ACCIDENT REPORT

Report on the investigation of the collision

between the general cargo vessel

Scot Carrier

and the split hopper barge

Karin Høj

resulting in the capsize of the barge with two fatalities

in the Bornholmsgat traffic separation scheme, Sweden

on 13 December 2021

VERY SERIOUS MARINE CASUALTY REPORT NO 5/2023 SEPTEMBER 2023

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2012 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This report is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

°	-	degrees
2/O	-	second officer
AB	-	able seaman
AIS	-	automatic identification system
BAC	-	blood alcohol content
BNWAS	-	Bridge Navigational Watch Alarm System
C/E	-	chief engineer
C/O	-	chief officer
COLREGs	-	Convention on the International Regulations for Preventing Collisions at Sea 1972, as amended
CPA	-	closest point of approach
DMA	-	Danish Maritime Authority
DMAIB	-	Danish Maritime Accident Investigation Board
DWT	-	deadweight tonnage
ECDIS	-	Electronic Chart Display and Information System
ECS	-	electronic chart system
EPIRB	-	Emergency Position Indicating Radio Beacon
gt	-	gross tonnage
ICS	-	International Chamber of Shipping
IMO	-	International Maritime Organization
ISM Code	-	International Safety Management Code
JRCC	-	Joint Rescue Coordination Centre
m	-	metre
m^3	-	cubic metre
MAIB	-	Marine Accident Investigation Branch
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
MMSI	-	Maritime Mobile Service Identity
MSN	-	Merchant Shipping Notice
nm	-	nautical miles
OOW	-	officer of the watch

OS	-	ordinary seaman/seamen
PFD	-	personal flotation device
SAR	-	search and rescue
SART	-	search and rescue transponder
SHK	-	Statens haverikommission (Swedish Accident Investigation Authority)
SMC	-	search and rescue mission coordinator
SOLAS	-	International Convention for the Safety of Life at Sea 1974, as amended
STCW	-	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended (STCW Convention)
SMS	-	safety management system
TCPA	-	time to closest point of approach
TSS	-	traffic separation scheme
UK	-	United Kingdom
UNCLOS	-	United Nations Convention on the Law of the Sea
UTC	-	coordinated universal time
VDR	-	voyage data recorder

TIMES: all times used in this report are UTC+1 (Central European Time) unless otherwise stated

SYNOPSIS

At 0327 on 13 December 2021, the UK registered general cargo ship *Scot Carrier* and the Denmark registered split hopper barge *Karin Høj* collided in the precautionary area adjacent to the Bornholmsgat traffic separation scheme, Sweden. As a result of the collision, *Karin Høj* capsized and its two crew lost their lives.

The vessels collided after the second officer on board *Scot Carrier* altered course at a planned waypoint without checking the traffic in the area or that it was safe to execute the manoeuvre. Following the collision, *Scot Carrier*'s second officer did not immediately call the master or raise the alarm, but returned the ship to its original course and speed. Danish and Swedish coastguards were alerted to the incident following the activation of *Karin Høj*'s emergency beacon and determined that the two ships might have collided. The Swedish Coast Guard subsequently questioned the second officer about the track of *Scot Carrier* via very high frequency radio and, 17 minutes after the collision, the master was finally alerted to the situation and sounded the general alarm.

The investigation found that neither vessel had posted a lookout during the hours of darkness. It further established that *Scot Carrier*'s second officer was distracted throughout his watch by the continual use of a tablet computer and had also consumed alcohol before taking over the watch. It was not possible to establish what actions were taken by the crew of *Karin Høj* because the vessel was not fitted with a voyage data recorder and there were no survivors.

Following the accident both ship operators have taken action to prevent a recurrence.

The MAIB has issued recommendations to: the managers of *Scot Carrier* to expand its third-party navigation audits across the fleet; the owners of *Karin Høj* to introduce stricter manning oversight on board its vessels; and the Maritime and Coastguard Agency to clarify the requirement for a dedicated lookout during the hours of darkness for both UK registered ships and ships in UK waters.

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *SCOT CARRIER*, *KARIN HØJ* AND ACCIDENT

SHIP PARTICULARS		
Vessel's name	*Scot Carrier*	*Karin Høj*
Flag	UK	Denmark (DIS[1])
Classification society	Lloyd's Register	Not applicable
IMO number	9841782	8685844
Type	General cargo	Split hopper barge
Registered owner	Scot Carrier Shipping Ltd	Rederiet Høj A/S
Manager(s)	Intrada Ships Management Ltd	Rederiet Høj A/S
Construction	Steel	Steel
Year of build	2018	1977
Length overall	89.98m	55.06m
Breadth	15.20m	9.20m
Gross tonnage	3450	408
Deadweight	4789	492
Minimum safe manning	6	4
Authorised cargo	General	Bulk

VOYAGE PARTICULARS		
Port of departure	Salacgrīva, Latvia	Södertälje, Sweden
Planned port of destination	Montrose, Scotland	Nykøbing Falster, Denmark
Type of voyage	International	International
Cargo information	Timber	Ballast
Draught	5.10m forward, 5.3m aft	1.7m (estimated)
Manning	8	2

Image courtesy of Johan Nilsson/TT News Agency/via REUTERS

Scot Carrier

[1] Danish International Register of Shipping.

MARINE CASUALTY INFORMATION		
Date and time	13 December 2021 at 0327 (UTC +1)	
Type of marine casualty or incident	Very Serious Marine Casualty	
Location of incident	Bornholmsgat traffic separation scheme, Sweden 55° 13’.4 N 014° 14’.7E	
Place on board	Not applicable	Not applicable
Injuries/fatalities	None	2 fatalities
Damage/environmental impact	Forward hull damage to stem, plating and frames	Total loss. Damage to hull. Minor diesel oil pollution, dispersed
Ship operation	On passage	On passage
Voyage segment	Transit	Transit
External/internal environment	Wind south-westerly force 1; low swell; partly cloudy sky, no moonlight; good visibility with the possibility of reduced visibility in places; sea/air temperature 4°C.	
Persons on board	8	2

Image courtesy of Frits Olinga

Karin Høj

1.2 BACKGROUND

Scot Carrier was fitted with a voyage data recorder (VDR) and the ship's crew were uninjured, which provided the investigation teams with comprehensive information about the sequence of events on board. The crew of *Karin Høj* did not survive and there was no recoverable data from its on board equipment. The sequence of events for *Karin Høj* was reconstructed from a variety of sources, including automatic identification system (AIS) data, coastguard surveillance footage, radio communications, search and rescue (SAR) logs and interviews with the shipowner's office staff and crew members of ships working on the same project as *Karin Høj*.

1.3 NARRATIVE

1.3.1 Preceding events

At 1000 on 7 December 2021, the Denmark registered split hopper barge *Karin Høj* departed Köping, Sweden, in ballast and was navigated south through the Swedish archipelago, heading for the Baltic Sea and its destination port, Nykøbing Falster, Denmark **(Figure 1)**. The vessel's crew comprised a master, mate and able seaman (AB).

By 0230 the following day, the vessel had reached Södertälje. The weather forecast was unfavourable for the seagoing voyage and the master decided to stay in port until conditions improved. At 0005 on 11 December, *Karin Høj* departed with just the master and mate on board, the AB having disembarked to join another company vessel.

At 1915 on 11 December, the UK registered general cargo ship *Scot Carrier* departed Salacgrīva, Latvia. The vessel was loaded with timber and bound for Montrose, Scotland, with eight crew on board.

At 1248 on 12 December, a Swedish Coast Guard maritime surveillance aircraft flew over *Karin Høj* and captured footage of the barge in transit **(Figure 2)**, which showed the vessel carrying a part load of silt and water as ballast.

At 1544, just after sunset, *Scot Carrier*'s chief officer (C/O) went to the bridge to relieve the second officer (2/O), taking over the 1600 to 2000 watch. At 1700, the 2/O returned to the bridge to enable the C/O to go and eat his dinner in the messroom.

At 1710, the master went to the bridge and informed the 2/O that he would take over the watch. He explained he had seen the C/O at dinner, smelled alcohol on his breath and ordered him to rest. The 2/O agreed to relieve the master at about 2300 and left the bridge. He went to his cabin, watched a film and consumed several beers before sleeping from about 2000.

At 2214, *Scot Carrier*'s 2/O returned to the bridge and engaged in conversation with the master. At 2313, the master handed the watch over to the 2/O and they discussed the traffic situation, which included the overtaking of a slower vessel that was 3 nautical miles (nm) ahead. At 2315, with the watch handover completed, the master left the bridge and went to his cabin.

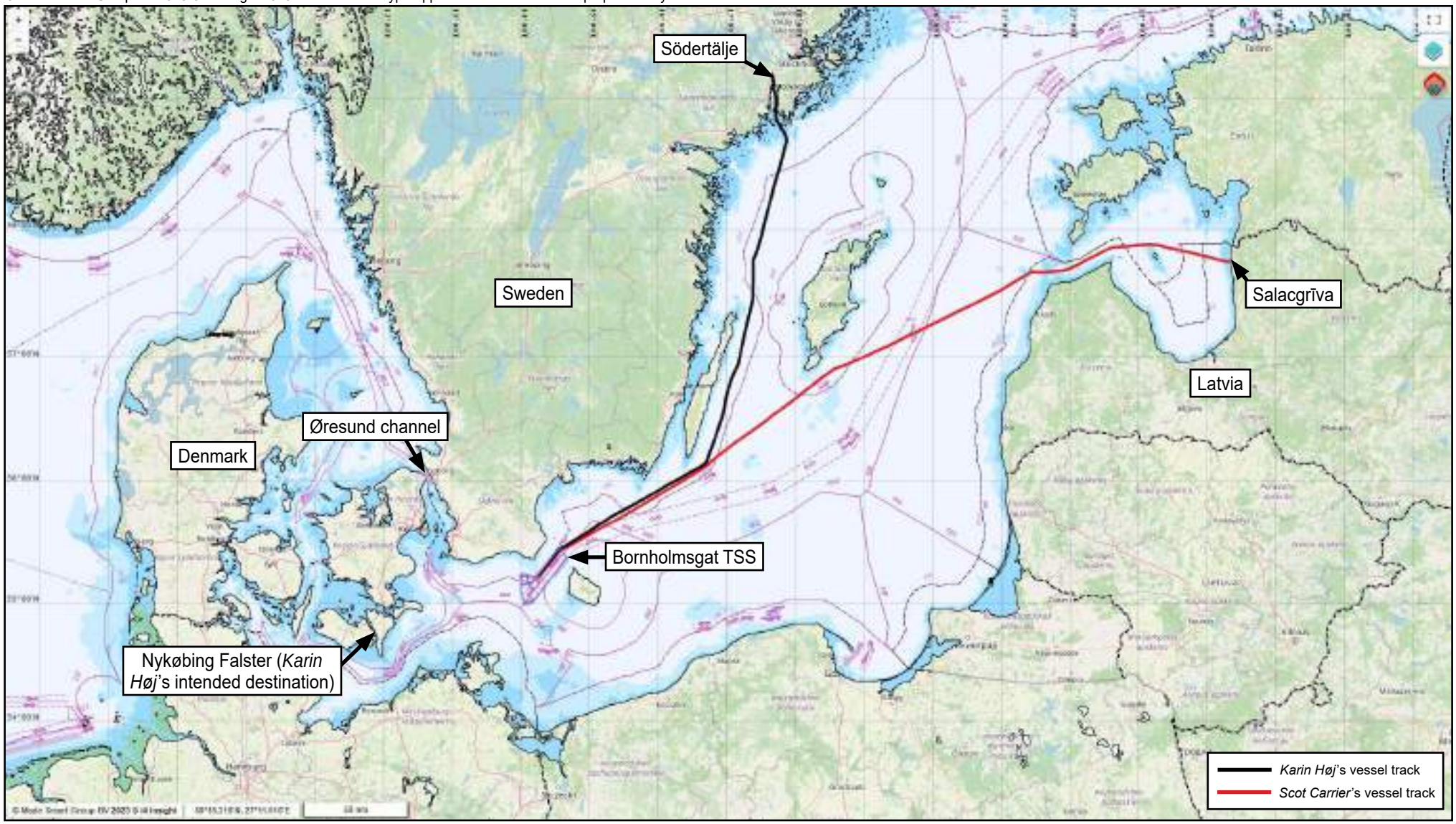

Figure 1: Overview of the vessels' departure points and *Karin Høj*'s intended destination

Image courtesy of the Swedish Coast Guard

Figure 2: Swedish Coast Guard maritime surveillance photograph of *Karin Høj* on 12 December

The wind was south-westerly force 4 with a low swell, partly cloudy sky and good visibility. The setting gibbous[2] moon was in the west, 19° above the horizon, and predicted to set at 0027.

Scot Carrier was heading 240° with autopilot engaged and making a speed of about 12 knots (kts). Both Electronic Chart Display and Information System (ECDIS) displays were in use, and the radars were set to 6nm and 12nm ranges on the port and starboard side sets, respectively **(Figure 3)**. At 2321, the 2/O altered course to 244° to give more sea room to the ship being overtaken. Besides his navigational duties the 2/O sporadically watched a video on his personal tablet computer and listened to music.

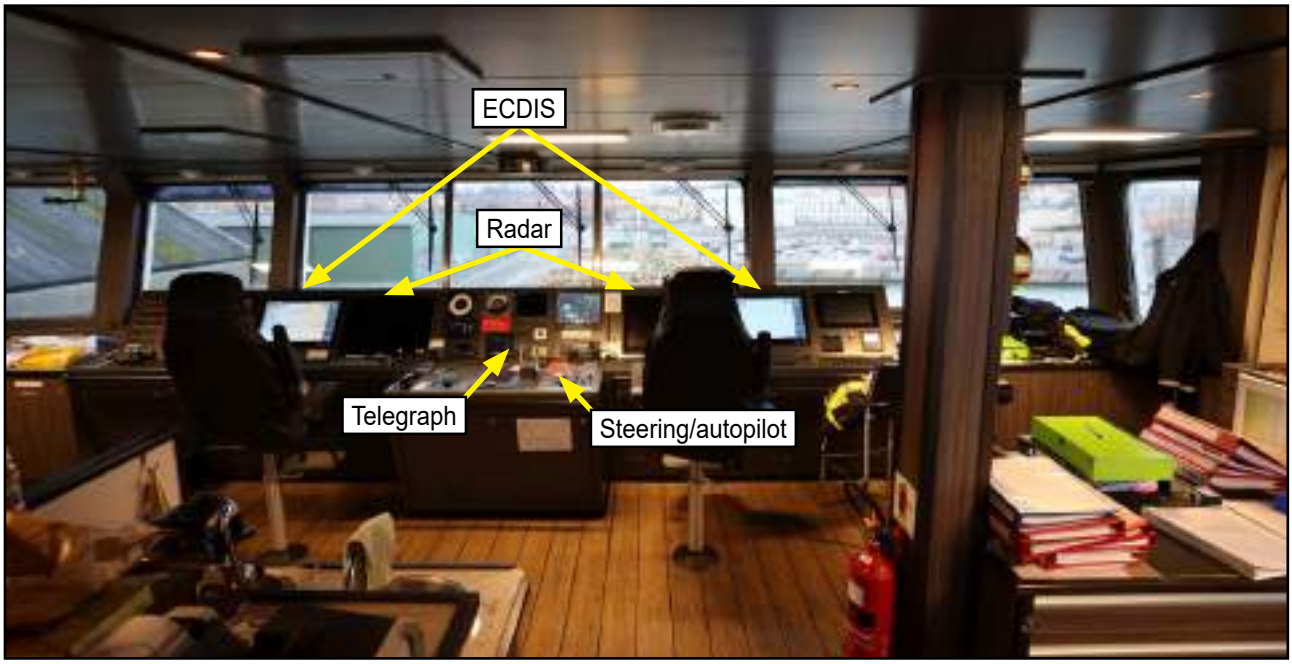

Figure 3: *Scot Carrier*'s bridge, showing displays and course and engine controls

[2] More than a half-moon but less than fully illuminated.

At 0020, *Karin Høj* entered the Bornholmsgat traffic separation scheme (TSS) and proceeded on a south-westerly course at a speed of between 5.5kts and 6kts, staying close to the west side of the traffic lane **(Figure 4)**.

At 0148, *Scot Carrier*'s 2/O made a hot beverage and, 6 minutes later, while sitting in the starboard navigation chair, used his tablet computer to engage with a stranger on a video chat site.

At 0158, *Scot Carrier* entered the TSS steering a 220° course with *Karin Høj* 7.7nm ahead, a few degrees on the starboard bow. *Karin Høj* was making good a course of 217° at a speed of 5.5kts **(Figure 5)**. The 2/O simultaneously turned on the interior lights of *Scot Carrier*'s bridge to show his surroundings to the chat user. He continued to chat sporadically with other random individuals after ending his conversation with this user.

At 0202, he altered course to 220° while at the same time continuing with his online chat. Shortly afterwards, he switched on the searchlight to show the chat user the ship's deck and cargo on the hatches forward. He then continued to engage with several different individuals on the chat site.

At 0303, *Scot Carrier*'s automatic identification system (AIS) registered *Karin Høj* as a *dangerous target* 2.21nm ahead on the starboard bow, with its closest point of approach (CPA) at 0.88nm and a time to closest point of approach (TCPA) of 19 minutes and 41 seconds.

1.3.2 Collision

At 0319, *Scot Carrier*'s 2/O zoomed out on the ECDIS to show a chat user the ship's location **(Figure 6)**. Two minutes later, with the vessel close to waypoint number 11 near the Svartgrund buoy, he told the chat user that he needed to alter course and adjusted the autopilot to 270°; *Karin Høj* was bearing 289° at 0.82nm range **(Figures 7** and **8)**.

By 0322, both vessels had exited the south-west bound lane of the TSS and entered the precautionary area[3]. The 2/O on board *Scot Carrier* once again connected with a different chat user and conversed with them while altering course. At 0323, *Scot Carrier* was steering the new course of 270°, with *Karin Høj* on a steady bearing of 298° at a range of 0.6nm **(Figure 9)**.

At 0326:35, while still in conversation, the 2/O observed a light close to *Scot Carrier*, between 20° to 30° off its starboard bow. He exclaimed *"Wait, wait, wait!"*, pulled back the main engine propeller pitch control lever (telegraph), switched on a second steering motor and disengaged the autopilot. Fifteen seconds later, the 2/O moved the telegraph to full astern.

At 0327:25[4], *Scot Carrier* collided with the port side of *Karin Høj* at an angle of about 50° and a relative speed of 8.7kts **(Figures 10** and **11)**. *Karin Høj*'s last AIS transmission occurred 9 seconds later[5].

Scot Carrier's master awoke when he felt the vessel move; however, because the motion was similar to a large wave hitting the bow, he did not consider it unusual and tried to resume sleep.

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[3] A routeing measure, not part of a TSS, used within an area of defined limits where ships must navigate with particular caution.

[4] This is the most likely time from AIS and radar data inspection.

[5] The AIS on board *Karin Høj* transmitted information every 10 seconds.

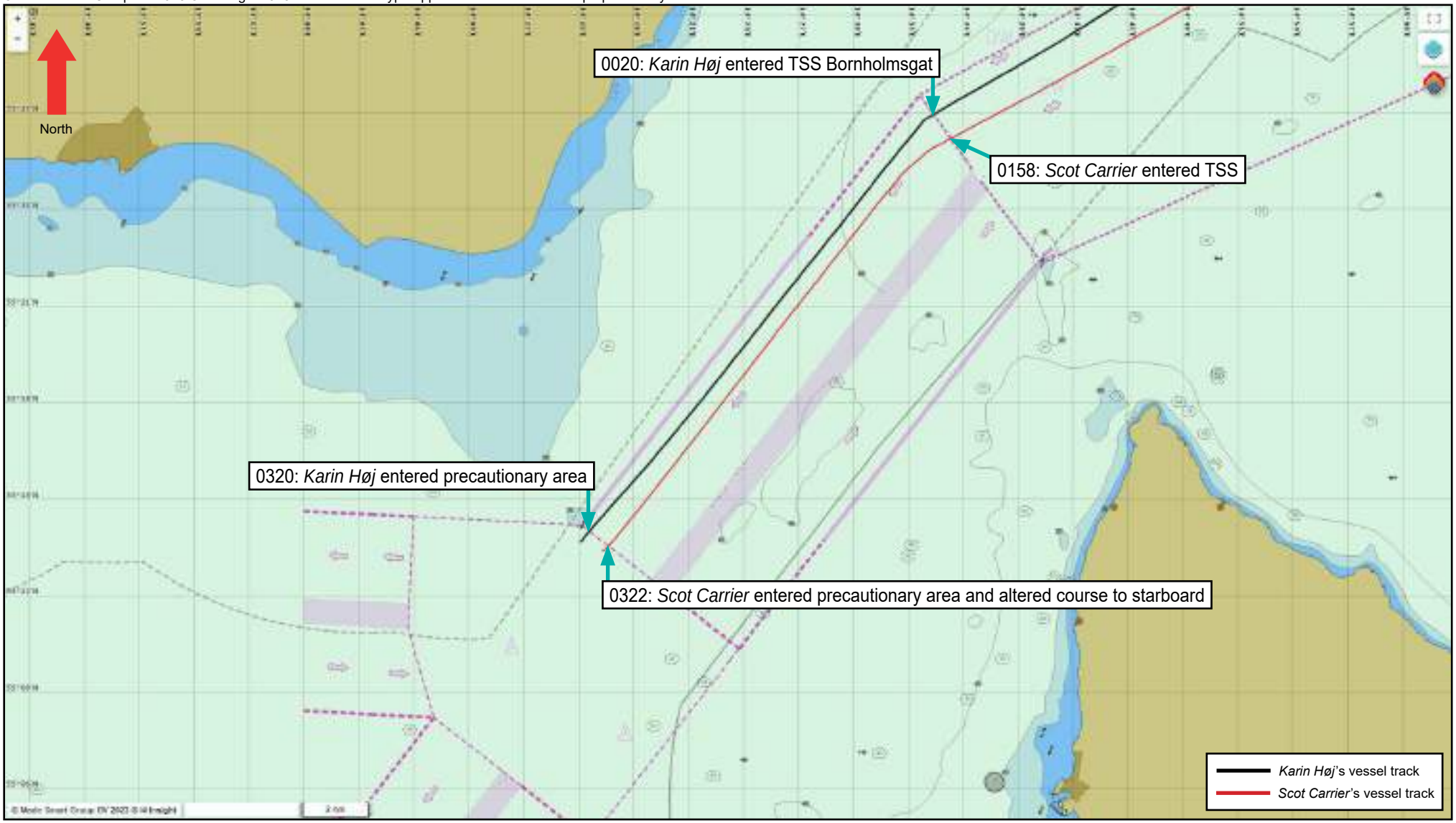

Figure 4: Vessels' routes through Bornholmsgat traffic separation scheme

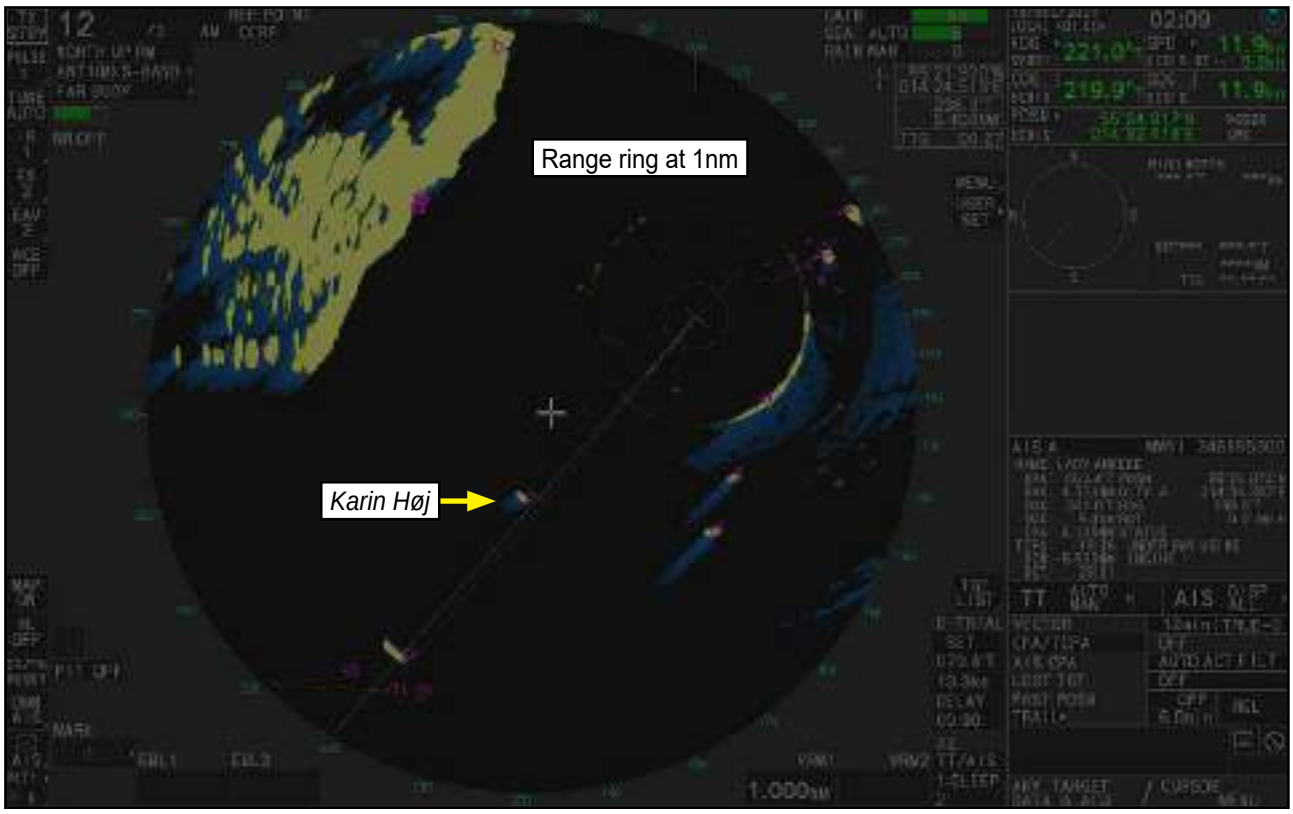

Figure 5: *Scot Carrier*'s starboard radar image showing position of *Karin Høj* at 0209

Figure 6: VDR replay image of zoomed out ECDIS image on starboard monitor

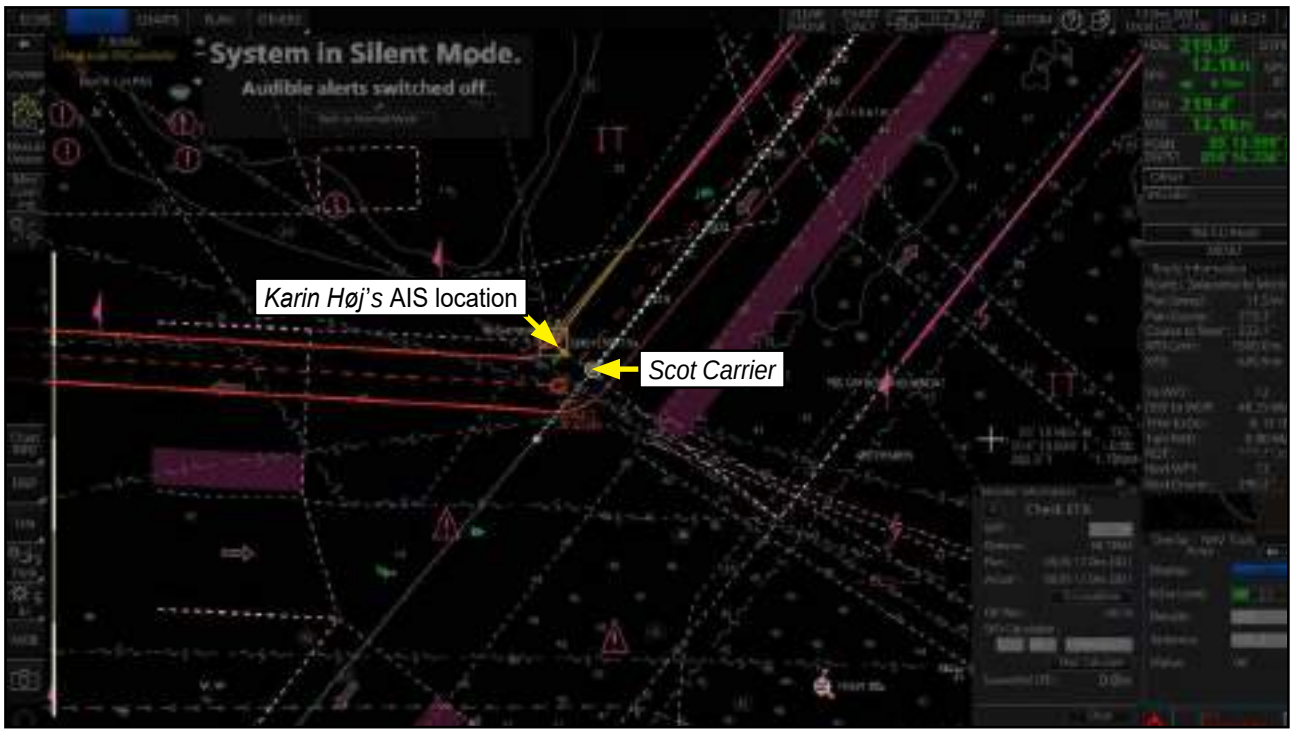

Figure 7: *Scot Carrier*'s starboard ECDIS image at 0321, before altering course

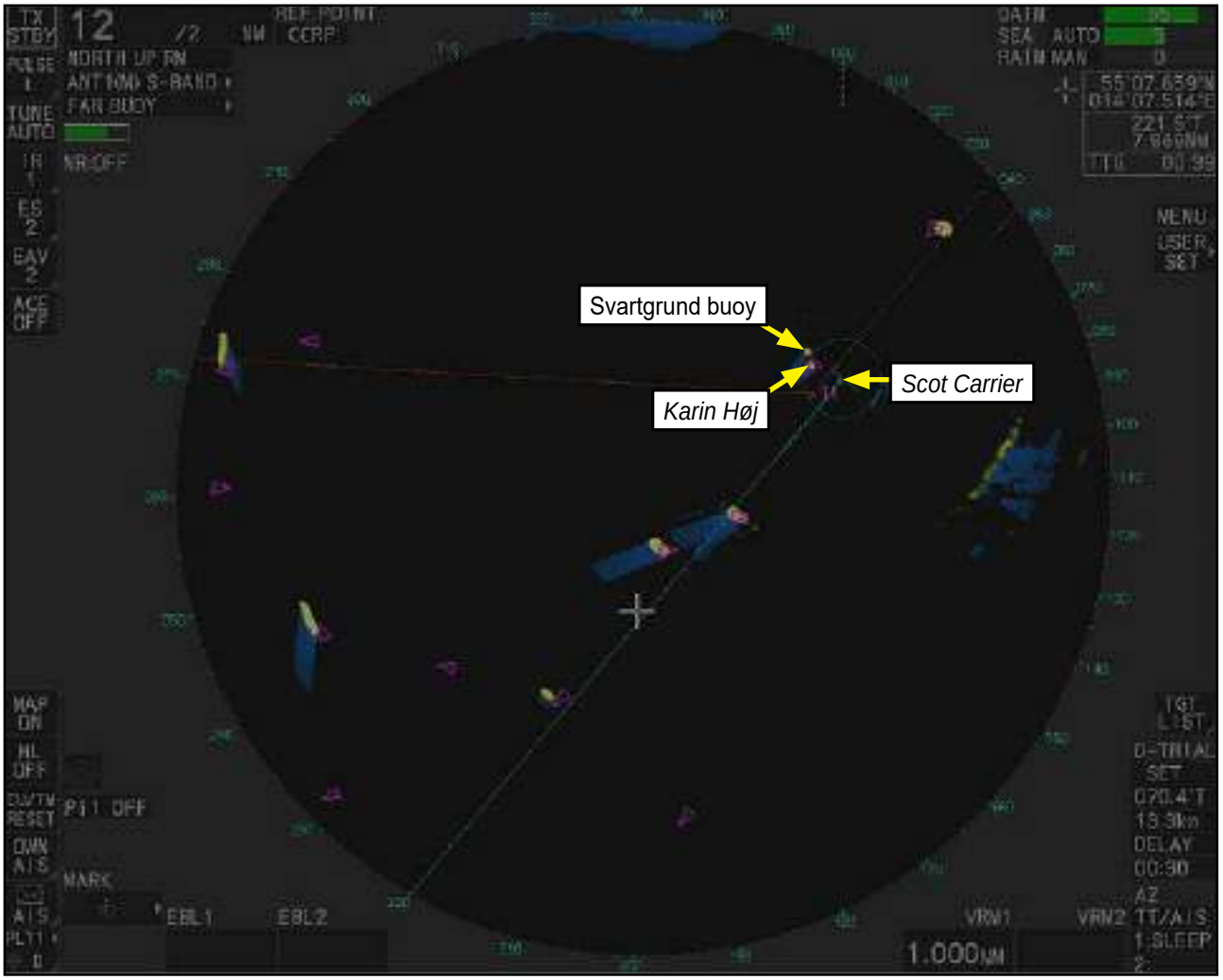

Figure 8: *Scot Carrier*'s starboard radar image at 0321, before altering course

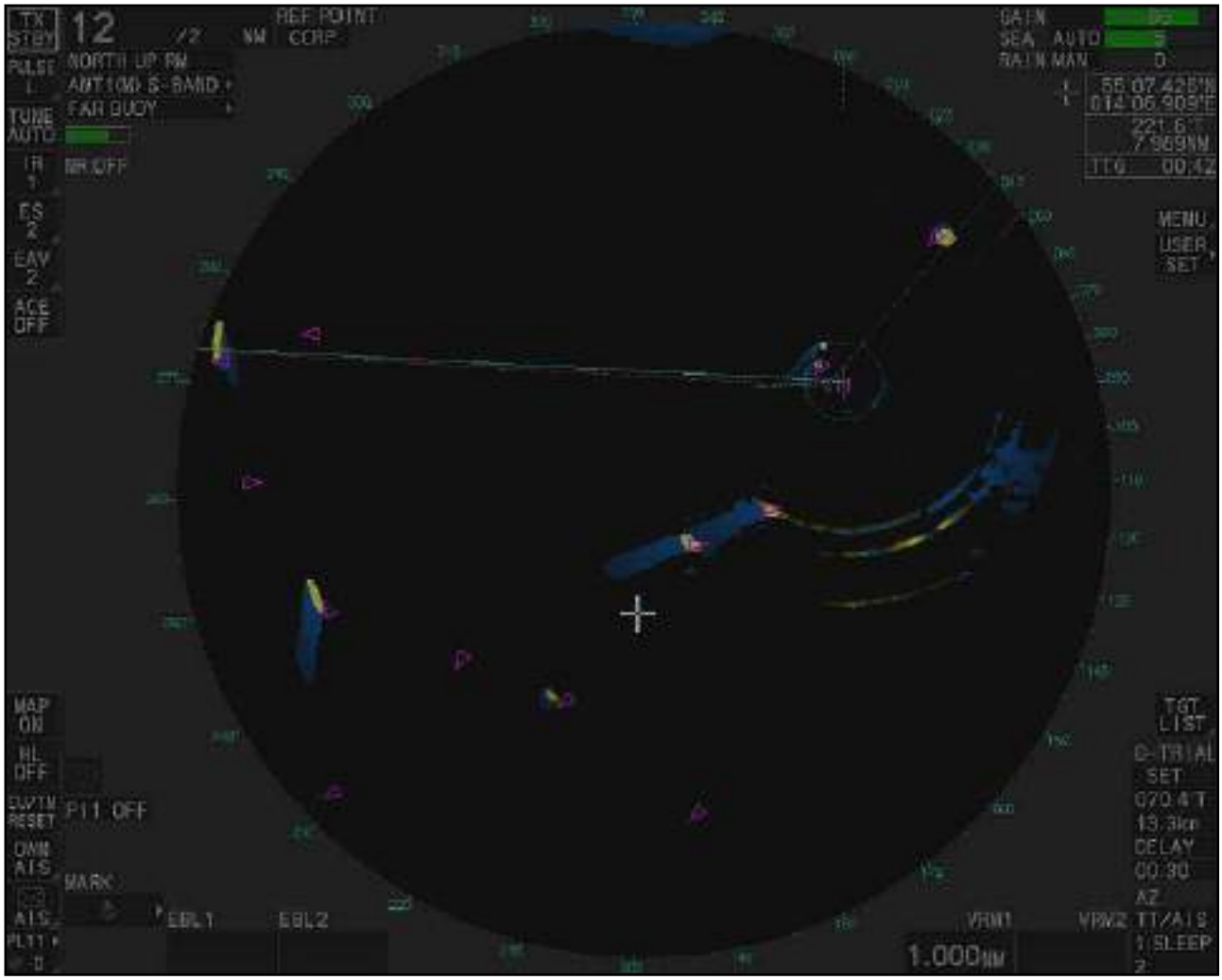

Figure 9: *Scot Carrier*'s starboard radar image at 0323

For illustrative purposes only: not to scale

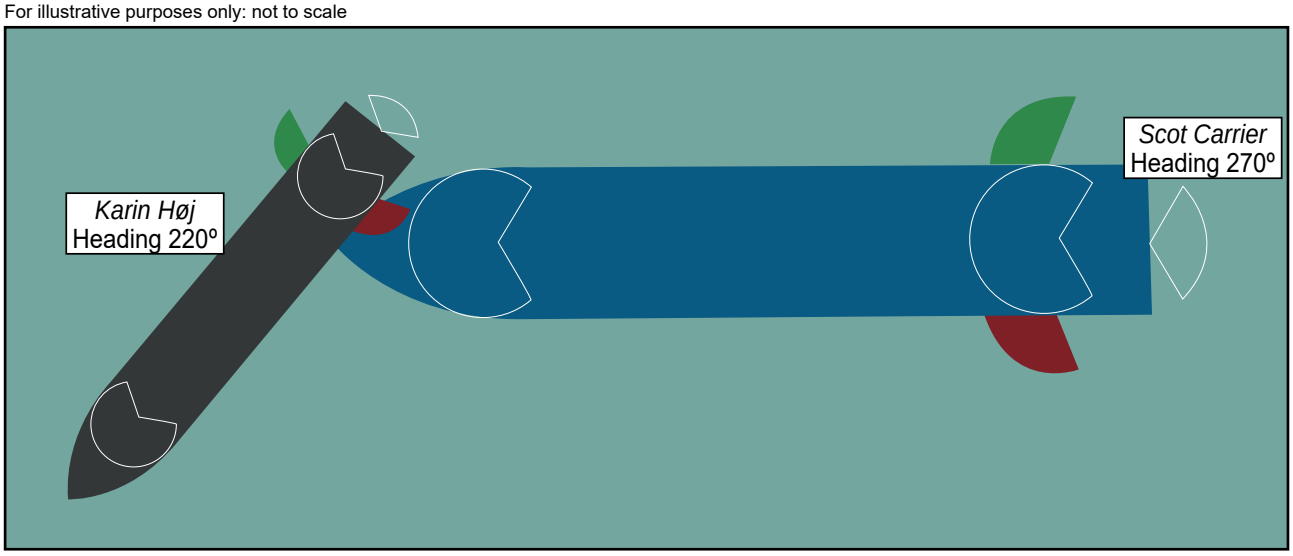

Figure 10: Collision angle (50º)

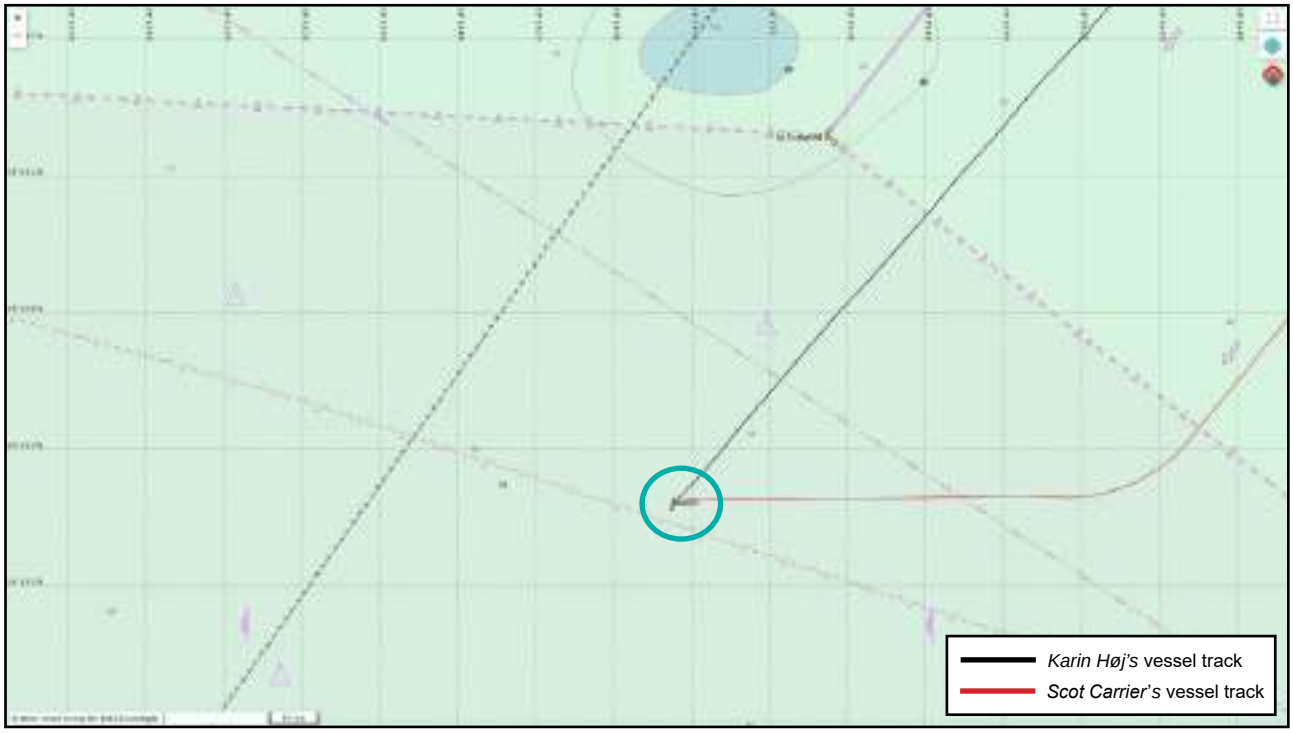

Figure 11: Point of collision at 0327:25

1.3.3 Post-collision

Scot Carrier's 2/O went to the starboard bridge wing, making several exclamations of "*Oh, my God!*". The vessel made a slow turn to port with the helm control in manual and the rudder amidships. The 2/O then moved across to the port bridge wing, but saw nothing in the darkness.

At 0327:55, the 2/O returned to the centre console and put the telegraph to full ahead. Five minutes later, after pacing up and down the bridge, he steadied the course **(Figure 12)** then, shortly afterwards, initiated a slow turn to starboard and switched the starboard radar range from 12 to 0.75nm.

At 0329, the Joint Rescue Coordination Centre (JRCC) of the Royal Danish Navy, received a distress message from *Karin Høj*'s Emergency Position Indicating Radio Beacon (EPIRB).

At 0334:20, *Scot Carrier*'s 2/O re-engaged the autopilot and the vessel continued a slow turn to starboard.

At 0335:46 and 0336:24, the JRCC called *Karin Høj* via VHF[6] channel 16 using callsign *Lyngby Radio* but did not receive a reply.

At 0337, *Scot Carrier*'s unmanned engine room alarm sounded on the bridge and in the chief engineer's (C/E) cabin. The C/E silenced the alarm and went to the engine room. The 2/O put the helm control to manual shortly afterwards and steadied the course at 305°. At 0339, the C/E called the bridge by telephone and asked the 2/O why two steering pumps were operating. The 2/O told him there was no problem and that he would switch the steering control back to autopilot.

[6] Very high frequency radio.

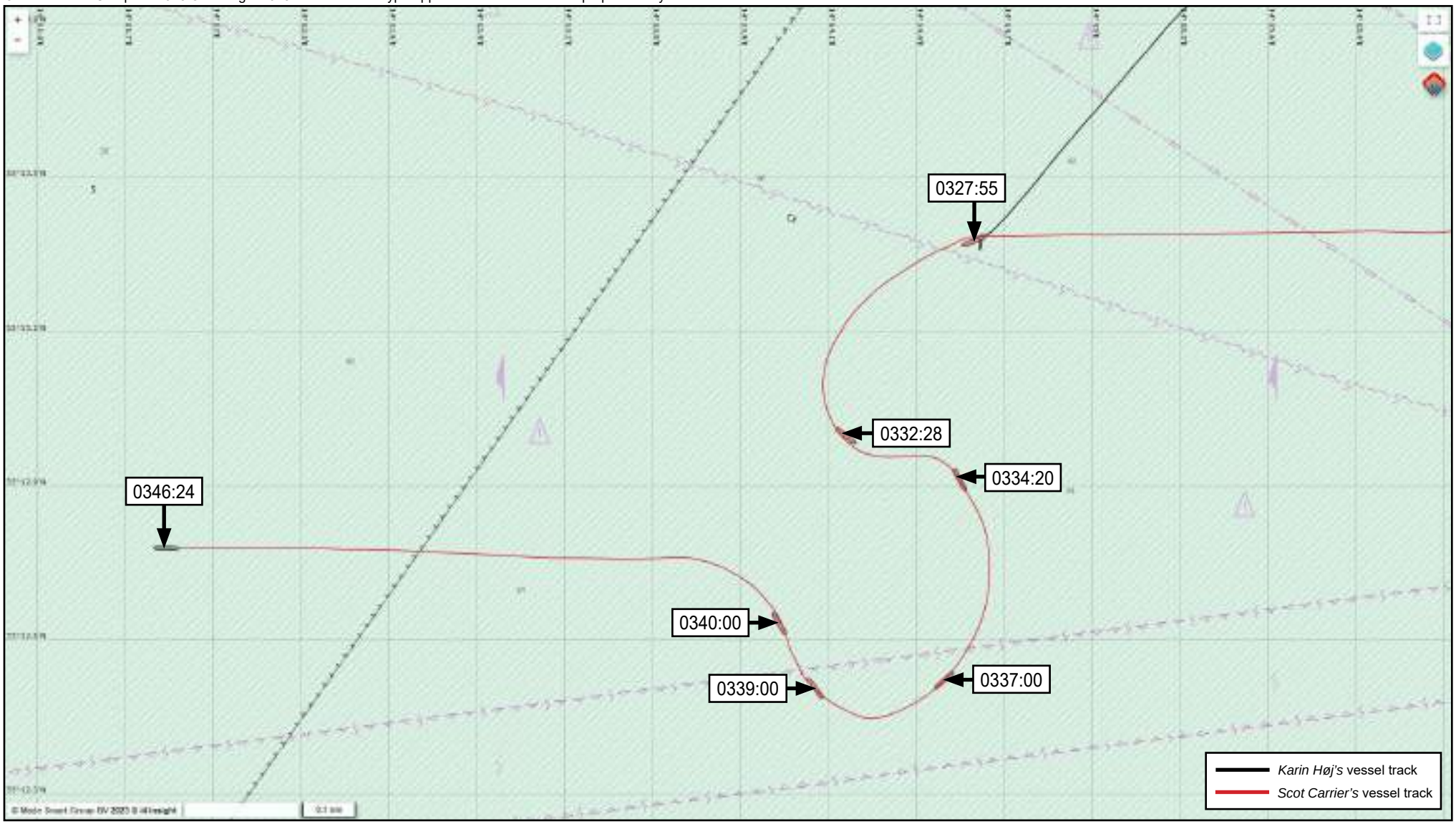

Figure 12: *Scot Carrier*'s post-collision track

At 0339:43, *Lyngby Radio* called the south-west bound cargo ship *Fionia Sea*, which was in the Bornholmsgat TSS and approaching the last received position of *Karin Høj*, requesting details of any sightings of, or information about, the distressed barge. The JRCC also informed the Swedish search and rescue authority about the activated EPIRB and lack of response from *Karin Høj* to its radio calls.

At 0340, *Scot Carrier*'s 2/O adjusted the autopilot to steer a course of 270° and continued at full ahead. JRCC Sweden, using callsign *Sweden Rescue*, called *Scot Carrier* and the 2/O asked for details in response to its enquiry about a vessel in the ship's vicinity. JRCC Sweden replied with *OWHM2*, the callsign of *Karin Høj*, to which the 2/O answered that his equipment was not displaying anything with that callsign.

On the basis of the AIS tracks in the area at the time of the EPIRB distress message, the two JRCCs suspected that a collision had occurred between *Scot Carrier* and *Karin Høj* and immediately started a joint search and rescue operation. Swedish and Danish airborne and seagoing rescue units were tasked to *Karin Høj*'s last known position and, because *Karin Høj*'s last observed position was in Swedish waters, JRCC Sweden assumed the role of search and rescue mission coordinator (SMC).

At 0342, Sweden Radio asked *"So you don't have anything in your vicinity?"* The 2/O replied *"Standby"* and paced up and down the bridge for a minute before affirming: *"Sweden control, Scot Carrier. No vessel with that callsign appearing on my equipment"*. Sweden Rescue responded, *"What was going on? AIS shows you going to port then starboard again"*, to which the 2/O again replied *"Standby"*.

At 0343:57, *Scot Carrier*'s 2/O telephoned the master who arrived on the bridge shortly afterwards. The 2/O explained that their ship might have hit another vessel and that the Swedish coastguard had observed *Scot Carrier*'s manoeuvres and called him on VHF. The 2/O continued with his explanation and, at 0346:24, the master sounded the general alarm and moved the telegraph to half ahead.

Scot Carrier's master questioned the 2/O further about the other vessel and then called Sweden Rescue to request a last known position for *Karin Høj*. Sweden Rescue again asked questions about *Scot Carrier*'s manoeuvres, to which the master responded that a collision may have occurred. At 0351, Sweden Rescue instructed the master to turn the ship around and return to the *Karin Høj*'s last known position. The master put the helm in manual control and altered course, noting that the visibility had dropped with patchy mist or fog now present.

The crew of *Scot Carrier* had assembled on the bridge in response to the general alarm. The master started the collision checklist, arranged for a damage assessment of the ship's bow and instructed the remaining crew to prepare the safety boat. At 0359, the master telephoned the company's designated person ashore to notify them of the situation.

At 0359:34, Lyngby Radio made a *"Mayday Relay"* call about *Karin Høj*. It transmitted the ship's name, Maritime Mobile Service Identity (MMSI)[7] number, callsign and last known position and requested assistance from all vessels in the vicinity. Four minutes later, *Fionia Sea* reported to the JRCC that the upturned hull of a vessel had been sighted near *Karin Høj*'s last known position.

At 0405, *Scot Carrier*'s C/O reported to the master that the ship's bow was damaged but hull integrity was intact. The master called Sweden Rescue to advise them of the ship's damage and inform them he could see a radar target near the last reported position of *Karin Høj*.

At 0406, *Scot Carrier* approached the scene and used searchlights and handheld torches to search and assess the situation around the upturned hull of *Karin Høj* **(Figure 13)**. Two other merchant vessels also headed to the reported position to assist with the search.

At 0423, *Scot Carrier*'s crew launched their rescue boat and conducted a search near the hull of *Karin Høj*. Coastguard rescue units reached *Karin Høj* shortly afterwards and searched for persons in the water. An on-scene rescue services dive unit determined that *Karin Høj* was too unstable for it to conduct an exploratory dive to search for the vessel's missing crew inside the upturned hull. The SMC subsequently arranged for *Karin Høj* to be towed into shallow waters and grounded so that divers could carry out their search.

At about 0730, a Swedish doctor boarded *Scot Carrier* and tested the crew for drugs and alcohol. The C/O and 2/O tested positive for alcohol and were arrested by the coastguard and taken ashore. Rescue services continued to search the area into the daylight hours, finding no sign of *Karin Høj*'s missing crew.

At 1340, Swedish rescue divers entered *Karin Høj*'s submerged accommodation and, 10 minutes later, found one partially clothed person in the accommodation hallway outside the starboard cabin **(Figure 14)**. The person was later declared deceased and identified as the vessel's master.

At 1400, Sweden Rescue directed *Scot Carrier* to proceed to the nearby port of Ystad, Sweden. Coastguard officers boarded and inspected the vessel on its arrival. Inspectors from both the MAIB and Danish Marine Accident Investigation Board (DMAIB) attended *Scot Carrier* later the same day, carrying out an immediate inspection of the ship's hull and taking photographs of the damage to its bow **(Figure 15)**. The inspectors noted silt stains above the ship's name on the starboard side and new damage to the paintwork on its port side **(Figure 16)**.

On the morning of 18 December, following completion of the coastguard's investigation, the Swedish authorities permitted *Scot Carrier* to sail and it departed for Montrose, Scotland, to discharge its cargo and effect repairs.

[7] The MMSI number was a nine-digit sequence that was unique to each vessel and enabled any distress message sent via digital selective calling or AIS to be attributed to it.

Figure 13: *Karin Høj*'s upturned hull, showing azimuth drive units at the stern

Image courtesy of DMAIB

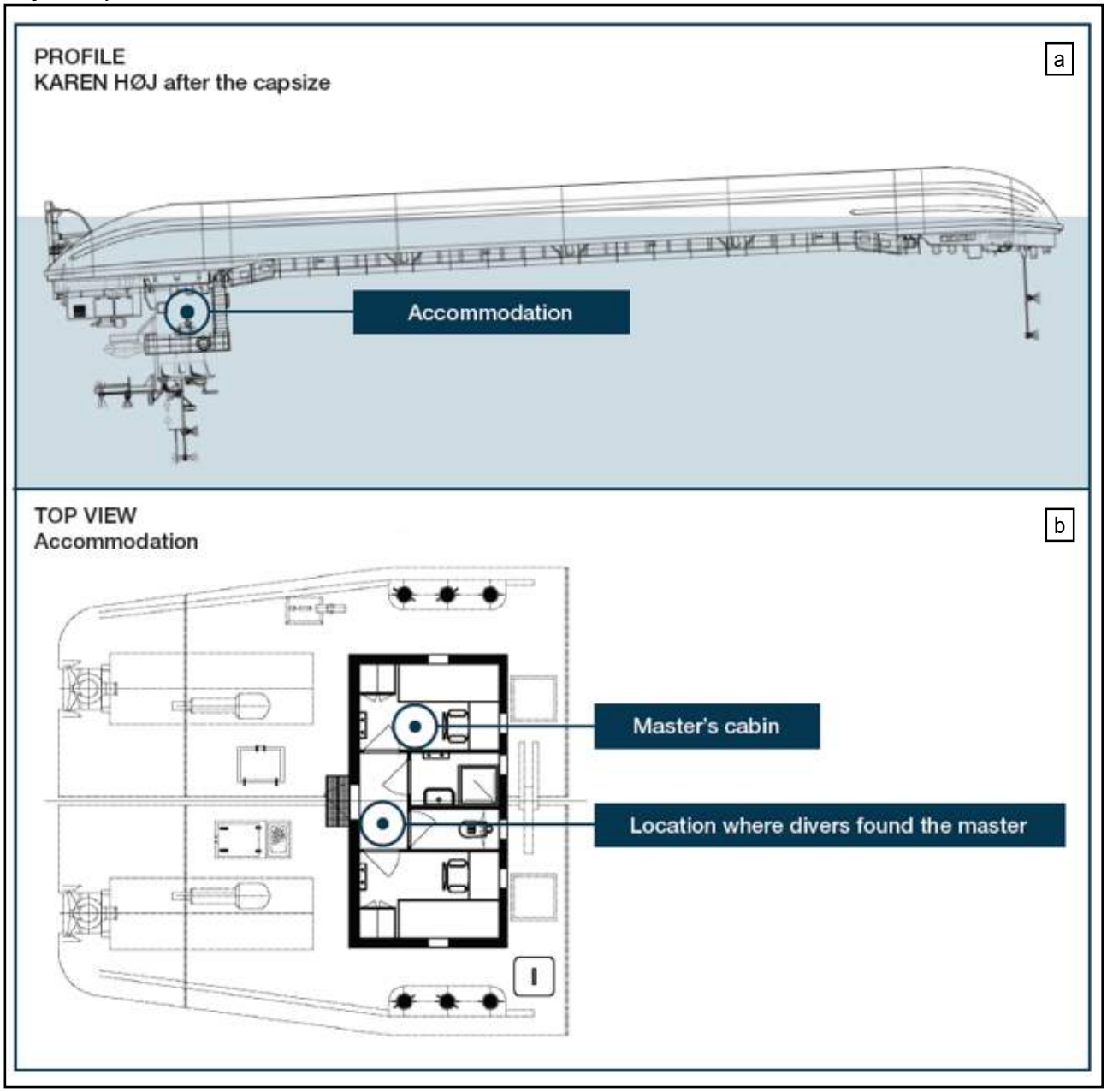

Figure 14: *Karin Høj*'s accommodation (a) and cabin layout (b)

Figure 15: Damage to *Scot Carrier*'s bow, showing collision damage on stem and hull, and silt staining above the ship's name

Figure 16: Damage to *Scot Carrier*'s paintwork on the ship's port side

1.4 SURVIVABILITY

At the time of the collision the sea and air temperature was about 4°C.

Sudden immersion in water temperatures of less than 15°C can result in cold water shock and/or cold incapacitation. Cold water shock happens within the first 30 seconds to 2 minutes and is associated with a gasp reflex and hyperventilation. The cardiovascular component of the cold shock response includes an increase in heart rate, cardiac output and blood pressure. These responses increase the likelihood of a cerebrovascular accident during the first minutes of immersion.

Panic can cause hyperventilation to continue after the initial physiological effects of cold water shock have subsided. Cold incapacitation usually occurs within 2 to 15 minutes of entering the water. The blood vessels become constricted as the body tries to preserve heat and protect vital organs. This results in the blood flow to the extremities being restricted, causing cooling and consequent deterioration in the functioning of muscles and nerve ends. Hands and feet lose useful movement, leading to the progressive incapacitation of arms and legs and impeding the ability to swim and grip. Debilitation of body movement of a person without additional flotation, such as a lifejacket, will result in drowning[8].

1.5 ENVIRONMENT

Just before the collision the wind was reported to be south-westerly force 1 with a low swell. The sky was partly cloudy with no moonlight and visibility was over 5nm. Nearby vessels and SAR aircraft reported poor visibility after the collision, recording less than 500m at times.

During the month of December daylight lasted for about 7 hours in the Bornholmsgat TSS region of the Baltic Sea; the area was in darkness from around 1530 until 0815.

1.6 BORNHOLMSGAT TRAFFIC SEPARATION SCHEME

The collision occurred in the Bornholmsgat TSS, which was established in 2006 and located in the Baltic Sea between Sweden and Bornholm, Denmark.

The TSS comprised three parts, described as the main part, the south-west part and the west part, respectively, each comprised of two opposing traffic lanes divided by a separation zone. The traffic routeing system included a precautionary area at the junction where the main, south-west and west lanes met **(Figure 17).** The precautionary area was indicated with an exclamation mark on the electronic chart display and the instruction *Ships must navigate with particular caution* was embedded in the system's integrated information data.

1.7 *SCOT CARRIER*

1.7.1 General information

Scot Carrier was a 4789 deadweight tonnage (DWT)[9] general cargo ship, purpose-built for operation by Scotline Ltd (Scotline) to carry timber cargoes between the Baltic and north-western Europe.

[8] M.Tipton, The Science of Beach Lifeguarding, Chapter 6 (2016).

[9] A measure used by the shipping industry to establish the total weight a ship can carry and is the sum of the weights of its cargo, crew, fuel, fresh water, food and provisions, etc.

Image courtesy of The SafeSeaNet Ecosystem GUI

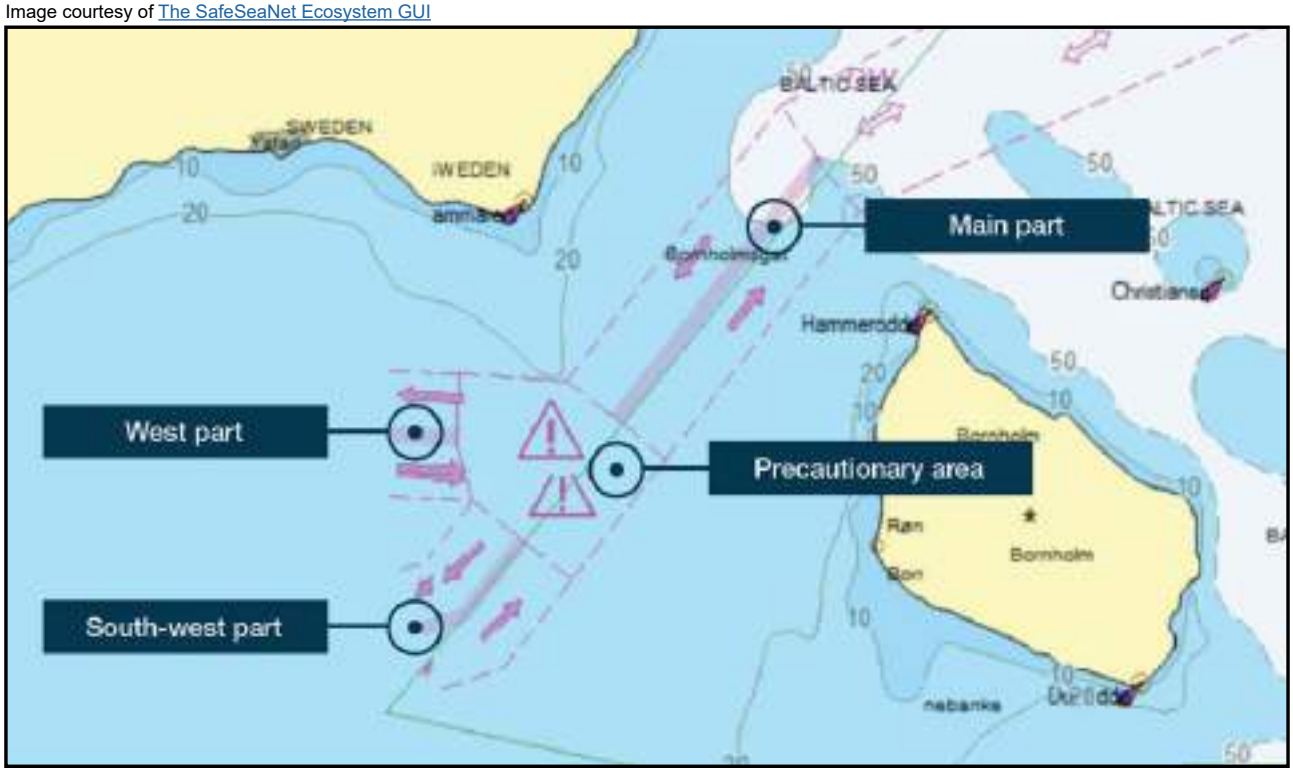

Figure 17: Bornholmsgat traffic separation scheme

The vessel was constructed to the Finnish-Swedish/Lloyd's Register ice class standard 1B for ships capable of being navigated in moderate Baltic ice up to 0.6m thick. The requirements for ice class standard 1B included an enhanced bow strength, with thicker hull plating and increased frame strength, and a minimum main engine power rating.

1.7.2 Post-collision damage

On 14 December, a Lloyd's Register surveyor attended *Scot Carrier* to assess the damage to the ship's bow **(Figures 15**, **16** and **18)** and noted:

> *Indentations in the bow in height of paint store, well above waterline. An area of 600x500x500[mm] in the bow, internals (stiffener+ brackets) bent on both side of bow about half frame distance* [sic]

The surveyor issued *Scot Carrier* with a condition of class[10] that required repairs to be completed within 2 months.

1.7.3 Bridge equipment

Scot Carrier's integrated bridge incorporated two linked ECDIS units, one each on the port and starboard conning stations **(Figure 3)**, with adjacent 27-inch radar display monitors; the port radar operated on an X-band frequency and the starboard radar operated on an S-band frequency[11]. The bridge was also equipped with an AIS unit, a Bridge Navigational Watch Alarm System (BNWAS), a global positioning system and two VHF transceivers.

[10] A requirement imposed on a ship to the effect that specific measures, repairs, surveys etc. are to be carried out within a specific time limit in order to retain its classification.

[11] X-band operates at a higher frequency and is used to achieve a sharper image and better target resolution. S-band has a larger antenna and is capable of seeing through heavy rain or fog.

Figure 18: Damage to *Scot Carrier*'s internal bow structure

The ship's navigational systems were integrated into the ECDIS, which could display AIS and radar information on its screens. Both the AIS and radars could be independently operated and alarm functions for the bridge navigation equipment were set by the user; the navigation officers routinely disabled the ECDIS look ahead, radar and AIS alarms because they caused frequent audible and visual distraction.

The VDR recorded:

- port and starboard ECDIS and radar displays;
- AIS information;
- BNWAS status;
- telegraph pitch demand, actual propeller pitch and engine speed;
- helm control status and rudder (ordered/actual)
- bridge audio, including the external bridge wings and primary VHF; and
- bridge and engine room alarms.

The BNWAS on board *Scot Carrier* was not switched on during the 12 and 13 December watches.

1.7.4 Manoeuvrability

Scot Carrier's manoeuvring data showed that it took 120 seconds for the ship to move from full ahead to full astern. A crash stop would take the ship 141 seconds in its loaded condition, during which *Scot Carrier* would advance 600m through the water. The turning circle diagram showed that, at full starboard rudder, it would take the ship 20 seconds to alter course by 20°, during which *Scot Carrier* would advance 130m through the water.

1.7.5 Crew

Scot Carrier was manned in excess of the six crew required by its safe manning certificate. The crew comprised four officers and four ratings, all of whom were suitably qualified for their roles. The master and 2/O were British, the C/O and C/E were Croatian and the two ABs, AB/cook and the motorman were Filipino.

The master was 29 years old and had been a seafarer since 2014. He qualified as an officer of the watch in 2017, on completion of his cadetship, and started work on Scotline vessels as a 2/O. Two years later, he was promoted to C/O and, in July 2021, he gained his master unlimited certificate of competency. He was promoted to master of *Scot Carrier* 3 weeks before the collision with *Karin Høj*.

The 2/O was 30 years old and qualified as officer of the watch in 2016, on completion of his cadetship. In January 2018, having served on a variety of ships, he started working on Scotline vessels and had received consistently positive appraisal reports. The 2/O had worked on board *Scot Carrier* for 10 weeks and was due to leave the vessel on arrival at Montrose.

1.7.6 Shipboard working arrangements

The crew worked according to a published schedule **(Figure 19)**. The two ABs were listed for 6-hour watches at sea and in port, with no additional comments regarding variability of hours required for maintenance or other work.

Deck logbook entries consistently documented that a lookout was on the bridge during hours of darkness. The deck logbook entries for 12 December, the day before the collision, stated that a lookout was present from midnight to 0700 and from 1700 until midnight. On 13 December, a lookout was recorded as being present from midnight **(Figure 20)**. Lookouts were not physically posted at these times, nor any other times in hours of darkness. Recorded hours of work and rest showed that the two ABs were keeping the 6 to 12 and 12 to 6 watches, respectively.

The ABs were employed on a consolidated contract for 44 hours per week plus overtime. The C/O was head of the deck department and managed the use of working hours to cover lookout duties at sea, port arrivals and departures and cargo operations. The AB/cook was certificated to keep a lookout and the motorman was not.

1.7.7 Master’s standing and night orders

The master had adopted the standing orders from the previous master. For watches at sea the orders stated, among other things, that:

> *The first and foremost duty of the OOW is the keeping of a **GOOD LOOKOUT** using all means available visual, audible and electronic.*
>
> *Prohibit to switch off permanently ECDIS alarms when vessel underway*
>
> *Always activate the bridge watchkeeping alarm when on duty bridge watch.* [sic]

Other requirements:

Minimum hours of rest: 77

'#' in the comments section indicates that exact times of non-watchkeeping hours may vary

Latest update of table: 15-Dec-21

Position / Rank	Scheduled daily work hours at sea		Scheduled daily work hours in port		Comments	Total daily rest hours	
	Watchkeeping (from...to)	Non-Watchkeeping duties (from...to)	Watchkeeping (from...to)	Non-Watchkeeping duties (from...to)		At Sea	In Port
Master	08:00 - 12:00	13:00 - 14:00	08:00 - 12:00	13:00 - 14:00		15	15
	20:00 - 24:00		20:00 - 24:00				
Chief Engineer	08:00 - 12:00	20:00 - 21:00	08:00 - 12:00	20:00 - 21:00		15	15
	13:00 - 17:00		13:00 - 17:00				
Chief Officer	04:00 - 08:00		04:00 - 08:00			16	16
	16:00 - 20:00		16:00 - 20:00				
Second Officer	00:00 - 04:00					16	24
	12:00 - 16:00						
AB1	00:00 - 06:00		00:00 - 06:00		Watchkeeping during hours of darkness &as	14	14
	13:00 - 17:00		13:00 - 17:00				
AB2	06:00 - 12:00		08:00 - 12:00		Watchkeeping during hours of darkness &as	12	14
	18:00 - 24:00		18:00 - 24:00				
Motorman	08:00 - 12:00	07:00 - 08:00	08:00 - 12:00	07:00 - 08:00		15	15
	13:00 - 17:00		13:00 - 17:00				
Cook/AB	06:00 - 08:00		06:00 - 08:00			16	16
	09:00 - 13:00		09:00 - 13:00				
	15:00 - 17:00		15:00 - 17:00				

Signature of Master: [redacted]

Figure 19: *Scot Carrier*'s watchkeeping schedule

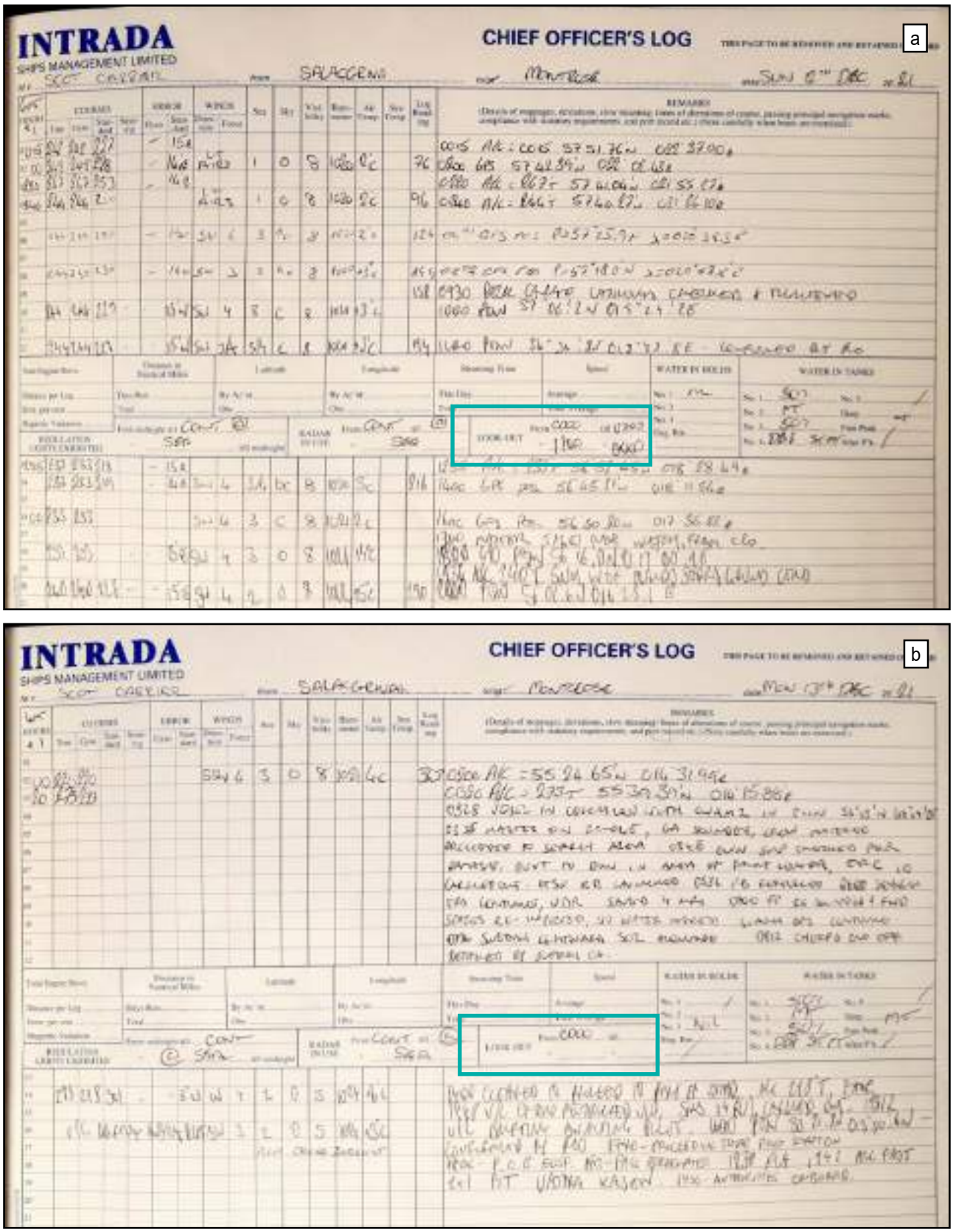

Figure 20: *Scot Carrier*'s deck logbook, showing lookout entries dated 12 December (a) and 13 December (b)

The OOW was directed to call the master in certain circumstances, such as:

- *If you are intending to reduce speed due to navigational reasons*
- *If the closest point of approach (CPA) of the crossing our course of another ship, vessel, boat, yacht, pleasure craft in the deep sea less than 1 mile… Distress or "Pan Pan" messages received by you or other vessels in the area or you see any vessel/aircraft or person(s) which could be in distress*. [sic]

The master had not written night orders for 12 December. The previous night's orders had instructed the OOW to:

- *Follow master's and company's standing orders and bridge procedures*
- *Keep a sharp lookout for small vessels and fishing boats in coastal areas*
- *Please call me if you are in any doubt at all or if I am required on bridge.* [sic]

1.7.8 Ownership and management

Scotline was formed in 1979. The company operated 13 vessels, including *Scot Carrier*. The size of the vessels ranged from 1996 DWT to 4803 DWT. Intrada Ships Management Limited (Intrada) managed the fleet's technical, crewing and administrative functions.

1.7.9 Safety management system

Scot Carrier's safety management system (SMS) was common to the Scotline fleet. It was issued by Intrada and contained policies and procedures to comply with the International Safety Management Code (ISM Code). Intrada's document of compliance with the ISM Code was issued on 22 August 2017.

The SMS procedures for keeping a safe navigational watch required that:

> *During the hours of darkness and also when circumstances dictate (for example in periods of restricted visibility, heavy commercial traffic density, heavy concentrations of fishing vessels or pleasure craft and in narrow or busy channels) additional personnel should be posted for lookout duties.* [sic]

It also instructed that:

> *…only duties pertinent to navigation are to be carried out whilst on watch.*

And that:

> *The Officer of the Watch (OOW) is the Master's representative and is primarily responsible for the safe navigation of the vessel, maintaining the Passage Plan, complying with the ColRegs and Master's Standing Orders/Instructions.*
>
> *This includes, but is not limited to, monitoring the vessel's position, collision avoidance, complying with reporting requirements, maintaining a radio watch and in particular listening for any VHF communications from VTS as they may be trying to contact the vessel with some important navigational information.* [sic]

There were no documented procedures or requirements for the setting of navigation equipment alarms in Intrada's SMS.

The SMS contained a drug and alcohol policy, which required that no alcohol was to be consumed while the vessel was underway, at anchor, or when working cargo. It also required that the consumption of alcohol was to be avoided within 4 hours of starting duty. The drug and alcohol policy was issued by Intrada to all officers as part of the crew introduction pack before their initial appointment, and to all Filipino crew at the start of each contract. It was also displayed on the bridge and in the messroom of each vessel.

Alcohol, in the form of beer, was kept on board for sale to the crew. It was reported that the vessel's non-British crew misunderstood the company's policy on alcohol consumption[12] within 4 hours of going on duty, believing that it also applied when the vessel was at sea. Intrada's alcohol policy included a statement detailing that unannounced drug and alcohol testing would be conducted by an approved medical contractor or duly appointed company official or, when underway, by the master when a crew member was suspected of being over the alcohol limit.

A procedure for the use of mobile phones required that, to prevent distraction, neither these nor similar devices were to be used while on duty to make calls, send texts, watch videos or interact with social media.

1.7.10 Purchasing of bonded stores

The master kept the accounts for all beer transactions. In the 4 months before the accident 12 cases (72 litres) of beer had passed through the bonded store, having been purchased by various crew members.

The alcohol purchasing record for *Scot Carrier*'s bonded store did not indicate that beer consumption on board the vessel exceeded the limits suggested by the company's drug and alcohol policy. Intrada did not prohibit alcohol purchased ashore from being brought on board.

1.7.11 Safety management system audits

On 24 September 2021, Lloyd's Register audited *Scot Carrier*'s compliance with the ISM Code. The auditor found no major or minor non-conformances, and previous audit items had been closed. One observation was made about SMS updates for cyber security regulation. The audit report noted that records of hours of work and rest had been *reviewed and found generally controlled*.

Internal company audits had identified no issues with navigational practices or discrepancies with hours and work records.

1.7.12 Port state control inspections

In the 3 years before the accident *Scot Carrier* had undergone five port state control inspections; the Swedish authority conducted the last inspection on 26 March 2021, recording no defects or comments. None of the defects identified during previous inspections were relevant to this accident.

[12] Intrada's policy at the time of the accident followed the guidance in MGN 590 (M+F) STCW, 1978 as amended, Manila Amendments: Alcohol Limits.

1.8 *KARIN HØJ*

1.8.1 General information

Karin Høj was a split hull hopper barge[13] with a cargo capacity of 510 cubic metres (m^3). Built in 1977 in the Netherlands, the barge was propelled by two azimuth drive propellers, driven by two separate Caterpillar engines mounted on the aft deck.

In 2015, the Danish shipping company Rederiet Høj A/S took ownership and management of *Karin Høj* and registered the ship on the Danish International Register of Shipping. The ship's trading permit, issued by the Danish Maritime Authority (DMA), limited the barge's trading area to the North Sea and Baltic Sea and a maximum distance of 25nm from the coast. The vessel was not required to comply with the ISM Code as its size was below 500 gross tonnage (gt).

1.8.2 Manning

Karin Høj's minimum safe manning document required two navigation officers holding STCW[14] II/3 certificates and two ordinary seamen (OS). An exemption from this requirement was permitted for seagoing voyages of less than 14 hours in that OS were not required if the navigation officers could perform their duties in compliance with DMA hours of rest regulations. For voyages exceeding 14 hours, only one OS was required if the crew could perform their duties in compliance with rest hour requirements.

The Danish master and mate were appropriately qualified and experienced for their roles. The watch schedule for the voyage could not be determined as all records were lost or destroyed following *Karin Høj*'s capsize and salvage.

A 2019 DMAIB investigation had documented a planned seagoing voyage watchkeeping schedule that followed a 6-hour watch rotation, with the mate taking the 12 to 6 watch and the master taking the 6 to 12 watch. An OS was to keep bridge lookout duties between 1800 and 0600 **(Figure 21)**. Previous crew reported that similar 6 hours on/6 hours off watches had been maintained on board during *Karin Høj*'s seagoing voyages.

1.8.3 The voyage

Since August 2021, *Karin Høj* had been engaged in a long-term dredging project on Lake Mälaren, Sweden. With the onset of winter and the lake starting to freeze, the project was halted and *Karin Høj* left the area to avoid becoming trapped in the ice.

Karin Høj was scheduled to head for Nykøbing Falster, Denmark, to support one of the company's dredgers with an ongoing project. The master and mate had joined the barge on 1 December 2021 and, before their departure from the port of Köping, an OS had also signed on to assist them on the voyage. In preparation for departure the cargo hold had been loaded with 60m^3 of silt and water ballast, which increased the draught aft to protect the propellers from potential ice damage during the vessel's passage.

---

[13] A dredging vessel that uses hydraulic rams to split its hull longitudinally to discharge cargo.

[14] International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended (STCW Convention).

Image courtesy of DMAIB

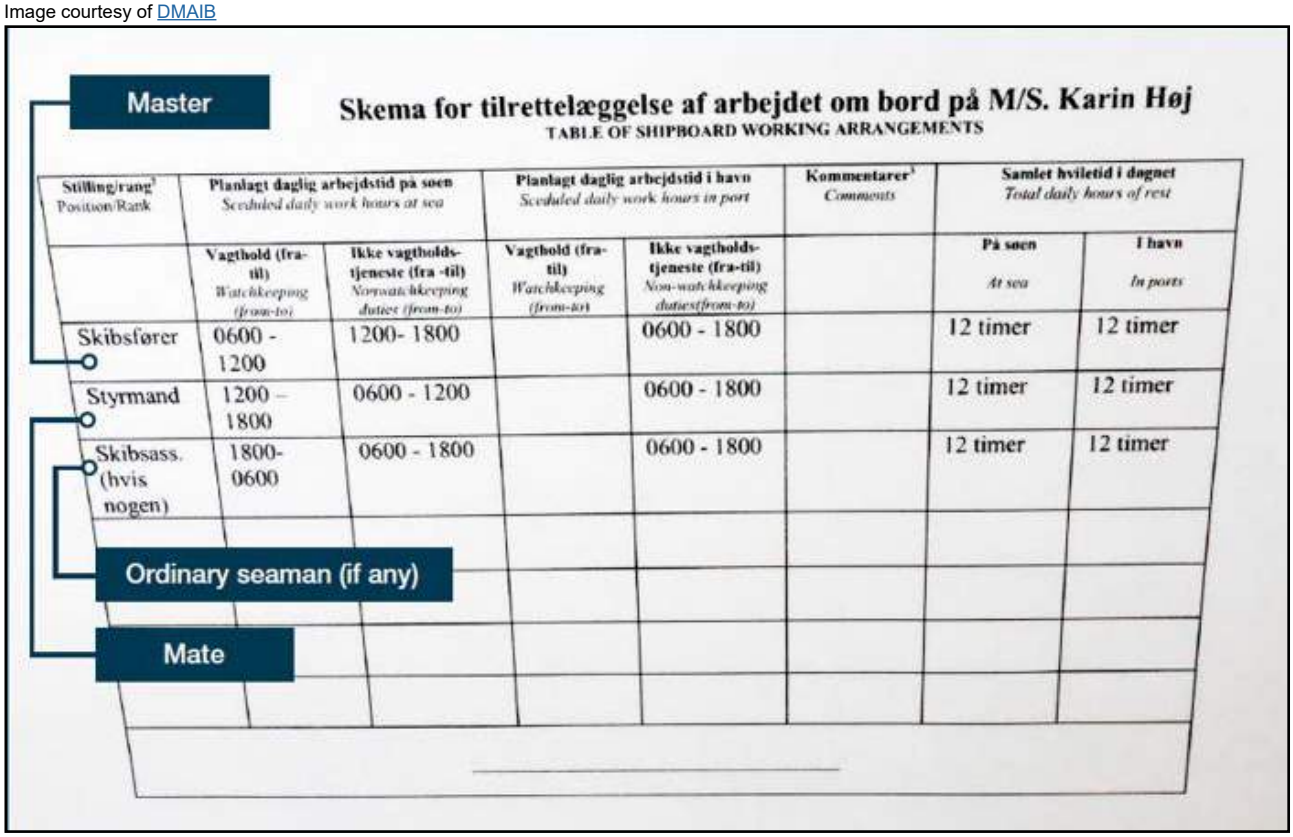

Figure 21: *Karin Høj*'s watchkeeping schedule (2019)

Karin Høj's planned route to Nykøbing Falster through the Bornholmsgat TSS could not be determined due to the destruction of both the bridge and its equipment.

1.8.4 Bridge

Karin Høj's bridge was accessed from the main deck by an external staircase to doors on the port and starboard side **(Figure 22)**. It was not possible to enter the bridge directly from the accommodation. The bridge was fitted with windows on all sides.

A single fully rotating helm chair was mounted to the deck at the centre of the bridge. Monitors for electronic navigational equipment were mounted on the forward windowsill and suspended from the deckhead **(Figure 23)**. The chart table was aft of the helm chair and a small adjustable lamp was fitted above it.

Previous crew reported that tinted solar film had been fixed to the bridge's aft windows to reduce reflection of sunlight on the monitors. The tinted solar film had been purchased at a car equipment wholesaler and fitted by the crew.

1.8.5 Navigational equipment

The approved method of navigation for *Karin Høj* was paper charts. The barge was also equipped with an electronic chart system (ECS), which was used for the day-to-day navigation.

An AIS unit was fixed to the deckhead at the front of the bridge and was viewable from the helm chair. It displayed the bearing, range, TCPA and ship's name, usually in range order unless configured otherwise. It was integrated with the ECS and radar to display AIS targets on each monitor.

Image courtesy of DMAIB

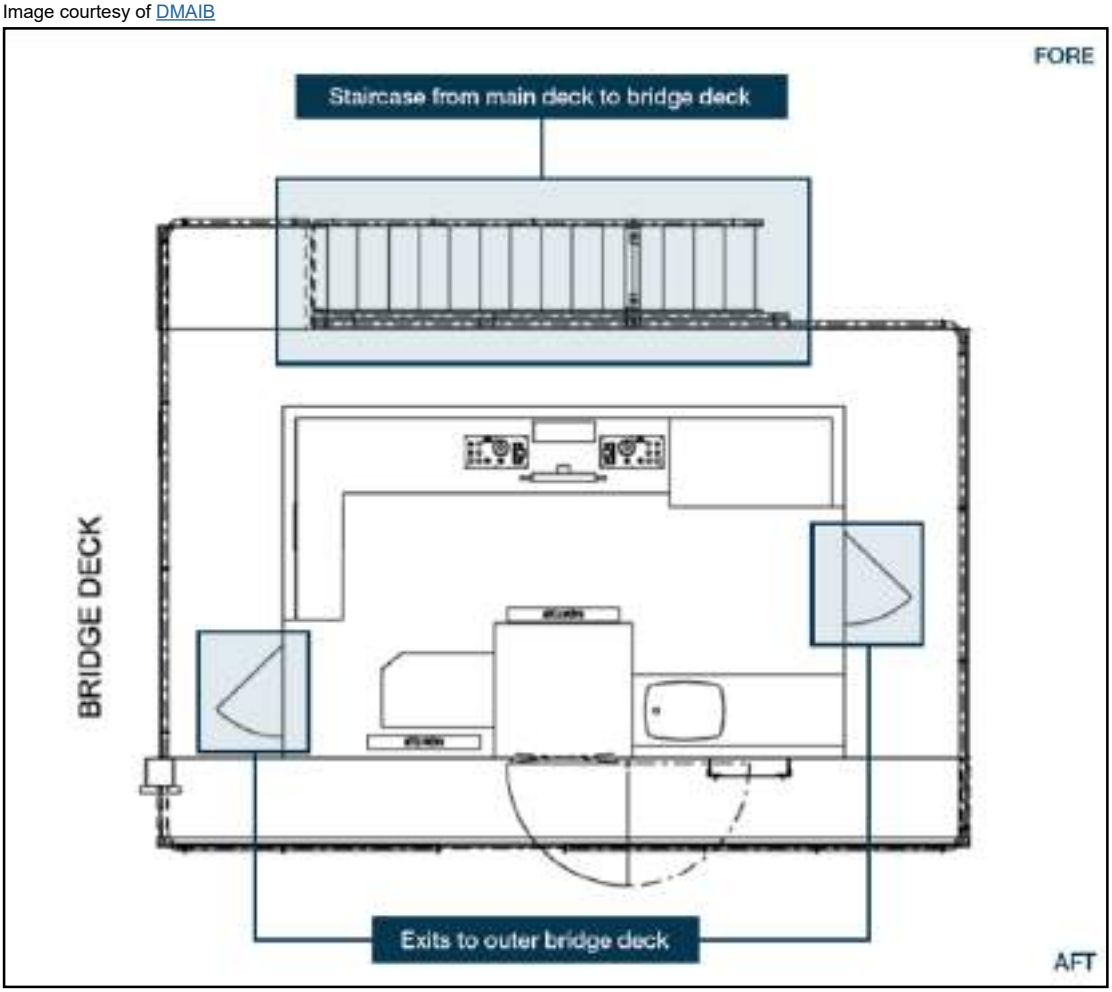

Figure 22: *Karin Høj*'s bridge arrangement, modified from the fire plan

Image courtesy of DMAIB

Figure 23: *Karin Høj*'s bridge (2019)

A 10.4-inch X-band radar monitor with colour display that could store up to 50 AIS targets was mounted in the deckhead to starboard of the helm chair. The radar had no automatic target acquisition facility. Maintenance software records[15] showed that the last test of radar functionality had been carried out by the master on 4 December 2021, with a remark that the radar was in working order.

A BNWAS was installed to starboard of the conning station and activated by using a key in the panel. The alarm system timer could be set to intervals of between 3 and 12 minutes. The unit was reset by pressing a button on the panel within the selected interval period. A 15-second visual warning was displayed if the unit was not reset, followed by an audible alarm that sounded for an additional 15 seconds. A further failure to reset would activate an audible alarm in the master's cabin that sounded for between 60 and 180 seconds, depending on the setting; the general alarm would then activate if the alarm was still not reset.

The BNWAS was tested every two weeks. Maintenance software showed that the master carried out the last test on 4 December 2021, with a remark that the BNWAS was in working order.

1.8.6 Propulsion and steering

Karin Høj was propelled and powered by two azimuth drives, which provided a maximum power of 590 kilowatts. The direction of the vessel was changed at full speed by using the starboard drive to alter the heading, with the port drive providing full forward thrust. Previous crew of *Karin Høj* advised that the most effective turning moment at full speed was obtained when the azimuth drives were at 15° and that the drives lost efficiency beyond this angle.

Autopilot control was connected to the starboard azimuth drive only, and the course was controlled by altering the heading selector on the autopilot unit. Switching from autopilot to manual control required pressing a button on the autopilot unit. Alternatively, the autopilot could be disengaged by pressing and holding the *off* button for 2 seconds. The operation of the azimuth drive port and starboard helm controls **(Figure 23)** did not override the autopilot.

1.8.7 Emergency equipment

EPIRB

Karin Høj was equipped with a float-free automatic activation EPIRB fitted on the railing on the outer bridge deck. A portable manually activated EPIRB and an AIS search and rescue transponder (SART) were mounted to the bridge deckhead. The float-free EPIRB was released from its mounting after the ship capsized. The portable EPIRB was missing after the vessel was salvaged but the SART was still on board.

Liferafts

Two 6-person liferafts were fitted in cradles, one on either side of the outer bridge deck. Both were fitted with a hydrostatic release unit, which would activate and free a liferaft from its cradle if submerged to a depth of between 1.5m and 4m.

[15] Maintenance records were transmitted ashore to the company office when the vessel was within mobile phone range.

The liferafts were attached to the ship with 50m painters; if the ship sank deeper than 50m, a weak link would free the liferafts from the ship. The liferafts had been serviced on 30 October 2019.

The liferafts, uninflated and still in their storage canisters, surfaced when *Karin Høj* was righted during the salvage operation. The hydrostatic release units had activated and released the liferafts from their cradles, but the storage canisters were still attached to the painter lines. The manufacturer, Viking A/A, carried out a performance test on the liferafts; the results showed the liferafts to be in working order and each of them inflated when the painter line was manually pulled.

Lifejackets

Karin Høj was equipped with three personal flotation devices (PFDs) and six foam-filled lifejackets. The PFDs were provided for the crew to wear when working on deck. The PFDs were found on board after the vessel was salvaged and it is unknown where they were stowed at the time of the accident. The foam-filled lifejackets were stowed in a locker at the aft of the bridge deck and were solely for use in the event of an abandon ship emergency. Following the salvage, the door to the locker room was found open with the foam-filled lifejackets spread out on the deck.

Immersion suits

Four immersion suits were stowed in a locker room aft of the bridge. The immersion suits provided cold water protection to people abandoning the ship to the water and were to be used with a lifejacket for flotation.

1.8.8 Ship management

Rederiet Høj A/S specialised in marine construction and dredging projects. *Karin Høj* was primarily used for assisting the company's dredgers with transporting excavated material between dredging sites.

The company's safety management procedures stated it was the master's responsibility to ensure that the vessel was crewed and operated in accordance with the minimum Safe Manning Document. The on board crew planned their watch schedule without company supervision. The SMS did not contain a watchkeeping schedule for seagoing operations exceeding 14 hours.

1.9 DMAIB POST-SALVAGE INSPECTION OF *KARIN HØJ*

1.9.1 Bridge

Karin Høj's bridge had sustained extensive damage while the vessel was being towed while inverted and later grounded. All of the window panes were missing and the helm chair and navigational equipment had been torn from their mountings **(Figure 24)**. Paper objects such as charts and logbooks were lost. No data was recoverable from the electronic navigation systems.

The switches to the masthead lights, port and starboard sidelights and stern light were in the *on* position **(Figure 25)**. The key in the BNWAS control panel was in the *on* position **(Figure 26)**. It was not possible to determine the BNWAS alarm interval setting selected.

Image courtesy of DMAIB

Figure 24: *Karin Høj*'s bridge, post-salvage

Image courtesy of DMAIB

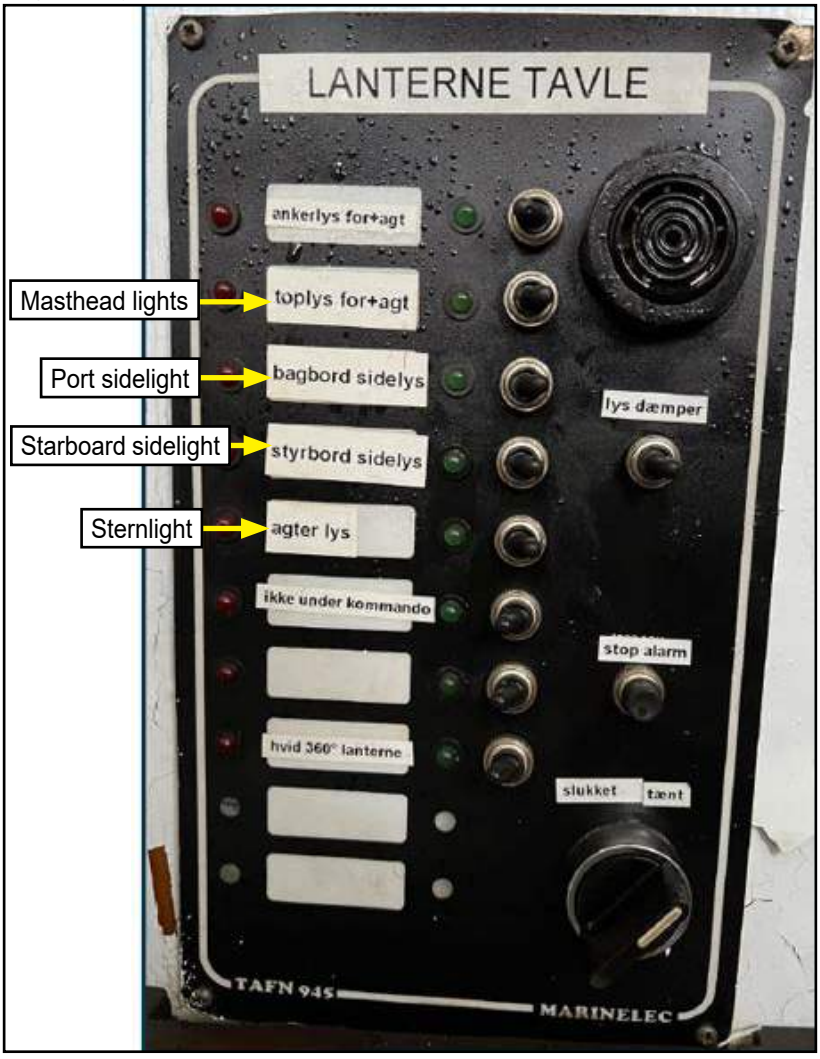

Figure 25: *Karin Høj*'s control panel for navigation lights

Image courtesy of DMAIB

Figure 26: *Karin Høj*'s BNWAS control panel

1.9.2 Azimuth drives

Both bridge azimuth drive angle control wheels were positioned at 30° thrust to port with the speed control lever at full ahead **(Figure 27)**. The controls were easily turned, and their position as well as the position of the azimuth drive units might have changed during the salvage operation.

Image courtesy of DMAIB

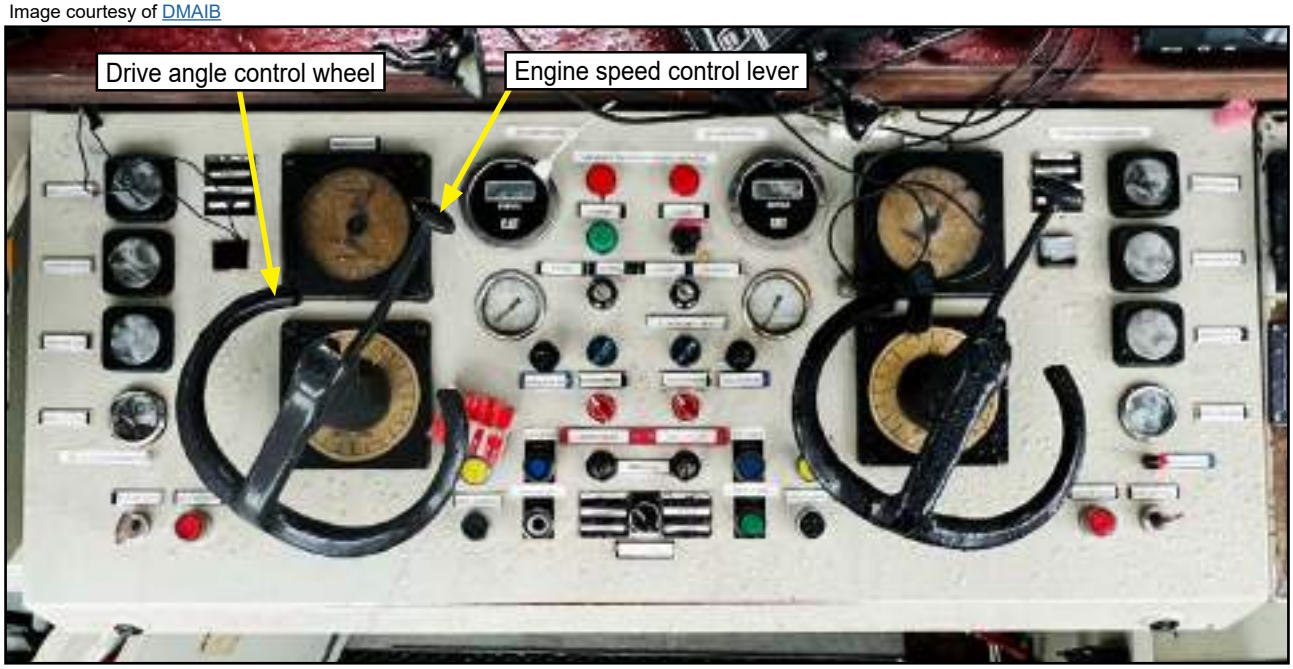

Figure 27: *Karin Høj*'s azimuth drive controllers

1.9.3 Hull damage

Karin Høj's hull had sustained severe damage forward of the accommodation, between frames 28 and 34 **(Figure 28)**, including:

a) indentation in the side plating at the gunwale and a crushed upper fender;
b) large indentation in the upper part of the bilge plating;
c) indentation on the lower part of the bilge plating;
d) penetration of the hull plating on the port side of the keel;
e) indentation in the bilge plating; and
f) a crushed fender.

Image courtesy of DMAIB

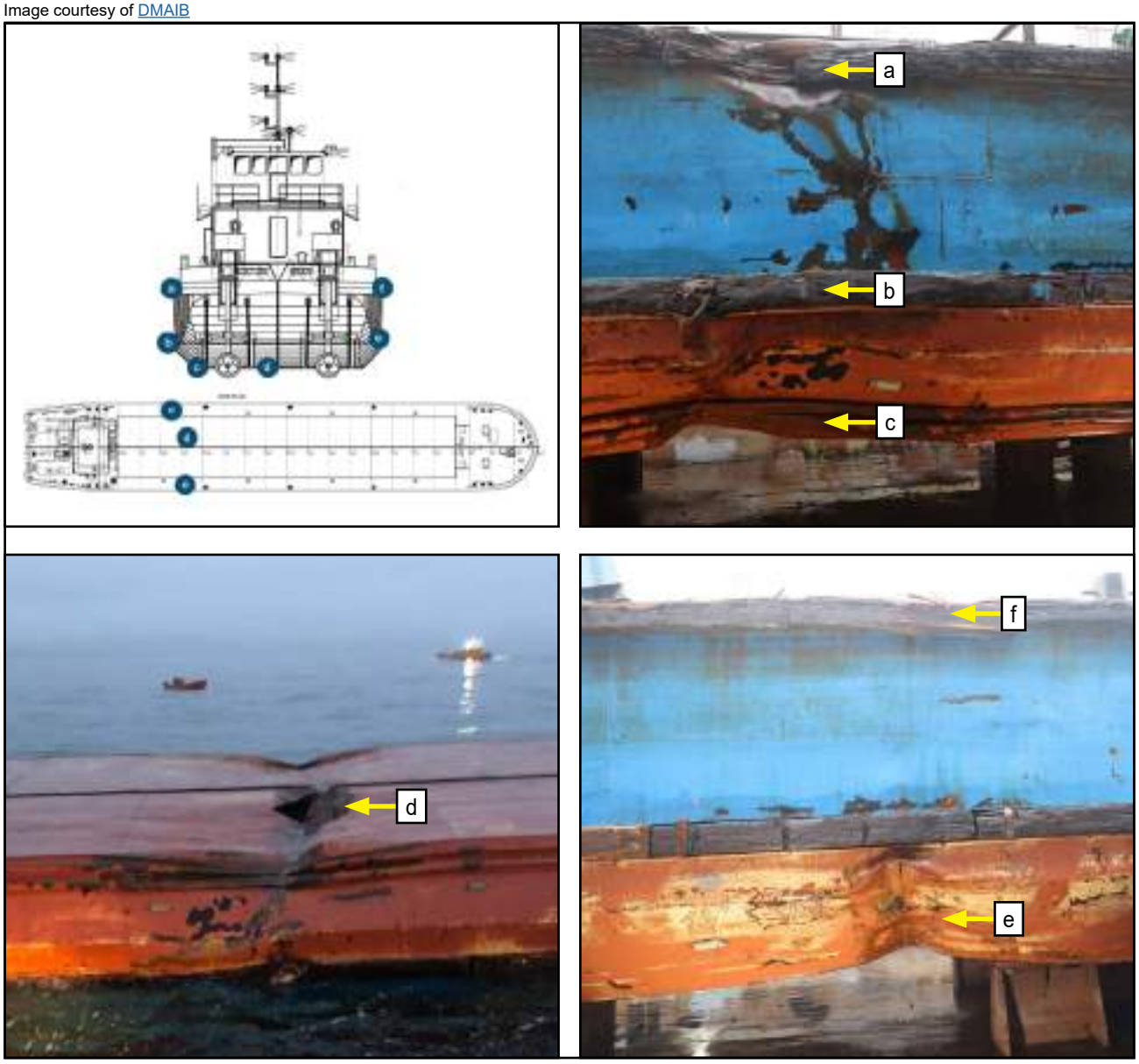

Figure 28: *Karin Høj*'s hull damage

1.9.4 Post-accident stability assessment

DMAIB reconstructed the loading condition using the barge's estimated draught and stability booklet. It was calculated that *Karin Høj*'s intact stability fulfilled the criteria set by the International Maritime Organization (IMO) in its adoption of the International Code on Intact Stability, 2008[16]. The vessel's damage stability was calculated in line with the accident condition and showed that the breached hull integrity at frame 33 to 34 allowed water ingress into the void spaces between frames 20 and 52 **(Figure 29)**.

Image courtesy of DMAIB

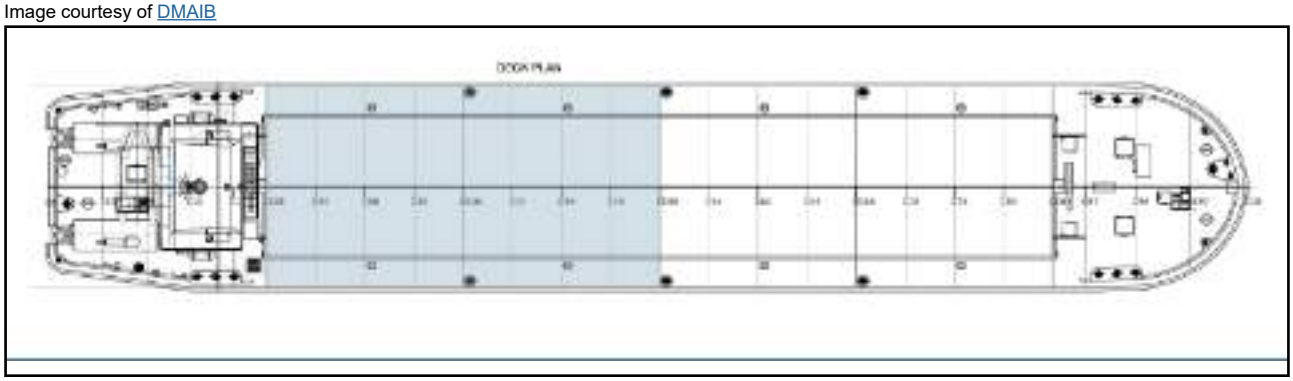

Figure 29: *Karin Høj*'s void spaces in area of frames 20 to 52

Two scenarios were considered:

1. Damage to aft port void space and filled to the immersion line.

2. Damage to both port and starboard void spaces and filled to the immersion line.

For both scenarios, the damage stability was calculated in line with the ship being in an upright position. The results of both scenarios showed that filling the void spaces near the hull breach would not have influenced the vessel's stability sufficiently enough to cause it to capsize.

1.10 ALCOHOL

1.10.1 Post-accident alcohol tests

At 0905 on the morning of the collision, the blood alcohol content (BAC) test of *Scot Carrier*'s C/O and 2/O was conducted by the Swedish coastguard. The test results showed a BAC of 0.018% for the C/O and a BAC of 0.042% for the 2/O.

1.10.2 Regulatory limits

The International Labour Organization's Maritime Labour Convention required member states to introduce national legislation limiting the BAC of seafarers to a maximum of 0.05%.

[16] https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MSCResolutions/MSC.267(85).pdf

The UK Railways and Transport Safety Act 2003, as amended, applied to UK registered ships and prescribed a BAC limit of 0.05%.

The Swedish Maritime Code (1994:1009) applied to all vessels navigating in Swedish waters and prescribed a national legal limit of 0.02% BAC.

1.10.3 Effects of alcohol

The effects of alcohol vary between individuals and depend on a range of factors, including weight, gender, age, metabolism, stress levels and the amount of alcohol consumed. Alcohol can impair motor coordination skills and judgment, affect cognitive ability, prolong reaction times and reduce peripheral and night vision. It can also affect a person's mood by reducing levels of anxiety, relaxing inhibitions and increasing their confidence.

Alcohol is removed from the body at the rate of about one unit an hour[17]; however, this will vary from person to person dependent on body size, gender, how much food has been consumed, liver functionality and metabolism.

1.11 COLLISION REGULATIONS

Both vessels were required to be navigated in accordance with the Convention on the International Regulations for Preventing Collisions at Sea 1972, as amended (COLREGs). Rule 5 of the COLREGs required every vessel, at all times and by all means available, to keep a proper and effective lookout in order to *make a full appraisal of the situation and of the risk of collision*. Other COLREGs relevant to this accident are at **Annex A**.

1.12 STCW CONVENTION AND CODE

The STCW Convention is a set of international regulations adopted by the IMO in 1978. It sets minimum training, certification, and watchkeeping standards for seafarers on ships engaged in international voyages.

The STCW Convention covers a wide range of topics, including basic safety training, advanced firefighting, medical care, ship handling, and navigation. It also covers issues related to shipboard working conditions, such as rest periods, hours of work, and the prevention of fatigue. It is regularly updated to reflect changes in technology and the needs of the maritime industry.

The regulations contained in the Convention are supported by sections in the STCW Code. Part A of the Code is mandatory. The minimum standards of competence required for seagoing personnel are given in detail in a series of tables. Part B of the Code contains recommended guidance intended to help parties implement the Convention. All seafarers working on ships covered by the Convention are required to meet the minimum training and certification requirements set out in the Code.

[17] One unit equals 10ml or 8g of pure alcohol and will increase BAC by approximately 0.01% to 0.03% within an hour. https://www.nhs.uk/live-well/alcohol-advice/calculating-alcohol-units/

1.13 BRIDGE WATCHKEEPING REGULATIONS AND GUIDANCE

1.13.1 STCW Code

The STCW Code Section A-VIII / Part 4 mandated that:

> The master of every ship is bound to ensure that watchkeeping arrangements are *adequate for maintaining* a safe navigational or cargo watch. Under the master's general direction, the officers of the navigational watch are responsible for navigating the ship safely during their periods of duty, when they will be particularly concerned with avoiding collision and stranding.
>
> In determining that the composition of the navigational watch is adequate to ensure that a proper look-out can continuously be maintained, the master shall take into account all relevant factors… [sic]

The STCW Code listed 13 points to be considered, including:

- *visibility, state of weather and sea*
- *traffic density, and other activities occurring in the area in which the vessel is navigating*
- *the attention necessary when navigating in or near traffic separation schemes or other routeing measures*
- *the additional workload caused by the nature of the ship's functions, immediate operating requirements and anticipated manoeuvres*
- *the fitness for duty of any crew members on call who are assigned as members of the watch*
- *any other relevant standard, procedure or guidance relating to watchkeeping arrangements and fitness for duty which has been adopted by the Organization.*

The STCW Code expanded further, stating that *A proper look-out shall be maintained at all times in compliance with Rule 5 of the International Regulations for Preventing Collisions at Sea, 1972 and shall serve the purpose of:*

> *.1 maintaining a continuous state of vigilance by sight and hearing as well as by all other available means, with regard to any significant change in the operating environment.* [sic]

And that:

> *The lookout must be able to give full attention to the keeping of a proper look out and no other duties shall be undertaken or assigned which could interfere with that task.*

The STCW Code further described that the OOW may be the sole lookout in daylight with specific criteria to consider regarding safety, weather and visibility, and navigational challenges such as high density of traffic.

1.13.2 Maritime and Coastguard Agency

The MCA drew attention to the requirements of the STCW Code in two Marine Guidance Notes (MGN) and a Merchant Shipping Notice (MSN):

- MGN 137 (M+F) Look-out During Periods of Darkness and Restricted Visibility described the dangers of an ineffective lookout and advised that, *Having regard to STCW 95, masters ought not to operate with the officer of the navigational watch acting as sole look-out during periods of darkness and restricted visibility* [sic]

- MGN 315 (M) Keeping a Safe Navigational Watch on Merchant Vessels provided guidance to masters and ship operators on the principles of the STCW Code and further affirmed that, *Masters, owners and operators are reminded that the MCA considers it dangerous and irresponsible for the OOW to act as sole lookout during periods of darkness or restricted visibility and that, It is implicit in STCW 95 that at all times when a ship is underway a separate dedicated look-out must be kept in addition to the OOW*. The MGN reinforced that the OOW may be the sole lookout in clear daylight conditions only.

- MSN 1868 (M) Standards of Training, Certification and Watchkeeping Convention: UK Requirements for Safe Manning and Watchkeeping addressed, in section 12, the principles of keeping of a safe watch, stating that:

  The Regulations require the Master of any ship to be responsible for the overall safety of the ship. He must also ensure that the watchkeeping arrangements are adequate for maintaining safe navigational watches at all times, including the provision of a lookout as required under the International Regulations for the Prevention of Collisions at Sea 1972, as amended. Masters, owners and operators are reminded that the UK does not consider it safe for the officer of the navigational watch to act as sole look-out during periods of darkness or restricted visibility. [sic]

1.13.3 Danish Maritime Authority

The statutory requirements for watchkeeping on board all Danish ships were set out in the DMA's *Executive Order on Watchkeeping on Ships*, which adopted the provisions in the STCW Code. It stated that:

The officer on navigational watch may be the sole lookout in daylight provided that on each such occasion:

.1 the situation has been carefully assessed and it has been established without doubt that it is safe to do so,

.2 full account has been taken of all relevant factors including, but not limited to:

- state of weather

- visibility

- traffic density

- proximity of dangers to navigation and

- the attention necessary when navigating in or near traffic separation schemes, and

.3 assistance is immediately available to be summoned to the bridge when any change in the situation so requires. [sic]

1.13.4 International Chamber of Shipping Bridge Procedures Guide

The International Chamber of Shipping (ICS) Bridge Procedures Guide (the guide) promoted best practices in the shipping industry and was used as a source of reference within Intrada's SMS.

The fifth edition of the guide (2016) referred to the effects of distraction from the use of ships' internet and email and personal electronic devices while on the bridge. It recommended that company policies should limit access to only that necessary for safe navigation purposes.

Section 2.2 of the guide clarified that the OOW could be the sole lookout in certain circumstances in daylight conditions and that clear guidance should be included in the SMS. Section 4.4 of the guide, *Maintaining a Proper Lookout*, stated that:

The OOW should ensure that a proper look-out by sight and hearing, as well as by all other available means, is maintained at all times. No other activity or duties carried out should be allowed to interfere with keeping a proper look-out. [sic]

1.14 DISTRACTION CAUSED BY THE USE OF ELECTRONIC DEVICES

In 2020, the MCA published MGN 638[18], which addressed distraction and the dangers of using mobile phones and other devices when working. The MGN was published because of repeated evidence showing that distraction was a cause of, or a significant contributory factor to, accidents and near misses. The MGN drew attention to distraction, situational awareness and human ability, stating in sections 2.2 to 2.4 that:

Inappropriate use of mobile phones and other personal devices is a major cause of distraction and loss of awareness. In a safety critical environment this has led to death, injury and serious damage. While this notice deals with the risks from mobile devices, the points made in this section apply equally to other sources of distraction such as preoccupation with ECDIS and alarm systems onboard.

Humans have a finite ability to pay attention to their surroundings and activities. Operating ships and ships' equipment demands a great deal of this attentional ability. Similarly, holding a conversation by mobile phone or operating a personal electronic device for entertainment also demand a considerable amount of human attentional ability. Using such devices while operating vessels places increased demands on the human brain which can lead to cognitive overload and impairment leading to reduced performance, for instance;

- *Reduced situational awareness;*
- *Failure to recognise vessels or navigational hazards;*

[18] MGN 638 (M+F) Human Element Guidance Part 3. Distraction – the fatal dangers of mobile phones and other personal devices when working.

- *Slower reaction times;*
- *Impaired risk assessment;*
- *Taking more risks;*
- *Loss of concentration, concentrating on the conversation rather than the job;*
- *Greater stress and fatigue; and*
- *Inattentional blindness.*

There are various psychological theories that explain how and why individuals may become distracted. One such theory and a key concern of using mobile devices is the impact on "inattentional blindness" (explained further in the MCA publication "Being Human in safety critical organisations"). Inattentional blindness occurs when someone is paying attention to something that is important or interesting– a phone call or streaming videos – but misses huge amounts of information that may be critical. [sic]

1.15 HOURS OF WORK AND REST REGULATIONS

The International Labour Organization's Convention 180 (ILO 180) deals with seafarers' hours of work and manning of ships. The convention stated:

> *Within the limits set out in Article 5, there shall be fixed either a maximum number of hours of work which shall not be exceeded in a given period of time, or a minimum number of hours of rest which shall be provided in a given period of time.*

Maritime administrations have the choice to regulate either seafarers' hours of work or their hours of rest, providing those hours are within the following limits prescribed in ILO 180:

> *Maximum hours of work shall not exceed:*
>
> *(i) 14 hours in any 24-hour period; and*
> *(ii) 72 hours in any seven-day period.*
>
> *Minimum hours of rest shall not be less than:*
>
> *(i) ten hours in any 24-hour period; and*
> *(ii) 77 hours in any seven-day period.* [sic]

Hours of rest may be divided into no more than two periods, one of which shall be at least 6 hours in length, and the interval between consecutive periods of rest shall not exceed 14 hours. The Danish and UK maritime administrations had both ratified ILO 180.

1.16 UNITED NATIONS CONVENTION ON THE LAW OF THE SEA

The duty to render assistance at sea is a rule of international law regulated generally in Article 98 of the United Nations Convention on the Law of the Sea (UNCLOS). It applies to all vessels and all areas of the sea, including territorial waters.

UNCLOS Article 98(1) places a duty upon the masters of flag state ships to render assistance to persons in distress and, after a collision to *render assistance to the other ship, its crew and its passengers and, where possible, to inform the other ship of the name of his own ship, its port of registry and the nearest port at which it will call.*

1.17 MAIB BRIDGE WATCHKEEPING STUDY

The MAIB published its Bridge Watchkeeping Study in 2004 after a series of groundings, collisions and contacts revealed common contributory factors. The study analysed accidents involving merchant vessels greater than 500gt, underway and without a pilot, that had been the subject of either a full investigation or a preliminary examination between 1994 and 2003.

Within the study, a review of the data identified three principal areas of concern:

1. a third of all groundings involved a fatigued officer alone on the bridge at night;

2. two-thirds of vessels involved in collisions were not keeping a proper lookout; and

3. a third of all accidents that occurred at night involved a lone watchkeeper.

1.18 MAIB AND DMAIB STUDY ON THE USE OF ECDIS

In 2018, a collaborative safety study written and produced by the MAIB and DMAIB reported on the application and usability of ECDIS. A joint statement issued by the branches' chief inspectors at the time of the study's publication highlighted several challenges with the system:

> *…the study found a wide spectrum of ECDIS integration and usage, and users were unanimous that the real-time positioning provided by ECDIS was a major contributor to safe navigation. However, thereafter the picture was bleak. Despite being in service for nearly two decades ECDIS could, at best, be described as being in its implementation phase. Specifically, most of the automated functions designed to alert the watchkeeper to impending dangers were not easy to use and lacked the granularity for navigation in pilotage waters. The consequent high false alarm rate eroded confidence in the automated warning, and most operators disabled the alarms or ignored alerts. To be an effective tool for safe navigation, ECDIS needs a high degree of operator input but many watchkeepers appeared to have limited understanding of the systems they were using, and in the main only used them to the extent they felt necessary.*

1.19 PREVIOUS ACCIDENTS

1.19.1 Overview

MAIB holds records of 63 incidents of groundings, collisions and contacts involving merchant vessels over 100gt that have occurred since 2011. Common safety issues identified in the cases included a lone bridge watchkeeper, system alarms that were either disabled or not set effectively, alcohol consumption and falsification of hours of work and rest records. Reports were published for 37 of these cases.

1.19.2 Scotline vessels

MAIB has previously published three reports involving Scotline vessels.

Scot Isles – collision

On 29 October 2008, the general cargo vessel *Scot Isles* collided with the bulk carrier *Wadi Halfa* in the Dover Strait during hours of darkness (MAIB report 10/2009[19]). The OOW was alone on the bridge and did not effectively use the bridge equipment to determine the risk of collision.

Scot Explorer – collision

On 2 November 2004, the general cargo vessel *Scot Explorer* collided with the Danish fishing vessel *Dorthe Dalsoe* in a navigation channel in the Kattegat, Scandinavia (MAIB report 10/2005[20]). Neither vessel was keeping a proper lookout and the master on board *Scot Explorer* was alone on the bridge and distracted by other duties at the chart table. Further, bridge equipment was not effectively used to assess either the risk of collision or passing distance.

Scot Venture – contact

On 29 January 2004, the general cargo vessel *Scot Venture* made contact with a buoy in restricted visibility and during hours of darkness in the Drogden navigation channel, Denmark (MAIB report 11/2004[21]). The OOW was alone on the bridge, and lookouts were not used.

Following all these accidents Intrada took action to improve the standards of watchkeeping through revised procedures, training, and the provision of an additional bridge officer where practical.

1.19.3 *Priscilla* – grounding

On 18 July 2018, the Netherlands registered general cargo vessel *Priscilla* ran aground on Pentland Skerries, Scotland (MAIB report 12/2019[22]). For about 2 hours before the accident the OOW had been unaware that *Priscilla* was drifting away from its planned passage. When the OOW finally realised, the route chosen to regain the navigational plan resulted in the vessel heading directly into danger. The accident happened because the OOW was distracted from keeping a lookout by watching videos on a personal mobile phone. The OOW was the sole watchkeeper at night as the vessel headed towards land, and the electronic navigation system was not set up to warn of danger ahead. The OOW had responded to two radio calls from shore authorities warning of the danger ahead; however, the watchkeeper's reaction to the warnings was insufficient to avoid danger.

The owner of *Priscilla* was recommended to review and improve both the safety management system and standards of watchkeeping on board the vessel.

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[19] https://www.gov.uk/maib-reports/collision-between-general-cargo-vessel-scot-isles-and-bulk-carrier-wadi-halfa-in-the-dover-strait-off-the-south-east-coast-of-england

[20] https://www.gov.uk/maib-reports/collision-between-general-cargo-vessel-scot-explorer-and-side-trawler-dorthe-dalsoe-in-the-kattegat-scandinavia

[21] https://www.gov.uk/maib-reports/contact-by-general-cargo-vessel-scot-venture-with-buoy-in-the-drogden-channel-denmark

[22] https://www.gov.uk/maib-reports/grounding-of-general-cargo-vessel-priscilla

1.19.4 *Ruyter* – grounding

At 2311 on 10 October 2017, the Netherlands registered general cargo vessel *Ruyter* ran aground on the north shore of Rathlin Island, Northern Ireland, when the master, who was the watchkeeper, left the bridge unattended (MAIB report 11/2018[23]). The BNWAS, which could have alerted the C/O that the bridge was unmanned, had been switched off. Consequently, no action was taken to correct a deviation from the ship's planned track.

The master had been drinking alcohol before taking over the watch, which was contrary to company policy. The C/O had previously raised concerns to the master about his excessive alcohol consumption, but had been satisfied at the watch handover that he was fit for watchkeeping duties.

The investigation found that, by not posting a lookout at night and routinely leaving the BNWAS switched off, the watchkeepers on board *Ruyter* had actively disabled the crucial alarms and defences intended as barriers to help prevent an accident. Further, as there had been no negative consequence or challenges to these decisions, this had become the normal routine on board the vessel.

1.19.5 *Daroja* and *Erin Wood* – collision

On 29 August 2015, in daylight and good visibility, the cargo ship *Daroja* and the oil bunker barge *Erin Wood* collided just east of Peterhead, Scotland (MAIB report 27/2016[24]). *Erin Wood* was badly damaged, and its crew was put in danger; there was also some minor pollution from leaking fuel cargo. The accident happened because a proper lookout was not being kept on either vessel, resulting in the watchkeepers on both vessels being unaware of the risk of collision and taking no action to avoid the other ship.

The report underlined several safety lessons, including:

- *similar to previous MAIB investigations, this accident highlights the potential consequences when the risks associated with the OOW being the sole lookout are not effectively addressed*
- *a high standard of watchkeeping involves using all the information available on the bridge to build and maintain a good picture. In this case radar, visual and Automatic Identification System (AIS) information could have been utilised more effectively on both ships.*
- *Safety recommendations were made to the managers of both vessels to raise the standards of watchkeeping when at sea.*

1.19.6 *Lysblink Seaways* – grounding

On 18 February 2015, the general cargo vessel *Lysblink Seaways* ran aground at full speed, near Kilchoan, Scotland (MAIB report 25/2015[25]). The vessel remained on the rocky foreshore for almost 2 days during adverse weather, resulting in material

[23] https://www.gov.uk/maib-reports/grounding-of-general-cargo-vessel-ruyter

[24] https://www.gov.uk/maib-reports/collision-between-general-cargo-vessel-daroja-and-oil-bunker-barge-erin-wood

[25] https://www.gov.uk/maib-reports/grounding-of-general-cargo-vessel-lysblink-seaways

damage to its hull and the breach of its double bottom, including some fuel tanks, releasing 25 tonnes of marine gas oil into the water. The vessel was declared a constructive total loss and scrapped after its salvage.

The report concluded that the OOW, who was the sole watchkeeper, had become inattentive due to the effects of alcohol consumption. The BNWAS was switched off and an off-track alarm on the ECS had been silenced. Although a radar watch alarm had sounded every 6 minutes, the OOW could reset the alarm without leaving his chair.

1.19.7 *Danio* – grounding

At 0330 on 16 March 2013, the general cargo vessel *Danio* grounded in the Farne Islands nature reserve, off the east coast of England (MAIB report 8/2014[26]). The C/O was the lone watchkeeper and had fallen asleep during the first hour of the watch. Hampered by bad weather, the vessel remained aground for 12 days before it was refloated.

A prominent notice had been displayed on *Danio*'s bridge implying a lookout was being maintained during both hours of darkness and, if required, daylight hours. However, the investigation found that, in reality, no lookouts were ever maintained.

1.19.8 *Seagate* and *Timor Stream* – collision

On 10 March 2012, the bulk carrier *Seagate* and the refrigerated cargo ship *Timor Stream* collided while transiting open waters, in good visibility, 24nm north of the Dominican Republic (MAIB report 17/2013[27]). There were no injuries, but both ships were badly damaged and there was some minor pollution.

The officers in charge of the navigational watch on both vessels failed to keep a proper lookout and neither assessed the risk of collision nor took appropriate action to avoid it. The report concluded that both officers failed to comply with fundamental elements of the COLREGs and documented navigational procedures issued by their respective company managers.

[26] https://www.gov.uk/maib-reports/grounding-of-general-cargo-vessel-danio-off-longstone-farne-islands-england

[27] https://www.gov.uk/maib-reports/collision-between-bulk-carrier-seagate-and-refrigerated-cargo-vessel-timor-stream-off-the-dominican-republic

SECTION 2 - ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2.2 OVERVIEW

The alteration of *Scot Carrier*'s course at the planned waypoint placed it on a collision course with *Karin Høj*, with little more than 3 minutes for action to be taken to prevent the collision. While *Karin Høj* was the stand-on vessel, both vessels had responsibilities to keep clear of each other. Although it was known what happened on *Scot Carrier*, the activities on *Karin Høj* could not be determined.

Karin Høj's subsequent rapid capsize led to the entrapment and death of its master. The mate's fate remains unknown as his body has not been found, but he is presumed to be deceased.

The analysis will examine the circumstances leading to the collision, the capsize of *Karin Høj* and the post-accident events.

2.3 THE COLLISION

2.3.1 *Karin Høj*

When *Scot Carrier* entered the TSS at 0209, *Karin Høj* was 7.7nm ahead and, with a low speed differential between the two vessels, the close quarters situation was slow to develop.

As *Karin Høj* approached the precautionary area at the southern end of the traffic lane, the Svartgrund buoy was close on its starboard beam, with *Scot Carrier* at 0.8nm near its port beam. *Scot Carrier* was the overtaking vessel and required to keep clear in compliance with COLREGs Rule 13, Further, and in line with COLREGs Rule 10 (b) (i), it may have been reasonable for *Karin Høj*'s watchkeeper to assume that *Scot Carrier* was continuing on an appropriate course as the vessel was already in the traffic lane. There would have been no expectation that *Scot Carrier* would alter course toward *Karin Høj* at a close distance in open water. The two masthead lights and the starboard sidelight of *Scot Carrier* should have been visible from *Karin Høj*'s bridge **(Figures 30** and **31)**.

Karin Høj's navigational equipment partially obstructed the forward view from the bridge, and the aftmost starboard windows were partially obstructed by a bookcase. There was limited space to move around on the bridge, but it was possible to have an all-round view of the sea if the OOW altered their physical position out of the bridge chair. The aft windows were fitted with solar film to shade the incoming light on the bridge and it was not possible to identify the degree of the tint as the window panes were missing after the barge was salvaged. However, the solar film would have reduced the crew's visibility of navigational lights from overtaking ships during the hours of darkness and may have been a contributory factor in its collision with *Scot Carrier*.

For illustrative purposes only: not to scale

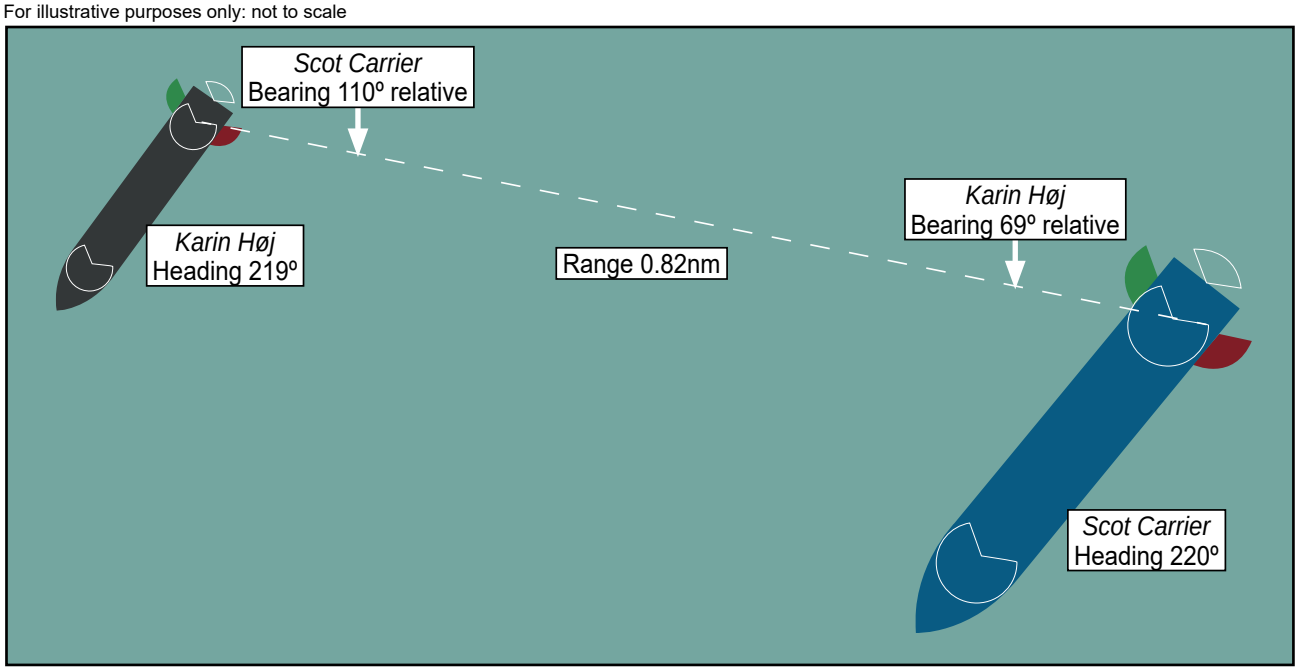

Figure 30: Relative positions of both ships at 0321, shortly before *Scot Carrier* altered course from 220º to 270º

For illustrative purposes only: not to scale

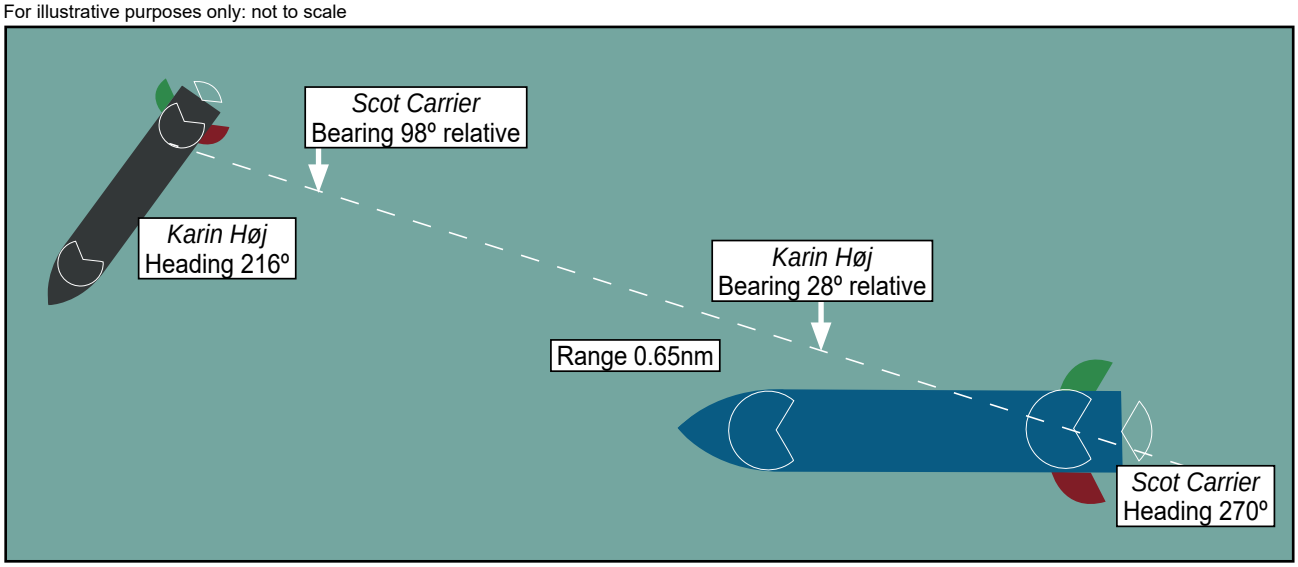

Figure 31: Relative positions of both ships at 0323:25, with *Scot Carrier* on its 270º course

Prudent seamanship required early and substantial action to be taken in order to make any intentions clear. The alteration of *Scot Carrier*'s course close to *Karin Høj* left barely 3 minutes for its watchkeeper to identify the collision risk and take action, assuming that he was actively monitoring the situation.

2.3.2 *Scot Carrier*

Scot Carrier's 2/O was distracted by a tablet computer and had not seen *Karin Høj*. The device had been almost constantly in use for over 2 hours, during which no interaction with navigational equipment such as target acquisition on the radar or target interrogation on the ECDIS was recorded on the VDR. The 2/O's use of the tablet computer limited his watch functions to altering course at planned waypoints. The bridge equipment was not set optimally, and the alarms designed to warn of dangerous situations were disabled, silenced or switched off.

The 2/O should have been able to see *Karin Høj*'s stern light until just before he altered course at 0321, when *Karin Høj* was at a 0.82nm range from *Scot Carrier*'s starboard beam. Once *Scot Carrier* was steadied on its new course the 2/O could have seen the masthead lights and port sidelight of *Karin Høj*, assuming good visibility in the 3 minutes before the collision when the vessels were on a converging course.

The 2/O did not apply the fundamental principle of good seamanship and undertake the appropriate checks when altering course.

2.4 ACTIONS TO AVOID COLLISION

2.4.1 *Karin Høj*

The underlying concept of the COLREGs is that the risk of collision can be foreseen and the vessels involved can take action to avoid it. In practice, the application of the COLREGs is dependent on the watchkeeping officer's understanding of the rules, perception of the navigational situation and time available. It is unknown how the watchkeeping officer on board *Karin Høj* applied the rules of COLREGs in the time leading up to the collision with *Scot Carrier*.

The exact position of the azimuth drives at the time of collision could not be determined from on-scene video footage and photographs. The port drive was in the fore-and-aft position, and the other drive was turned 30° to starboard, suggesting that directional control was still in autopilot mode (see 1.8.6). However, the dynamics of the capsize may have affected the azimuth drives' positions once power was lost on the vessel.

It was not possible to determine if the mate had attempted to alter course before the collision. The 'as found' positions of the bridge control wheels and levers **(Figure 27)** may have remained unchanged since the accident, which could suggest that the mate had attempted to alter course to avoid the collision. However, turning the controls would have had no effect unless he disengaged the autopilot, and it could not be determined whether he had done so.

2.4.2 *Scot Carrier*

The 0326:35 sighting of *Karin Høj* 30° off the starboard bow at a closing speed of 8.7kts left the 2/O of *Scot Carrier* little time to react and the collision occurred 50 seconds later. The sighting of a light on *Karin Høj* at close range prompted *Scot Carrier*'s 2/O to take emergency action by pulling back the telegraph lever to full astern and putting the helm in manual control. However, these actions were too late to avoid the collision given the distance between the two vessels.

Calculations based on AIS and radar data indicate that *Karin Høj* would have been about 225m away when sighted by *Scot Carrier*'s 2/O and any avoiding action taken would have been too late; the ship's manoeuvring data showed that it would take 141 seconds and a distance of 600m to crash stop. An immediate alteration of course to starboard may have resulted in a different collision dynamic and outcome, but it is likely the 2/O did not consider this because of the proximity of *Karin Høj*.

2.5 WATCHKEEPING

2.5.1 *Scot Carrier*

A lone watchkeeper navigated *Scot Carrier* during the hours of darkness, which was usual practice on the ship and in common with other vessels in the Scotline fleet. MAIB data from previous accidents suggested that vessels in the short sea trade frequently operated with only one person on the bridge during hours of darkness. Crews rationalised the practice as providing flexibility of useable hours of work, the perception being that they were *better employed* on other tasks, such as deck maintenance.

The requirement for a lookout during the hours of darkness was disregarded, contrary to international, national, and company requirements. The accident could have been avoided had the AB been assigned to lookout duties.

The bridge was fitted with modern navigational equipment and the OOW had little to do other than keep lookout and monitor the ship's progress along the planned passage programmed into the ECDIS. However, there was no effective lookout during the watch leading up to the collision as the 2/O was continuously distracted by his tablet computer and his focus on it would have used much of his cognitive function. The brightness and proximity of the device while viewing the video chat site would also have affected the 2/O's night vision. It is likely that the presence of another member of the crew on the bridge would have deterred the 2/O from breaching company policy on the use of personal electronic equipment. Further, a lookout could have warned the 2/O that he was altering *Scot Carrier*'s course towards *Karin Høj*, which may have prompted an alternative action. As discussed in section 2.10, the effects of the alcohol consumed by the 2/O before taking the watch may also have contributed to his actions.

All the alarms that could have warned the 2/O of either an imminent collision or a vessel in proximity were disabled. This practice was not unusual and, as highlighted in the MAIB/DMAIB ECDIS safety study, *most operators disabled the alarms or ignored alerts.*

2.5.2 *Karin Høj*

Two navigational officers covered OOW duty during the 2 days before the accident, each manning the bridge of *Karin Høj* for over 12 hours a day in that period. It is most likely that the two crew carried out back-to-back watches of 6 hours each, which is supported by evidence provided by previous crew of the vessel.

To meet the requirement that a lookout is posted in addition to the OOW during the hours of darkness, each crew member would have been required to work a further 8.5 hours each to cover the 17 hours of darkness.

The company's SMS did not contain a watchkeeping schedule for voyages over 14 hours in duration and so it was left to the master's discretion to organise and comply with the manning regulations. It is unknown why the master sailed without additional crew, contrary to the Danish Maritime Authority regulations.

2.5.3 Visibility

When the master of *Scot Carrier* arrived on the bridge 20 minutes after the collision he noted that patchy mist and fog had reduced the visibility. However, no preventative actions, such as sounding fog signals, calling a lookout to the bridge or interacting more positively with the radar, had been taken by the 2/O during his watch to maintain the ship's safe passage.

It is possible that restricted visibility prevailed at the time of the collision, which may have affected the early visual detection by both sets of crew of their vessels' proximity to one another.

2.6 COLLISION DYNAMICS AND THE CAPSIZE OF *KARIN HØJ*

DMAIB combined AIS data, the locations of the damage to each vessel and their relative draughts to determine a likely scenario for the capsize of *Karin Høj*.

It was estimated that the draughts of *Scot Carrier* and *Karin Høj* measured 5.10m and 1.70m, respectively **(Figure 32)**. As the ships collided at a relative speed of 8.7kts, *Scot Carrier*'s bulbous bow struck *Karin Høj*'s bilge plating broad on the port quarter; AIS data showed that the angle of impact was about 50°, which corresponded with both the angle of indent in the bilge plating on *Karin Høj* and the damage and silt residue to *Scot Carrier*'s bow.

The impact from the collision with the vessel's port quarter caused *Karin Høj* to pivot to port, increasing the angle between the two ships to about 70° and causing *Karin Høj* to be pushed transversely, meeting water resistance on the starboard side, and simultaneously lifted on its port side by *Scot Carrier*'s bulbous bow. This caused *Karin Høj* to roll over, resulting in a series of impacts with both the bow and bulbous bow of *Scot Carrier* **(Figure 33)**, and ultimately capsize. This sequence of events is supported by the damage sustained to *Karin Høj*'s port side gunwale, bilge plating and hull bottom and starboard side bilge plating and fendering. It is estimated that *Karin Høj* may have capsized in less than 20 seconds.

Fresh paint transfer found in scratches on the port side of *Scot Carrier*'s bow supported the dynamic that *Karin Høj* continued to pivot to port as it overturned, slipping down the port side of *Scot Carrier* **(Figure 34)**.

2.7 THE CREW OF *KARIN HØJ*

The master of *Karin Høj* was found outside his cabin. He was partially clothed, suggesting that he was resting before the collision and had some time to react, but little time to prepare before the vessel's accommodation was completely inverted. The accommodation would have become quickly flooded with water, resulting in his death.

The mate's body was not recovered and it is presumed that he was alone on the bridge at the time of the accident. The rapid capsize would have prevented him from donning any PPE. Had he escaped the accommodation, without thermal protection and a lifejacket his reaction to sudden immersion, and the effects of cold water shock and incapacitation, would have most likely limited his survival time to a few minutes.

Image courtesy of DMAIB

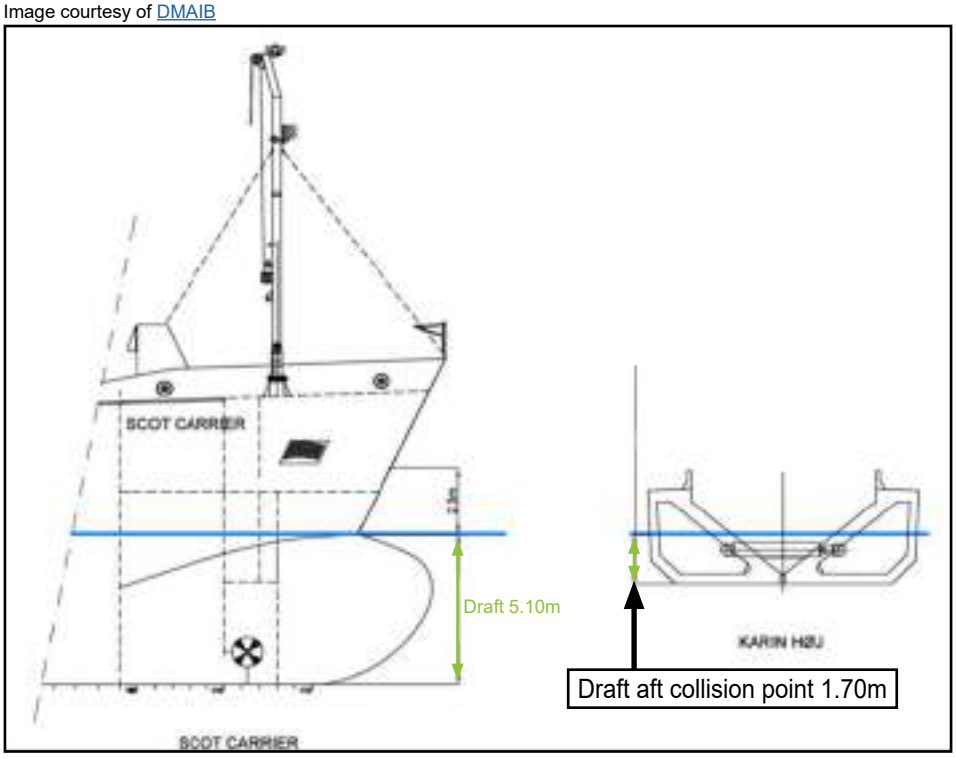

Figure 32: Relative draughts of *Scot Carrier* and *Karin Høj*

Image courtesy of DMAIB

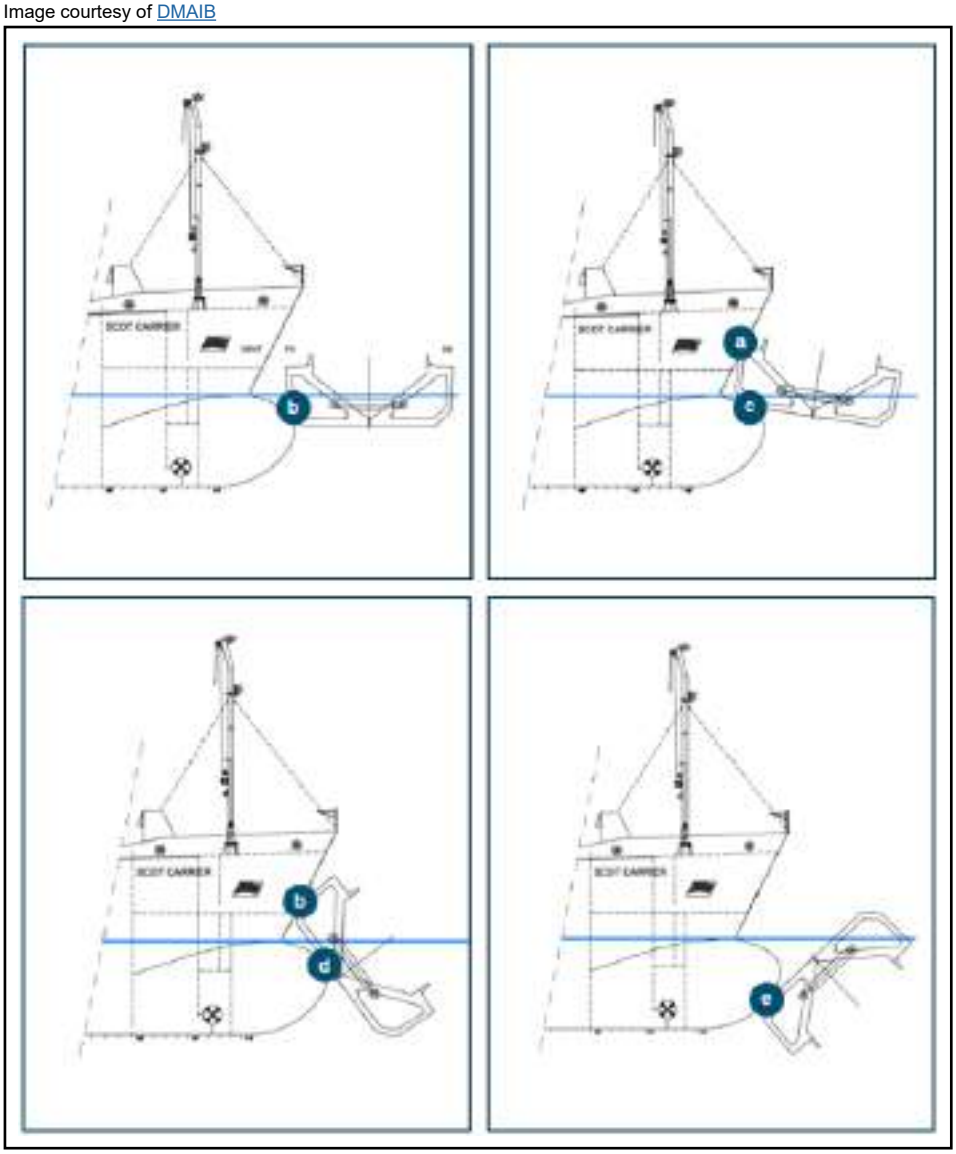

Figure 33: Likely dynamics of collision and *Karin Høj*'s capsize, showing damage points

For illustrative purposes only: not to scale

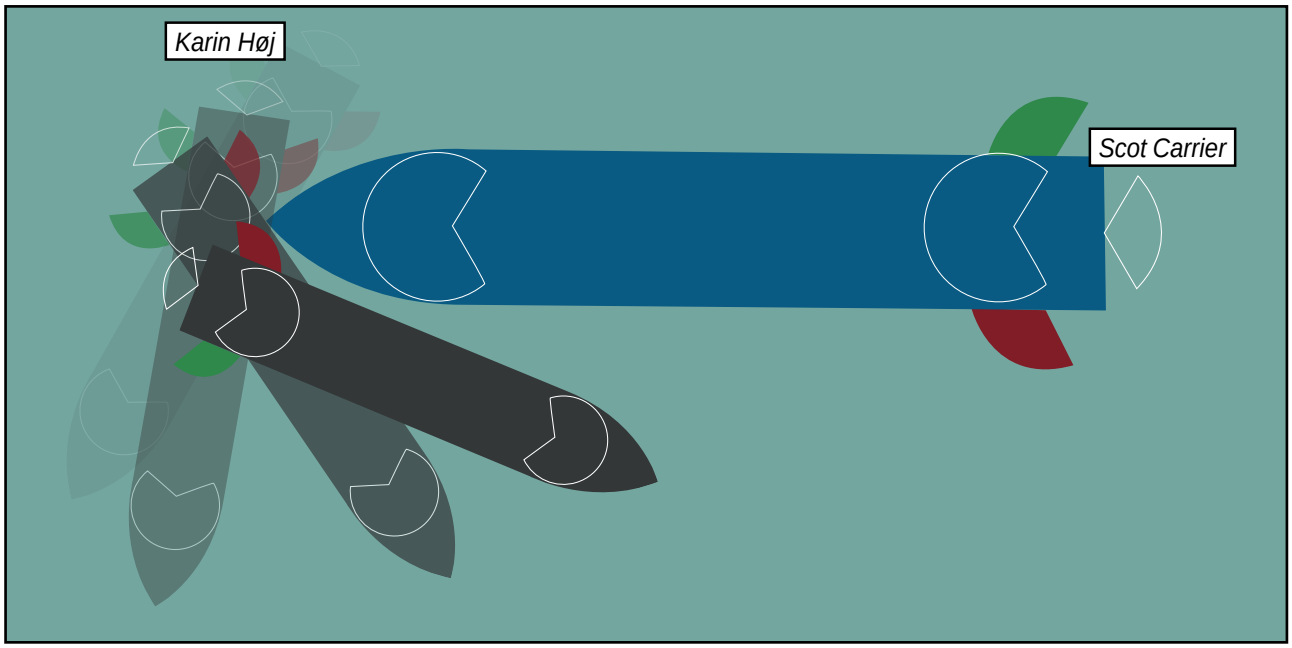

Figure 34: Likely dynamics of collision and the effect on *Karin Høj*

2.8 POST-COLLISION ACTIONS

The 2/O on board *Scot Carrier* reacted to the collision with shock and surprise as evidenced by the VDR. Despite knowing that a serious incident had occurred he decided not to inform the master, which was contrary to master's standing orders, company SMS procedures and the fundamental principles of good seamanship. The 2/O's choice to resume the ship's original speed and course to the west may have been due to shock and subsequent denial, influenced by his earlier alcohol consumption.

When *Scot Carrier*'s C/E responded to the engine alarm 8 minutes after the collision he asked the 2/O why there were two steering motors running and was told that there was no problem. There would have been no reason for the C/E to further challenge the 2/O because the sounding of an engine alarm was not unusual. The 2/O's denial that anything had happened continued until he was challenged by JRCC Sweden, at which point the truth was inescapable.

The master and ship's crew did not react to the movement of the ship as it collided and consistently described the impact as similar to a large wave hitting the bow. The dynamics of the collision, whereby *Karin Høj* pivoted around the bow of *Scot Carrier*, may explain the relatively minor movement of *Scot Carrier* at the point of collision and the lack of questions raised by the crew. The ice strengthening at the bow may also have dampened any resonance and sound.

The master and crew would have expected the sounding of an alarm in the event of an emergency situation and did not respond because no such alert was raised at the time of the accident. The master of *Scot Carrier* reacted professionally once the alarm was raised and his subsequent actions, and that of his crew, were appropriate in the circumstances.

The fundamental principle of the UNCLOS requirement for masters to assist other vessels as soon as possible is instilled as a basic officer competency within the STCW syllabus. The master could not fulfil his obligation shortly after the collision

because the 2/O did not raise the alarm until challenged by JRCC Sweden. Similarly, the SMS and master's standing orders delegated authority to the 2/O and the appropriate action would have been to call the master and coastguard as soon as practicable following the collision.

2.9 EFFECTS OF ALCOHOL

Scot Carrier's 2/O consumed beer during the time between going to his cabin, at about 1715, and going to sleep at 2000. The 2/O's BAC of 0.042% 5.5 hours after the collision indicated that he was considerably over the 0.05% limit both when taking over the watch and at the time of the collision. Despite this, the VDR audio from *Scot Carrier* did not show any noticeable effects on the 2/O's speech between his arrival on the bridge at 2214 and when the master handed the watch over at 2313. Further, the master had not detected any difference in the 2/O's behaviour during the handover. The 2/O was actively engaged in navigational duties throughout the watch; track-keeping, altering the ship's course at waypoints and adjusting the heading to increase the passing distance with another vessel.

Intrada had assessed the 2/O as a conscientious officer. He was not known to routinely drink alcohol on board and his purchasing habits were neither frequent nor gave cause for concern. The investigation found no evidence he had engaged in overly distracting activities at other times. Consequently, his decision to use his tablet computer to chat with people almost continuously while keeping a navigational watch on the bridge is likely to have been influenced by his alcohol consumption.

The C/O's consumption of alcohol on the same day as the 2/O appeared coincidental and they had not been drinking together. However, their actions confirm that some of the crew had little regard for, or misunderstood, the company's alcohol policy.

MAIB investigations have frequently found that the BNWAS was inactive in instances where the OOW fell asleep due to alcohol consumption. While the 2/O in this case remained awake and showed sufficient capability to alter course for another ship earlier in the watch and at waypoints, had he fallen asleep at any stage the BNWAS would not have alerted him or the crew because it was not switched on.

2.10 *SCOT CARRIER* MANAGEMENT OVERSIGHT

When alcohol consumption precedes an accident, other factors can assume a lesser importance as the judgement of those involved is doubted. In this case, however, the 2/O's consumption of alcohol likely resulting in his decision to use his tablet computer while watchkeeping, was just the last of many safety barriers to be routinely disabled or negated on *Scot Carrier*, none of which had been detected during audits. Specifically:

- Lookouts were not being used during the hours of darkness;
- AIS, radar and ECDIS alarms designed to warn watchkeepers of impending danger were silenced, disabled or switched off;
- Consumption of alcohol, including by two of *Scot Carrier*'s watchkeepers before taking the watch, due to its availability and ineffective application of the company's drug and alcohol policy;

- Falsification of hours of work and rest records; and

- The BNWAS was switched off while the ship was underway.

Previous accidents involving Scotline ships between 2004 and 2008 (section 1.19.2) resulted in actions designed to address crew fatigue and poor watchkeeping practices. However, the lessons from these accidents appear to have faded and in subsequent years the drift towards the disabling of safety barriers went undetected by audit.

More widely, the statistics and case histories of previous collisions and groundings listed in section 1.19, backed up by the findings of the ECDIS study, indicate that similar disabling of safety barriers has become normalised behaviour that is only discovered during post-accident investigations. If similar accidents are to be avoided in the future, management oversight of vessel operations has to become more rigorous and, specifically, targeted at ensuring onboard practices and company procedures are aligned.

2.11 MCA GUIDANCE ON LOOKOUT

The requirements within the regulations and guidance referred to in section 1.13.2 to have a dedicated lookout were open to misunderstanding or mistranslation, specifically:

- MGN 137 (M+F) – *masters ought not to operate with the officer of the navigational watch acting as sole look-out during periods of darkness and restricted visibility*;

- MGN 315 (M) –*…the MCA considers it dangerous and irresponsible for the OOW to act as sole look-out during periods of darkness and restricted visibility*; and

- MSN 1868 (M) –*…the UK does not consider it safe for the officer of the navigational watch to act as sole look-out during periods of darkness or restricted visibility.* [sic]

A more robust statement instructing that the lookout requirement is mandatory, rather than optional, for UK ships and ships in UK waters would clarify the UK's position to shipowners, managers, masters and crews.

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. The collision occurred after *Scot Carrier* changed course at a planned waypoint. Neither of the vessels' watchkeepers identified their converging courses until the collision was inevitable, and the action taken on board *Scot Carrier* was too late. It is unknown what action was taken by the crew on board *Karin Høj*. [2.3, 2.4]

2. The watchkeeper on board *Karin Høj* had little time to recognise and comprehend the action taken by *Scot Carrier*, assuming that he was actively monitoring the navigational equipment. *Scot Carrier* had been overtaking for over an hour and would have been expected to continue to keep clear. [2.3]

3. *Scot Carrier* struck the hull of *Karin Høj* at a relative speed of 8.7kts, causing it to heel to starboard. *Scot Carrier*'s bulbous bow then lifted *Karin Høj*'s hull and continued to push it bodily to starboard, reducing its stability and causing it to capsize. This resulted in the death of *Karin Høj*'s master and presumed death of the mate. [2.6, 2.7]

4. The 2/O on board *Scot Carrier* was distracted by using a personal tablet computer and had neither identified the proximity of *Karin Høj* nor the collision risk following a change of course. On board bridge equipment and watchkeeping systems designed to warn of vessels in proximity were either disabled, unused, or not configured to alert him. [2.3.2, 2.5.1]

5. Both vessels were operating with their watchkeeper as the sole lookout. The posting of an additional lookout on board *Karin Høj* was not possible as the only crew on board were the two watchkeepers. *Scot Carrier* routinely operated without a dedicated lookout, and this was normal practice on other ships in the company. [2.5]

6. Rederiet Høj allowed its masters discretion to organise manning and comply with watchkeeping regulations on board their vessels and did not have effective oversight to prevent a vessel from sailing without the statutory number of crew. [2.5.2]

7. *Scot Carrier*'s 2/O did not immediately raise the alarm following the collision, which delayed the search and rescue response. However, the speed of capsize and the environmental conditions, would have most likely reduced the survival time of *Karin Høj*'s crew to a few minutes. [2.7, 2.8]

8. Although the behaviour of *Scot Carrier*'s 2/O did not cause the master to suspect he had consumed alcohol before the watch handover, the 2/O had consumed alcohol to a level likely to have affected his judgement. [2.9]

9. Intrada had neither identified that its crews on board Scotline vessels were consistently not posting lookouts during hours of darkness nor that bridge systems were being used ineffectively. [2.10]

10. Alcohol was available on board *Scot Carrier* yet the company's policy was ineffective at controlling its consumption at sea. [2.10]

11. The language used in MCA guidance detracts from the absolute requirement for a dedicated lookout, in addition to the OOW, during the hours of darkness and in restricted visibility. [2.11]

3.2 OTHER SAFETY ISSUES NOT DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. The BNWAS on board *Scot Carrier* was switched off while a lone watchkeeper was on the bridge. [2.5.1]

SECTION 4 - ACTION TAKEN

4.1 ACTIONS TAKEN BY OTHER ORGANISATIONS

Rederiet Høj A/S has communicated to its masters that all national and international maritime rules and regulations, and the company safety management system must be followed, especially those relating to minimum safe manning.

Intrada Ships Management Ltd has:

- Issued a fleet circular to remind masters of the SMS requirements for lookouts during the hours of darkness, alcohol policy, use of personal electronic devices when on duty and the use of BNWAS. The company required that the fleet circular was to be raised at on board safety committee meetings.

- Amended its SMS to highlight the requirements for a lookout during the hours of darkness and revised its alcohol policy to require that any beer available on board must contain an alcohol by volume of less than 5%.

- Increased the frequency of random unannounced drug and alcohol screening of its ships' crews.

- Started a series of comprehensive audits by a consultant to review all aspects of navigational practices and record-keeping on its ships fitted with VDR. Prompted by the findings, it may carry out simplified audits on board its ships not equipped with VDR.

On 16 June 2022, **The Courts of Denmark** convicted *Scot Carrier*'s 2/O of manslaughter and maritime drunkenness. He was sentenced to 18 months' imprisonment.

SECTION 5 - RECOMMENDATIONS

Intrada Ships Management Ltd is recommended to:

2023/105 Review the results of its programme of navigational audits and determine what additional training and instruction is needed for its masters and crews. Any additional development needs identified from this process should be completed within 12 months.

Rederiet Høj is recommended to:

2023/106 Ensure that it actively monitors crewing levels to ensure its vessels are adequately crewed at all times.

The Maritime and Coastguard Agency is recommended to:

2023/107 Advise the shipping industry that the posting of a lookout in addition to a bridge watchkeeper during the hours of darkness and restricted visibility is an absolute requirement in UK waters and on UK ships, and to clarify this in its publications.

Safety recommendations shall in no case create a presumption of blame or liability

Annex A

Extract of relevant rules from the Convention on the International Regulations for Preventing Collisions at Sea 1972, as amended

Rule 2

Responsibility

(a). Nothing in these Rules shall exonerate any vessel, or the owner, master or crew thereof, from the consequences of any neglect to comply with these Rules or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

(b). In construing and complying with these Rules due regard shall be had to all dangers of navigation and collision and to any special circumstances, including the limitations of the vessels involved, which may make a departure from these Rules necessary to avoid immediate danger.

Rule 5

Look-out

. Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.

Rule 7

Risk of collision

(a). Every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists. If there is any doubt such risk shall be deemed to exist.

(b). Proper use shall be made of radar equipment if fitted and operational, including long-range scanning to obtain early warning of risk of collision and radar plotting or equivalent systematic observation of detected objects.

(c). Assumptions shall not be made on the basis of scanty information, especially scanty radar information.

(d). In determining if risk of collision exists the following considerations shall be among those taken into account:

(i). such risk shall be deemed to exist if the compass bearing of an approaching vessel does not appreciably change;

(ii). such risk may sometimes exist even when an appreciable bearing change is evident, particularly when approaching a very large vessel or a tow or when approaching a vessel at close range.

Rule 8

Action to avoid collision

(a). Any action to avoid collision shall be taken in accordance with the Rules of this Part and shall, if the circumstances of the case admit, be positive, made in ample time and with due regard to the observance of good seamanship.

(b). Any alteration of course and/or speed to avoid collision shall, if the circumstances of the case admit, be large enough to be readily apparent to another vessel observing visually or by radar; a succession of small alterations of course and/or speed should be avoided.

(c). If there is sufficient sea-room, alteration of course alone may be the most effective action to avoid a close-quarters situation provided that it is made in good time, is substantial and does not result in another close-quarters situation.
(d). Action taken to avoid collision with another vessel shall be such as to result in passing at a safe distance. The effectiveness of the action shall be carefully checked until the other vessel is finally past and clear.
(e). If necessary to avoid collision or allow more time to assess the situation, a vessel shall slacken her speed or take all way off by stopping or reversing her means of propulsion.
(i). A vessel which, by any of these Rules, is required not to impede the passage or safe passage of another vessel shall, when required by the circumstances of the case, take early action to allow sufficient sea-room for the safe passage of the other vessel.
(ii). A vessel required not to impede the passage or safe passage of another vessel is not relieved of this obligation if approaching the other vessel so as to involve risk of collision and shall, when taking action, have full regard to the action which may be required by the Rules of this part.
(iii). A vessel the passage of which is not to be impeded remains fully obliged to comply with the Rules of this part when the two vessels are approaching one another so as to involve risk of collision.

Rule 10

Traffic separation schemes

(a). This Rule applies to traffic separation schemes adopted by the Organization and does not relieve any vessel of her obligation under any other rule.
(b). A vessel using a traffic separation scheme shall:
(i). proceed in the appropriate traffic lane in the general direction of traffic flow for that lane;
(ii). so far as practicable keep clear of a traffic separation line or separation zone;
(iii). normally join or leave a traffic lane at the termination of the lane, but when joining or leaving from either side shall do so at as small an angle to the general direction of traffic flow as practicable.
(c). A vessel shall, so far as practicable, avoid crossing traffic lanes but if obliged to do so shall cross on a heading as nearly as practicable at right angles to the general direction of traffic flow.
(d).
(i). A vessel shall not use an inshore traffic zone when she can safely use the appropriate traffic lane within the adjacent traffic separation scheme. However, vessels of less than 20 metres in length, sailing vessels and vessels engaged in fishing may use the inshore traffic zone.
(ii). Notwithstanding subparagraph (d)(i), a vessel may use an inshore traffic zone when en route to or from a port, offshore installation or structure, pilot station or any other place situated within the inshore traffic zone, or to avoid immediate danger.
(e). A vessel other than a crossing vessel or a vessel joining or leaving a lane shall not normally enter a separation zone or cross a separation line except:
(i). in cases of emergency to avoid immediate danger;
(ii). to engage in fishing within a separation zone.
(f). A vessel navigating in areas near the terminations of traffic separation schemes shall do so with particular caution.
(g). A vessel shall so far as practicable avoid anchoring in a traffic separation scheme or

in areas near its terminations.
(h). A vessel not using a traffic separation scheme shall avoid it by as wide a margin as is practicable. (i). A vessel engaged in fishing shall not impede the passage of any vessel following a traffic lane.
i). A vessel engaged in fishing shall not impede the passage of any vessel following a traffic lane.

(j). A vessel of less than 20 metres in length or a sailing vessel shall not impede the safe passage of a power-driven vessel following a traffic lane.
(k). A vessel restricted in her ability to manoeuvre when engaged in an operation for the maintenance of safety of navigation in a traffic separation scheme is exempted from complying with this Rule to the extent necessary to carry out the operation.
(l). A vessel restricted in her ability to manoeuvre when engaged in an operation for the laying, servicing or picking up of a submarine cable, within a traffic separation scheme, is exempted from complying with this Rule to the extent necessary to carry out the operation.

Rule 13
Overtaking
(a). Notwithstanding anything contained in the Rules of part B, sections I and II, any vessel overtaking any other shall keep out of the way of the vessel being overtaken.
(b). A vessel shall be deemed to be overtaking when coming up with another vessel from a direction more than 22.5 degrees abaft her beam, that is, in such a position with reference to the vessel she is overtaking, that at night she would be able to see only the sternlight of that vessel but neither of her sidelights.
(c). When a vessel is in any doubt as to whether she is overtaking another, she shall assume that this is the case and act accordingly.
(d). Any subsequent alteration of the bearing between the two vessels shall not make the overtaking vessel a crossing vessel within the meaning of these Rules or relieve her of the duty of keeping clear of the overtaken vessel until she is finally past and clear.

Rule 15
Crossing situation
When two power-driven vessels are crossing so as to involve risk of collision, the vessel which has the other on her
own starboard side shall keep out of the way and shall, if the circumstances of the case admit, avoid crossing ahead of the other vessel.

Rule 16
Action by give-way vessel
Every vessel which is directed to keep out of the way of another vessel shall, so far as possible, take early and
substantial action to keep well clear.

Rule 17
Action by stand-on vessel
(a).
(i). Where one of two vessels is to keep out of the way the other shall keep her course and speed.
(ii). The latter vessel may however take action to avoid collision by her manoeuvre

alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is not taking appropriate action in compliance with these Rules.
(b). When, from any cause, the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.
(c). A power-driven vessel which takes action in a crossing situation in accordance with subparagraph (a)(ii) of this Rule to avoid collision with another power-driven vessel shall, if the circumstances of the case admit, not alter course to port for a vessel on her own port side.
(d). This Rule does not relieve the give-way vessel of her obligation to keep out of the way.

Rule 19

Conduct of vessels in restricted visibility

(a). This Rule applies to vessels not in sight of one another when navigating in or near an area of restricted visibility.
(b). Every vessel shall proceed at a safe speed adapted to the prevailing circumstances and conditions of restricted visibility. A power-driven vessel shall have her engines ready for immediate manoeuvre.
(c). Every vessel shall have due regard to the prevailing circumstances and conditions of restricted visibility when complying with the Rules of section I of this part.
(d). A vessel which detects by radar alone the presence of another vessel shall determine if a close-quarters situation is developing and/or risk of collision exists. If so, she shall take avoiding action in ample time, provided that when such action consists of an alteration of course, so far as possible the following shall be avoided:
(i). an alteration of course to port for a vessel forward of the beam, other than for a vessel being overtaken;
(ii). an alteration of course towards a vessel abeam or abaft the beam.
(e). Except where it has been determined that a risk of collision does not exist, every vessel which hears apparently forward of her beam the fog signal of another vessel, or which cannot avoid a close-quarters situation with another vessel forward of her beam, shall reduce her speed to the minimum at which she can be kept on her course. She shall if necessary take all her way off and in any event navigate with extreme caution until danger of collision is over.

Marine Accident Report