Investigation report

B2/2011M

M/V AMAZON (BHS) and F/V FLORENCE (FIN), collision resulting in the sinking of the fishing vessel in the Gulf of Finland on 23 October, 2011

Translation of the original Finnish report

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Käännös/ Översättning/ Translation: Käännöspolku

ISBN 978-951-836-390-6 (nid.)
ISBN 978-951-836-391-3 (pdf)
ISSN 1239-5323 (nid.)
ISSN 2242-7732 (pdf)
ISSN-L 1239-5323

Multiprint Oy, Vantaa 2013

SUMMARY

M/V AMAZON (BHS) AND F/V FLORENCE (FIN), COLLISION RESULTING IN THE SINKING OF THE FISHING VESSEL IN THE GULF OF FINLAND ON 23 OCTOBER, 2011

Early in the morning on Sunday 23 October, 2011, some time before 05:00, Bahamian-flagged bulk carrier AMAZON and Finnish-flagged fishing vessel FLORENCE collided in dense fog in the Gulf of Finland, in the sea area between the Porkkala peninsula and the Estonian Naissaar island. The cargo vessel was on her way from St. Petersburg to Chittagong, Bangladesh, carrying potassium carbonate, and the fishing vessel had started pair trawling with another fishing vessel, the MENHADEN, some hours earlier. The fishing vessel FLORENCE sank as a result of the collision, but its four-man Estonian crew managed to survive on the vessel's life raft. The Finnish Border Guard found the life raft in the morning some time after 09:00 and evacuated all of the four-man crew off the raft. No serious physical personal injury resulted from the incident.

The slightly intersecting courses of the pair-trawling fishing vessels and the AMAZON heading to the opposite direction had remained mostly unchanged for an hour before the collision. The masters of the two fishing vessels had both detected the approaching AMAZON on their radars and they predicted that the AMAZON would pass them on the port side. This observation was not discussed between the fishing vessels and it did not lead to any actions. Also the officer on watch on the AMAZON had observed two echoes approaching slowly on the radar. When the echo of the FLORENCE disappeared from the radar, the OOW of the AMAZON assumed two echoes had merged into one. He began to give way by a moderate change of vessel's course to port when the distance between the vessels was slightly under 0.6 nautical miles.

The master of the FLORENCE saw the navigation light on the bow of the AMAZON just before the collision, when it was no longer possible to avoid the collision. The port side of the AMAZON's bow hit the port side of the FLORENCE, damaging her side structures. The collision took place within a precautionary area. The FLORENCE sank in approximately ten minutes. AMAZON and MENHADEN continued their voyages; the AMAZON's OOW stated, that he had felt a light bump to the hull of the vessel and assumed the vessel had hit a fishing buoy or something alike, while the master of the MENHADEN stated never observing the AMAZON by eye due to the dense fog.

There were several factors contributing to the accident. The fishing vessels were trawling in a dense fog and proceeding against the recommended direction of traffic flow in the precautionary area, and towards the oncoming traffic. Both fishing vessels had just one person on the bridge for the early morning watch. The S-VDR audio recording from the AMAZON does not confirm, that a lookout was present on the bridge. The actions on the bridge of the AMAZON did not comply with the standing orders of the shipowner and master given on safe navigation and the manning of the bridge. The masters of the fishing vessels were accustomed to merchant vessels passing them with a close distance, which is why they ignored the approaching vessel and failed to react to the situation.

Both fishing vessels had their fishing lights switched on, but those were not visible in the dense fog. Helsinki Traffic was not notified about starting the fishing or about the fishing vessels' restricted manoeuvrability. As neither of the fishing vessels was equipped with an AIS transmitter, which, at the time of the incident, were not compulsory, other parties did not know for sure that the two vessels were pair trawling. This decreased the possibilities of Helsinki Traffic, as a monitoring authority, to interfere with the situation by providing advice to the fishing vessels. At no point was there any communication between the vessels. Helsinki Traffic was not in contact with any of the vessels, nor did it warn AMAZON of the risk of collision.

Furthermore, on the AMAZON, too, the situation was allowed to develop into a close-quarter situation. The radar echo of the smaller fishing vessel, the FLORENCE, disappeared from radar due to radar adjustments that were not optimal for the situation. Because of insufficient radar observations, the AMAZON gave way to the port in order to avoid a collision with the MENHADEN at the last moment, but collided with the FLORENCE.

The FLORENCE sank quickly, as her side structures were damaged, her cargo hold hatches were open and she was dragged along with the AMAZON in a listing condition, which allowed water to flow into the vessel. The liferaft and the EPIRB transmitter, both recently renewed, worked reliably and played a significant role in rescuing the crew of the FLORENCE. The emergency and rescue operations by the rescue authorities were effective considering the circumstances and the manner in which alarm was raised.

As a result of the investigation, the Safety Investigation Authority recommends that the Finnish Transport Agency to ensure, by training and instructing the VTS operators, that when the traffic situation within the GOFREP area so requires, the VTS operators to interfere with the course of events by actively sharing information. Moreover, it is recommended that the shipowner of the AMAZON makes sure that all the measures for rectifying the non conformities exposed by the accident are thoroughly inspected and corrective actions are implemented, and that the Bahamas Navigation Administration ensures that these measures are completed.

In addition to the safety recommendations, a safety observation was made, stating that the cooperation and information exchange between fishing-related authorities should be improved to ensure better marine safety in the field. The objective should be, first and foremost, to ensure better safety for professional fishers themselves.

CONTENTS

ABBREVIATIONS USED

Abbreviation	English
AB	Able bodied seaman
AIS	Automatic Identification System
ARPA	Automatic Radar Plotting Aid
BRG	Bearing
COG	Course Over Ground
COLREGs	International Regulations for Preventing Collisions at Sea
CPA	Closest Point Approach
DWT	Dead Weight Tons
EBL	Electronic Bearing Line
ECS	Electronic Chart Display
EPIRB	Emergency Position Indicating Radio Beacon
ELT	Emergency Locator Transmitter
GEOSAR	GEOSAR Geostationary Search and Rescue System
GOFREP	Gulf of Finland Reporting
HDG	Heading
ISM code	International Safety Management code
JRCC Tallinn	Joint Rescue Coordination Centre in Tallinn
LEOSAR	Low-altitude Earth Orbit Search and Rescue system
LUT	Local User Terminal
MCC	Mission Control Centre
MCR	Maximum Continuous Rating
MMSI	Maritime Mobile Service Identity
MRCC	Marine Rescue Coordination Centre
MRSC	Marine Rescue Sub-Centre
OOW	Officer on Watch
PLB	Personal Locator Beacon
ROV	Remotely Operated (underwater) Vehicle
SAKL	“Finnish Fishermen Association”
SIAF	Safety Investigation Authority Finland
SMS	Safety Management System
SOG	Speed Over Ground

SOLAS	(International convention for the) Safety Of Life At Sea
SPOC	SAR Points of Contact
STCW	Standards of Training, Certification and Watchkeeping
S-VDR	Simplified Voyage Data Recorder
UTC	Universal Time Coordinated
VHF	Very High Frequency (30–300 MHz)
VTS	Vessel Traffic Service
TCPA	Time to Closest Point Approach
TRAFI	Transport Safety Agency, Finland
RPM	Revolutions Per Minute

FOREWORD

The duty officer of the Safety Investigation Authority Finland (hereafter referred to as SIAF) received notice of the accident from the Helsinki MRSC at 08:49, approximately four hours after the accident had occurred. A SIAF investigator visited the AMAZON later the same day when she was stopped south of Russarö, in front of Hanko. During the visit, preliminary interviews were conducted with the vessel's master and officer on watch (hereafter referred to as OOW), the vessel's radar was tested and vessel documents were photographed and recorded. In addition, the investigator obtained the S-VDR recording. The preliminary investigations soon revealed that the sinked fishing vessel FLORENCE had been trawling as a pair with another fishing vessel, the Finnish-flagged MENHADEN.

After the preliminary investigations, the SIAF decided to initiate a full safety investigation on the collision of the AMAZON and the FLORENCE under sections 2 and 17 of the Act on Safety Investigations (505/2011). Safety Investigaton Authority expert M.Sc. (Tech.) Ville **Grönvall** was appointed investigator-in-charge and sea captain Risto **Repo**, sea captain Juha **Sjölund** and M.Sc. (Tech.) Timo **Naskali** were appointed as investigators in the team. The investigation has been conducted in cooperation with Bahaman and Estonian safety investigation authorities. The safety investigation report was translated into English by Käännöspolku Oy.

The investigation team arranged a hearing with the owner and the CEO of the company of the fishing vessel FLORENCE soon after the accident. The Estonian maritime administration provided the material of the fishing vessel masters' hearings. The Finnish Border Guard provided the investigation team with the records of the hearings of both fishing vessel masters as well as the ROV video material from the sinked fishing vessel. Three members of the investigation team were present when the master of the FLORENCE gave a maritime declaration. The record of the maritime declaration has been available to the investigation team.

The investigators received written statements on the incident from the AMAZON master, OOW and watchkeeping rating, and later on a further written clarification from the OOW. Furthermore, the vessel's drawings have been available to the investigators.

For the purposes of the investigation, the accident was reconstructed using a ship simulator. The objective of the simulations was to investigate what the situation looked like from the bridge of the AMAZON just before the accident, and other alternatives to avoid the collision (Appendix 4).

The objective of the SIAF's investigation is to improve safety. Questions on liability and compensations for damage will be ignored. Neither the contents nor the style of the investigation report are intended to be used in a trial. The conclusions and safety recommendations made in the report do not postulate liability or obligation for damage compensation.

The final draft of the investigation report was finished on 16 January, 2013. It was submitted for comments on 16 January, 2013. The comments have been taken into consideration when finishing the report. The comments received are available in the appendix.

The investigation was finished on 22 May, 2013 and the report is available online at www.sia.fi. The investigation materials have been stored in the SIAF's premises.

The time zone used in the investigation report is UTC+3 unless otherwise stated.

1 EVENTS AND INVESTIGATIONS

1.1 Vessels

1.1.1 General information

AMAZON

Image 1. The AMAZON off Hanko after the collision.

Name	M/V AMAZON (ex DS MIRAGE, ex CLIPPER MIRAGE, ex PROKOP HOLY)
Type	General cargo vessel
Nationality	the Bahamas
Home port	Nassau
Call sign	C6QI2
IMO number	9138616
MMSI	308287000
Place and time of construction	Guangzhou Shipyard International CO. Ltd, in 1997
Length overall	172 m
Beam (moulded)	25 m
Draught	10.1025 m (summer load line)
Gross tonnage	16405
Net tonnage	9211
DWT	26096
Freeboard	4.23 m (summer load line)
Owner	Amazon Navigation CO LTD, Greece
Operator	Tide Line, Greece
Classification society	Nippon Kaiji Kyokai
Class	NS(BC)(ID IS)(ESP)/MNS
Main engine	Hudong Zhoughua 6L50MC, 111 RPM
Output	4949,71 kW (MCR)
Propulsion	1 x rudder and 1 x fixed pitch propeller
Max. speed	15.8 knots

FLORENCE

Image 2. FLORENCE in 2003. *(© Markku Saiha)*

Name	F/V FLORENCE (FIN-1110-U) (ex DRIE GEBROEDERS 1987, ex JANNEKE 1974, ex J.F KENNEDY 1970, ex PIETER JUNIOR 1968, ex ZEEZWALUW 1964)
Type	Fishing vessel
Nationality	Finnish
Home port	Pori
Port of registry and registry number	Helsinki 11780
Owner	M.R. Trooli Oy, Helsinki
Call sign	OF-2173
INMARSAT number	423033312
MMSI	230333000
Place and time of construction	NV Scheepsbouwwerf en Machinefabriek H. de Haas – Maassluis, Netherlands 1962 (Hull no 116)
Construction material	Steel
Length overall	27,56 m
Length between perpendiculars	23.23 m
Beam	6.3 m
Height	2.9 m
Gross tonnage	105
Traffic area	Fishing area II
Class	Trafi
Max. number of persons	3 persons
Main engine output	345 kW
Max. speed	approx. 10 knots

M.R. Trooli Oy bought the FLORENCE from the previous Finnish owner in June 2009. After the purchase the vessel was taken to the Reposaari shipyard, where she was reconditioned. A partition wall and a new longitudinal bulkhead were installed into the hold. A new fishing pump was also installed.

MENHADEN

Image 3. The MENHADEN in 2008. *(© Mika Muhli)*

Name	F/V MENHADEN (FIN-164-0)
Type	Fishing vessel
Nationality	Finnish
Home port	Haukipudas
IMO number	7817153
Port of registry and registry number	Helsinki 12357
Owner	Menhaden Oy, Oulu
Call sign	OJLM
Place and time of construction	Scheepsbouw- en Constructiebedr. K. Hakvoort B.V., Monnickendam, Netherlands 1979 (Hull No.162)
Construction material	Steel
Length overall	27.02 m
Length between perpendiculars	23.90 m
Beam	7.4 m
Draught	2.59 m
Height	3.71 m
Gross tonnage	229
DWT	174
Traffic area	Fishing area II
Max. number of persons	3 persons
Main engine output	749 kW
Max. speed	approx. 10 knots

1.1.2 Manning

AMAZON

On the accident voyage, the AMAZON had an international crew of 24 men. The vessel was properly manned. Most of the officers were from Ukraine and most of the deck crew from Myanmar. The size of the deck crew far exceeded the minimum safe manning requirements. The engineering crew included one Russian citizen and one Polish citizen.

The master of the vessel (born in 1958) was a citizen of Ukraine. He had been working at sea since 1976. The master's certificate of competency had been issued on 20 March, 2003. After the latest renewal, the certificate was valid from 7 June, 2011 to 8 April, 2016. He had been working for the same company since 1999. He had been working on the AMAZON since 8 September, 2011. This was his first assignment on this vessel. The master was not on the bridge at the moment of the accident.

At the moment of the accident, the OOW was the vessel's Ukrainian chief officer (born in 1956). He had been working at sea since 1980. He had worked as a radio operator until 1999, and then undertook studies for a deck officer's certificate of competency[1], which was issued to him in 2000. His current Chief Officer's Certificate was issued in Ukraine in 2004, and it is valid from 17 June, 2009 to 13 May, 2014. In addition, he had a certificate for radar navigation (Radar, ARPA, Bridge Team Work and search and rescue). He had worked as chief officer on general cargo vessels and bulk carriers since 2006. He was well-acquainted with the Gulf of Finland as a navigation area.

The chief officer had started working on the AMAZON on 21 October, 2011, two days before the accident occurred. This was his first voyage on the AMAZON and in the service of the employer. He was familiarized to the ship in the port of St. Petersburg by the previous chief officer and the vessel's master on 21 and 22 October, 2011. The familiarization included information on cargo and ballast matters, bridge equipment and its use, security and fire fighting equipment as well as all the procedures given in the vessel's safety management system.

The vessel had two familiarization checklists. The first was applied when familiarising the whole crew to the vessel; these familirazions were conducted by the chief officer on Friday 21 October, 2011. The other checklist, which dealt with vessel safety, only concerned the deck officers. As a security chief, the vessel's master familiarized the chief officer to the vessel in accordance with this checklist on Saturday 22 October, 2011. On the same day, the chief officer also read the master's standing orders and signed the document.

According to the vessel's shift list, the watchkeeping rating assigned for the chief officer's watches from 04:00 to 08:00 and from 16:00 to 20:00 was an able bodied seaman from Myanmar (born 1984). According to the shift list, the able bodied seaman was assigned to deck work after the morning sea watch, between 08:00 and 10:00. The watchkeeping AB had been working at sea for approximately four years and he had

[1] Class 3 deck certificate

been issued an able bodied seaman's certificate of competency on 19 August, 2008. He had been working on the AMAZON since 25 January, 2011, for about nine months at the time of the accident. This was his first assignment working for the employer and on this vessel.

FLORENCE

On the accident voyage, the FLORENCE had an Estonian crew of four. According to the vessel's inspection certificate, the maximum allowed number of persons onboard the vessel was three. However, a deck officer had been taken onboard as the fourth member, as he had useful experience on pair trawling.

At the time of the accident, the only person on watch duty on the bridge was the vessel's master (born in 1965). He had received his education in a fishing industry institute in Tallinn, after which he had been issued with an Estonian deck officer's certificate for vessels with a gross tonnage of over 500. The certificate of competency is valid until 18 December, 2014. According to the Finnish Transport Safety Agency, it is not endorsed in Finland, as national Estonian certificates are not of STCW level.

The master had been working at sea since 1988 and as a deck officer since 1991. Between the years 1990 and 1994, he primarily practised pair trawling, but switched to single-vessel trawling later on. He had trawled as the master of the FLORENCE in pair with the MENHADEN 5 or 6 times before the accident. The master had been working on the FLORENCE since 1 January, 2011.

The deck officer of the FLORENCE (born in 1963) had a STCW-level certificate of competency that was endorsed in Estonia until 14 June, 2011. It was thus outdated at the time of the accident and could not have been endorsed after 14 June, 2011.

In addition, the crew included an Estonian engineer (born in 1956) and a deck rating (born in 1980), of whom no register information was found in Finland. It is possible for support level crew to work on Finnish vessels while only registered in their own national register.

The crew of the FLORENCE exceeded the allowed number of persons onboard, the deck officer's certificate of competency was outdated, and the master was acting as master of a Finnish fishing vessel, although he held an Estonian certificate of competency. Therefore, the manning of the FLORENCE was not adequate.

MENHADEN

On the accident voyage, the MENHADEN had a three-man crew. At the time of the accident, the vessel's Estonian master (born in 1973) was alone on the bridge on watch duty.

The master's Estonian certificate of competency had been issued Finnish endorsement for the period between 22 August, 2011 and 24 August, 2012. This gave him the right to act as master on vessels with a gross tonnage of no more than 500 in the Baltic Sea; however, the vessels in question could not be oil, chemical or LPG tankers or passenger

ships. The master's competency also excluded vessels that require ECDIS and ARPA. The master was appropriately competent.

The master had 20 years of seafaring experience and seven years of experience in pair trawling. He had 14 years worth of experience in acting as master. He had been working on the MENHADEn for two years, of which one and a half as master.

1.1.3 Bridge and bridge equipment

AMAZON

The layout of the AMAZON's bridge is traditional and the wings of the bridge are open (image 4). The OOW's chair is located by the steering console slightly on the starboard side of the vessel (image 4, number 5). The chart table is located behind the OOW's chair (image 5).

The bridge is equipped with 3 cm (x-band) and 10 cm (s-band) radars. In addition to the radars, other location equipment onboard includes a DGPS navigator and an electronic chart system which was not in accordance with the ECDIS standard. The communication equipment consists of a normal marine VHF radio and a radio station along with its devices. The steering equipment consists of autopilot and an engine order telegraph.

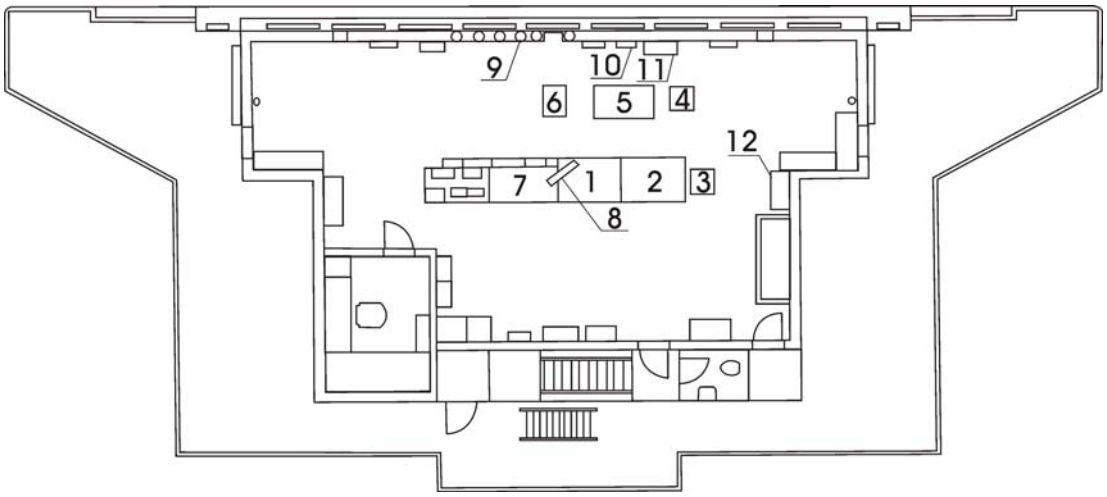

Image 4. The AMAZON bridge and the positions of equipment relevant to the case.

Table 1. Legend of numbers on image 4.

1	Chart table	7	Radiostation
2	Chart table	8	ECS display TRANSAS (unofficial)
3	10 cm radar (ARPA) Kelvin Hughes	9	Rudder angle display
4	3 cm radar (ARPA) JRC	10	Foghorn timer
5	Steering console	11	VHF radiophone
6	Handwheel and autopilot	12	AIS FURUNO

Image 5. The bridge of the AMAZON. In the dark the chart table is separated from the rest of the bridge with a curtain, as shown in the image. It obstructs the view outside from the chart table.

The four cranes on the AMAZON obstruct the view from a certain angle on the bridge (image 6).

Image 6. View forward from the AMAZON bridge. (Picture taken by the master of the vessel.)

FLORENCE

A drawing of the bridge of the FLORENCE is shown in image 7, based on a drawing by the vessel's master. According to the master, the vessel was equipped with a Furuno GPS, three Furuno sonars, two VHF radiophones and one Simrad VHF radiophone, a Raytheon GPS, a Furuno radar and an electronic chart system, Navigator fishing pro. The vessel had no AIS device. The radars did not have ARPA capability.

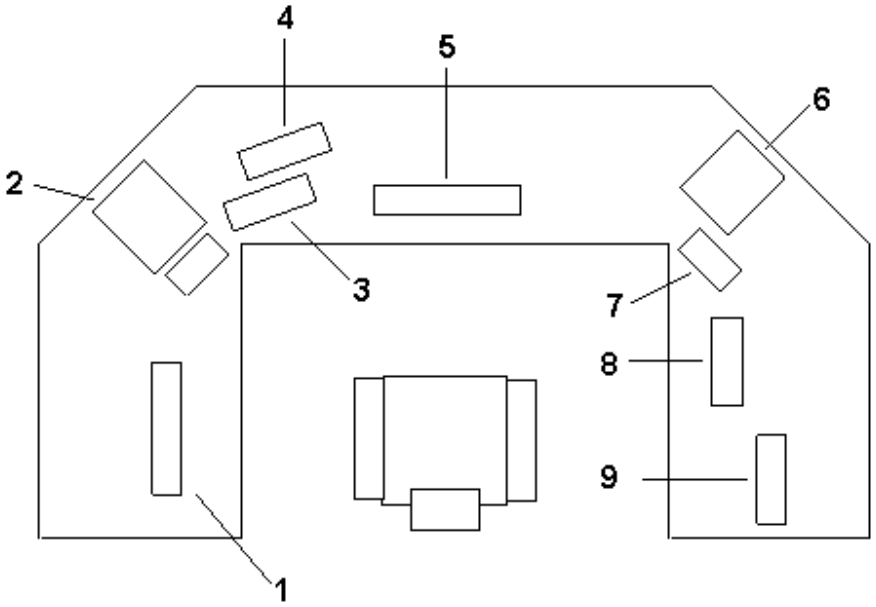

Image 7. The bridge and the devices of the FLORENCE according to a drawing by the vessel's master.

Table 2. Legend of the numbering on image 7.

1	Electronic chart system, Navigator fishing pro	6	Furuno Radar (on standby)
2	Furuno Radar (in use)	7	Raytheon GPS
3	Sailor VHF radiophone	8	Sailor VHF radiophone
4	Simrad Fish Finder echo sounder	9	VHF radiophone
5	Furuno GPS		

MENHADEN

According to the master of the MENHADEN, the vessel's bridge equipment comprised:

- a helm,
- autopilot Robertson connected to a gyro-compass, including manual controls
- an engine order telegraph,
- a Koden radar (not in use),
- a standby Furuno radar (in use at the moment of the accident),
- Fishing-Pro electronic chart,
- a radio station with two Sailor radiophones,
- emergency mobile phone
- a GPS device,
- Furuno and JRC echo sounder, and
- a magnetic compass.

The radars did not have ARPA capability.

1.1.4 Cargo

MV AMAZON

The AMAZON had been loaded in the port of St. Petersburg with 24,540 tonnes of potassium carbonate, which is used as fertilizer. Potassium carbonate is not considered hazardous to the environment.

FV FLORENCE and FV MENHADEN

The FLORENCE and the MENHADEN had started trawling as a pair approximately two hours before the accident, thus neither of them was yet carrying fish.

1.2 The accident event

1.2.1 Weather conditions

According to the marine weather report given on the previous evening at 21.50 by the Finnish Meteorological Institute, the Gulf of Finland had west wind 11 m/s. An area of high pressure was expected to move over Finland towards east. The forecast for the Gulf of Finland until the following evening predicted western winds 7–11 m/s. The wind was expected to weaken to 2–7 m/s starting before noon. Visibility was estimated to be mostly good. On the day of the accident, the sun rose in Helsinki at 08:19.

On the night of the accident, there was an area of stratus cloud over the south-western archipelago that also reached Porkkala and the western Gulf of Finland early in the morning. The weather observations did not detect any rains on the Gulf of Finland. Weather in the central parts of the Gulf of Finland was clear and visibility was good. The Finnish Meteorological Institute estimated that visibility within the stratus cloud and in its

border areas was at least 300–400 metres. A satellite image of the clouds taken at 05:53, approximately one hour after the accident, is shown in image 8.

The meteorological stations closest to the accident site are Bågaskar in Inkoo, approximately 35 km to the northwest, and Jussarö in Raasepori, approximately 60 km to the west-northwest. At the Bågaskär station in Inkoo, visibility was 8–11 kilometres at the time of the accident, but it fell rapidly within a period of twenty minutes and remained at an average of 440 metres for the next two hours. The temperature was 7.5 °C. At the Jussarö station in Raasepori, visibility was 520 metres at the time of the accident and remained at an average of 580 metres for the two hours that followed. Wind speed was at 5.7 m/s and air temperature was 8.5 °C. At the Helsinki lighthouse, the average speed of wind at the time of the accident was 4.7 m/s and air temperature was approximately 8 °C.

The observations made by the coastal meteorological stations cannot be used to determine the actual circumstances at the accident site, as visibility, for example, may suddenly be reduced locally. In addition, darkness made observation more difficult, as sun had not yet risen.

According to the parties of the accident as well as those conducting the search and rescue operation, visibility in the area of the accident was occasionally just some dozens of metres. A photograph taken in daylight some time after 11 in the morning (image 23) gives a suggestion of what visibility may have been like in the fog. According to the master of the FLORENCE, he saw the lights on the MENHADEN before the collision. At the time, the distance between the two trawling vessels was around 200 metres. The master of the MENHADEN estimated that visibility in the fog was between 50 and 70 metres. The watchkeeping officer of the AMAZON recounted not being able to see the vessel's front crane, which suggests that visibility was approximately 100 metres at best.

According to the measurements of a data buoy located some 22 nautical miles to the east-northeast from the accident site, the significant wave height[2] at the moment of the accident was at 1.15 metres and the wave direction was 244°. Water surface temperature was 9.15°C. The Meteorological Institute forecast for wavelength around the time of the accident was over 80 metres.

[2] Significant wave height refers to the height difference between the wave's crest and its trough. It is used to describe the average height of waves in rough sea. In deep waters the significant wave height corresponds to approximately the average of the highest third of waves.

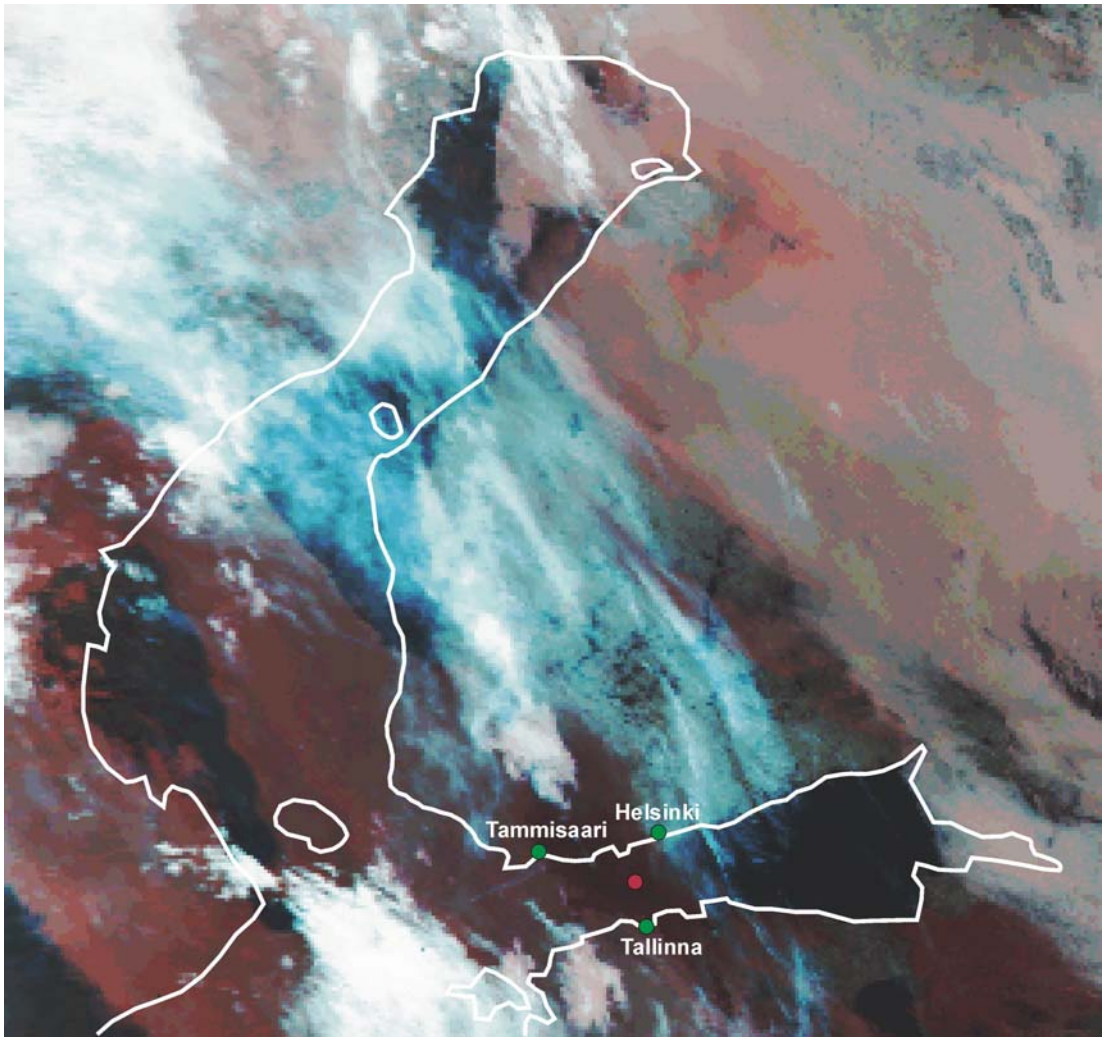

Image 8. Satellite image taken on 23 October, 2011 at 05:53, approximately one hour after the accident. The accident site[3] is marked with a red spot. There are low clouds from Tallinn towards Tammisaari and west of the area. Low clouds are visible in the image as purple.
(Source of base image: Finnish Meteorological Institute)

1.2.2 The accident voyage and preparations for it

FLORENCE and MENHADEN

The MENHADEN was normally trawling in pair with another fishing vessel of the same owner, the BALTIC. The BALTIC had been stranded and badly damaged at the beginning of October, 2011[4]. As the BALTIC was not available for fishing, the FLORENCE, which was owned by M.R. Trooli Oy and normally trawled alone, was

[3] A darker shade of purple can be seen near the site of the accident. Clear sea is shown as black (eastern parts of the Gulf of Finland). Low clouds visible in the image were very low, but it is not possible to tell whether or not they actually reached the level of the sea.

[4] Investigation B3/2011M FV BALTIC (FIN) drifting to a shoal and the evacuation of crew on the Estonian coast 4.10.2011

made the MENHADEN's trawling partner. The MENHADEN and the FLORENCE had trawled as a pair 5 to 6 times before the voyage on which the accident occurred.

The MENHADEN left with a crew of three the port of Paldiski, located approximately 45 km west of Tallinn, at 21:30 on 22 October, 2011. An hour later, at around 22:30, the FLORENCE left with a crew of four the Miiduranna port, northwest of Tallinn, towards the Finnish economic zone. There was no specific plan for the fishing, they were merely intending to fish in the areas that the echo sounder would show to have fish. Once the catch was large enough, they would stop fishing, the catch would be hoisted aboard the MENHADEN and they would return to port.

At around 02:20, the fishing vessels stopped next to each other on the ”TSS off Porkkala Lighthouse" traffic separation scheme lane for west-bound vessel traffic from Tallinn. The vessels began preparing for pair trawling, and the trawl was prepared to be set (image 9).

The fishing vessels made no notice to Helsinki Traffic about crossing the GOFREP reporting line. Neither was notice given on restricted manoeuvrability after the vessels had started pair trawling.

The accounts of the two fishing vessel masters are contradictory on how the responsibilities of fishing and navigation were distributed between the vessels and what the main contact channel on the VHF was. According to the master of the FLORENCE, it had been agreed that the MENHADEN would be in charge of the fishing and monitoring the surrounding traffic, while the FLORENCE would keep the length of the trawl’s steel ropes and the distance to the MENHADEN correct. On other matters, they would act according to the circumstances. The Master of the FLORENCE stated that the VHF communication channel they had agreed on was channel 15, but that they had not agreed on regular communications. He stated that the distribution of duties had been arranged verbally on previous trawling occasions. One reason for this kind of task distribution was the fact that the MENHADEN had more radars than the FLORENCE.

According to the master of the MENHADEN, it had been agreed that the MENHADEN would make the decisions relevant to fishing activities. However, both vessels would be responsible for safe navigation, as usual. Course would be chosen by mutual agreement. The master of the MENHADEN stated he had used VHF channel 12 for communications with the FLORENCE, but he also said that channel 15 was used in case there was interference in the connection. Furthermore, channel 16 was listened to. He stated that the communications were functional at all times, but that the masters did not discuss much, as they did not know each other well. The VHF connection was only used if something was not working according to plan or changes needed to be made; silence was a sign of all things working properly. The masters of the vessels did not have each other’s mobile phone numbers.

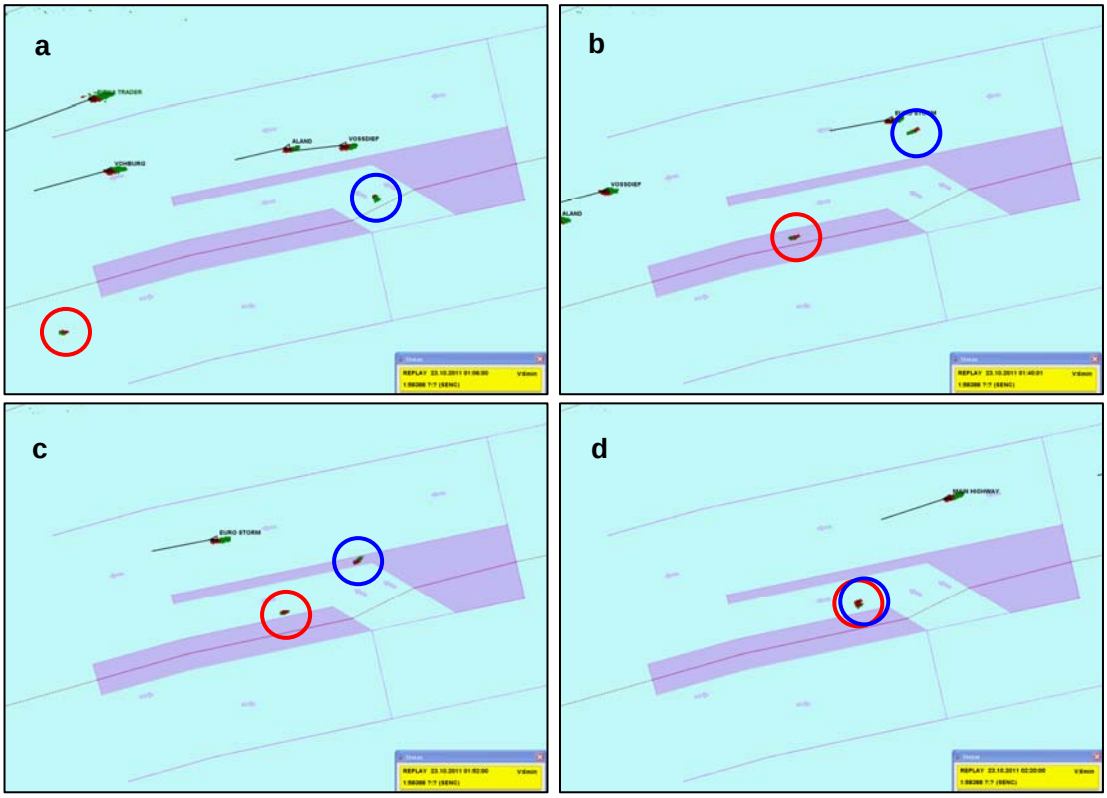

Image 9. The beginning of the trawling in screenshots taken from the VTS recording. The MENHADEN is marked on the picture with a red circle and the FLORENCE with a blue circle. (© Finnish Transport Agency)

a At 01:06: the Florence has arrived at the TSS feeder lane. The MENHADEN is on her way.

b At 01:40: the FLORENCE has started moving against the east-bound traffic of the TSS, passing an oncoming container ship.

c At 01:52: the FLORENCE is approaching the MENHADEN, stationary on the feeder lane for west-bound vessel traffic from Tallinn.

d At 02:20: the radar echoes from the fishing vessels have merged into one. Preparations for trawling have been started.

At approximately 02:30, the vessels started pair trawling, moving eastwards. The fishers stated that visibility was good at the time. During the trawling, the fishing vessels moved at a speed of approximately 2.3 knots on courses of 60–70°. Distance between the vessels was approximately 1–1.5 cable lengths[5] (185–280 m). In addition to the normal navigation lights, the vessels also had their fishing lights[6] switched on.

The master of the MENHADEN was monitoring the trawling's progression by radar with the radar's scale set at 6 miles. The master of the FLORENCE was monitoring the distance between the vessels by radar with the scale set at 0.25 miles, as assessing the

[5] One cable length is one tenth of a nautical mile , 1852 m/10 = 185.2 m.

[6] In addition, the master of the FLORENCE stated seeing that the lights inside the MENHADEN's bridge were switched on. The master of the MENHADEN stated thta the MENHADEN's search light was switched on and pointed at the FLORENCE

distance by eye was not accurate enough. He would occasionally change the scale to six miles to observe a larger area of the environment.

In both fishing vessels, the masters were alone at the bridge while the rest of the crew was sleeping. For both masters, this voyage was the first after an off-duty period. They stated they were feeling well-rested.

According to the masters, the vessels drifted into fog at around 04:30, after having trawled for approximately two hours. The thick fog made visual observing difficult and they had to rely on the radar alone. At the same time, the fishing vessels moved out of the TSS traffic separation zone and into the precautionary area (image 10 d). The pair trawling vessels were moving eastwards.

The master of the FLORENCE recounted noticing the AMAZON approaching from the east when her distance to the fishing vessels was approximately 6 miles. He assumed the vessel would pass the pairtrawling vessels on the port side. He monitored the situation on the radar for a few minutes and afterwards checked the AMAZON's movements only occasionally. The next time he reviewed the situation with a scale of six miles, the distance to the AMAZON was about three miles. The master did not consider the situation to be threatening, and switched the scale back to 0.25 miles. He did not report his observations to the MENHADEN.

The master of the MENHADEN stated he had noticed the AMAZON for the first time when the distance between the fishing vessels and the AMAZON was approximately 5 miles. Like the master of the FLORENCE some time before, also the MENHADEN master concluded, based on his observations, that the AMAZON and the pairtrawling vessels would pass each other with their port sides facing. He thought maintaining the current course and speed would be enough to avoid a close-quarter situation. He did not report his observations to the FLORENCE.

The trawling's progression is presented in screenshots of the VTS recording in image 10.

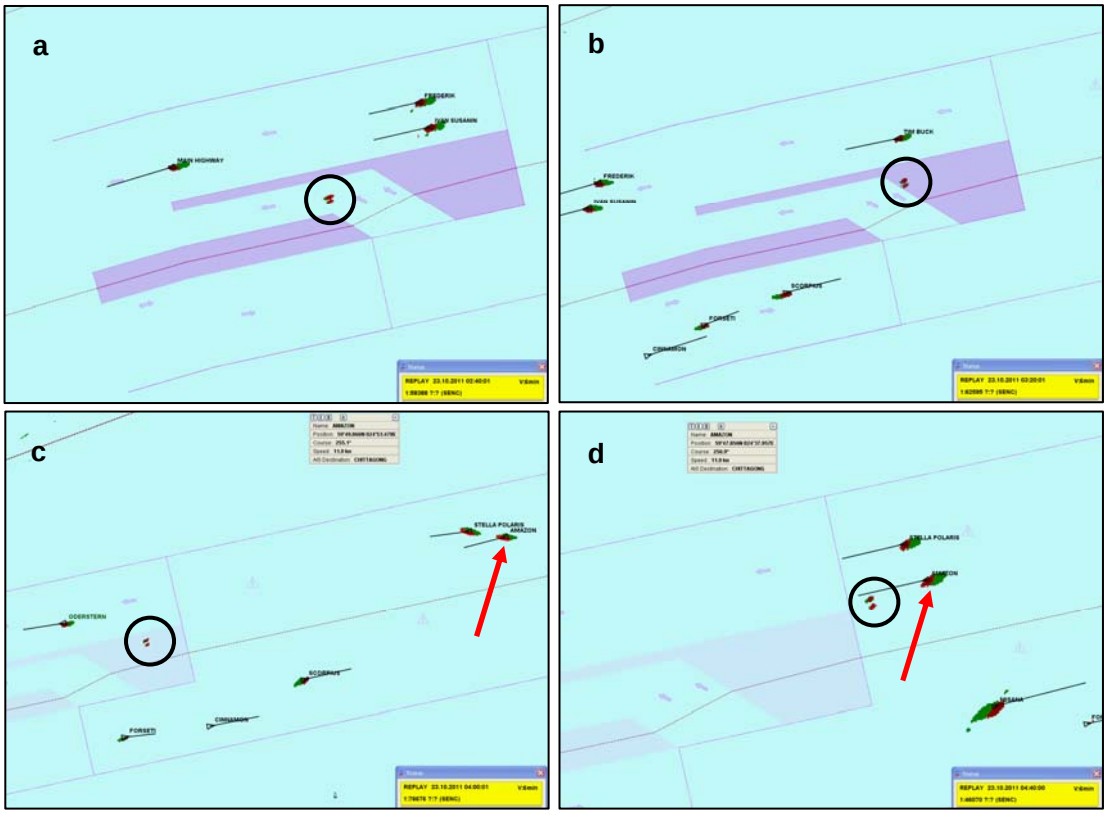

Image 10. Progression of the trawling. The pair-trawling vessels have been marked with a black circle and the AMAZON with a red arrow. (© Finnish Transport Agency)

a At 02:40: the vessels have started trawling a moment before.

b At 03:20: the fishing vessels have been trawling for approximately 50 minutes and they have moved to the traffic separation zone between the lanes.

c At 04:00: the fishing vessels are approaching the eastern border of the traffic separation zone. The AMAZON is approaching from the east.

d At 04:40: the fishing vessels have proceeded on the same course, moving out of the traffic separation zone and into the precautionary area. The moment of collision is approximately four minutes away. The AMAZON has not changed course to give way to the fishing vessels (the vector of the vessel is pointing forwards).

AMAZON

The AMAZON left the port of St. Petersburg at 11:50[7], carrying a cargo of potassium carbonate and heading to Chittagong, Bangladesh. The pilot left the vessel earlier than normally due to the poor weather conditions. The master steered the vessel through narrow passages until the start of the actual sea voyage at 15 hours, when the master passed the command to the chief officer. On the vessel the master had no actual sea

[7] Ship's time on the AMAZON has been changed to Finnish daylight saving time (UTC+3) to maintain correspondence with the time on the fishing vessels.

watch, as the watch was assigned to the three deck officers on the vessel, so that the chief officer's watches took place from 04 to 08 and from 16 to 20, and the watches of the two other officers between 00–04 and 12–16 and between 08–12 and 20–24.

It was the first time the chief officer acted as OOW onboard this vessel. Traffic was abundant and the master stayed on the bridge for two hours to ensure that the new chief officer could manage as an OOW and that he knew how to use the bridge equipment. At the start of the voyage, they moved along the Gulf of Finland TSS, towards the northern Baltic Sea. After his watch, the chief officer retired into his cabin to rest[8] at around 20 hours (21 hours ship's time).

The chief officer[9] began another sea watch at 03:00 (the 04–08 watch in ship's time). There are contradictory accounts[10] on whether a lookout was on the bridge. The vessel was moving on autopilot in direction 260 degrees at a speed of 11.5 knots. There were two radars on the bridge, one with a scale of 12 miles and the other with a scale of 6 miles, with the distance rings between 1 nautical mile on the latter. The wind was WSW 5[11] and visibility was good. The traffic situation was calm and there was some traffic on the oncoming lane. Tanker STELLA POLARIS was travelling to the same direction as the AMAZON, about 2 miles ahead on the starboard side of the bow.

According to the OOW, fog reduced visibility to very poor at approximately 03:50. The vessel's frontmost crane was not visible through the windows of the bridge. According to the OOW, he had switched on the fog horn[12] and proceeded on autopilot, maintaining radar lookout. The OOW did not call the master to inform of poor visibility, even though the master's standing rules dictated this should be done if visibility went down to 3 NM.

At around 04:00, the AMAZON reached the STELLA POLARIS, moving at a speed some 1–2 knots slower, and the OOW began passing her on the port side, changing the direction two degrees to port to direction 258° (image 10 c below). The passing took a long time due to the small difference in the vessels' speeds.

At approximately 04:25, the OOW reported having noticed a radar echo of a vessel approximately 4 to 5 nautical miles ahead. The ARPA data on the radar indicated the echo was moving at a speed of 2–3 knots in direction 78 degrees, more or less to an opposing direction to that of the AMAZON. The expected closest point of approach, CPA, was between 0.4 and 0.5 miles. At times the radar detected two separate echoes, but at times only one.

At 04:36, the CPA and TCPA values set for the radar were exceeded for the first time, which set off the radar's alarm. The OOW acknowledged the alarm, but took no further

8 In practice, the resting time is approximately six hours, as you will not fall asleep immediately after entering the cabin and crewmembers were woken up for the next duty thirty minutes in advance.

9 The chief officer will be hence referred to as the OOW.

10 In a written statement on 27 October, 2011, the able seaman stated that he had been on lookout at the time of the accident. He had neither seen nor heard anything concerning the accident. Also the chief officer stated that the able seaman had been on lookout. As no communication can be heard on the S-VDR audio recording before or after the accident, it cannot be confirmed tha a lookout was present on the brigde of the AMAZON.

11 WSW, 5 Beauforts of the west-southwest

12 The signals are not audible on the vessel's S-VDR recording.

measures. The alarm limits on the radar were exceeded more than once[13], setting off the collision alarm. The alarms were acknowledged.

The ARPA monitoring altered between the trawlers when they were located close to each other, which skewed the course and speed data the ARPA system displayed on the radar screen. This further affected the CPA value. The bearing towards the target never changed significantly, and therefore the danger of collision was evident.

1.2.3 Site of the accident

The accident took place in the Gulf of Finland, in the sea area between the Porkkala peninsula and the Estonian Naissaar island, at lat 59°47,5N, long 024°36,6E[14] (Img 11).

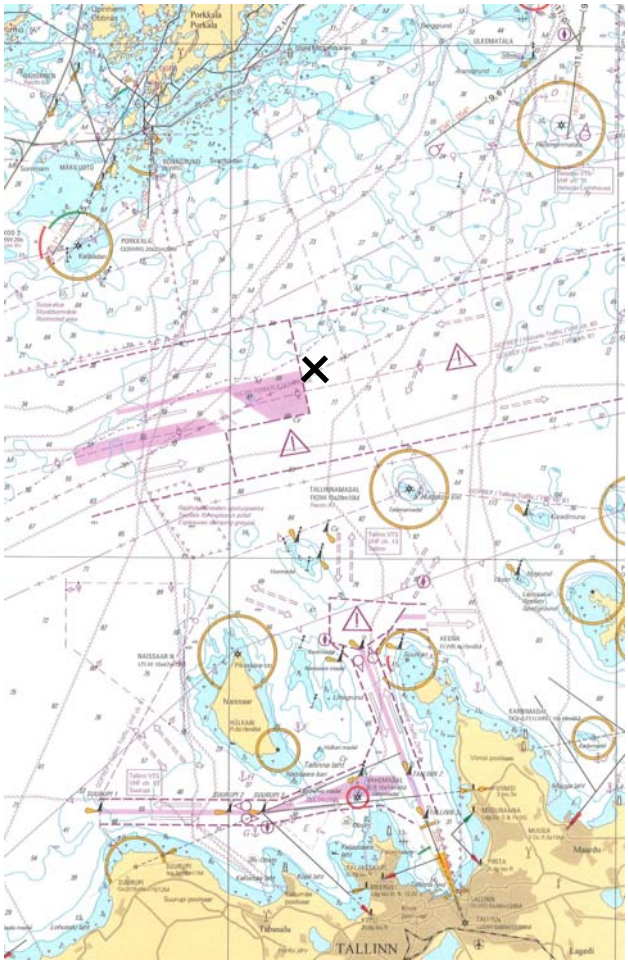

Image 11. The site of the accident is marked on the map with a black cross. The precautionary area is marked with exclamation signs placed inside triangles. In the image the area begins east of the vertical stepped dash line. The arrows shown on the precautionary area indicate the recommended direction of traffic flow. (© Finnish Transport Agency)

13 The alarm signals are audible on the soundtrack of the S-VDR recording.

14 The coordinates for the site of the accident were acquired through the VTS recording. For comparison, the coordinates on the Conning display of the AMAZON's S-VDR recording at the time the sound of the collision can be heard are lat. 59°47,55N and long. 024°36,47E.

The site of the accident is located in the open sea, east of the TSS off Porkkala Lighthouse traffic separation zone in the precautionary area, where the routes of westbound vessel traffic and the vessels sailing between Tallinn and Helsinki cross. The precautionary area is marked on the nautical chart with attention signs. The depth of water in the area is 60–70 metres.

1.2.4 The accident

Of the two echoes detected by the AMAZON's radar, the left one (that of the FLORENCE) disappeared from radar at around 04:40 (image 12). This was interpret by the OOW of the AMAZON as two echoes merging into one. The Anti Clutter Sea and rain settings of the AMAZON's radar were set to automatic (explained in more detail in Appendix 3).

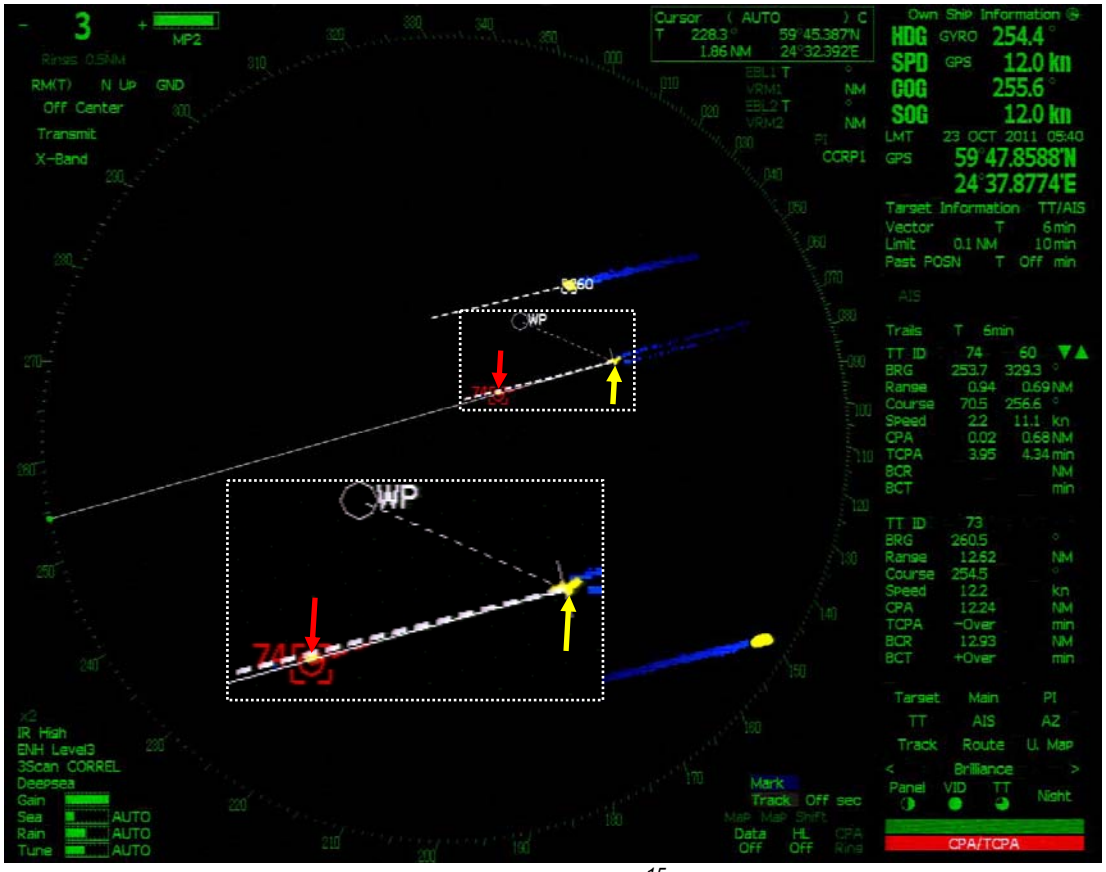

Image 12. A screenshot of the S-VDR recording[15], some time before the AMAZON began changing her course. At 04:40:12, 3.5 minutes before the collision. The course of the AMAZON is 255.6° and speed of 12 knots. The AMAZON is marked with a yellow arrow and the MENHADEN with a red arrow; the echo of the FLORENCE is not visible on the radar. The fishing vessels are 0.94 miles away from the AMAZON. The STELLA POLARIS is shown on the starboard side of the AMAZON in the image.

[15] The OOW of the AMAZON used both this x-band radar (used by the S-VRD recorder to record the radar image) and another s-band radar (cf. appendix 2). The sea and rain clutter adjustments on the recorded radar had been set to automatic.

When the approaching echo was some 0.6–0.7 miles ahead, the AMAZON's OOW noticed that the target's vector was growing longer and her course was changing. He assumed that the target had increased her speed and was now moving towards them, as also the CPA value was zero. The OOW decided to change course to avoid collision. As the tanker STELLA POLARIS was moving to the same direction as the AMAZON approximately 0.8 miles ahead on starboard side, the OOW decided to change course to port and did this on autopilot (image 13). The distance between the fishing vessels and the AMAZON was 0.58 miles when the vessel started changing her course.

The development of the situation has been depicted in more detail with radar images in Appendix 1.

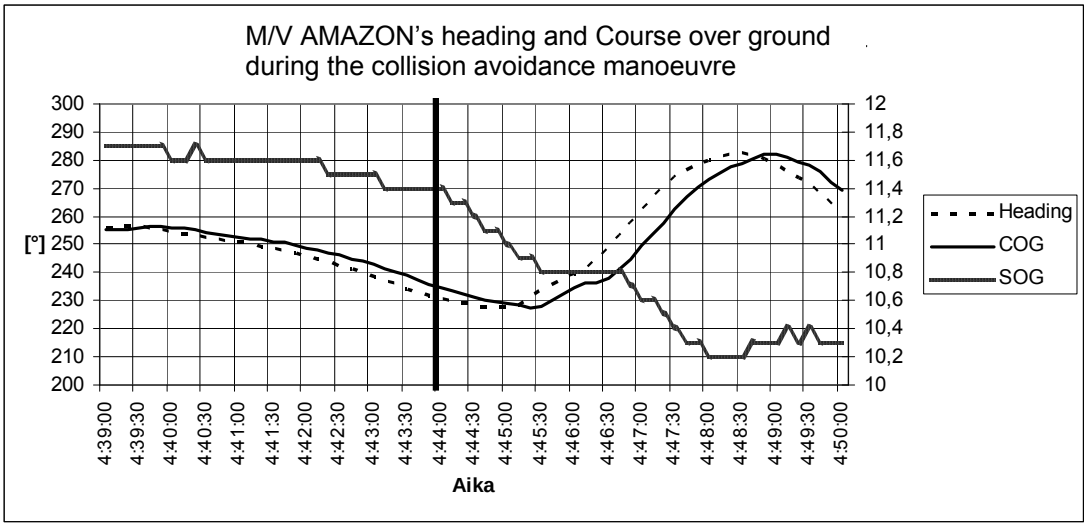

Image 13. Graphs of the AMAZON's course, heading and speed before and after the accident based on the vessel's S-VDR data. The moment of collision has been marked on the chart with a thick black vertical line. Legend:

Heading = direction of the bow
COG = Course over ground
SOG = Speed over ground

Earlier, the master of the MENHADEN had concluded that there was no danger of collision with the oncoming AMAZON and the vessels would pass each other with their port sides facing. After this he kept the radar's scale at six miles and observed the incoming encounter by radar, occasionally also reviewing the trawling situation as monitored by the echo sounder. As the AMAZON approached, her echo on the MENHADEN's radar was merged with the echoes from the fishing vessels. According to the master of the FLORENCE, the radar echoes also merged on the radar of the FLORENCE when the scale was set to six miles some time before the collision. When the master of the FLORENCE changed the radar's scale to 0.25 miles, the radar no longer detected anything.

The master of the FLORENCE recounts seeing just before the accident the green and white fishing lights on top of each other on the MENHADEN's mast, the green starboard

side navigation light and the stern light, as well as the lights on the bridge of the MENHADEN. The master of the MENHADEN said that he monitored the radar and did not maintain visual lookout.

The master of the FLORENCE recounts seeing the white navigation light on the bow of the cargo vessel when the AMAZON was approximately one cable length away from the fishing vessel. The master of the FLORENCE began signalling with the fog horn. The fog horn's control button on the bridge was jammed and the signal became continuous[16].

The master of the FLORENCE recounts calling the MENHADEN on VHF channel 15 twice before the accident, shouting that a vessel was heading straight at them. The master of the MENHADEN told that he never heard the call and thus failed to respond to it. According to the Master of the FLORENCE, he switched the main engine to run idle.

There was no radio communication between any of the vessels before the collision.

The OOW of the AMAZON changed the course of the vessel a little less than 30 degrees to the port on autopilot (image 13). Collision with the MENHADEN was avoided, but the AMAZON proceeded directly at the FLORENCE.

The port side of the AMAZON's bow hit the port side of the FLORENCE. The AMAZON's OOW felt a soft bump to the hull of the vessel and assumed they had hit a fishing buoy or something similar.

After the collision, the FLORENCE was dragged along[17] with the AMAZON for about ⅓ of a mile before disengaging (image 14). According to the VTS recording, the collision occurred at 04:44.

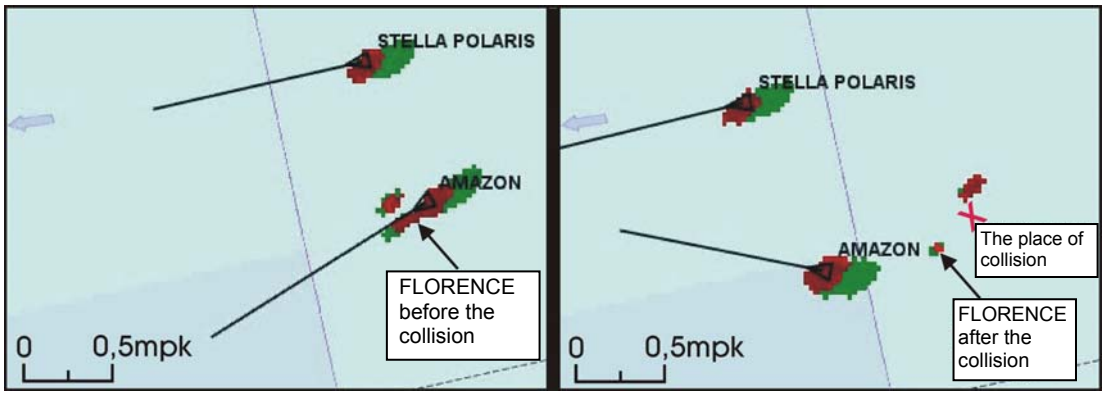

Image 14. At the collision the FLORENCE was moved approximately ⅓ of a nautical mile against her original direction. (© Finnish Transport Agency)

16 The signal is not audible on the AMAZON's S-VDR recording.

17 The distance has been estimated in accordance with the VTS recording and the AMAZON's AIS coordinates. The notion of the FLORENCE being dragged after the collision is supported by the fact that the vessel's wreck was discovered near the spot where it was last detected on the VTS-recording.

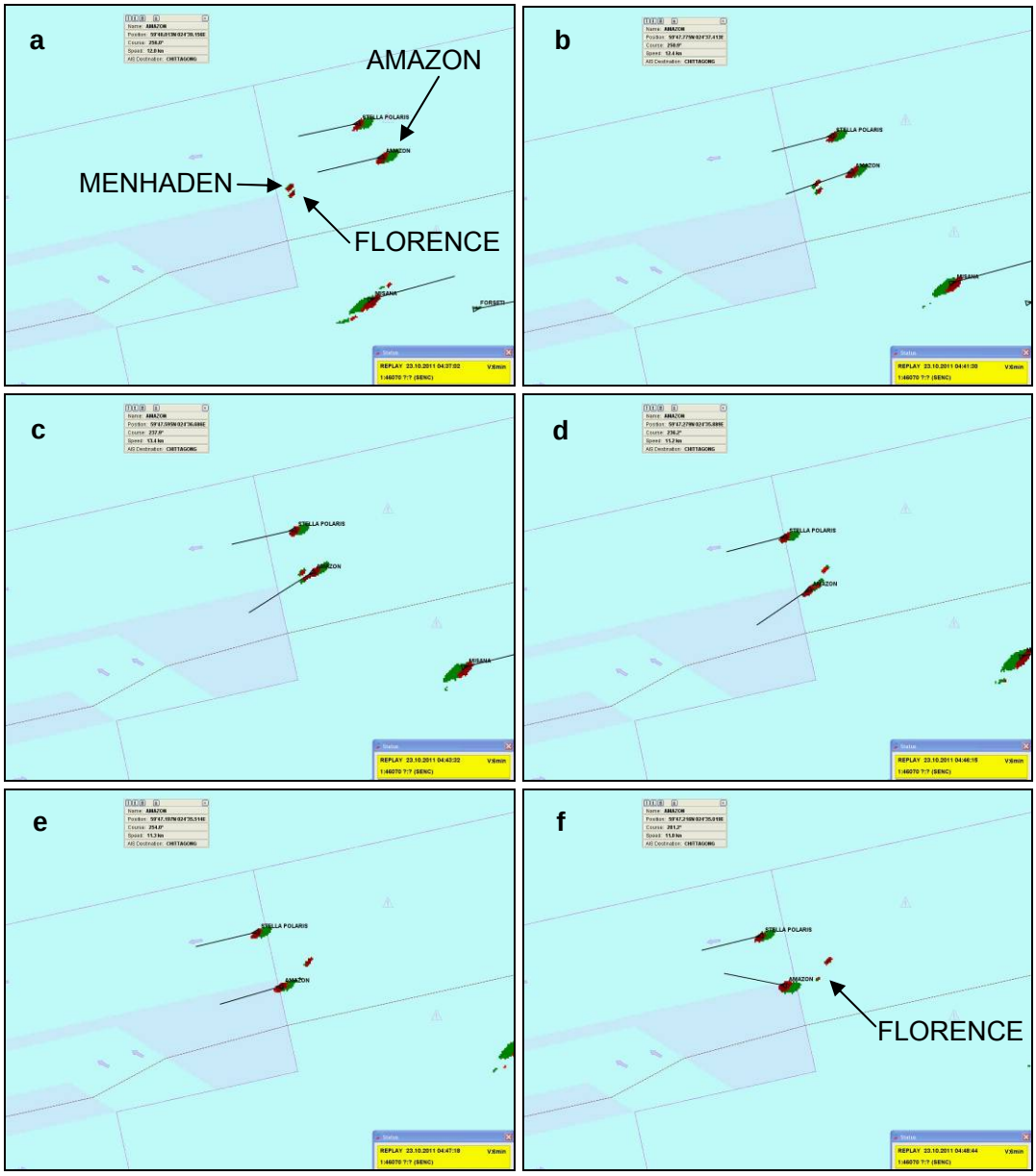

Image 15. Events during the collision according to the VTS recording. (© Finnish Transport Agency)

a *At 04:37: the pairtrawling vessels MENHADEN and FLORENCE are moving north-eastwards on the precautionary area, against the recommended direction of traffic flow*

b *At 04:41: the fishing vessel MENHADEN is on a collision course with the AMAZON. The AMAZON begins changing her course to the port.*

c *At 04:43: The AMAZON has turned and is now on a collision course with the FLORENCE. At 04:44 the vessels collide.*

d *The FLORENCE is dragged along with the AMAZON.*

e & f *The FLORENCE has disengaged from the AMAZON and remains visible as a weak echo on the radar for about ten minutes.*

1.2.5 Measures after the incident

AMAZON

After observing a bump to the hull of the vessel, the OOW looked out and visited the starboard wing of the bridge to review the situation. He did not notice anything. There were two echoes on the radar: one on the starboard side (the STELLA POLARIS) and a single weak echo behind them. He checked the distance to the STELLA POLARIS and then started turning the vessel back to the original track. He did not notify Helsinki Traffic of the incident.

In the morning, as the master arrived on the bridge at 08:00, the OOW told him that weather during the watch had been foggy and the vessel had hit something during the early morning hours. The master and the OOW checked the vessel for any possible damages and noticed scratches on the bow on the port side of the vessel. They continued the voyage without trying to investigate what the vessel had hit. No report was made of the observations.

FLORENCE

The AMAZON hit the FLORENCE in the midships by the hold. The FLORENCE listed heavily to starboard, the windows on the bridge were broken and the bridge started to take in water. The three crewmembers that had been sleeping quickly arrived on the bridge, where the master explained, surrounded by a great racket, that a merchant vessel had hit them.

The crew decided to abandon the vessel. They tried to exit the vessel through the saloon door in the back of the vessel (image 16), slightly to starboard of the center line of the vessel. The door led to the vessel's aft deck. The door could not be opened enough to allow the crew to exit through it, as the water pressure kept closing it.

After numerous attempts they managed to open the door wide enough to allow the crew to exit to the aft deck. The liferaft was located on the port side of the vessel, up on the back wall of the deckhouse (image 16). The crew managed to launch the raft before going afloat. They managed to climb into the raft from the water. The FLORENCE sank soon after the ropes of the raft had been cut.

Image 16. The red arrow shows the location of the liferaft on the FLORENCE. The crew managed to escape the deckhouse through the backdoor open in the photograph. (© Kalavara)

MENHADEN

The MENHADEN continued trawling for some minutes. Once the master of the MENHADEN had detected by echo sounder that the position of the trawl had changed, he tried to call the FLORENCE on VHF channel 12. When the FLORENCE did not respond, he tried again on channel 16. This can be heard on the VTS recording at 04:46:42 and again at 04:48:14.

After this, the MENHADEN continued pulling the trawl and tried to reach the FLORENCE in a roundabout way through the owner of the FLORENCE, but without success. The master of the MENHADEN did not know the phone number of the master of the FLORENCE. Later on, the MENHADEN heard the emergency communications on the VHF during the search operation for the FLORENCE.

At 06:03 the master of the MENHADEN contacted the JRCC Tallinn (Joint Rescue Coordination Centre in Tallinn), told them he had trawled together with the FLORENCE and asked what had happened. The JRCC Tallinn explained that the EPIRB of the FLORENCE had sent out a distress signal and asked the MENHADEN to investigate the situation. After this, the MENHADEN began to haul the trawl in.

1.2.6 Personal injuries

The crew of the FLORENCE had no time to take aluminium thermal blankets with them when escaping, and they were cold when discovered on the raft. None of them suffered from hypothermia. One of the men had injured his finger and two others had surface bruises and wounds. One of them had no physical injuries. The collision itself, as well as

the four hours they spent on the liferaft before being rescued, caused the crew of the FLORENCE emotional distress.

1.2.7 Damage to the vessels

AMAZON

The AMAZON suffered little damage, consisting mostly of scratches and damage to the paint on the bow at anchor height and above the waterline on the port side (image 17). It was not possible to study the damages up close due to the weather conditions.

Image 17. Photograph of the bow of the AMAZON, taken while the vessel was detained in front of Hanko after the accident. Scratches and damage to the paint are visible on the port side of the bow.

FLORENCE

The FLORENCE sinked as a result of the collision. The sunken vessel was discovered in the evening on the day of the accident at a depth of 65 metres. The vessel lies on the bottom, the right side up with her bow pointing approximately at 180°. Based on the underwater photography, the vessel seems to have suffered observable damage to the rail on the port side by the hold, to the port side of the bridge, and to the rail and the part of the deckhouse located port of the bridge (image 18). Judging from the photographs, it seems that the rest of the vessel's structures are intact. All visible damages are above the waterline and thus cannot by themselves account for the vessel's sinking.


A B C D E F
A
ROLL PITCH DEPTH HEAD TWI
-1 -28 065.0 288 -4
MASTER 2011/10/23 23:00:46
D
ROLL PITCH DEPTH HEAD TWI
-2 -28 065.8 291 -4
MASTER 2011/10/23 22:54:06
B
ROLL PITCH DEPTH HEAD TWI
-3 -30 065.0 285 -4
MASTER 2011/10/23 23:01:10
E
ROLL PITCH DEPTH HEAD TWI
-4 -14 065.3 284 -4
MASTER 2011/10/23 22:58:15
C
ROLL PITCH DEPTH HEAD TWI
-3 -30 065.5 283 -4
MASTER 2011/10/23 23:01:16
F
ROLL PITCH DEPTH HEAD TWI
-2 -14 065.9 277 -4
MASTER 2011/10/23 22:57:54

Image 18. A series of the underwater photographs showing the damages suffered by the FLORENCE. The damaged parts have been marked on the photo with a red oval and the damages shown in the photographs are marked with letters. The photographs on the left show the rail by the hold and the photographs on the right show the bridge. (Photograph of the vessel: © Markku Saiha, underwater photographs: © Finnish Border Guard)

1.2.8 Other damages

No oil leaks had been detected from the sunken vessel at the time this investigation report was being written.

The accident caused indirect expenses and income losses to the operation of the trawling companies. The MENHADEN's trawl breaking caused some thousands of euros worth of expenses.

The AMAZON was delayed by approximately twelve hours.

1.2.9 Recording equipment

The AMAZON is equipped with a Rutter 100G2 type S-VDR (simplified voyage data recorder). When the save-button is pressed, the device saves the data recorded during the previous 24 hours.

The recording includes the radar image displayed on the AMAZON's bridge, the image's normal digital information as well as the vessel's location coordinates, speed, heading and course over ground as shown on the programme's own Conning Display. Furthermore, the record includes the AIS situation image and AIS target information, a voice recording from the bridge as well as a voice recording of VHF channel 16. In addition, all radar alerts and alarms and user-made adjustments to the radar's configurations can be viewed. The S-VDR recording was studied during the investigation.

The moment of collision was deduced from the noise caused by the collision. No communication can be heard on the record before or after the accident.

The AMAZON also has an electronic nautical chart which was not in accordance with the ECDIS standard. This had tracked the vessel's movements. A photograph of the course of the AMAZON as displayed on the electronic nautical chart was used in the investigation.

The fishing vessels provided no records and they were not equipped with AIS devices. The fishing vessels were visible on the AMAZON's radar and they were ARPA-tracked while the situation was developing. Their movements could be studied through the radar image on the AMAZON's S-VDR recording as well as the ARPA data displayed on the radar, showing the fishing vessels' motion variables. These factors could be used as a basis for determining the course of events. A more detailed account of the data achieved through the radar recording can be viewed in Appendix 1.

Moreover, the investigation group received a VTS radar recording from the Gulf of Finland Vessel Traffic Service, which showed the fishing vessels' radar echoes as well as the AMAZON along with the data on her location, heading and speed just before the collision. The images above (9, 10, 14 and 15) are screenshots from the VTS recordings.

1.2.10 GOFREP, Traffic separation scheme and precautionary area

GOFREP (Gulf of Finland Reporting System) is a mandatory ship reporting system for vessel traffic on the Gulf of Finland. Its objective is to increase marine safety, to improve the protection of the marine environment and to monitor compliance with the COLREGs in the area. The traffic centres[18] in Helsinki, Tallinn and St. Petersburg monitor vessel traffic in the GOFREP area and provide the vessels with advice and information on marine hazards and weather conditions on the Gulf of Finland. In Finland the traffic centre, the Helsinki Traffic, is organised by the Finnish Transport Agency as the official VTS authority under the Vessel Traffic Service act[19]. Helsinki Traffic operates in the Gulf of Finland Vessel Traffic Centre.

Any vessel with a gross tonnage of at least 300 must make a fixed-form GOFREP report to the relevant traffic centre after crossing the designated reporting line on the Gulf of Finland. The reporting lines and the sectors of each traffic centre are displayed in image 19.

Vessels with a gross tonnage of less than 300 are not completely exempt from the reporting obligation; they must report themselves for example if their manoeuvrability is restricted. Furthermore, according to the GOFREP instructions, a vessel should always notify the traffic centre when her navigational status changes. Traffic in the GOFREP area is monitored by radar and through AIS.

[18] Helsinki Traffic, Tallinn Traffic and St. Petersburg Traffic.
[19] Vessel Traffic Services act 5.8.2005/623, Section 20.

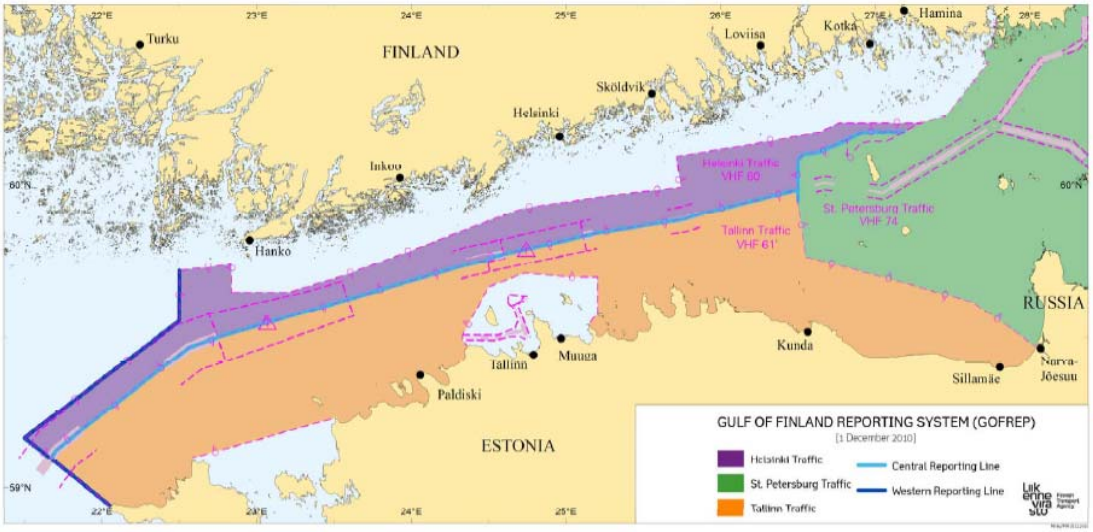

Image 19. GOFREP area of the Gulf of Finland. The areas marked in purple belong to Helsinki Traffic, green areas to St. Petersburg Traffic and orange areas to Tallinn Traffic. The reporting area changes when the vessel crosses the light blue line. The western border is marked with a dark blue line. The Finnish VTS area begins north of the purple area. (© Finnish Transport Agency)

The GOFREP area comprises three traffic separation schemes[20] on the international water area by the coast of Finland (image 19, rectangles marked with a dash line). They use fixed routes to channel traffic to different directions into different lanes, thus decreasing the risk of accidents on busy water areas. The accident took place within the Porkkala TSS. TSS traffic regulations are given in the COLREGs, explained in more detail in section 1.5.4 of this report.

The fishing vessels were not equipped with AIS transmitters and were therefore not visible in the traffic centre's AIS-system. The fishing vessels, even though under gross tonnage 300, did not report themselves after crossing the reporting line at night before starting trawling. Neither was a report made after they had started trawling as a pair and the manoeuvrability of the vessels was restricted. Thus Helsinki Traffic could not identify the vessels' radar echoes. Helsinki Traffic did not contact any of the three vessels that were parties to the collision.

Incidents that a vessel's master should report to the VTS authority include all dangerous situations and accidents that occur in the VTS area or nearby that may affect the safety of the vessel or of maritime transport in general[21]. The AMAZON did not report a close-quarter situation or the sound of having hit something within the TSS. Neither was a report made the following morning, after the OOW had described the events of the early morning hours and the master and the OOW had found scratches on the bow of the vessel. No report was made from the MENHADEN, either.

[20] Traffic Separation Schemes outside Porkkala, Kallbådagrund and Hankoniemi.
[21] GOFREP Master's Guide. Available at: www.liikennevirasto.fi/gofrep.

Precautionary area

The Porkkala TSS includes a precautionary area. In this area, the east- or westbound vessel traffic encounters the vessels operating between Helsinki and Tallinn and those turning towards Tallinn or Helsinki from the traffic lanes. The borders of the precautionary area have been marked on the chart with vertical dash lines, and the area itself is marked with an exclamation sign placed inside a triangle.

The recommended direction of traffic flow on the precautionary area is marked on the navigation chart with a dashed outlined arrow. Special care should be taken when navigating inside the precautionary area.

1.3 Rescue activities

1.3.1 Alerting activities

According to the VTS recording, the collision occurred at 04:44. The master of the FLORENCE recounts calling the MENHADEN on VHF channel 15 twice before the collision, shouting that a vessel was heading straight at them. The master of the MENHADEN told that he never heard the call and thus failed to respond. Neither of the fishing vessels contacted the AMAZON.

On the VTS recording, it is possible to hear the MENHADEN calling the FLORENCE on VHF channel 16 after the collision at 04:46:42 and again at 04:48:14. Actual emergency communications were not initiated.

The radar echo from the FLORENCE disappeared from the VTS screen at 04:53:16. The EPIRB beacon on the FLORENCE transmitted a distress signal on being affected with water; the alarm was recorded at 01:54 UTC (04:54 Finnish daylight saving time). Therefore it seems likely that the FLORENCE sank at 04:54.

At approximately 04:55–05:00, the MENHADEN's master called the owner of the FLORENCE, stating that he could not contact the FLORENCE. The master of the MENHADEN asked if the vessel's owner could call the master of the FLORENCE. The owner tried to call the master, but could not reach him. He continued attempting to call the phones of both the master and the two other crewmembers. He could not reach any of them, and notified the master of the MENHADEN of this by phone. The master of the MENHADEN suggested that the owner of the FLORENCE contact the JRCC Tallinn and ask them to check if they could detect two fishing vessels on the radar.

MRCC Turku received a Cospas-Sarsat EPIRB distress signal at frequency 406 MHz at 05:32[22]. The signal came from the Finnish economic zone but from the Estonian zone of rescue reponsibility on the Gulf of Finland, so the signal's information was forwarded to JRCC Tallinn. The data was also sent to the Helsinki MRSC, as it was thought probable that they, too, might aid JRCC Tallinn on the operation.

At 06:03, the MENHADEN contacted JRCC Tallinn, explained having trawled as a pair with the FLORENCE and asked what had happened. JRCC Tallinn explained that the

[22] It takes time for the EPIRB distress signal to reach the recipient after being transmitted, as it first travels through a satellite to the Cospas-Sarsat local user terminal and is then forwarded to the predetermined recipient.

EPIRB on the FLORENCE was sending a distress signal and asked the MENHADEN to investigate the matter. The MENHADEN agreed to do this.

JRCC Tallinn tried to contact the FLORENCE numerous times, but received no response. A marine rescue operation was initiated at 06:17. JRCC Tallinn called an Estonian marine rescue helicopter to the scene of the accident and ordered cargo vessel KAUNAS to participate in the search operation.

The owner of the FLORENCE called JRCC Tallinn at 06:30, asking if their radars detected two fishing vessels in the location given by the master of the MENHADEN. JRCC Tallinn replied that only one fishing vessel was visible. The owner of the FLORENCE recounts calling the MENHADEN master after this, stating that he suspected that the FLORENCE had sunk. The master of the MENHADEN said he would pull the trawl out of the water.

JRCC Tallinn requested equipment aid from the MRSC Helsinki due to poor visibility. The Finnish Border Guard called the patrol boat PV 120 to the scene from the Porkkala coast guard station at 06:47, and the offshore patrol vessel MERIKARHU at 07:00. An air patrol squadron Dornier 228, the FinnGuard08, was called at 08:36. JRCC Tallinn read a Mayday Relay message on VHF channel 16 at 08:37.

At 08:47, the MRSC Helsinki sent the patrol boat PV-161 from the Hanko coast guard station to check on the AMAZON, which had been detected on the radar as present in the area at the time of the accident. At this point the AMAZON was located in front of Hanko, heading westwards.

MRSC Helsinki notified the Safety Investigation Authority duty officer of the collision at 08:49, the Finnish Environment Institute duty officer at 08:53 and the marine inspector at 08:54.

1.3.2 Starting the rescue operation

The rescue operation was conducted by an Estonian marine rescue helicopter, the cargo vessel KAUNAS sailing under the Lithuanian flag as well as the offshore patrol vessel MERIKARHU, patrol boat PV 120 and the Dornier 228 from Finland.

Patrol boat PV-161 from the Hanko coast guard station stopped the AMAZON at about 10.00 hrs in front of Hanko for inspection. An Estonian marine rescue helicopter visited the site of the accident, but returned soon after due to poor visibility.

The first to reach the site of the accident was the patrol boat PV-120, which had been called to join the operation from the Porkkala coast guard station and reached the site at 07:43, 56 minutes after receiving the call. The patrol boat started the search at the spot where the EPIRB distress signal had originated, starting with a search pattern in the shape of an expanding square.

The search and rescue operation was hindered by the extremely poor visibility caused by the dense fog. The master of the patrol boat recounted that they left Porkkala for the operation in a thick fog that prevailed throughout the operation and did not lift until they returned to Porkkala after the operation. Visibility was just some dozens of metres.

There were old swell in the search area. The master of the patrol boat said that some sea clutter had to be filtered out of the radar to clarify the image; this was one of the reasons for why the life raft, a poor radar target by nature, was not detected.

The cargo vessel KAUNAS arrived at the site some time later. There were numerous people on lookout onboard the vessel and many observations on objects on the surface were made. The KAUNAS could not be manoeuvred in the manner required by search activities due to her large size, and thus the PV-120 went to check the correctness of the observations made on the KAUNAS.

Whistles were heard on both vessels, but it was difficult to take a bearing in the fog. The PV 120 had crew listening on the deck and her machines were occasionally stopped for better hearing.

The phases of the search and rescue operation can be reviewed in Table 3.

Table 3. Phases of the rescue operation in accordance with the MRSC list of measures.

Time	Agent	Description	Number in image 20
08.05	KAUNAS	The KAUNAS noticed oil in location lat. 59°47,4N and long. 024°35,80E.	2
08.11	KAUNAS	The KAUNAS noticed a light and floating material in the water at lat. 59°47,3N and long. 024°36,27E.	3
08.20	PV-120	The patrol boat discovered wreck scrap, oil and the cover of a life raft at lat. 59°47,33N and long. 024°36,16E.	4
08.32	PV-120	The patrol boat reported hearing whistles.	
08.32	KAUNAS and PV-120	The KAUNAS noticed what were probably fishing equipment on the water. The patrol boat kept hearing whistles.	
08.37	JRCC Tallin	MaydayRelay –message on VHF Ch. 16.	
08.52	PV-120	The patrol boat found the EPIRB of the FLORENCE at lat. 59°47,653N and long. 024°37,484E.	5
09.07	PV-120	The patrol boat found the crew of the FLORENCE on a liferaft, in a good condition considering the circumstances, at lat. 59°47,954N and long. 024°37,605E. The crew did not require medical attention.	6
09.41	JRCC Tallinn	JRCC Tallinn released the PV-120 of its duty.	
09.43	JRCC Tallinn	JRCC Tallinn cancelled the distress call on VHF channel 16 at 09:43.	

The patrol boat PV-120 discovered the life raft at 09:07 following the whistles. When the boat approached, four persons appeared at the doorway of the life raft, stating that they were the complete crew of the FLORENCE. The master of the FLORENCE told the patrol boat's crew that their vessel had been hit by a cargo vessel and she had consequently sinked quickly.

The crew of the FLORENCE said they had heard engines from the nearby vessels and started whistling, shouting and using distress beacons. Three of the men were discovered wearing only their underwear and one was wearing a tracksuit. According to the Porkkala patrol boat crew, they did not seem to be suffering from any serious injuries and all of them seemed dry.

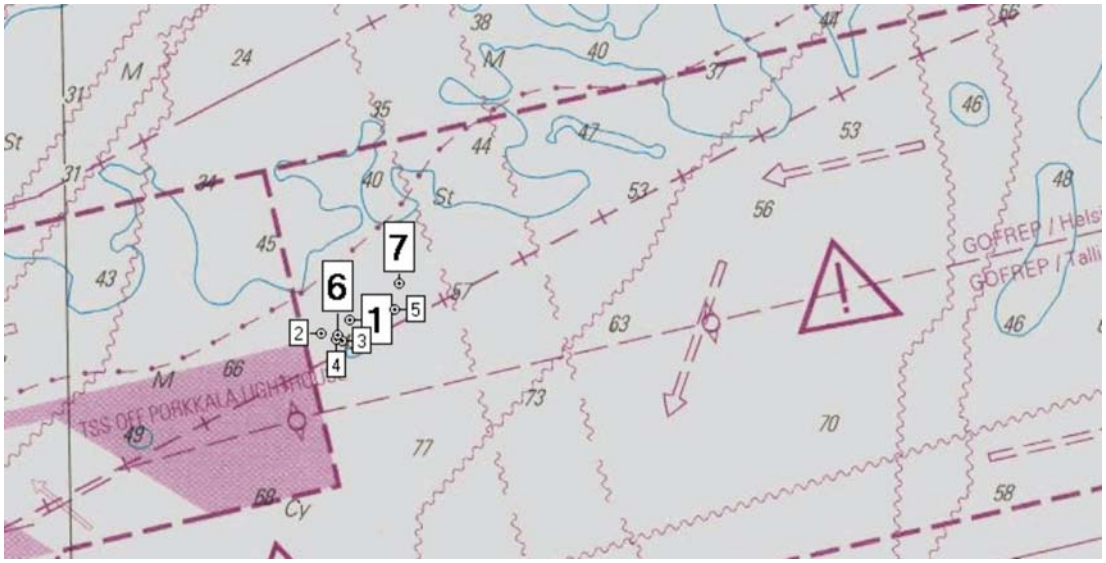

Image 20. Locations marked on the image: 1) Site of the collision, 2) where the KAUNAS observed oil, 3) where the KAUNAS observed a light and floating material, 4) where the patrol boat found waste, oil and the covers of a life raft, 5) where the patrol boat found the EPIRB of the FLORENCE, 6) the place where the FLORENCE sinked, 7) where the patrol boat discovered the crew of the FLORENCE on a liferaft. The distance between the location of the sinking and the place where the life raft was discovered is approximately 0.75 nautical miles. (Map base © Finnish Transport Agency)

The patrol boat took the evacuees to the offshore patrol vessel MERIKARHU, and afterwards they were taken to Tallinn on an Estonian police patrol boat.

The crew of the FLORENCE stayed on the life raft for approximately 4 hours and 20 minutes before the raft was discovered.

1.3.3 Rescuing the vessel

The FLORENCE sank to a depth of 65 metres. According to a representative of the insurance company, it is not likely the vessel will be raised.

1.4 Special investigations

1.4.1 AMAZON radar experiments

While the AMAZON was detained off Hanko, it was noticed that the Anti Clutter Sea adjustments on the vessel's second (S-band) radar had been set to automatic, which often removes all smaller radar echoes from targets near the vessel. According to the OOW, the radar adjustments had been equivalent to these adjustments at the time of the accident. He stated he had monitored the development of the situation on the radar in question before the collision. He had seen two small echoes ahead of the vessel, which, according to his interpretation, had merged into one later on.

It was decided that the effect that radar adjustments have on the radar image should be tested by having a small vessel approach the vessel. The results of this experiment can be viewed in Appendix 2.

1.4.2 Investigations at the site

During the investigations, parts of wooden vessel structures and fishing equipment were discovered floating in the sea near the site of the accident. The sinked vessel was discovered in the evening on the day of the accident, at around 23:00. After the vessel had been discovered, the Finnish Border Guard used a diving robot (Remotely Operated Vehicle, ROV) to shoot a little over one hour of video material of the vessel and the visible damages on it. The video recording has been available to the investigation group.

The recording shows that the vessel rests on the seabed at a depth of 65 metres, the right way up, leaning on the formations of the seabed. The vessel has no list and stands nearly upright. Underwater video material was taken to investigate the damage the vessel has suffered. The only clearly visible damages are located on the rail on the port side of the vessel, by the hold, and by the bridge on the deckhouse (image 18).

1.4.3 Pair trawling and its practise[23]

Trawling as a pair is a form of trawling that has been practised in Finland since the 1970s. This form of fishing is especially suited for smaller vessels and shallow water areas. When pair trawling, the trawl is pulled by two fishing vessels, each on one side of the trawl (image 21).

[23] History and technical details of pair trawling have been treated before in the SIAF investigation report B2/1999M, Trawler LEA, sinking with two fishermen in the Gulf of Bothnia on 12.4.1999 (available: www.sia.fi). The points presented here are a summary of the report.

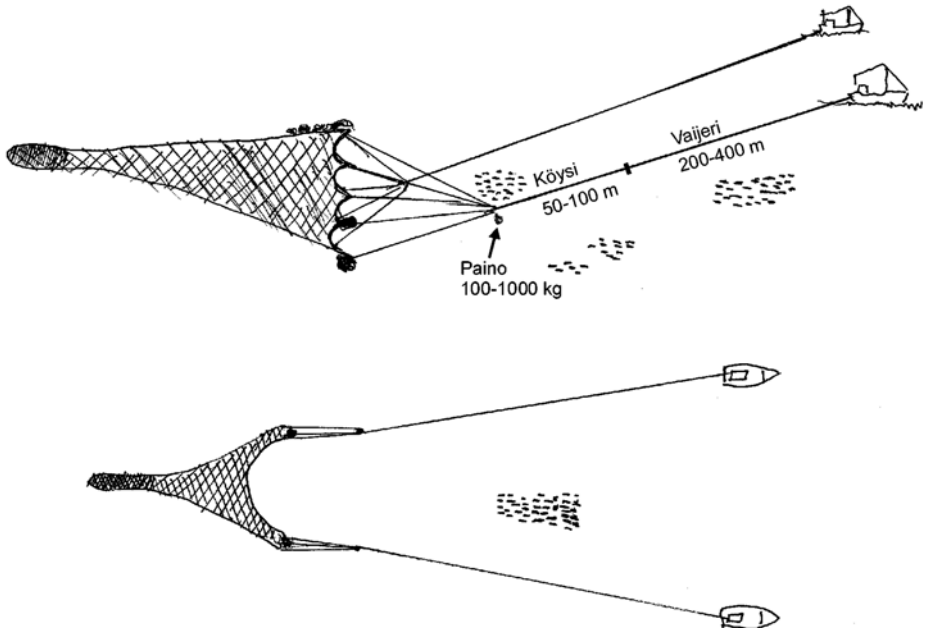

Image 21. Illustration of pair trawling.

When fishing is started, one of the vessels, proceeding tailwind, lowers the trawl from the trawl drum on the afterdeck into the water. Wire ropes (bridles) attached to the two corners on one side of the trawl are attached to the towing rope on one of the vessels (the auxiliary vessel). Weights needed to keep the mouth of the trawl open (vertically) are then attached to the trawl's bottom corners on both vessels, and both vessels let out the necessary length of their towing ropes, thus starting towing the trawl. The length of the tow rope and the amount of weights required depends on whether the trawl is towed in middle water or near the bottom, and how deep the trawl should land. The size of trawls available varies by vessel power so that the measurement of the trawl's mouth is 300-350 metres for bottom trawling and 350-750 metres for midwater trawling.

During the trawling, the trawl's movements, its depth in relation to the fish and its distance to the seabed are monitored through a trawl sonar[24]. Thus it is possible to constantly monitor the trawl's movements and the length of the towing ropes from the vessel. The vessels keep in contact with each other during the trawling to agree on relevant matters, such as the towing speed, the distance maintained between the vessels, etc. When necessary, towing speed can be adjusted to change the position of the trawl and its distance to the seabed. Varying based on the size of the trawl and the length of the tow ropes, the distance between the vessels during trawling is some 200–300 metres.

To examine the catch, both vessels reel in their towing cables while moving closer to each other. The weights on the ends of the tow ropes are detached on both vessels, after which the vessels move downwind to meet each other and the "auxiliary vessel" moves to the vessel that will hoist the catch. Meanwhile the crew, or parts of it, move to

[24] A trawl probe is a sonar probe attached to the trawl, sending information through a cable up to the receiver aboard the fishing vessel.

the other vessel to help with hoisting the trawl. The trawl is reeled into the drum winch until the end of the trawl and the fish inside reach the surface and can be placed next to the vessel.

After this, the trawl and the fish inside are pulled to the side of the vessel. The catch is pulled out of the trawl on top of the sorting hold with a net bag. Depending on the size of the net, a single load of fish hoisted from the sea is between 1000–2000 kg. The procedure will be repeated until the whole catch is on the vessel. Sorting the catch is started as soon as the first load has been emptied into the sorting hold. More of the catch is hoisted as the sorting progresses. When the trawl has been emptied, it is reeled completely onto the winch drum.

1.4.4 The Cospas-Sarsat system

The Cospas-Sarsat is an international search and rescue system meant to speed up the transfer of the distress call from the scene of the accident to the rescue organisations and to reduce the time needed to determine the location of the accident, thus allowing aid to arrive at the site sooner. The system consists of four different parts:

- EPIRB emergency beacon (seafaring)
- a satellite network,
- Local User Terminals, LUT, and
- Mission control Centres, MCC.

The Cospas-Sarsat system uses satellites to detect and locate activated EPIRB beacons. Once an EPIRB is activated, a satellite will receive the transmission and forward it to the nearest possible LUT. The LUT sends the transmission to its MCC, where the location of the EPIRB is determined. After locating the beacon, the MCC will transmit a fixed-form emergency message to the SPOC in the country where the emergency site is located. The SPOC will forward the data to the suitable MRCC, where the rescue operation will be started. The system is illustrated in image 22.

Finland has no LUT of its own, but mostly receives distress calls from either Tromsö or Bodø in Norway. In this case, the call came from Bodø. MRCC Turku is the SPOC in Finland.

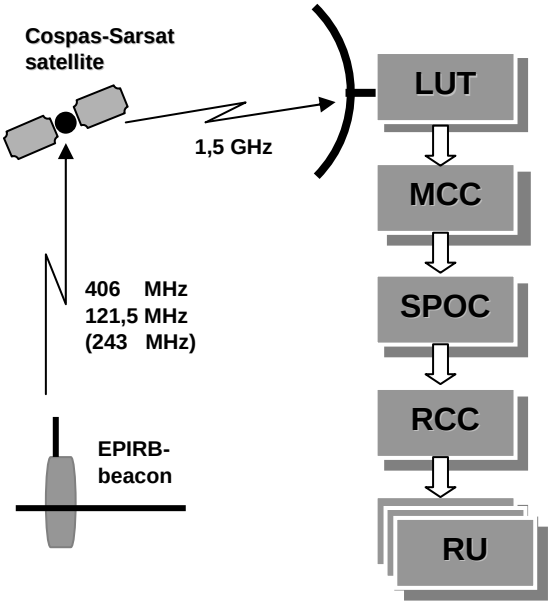

Image 22. The 406 MHz EPIRB distress call route.

LUT Local user Terminal
MCC Mission Control Centre
SPOC SAR Point of Contact
RCC Rescue Co-ordination Centre
RU Rescue Unit

The EPIRB on the FLORENCE

The EPIRB is a low-power, buoy-shaped emergency beacon that is installed on the outside of a vessel. When activated, it will initiate the Cospas-Sarsat search and rescue system. The EPIRB transmits out the vessel's MMSI as its sign. The EPIRB also dispatches its location data, which it automatically determines through the built-in GPS navigator. Moreover, data on the EPIRB itself is transmitted. The Finnish Transport Safety Agency regulates the radio equipment on fishing vessels, including the EPIRB, in accordance with the vessel's fishing area.

For the EPIRB to activate, it first has to be released from the mounting bracket to which it is installed on the vessel. Deployment can be achieved through the hydrostatic pressure of water or manually. After the EPIRB has been detached, water's hydrostatic pressure will activate the EPIRB through its "sea switch". It is also possible to activate the device manually through a push-button switch. After activation, the EPIRB will remain afloat, emitting a blinking light.

The EPIRB on the FLORENCE was a Sailor Thrane & Trane SE406-II. It was a new beacon the vessel had acquired just some months before the accident. It was in good condition and worked reliably. Based on different records, it seems to have sent out a signal of the vessel's sinking immediately after hitting water.

1.4.5 FLORENCE liferaft

The FLORENCE had a six-person Sea-Safe KHY-6 liferaft (image 23). It is a rubber-made liferaft that will automatically turn right way up in the water. The liferaft was stored in a fibre glass case outside the vessel's deckhouse (image 16). The raft is deployed by pulling the release cord.

The raft had been purchased in Estonia in 2010, circa one year before the accident. The raft had been recently inspected and worked faultlessly during the accident.

Image 23 The liferaft of the FLORENCE on the deck of the MERIKARHU after the crew was rescued. The image also illustrates the visibility near the site of the accident. (© Finnish Border Guard)

1.4.6 Organisation and leadership

AMAZON

The master of the vessel is responsible for safety on the vessel and acts as a representative of the shipowners on the vessel. The flag state's authority is the chief supervisory body to the vessel and her operation. It is the responsibility of the shipowner to determine safe procedures for using the vessel and to ensure that these procedures are followed.

MENHADEN and FLORENCE

In vessels trawling as a pair, the masters are responsible for safety in their respective vessels. Fishing vessels and their owners do not fall under Safety Management System requirements, and thus safety matters are left to the owner's judgement. Depending on

the vessel's owner, taking care of safety matters may also be left to the responsibility of the master alone. This may be observable in the whole of safety management.

It has been imposed between member states of the European Union, that the biggest allowed catches of he important and commercially utilizable fish species shall quotas. This agreement concernes also the Baltic Sea area, excluding Russia. The allocation of quotas is based on the catch history of the reference years agreed together. Also the maximum fishing vessel capacity, which is measured as gross tonnage (GT) and engine power (kW) of the vessels, per EU member state has been defined.

Fishing quotas of each member state may be utilised only by a registered fishing vessels sailing under the flag of the member state in question. In Finland a company (a legal person), whose permanent domicile is in Finland and which uses a vessel carrying a certificate of nationality of Finland for fishing, may register a fishing vessel. However, in such case it is possible that the natural persons who own the company, are foreign EU citizens, but instead of persons there is a company, as a legal person, registered to the fishing register of Finland. Such vessels are ostensibly Finnish but in reality they are operated by foreign companies. FLORENCE and MENHADEN were such vessels. [25]

The vessel inspections, monitoring the competence of the crew, crew regulations and monitoring the hauls are the responsibility of the flag state. Strawman activities and complex ownership relations make it difficult to maintain up-to-date surveillance and to keep track of how flaws are corrected. Sometimes defects and irregularities only become visible after an accident has occurred.

1.4.7 Fishing vessels and AIS

The AIS (Automatic Identification System) transmits data i.a. on the vessel, her cargo, destination and movements to other vessels and the traffic surveillance body. The system is meant to facilitate identifying the vessels, information transfer between different bodies and tracking the vessels' movement, thus improving marine safety.

AIS improves vessel safety especially on busy traffic lanes, which is why Directive 2002/59/EC gave provisions on the use of AIS to improve marine safety and efficiency and to improve authorities' ability to function when dangerous situations occur at sea. However, the directive is not applied to fishing vessels with an overall length of less than 45 metres[26].

Originally, the use of AIS was regulated by the SOLAS convention[27], but SOLAS and its provisions did not apply to fishing vessels.[28].

[25] SAKL bulletin 3/2012: Ownership of open sea vessels changed; at the beginning of March 40 % of the gross tonnage of open sea vessels was owned by foreigers. Of the vessels over 100 gross tonnage 51 % were owned by foreigners. Most of the vessels are owned by Estonians. Owner companies domicile is in Finland. Information based on the fishing vessel register maintained by Ministry of Agriculture and Forestry.

[26] Directive 2002/59/EC, articles 1 and 2.

[27] SOLAS Consolidated edition 2009, ISBN 978-92-801-1505-5, Chapter V, Regulation 19.

[28] SOLAS Consolidated edition 2009, ISBN 978-92-801-1505-5, Chapter I, Part A, Regulation 3.

Directive 2009/17/EC was given in 2009 as an amendment to directive 2002/59/EC. One of the initiators behind amending the directive was the large number of collisions that included fishing vessels not detected by merchant vessels, or that had not themselves detected nearby merchant vessels. The amendment in directive 2009/17/EC relevant to this investigation concerned was extending the AIS obligation to fishing vessels with an overall length of less than 45 metres. The directive's schedule for AIS installations in fishing vessels is as follows:

- length overall 24–45 m, at latest 31 May, 2012,
- length overall 18–24 m, at latest 31 May, 2013,
- length overall 15–18 m, at latest 31 May, 2014, and
- new fishing vessels with a length overall of over 15 m, starting on 30 November, 2010.

The length of the FLORENCE was 27.56 m and the MENHADEN's 27.02 m, and therefore the deadline for their AIS installations was 31 May, 2012. Thus, AIS was not obligatory for them at the time of the accident.

1.4.8 Similar incidents

Many safety investigation reports exist on collisions of fishing vessels and merchant vessels. Some of them have been summarized in Appendix 5.

1.5 Rules and regulations guiding the operations

In terms of rules and regulations, the accident falls under fishing within the Traffic Separation Scheme and inside the precautionary zone and the way fishing affects the obligation to give way. Moreover, rules and regulations on sea watch duties, actions to prevent collision as well as the trawling vessels' obligation to make a report on entering a GOFREP zone apply to this case.

1.5.1 National legislation

In terms of national legislation, the accident falls under GOFREP zone surveillance.

The Finnish Transport Agency is in charge of the Vessel Traffic Service in Finland. According to the Vessel Traffic Service act, the VTS authority has to regulate compliance with the TSS and the obligatory reporting systems in the international sea areas located within its VTS zone.

1.5.2 Official regulations and instructions

The International Maritime Organization's circulars SN/Circ.225 and SN.1/Circ.258 include the requirements for vessels with regards to the GOFREP. Based on these circulars, the Finnish Transport Agency and the Estonian maritime authority have written a GOFREP Master's Guide, which includes instructions for operating in the GOFREP

zone. The publication can be downloaded for free on the Finnish Transport Agency website[29].

According to the publication, all vessels with a gross tonnage of no more than 300 should report themselves to the VTS for example when their manoeuvrability is restricted. Under COLREGs, a unit of to pair-trawling vessels is regarded as having restricted manoeuvrability[30].

A vessel has to report to the traffic centre every time the navigational status changes.

The Finnish Transport Safety Agency in its regulation of watchkeeping31 has processed watch arrangements which are followed with the Finnish fishing vessels: navigation, the observation of weather conditions, watchkeeping and radio watchkeeping during fishing. According to this regulation, the COLREGs rule No.5 must be observed in the lookout.

1.5.3 Operator regulations

AMAZON

The vessel's shipowner has provided instructions for safe sea watch procedures in its safety management system, as required by the ISM code. In addition, the master of the AMAZON has given standing orders to clarify the procedures onboard the vessel.

The shipowners' procedure instructions stress the importance of lookout, traffic monitoring and slower speeds during poor visibility. Moreover, they especially emphasize that one person alone cannot navigate safely when visibility is poor. It is not possible for a single person to simultaneously control the helm, monitor the radar, be on lookout, determine the vessel's location and communicate with other vessels.

FLORENCE and MENHADEN

The owners of the vessels had not provided any extra instructions concerning navigation or the TSS. The master of the FLORENCE was working on the sparse instructions given by the master of the MENHADEN on trawling.

1.5.4 International regulations, conventions and recommendations

In terms of international regulations, the collision of the AMAZON and the FLORENCE falls under traffic within the TSS, maintaining appropriate lookout and the obligation to give way. Thus the primary document relevant to the incident is the Convention on the International Regulations for Preventing Collisions at Sea from 1972, abbreviated to COLREGs[32]. In Finland, the COLREGs has been implemented through an act (17.6.1977/538).

[29] GOFREP Master's Guide. Available at: www.liikennevirasto.fi/gofrep.
[30] COLREGs, section A, rule 2, provision d
[31] Trafi/16654/03.04.01.00/2011, in force since 1.10.2011
[32] Also called the Rules of the Road.

COLREGs

The following is a brief summary of the provisions of the COLREGs relevant to this case. The relevant rules include mainly rules 5, 6, 7, 8 and 10 of section 1, which concern the conduction of vessels in any condition of visibility, as well as rule 19 of section 3 on the conduct of vessels in restricted visibility.

Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions. This rule is adapted among others in restricted visibility and in the areas of high density of traffic.[33]

When inside the Traffic Separation Scheme, a vessel shall move along the common direction of travel on the lane. Crossing the lanes should be avoided; if, however, a lane is to be crossed, it should be achieved as nearly as practicable at right angles to the general direction of traffic in order to disturb the traffic on the lanes as little as possible. Disregarding some exceptions, the traffic separation zone between the lanes is not to be entered, but fishing in the zone is allowed. However, a fishing vessel must not impede the passage of any vessel using the the lane.[34]

Appropriate lookout must be maintained on the vessels and the risk of collision[35] should be appraised; a risk is considered to be present when the compass bearing to the approaching vessel is not significantly altered. The vessel's radar has to be used in a way that allows observing of the risk of collision early on. Detected targets have to be monitored through ARPA and in general detected threats are to be systematically monitored. Assumptions are not to be formed on the grounds of insufficient radar observations. If there is doubt of whether or not there is risk of collision, risk of collision is to be considered present.[36]

If a vessel only detects another vessel through radar, the development of a close-quarter situation and the risk of collision should be appraised. If a risk is detected, the vessel is to take measures to prevent the collision, but, when practicable, it should avoid changes of direction to the port.[37]

The changes to direction and speed made to avoid collision should be timely and great enough to be easily detectable through the other vessel's radar or visually. The execution of the measures are to be monitored and it should be ensured that the other vessel sails past at a safe distance. The vessel that may not impede the passage of another vessel must take the measures required by the circumstances in good time in order to give way to the other vessel.[38]

33 COLREG section B. rule 6
34 COLREG, section B, rule 10
35 COLREG, section B, rule 5
36 COLREG, section B, rule 7
37 COLREG, section B, rule 19
38 COLREG, section B, rule 8

Instructions for the Precautionary Zones

According to the publication Ship's Routeing, published by the IMO, the dashed outlined arrow marked on the precautionary areas in navigation charts indicate the recommended direction of traffic flow. Thus the regulations concerning fishing are not the same in precautionary areas than in the TSS.

Extract from the Regulations of the use of autopilot

Solas Chapter V Regulation 24

1. In areas of high traffic density, in conditions of restricted visibility and in all other hazardous navigational situations where heading and/or track control systems are in use, it shall be possible to establish manual control of the ship's steering immediately.

2. In circumstances as above, the officer in charge of the navigational watch shall have available without delay the services of a qualified helmsperson who shall be ready at all times to take over steering control.

3. The change-over from automatic to manual steering and vice versa shall be made by or under the supervision of a responsible officer.

2 ANALYSIS

2.1 Premises of the analysis

There were three parties to the accident: the cargo vessel AMAZON and the fishing vessels FLORENCE and MENHADEN, which were trawling as a pair. Neither the vessels nor their equipment seemed to suffer from a technical defect that could account for the collision. Therefore the analysis of events leading up to the accident is primarily concerned with cultural and humane factors. Moreover, factors relating to the use of radar are reviewed.

The incident consists of a chain of events that could have been interrupted at numerous occasions. However, this was never accomplished, which led to the collision and the sinking of the FLORENCE. The applied Reason model[39] in image 24 illustrates this. The analysis text is based on this image.

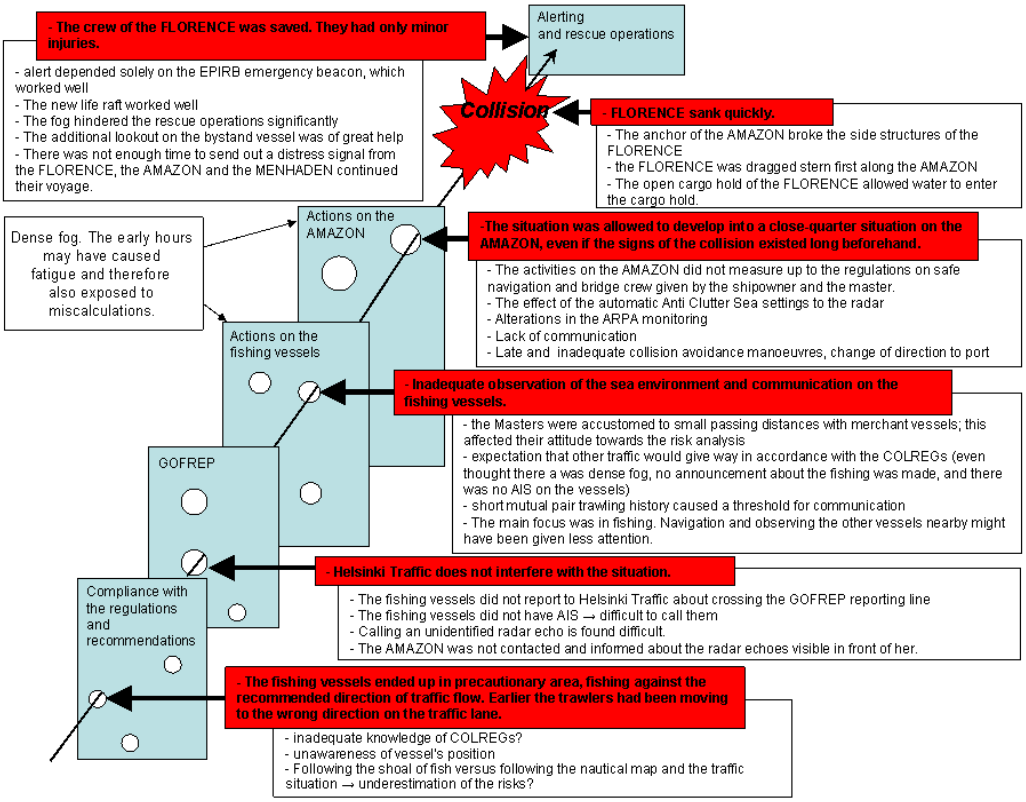

Image 24 The events leading up to the accident illustrated through a applied Reason model.

[39] The image shows four barriers (light blue rectangles), each of which could have intercepted the chain of events. The reasons for why the barriers did not work and the event was able to progress a step forward (a hole in the barrier) are written in the red boxes. The factors behind a barrier's flaws are further explained underneath.

2.2 Environmental factors

Weather during the moment of the accident was extremely foggy, rendering visibility to very poor. The sun had not yet risen and it was dark. Neither vessels in the area nor Helsinki Traffic were aware of the MENHADEN and the FLORENCE pair trawling (section 1.2.10).

The accident occurred during early morning hours, when, according to studies, a person's mental alertness is reduced. Reduced alertness will increase the probability of miscalculations.

There is heavy traffic in the accident area, which emphasizes the effect of the abovementioned factors.

2.3 The COLREGs and compliance with them

The fishing vessels started trawling as a pair on a TSS lane that is used by traffic from Tallinn when joining the lane that leads westwards. The trawling progressed to the traffic separation zone and through it to the precautionary area. The progression of the trawling is shown in image 25.

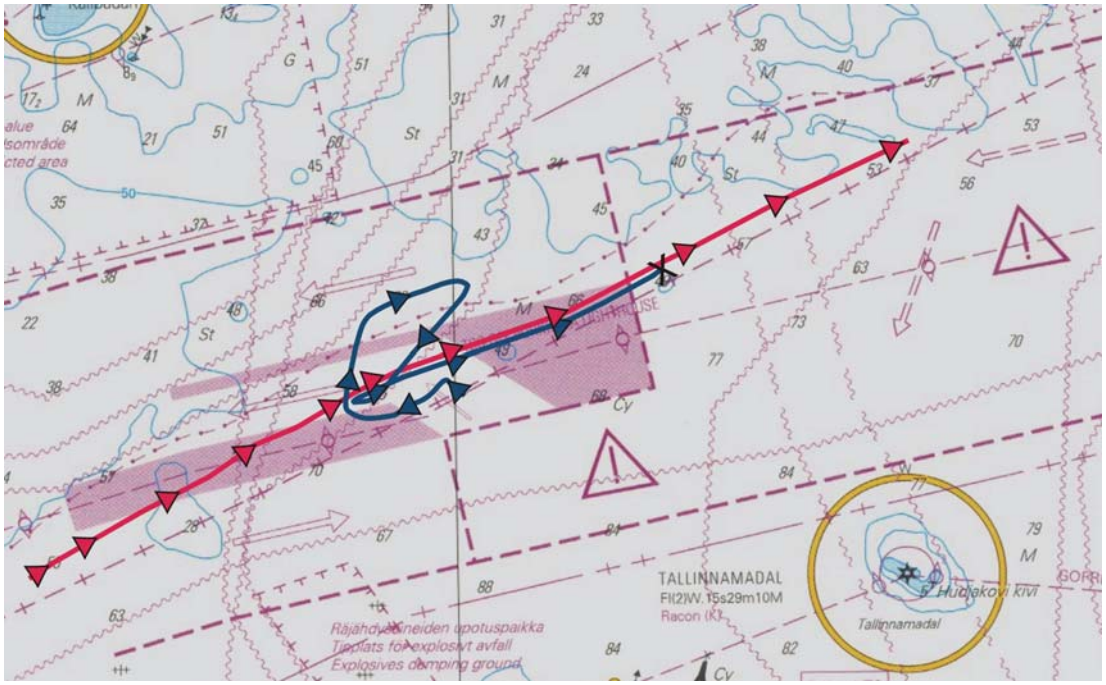

Image 25. The fishing vessels' routes before and during the trawling according to the VTS recording. The route of the FLORENCE is marked in blue and the MENHADEN's in red. *(© Finnish Transport Agency)*

Trawling in the traffic separation zone is allowed in the COLREGs, but impeding the passage of a vessel using the lane is not (section 1.5.4).

The aim of the precautionary area is to control the intersecting traffic flows. The dashed outlined arrows represent the recommended direction of traffic flow. In this area the arrows therefore indicate the primary directions of traffic flow (image 25); slight deviations from them are allowed. Failing to comply with the arrows indicating the direction of traffic flow is against good seamanship.

The masters of the fishing vessels were aware of the areas in which fishing was allowed. However, they were not certain of the location of their vessels in relation to the different parts of the TSS at the moment of the collision. The decision to trawl against the recommended direction of traffic flow and against the actual traffic flow suggests that the masters of the fishing vessels were not monitoring their position properly, or they took a deliberate risk in their choice of direction or were not familiar enough with the rules.

When trawling, several echo sounders are used to monitor the moves of the shoal of fish as well as the trawl's position and distance to the seafloor. A shoal of fish, once discovered, is monitored closely on the vessel. Navigation and observing the other vessels nearby may receive less attention. The pursuit of economic profits may occasionally be given priority over safe navigation.

Many fishing spots considered fruitful are located in the precautionary area and within the TSS, so fishing in the area is not exceptional. It increases the probability of close-quarter situations and collisions in the busy traffic area. According to the masters of the fishing vessels, they are often passed by merchant vessels at very close proximity, even less than 0.1 miles away, but it has never caused serious problems before. Close-quarter situations were considered common on the vessels, which weakened their risk assessment skills, and a merchant vessel approaching at nearly colliding course was not considered a real threat.

2.4 GOFREP and traffic surveillance

The accident site is located within the GOFREP area, the mandatory ship reporting system on the Gulf of Finland. The accident site belongs to the surveillance are of the Helsinki Traffic. Its tasks include monitoring compliance with the COLREGs within its area, as well as providing vessels with advice and information on marine hazards in the Gulf of Finland. Thus it would have been reasonable to make an inquiry of the fishing vessels' intentions after they had started fishing and moving against the chart-marked direction of traffic flow on the TSS lane, and after they had entered the precautionary area against the recommended direction of traffic flow. In the light of the responsibilities of the Helsinki Traffic, the other traffic could also have been alerted of the fishing vessels.

In practice, however, the surveillance of Helsinki Traffic was hindered by two factors.

Neither of the fishing vessels had an AIS transmitter, making it impossible for the Helsinki Traffic operators to identify them. Calling the fishing vessels on the VHF would thus have required them to be called based on their location. Reaching vessels in this way is highly unlikely.

Helsinki Traffic has called unidentified radar echoes before, and usually they have not been reached. Moreover, not all echoes visible on the radar screen are vessels, as some may be error echoes. Thus calling unidentified echoes has become less common.

However, it should not have prevented the Helsinki Traffic operator from alerting the AMAZON of the radar echoes on her course and the possible danger of collision.

The fishing vessels did not make a GOFREP report to Helsinki Traffic on crossing the reporting line and entering its surveillance area. This further reduced the chances of Helsinki Traffic to reach the fishing vessels and interfere with the situation. The masters of the fishing vessels had interpreted that the obligation to make a report stated in the rules did not apply to them, as both vessels had a gross tonnage of less than 300.

A GOFREP report needs to be made, for example, when the vessel has a gross tonnage of over 300 or vessel's manoeuvrability is restricted. At the time the vessels crossed the line they fulfilled neither of the criteria. Their manoeuvrability was only restricted after they had lowered the trawl. A changed navigational status should have been reported[40] to Helsinki Traffic.

It is important to the safety of the fishing vessels themselves to take care of the reporting. It would allow Helsinki Traffic to monitor their movements more easily and any other vessels sailing in the area could better prepare for the fishing vessels' restricted manoeuvrability. The crews aboard fishing vessels should also acknowledge the fact that in a collision with a merchant vessel, they are likely to suffer the damage. Reporting one's intentions creates a mutual understanding between different parties, thus significantly increasing safety to oneself and other parties.

AIS-devices will be mandatory for fishing vessels in the future. Neither the MENHADEN nor the FLORENCE were equipped with an AIS device at the time of the accident. The accident took place during a transition phase dependant on the vessel's length overall (section 1.4.7). The vessels that took part in the accident are obliged to have an AIS device installed by 31 May, 2012.

In this case, the importance of reporting was emphasized by the dense fog in the area. The other parties, the AMAZON and Helsinki Traffic, were unaware of the trawling. When visibility is good, pair trawling signal lights indicate ongoing fishing. A notification would have allowed Helsinki Traffic to identify and monitor the vessels, and thus failing to make a report can be considered one of the factors contributing to the accident.

2.5 Action on the fishing vessels

2.5.1 Navigation and lookout

The fishing vessel masters' accounts are incompatible regarding the organisation of navigation and lookout on the vessels during pair trawling.

[40] Vessels should always report themselves to the VTS if there is a change to their navigational status. (www.liikennevirasto.fi/gofrep)

The masters' attention was primarily targeted at fishing and any related activities, and thus they were not actively paying attention to navigation. The masters believed that their vessels were visible on the radars of other vessels, and that their fishing lights were visible and indicating ongoing trawling. On these grounds, they expected other traffic would give them way in accordance with the COLREGs.

However, a dense fog hindered the visibility of navigation and fishing lights, changing the situation crucially. This was not completely acknowledged on the fishing vessels. Image 26 illustrates the visibility just before the accident in a photograph taken on a simulation run.

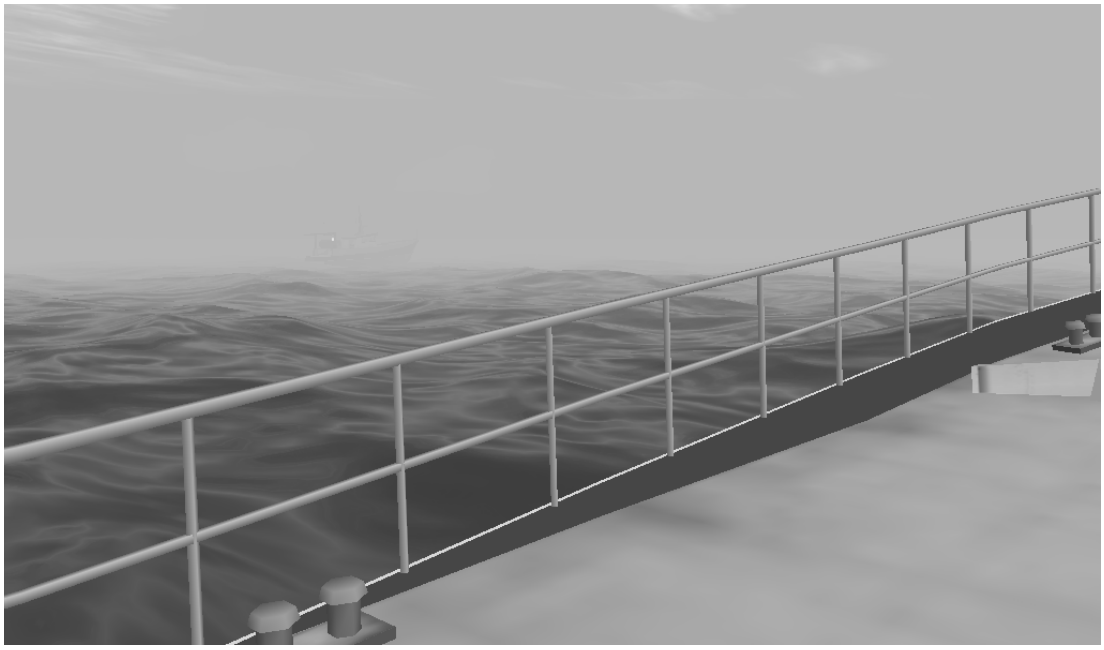

Image 26 Image of the simulation[41]. View from the FLORENCE towards MENHADEN when visibility in the fog was 200 m. To better demonstrate the circumstances, the picture shows daylight. The silhouette of the MENHADEN and its SB navigation light are barely visible.

Due to the fog and darkness, the surrounding traffic was primarily observed by radar. The masters of the fishing vessels were used to merchant vessels passing them at a close proximity. This had an effect on how the radar was used and the radar image interpreted. The master of the MENHADEN estimated already at an early stage, based on the radar image, that the AMAZON would pass them on the port side. The approaching echo from the AMAZON was not considered exceptional enough to monitor it more closely or to intensify radar lookout. This notion is supported by the fact that on the MENHADEN, the scale of the radar was never altered to monitor the situation more closely.

Also the master of the FLORENCE assumed at an early stage, based on a radar image, that the approaching AMAZON would clearly pass them on the port side. Due to this

[41] Appendix 4, simulation on 7 March, 2012

observation, he did not consider it necessary to interfere with the situation or to monitor the situation on his own radar.

Navigation and lookout are exceptionally crucial when trawling as a pair, as the activity significantly reduces the vessels' manoeuvrability. Close-quarter situations have to be avoided even more vigorously than usually, as with a two-vessel unit it is not possible to make any great course alterations quickly.

It has been established that the accident took place at a time of day when a person's alertness is reduced[42]. This affects decision making and actions by making them more rigid. Both vessels had just one person on watch, which emphasized the persons' reduced alertness. It is likely that regular communication between the vessels would have improved their alertness.

2.5.2 Communications

Before the accident, the fishing vessels had trawled together a few times, and the masters did not know each other well. On the day of the accident, the vessels managed to trawl for just over two hours before the accident. During this time there was no radio communication, excluding some trawling related orders given by the master of the MENHADEN at the start of the trawling. After this, the trawling was continued without communications until the collision occurred.

Communication procedures had not been properly agreed on before starting pair trawling. Based on the masters' accounts, it seems there may have been a misunderstanding about the VHF channels that were to be used for communications. This notion is supported by the fact that the MENHADEN did not respond when the master of the FLORENCE tried to call him just before the collision.

The approaching AMAZON was detected early on both vessels. This observation, the upcoming passing and any measures the situation might require, were not discussed at any point. Poor visibility further increased the need for communication. In a situation of this kind, the masters having a mutual understanding of the passing situation and the measures required would have been essential. The lack of communication between the fishing vessels greatly influenced the development of the close-quarter situation and the collision. Clear and pre-determined communication procedures would have lowered the threshold of communication between the masters.

2.5.3 Safety culture

Fishing vessels rarely have detailed instructions formulated by the owner on how to operate the vessels. The approaches depend mainly on the habits of the masters. In addition to the individual habits of the masters, safe operation during pair trawling is also affected by the efficiency of the collaboration between the fishing vessels, the pair trawling experience of the masters, and the predetermined practices.

[42] Theme investigation S3/2004M, Factors contributing to fatigue and its frequency in bridge work. Page 14, image 1. Available at: www.turvallisuustutkinta.fi.

The fishing vessels are not obliged to give way while fishing. They are small and their speed is low. Merchant vessels are aware of their obligation to give way, but due to their considerably higher speed and size they might – as the dominating party – pass by with a small safety margin. Fishing vessels should try to avoid situations like this with their own actions because, due to their smaller size, they will be the suffering party when colliding with a merchant vessel.

During trawling, the vessels' manoeuvrability is restricted, their speed is very low, and their course might deviate significantly from other traffic. In this case, the risk of a collision with other traffic within a busy area increases significantly, and is further accentuated by poor visibility. Fishing is not forbidden within precautionary areas, but if the area is chosen for fishing, following the recommended direction of traffic flow is a minimum requirement to ensure safety.

Whether within a traffic separation scheme or a precautionary area, the vessels follow shoals of fish while fishing. In addition to the permits dictated by the fishing vessel's flag state, the choice of a fishing ground is also affected by the fishers' experiential knowledge about the location of fish. According to the information gathered from the fishers, there are important fishing grounds within the traffic separation scheme in the Gulf of Finland.

The current fishing vessel safety culture involves taking risks. In order to ensure that the vessels travelling within the TSS have a clear image of the situation, the fishers should always report their fishing according to the GOFREP instructions. Although fishing affects the rules on giving way, the fishing vessels should be aware of the fact that in case they have not reported their fishing actions to the supervisory authority monitoring the traffic, they are not necessarily presumed to be fishing. The fishing lights cannot be seen from far away in poor visibility. This means the other vessels cannot see that fishing is under way. It must also be acknowledged that vessels are fairly near to each other when pair trawling, which means that they are not necessarily distinguishable as two separate radar echoes.

The fishing vessels' common uncommunicativeness about their planned actions or manoeuvres makes it difficult for other vessels and traffic controllers to interpret the situation. However, at the same time the fishing vessels presume that the other vessels have noticed that they are fishing, and that they will act according to the related rules.

The ownership of fishing vessels operating in the Gulf of Finland is divided to enterprises and private individuals in different countries, and the statuses of ownerships are often complicated. This means that there is more than one single channel for improving the safety culture. The vessel owners play a big role in guiding the operating culture in a safer direction. However, a comprehensive change of occupational behaviour takes time, and it is the most effective when originating among the players themselves.

2.6 Action on the AMAZON

2.6.1 Watchkeeping and lookout

Seawatch

There are clear regulations on watchkeeping in the STCW[43], in the vessel's safety management system, and in the master's standing orders. The duty of the OOW is to ensure a safe navigation for the vessel. This means reserving a sufficient sea are for the vessel, and using all the possible means to thoroughly evaluate the situation and the risk of collision.

In a dense fog, the watchkeeping officer must pay more attention than usual to the operation of navigation systems, which means that it may become more difficult to concentrate on steering the vessel. In a situation like this, the human resources on the bridge should be increased to ensure a safe navigation.

The shipowner and the master were also aware of the fog being a risk factor; according to the master's standing orders and the guidelines of the shipowner, the master should have been asked to come to the bridge to secure the navigation in the dense fog. In this case the OOW did not act according to these regulations. Radar navigation by two individuals would have been more effective, and it would have helped in facing the circumstances that had become more challenging.

When circumstances change, also the need of a helmsman should be considered in order to give the OOW more time for navigation. However, it should be kept in mind that a lookout should not be assigned any other assignments: the helmsman and lookout should be separate individuals.

The OOW must acknowledge the need to change over to manual steering in time in order to safely avoid any possible hazards. While the vessel is on autopilot, it is extremely dangerous to let the situation evolve to a point where the OOW has to stop the lookout in order to perform an emergency measure.

Well-written procedure guidelines do not in themselves guarantee safe operation – they must also be put to practice. The master has to create an atmosphere that enables the guidelines to be established onboard the vessel and encourages people to follow them.

Lookout

During dark hours and poor visibility, there must always be a lookout to help the OOW on the bridge. The presence of a lookout must be utilised efficiently for example by pointing him/her to the vessel's second radar in order for him/her to participate in the bridge work.

[43] International Convention on the Standards of Training, Certification and Watchkeeping

The S-VDR audio recording from the AMAZON does not confirm, that a lookout was present on the bridge to help the OOW.

2.6.2 Use of the radar

The S-VDR recording of the AMAZON (appendix 1, image 6) reveals that there are two echoes near each other on the port side of the heading within 3.3 nautical miles. The scale of the X-band radar was 6 nautical miles. When approaching further, the echoes of the vessels weaken significantly, and the echo of the FLORENCE occasionally disappears from the radar (appendix 1, image 7).

When an echo disappears from the radar, the adjustments should be thoroughly examined in order to ensure the validity of the interpretation of the situation. To allow this, the OOW must be fully familiarized with the electronic navigation systems and the features and the limits of their operation[44].

The investigator observed some lack of familiarity with the equipment in the OOW's radar operation while aboard the AMAZON off the coast of Hanko after the accident. According to the OOW, the S-band radar anti-clutter sea controls were also on automation during the accident. Based on an experiment[45] (appendix 2), the radar adjustments during the accident suppressed the echoes of smaller vessels off the radar screen.

The user should be familiar with the effect an automatic anti-clutter control has on a radar screen before using the radar. This was apparently not the case in this situation, and/or the OOW did not know how to utilise the feature. The collision occurred during the OOW's second sea watch on this particular vessel. It is presumable that he had not been familiarized with the use of the radars before the voyage well enough to estimate the risk of collision in the manner given in the COLREGs.

The automation of the anticlutter sea adjustments on the S-band radar used by the OOW before the accident was probably the reason for the occasional disappearance of the FLORENCE from the radar. This distorted the OOW's awareness of the situation; changing the course to the port helped to avoid a collision with the MENHADEN but led to an unexpected situation and collision with the FLORENCE.

The AIS is an important additional information source for shaping the situational awareness of the bridge crew during encounter situations. It is therefore an important extra tool for preventing collisions. The fishing vessels had no AIS-transmitters, which was one of the reasons for why it was difficult to observe them on the radar. There was not any receiving device for AIS-signal on the AMAZON that could have been used for identifying radar targets.

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44 STCW Part A, Chapter VIII, Regulation 36.

45 The radar experiment after the accident was conducted with different radar than the one which recorded the S-VDR. However, the both radars had their anti-clutter controls on automation, and the same occurrence of the disappearance of smaller echoes was noticeable (appendix 1, image 7).

In the S-VDR recording, it is also possible to see (appendix 1) that the speed and course of the fishing vessel echoes were fluctuating. This confused the OOW's radar observations. The fluctuations in the length and course of the vector that indicates the radar targets' course and speed are a result of the ARPA monitoring altering between two radar targets that were close to each other. According to the S-VDR, the bearing to the target did not alter significantly at any point, thus the risk of collision was evident. This would have been acknowledgeable for example with the radar's electronic bearing line (EBL) which is a good tool for evaluating risks of collision. The OOW did not utilise this feature.

The radar screen showed that the CPA limit had been set at 0.5 miles and the TCPA limit at 10 minutes. In other words, when the smallest passing distance is less than 0.5 miles, and when the remaining time to the passing of the radar target is less than 10 minutes, the radar will give an alarm. Given that the limits are this small, the alarm should have caused a swift reaction and measures should have been taken. In this case, the radar gave multiple alarms about the risk of collision. The OOW acknowledged the alarms but did not take any measures.

2.6.3 Decision making, manoeuvring and communication

Decision making

The OOW was managing the navigation, positioning, radar monitoring and lookout. Managing so many tasks simultaneously in demanding conditions is burdening. The early hours may also have reduced his alertness and therefore also affected actions and decision making.

The situation evolved into a close-quarter situation. The OOW began to change the course extremely late, although the development of the situation did not happen suddenly but gradually due to the low speed of the fishing vessels. Moreover, due to a misinterpretation of the radar image, the change of the course was based on inadequate radar observations. The change of the course was very moderate (image 13) considering the actual state of affairs.

Manoeuvring

Reducing speed or stopping the vessel are effective actions for avoiding close-quarter situations or collisions, provided they are done in ample time with a sufficient distance so that the other vessel can clearly observe the procedures[46]. The COLREGs do not numerically define when and from what distance the actions to avoid a collision should be executed. Defining this is the duty of the OOW.

In some cultures the OOWs hesitate to use the engine order telegraph because it is seen as a device that only the master uses and its use will be widely noticed at the

[46] It should be noted that in situations where the party obliged to give way starts to pass the other vessel on the stern side, a reduction in the speed of the party that is being overtaken might complicate the possibility of the other party to pass the vessel.

vessel. It must be emphasized that the engine order telegraph is a device that is closely linked with safe navigation. It is of equal value with other navigation systems, and the OOW is free to use it.

The change of course to avoid the incoming target was made to the port. A steering action like this should be avoided according to the rules of the road. The OOW's choice of course was affected by the STELLA POLARIS on the front starboard side, which was navigating to the same direction and which the AMAZON was passing. However, based on the facts that have come up in the investigation, this could not have been an obstacle for changing the direction to the starboard, because the speed difference was small and the distance was sufficient. The same conclusion was reached after the simulations (appendix 4).

The most effective procedure would have been to change the course of the AMAZON by the rudder command "*hard to starboard*", in which case the fishing vessels navigating with the speed of 2.5 knots would have stayed far behind on the port.

Communication

The vessel (STELLA POLARIS) that was being passed could have been informed about the change of direction and its grounds with the VHF. This would have ensured that both vessels had a mutual understanding of the situation and its objective. Hesitating to make contact and the free sea area on port side made the yield to the port a more easily practicable alternative.

The effects of different decisions regarding operation that are made in the simulator are analysed in appendix 4.

2.7 Collision and sinking

The FLORENCE sank in approximately 10 minutes after the collision, although the area below the vessel's waterline appeared undamaged in the underwater footage. Furthermore, the wreck was discovered at a location different from that of the collision. Based on this, the investigation team considered it necessary to analyse the collision and the process of sinking more accurately. The analysis is based on the reports of those involved, on the ROV-shootings and on the VTS and S-VDR recordings.

The AMAZON and the FLORENCE collided at a slight angle based on the damages and the reports of those who were involved. The FLORENCE listed to starboard at the collision. Based on the damages seen in the underwater footage (image 18) the anchor of the AMAZON hit the FLORENCE in the bulwark by the hold. There were no visible damages on this part or towards the bow. The anchor ripped open few meters of the gunwale as the vessels were moving to opposite directions. There were no more noticeable damages on the sides of the FLORENCE until the bridge, where the anchor had hit the gunwale and the deckhouse reaching all the way to the side of the vessel.

The bow wave of the AMAZON raises the water level (image 27). The FLORENCE rose higher by the side of the AMAZON near her bow. This was one of the factors contributing to the height at wich the AMAZON's anchor hit the side of the FLORENCE. The blue paint mark (image 17) visible on the front side of the anchor in the bow of the AMAZON is probably caused by the steel structure on the FLORENCE's stern.

Image 27. The AMAZON moving in loaded condition. The water level rises due to the bow wave. The picture is taken on the day of the accident on 23 October, 2011, so the draught is the same as it was during the accident.

Based on the recordings and the distance between the collision site and the location where the wreck was found, it seems that the FLORENCE was dragged stern first along with the AMAZON. This is supported by the crew's report about the difficulty of opening the stern door due to water pressure. They were able to open the door afterwards, once the vessel had been detached from the AMAZON. The vessels were attached to each other when the anchor stuck on the deck structures of the FLORENCE and the trawl cable possibly twisted around the AMAZON's bow.

The AMAZON kept on turning to the port after the collision, which was one of the reasons the vessels remained attached to each other. Based on the VTS recording and the sites of the collision and the sinking, and the information about the location where the wreck was found, the FLORENCE was dragged along the AMAZON for about 1/3 of a nautical mile. The AMAZON was moving at the speed of 11 knots according to the AIS data.

Because the FLORENCE listed and moved backwards, water entered the vessel over the board. The hatches to the hold were open, so water was able to enter the hold freely. According to the VTS recording, the vessels were detached when the AMAZON

stopped turning. Once the crew managed to open the stern door, water also entered the interior of the vessel.

It is presumable that enough water entered the hold, the interior, and the deck of the FLORENCE while it was dragged along with the AMAZON that the joint effect of the freeboard damages and the water inside the vessel caused it to sink some 10 minutes after the collision. Image 28 demonstrates the whole process of collision and the positioning of the vessels in relation to each other.

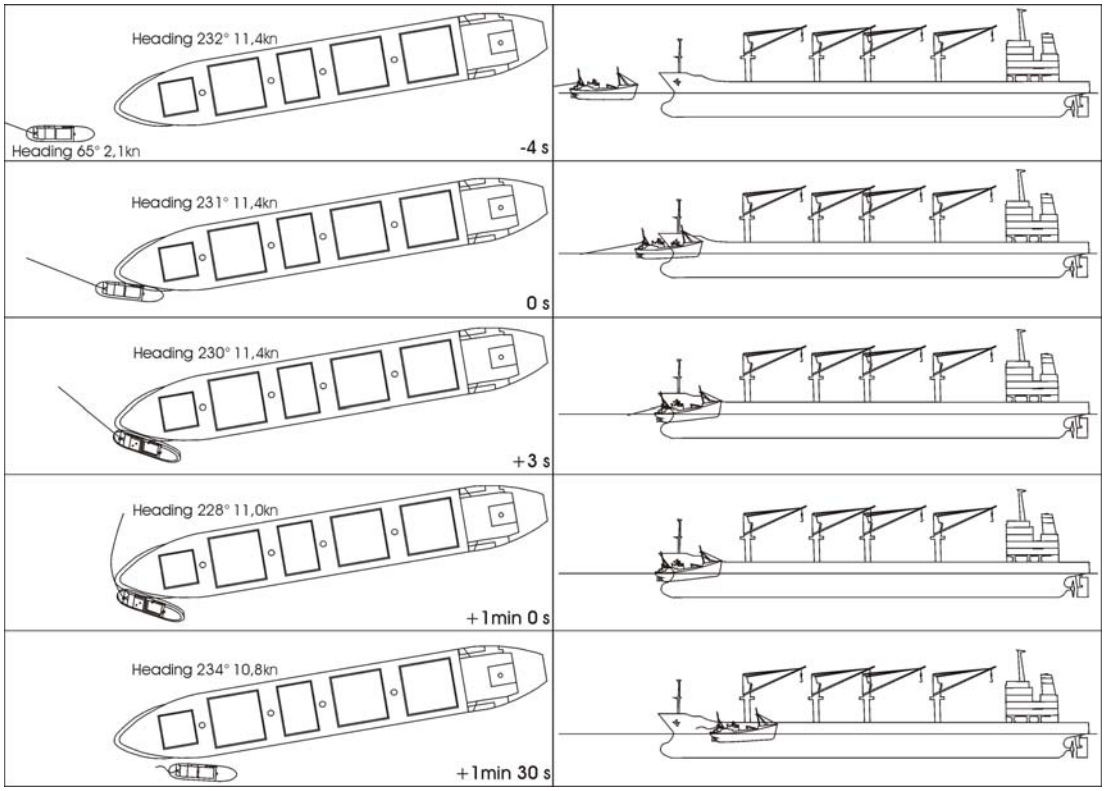


Image 28. Pictures of the assumed process of the collision. The pictures do not illustrate the possible impact of the AMAZON's bow wave which probably raised the FLORENCE higher, or that the AMAZON pushed the FLORENCE for about 1/3 of a nautical mile during the collision.

2.8 Alerting and rescue operations

Alerting

The collision situation was chaotic. The crew of the FLORENCE had to concentrate solely on getting out of the vessel. Thus, there was no time to send out a distress signal. The VHF call for the MENHADEN before the collision did not reach its target, and neither the AMAZON nor the MENHADEN understood what was actually happening. Therefore, the alert depended solely on the EPIRB emergency beacon. It functioned reliably and sent out an alarm of the vessel's sinking immediately after hitting water.

The Cospas-Sarsat system received the EPIRB transmission 38 minutes after it had been activated. There is typically some delay in the system because the EPIRB's message proceeds to the receiver through satellites and land units. After receiving the alarm, the Maritime Rescue Coordination Centre confirmed the vessel's disappearance from the radar recordings.

The master of the MENHADEN started to look into the situation when he was not able to contact the FLORENCE anymore. This together with the EPIRB alarm ensured the Maritime Rescue Coordination Centres that the EPIRB alarm was justified. The rescue operation would probably have been significantly delayed without the alarm that was given by the EPIRB radio beacon.

Rescue operation

The collaboration between the Tallinn JRCC and the maritime rescue sub-centre of Helsinki worked well. The cargo vessel KAUNAS was very helpful and reported multiple observations of floating objects that were found near the scene of the accident. The collaboration at the site of the accident was efficient as a patrol boat of the Finnish Border Guard inspected the obsevations made by the KAUNAS.

It took 56 minutes for the patrol boat to get to the site of the accident after receiving the alert. After the patrol boat started the search operation on the spot, it took a little less than an hour and a half before the liferaft was found. The search operation started while it was dark, and the sun rose about 30 minutes afterwards. The rescue operation can be considered a success considering the dense fog, the site of the accident in the middle of the Gulf of Finland, and the fact that liferafts make poor radar targets (i.e. it could not be seen on the radar).

The Mayday Relay- message could have been transmitted considerably earlier, in order to inform all the vessels in the area about the rescue operation in progress. It was very fortunate that the liferaft did not get run over by other vessels in the traffic separation scheme, as some traffic was present according to radar observations.

The actions of those involved in the accident

The AMAZON's OOW knew he had hit something. He did not investigate what it was, nor did he inform Helsinki Traffic. The AMAZON did not stop after the accident. The possibilities to clarify the situation thoroughly were limited, but a notification to the authority would have given the first indication of an accident and improved the situational awareness of the JRCC and MRSC Helsinki later when the EPIRB alarm was received. The notification would have also helped to bring forward the rescue operation and to focus it better by taking into account the route of the AMAZON.

In accordance with regulations as well as good seamanship, all abnormal events should be reported. No report was made even in the morning when the OOW and the master found scratches in the bow as they were checking the reasons for the sounds of collision heard during the early morning hours.

According to the master of the MENHADEN, he had not noticed the AMAZON which had passed between the two fishing vessels. He did not notice the accident until he observed the change in the trawl's position by sonar. However, he misinterpreted the situation and assumed, in accordance with this observation, that the FLORENCE had drifted aside from her course. He suspected that perhaps the master of the FLORENCE had fallen asleep. After his observation he tried to contact the FLORENCE on VHF channel 12 and after this on the common calling channel 16 without result.

Slowly, the situational awareness of the master of the MENHADEN as well as the owner of the FLORENCE began to evolve. The inkling of a possible emergency was based on the fact that they could not contact the FLORENCE. The poor visibility due to the dense fog prevented the MENHADEN to build an unambiguous picture of the situation.

Lack of a comprehensive mutual fishing history and inadequately agreed communication practices between the fishing vessels hindered the alerting the same way they had hindered the communication even before the accident. Also the insecurity of the actual state of affairs made it difficult for the MENHADEN to contact the MRSC. Alerting activities were never initiated on the MENHADEN.

Due to the passiveness of the MENHADEN, the party who knew the most about the events that had led to the accident, and who was nearest to the site was not at all involved in the alarm operation during the first hours. This is why the uncertain situation caused by the EPIRB alarm only became an actual emergency situation much later.

The MENHADEN first contacted the JRCC Tallinn approximately an hour and 20 minutes after the collision at 06:03 by inquiring what had happened. After hearing that the FLORENCE's EPIRB was alarming, the crew began to realise that the situation was an actual emergency.

Once the information about the FLORENCE's EPIRB alarm was received, the MENHADEN began to lift the trawl. It took longer than usual, about two hours, because the trawl was broken and there was a lot of catch to be lifted alone. While the trawl was in the water, the chances of the MENHADEN attending the rescue operation were poor due to her restricted manoeuvrability. The trawl could have been dropped into water, but they did not do so because the crew thought it might have endangered other vessel traffic.

Once the trawl had been lifted, the MENHADEN tried to contact JRCC without success. Around one hour afterwards, they received a notification that the liferaft and the people on it had been found.

3 CONCLUSIONS

3.1 Findings

1. The fishing vessels had few times carried out pair trawling together. The masters of the fishing vessels did not know each other very well, so the threshold for mutual communication was higher than normally.
2. The crew of the FLORENCE did not meet the requirements of the minimum safe manning document.
3. The masters of the fishing vessels had not agreed on communication practices beforehand precisely enough. Among other things, they may have had different conceptions about the VHF channels that were to be used.
4. The communication between the masters of the fishing vessels was sparse and only concerned trawling.
5. The main focus of the masters of the fishing vessels was in the matters concerning fishing, for example in observing the positioning of the trawl and maintaining the distance between the vessels. Navigation and observing the other vessels nearby might have been given less attention.
6. Both fishing vessels only had their masters on the bridge. The rest of the crew was sleeping.
7. The fishing vessels had no AIS. During the time of the accident the AIS was not mandatory since vessels this size were not obliged to have AIS installed until 31.5.2012 at the latest.
8. The fishing vessels did not report to Helsinki Traffic about crossing the GOFREP reporting line. Nor did they report about their restricted manoeuvrability after starting pair trawling.
9. The fishing vessels advanced against the recommended direction of traffic flow in the dense fog after reaching the precautionary area.
10. It is difficult for Helsinki Traffic to contact fishing vessels that have not reported themselves and do not have an AIS transmitter. The only way for calling them is based on the position of the vessel. Contacting a vessel this way is unlikely.
11. The AMAZON had an AIS transmitter, and was therefore recognisable.
12. The masters of the fishing vessels noticed the AMAZON in good time (approximately 6 nautical miles before) on their radars, but interpreted at an early stage that it would pass them on the port side.
13. Merchant vessels and fishing vessels often pass each other on close proximity. This affected the fishing vessel masters' interpretation of the radar image and their view of the developing situation.

14. The AMAZON's OOW was onboard that particular vessel for the first time. It was his second sea watch. He had been familiarized to the vessel in the port of departure and during a day and a half at the beginning of the voyage.
15. The S-VDR audio recording from AMAZON does not confirm that a lookout was present on the bridge of the AMAZON.
16. The AMAZON was passing the STELLA POLARIS which was travelling on her starboard side with a minor speed difference, but was still clearly behind the level of her midship.
17. A moment before the accident, visibility was suddenly reduced because of the fog. This contributed greatly to the development of the accident. The fog also complicated the rescue operation later on.
18. The AMAZON's safety management system and the master's standing orders have clear operating instructions on safe navigation during limited visibility. The instructions were not followed properly.
19. The AMAZON's radar adjustments were not optimal in regard to the weather; the radar echoes of small vessels occasionally disappeared off the radar screens or were covered by the radar vectors.
20. The familiarization of the AMAZON's chief officer had been insufficient.
21. The monitoring of ARPA targets on the AMAZON's radar varied between the fishing vessels. This produced incorrect information about the courses of the fishing vessels. The bearing (BRG) on the radar screen indicated a risk of collision the whole time.
22. The radar sounded multiple alarms about a collision due to the alarm limits being exceeded. The alarm was acknowledged, but no other measures were taken at this stage.
23. The fishing vessels were seen as one target on the AMAZON's ARPA monitoring but as two echoes occasionally. The situation was allowed to develop into a close-quarter situation as defined in the COLREGs, and ensuring a sufficient passing distance was not possible anymore.
24. The AMAZON's OOW assumed later that the two echoes had merged into one, and decided to change the course of the vessel to the port in order to avoid a collision. A collision with the MENHADEN was avoided, but the change of course led to a collision with the FLORENCE.
25. The FLORENCE tried to contact the MENHADEN a moment before the collision without succeeding.
26. The collision took place within a precautionary area.
27. Helsinki Traffic did not warn the AMAZON at any stage about the risk of collision.
28. The FLORENCE got stuck on the bow of the AMAZON for some time, listed and was dragged stern first along with the AMAZON for about 1/3 of a nautical mile. Water entered the vessel's interior and her hold that had open hatches.

29. The FLORENCE sinked approximately 10 minutes after the collision.
30. The MENHADEN did not notice the collision and continued trawling. The vessel tried to contact the FLORENCE once they noticed the positioning of the trawl had changed.
31. The OOW of the AMAZON took no measures after the collision, but navigated the vessel back to the route that had been followed before the course had been changed.
32. All the four crew members of the FLORENCE were able to exit the vessel's interior after multiple efforts at opening the door, and they managed to escape to the liferaft. They were slightly injured. The crew members were in danger of hypothermia.
33. The immaculate working condition of the recently renewed EBIRP and liferaft significantly improved the chances of rescue.
34. Reading of the MaydayRelay message was considerably delayed.
35. The crew members of the FLORENCE were rescued from the liferaft a little over four hours after the collision.
36. The rescue operation went well considering the circumstances. The teamwork worked well between the MRSC Helsinki and JRCC Tallinn as well as the vessels and patrol boats that came to help at the site of the accident.
37. The Finnish Border Guard detained the AMAZON off Hanko later the same morning based on radar observations that indicated she had been involved in the accident.
38. During the visit by the Finnish Border Guard it was confirmed that the AMAZON was party to the accident.

3.2 Factors that contributed to the accident

Before the collision, the course of the fishing vessels remained nearly unchanged for about two hours all the way from the start of the trawling until the collision. The course of the AMAZON fluctuated only a little during the hour before the collision. Both the crossing courses and hence also the risk of collision were observable by the parties long before the actual collision.

The fishing vessels were trawling in a dense fog against the recommended direction of traffic flow within the precautionary area. The masters were alone on the bridge in both fishing vessels. It is very likely that the oncoming AMAZON's OOW was also alone on the bridge. Simultaneous positioning, radar monitoring, lookout and navigation in challenging environmental circumstances are more burdening than usual for one person. Moreover, due to the early hours the alertness of the parties had probably weakened. Thus vulnerability to miscalculations had been increased.

The activities on the AMAZON did not measure up to the regulations on safe navigation and bridge crew given by the shipowner and the master. The prerequisites for safe navigation had weakened. In practice, the safety culture of the vessel and the familiarization of the OOW did not measure up to the instructions.

After the fishing vessel masters had observed the AMAZON on the radar, they assumed she would pass them on the port side and did not react to the situation in any way. The fact that the fishing vessel masters were accustomed to small passing distances with merchant vessels affected their attitude towards the oncoming vessel.

According to the rules, power-driven vessels must give way for vessels that are fishing. The fishing vessels had their lights on, but they were not visible in the dense fog. The starting of the fishing and the restricted manoeuvrability were not reported to Helsinki Traffic by radio. Because the fishing vessels did not have either AIS transmitter (which was not mandatory during the accident) the other parties did not know for sure that they formed a pair trawling vessel unit. This could be concluded only by carefully interpreting the radar screen.

There was no communication between the vessels. Thus, no mutual understanding of the situation and of the necessary procedures was formed. Helsinki Traffic did not contact any of the vessels, nor did it warn the AMAZON about the danger of collision. Contacting the fishing vessels is difficult due to the fact that they cannot be identified. The lack of the AIS transmitters and the fact that the fishing vessels did not report themselves significantly weakened the capability of Helsinki Traffic to intervene in the situation as the supervisory authority. There was also a communication threshold between the masters of the fishing vessels, and reporting practices had not been agreed upon in sufficient detail.

The AMAZON allowed for the situation to develop into a close-quarter situation even though it had noticed the slowly advancing fishing vessels approximately 4–5 miles earlier and bearing to the fishing vessels stayed fixed for about an hour. After the fishing vessels came closer, the echo of the FLORENCE disappeared off the AMAZON's radar screen due to radar adjustments. Also the fluctuation of the ARPA monitoring between the fishing vessels that were navigating close to each other caused ARPA information inaccuracy on the radar, and complicated the AMAZON's OOW's interpretation of the radar image.

The AMAZON's change of course was made to the port, although a manoeuvre of this kind should be avoided according to the COLREGs. This choice was probably affected by a vessel that was steaming at the front starboard side and that the AMAZON was passing. The AMAZON avoided collision with the MENHADEN at the last minute but collided with the FLORENCE.

The FLORENCE sank quickly, as her side structures were broken by the AMAZON's anchor, the hatches to her hold were open and she was dragged along with the AMAZON in a listed condition, which allowed water to flow into the vessel. The recently replaced liferaft and EPIRB transmitter functioned reliably and had a significant role in survival of the crew of FLORENCE without personal injuries.

The emergency and rescue operations were swift considering the circumstances and the manner of raising alarm. The cooperation between the vessels participating in the rescue as well as between the MRSC Helsinki and JRCC Tallinn was successful.

4 IMPLEMENTED PROCEDURES

AIS transmitter

After the accident, an AIS transmitter has become mandatory for all fishing vessels the same size as the FLORENCE and the MENHADEN. This makes the identification of vessels, exchange of information between different parties and the monitoring of the vessels' moves considerably easier. This is a significant improvement for the future.

Helsinki Traffic

Helsinki Traffic has noticed an increase in the AIS transmitters on fishing vessels after the accident. This has made the identification, monitoring and advicing of fishing vessels easier and enabled sending notifications to their flag states when necessary.

Reports of restricted manoeuvrability (fishing) within the GOFREP area are extremely rare.

The shipowners of the AMAZON

According to the shipowners of the AMAZON, the following corrective actions have been implemented after the accident:

After the accident, the chief officer was reassigned from the 04.00–08.00/16.00–20.00 watches to the 08.00-12.00/20.00–24.00 watches, making it easier for the master to supervise his actions. The chief officer was later replaced.

The vessel has organized several briefings and additional familiarizations in relation to the COLREGs and company regulations. The shipowners' other vessels have been educated on the details of the accident in order to prevent similar incidents.

It must be made sure that all of the safety management system's procedures are implemented on the vessel. The shipowners will formulate a rule for the SMS's navigation section concerning the master, according to which the master must ensure that the watchkeeping officers strictly follow the navigation instructions before departure.

5 SAFETY RECOMMENDATIONS

The following safety recommendations are meant to prevent similar accidents. The safety recommendations do not contain assumptions on liability or compensation for damages.

5.1 Communication

The chances of Helsinki Traffic, which is the supervisory vessel traffic authority within the GOFREP area, of contacting fishing vessels that do not have an AIS transmitter or have not reported themselves are poor. In this case, the situation could have been intercepted by informing the AMAZON about the radar echoes on her course, and about the danger they were indicating. This intervention would have also ensured compliance with the COLREGs.

The SIAF recommends that:

1. *the Finnish Transport Agency ensure, by training and instructing the VTS operators, that when the traffic situation within the GOFREP area so requires, the VTS operators interfere with the course of events by actively sharing information.*

5.2 Safety culture

The instructions on safe navigation and manning given by the AMAZON's shipowner company and master were comprehensive. The COLREGs had been taken into account, and they also included instructions for situations with limited visibility. The actual safety culture of the vessel did not follow the instructions. This weakened the prerequisites for safe navigation.

According to a report received from the shipowner, they have implemented some corrective actions that aim at ensuring safer navigation.

Some of the corrective actions are yet to be implemented.

The SIAF gives the Tide Line Inc. shipowning company and the Bahamas Maritime Authority the following recommendation:

2. *Tide Line Inc shipowning company should ensure that the corrective actions that have yet to be completed are completed, and the Bahamas Maritime Authority should monitor that these actions are properly implemented.*

Safety culture on fishing vessels is covered in chapter 2.5.3. Improving the safety culture is the most effective when it stems from the crew itself.

5.3 Safety while fishing – a safety observation

Following shoals of fish determines the course while trawling. There is usually no specific route planning, and only the fishing area is decided. During the investigation, it has become clear that the scene of the accident is located within a good fishing area, and fishing within it is not unusual. According to Helsinki Traffic, reports about restricted manoeuvrability (fishing) within the GOFREP area are extremely rare.

It is extremely important for the fishing vessels to report their moves to the authority supervising the vessel traffic, and to follow the rules given in the COLREGs and the recommended direction of traffic flow. This is even more significant in foggy conditions, when other vessels cannot see the beacons on the fishing vessels. It is primarily the safety of the fishing vessels that is at stake, as they are usually the party suffering the most damages in case of a collision with a merchant vessel. There are several examples of this kind of collisions (appendix 5).

The Finnish Transport Safety Agent supervises the condition of the vessels and the competence of the crew with the additional help of the Finnish Border Guard. The Finnish Transport Agency supervises and instructs vessels while they are navigating. Due to the difficulties in contacting the owners, it is hard for the authority to interfere in deviations that are observed in the operation of fishing vessels, when the fishing vessel in question is actually in foreign ownership and when the vessel mainly operates out of a foreign port.

Based on the abovementioned facts, a safety observation has been formulated, stating that the cooperation and exchange of information between authorities should be as effective as possible when aiming to intervene in such navigation of fishing vessels that deviates from rules and recommendations and therefore has a potential to cause dangerous situations[47]. Most of all, the aim should be enhancing safety awareness among professional fishing, and thus improving the safety of fishermen themselves.

Helsinki, 22 May, 2013

Ville Grönvall Juha Sjölund

Timo Naskali Risto Repo

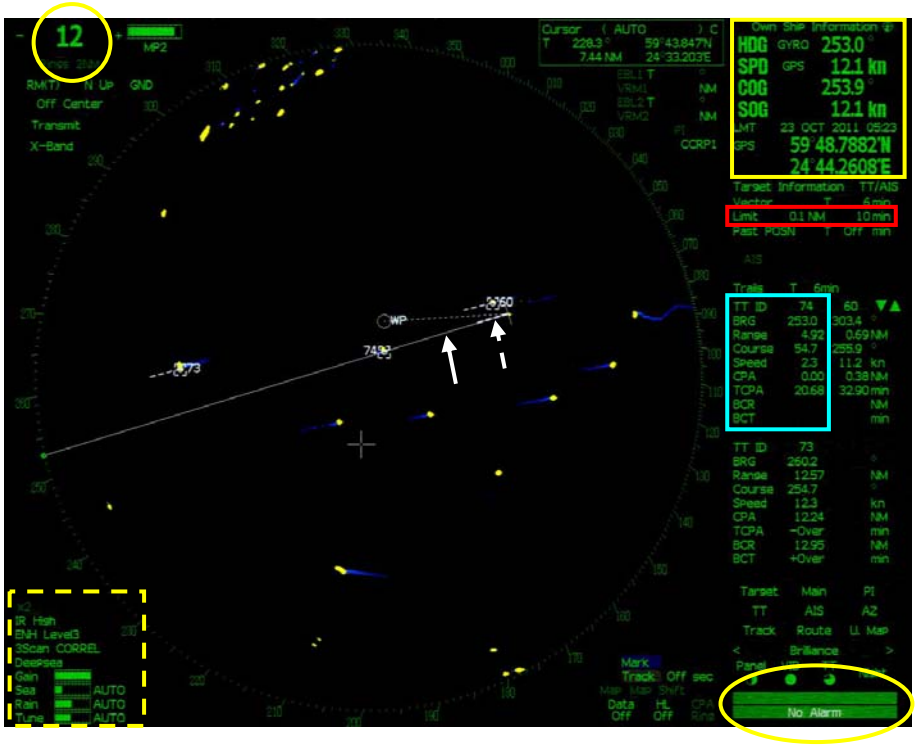
[47] According to the comments by the Finnish Transport Agency, the VTS non-conformance reports and the SRS Violation reports of GOFREP on the offences of the fishing vessels as well as other vessels have been delivered to the Transportation Safety Agency (Trafi) already since year 2010. Furthermore, the information on the perceived offences of fishing vessels in the TSS areas is delivered to the coordination centre of Finnish coastguard. Within the Finnish Transport Safety Agency reports are forwarded to the inspectors in order to be utilized in the supervision of the vessel safety.

APPENDIX 1. IMAGES OF THE DIFFERENT STAGES LEADING UP TO THE ACCIDENT

Source: MV AMAZON Voyage Data Recorder (S-VDR)

How to read the appendix

The images in the appendix are screenshots that are taken from the radar recording of the AMAZON's Voyage Data Recorder. The radar screen image is saved four times in a minute, and the collision cannot therefore be tracked afterwards in real time with the help of the radar images. However, the audio tape and the conning display do give continuous information from the vessel. The radar images show the MENHADEN as a red, the FLORENCE as a blue, and the AMAZON as a yellow arrow.



An example image and explanations for the drawings:

The yellow circle at the top left corner indicates the range of the radar in miles. The yellow dash line square at the bottom left corner indicates the radar adjustments (Gain = sensitivity of the received radar signal, Sea = anti-clutter sea control, Rain = anti-clutter rain control, Tune = tuning of the radar image focusing, AUTO = automation).

The yellow oval at the bottom right corner shows the location where the radar alerts appear. They also include an alarm signal on the bridge.

The turquoise rectangle indicates the information about the movements of the target within the ARPA monitoring (BRG = bearing from own vessel [°], Range = distance of the target from own vessel [nautical miles], Course = the course of the target [°], Speed = the speed of the target [knots], CPA = the nearest passing distance with the target [nautical miles], and TCPA = the time to closest point approach [minutes]).

The red rectangle indicates the radar's CPA and TCPA alarm limits. When the CPA is less than 0.1 miles and there is less than 10 minutes until it is reached, the radar sets both a visual alarm on the radar screen and an audible alarm.

The yellow square at the top right corner indicates the vessel's own navigation information and position coordinates (HDG = the heading [°], SDP = the speed [knots], COG = the course over ground [°], and SOG = the speed over ground [knots]).

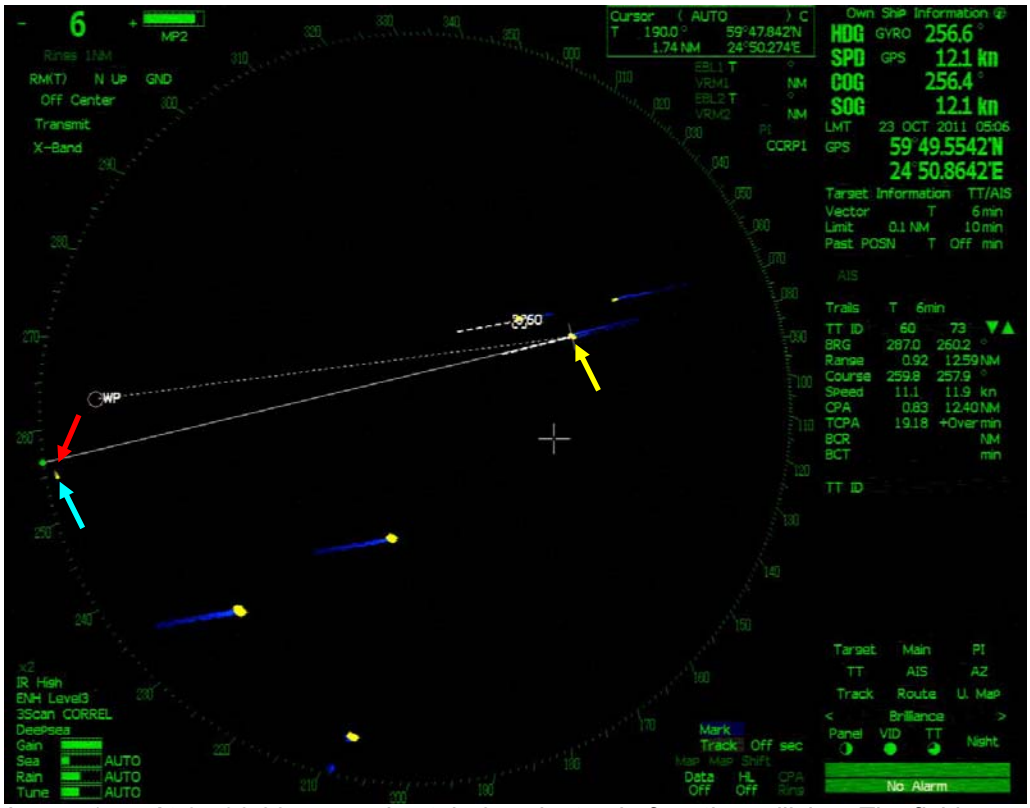


Image 1. *At 04:06:33, approximately 37 minutes before the collision. The fishing vessels appear on the radar screen of the AMAZON for the first time. The radar range is six miles. The course of the AMAZON is 256.4° with a speed of 12.1 knots.*

Image 2. *At 04:09:34, approximately 34 minutes before the collision. The radar range is 12 miles. The OOW of the AMAZON has just begun the ARPA monitoring of the fishing vessels (number 74 on the screen) so the additional radar information is not displayed on the radar screen yet. The course of the AMAZON is 255.7° with a speed of 12.2 knots.*

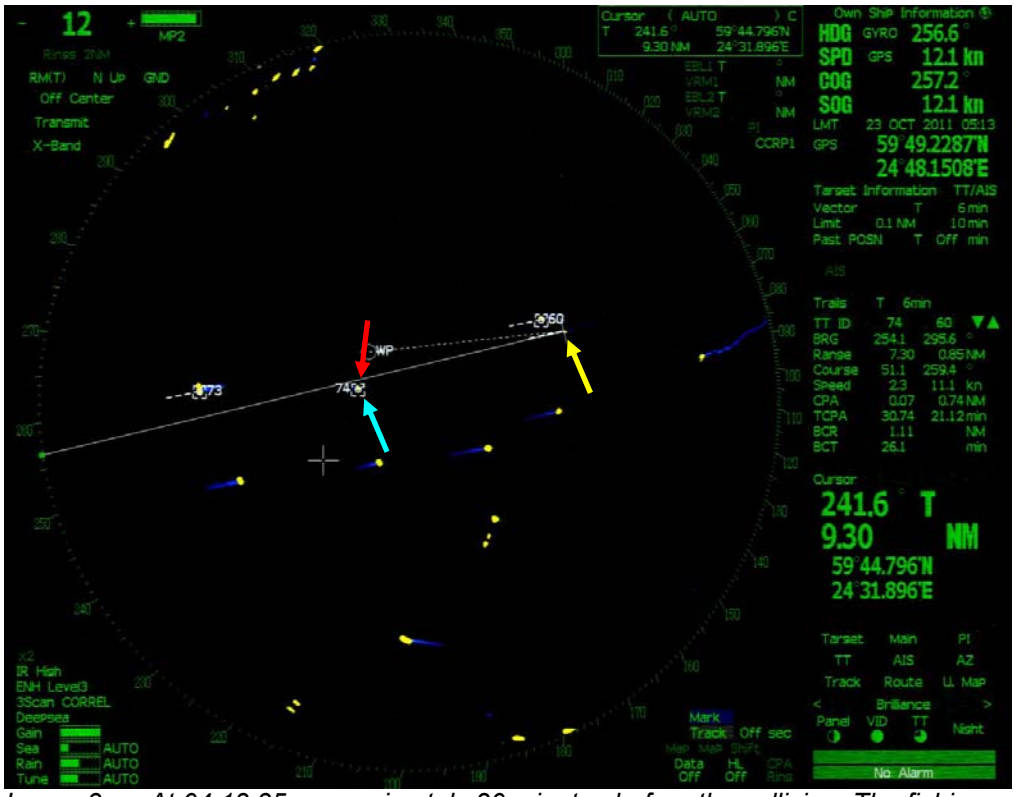


Image 3. *At 04:13:35, approximately 30 minutes before the collision. The fishing vessels' navigation information is displayed on the radar screen of the AMAZON (TT ID 74). The fishing vessels are within 7.3 miles of the AMAZON in a heading of 254°. The course of the fishing vessels is 51°, and the speed 2.3 knots. The CPA is 0.07 miles, and the TCPA is 30.74 minutes.*

Image 4. *At 04:20:18, approximately 23 minutes before the collision. The fishing vessels are within 5.69 miles of the AMAZON in a heading of 253°. The course of the fishing vessels is 43°, and the speed 2.4 knots. The CPA is 0.09 miles, and the TCPA is 24.07 minutes. The course of the AMAZON is 257° with a speed of 12.1 knots.*

Appendix 1/4 (10)

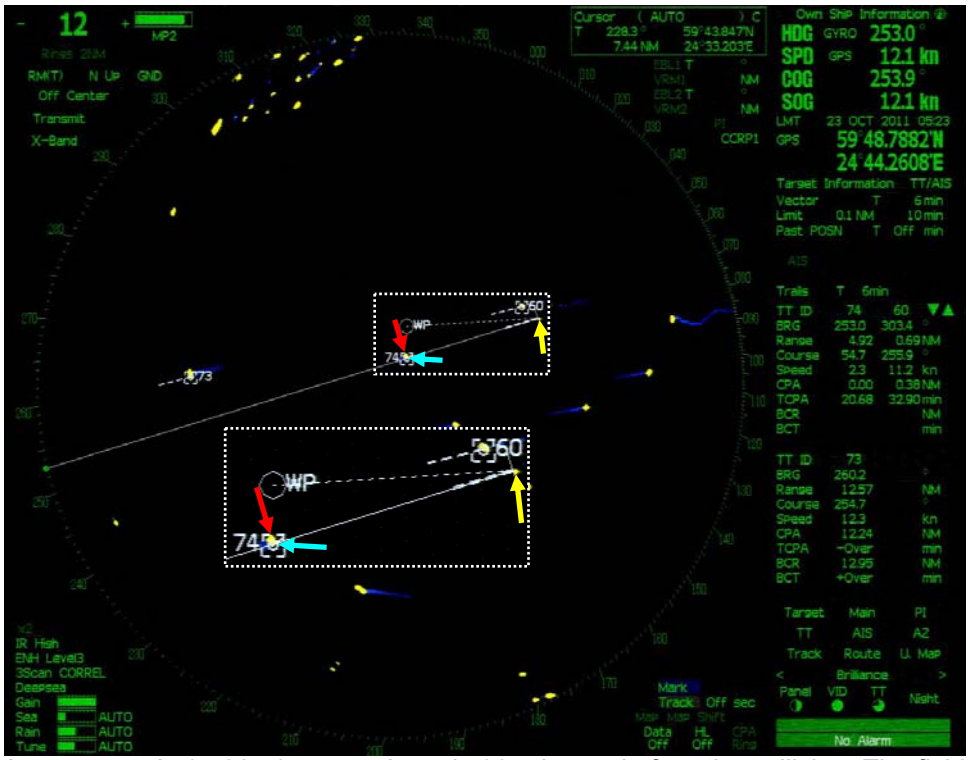


Image 5. *At 04:23:42, approximately 20 minutes before the collision. The fishing vessels are within 4.92 miles of the AMAZON in a heading of 253°. The course of the fishing vessels is 55°, and the speed 2.3 knots. The fishing vessels are directly underneath the AMAZON's vector that indicates the course (CPA 0 miles). TCPA 20.68 minutes. The course of the AMAZON is 253.9° with a speed of 12.1 knots.*

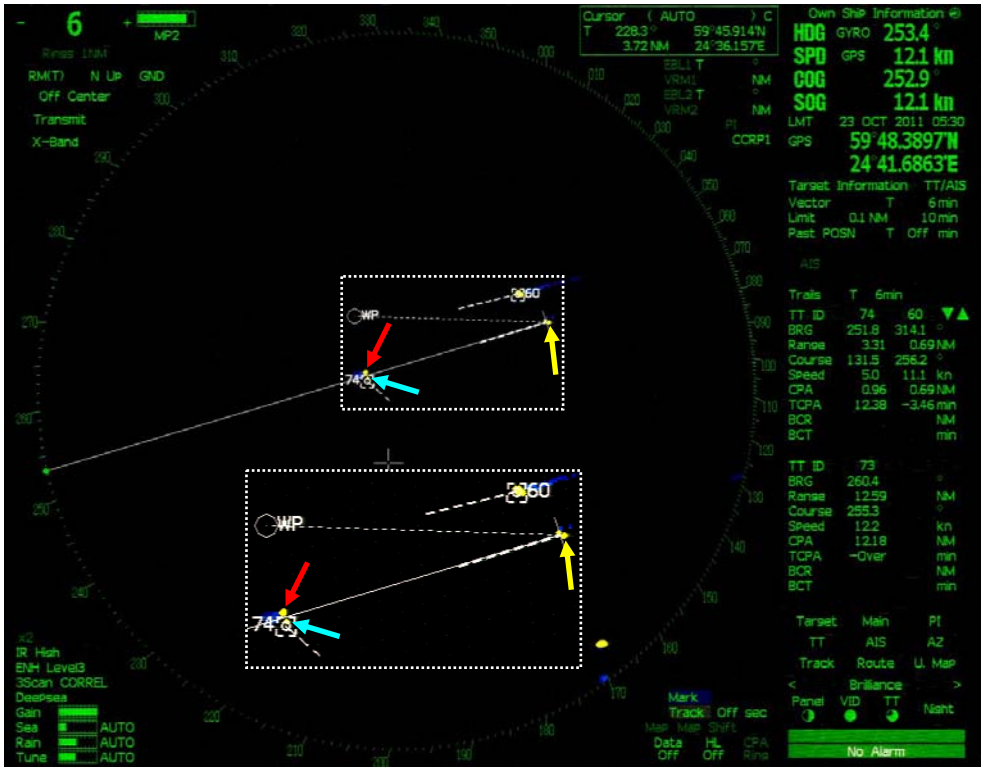


Image 6. *At 04:30:13, approximately 13.5 minutes before the collision. The radar range has been changed to 6 miles, and there are two distinguishable echoes on the radar by the fishing vessels. The vector of the lower echo points inaccurately to the south-east. The fishing vessels are within 3.31 miles of the AMAZON in a heading of 252°. The CPA is 0.96 nautical miles, and the TCPA is 12.18 minutes. The course of the AMAZON is 252.9° with a speed of 12.1 knots.*

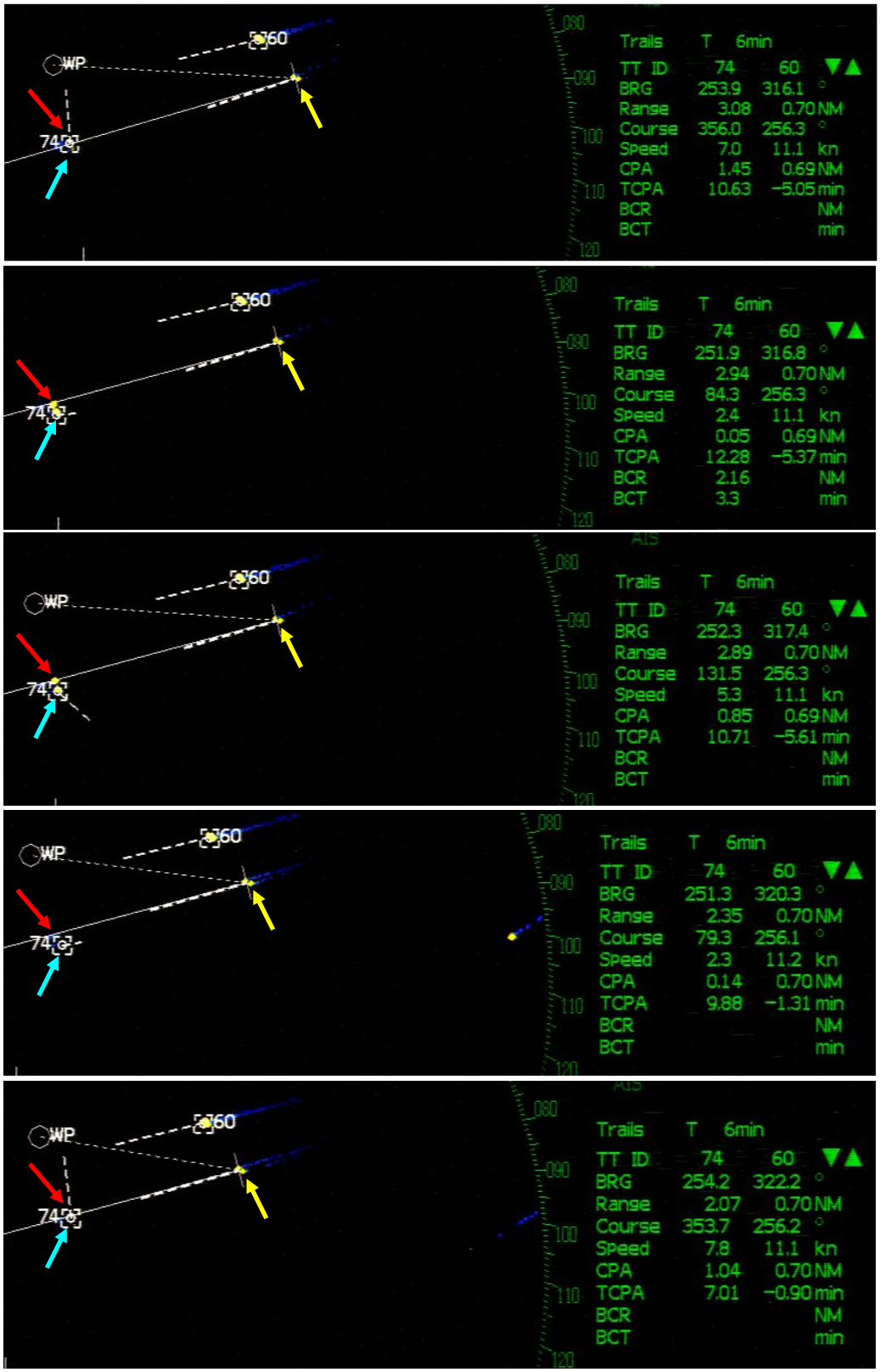


Image 7. *At 04:31:22–04:35:36, depending on the image approximately 9–13 minutes before the collision. The collage of images indicates how the ARPA monitoring fluctuates between the MENHADEN and the FLORENCE. The course vector and speed vector directions and the size of the ARPA target fluctuate considerably. The second and third images from the top show the echoes of the fishing vessels. These echoes are only barely, if at all, visible in the other images. The anti-clutter sea and rain control adjustments have probably affected the visibility of small radar targets on the radar.*

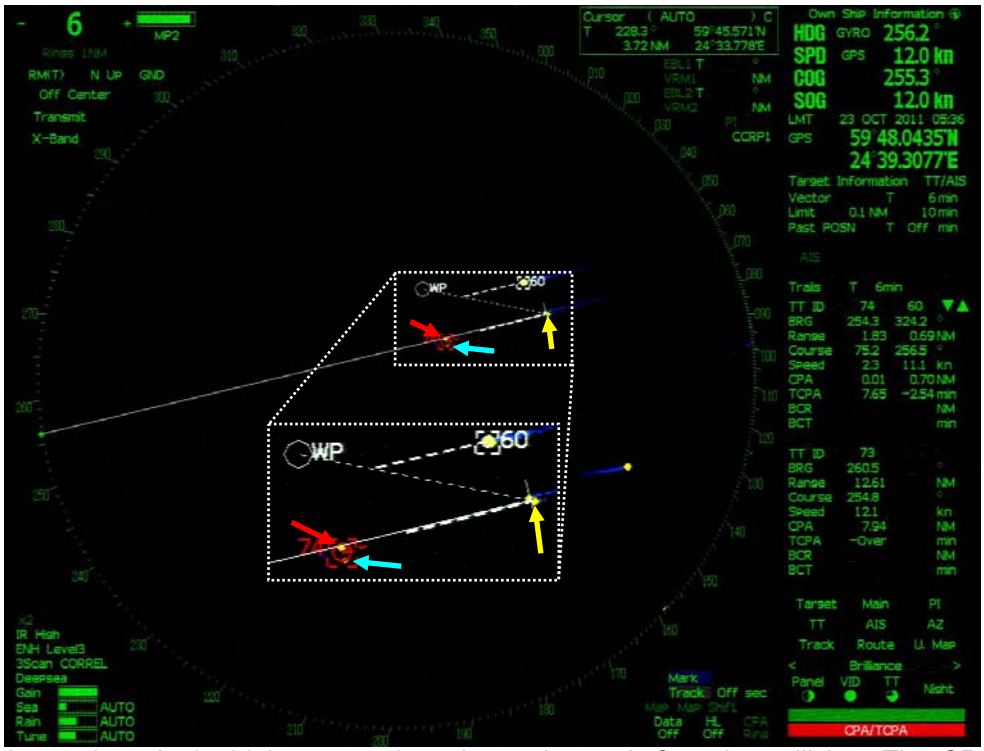


Image 8. *At 04:36:27, approximately 7 minutes before the collision. The CPA/TCPA values are lower (CPA 0.01 nautical miles and TCPA 7.65 minutes) than the limit value that is set on the radar, and the radar sets a Dangerous Target alarm about the fishing vessels. The fishing vessels are within 1.83 miles of the AMAZON in the heading of 261°. The course of the AMAZON is 255.3° with a speed of 12 knots.*

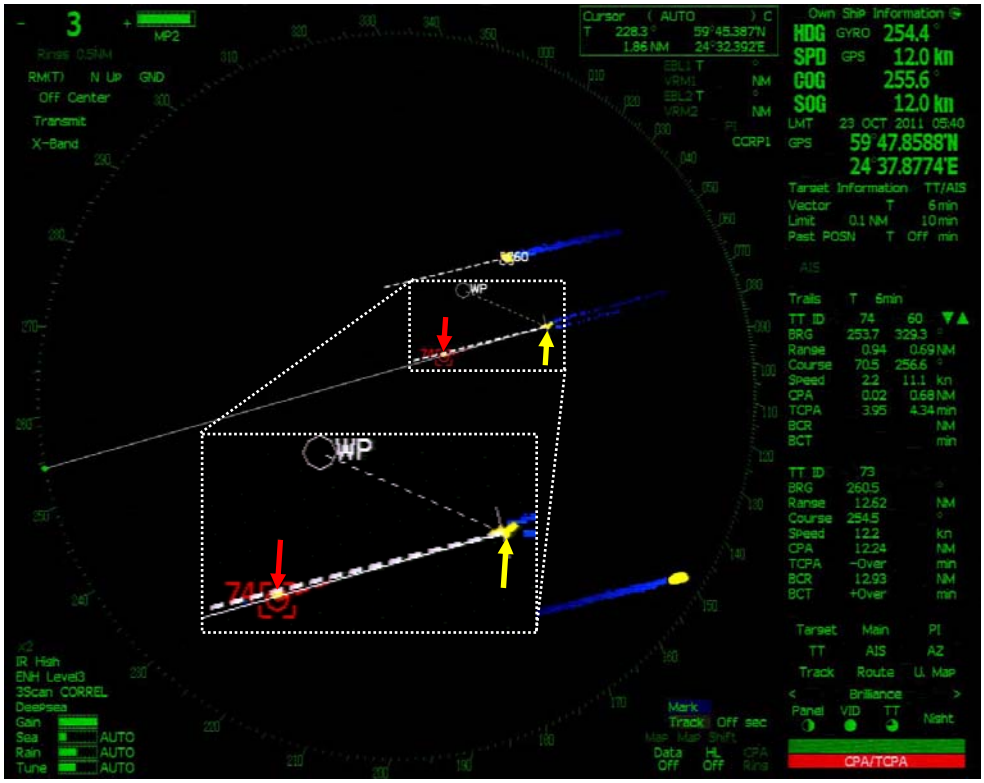


Image 9. *At 04:40:12, approximately 3.5 minutes before the collision. The radar range has been changed to 3 miles. The course of the AMAZON is 255.6° with the speed of 12 knots, thus the course and the speed have not changed during the 4 minutes since the last image. The fishing vessels are within 0.94 miles of the AMAZON in the heading of 254°. The CPA is 0.02 nautical miles, and the TCPA is 3.95 minutes. The FLORENCE's radar echo is not displayed on the radar (the turquoise arrow is missing).*

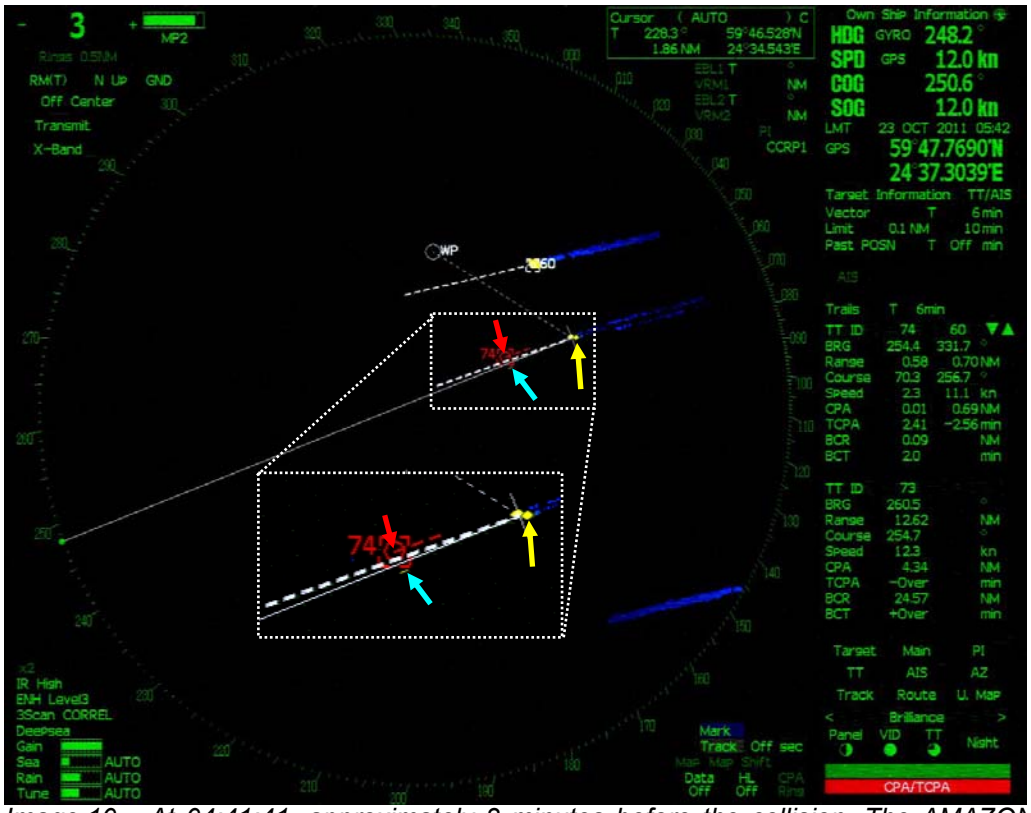


Image 10. At 04:41:41, approximately 3 minutes before the collision. The AMAZON has started to change heading (course 250.6°, speed 12 knots) to the port. The ARPA monitoring of the MENHADEN, the FLORENCE gives a weak echo below it.

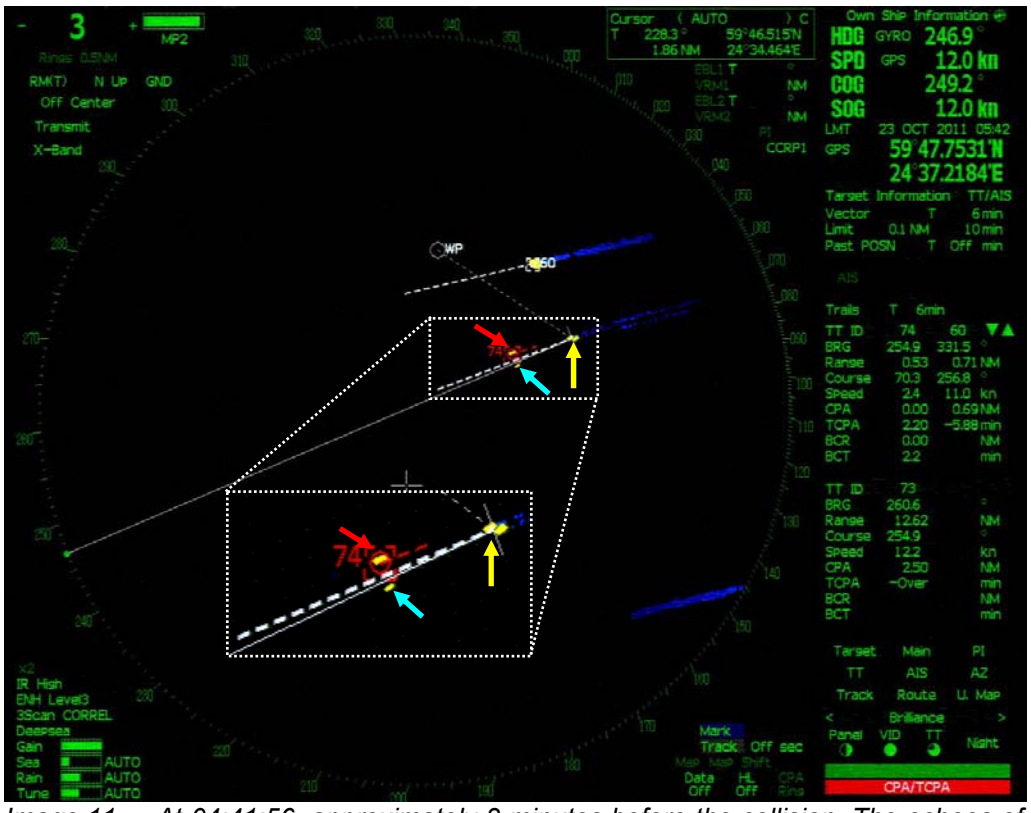


Image 11 .At 04:41:56, approximately 3 minutes before the collision. The echoes of the both fishing vessels is displayed again. The course of the AMAZON is 249.2°, with a speed of 12 knots.

Appendix 1/8 (10)

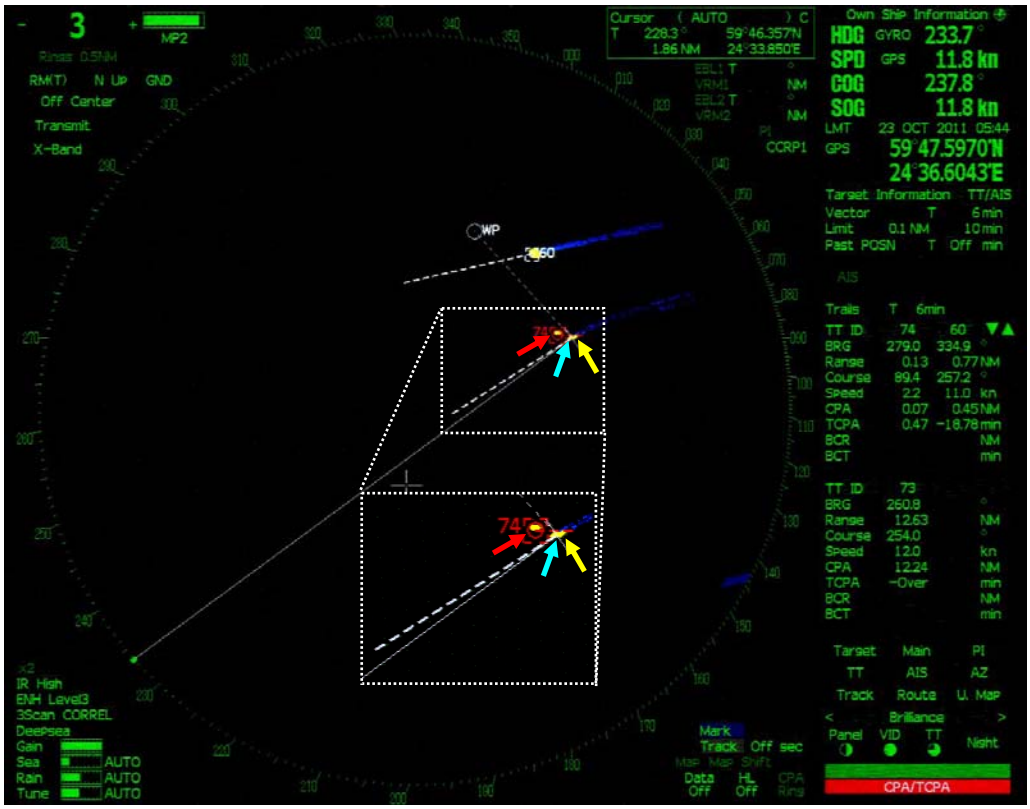


Image 12. At 04:43:41, the screenshot preceding the collision. The ARPA monitoring of the MENHADEN indicates that the MENHADEN is on the starboard side within 0.07 miles of the AMAZON. The course of the AMAZON is 237.8°, with a speed of 11.8 knots.

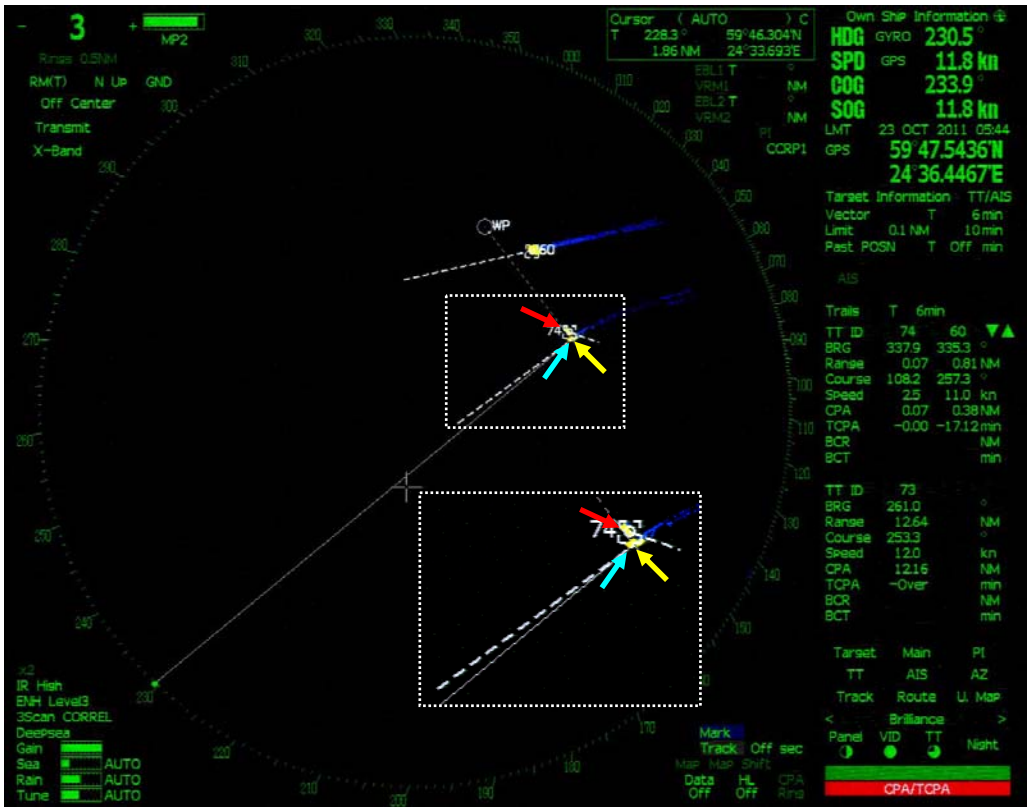


Image 13. At 04:44:10, according to the sound recording, the collision took place 10 seconds earlier. The course of the AMAZON is 233.9°, with a speed of 11.8 knots.

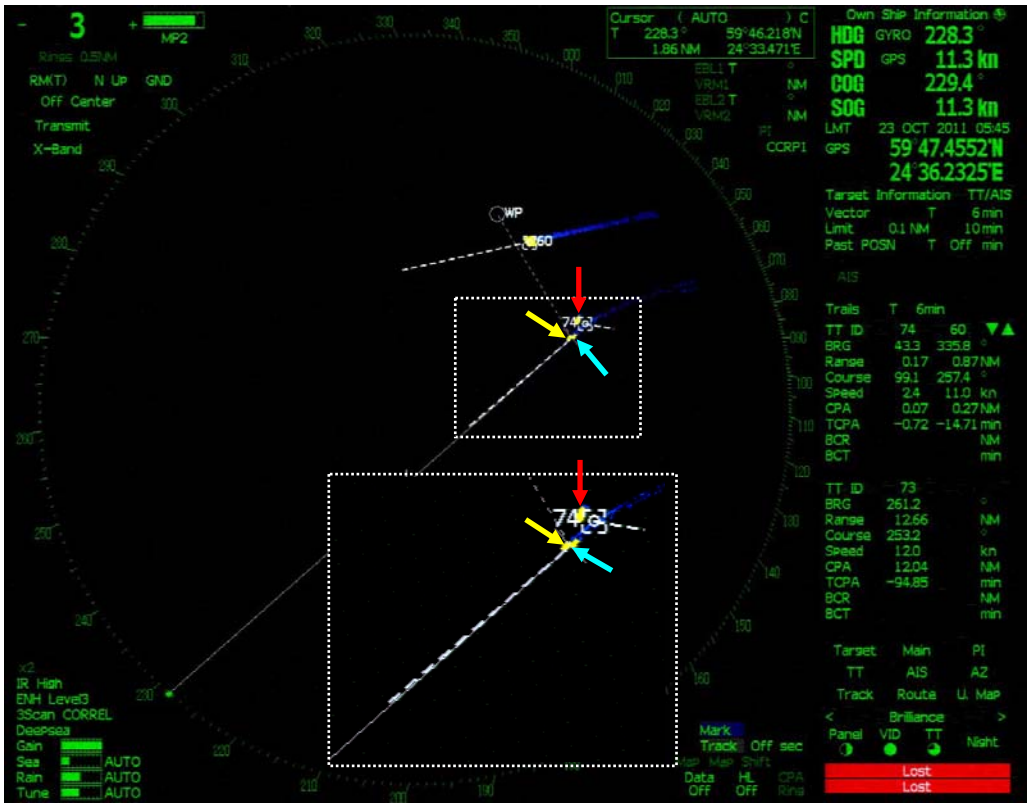


Image 14. At 04:44:56, the AMAZON's change of the course to the port has ceased (the heading, and the vectors indicating the course, are overlapping). The course of the AMAZON is 229.4°, with a speed of 11.3 knots.

Image 15. At 04:45:25, approximately 1.5 minutes after the collision. The AMAZON has started to turn back to the starboard, and the ARPA monitoring of the FLORENCE has been lost (red tick). The course of the AMAZON is 226.5°, with a speed of 11.4 knots.

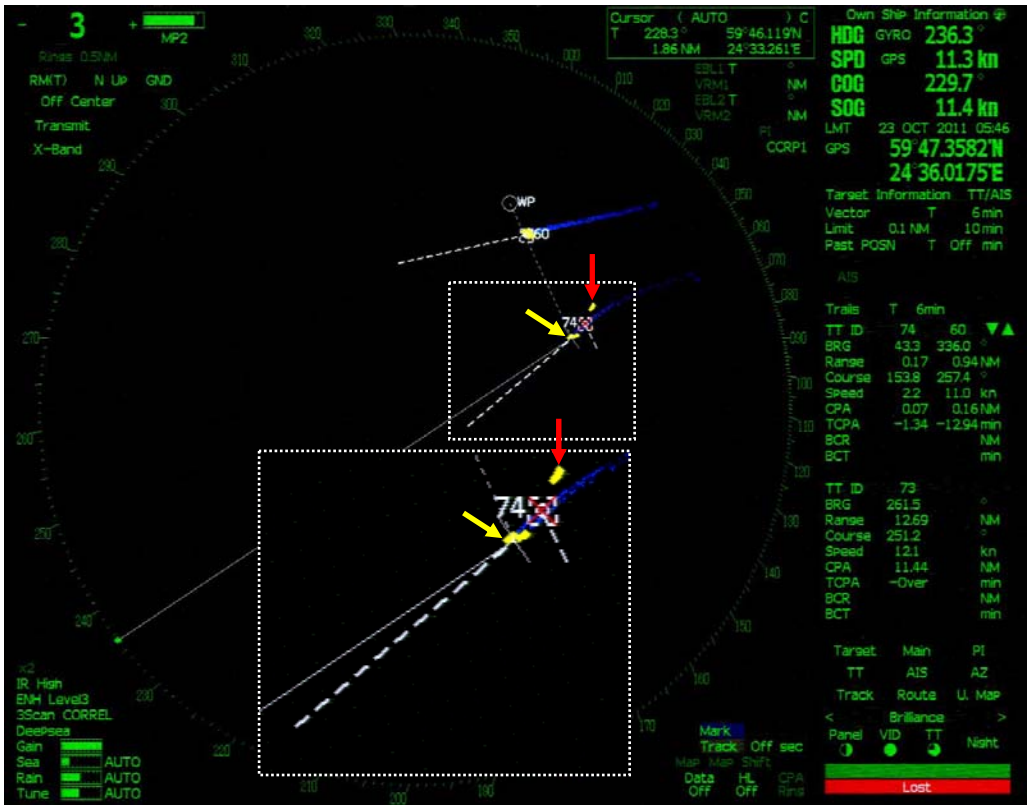


Image 16. At 04:45:43, approximately 2 minutes after the collision. The AMAZON turns back to the starboard and takes the route line it had before the change of the course. The course of the AMAZON is 229.7°, with a speed of 11.4 knots.

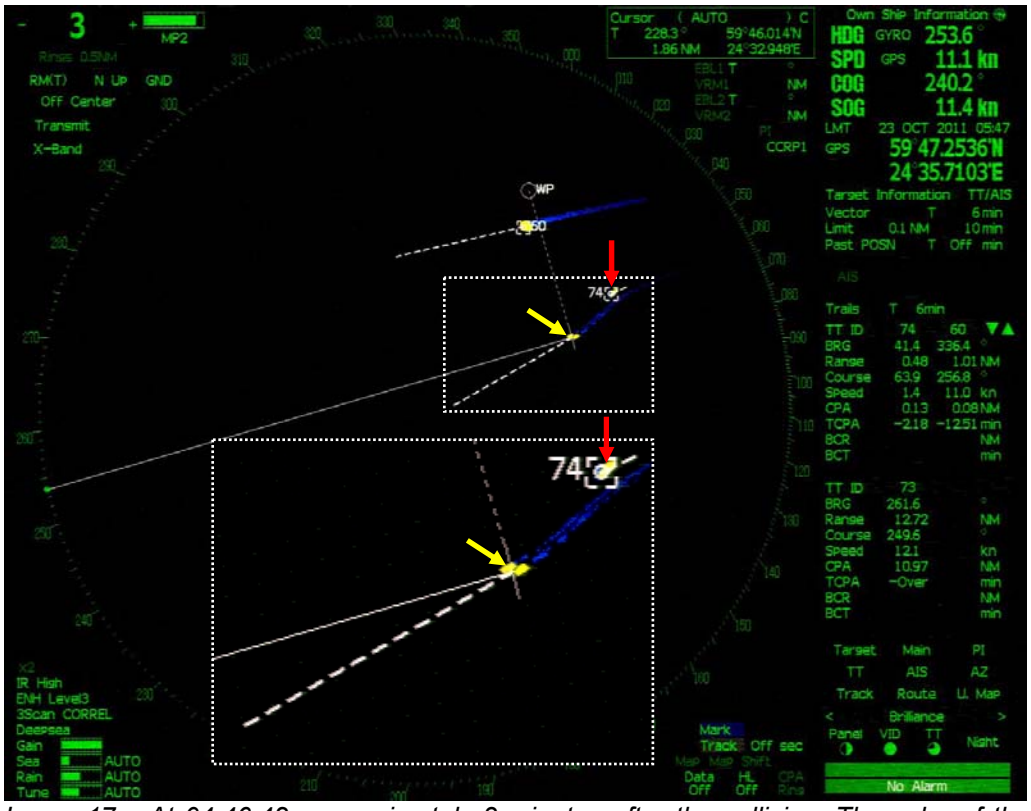


Image 17. At 04:46:42, approximately 3 minutes after the collision. The echo of the FLORENCE is not displayed on the radar, and the ARPA monitoring has changed over to the MENHADEN. The course of the AMAZON is 240.2°, with a speed of 11.4 knots.

APPENDIX 2. RADAR EXPERIMENT ON THE AMAZON AFTER THE ACCIDENT, ON 23 OCTOBER 2011

Introduction

While the AMAZON was at anchor, it was discovered that the vessel's S-band radar anti-clutter sea adjustments were on automation. The automation often eliminates all radar echoes from smaller targets that are close to the vessel. According to the received information, the radar adjustments had been equivalent to these adjustments at the time of the accident. According to the watchkeeping officer, he had monitored the development of the situation e.g. on the S-band radar in question before the collision. He had seen two little echoes ahead of the vessel which, according to his interpretation, later merged into one.

It was decided that the effect of the radar adjustments on the radar image should be tested with a small vessel approaching the vessel. This appendix describes the results of this experiment.

The radar experiment

According to the watchkeeping officer, he had focused the surveillance of other traffic in the dense fog on monitoring the S-band radar with a range of six nautical miles. The area of the accident had some rough sea and old swells. According to the watchkeeping officer, the radar adjustments were equivalent to image 1 during the time of the accident.

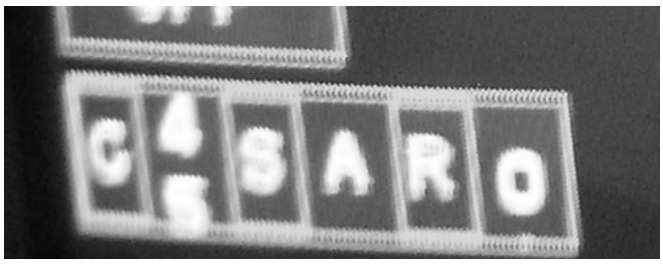


Image 1. The radar range adjustments of six nautical miles during the time of the accident, starting at the left: G=Gain (sensitive control of the received radar signal, 4.5), S=SeaClutter (anti-clutter sea control, A=automation, which deletes the sea clutter completely), and R=RainClutter (anti-clutter rain control, value 0).

Both of the radars had the anti-clutter sea control on automation. All distractions and weaker echoes cannot be distinguished on these adjustments when a vessel is approaching.

This experiment concentrated on the radar which the watchkeeping officer was using while he was keeping watch on the bridge. During the accident he used the S-band radar next to the chart table on the SB side of the bridge. The radar range was six nautical miles, with distance circles of 1 nautical mile.

The S-band radar adjustments during the experiment were identical to the adjustments during the accident (image 1). The target was a Finnish Border Guard patrol boat PV-161 (image 2) that was approaching the vessel.

Image 2. The radar target, a patrol boat PV-161 of the Finnish Border Guard.

The PV-161 was well distinguishable on the S-band radar when the distance to it was more than one nautical mile (image 3).

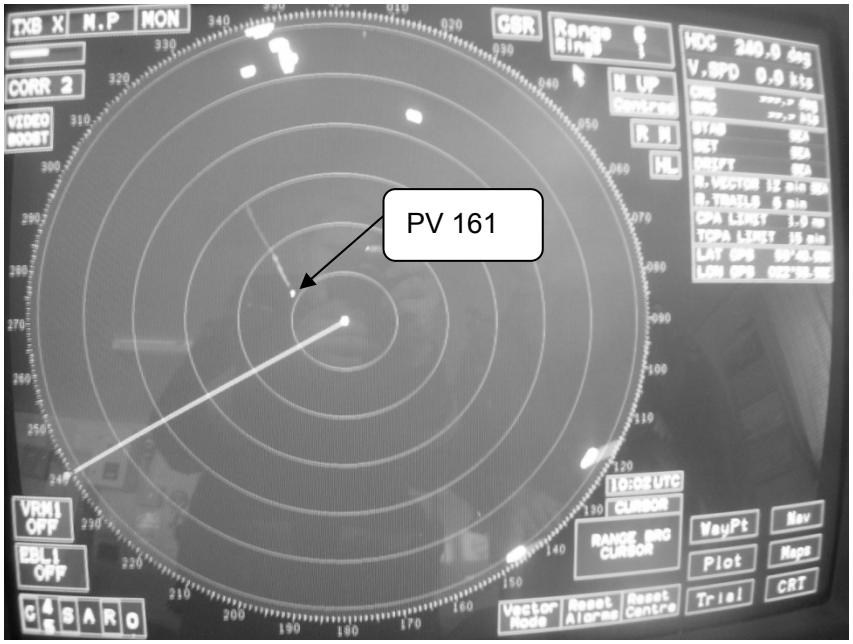


Image 3. The PV-161 within slightly more than one nautical mile of the vessel.

The vessel disappeared from the screen of the S-band radar at the distance of one nautical mile when the settings were as mentioned above (image 4).

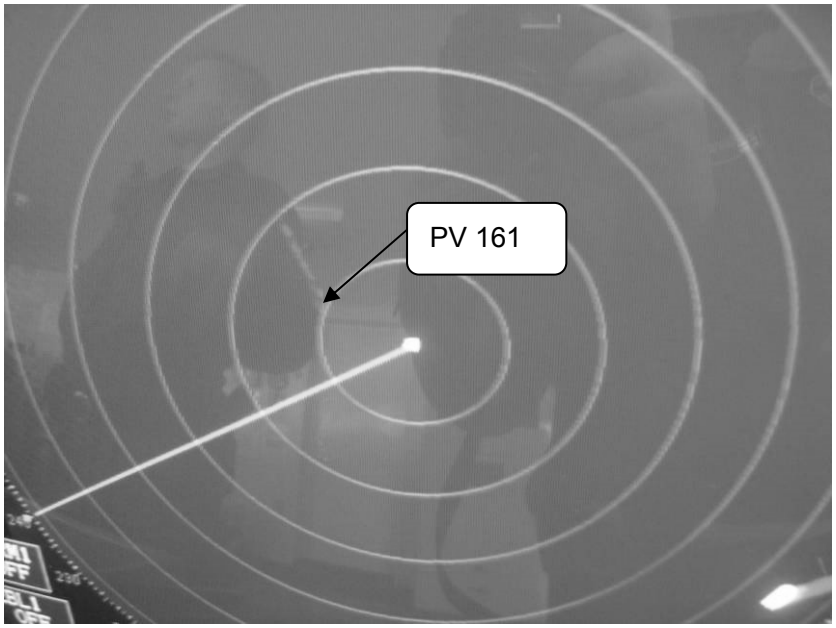


Image 4. The echo of the PV-161 disappears from the radar screen at the distance of one nautical mile.

The experiment was continued by setting the S-band radar adjustments in the way shown in image 5.

Image 5. The radar adjustments when the PV-161 approaches the vessel for the second time.

The watchkeeping officer was asked to adjust the radar settings to make smaller echoes distinguishable. The adjustment did not go very well, and the watchkeeping officer had to ponder for a long time before he was able to change the settings.

Sea clutter was somewhat visible with the changed settings (image 5 above), but not to a distracting extent. These settings ensure that also the weaker echoes are distinguishable all the way to a close-quarte situation. The adjustments are radar specific, thus they should not be considered universal.

The effect of the adjustments on the visibility of an approaching smaller vessel on radar is illustrated in images 6, 7 and 8 on the next page.

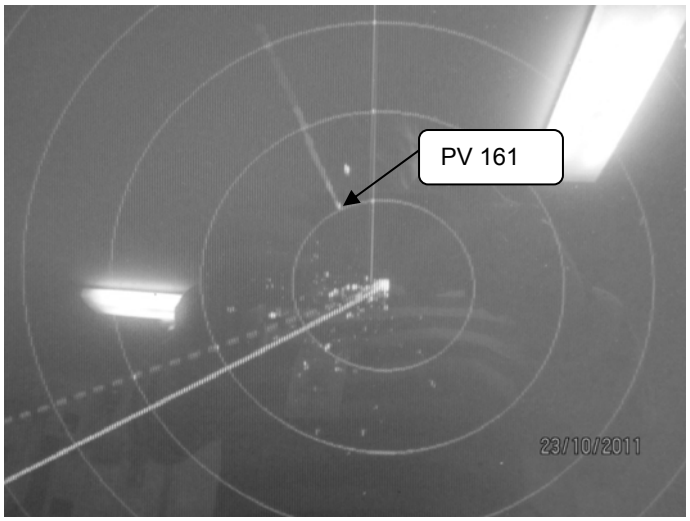


Image 6. The echo of the PV 161 at the distance of one nautical mile.

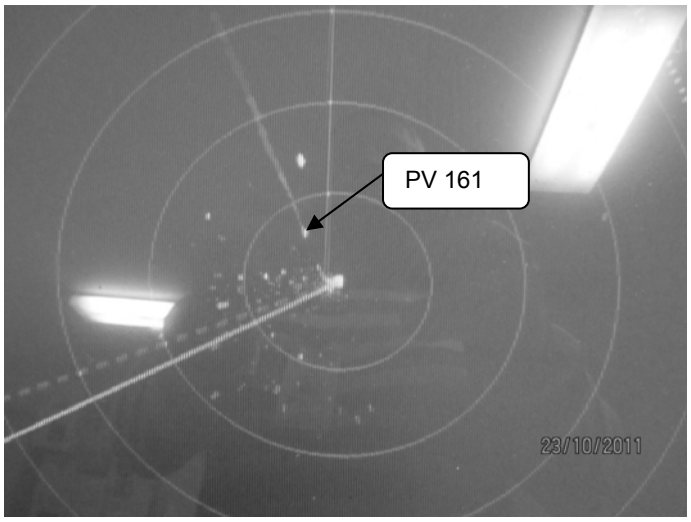


Image 7. The echo of the PV-161 at the distance of approx. 0.6 nautical miles.

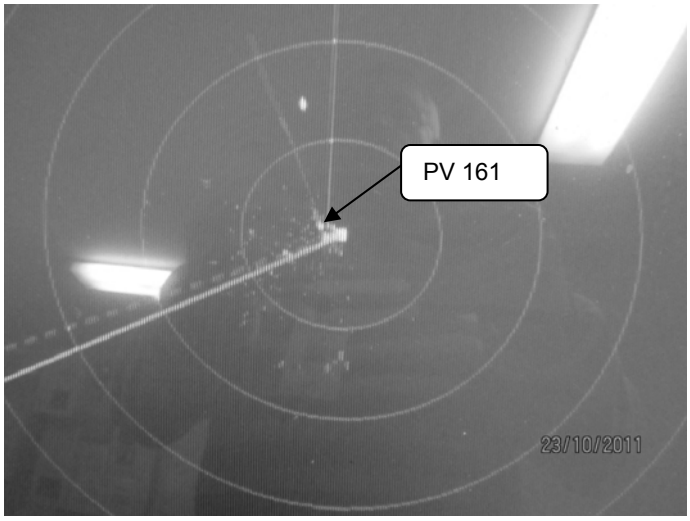


Image 8. The echo of the PV 161 right next to the AMAZON.

The S-band radar images above prove that different adjustments can make smaller vessels visible on the radar also in close-quarter situations.

APPENDIX 3. RADAR BASICS

1. Radar determines the distance and the bearing

Radio waves are used to send the radar pulse. A S-band 3 Ghz with a wavelength of 10 cm, and an X-band 9 Ghz with a wavelength of 3 cm. Radio waves and light travel at almost the same speed, 186.000 nautical miles per second. Because of this, the radar is capable of processing a large amount of data in a very short period of time.

The radar determines the distance to a target by measuring the time that is needed for the reflected echoes to return back to the antenna. The bearing to a target is determined by the direction from which the reflected echo returns back to the transmitter.

The antenna rotates 360°. When defining an exact bearing, the antenna sends out a beam that is very accurately directed. Beams that are very accurate, even 1° or less, can create a very precise bearing. The sharper (narrower) the beam is, the more accurate the bearing is.

The targets the radar has detected are displayed on the screen that has the own vessel at the centre. The target echoes are displayed as bearings, and the distances are displayed in relation to the centre of the screen. Nowadays there are also true motion radars that also show the targets' course and AIS information: target's course, speed, CPA and the moment of the passing.

Table 1. The rough differences between the X-Band and S-Band radars.

Wavelength	**Features**
X-Band	– a short wavelength produces good resolution – major disadvantage of sea and rain clutter – a small and light antenna
S-Band	– a long wave length enables observing far targets – breaks effectively through sea and rain clutter in poor weather conditions – a large antenna

Speaking about radar resolution one means the capability of the radar to distinguish between echoes that are near each other. Radars have two types of resolution: distance resolution and bearing resolution. Bearing resolution means the radar's capability to display separate echoes of targets that are at the same distance and near to each other (image 1).

The main factor affecting the bearing resolution is the horizontal width of the wave (pulse). The narrower the horizontal wave (pulse) is, the better the bearing resolution.

Appendix 3/2 (3)

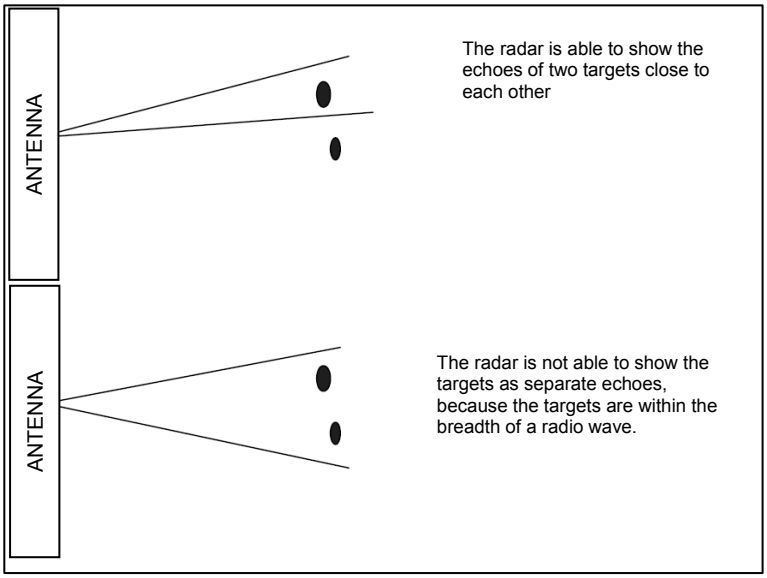


Image 1. An example of a bearing resolution.

The distance resolution means the radar's capability to show the echoes of targets that are near to each other at the same bearing. The pulse length affects the resolution capability of distance (image 2).

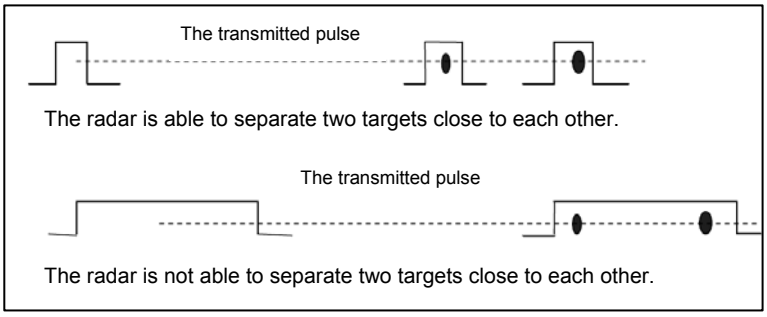


Image 2. An example of a distance resolution.

Even if the radar could not distinguish between two echoes near to each other, an experienced radar user can identify two close targets based on the received echo.(image 3).

Image 3. An example of a radar echo when the radar cannot distinguish between two targets close to each other.

The angle of a horizontal pulse changes 0.75°–5° between different radars. A vertical angle usually changes between 20°–25°.

The pulse repetition frequency means the number of radio pulses transmitted in a second. The radar automatically defines this as pulse length and distance. The pulse length is short and repetition frequency is high within small distances. The pulse length is long and the repetition frequency is low within long distances.

2. Radar's anti-clutter adjustments and the effect of radar conditions

Radar adjustments are very important, and their settings must be continuously monitored as the voyage progresses and the weather conditions change.

2.1 Adjustment of the echo display with a "Gain" scope

Gain adjusts the transmitter's response to receive an echo. By increasing or reducing Gain, it is possible to adjust how the echoes are displayed with the scope. When the radar is on long range, the Gain is often adjusted in such a way that the background noise is barely visible. When on small-scale, some radar users turn this adjustment up and adjust a suitable echo display with the anti-clutter sea control. Several radar manufacturers use the abbreviation ACS (Anti Clutter Sea control) for this.

2.2 Anti-clutter sea control

The intensity of echoes that are caused by waves close to the vessel can be weakened with the help of the anti-sea clutter control. Echoes reflected from waves at rough seas are often very strong, and usually cover the centre part of the radar screen. Especially weaker echoes among the sea clutter can partially or completely blend in it.

This control can reduce or remove sea clutter. To reduce clutter until the right echoes are distinguished is a good method of control. In case the adjustment is too strong, both the sea clutter and the significant echoes from near-by targets disappear. The radar screen should display a little sea clutter.

In case there is no sea clutter displayed on the radar screen, and the suppression should be reduced subtly without losing the significant echoes. The user should be familiar with the effects of radar adjustments and their sensitivity. This is important especially in conditions of poor visibility, because the monitoring of other vessels and environment rests largely on the use of radar.

2.3 Anti-clutter rain control

Echoes that are caused by rain, hailstones or snowfall can be reduced with the help of anti-clutter rain control. Significant echoes might disappear off the screen and/or monitoring, or drown in the rain clutter due to the short pulses of the X-band radar. The anti-clutter rain control can reduce possible substantial rain clutter until it almost disappears, but it still displays the significant echoes.

APPENDIX 4. SIMULATION ON 7 MARCH, 2012

The objective of the simulation was to investigate what the situation looked like on the bridge of the AMAZON just before the accident, and what possibilities they might have had to avoid the collision. It was also studied what what kind of a final result would have been reached using different manoeuvres and timing.

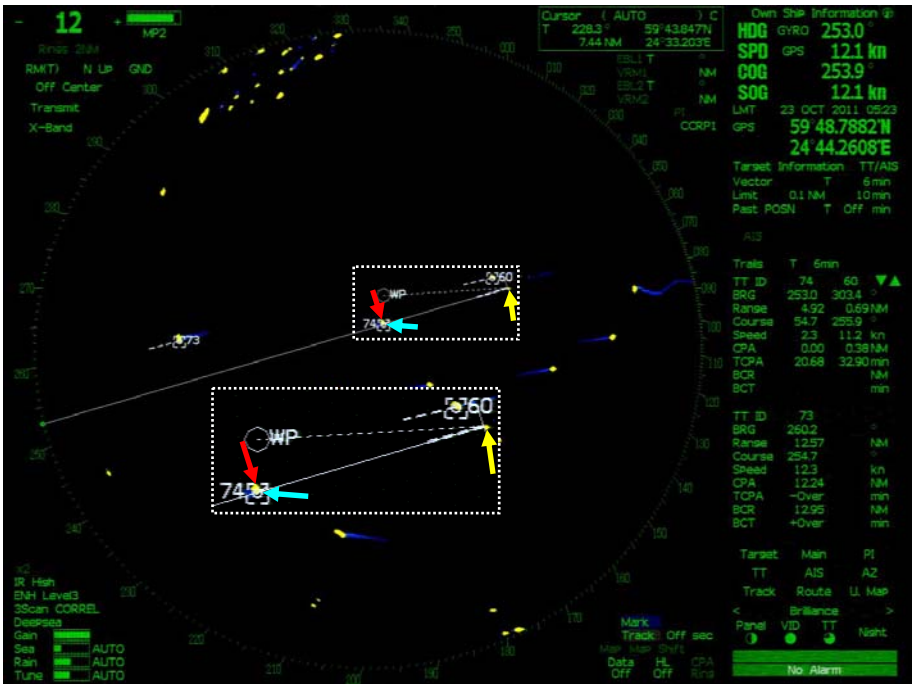
The simulation was conducted on the AMAZON. A freighter model with almost similar features and size as the AMAZON was used as a vessel model. The only visual difference was the lack of cranes that limited the visibility to front during the actual situation. Fishing vessel models with similar features were used as models for the fishing vessels.

With the help of a screenshot from the AMAZON's S-VDR, image 1 represents the initial situation from which the simulation was started (the watchkeeping officer of the AMAZON observed the approaching fishing vessels). The locations of the STELLA POLARIS (nr. 60 on the radar) and the fishing vessels (nr. 74 on the radar) were determined based on this image. The movement variables of the vessels that were used in the simulation were received from the ARPA data displayed on the radar.

The position of the fishing vessels was set to lat 59°47.3N and long 24°35.0E. According to the ARPA data, their speed was 2.3 knots, and their course was 54.7°. The distance between the fishing vessels was set to 200 metres.

The position of the STELLA POLARIS that navigated ahead of the AMAZON at the starboard side was set to lat 59°49.1N and long 24°43.1E. The speed was 11.2 knots, and the course was 255.9°.

The weather condition information from the time of the accident was used in the simulation. The significant wave height was set to 1.1 metres, wave direction to 244°, and the speed of the west wind to 5m/s. The visibility in the fog was set to 200 metres according to the information that was gathered during the hearings.



Img. 1. At 04:23:42, approximately 20 minutes before the collision. The fishing vessels are within 4.92 miles of the AMAZON in a heading of 253°. The course of the fishing vessels is 55°, and the speed 2.3 knots. The fishing vessels are directly underneath the AMAZON course vector (CPA 0 miles). TCPA 20.68 minutes. The course of the AMAZON is 253.9°, with a speed of 12.1 knots.

Appendix 4/2 (7)

Simulation runs

The first run simulated the occurred accident. The circumstances had been created as authentic as possible in regard to the time of the accident. It was dark, and there was a dense fog (visibility 200 metres). The simulation conducted the change of the course to the port in order to avoid the MENHADEN, and collided with the FLORENCE. The change of the course was started within 0.58 miles of the fishing vessels, similar to the actions of the AMAZON (appendix 1, image 10).

While the anti-clutter sea controls were on automation, the fishing vessels disappeared off the screen as they were approaching. The lights of the fishing vessels appeared only shortly before the collision (image 2). When the lights appeared, there was nothing to be done to prevent the collision. Shortly before the collision, the lights of the FLORENCE disappeared behind the forecastle of the AMAZON. The MENHADEN was slightly ahead of the AMAZON's starboard wing during the accident, and its navigation lights were visible from the bridge of the AMAZON.

Image 2. *The simulated collision is just about to happen in the fog (visibility 200m) and darkness. The FLORENCE is marked with a red circle. Its navigation lights have appeared a moment earlier. The fishing vessel's white mast-head light, green navigation light, and some of its deckhouse are visible. (During the actual accident, the vessel's cranes have probably hindered the visibility especially when looking out from the starboard side of the bridge. In that case it is possible that also the fishing vessel lights have been in a blind spot.)*

The second run simulated the accident in daylight without the fog in order to be able to monitor the progress of the situation visually through the bridge windows. The change of the direction was initiated based on radar observations only. The simulation conducted the change of course to the port in order to avoid the MENHADEN, and collided with the FLORENCE.

Image 3. The initiation of the change of direction is approaching. The FLORENCE is marked with a blue arrow, the MENHADEN with a red arrow, and the STELLA POLARIS with a black arrow. The VRM[48] ring on the radar that is seen in the foreground of the image is set to 0.58 miles (white arrow). The change of the course is initiated when the ring hits the displayed radar echoes of the fishing vessels. The distance to the fishing vessels in the image is approximately 0.8 miles.

Image 4. The simulated collision has just taken place. The corner of the FLORENCEs' deckhouse of is visible behind the AMAZON's forecastle (blue arrow). The MENHADEN, which is by the starboard wing, is marked with a red arrow. The STELLA POLARIS (black arrow) can be seen further at the starboard.

[48] VRM, an electronic, variable range marker on a radar

Image 5. *An aerial view of the time of the accident. The FLORENCE is the blue arrow, the MENHADEN is the red arrow, and the STELLA POLARIS is the black arrow.*

During the third run, the change of direction to the starboard in daylight without fog was conducted in order to be able to monitor the change of direction visually. The change was initiated based on radar observations only.

The change was initiated in good time before the close-quarters situation with the fishing vessels while passing the STELLA POLARIS. Speed was not reduced (image 6). After the change of direction the simulation continued to north of the STELLA POLARIS.

Image 6. *The FLORENCE is marked with a blue arrow, the MENHADEN with a red arrow, and the STELLA POLARIS with a black arrow. Despite the turn initiated during the passing, no close-quarters situation with the STELLA POLARIS is developed because the distance to it grows during the turn.*

The fourth run consisted of the change of direction to the starboard in daylight without fog in order to monitor the change of direction visually. The initiation of the change was based on radar observations only, and it was conducted when the distance to the fishing vessels on the radar was 0.58 miles (the same distance as in the actual situation before initiating the change). After the change was done, the vessel was driven between the fishing vessels and the STELLA POLARIS. Speed was not reduced.

Image 7. The change of direction to the starboard starts with the rudder command "hard to starboard". The distance to the fishing vessels is 0.58 miles. The FLORENCE is marked with a blue arrow, the MENHADEN with a red arrow, and the STELLA POLARIS with a black arrow.

Image 8. The change of direction to the starboard is approximately half-way through. The FLORENCE is marked with a blue arrow, the MENHADEN with a red arrow, and the STELLA POLARIS with a black arrow.

Appendix 4/6 (7)

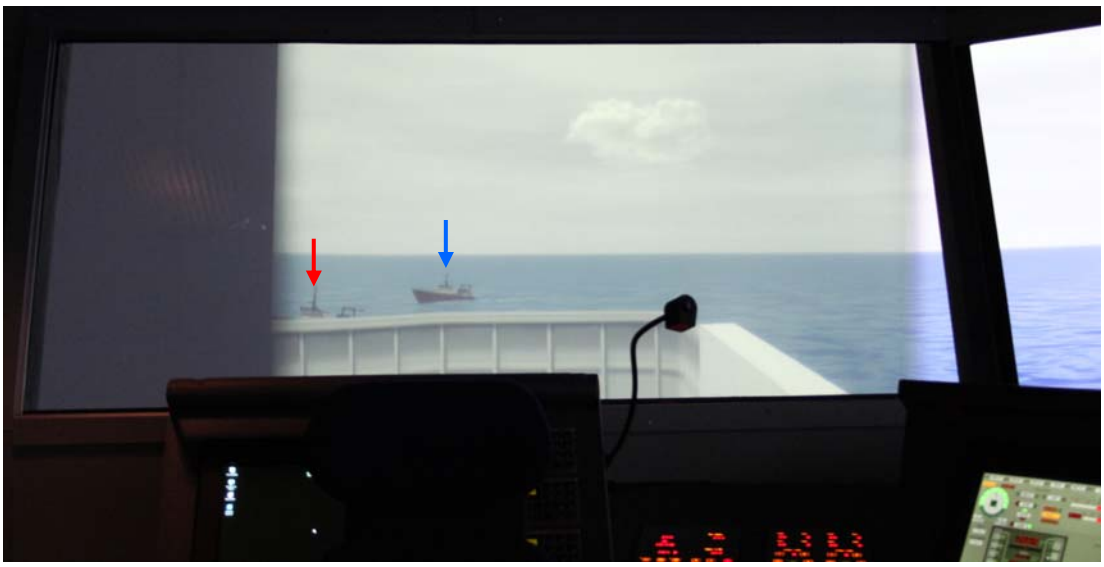


Image 9. The change of direction to the starboard is ready. The fishing vessels pass from the port side. Distance to the nearest fishing vessel is 0.1 miles. The FLORENCE is marked with a blue arrow, and the MENHADEN is marked with a red arrow.

Image 10. The change of direction to the starboard is ready, and the change of direction back to the original course has been initiated a moment earlier. The fishing vessels pass from the port side, and the distance to the STELLA POLARIS (black arrow) is approximately 0.4 miles.

During the fifth run, which was conducted in darkness and fog, the engine speed was reduced (engine order: dead slow ahead), after which the engine speed was gained (in order to increase the rudder flow), and the change of direction was conducted with the command “hard to starboard”. The engine speed was reduced significantly before the development of the close-quarters situation. The timing of the manoeuvres was based on radar observations only.

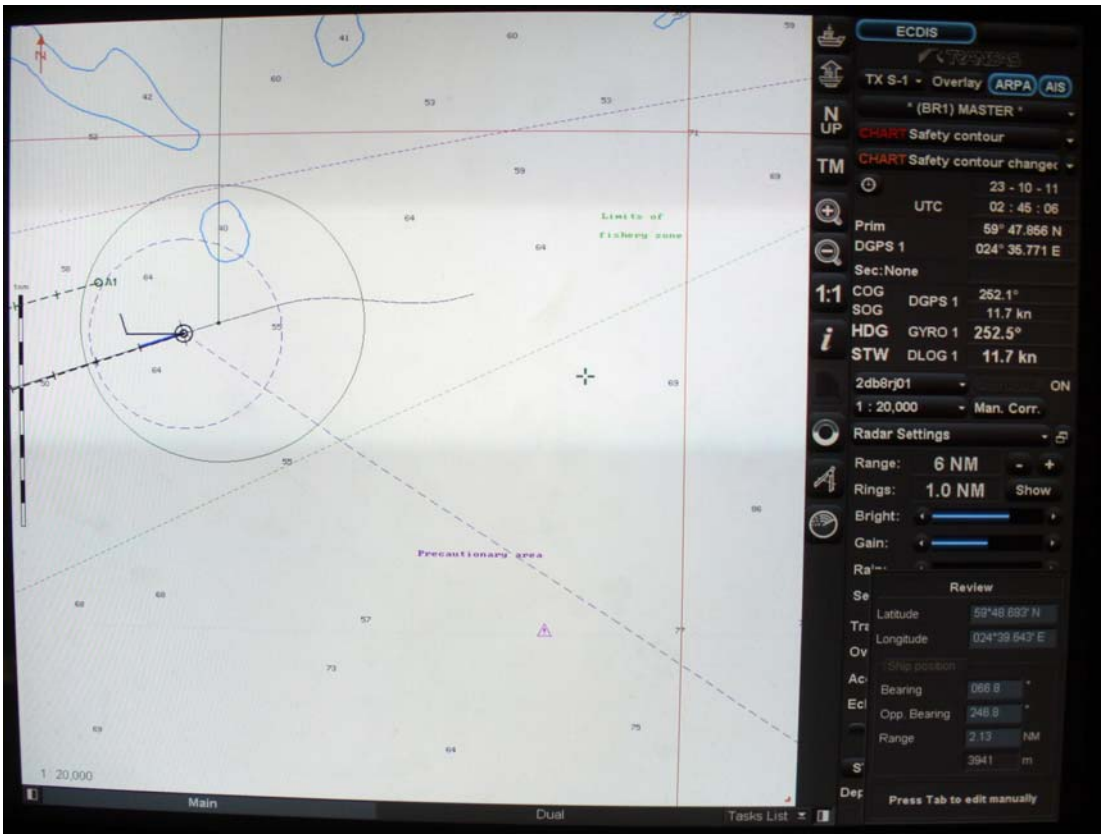


Image 11. *Image of the vessel’s course on the ECDIS after the successful collision avoidance action. The eventual distance to the MENHADEN was 0.2 miles. The STELLA POLARIS got a small lead before the change of the course. After the manoeuvre, the distance to it was approximately 0.8 miles.*

APPENDIX 5. SUMMARIES ABOUT OTHER INVESTIGATED COLLISIONS BETWEEN FISHING AND MERCHANT VESSELS

The collision between F/V HENDRIK SENIOR and M/S BIRKA EXPORTER off the coast of Netherlands in 2008 [49]

According to the COLREGs, HENDRIK SENIOR was obligated to give way. The watchkeeping officer noticed BIRKA EXPORTER but did not conduct a sufficient collision avoidance manoeuvre in time. Instead, the fishing vessel turned approximately 60° to the starboard towards the approaching BIRKA EXPORTER. The BIRKA EXPORTER was not obligated to give way, and it did not take sufficient evasive measurements in order to avoid the collision.

According to the investigation report, small safety margins in an encounter situation can quickly lead to a close-quarters situation and serious accidents. Neither one of the vessels followed the rules of the roads at sea, which resulted in a collision between two up-to-date vessels in spite of the fact that they both were conscious of the risk. The bridge equipment was not utilized effectively, and neither one of the vessels had a lookout on the bridge.

The collision between TEBOSTAR and LADUSHKIN on the south-west side of Gotland in 1989 [50]

The TEBOSTAR collided into the port side of the stern of the LADUSHKIN. The LADUSHKIN keeled over and trundled along the bow of the TEBOSTAR for some time. After falling off, the LADUSHKIN moved along with the TEBOSTAR's port side with its stern deep under the water and with a small part of its bow visible, and proceeded behind the TEBOSTAR's stern where it quickly sinked.

The primary reason for the accident was the fact that the watchkeeping officer of the TEBOSTAR tanker abdicated his lookout duties. The enormity of the accident was increased by the fact that the tanker engines were not stopped immediately, and because of this the pressure of the water that was bursting on top of the vessel prevented the escape of the crew of the LADUSHKIN.

The collision between M/V BIRKA TRANSPORTER and F/V WILLEMPJE HOEKSTRA off the coast of Netherlands in 2011[51]

The courses of the vessels were intersecting with each other. As the one obligated to give way, the fishing vessel did not take sufficient evasive measurements in time. The watchkeeping officer of the BIRKA TRANSPORTER realised that there a close-quarters situation was developing, and decided to reduce speed and turned the steering wheel to the starboard. Soon after this he realised that this was not enough, and he conducted an emergency stop which caused the vessel to turn starboard towards the fishing vessel that had reduced its speed. The vessels collided at 04:00. The bow of the BIRKA TRANSPORTER hit the fishing vessel's starboard side. The fishing vessel got a leak in its bow storage, but did not sink.

The accident was caused by the late, insufficient and unclear collision avoidance actions of the WILLEMPJE HOEKSTRA and the late and insufficient measurements of the BIRKA

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49 Investigation report C5/2008M. Available at: www.turvallisuustutkinta.fi
50 Investigation report 3/1989. Available at: www.turvallisuustutkinta.fi
51 Investigation report C2/2011M.

TRANSPORTER to avoid the collision. Other contributory factors were the BIRKA TRANSPORTER's watchkeeping officer's possibly reduced alertness and the lack of a lookout on the bridge.

Other incidents

The database of the safety investigation authority of Great-Britain, MAIB, contains 147 cases about collisions between merchant and fishing vessels in territorial waters during 1991–2009. This gives an idea about the frequency of accidents of this kind at the waters at issue.

In addition to individual accident investigations, MAIB has conducted general safety reports about the subject. These reports are available on the MAIB web page[52].

[52] http://www.maib.gov.uk

APPENDIX 6. SUMMARY ON THE RECEIVED STATEMENTS

The following parties have submitted statements within the prescribed time limit: the Finnish Transport Agency, the Finnish Transport Safety Agency, the Fisheries Industry Unit at the Ministry of Agriculture and Forestry, the flag state of the AMAZON, the Gulf of Finland Coast Guard, the Finnish Fishermen's Association and the agents of the AMAZON and the FLORENCE.

Summaries of the statements are presented below. The non-abridged versions of the statements are filed at the Safety Investigation Authority.

Statement by the Finnish Transport Agency

The Finnish Transport Agency found it positive that the investigation report discusses the essential importance of vessel traffic services, the use of AIS equipment as well as training and instruction in the prevention of dangerous situations at sea.

The Finnish Transport Agency shares the investigation commission's view according to which the failure to inform about fishing activities and the lack of AIS equipment made the observation of the fishing vessels more difficult. It is highly likely that this was the reason why Helsinki Traffic did not intervene with the situation or warn the AMAZON about radar targets.

The Finnish Transport Agency comments on the safety observation presented in 5.3 in the investigation report that since 2010 the non-conformity reports drawn by the VTS and the GOFREP SRS Violation reports on the violations of all vessels have been sent to the Finnish Transport Safety Agency. Information on the violations by fishing vessels is also forwarded to the Coast Guard Control Centre.

As to the safety recommendation issued to the Finnish Transport Agency pertaining to the training and instruction of vessel traffic operators, the Agency concludes that judicial training has been added to the VTS operator curriculum and possibilities to accentuate VTS operations in order to prevent maritime accidents have been studied.

Statement by the Finnish Transport Safety Agency

The Finnish Transport Safety Agency made no comments on the investigation report.

Statement by the Fisheries Industry Unit at the Ministry of Agriculture and Forestry

The statement made by the Fisheries Industry Unit at the Ministry of Agriculture and Forestry proposed specifications on the determination bases of fishing quotas as well as on the right of use of these quotas.

Statement by the flag stage of the AMAZON

Statements were obtained both from the flag state (Bahamas Maritime Authority) and from the flag state representative in Finland. These statements proposed minor modifications and specifications to the investigation report parts describing the cargo information of the AMAZON and the vessel's bridge manning.

In addition, after the accident the flag state issued a Safety Bulletin on radar use directed to vessels sailing under the Bahamian flag.

Appendix 6/2 (2)

Statement by the Gulf of Finland Coast Guard

The Gulf of Finland Coast Guard had no comments on the draft of the report.

Statement by the Finnish Fishermen's Association

The Finnish Fishermen's Association concluded in their statement that the fishing event described in the investigation report does not in all respects correspond with customary procedures and actions complying with good seamanship when trawling in pairs.

The Finnish Fishermen's Association noted that the changes in the ownership structure of the fishing fleet have brought about diverse phenomena which can be prevented if the shipowners and authorities pay enough attention to the vessels' condition and to crew qualifications.

According to the Association, safety will be improved when AIS transmitters are introduced on vessels and fishing notifications are made to Helsinki Traffic, the authority monitoring vessel traffic. The merchant fleet also has to pay appropriate attention to fishing vessels engaged in fishing operations.

The Association stated that it has aimed at contributing to the safety of fishing vessels e.g. by taking initiative in the organising of fishing vessel skipper courses and by proposing that safety related matters play a pivotal role in the following Operational Programme for the Finnish Fisheries Industry (2014-2020).

In their statement the Finnish Fishermen's Association gave their support to the safety recommendations issued by the investigation.

Statement by the AMAZON's agent

The statement made by the AMAZON's agent commented on the number of bridge crew at the time of the accident, on the adequacy of the familiarisation training of the Chief Officer and on the describing of weather in the investigation report.

Statement by the FLORENCE's agent

The statement made by the FLORENCE's agent proposed specifications to the investigation report.