td>345 °</td>
<td>5.12 miles</td>
<td></td>
</tr>
<tr>
<td>Observer ship</td>
<td>35 °</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2) Data Analysis
From the data that has been obtained, the analysis process can be carried out using a maneuver board to help calculate $CPA$, $TCPA$, object direction, object speed, and aspect. Analysis with the maneuver board can be done by two methods, namely the large triangle method and the small triangle method.

a) Great triangle method

$CPA$ calculation is done by drawing a perpendicular line to the relative motion line (RML), measuring the distance from the center of the circle to the point of intersection with the result 1.8 Nm. The target speed can be calculated with data in the form of time intervals and the distance from the first bearing target ($M_1$) to the second bearing distance ($M_2$). The top line is the scale, the middle line is the distance scale, and the bottom line is the nomogram speed scale and draw a line past that point to the speed description line, with the result 7.5 knots.

$TCPA$ time calculation, nomogram scale can be used, the point on the speed scale is drawn a line until it passes the distance scale point, at a distance of 4.5 Nm (distance from point $M_2$ and point $CPA$) with the result 36 minutes. The direction of the target can be determined by making a DRM (direct relative motion) line at the end of the bow line. The bow is 8 Nm, because the ship's speed is 8 Knots (8 mph). The DRM line was 7.5 miles long, due to the target ship's speed of 7.5 Knots (7.5 miles per hour). Draw a line from the center of the circle to the DRM point, so that it forms a triangle, the line is the line of the ship's bow, with a result of 87 degrees. Aspects can be created by drawing a second target bearing line and drawing the angle of that line with the target ship's bow line.
b) Little triangle method

Calculation of CPA can be easily done by drawing a line from the center of the circle until it intersects the line of relative movement. Forming an angle of 90° between the two lines, that's the closest point of approach jarak (CPA) with a yield of 1.8 Nm. TCPA can be calculated using the formula

\[
TCPA = \frac{NM_1 \times \text{time interval}}{M_1 \times M_2}
\]

\[
TCPA = \frac{4.5 \times 12}{1.5} = 3 \times 12 = 36 \text{ menit}
\]

The target course is calculated by knowing the point w or way another ship by using the calculation beside

Before calculating the target speed, the distance from point W to point M2 must first be calculated. Then the target speed can be calculated by the following formula

The aspect or angle formed by the target line with the final object bearing is:

\[
\text{Aspect} = 300° - 242° = 78° \text{ green}
\]

From the above calculation Based on the calculation of the aspect angle of 78° and the target ship is to the left of the observer ship, the observer ship will see a green light on the left hull of the target ship, this situation will be dangerous if it does not immediately make contact for the crossing maneuver, the target ship should cross the target ship at the stern, because the speed of the MV Amrta observer ship Jaya 1 is faster than the target ship. Crossing will occur at 20.18 LT

In order to prevent a collision hazard, one of the ships in a crossing situation must change course or reduce speed, according to Rule 15 of the Rules for Preventing Collision at Sea (P2TL). A ship that sees another ship on its starboard side must deviate if circumstances permit it to avoid crossing in front of another ship. A ship that sees another ship on its
starboard side avoids crossing in front of a ship that is looking at its starboard side. The following are some calculations that can be taken when taking action to prevent a collision hazard.

i) Turnaround for safer CPA distance

Draw a line from the point M₂ to the regular circle at a distance according to the provisions in this case 3 Nm. Then make a circle with the center of the point W that passes through the point M₁, draw a line from the point W to the point where the circle intersects the line at the point M₂. The following is a schematic of the maneuvering board, the predetermined CPA distance is 3 Nm the observer vessel must change course from 35° and change to 357°

ii) Speed change for safer CPA distance

Draw the object’s bearing point on the maneuvering board, then draw a line from point M₂ towards a regular circle 3 Nm apart. Then draw a line parallel to the first line through the point W, connecting the two lines with a line opposite the direction of the bow. Measure the length of the line from the first line to the point where it intersects the second line.

The distance obtained is 1.2 Nm, the distance of 1.2 Nm is the distance obtained within 12 minutes (interval of time the object moves). If
in 12 minutes the distance is 1.2 Nm, then in 60 minutes the distance is 6 Nm or 6 knots. This means that if the speed of the observer ship is changed to 6 knots, the CPA distance formed is 3 Nm.

iii) Target Turnaround to make CPAs safer

The change of course of the target can be analyzed by drawing point Y and point Z which are reflections of the first triangle. Then make a circle centered on the point, draw a line until it intersects the new relative motion line. Move the line to the center point to find the bearing of the new target course. The new target's bow changes to 65°.

iv) Change of Target Speed for Safer CPA

Measure the course of the target by using from point Y to the point where it intersects with the relative motion line. The distance of 1.6 Nm is the distance covered in 12 minutes. So, if the ship travels for 60 minutes, the distance traveled by the ship is 8 Nm, meaning that the target ship will move faster by 8 knots.
4. Closing

a. Conclusion

Based on the results of the research obtained regarding "ANALYSIS OF COLLISION HAZARDS WITH NCD - 453 TYPE RADAR OPERATING ON MV AMRTA JAYA 1" then there are conclusions that can be drawn as follows:

1) The role of RADAR on MV Amrta Jaya 1, especially Binocular RADAR Type NCD – 453 is
   a) Detecting objects around the ship
   b) Measuring object distance from ship
   c) Knowing the bearing of the object
   d) Generate data that can be processed into data on the maneuver board

2) The large triangle plotting technique has better accuracy than the small triangle plotting technique. This is because each sheet can only be used for one target. In addition, the large triangle technique also has another drawback, namely that this technique can only be used on plotting sheet paper.

3) The small triangle plotting technique has better advantages than the large triangle because this calculation does not have to use a plotting sheet. In addition, it can be used for more than one target and also small triangle calculations are the basis for ARPA calculations. Changes of course and speed are also easier to calculate and perform with the small triangle plotting technique.

b. Suggestion

After observing and discussing the ANALYSIS OF COLLISION HAZARDS WITH RADAR OPERATING TYPE NCD – 453 ON MV AMRTA JAYA 1 the authors provide the following suggestions:

1) Because RADAR plays an important role in shipping, it is advisable for the crew to have good skills regarding RADAR operating procedures, especially Binocular RADAR on MV Amrta Jaya 1. With these skills, it is hoped that the use of RADAR will be more optimal in preventing collision hazards.

2) The ship crew should observe or look out for the RADAR signal in order to detect objects around the ship and ensure the ship is on a safe path.

3) The author provides suggestions for upgrading the RADAR operating on the MV Amrta Jaya 1 ship to support the effectiveness and optimization of the performance of the navigation tools on board.

5. References

1) COLREG (2021) 'Convention on the International Regulations for Preventing Collisions at Sea (COLREG)', The Legal Order of the Oceans.


