FEBIMA

Vooruitgangstraat 56

B - 1210 Brussels

Belgium

Report 2020/005040

Report on the collision between

fv Z.575 – HEIN SENIOR and mv ACEROMAR

on August 3rd 2020

in the traffic separation scheme Terschelling - German Bight

near Schiermonnikoog

with material and structural damage to the vessels.

Federal Bureau for the Investigation of Maritime Accidents

Extract from European Directive 2009/18

(26) Since the aim of the technical safety investigation is the prevention of marine casualties and incidents, the conclusions and the safety recommendations should in no circumstances determine liability or apportion blame.

In view of the COVID-19 pandemic in 2020, and local rules and regulations to prevent the further spread of the virus, the investigators of the Federal Bureau for the Investigation of Maritime Accidents adhered to all legislation in vigour, which might have hampered certain investigative acts. Nevertheless, no efforts were spared to conduct the investigation, into the cause of the marine accident mentioned in this report, to the largest possible extent and conclusions were only drawn after very large consideration.

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4. GLOSSARY OF ABBREVIATIONS AND ACRONYMS

%	Percent
*'	Minute
°	Degree
AIS	Automatic Identification System
ARPA	Automatic Radar Plotting Aid
BFA	Barrier Failure Analysis
Bft	Beaufort
BVBA	Besloten Vennootschap met Beperkte Aansprakelijkheid (Limited Company)
C	Celsius
COLREG	Convention on the International Regulations for Preventing Collisions at Sea
CPA	Closest Point of Approach
E	East
Etc.	Etcetera
Fv	Fishing Vessel
GmbH &Co. KG	Gesellschaft mit beschränkter Haftung & Compagnie Kommanditgesellschaft
IMO	International Maritime Organization
Kg	Kilogram
kW	kiloWatt
L	Litre
Lbpp	Length Between Perpendiculars
LT	Local Time
M	Metres
Mv	Motor Vessel
N	North
Nm	nautical miles
NxW	North By West
PREVIS	Preventie van Arbeidsongevallen aan boord van Visserijschepen (Prevention of Occupational Accidents on board Fishing Vessels
PS	Portside
SB	Starboard
Sec	Seconds
SOG	Speed Over Ground
SOLAS	International Convention for the Safety Of Life At Sea
TCPA	Time to Closest Point of Approach
TSS	Traffic Separation Scheme
TT	Target Tracking
UTC	Universal Time Coordinated
VHF	Very High Frequency
W	West

5. MARINE CASUALTY INFORMATION

5.1 RESUME

Throughout this report all times are in Central European Summer Time which is UTC+2, unless specified.

On August 3rd 2020, at 04:02 hours, the Belgian flagged beam trawler Z.575- HEIN SENIOR collided with the Luxembourg flagged general cargo vessel mv ACEROMAR. The collision occured inside the traffic separation scheme Terschelling-German Bight, approximately 16nm NxW off the North Tower lighthouse on the isle of Schiermonnikoog.
Mv ACEROMAR was following the TSS in westerly direction and was heading towards the port of Rotterdam and fv Z.575-HEIN SENIOR was crossing the TSS in northerly direction on her way to fishing grounds near Denmark.

After the collision the mv ACEROMAR was damaged on PS, above the waterline, from for'd of the beam to the aft. Some side shell plating, deck plating, railing and bulwark was bent.
The hatch cover gantry crane was damaged by the PS derrick of fv. Z.575-HEIN SENIOR.

Fv Z.575-HEIN SENIOR was ripped open on her PS bow, above the anchor lock, over a length of approximately 5 metres.
The PS derrick of fv Z.575-HEIN SENIOR was smashed against the wheelhouse after it had hit mv ACEROMAR.

After contact with the Dutch Coast Guard, fv Z.575-HEIN SENIOR returned to her port of departure, Lauwersoog, and mv ACEROMAR continued her voyage to the port of Rotterdam.

5.2 CLASSIFICATION OF ACCIDENT

According to Resolution A.849(20) of the IMO Assembly of November 27th 1997, Code for the investigation of Marine Casualties and Incidents, a *serious marine casualty* means a marine casualty involving a fire, explosion, grounding, contact, heavy weather damage, ice damage, hull cracking suspected hull defect, etc., resulting in:

- structural damage rendering the ship unseaworthy, such as penetration of the hull underwater, immobilization of main engines, extensive accommodation damage etc.;
- or pollution (regardless of quantity);
- and/or a breakdown necessitating towage or shore assistance.

According this definition, the accident was classified as a

SERIOUS MARINE CASUALTY

5.3 ACCIDENT DETAILS

Time and date	August 03rd 2020, 04:00 hours LT ,UTC+2
Location	53° 45' 8 N 006° 04' 5 W 16nm NxW off the North Tower lighthouse on the isle of Schiermonnikoog
Persons on board mv ACEROMAR	8
Persons on board fv Z.575-HEIN SENIOR	4
Injured persons	0

6. SYNOPSYS

6.1 NARRATIVE

On Sunday August 3rd 2020, around 01:10 hours, beam trawler fv Z.575- HEIN SENIOR had left the port of Lauwersoog, in the Netherlands, bound for fishing in the eastern part of fishing area 4.b, as indicated in Figure 1.

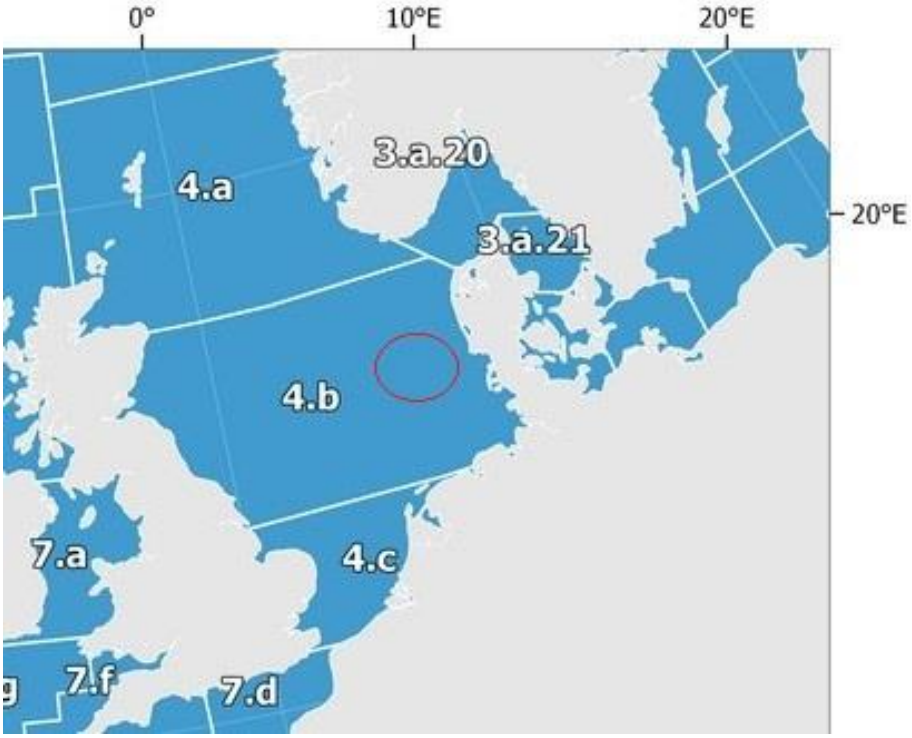


Figure 1 – Fishing area 4.b

Z.575-HEIN SENIOR was bound for the zone indicated in red.

The distance from the port of Lauwersoog to the fishing zone was about 100nm, which corresponded with approximately 10 hours sailing.

The derricks of fv Z.575-HEIN SENIOR were put at 45°, to increase the vessel's stability during sailing. Navigation lights and deck lights were switched on.

Fv Z.575-HEIN SENIOR sailed in convoy with fishing vessels SC.28-ORA ET LABORA, Z.41-ALBERT BOS and Z.189-CORNELIS GERRIT, as indicated in Figure 2.

The deck lighting of the fishing vessels was turned on.

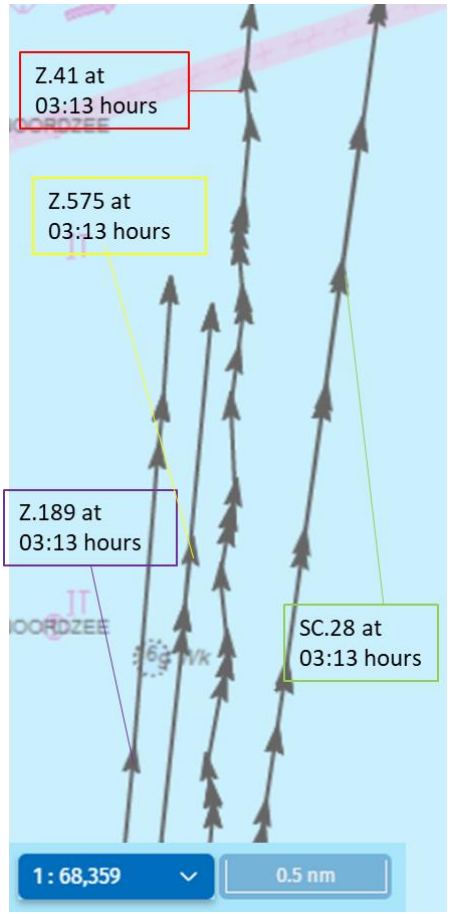


Figure 2 - Four fishing vessels sailing together, before entering the TSS

Once at sea, the head of the watch on board fv Z.575-HEIN SENIOR was alone in the wheelhouse. The other crewmembers went to bed.

Reportedly, the watchkeeper felt well rested and declared himself fit for duty. Prior to sailing the watchkeeper and the crew had had the weekend off and on Sunday afternoon, the watchkeeper had slept a few hours.

The sea was calm with good visibility.

The watchkeeper was sitting in the helmsman chair located in the back of the wheelhouse and had the autopilot switched on. Figure 3 shows where the helmsman chair was located.

The radar was set to a 12nm range, North -up, true motion. [1]The Bridge Navigational Watch System was set with a dormant period of 7 minutes. The VHF was stand-by on channels 16 and 06.

[1] More information about radar settings can be found in Annex 1 - Radar use

Figure 3 - Position of helmsman chair in the back of the wheelhouse

Mv ACEROMAR entered the TSS Terschelling-German Bight on Sunday, August 2nd around 22:00 hours and kept a course of 256° with a speed of approximately 9.5 knots, as indicated in

Figure 4 . Her navigation lights were switched on.

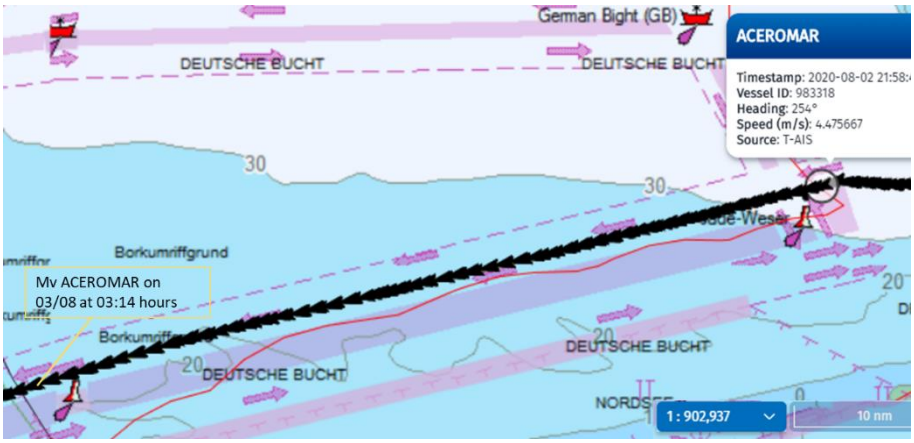


Figure 4 – Mv ACEROMAR sailing in the TSS

On Monday, August 3rd at 00:00 hours, the officer of watch was relieved.

The autopilot was activated, the radar was set to a range of 24nm, North -up, relative motion. The BNWAS was set at a dormant period of 3 minutes. The VHF was stand-by on channels 16 and 80[2].

Around 03:00 hours, mv ACEROMAR changed her course to 249°, following the slight bent in the TSS. Her speed was approximately 10,5 knots at that moment.

Some minutes later, the officer of watch noticed four fishing vessels on the radar entering the TSS. The fishing vessels were at a distance of approximately 10.5 nm and appeared to be crossing the TSS.

The CPA of the fishing vessels with the mv ARCEROMAR varied between 0.1 and 0.6 nm when entering the TSS. The TCPA was approximately 50 minutes.

Around 03:10 hours, the officer of watch started monitoring the fishing vessels on radar.

Fv Z.575- HEIN SENIOR entered the TSS around 03:25 hours, sailing a course of approximately 005° on automatic pilot with a speed of 9,5 knots.

Around 03:27 hours the first fishing vessel, Z.41-ALBERT BOS, started to cross the heading of the mv MANILA MAERSK, sailing in the inbound lane from the Atlantic Ocean. The officer of watch noticed that two fishing vessels altered course to cross the heading of the mv MANILA MAERSK with, from his point of view, an apparent small CPA as observed on his radar screen.

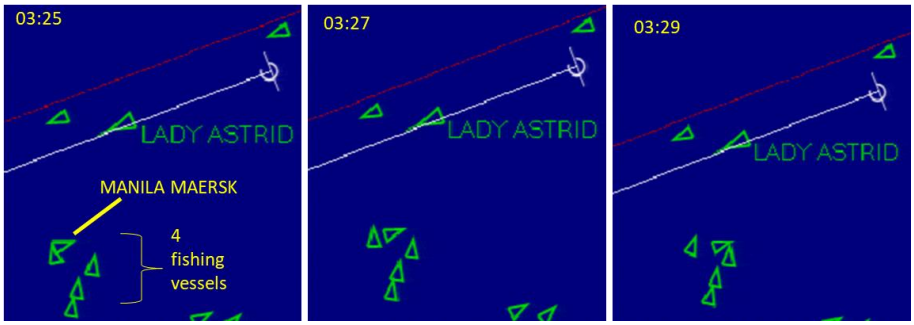


Figure 5 - Radar observation of four fishing vessels crossing the heading of the mv MANILA MAERSK

Mv ACEROMAR is represented by the white circle in the upper right corner in this figure. The radar was set to a range of 24nm, North up.

Fv Z.575-HEIN SENIOR did not alter course during the crossing of the TSS. She was well clear from mv MANILA MAERSK and she did not encounter any other vessels on her way.

[2] German Bight Traffic on VHF channel 80

At 03:43 hours fv SC.28-ORA ET LABORA, sailing in front of fishing vessels Z.575-HEIN SENIOR and Z.189-CORNELIS GERRIT, altered her course approximately 010° to SB.

Due to this alteration in course, fv SC.28-ORA ET LABORA was no longer crossing in front of mv ACEROMAR, but was passing 0,2 nm behind her.

At 03:50 hours, the officer of watch on board mv ACEROMAR had set the radar to a 6nm range and the radar indicated two *CPA/TCPA limit* alarms[3], one from fv Z.41-ALBERT BOS and one from fv SC.28-ORA ET LABORA, as indicated in Figure 6.

At 03:51 hours, a third alarm, from fv Z.575-HEIN SENIOR also appeared on the screen.

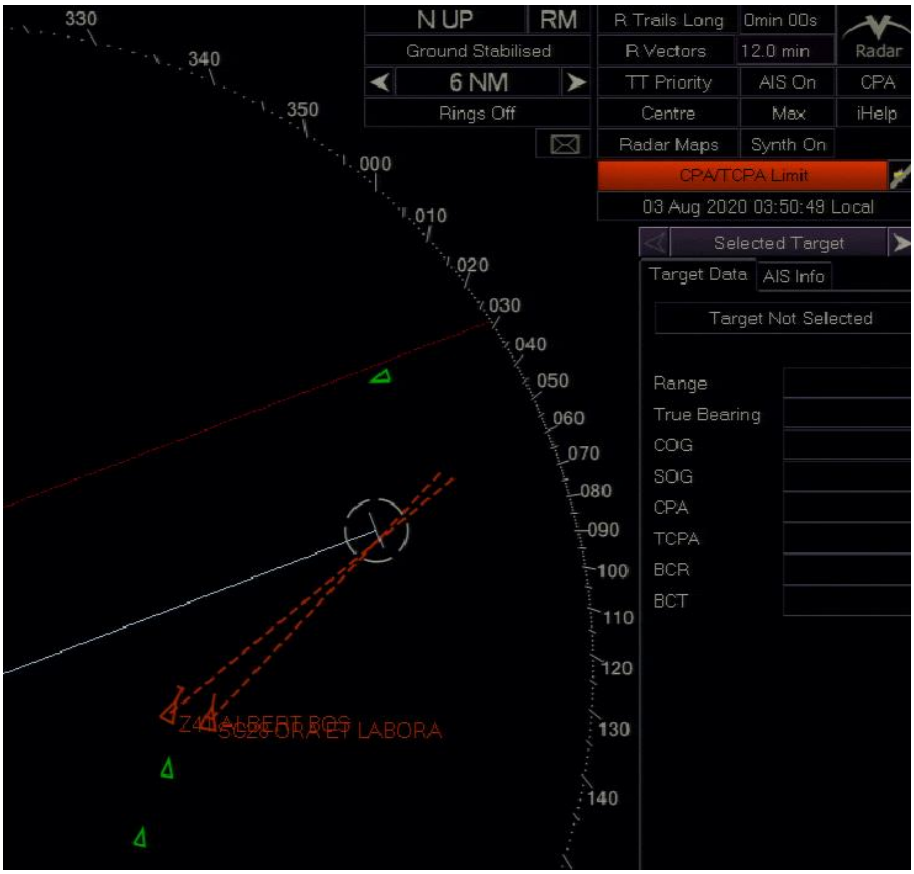


Figure 6 - CPA/TCPA limit alarm on radar on board mv ACEROMAR

At 03:52 hours fv Z.41-ALBERT BOS altered her course approximately 030° to PS in order to cross the track of mv ACEROMAR with a CPA of 0,4 nm.
This CPA no longer generated a *CPA/TCPA limit* alarm on board mv ACEROMAR.

[3] A CPA/TCPA limit alarm can be set on a radar to warn that a vessel will come too close within a certain timeframe. A CPA alarm set at 0.3 nm and a TCPA alarm set at 10 minutes will generate an alarm when a vessel will be at a distance of 0.3 nm or less within 10 minutes or less.

Fv Z.189-CORNELIS GERRIT was sailing behind fv Z.575-HEIN SENIOR and kept a course of approximately 006°. Small alterations in course of approximately 004° to PS and SB side were made continuously. Fv Z.189-CORNELIS GERRIT had a CPA with mv ACEROMAR of 0,3 nm and intended to pass behind mv ACEROMAR. At 03:54 hour, fv Z.189-CORNELIS GERRIT altered her course slowly towards 011° to keep clear from mv ACEROMAR.

Fv Z.575-HEIN SENIOR kept a course of approximately 005° that she was already following when she entered the TSS at 03:25 hours. Due to the use of the autopilot, there were continuously small alterations in course of approximately 002° to SB and PS. Fv Z.575-HEIN SENIOR had a CPA of approximately 0,05 nm with mv ACEROMAR.

Between 03:55 hours and 04:00 hours, the officer of the watch on board mv ACEROMAR noted that the CPA of fv Z.575-HEIN SENIOR had decreased to 0,00nm.

During the same time period, the officer ready to take over the watch at 04:00 hours had entered the wheelhouse. From that moment onward, two officers were present in the wheelhouse .

At 04:00 hours, the officer of the watch did not observe any manoeuvre by fv. Z.575 HEIN SENIOR and he realized that the fishing vessel would not be capable to avoid a collision.

At 04:00:50 hours, the horn of mv ACEROMAR was sounded to warn fv Z.575 HEIN SENIOR and the rudder of mv ACEROMAR was put hard to SB in order to try to avoid a collision.

Reportedly, the watchkeeper on board fv Z.575-HEIN SENIOR also reacted after hearing the horn, but a collision could not be avoided.

At 04:01:30, 40 seconds after blowing the horn, fv Z.575-HEIN SENIOR collided with mv ACEROMAR in position 53° 45’ 8 N 006° 04’ 5 W .

Fv Z.575 HEIN SENIOR ran with her PS bow into mv ACEROMAR and hit her on PS, from midships up to the aft.

The derrick of fv Z.575 HEIN SENIOR hit the railing and hatch cover gantry of the mv ACEROMAR where after the derrick turned over against the wheelhouse of fv Z.575-HEIN SENIOR.

Figure 7 - Fv Z.575-HEIN SENIOR damaged after collision

At 04:04 mv ACEROMAR hailed fv Z.575 - HEIN SENIOR on VHF channel 16. The officer of the watch on board mv ACEROMAR proposed to continue the conversation on VHF channel 06 in order to keep VHF channel 16 clear for other communication. After switching to VHF channel 06, mv ACEROMAR verified if any assistance was needed.

At 04:05 hours, the master and chief engineer of mv ACEROMAR entered the wheelhouse and the engine was put on dead slow ahead.

At 04:13 hours mv ACEROMAR hailed the Dutch Coast Guard on VHF channel 16. After making contact and subsequently switching to channel 23, the Coast Guard was informed about the collision and permission was asked to proceed the voyage.

At this time, the speed of mv ACEROMAR was reduced to 3 knots.

At 04:15 hours the general alarm on board mv ACEROMAR was sounded and a collision at sea was announced.

At 04:15 hours the Coast Guard hailed fv Z.575 Hein-Senior on VHF to inform about the situation on board.

At 04:23 hours the Coast Guard hailed mv ACEROMAR on VHF and granted permission to continue the voyage towards the port of Rotterdam.

At 04:24 the Coast Guard hailed fv Z.575 Hein-Senior on VHF and granted permission to return to the port of Lauwersoog.

7. FACTUAL INFORMATION

7.1 VESSEL'S PARTICULARS – Z. 575-HEIN SENIOR

Figure 8 - Fv Z.575-HEIN SENIOR

Type	Beam trawler
Flag	Belgium
Port of registry	Zeebrugge
Call Sign	OPWS
IMO N°	9092642
Shipyard	VD Werff & Visser
Year Built	2000
Owner	BVBA Rederij De Toekomst
LOA	23,99m
Breadth	6,26m
Gross tonnage	102
Net tonnage	30
Main Engine Type	Diesel
Main Engine Maker	Caterpillar
Engine power	221 kW

7.2 VESSEL'S PARTICULARS – MV ACEROMAR

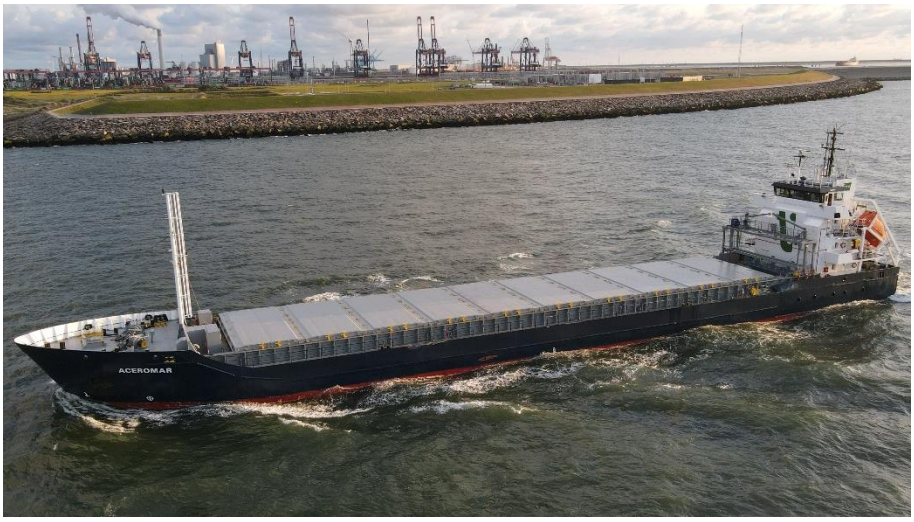


Figure 9 - Mv ACEROMAR

Picture: Fisherman4friends.nl- AJ Buurveld

Type	Multi-purpose dry cargo container, heavy cargo
Ice Class	1A
Flag	Luxembourg
Port of Registry	Luxembourg
Call Sign	LXRV
IMO N°	9552082
Gross Tonnage	3500
Deadweight	5237 mt
Keel Laid	2012
Shipyard	Western Marine Shipyard Ltd.
Owner	Vertom-Bojen Schiffahrts MS "Celine" GmbH & Co. KG
N° of Main Engines	1
Max. Engine Power	2,000 kW
Main Engine Type	MaK 6M25C
LOA	99,48 m
LBPP	92,49 m
BOA	13,43 m
Draught	6,15 m

7.3 TRAFFIC SEPARATION SCHEMES

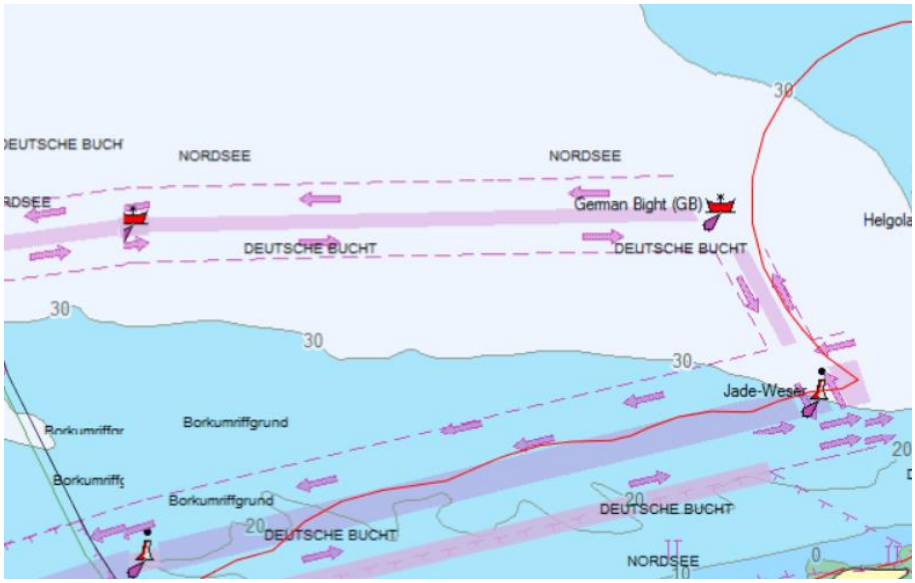


Figure 10 - A Traffic Separation Scheme as shown on a nautical chart

Traffic separation schemes are areas designated by the International Maritime Organization, or IMO, and authorized by the International Convention for the Safety of Life at Sea, or SOLAS, for separating marine traffic where it converges.

Their purpose is to reduce traffic density, and usually lessen the incidence of encounters between ships on reciprocal or nearly reciprocal courses.

In 1967 the first traffic separation scheme in international waters was implemented in the Dover Strait and its adjacent waters.

Today some hundred separation schemes have been adopted by the IMO and over two hundred, some imposed by governments within their territorial waters, appear on official charts.

Since the introduction of traffic separation schemes, the high incidence of collisions between vessels going in opposite directions has been largely eliminated and there has been a substantial reduction of collisions worldwide.

In 1977, revised Collision Regulations came into force and it became mandatory to comply with the new Rule 10 which deals with the observance of traffic separation schemes.[4]
The entire COLREG Rule 10 can be found in Annex 2.

[4] Sources : www.imo.org/en/OurWork/Safety/Pages/ShipsRouteing and IMO – Historical background on ship's routeing

Some highlights regarding sailing in a TSS:

- A vessel in a TSS shall proceed in the appropriate traffic lane and in the general direction of traffic flow for that lane;
- A vessel following a TTS shall so far as practicable keep clear of a traffic separation line or separation zone;
- A traffic separation scheme does not give right of way over other traffic;
- If the risk of collision exists you will have to take action as required by rule 18 of COLREGS;
- Fishing in a TSS is permitted, but vessels engaged in fishing shall not impede the users of a TSS;
- Crossing a TSS must happen on a heading as nearly as practicable at right angles to the general direction of traffic flow.

8. DAMAGES

8.1 Fv Z.575 - HEIN SENIOR

Fv Z.575-HEIN SENIOR was heavily damaged on her PS bow, in front of the collision bulkhead.

The ship's hull was ripped open in two positions above the PS anchor lock, as indicated in Figure 11.

Figure 11 - Ruptured hull of Z.575-HEIN SENIOR

Figure 12 shows the lower rupture from inside the vessel. Three stiffeners were partially teared through.

Figure 12 – Lower rupture in the hull of fv Z.575-HEIN SENIOR

Figure 13 shows the upper rupture from inside the vessel. Two stiffeners were completely teared through.

Figure 13 - Upper rupture of the hull of fv Z.575-HEIN SENIOR

Figure 14 shows the damage at the stem of fv Z.575-HEIN SENIOR. The central deck beam and the stiffeners below were bent. The knee joint of the second stiffener on PS was completely teared through.

Figure 14 - Damaged stiffened plate structure at the stem of fv Z.575-HEIN SENIOR

The derricks of fv Z.575-HEIN SENIOR were put at 45° during the sea passage. The PS derrick hit mv ACEROMAR and damaged the hatch cover gantry crane of the mv ACEROMAR. After hitting mv ACEROMAR, the derrick was swung against the wheelhouse of fv Z.575-HEIN SENIOR, as indicated in Figure 15.

Figure 15 - PS derrick hit the wheelhouse of fv Z.575-HEIN SENIOR

8.2 Mv ACEROMAR

Mv ACEROMAR had some material damages on PS, as indicated in Figure 16.

The PS side shell plate and main deck were hit for'd of the midship section, between frames 84 and 94.
The PS side shell plate was also damaged between frames 79-83.
Figure 17 shows a more detailed view of the PS side shell damages.
Some sharp indents were visible, but the hull had not been penetrated.

PS bulwark and PS railings were found contact damaged from the midship section up to the aft, between frames 19 and 95. The PS aft fairlead was found with the rollers blocked.

The hatch cover gantry crane was hit by the PS derrick of fv Z.575-HEIN SENIOR and was found contact damaged. It needed to be dismantled for repairs.

Figure 16 – Impact of the collision on PS of mv ACEROMAR

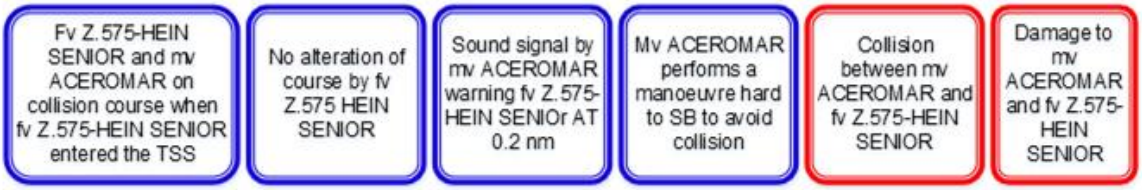
Pictures 16, 17 and 18 : Fishermen4friends.nl- AJ Buurveld

Figure 17 - Detail of damage on PS side plate of mv ACEROMAR

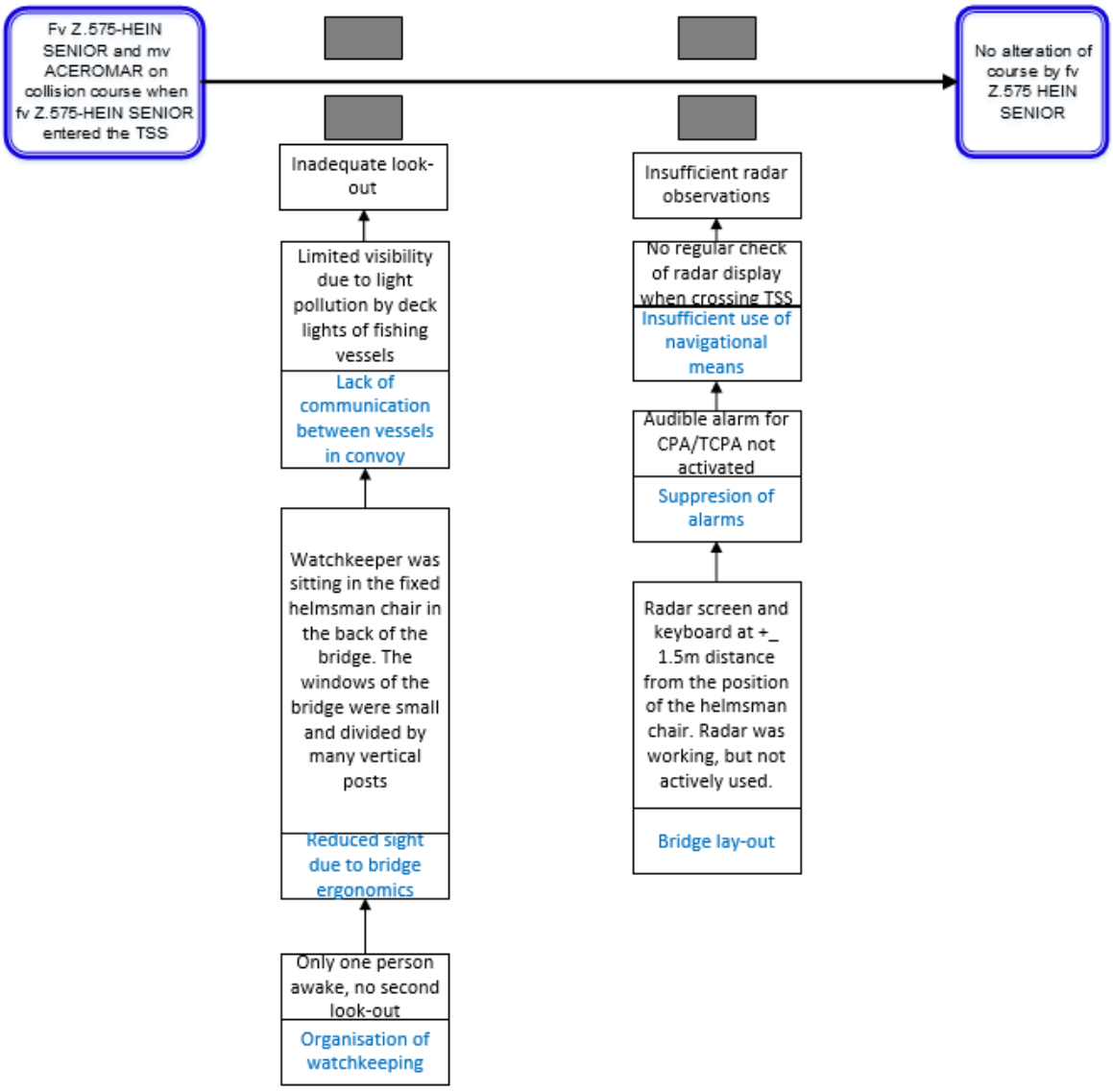
Figure 18 - Damaged railing, bulwark and gantry crane on board mv ACEROMAR

9. ANALYSIS

9.1 BARRIER FAILURE ANALYSES DIAGRAM (BFA)



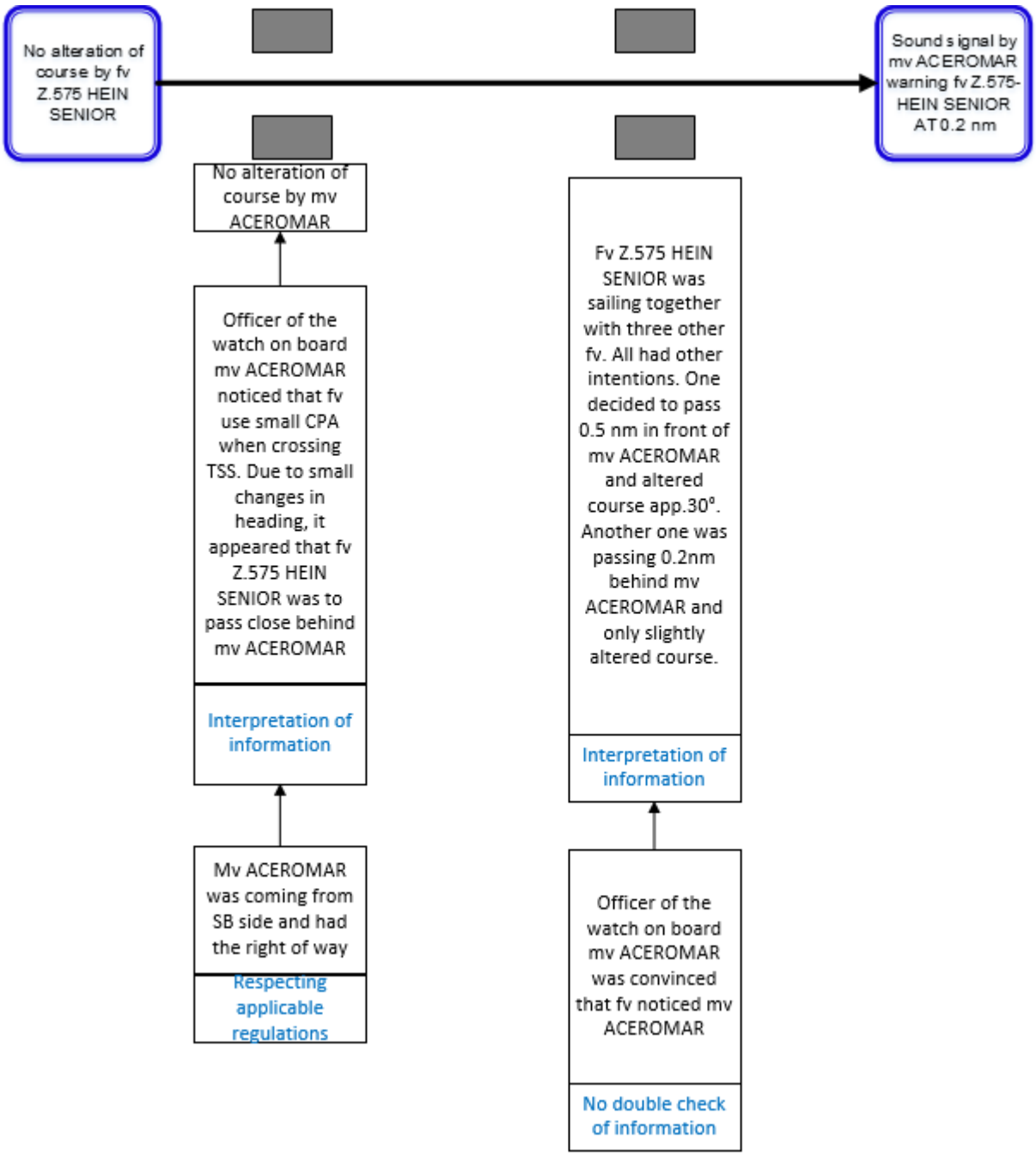
9.2 INCIDENT TREE CUT-UP



No alteration of course made by fv Z.575 HEIN SENIOR

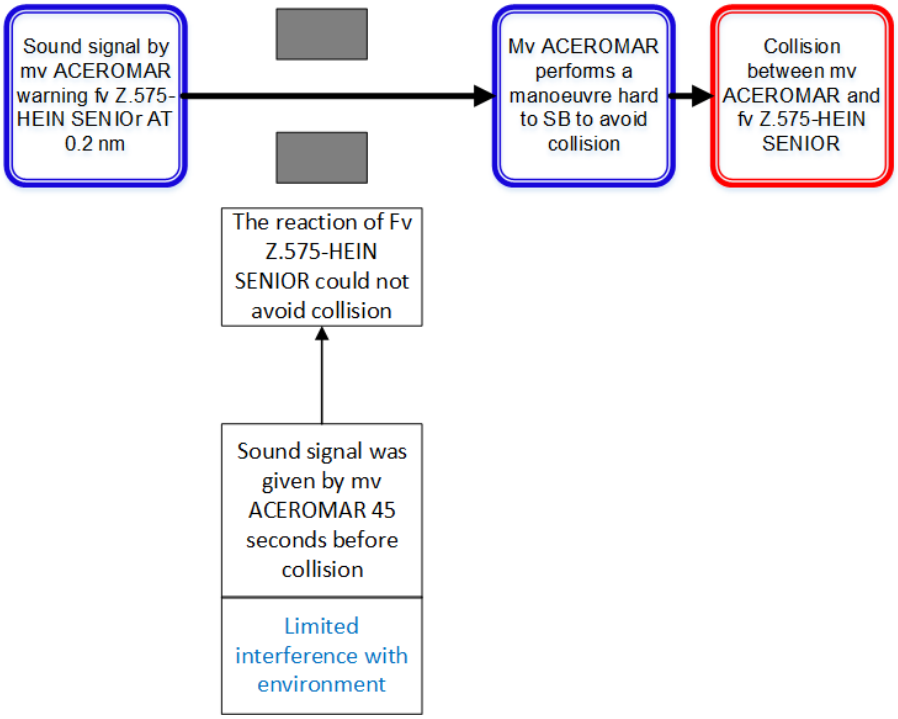
Incident Barrier Failed	Performance / RC categories	Barrier Challenge / Causes	Remarks regarding performance
Inadequate Lookout	BFA Primary Causes	Lack of communication between vessels in convoy	Limited visibility due to light pollution by deck lights of fishing vessels
	BFA Secondary Causes	Reduced sight due to wheelhouse ergonomics.	Watchkeeper was sitting in the fixed helmsman chair in the back of the wheelhouse. The windows of the wheelhouse were small, divided by many vertical posts.
	BFA Tertiary Causes	Organisation of watchkeeping	Only one person awake, no second lookout

Incident Barrier Failed	Performance / RC categories	Barrier Challenge / Causes	Remarks regarding performance
Insufficient radar observations	BFA Primary Causes	Insufficient use of navigational means	No regular check of radar screen when crossing TSS
	BFA Secondary Causes	Suppresion of alarms	Audible alarms for CPA/TCPA not activated
	BFA Tertiary Causes	Wheelhouse lay-out	Radar screen and keyboard at +-1.5m distance from position of chair where lookout was sitting. Radar was working, but not actively used



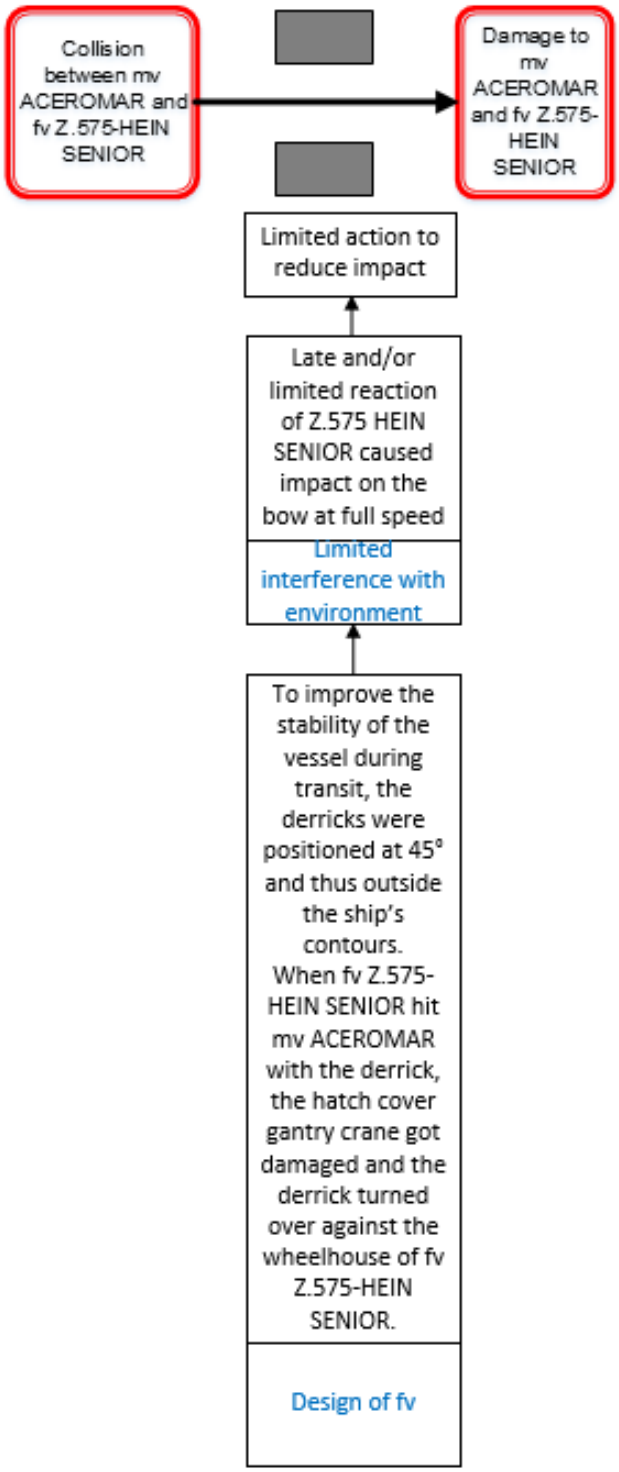
Sound signal by mv ACEROMAR to warn fv Z.575 HEIN SENIOR at 0.2nm

Incident Barrier Failed	Performance / RC categories	Barrier Challenge / Causes	Remarks regarding performance
No alteration of course made by mv ACEROMAR	BFA Primary Causes	Interpretation of information	Officer of the watch noticed that fishing vessels apply small CPA when crossing vessels. Due to small changes in heading, it looked like fv Z.575 HEIN SENIOR was to pass at close CPA behind mv ACEROMAR
	BFA Secondary Causes	Regulations do not encourage to initiate action	mv ACEROMAR was coming from SB side and had right of way, so watchkeeper had not the intention to take action early
Incident Barrier Failed	**Performance / RC categories**	**Barrier Challenge / Causes**	**Remarks regarding performance**
No VHF communication	BFA Primary Causes	Interpretation of information	Fv Z.575-HEIN SENIOR was sailing with 3 other fishing vessels, all had other intentions; One decided to cross 0,5 nm in front of mv ACEROMAR and made a wide alteration in course (>30°), another one was passing at 0.2nm behind mv ACEROMAR and made a small alteration in course (< 10°).
	BFA Secondary Causes	No double check of information	Officer of the watch on board mv ACEROMAR was convinced that fishing vessels noticed mv ACEROMAR



mv ACEROMAR makes an emergency manoeuvre, hard to SB to avoid collision

Incident Barrier Unreliable	**Performance / RC categories**	**Barrier Challenge / Causes**	**Remarks regarding performance**
The reaction of Fv. Z.575-HEIN SENIOR could not avoid collision	BFA Primary Causes	Limited interference with environment	Sound signal was given 45 sec before collision



Sound signal by mv ACEROMAR to warn fv Z.575 HEIN SENIOR at 0.2nm

Incident Barrier Failed	Performance / RC categories	Barrier Challenge / Causes	Remarks regarding performance
Limited action to reduce impact	BFA Primary Causes	Limited interference with environment	Late and/or limited reaction of fv Z.575 HEIN SENIOR caused impact on the bow at full speed
	BFA Secondary Causes	Design of vessel	To improve the stability of fv Z.575-HEIN SENIOR during sailing, derricks were placed at 45° and outside ship's contours. When fv Z.575-HEIN SENIOR hit mv ACEROMAR with the derrick, the hatch cover gantry crane got damaged and the derrick turned over against the wheelhouse of fv Z.575 HEIN SENIOR.

9.3 VISIBILITY FROM THE WHEELHOUSE OF FV Z.575-HEIN SENIOR

The watchkeeper on board fv Z.575-HEIN SENIOR was sitting in the helmsman chair, situated in the back of the wheelhouse, as indicated in Figure 19.

The wheelhouse was fitted with 11 windows that were divided by near vertical posts.

Figure 19 - Overview wheelhouse fv Z.575-HEIN SENIOR

The picture was taken during repairs after the accident. The wooden plates were only temporarily in place in the shipyard.

Sitting in the helmsman chair, the view was limited by the size of the windows, with the vertical posts in between, and by the distance from the chair to the windows.

Due to the position of the helmsman chair and the rectangular shape of the wheelhouse, one had to turn his head towards SB to have an overview of the traffic coming from that side.

Figure 20 and Figure 21 give an indication of the outside view when sitting in the helmsman chair.

Figure 20 - Front view from helmsman chair

Figure 21 - SB view from helmsman chair

The view on board fv Z.575-HEIN SENIOR was also influenced by outside factors, as discussed in the following paragraphs.

The general visibility was good. The sky was cloudy, but there was full moon on August 3rd. There was no precipitation within sight.

Fv Z.575-HEIN SENIOR was not sailing alone. Three other fishing vessels were sailing in the same direction, at distances of approximately 0.6 nm.

Figure 22 gives a radar overview at 03:52 hours when the fishing vessels were in the traffic separation zone, in the middle of the TSS.

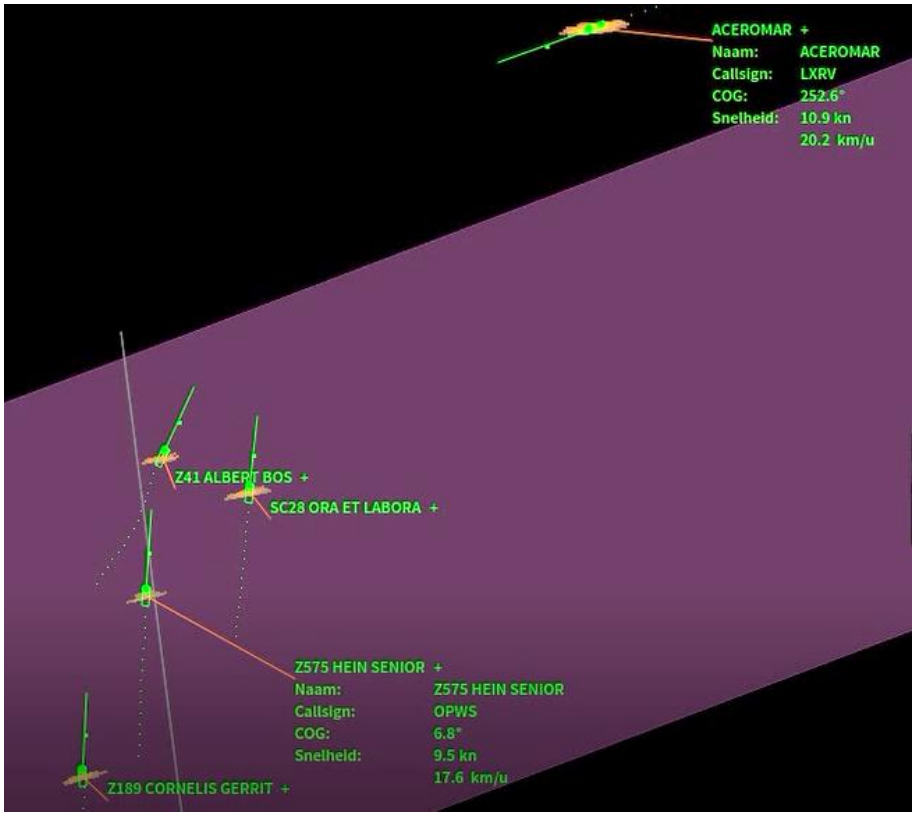


Figure 22 - Position of fishing vessels at 03:52 hours

Source: Radar VTS

Seen from fv Z.575-HEIN SENIOR, Fv SC.28-ORA ET LABORA and mv ACEROMAR had the same bearing. Fv SC.28-ORA ET LABORA was well illuminated and sailing at 0.6 nm away from fv Z.575-HEIN SENIOR. At that moment, mv ACEROMAR was at a distance of 2,74 nm with only her navigation lights switched on.

Figure 23 gives an overview of the bearings and distances of both fishing vessels as seen from mv ACEROMAR, up to 15 minutes before the collision. From 03:57 hours there is a clear difference in bearing between fv Z.575-HEIN SENIOR and fv SC.28-ORA ET LABORA.

Time (LT)	Bearing Z.575	Bearing SC.28	Distance Z.575	Distance SC.28
3:47	221,0	221,2	4,15	3,58
3:48	221,0	220,8	3,86	3,30
3:49	221,0	220,6	3,58	3,02
3:50	220,7	220,2	3,31	2,74
3:51	220,6	219,6	3,03	2,46
3:52	220,6	219,1	2,74	2,19
3:53	220,6	218,4	2,45	1,92
3:54	220,5	217,6	2,17	1,65
3:55	220,4	216,5	1,88	1,37
3:56	220,3	214,5	1,60	1,10
3:57	221,0	211,3	1,30	0,83
3:58	220,2	205,2	1,04	0,56
3:59	221,5	188,8	0,73	0,31
4:00	220,5	130,0	0,47	0,18
4:01	218,8	76,5	0,20	0,35

Figure 23 - Bearing and distance of fishing vessels

Source: AIS data extracted from the VDR of mv ACEROMAR

Figure 24 shows the traffic situation at 03:59 hours. At that moment, there is a difference in bearing of approximately 030° between both fishing vessels.

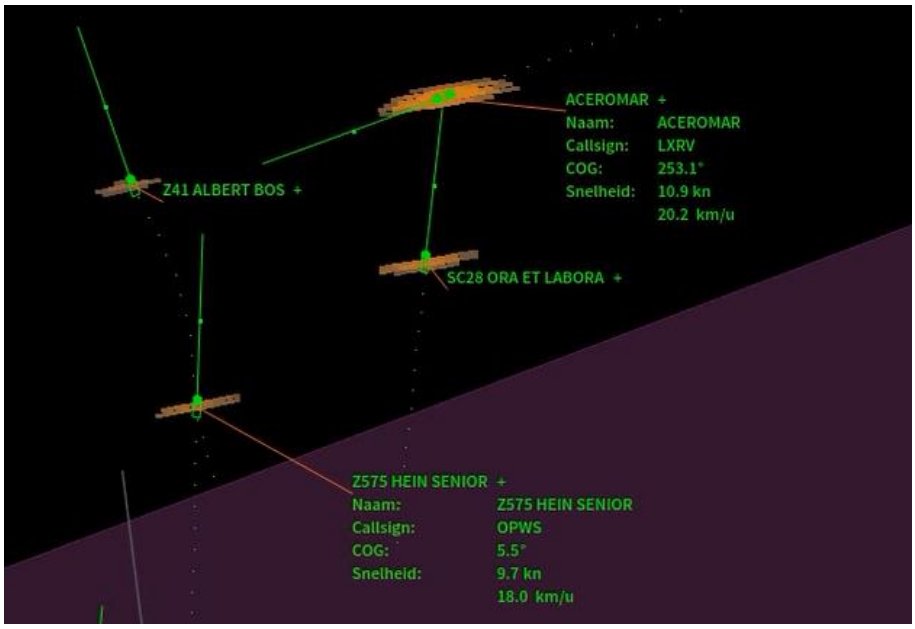


Figure 24 – Radar positions at 03:59 hours

Source: Radar VTS

The physical and psychical condition of the watchkeeper on board fv Z.575-HEIN SENIOR could also have impaired his ability to observe.

The watchkeeper reported that he was in the wheelhouse during the entire voyage. All other crewmembers were resting. There was no second lookout available.

Reportedly, the watchkeeper felt well rested.

He had slept in the afternoon, and also the night before, he had a good rest. He reported to be in a healthy condition.

During the watch, the BNWAS was set at 7 minutes.
The watchkeeper did not have a lot of work since there was not a lot of traffic that night. From 02:40 hours, fv Z.575-HEIN SENIOR was heading North and did not encounter any other vessels, other than the three fishing vessels, at a distance of less than 1nm.

Between 02:30 and 03:00 hours, the watchkeeper had been texting with the watchkeeper on board fv SC.28-ORA ET LABORA, but he was not disrupted by his smartphone anymore after 03:00 hours.

The watchkeeper on board fv Z.575-HEIN SENIOR stated that he had not noticed the presence of the mv ACEROMAR at any time before it appeared in front of fv Z.575-HEIN SENIOR.

No communication regarding traffic had taken place between fv SC.28-ORA ET LABORA and fv Z.575-HEIN SENIOR.

9.4 RADAR OBSERVATIONS ON BOARD Z.575-HEIN SENIOR

Fv Z.575-HEIN SENIOR was equipped with a FURUNO FAR-2117 radar with target tracking, or ARPA and AIS display. Specifications of this type of radar can be found in Annex 3.

There were two monitors on board on which the radar could be displayed. Both were visible from the helmsman chair, as indicated in Figure 20.

The radar was set to a 12nm range, north-up, true motion and the settings had not been changed during the voyage.

The radar was in normal working condition.

The position of the radar antenna on board did not cause any blind sectors.

Figure 25 - Position of radar antenna on board

Picture: www.tschippertje.be

According to the radar manual, the range discrimination was only 26 metres[5]. Since the distance between fishing vessels Z.575-HEIN SENIOR, SC.28-ORA ET LABORA and mv ACEROMAR was bigger than 26m, the range discrimination had no influence on the detection of mv ACEROMAR by radar.

[5] The echo of two vessels at 26 metres distance of each other with a same bearing are represented on the radar screen as one echo and so no distinction can be made.

Since no other vessels than mv ACEROMAR were at the same distance from the fv Z575 – HEIN SENIOR, there was no bearing discrimination that impeded the detection of mv ACEROMAR by radar.[6]

There was no evidence that the echo of mv ACEROMAR did not appear on the radar screen.

The watchkeeper on board fv Z.575-HEIN SENIOR had not observed mv ACEROMAR on the radar.

The radar functionality to warn the watchkeeper in case of a limited CPA/TCPA had not been used.

9.5 TRACK OF FISHING VESSELS CROSSING THE TSS

The officer of the watch on board mv ACEROMAR had noticed that 4 fishing vessels were crossing the TSS.

He had been monitoring the fishing vessels on the radar and, basing himself on his radar observation, he was convinced that the fishing vessels maintained a small CPA when crossing mv MANILA MAERSK.

Since mv MANILA MAERSK came in on PS of the fishing vessels, mv MANILA MAERSK was the give way vessel.

At 03:16 hours, fv Z.41-ALBERT BOS altered 020° to PS in order to pass 0.6nm behind mv MANILA MAERSK at 03:27 hours.

From 03:20 hours onward, Fv SC.28-ORA ET LABORA started to make small course alterations to PS in order to pass 0.6nm behind mv MANILA MAERSK at 03:34 hours.

Fv Z.575-HEIN SENIOR and fv Z.189-CORNELIS GERRIT did not alter course.

Figure 26 shows the tracks of the fishing vessels that crossed the track of the mv MANILA MAERSK.

[6] Two vessels on the same distance with a different bearing can be detected as one echo by the radar if the difference in bearing between them is small. This value depends a.o. on the radar beamwidth and range.

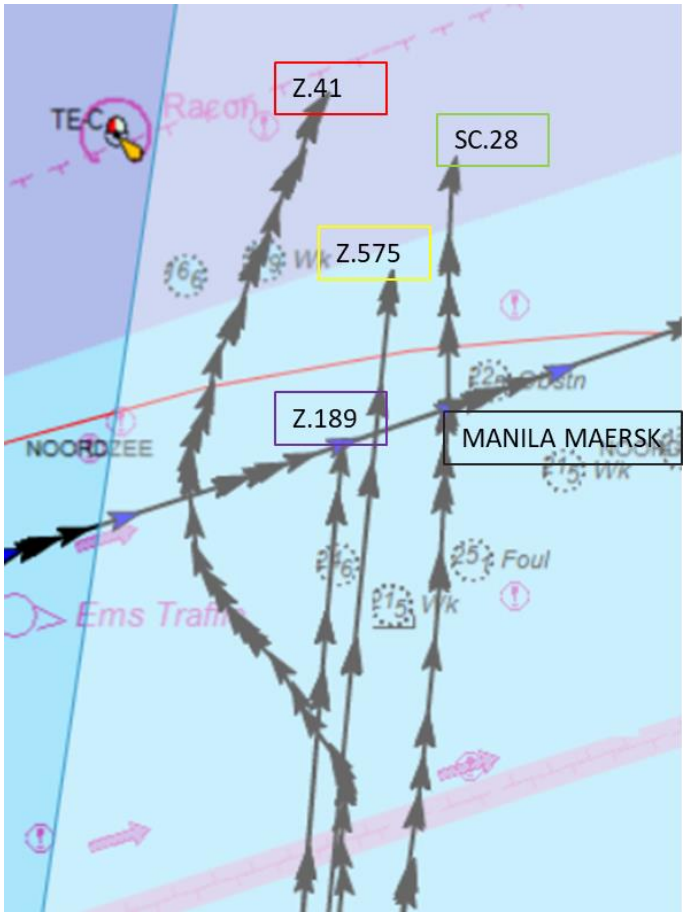


Figure 26 - Fishing vessels crossed mv MANILA MAERSK

After crossing mv MANILA MAERSK, around 03:43 hours, fv SC.28-ORA ET LABORA altered her course approximately 010° to SB and subsequently altered her course back to PS in order to pass behind mv ACEROMAR at a distance of 0.2nm.

Basing himself on the observed behaviour of the fishing vessels, the officer of watch on board mv ACEROMAR was convinced that the fishing vessels where aware of the presence of mv ACEROMAR.

Visibility was good, there was not a lot of traffic in the vicinity and mv ACEROMAR maintained course and speed for 2 hours already.

According to the COLREG regulations, the fishing vessels had to give way to mv ACEROMAR[7]. Consequentially, the officer of watch on board mv ACEROMAR had not considered the possibility that the vessel had not been observed by one of the fishing vessels.

[7] ColRegs Rule 15 regarding crossing situations states that: when two power-driven vessels are crossing so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way and shall, if the circumstances of the case admit, avoid crossing ahead of the other vessel.

Around 03:55 hours, the officer of the watch on board mv ACEROMAR noticed that the CPA of fv Z.575-HEIN SENIOR decreased to 0.00nm, where he was expecting the CPA to increase. Since the CPA did not increase, the officer of the watch decided to sound the horn and to alter his own course hard to SB in order to try avoiding a collision.

The VHF had not been used to hail fv Z.575-HEIN SENIOR.

Figure 27 shows how fv Z.41-ALBERT BOS clearly showed her intentions by altering course.

Figure 28 shows the small course alterations made by fv SC.28-ORA ET LABORA and Figure 29 shows the track of fv Z.575-HEIN SENIOR.

The track of fv Z.575 HEIN SENIOR was straight , since she did not alter course during the passage of the TSS.

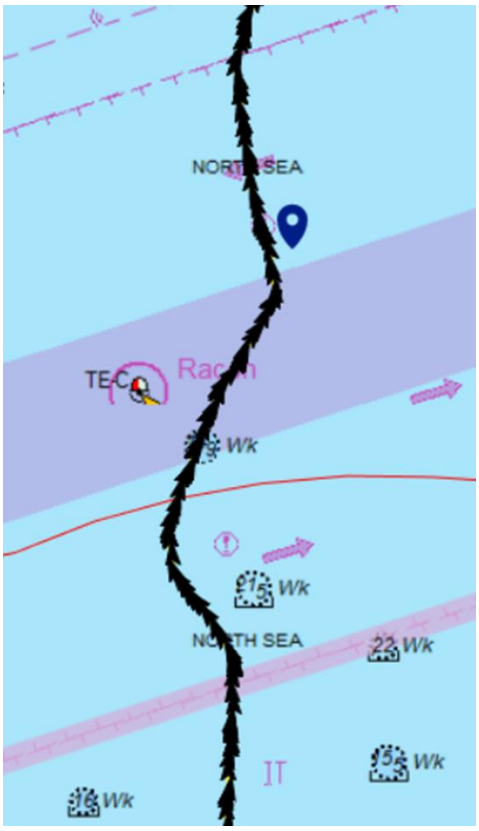


Figure 27 - Track of fv Z.41-ALBERT BOS

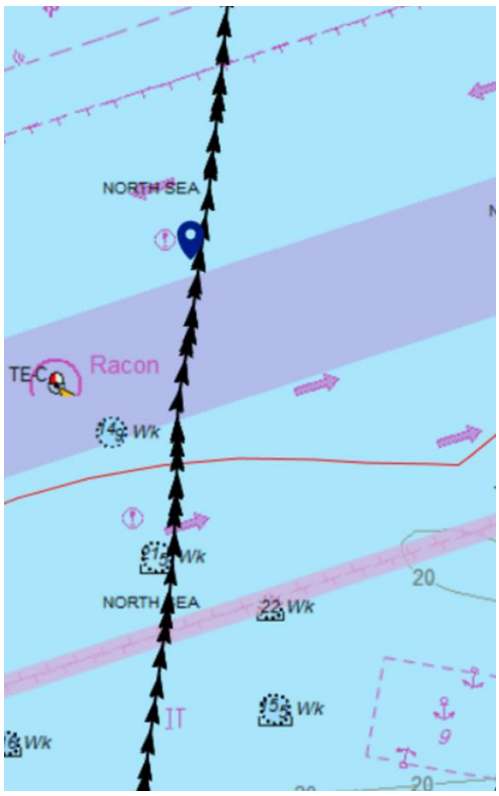


Figure 28 - Track of fv SC.28-ORA ET LABORA

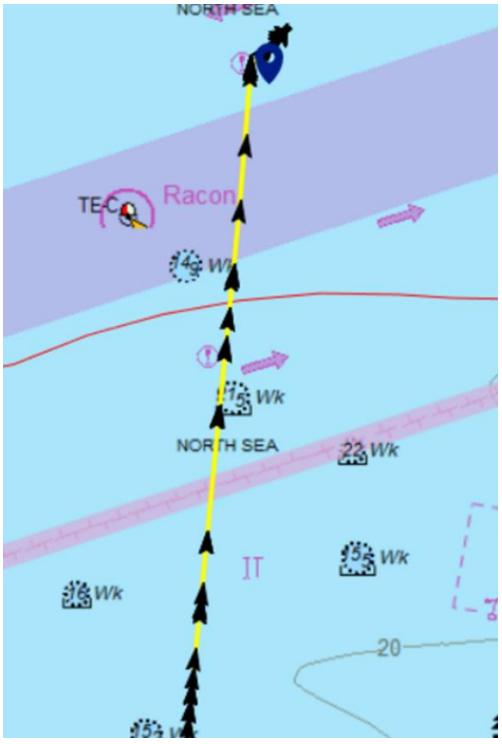


Figure 29 - Track of fv Z.575-HEIN SENIOR

10. CAUSE OF THE ACCIDENT

The collision between fv Z.575-HEIN SENIOR and mv ACEROMAR stemmed from mv ACEROMAR not being observed on board fv Z.575-HEIN SENIOR and the consequential lack of manoeuvring by both vessels in order to avoid the collision.

The apparent intentions of the four fishing vessels contributed to the accident.
The four fishing vessels that sailed in convoy did not all take early and substantial action to give way to mv ACEROMAR, which lead to assumptions on board mv ACEROMAR, being wrong.
Based on the assumption that the watchkeeper on board fv Z.575-HEIN SENIOR did notice mv ACEROMAR, there was no need for the officer of the watch on board mv ACEROMAR to call fv Z.575-HEIN SENIOR over the VHF and to take earlier action to avoid a collision.

11. SAFETY ISSUES

Watchkeeping habits on board fv Z.575- HEIN SENIOR did not allow to timely observe a vessel that had right of way. Not all available navigational aids to observe such vessels, including radar alarms, were used.

Light pollution from the deck lights of fv SC.28-ORA ET LABORA hindered the view of the watchkeeper on board fv Z.575-HEIN SENIOR.

Fv SC.28-ORA ET LABORA maintained a small CPA when crossing mv ACEROMAR.
A give way vessel should take early and substantial action to give way. Maintaining a small CPA brings confusion and leads to wrong assumptions.

12. RECOMMENDATIONS

12.1 THE OWNER OF THE VESSEL

2020/005040 -1: The owner of the vessel, BVBA Rederij De Toekomst, is recommended to adjust the watchkeeping practices on board to improve the detection of vessels that cause a risk for collision.

All available means to timely observe any risk for collision, including radar alarms, should be used.

12.2 PREVIS

2020/005040-2: PREVIS is recommended to create and/or increase awareness among the watchkeepers on board Belgian fishing vessels regarding:

- the influence of deck lighting on the observing capabilities of watchkeepers on board vessels nearby.

- the importance of early and substantial action for give way vessels in collision courses.

13. ANNEXES

Radar use[8]

Head -up mode :

When your own vessel, also called the observing vessel, is presented in the centre of the radar screen, a line pointing straight up from the centre of the screen represents the vessel's forward motion. This line is called the heading marker and always points to 000° in head-up mode.

Objects in front of the vessel are reflected at the top of the screen, objects on starboard side are on the right of the screen, and so on.

Radar observations in head-up mode are relative to the observing vessel. This means that any object or target is moving with respect to the observing vessel. The observing vessel is a fixed point on the radar display.
Any target moving towards the fixed observing vessel on the radar display, is on a collision course with the observing vessel.

If the radar is used in head-up mode while altering course, the heading marker remains upward and the targets move on the screen.
The picture below shows a radar in head-up mode. The course is 270° and the true bearing of the target is 240°. In this picture, the vessel alters course 030° to SB.

[8] Sources:
www.splashmaritime.com.au
Radar and Arpa Manual – ISBN 0 7506 0818 8
www.starpath.com

Course-up mode:

When your own vessel is presented in the centre of the radar screen, the heading marker points straight up and the vessel's course is showed at the top of the display.

In course-up mode, the input of an electronic compass is needed.

Objects in front of the vessel are reflected at the top of the screen, objects on starboard side are on the right, and so on.

When using radar bearings in course-up mode, true bearings can be read of the radar display.

Some radars give the possibility to switch between true motion presentation and relative motion presentation, see also next page.

If the radar is used in course-up mode while altering course, the heading marker remains upward and the objects and target move on the screen. In this example, there is a big course alteration and the radar display shows some disruption. With small course alterations, this disruption is not visible on the display.

***North-up mode*:**

When your own vessel is presented in the centre of the radar screen, the heading marker represents the vessel's course. The heading marker is pointing in the direction of the vessel's course.

The true North is always shown on the top of the display, similar to a nautical chart. The view on the radar display corresponds perfectly with the chart. Taking radar bearings for position determination is easier in North-up mode.

When the vessel alters course, the heading marker swings around to the new course, but all targets remain on their true bearings. Only the heading marker moves.

True motion presentation:

A radar in true motion presentation shows the movement of your own vessel and targets in accordance to their respective speed and direction.
This can be the speed and direction through the water or over the ground, so called sea stabilization or ground stabilization. Additional data input is required.

Stationary targets will not move.

In true motion presentation, the heading and speed of targets becomes immediately available.

Relative motion presentation:

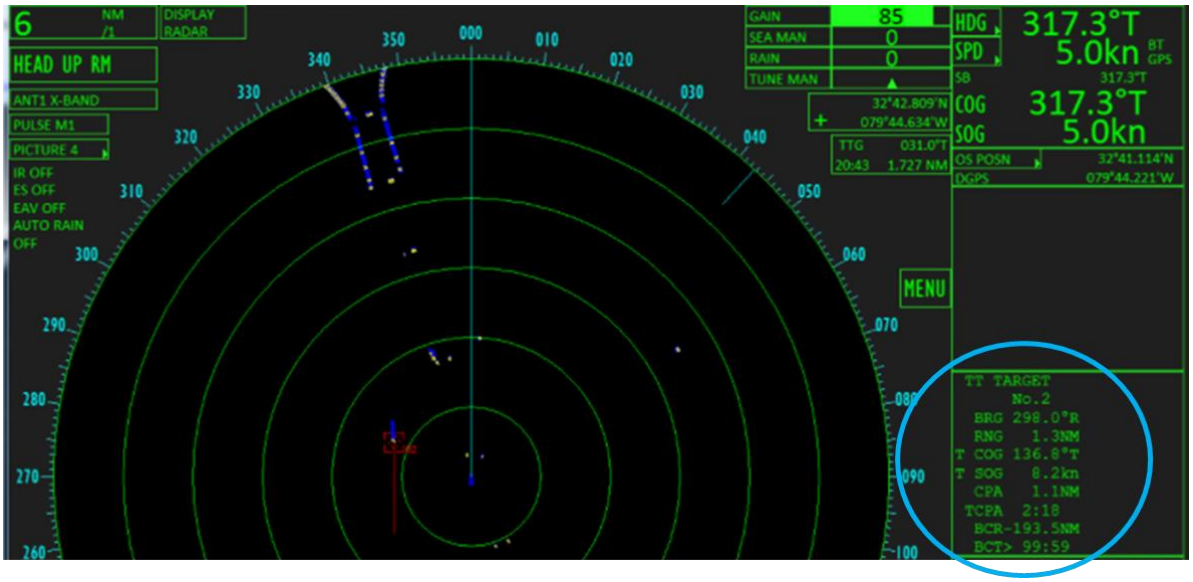
In relative motion presentation, the own vessel, also called observing vessel, is considered to be stationary and the motion of other targets is relative to the observing vessel.

Fixed objects are moving on the radar display when the observing vessel is moving.

ARPA/ TT :

Automatic Radar Plotting Aid/ Target tracking.
This is a computerized function of modern radars that can track, determine, and analyze interaction data for vessel targets on the radar screen. Such data might include CPA, time to CPA, true course and speed, relative course and speed, and so on.

For example, radars equipped with ARPA can show the navigator true bearings when the radar is set in head-up mode.



AIS Display:

AIS is connected to the radar and AIS information can be displayed, even with additional symbols to indicate a dangerous target, a lost target, etc.

Annex 1 - Radar use

COLREG Rule 10 (Traffic separation schemes)

(a) This Rule applies to traffic separation schemes adopted by the Organisation and does not relieve any vessel of her obligation under any other Rule.

(b) A vessel using a traffic separation scheme shall:

(i) proceed in the appropriate traffic lane in the general direction of traffic flow for that lane;

(ii) so far as practicable keep clear of a traffic separation line or separation zone;

(iii) normally join or leave a traffic lane at the termination of the lane, but when joining or leaving from either side shall do so at as small an angle to the general direction of traffic flow as practicable.

(c) A vessel shall, so far as practicable, avoid crossing traffic lanes but if obliged to do so shall cross on a heading as nearly as practicable at right angles to the general direction of traffic flow.

(d)

(i) A vessel shall not use an inshore traffic zone when she can safely use the appropriate traffic lane within the adjacent traffic separation scheme. However, vessels of less than 20 m in length, sailing vessels and vessels engaged in fishing may use the inshore traffic zones.

(ii) Notwithstanding subparagraph (d)(i), a vessel may use an inshore traffic zone when *en route* to or from a port, offshore installation or structure, pilot station or any other place situated within the inshore traffic zone, or to avoid immediate danger.

(e) A vessel other than a crossing vessel or a vessel joining or leaving a lane shall not normally enter a separation zone or cross a separation line except:

(i) in cases of emergency to avoid immediate danger;

(ii) to engage in fishing within a separation zone.

(f) A vessel navigating in areas near the terminations of traffic separation schemes shall do so with particular caution.

(g) A vessel shall so far as practicable avoid anchoring in a traffic separation scheme or in areas near its terminations.

(h) A vessel not using a traffic separation scheme shall avoid it by as wide a margin as is practicable.

(i) A vessel engaged in fishing shall not impede the passage of any vessel following a traffic lane.

(j) A vessel of less than 20 m in length or a sailing vessel shall not impede the safe passage of a power-driven vessel following a traffic lane.

(k) A vessel restricted in her ability to manoeuvre when engaged in an operation for the maintenance of safety of navigation in a traffic separation scheme is exempted from complying with this Rule to the extent necessary to carry out the operation.

(l) A vessel restricted in her ability to manoeuvre when engaged in an operation for the laying, servicing or picking up of a submarine cable, within a traffic separation scheme, is exempted from complying with this Rule to the extent necessary to carry out the operation.

Annex 2 – COLREG - Rule 10 Traffic Separation Schemes

Product Name MARINE RADAR/ARPA

Antenna Radiators

1. Type
Slotted waveguide array

2. Beamwidth and sidelobe attenuation

	X-Band			S-Band
Radiator Type	XN-12AF	XN-20AF	XN-24AF	SN-36AF
Length	4 ft	6.5 ft	8 ft	12 ft
Beamwidth(H)	1.9	1.23	0.95	1.8
Beamwidth(W)	20	20	20	25
Sidelobe (within 10)	-24 dB	-28 dB	-28 dB	-24 dB
Sidelobe (outside 10)	-30 dB	-32 dB	-32 dB	-30 dB

3. Rotation

	X-Band		S-Band	
Rotation	24 rpm	42 rpm	21/26 rpm	45 rpm
Gear Box	RSB-096	RSB-097	RSB-098 RSB-099	RSB-100 RSB-101 RSB-102

RF Transceiver

1. Frequency
X-band: 9410 MHz 30 MHz
S-band: 3050 MHz 30 MHz

2. Output power

	FAR-2117	FAR-2127	FAR-2137S
Output Power	12 kW	25 kW	30 kW
Transceiver	RTR-078	RTR-079	RTR-080

3. Pulselength/PRR

Range scale (nm)	Pulselength (s)	PRR (Hz)
0.125, 0.25	0.07	3000
0.5	0.07, 0.15	3000
0.75, 1.5	0.07, 0.15, 0.3	3000, 1500
3	0.15, 0.3, 0.5, 0.7	3000, 1500, 1000
6	0.3, 0.5, 0.7, 1.2	1500, 1000, 600
12, 24	0.5, 0.7, 1.2	1000, 600
48, 96	1.2	600

4. I.F.
60 MHz, Logarithmic

5. Bandwidth
Short pulse: 40 MHz
Middle pulse: 10 MHz
Long pulse: 3 MHz

Radar Display

1. Display
19" color LCD (SXGA 1280 x 1024 pixels),
376.3 (H) x 301.1 (V) mm,
Effective display diameter: 291 mm
Echo Color: Yellow, green or white in 32 levels

2. Range scales and ring intervals (nm)
Range: .125, .25, .5, .75, 1.5, 3, 6, 12, 24, 48, 96
Ring: .025, .05, .1, .25, .25, .5, 1, 2, 4, 8, 16

3. Minimum range
22 m

4. Range discrimination
26 m

5. Range ring accuracy
0.2 %

6. Presentation modes
Head-up, STAB head-up, Course-up, North-up, North-up True Motion (sea or ground stabilization)

7. Heading information
Furuno GPS compass is a recommendable heading sensor as a backup of a gyrocompass.
Confirm with your Administrations.

8. Parallel index lines
1, 2, 3 or 6 lines (menu selectable)

9. Radar map
20,000 points to create coastlines, own ship safety contour, isolated underwater dangers, buoys, traffic routing systems, prohibited areas, fairways as required by IMO.

Target Tracking

1. Acquisition
100 targets (e.g. manually 50, automatically 50) in 0.2-24 nm

2. Tracking
Automatic tracking of all acquired targets

3. Guard zone
Two zones, one of them 0.5 nm depth

4. Past positions
5 or 10 past positions on all targets

5. Collision warning
CPA limit: 0.2 - 10 nm, TCPA limit: 0 - 99 min.

6. Trial maneuver
Dynamic or static, with selected delay time.

AIS Display (Data input from AIS is required)

1. Symbols
Sleeping, Activated, Dangerous, Selected, Lost targets

2. Number of targets
1,000 targets max.

3. Data indication
Basic and expanded data

Power Supply (specify when ordering)

1. Processor Unit
100-115/220-230 VAC, 1ø, 50/60 Hz,
FAR-2117: 7.6 A (8.5 A for HSC application) at 24 VDC,
FAR-2127: 8.8 A (9.7 A for HSC application) at 24 VDC
FAR-2137S: 3.0 A for 100-115 VAC
1.5 A for 220-230 VAC
440 VAC, 1ø, 50/60 Hz with optional transformer RU-1803

2. Display Unit
100-230 VAC, 1ø, 50/60 Hz, 0.7 A
440 VAC, 1ø, 50/60 Hz with optional transformer RU-1803

3. Antenna Unit
FAR-2137S:
200/380 VAC, 3.0/1.5 A, 3ø, 50 Hz; 220/440 VAC, 3.0/1.5 A (3.5/1.7 A for HSC application), 3ø, 60 Hz
115 VAC, 3ø, 60 Hz with optional transformer RU-5693
230 VAC, 3ø, 50 Hz with optional transformer RU-6522
440 VAC, 3ø, 50 Hz with optional transformer RU-5466-1

EQUIPMENT LIST

Standard
1. Display Unit MU-190
2. Processor Unit RPU-013
3. Full-keyboard Control Unit RCU-014
   Trackball Control Unit (Palm Control Unit)
   RCU-015 (Specify when ordering)
4. Antenna Unit with cable, 15/20/30/50/100 m
   (Specify when ordering)
5. Power Supply unit PSU-007 for FAR-2137S
6. Standard Spare Parts and Installation Materials

Option
1. Performance Monitor PM-31 for FAR-2117/2127
   PM-51 for FAR-2137S (Specify when ordering)
2. Remote Control Unit RCU-016
3. Gyro Interface GC-10 (built in Processor Unit)
4. DVI-Analog RGB Conversion Kit (Buffer board built in) OP-03-180
5. RGB Connector DSUB-BNC-1 (for VDR)
6. Card Interface Unit CU-200
7. Transformer RU-1803/5466-1/5693/6522
8. Rectifier RU-3424/1746B
9. Junction Box RJB-001
10. Antenna Cable RW-9600
11. External Alert Buzzer OP03-21
12. Hand Grip FP03-09840
13. Bracket FP03-09820
14. Hub HUB-100

Annex 3 - Radar Specifications FURUNO FAR-2117

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