DMAIB
DANISH MARITIME ACCIDENT INVESTIGATION BOARD

ICE ROSE & KAZANETS

Marine accident report on collision

23 SEPTEMBER 2020

MARINE ACCIDENT REPORT ON COLLISION BETWEEN
ICE ROSE AND KAZANETS ON 23 SEPTEMBER 2020

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Photo: ICE ROSE after the collision
Source: DMAIB

SUMMARY

On the morning of 23 September 2020, the Marshall Islands registered refrigerated general cargo ship ICE ROSE collided with anti-submarine ship 311 KAZANETS of the Russian Navy in the Sound, Denmark. The collision happened as ICE ROSE and 311 KAZANETS were passing on crossing courses while navigating in a dense fog. Due to the restricted visibility, both ships' navigation relied on instrumentation only. Neither of the ships identified the other ship until a few minutes before the collision, and neither ship managed to avoid the collision once the risk of collision was recognised.

In the investigation report, DMAIB clarifies the circumstances for the late recognition of the risk of collision and the failed attempt to avoid the collision. The investigation primarily describes the events from the perspective of ICE ROSE, as DMAIB does not have jurisdiction to investigate warships and thus had limited access to data from to 311 KAZANETS.

DMAIB concludes that the collision happened as a result of the navigational practises on both ships on that day. On ICE ROSE several coinciding factors contributed to the bridge team not recognising the risk of collision until 311 KAZANETS was at close quarters. Those factors included bridge layout, radar settings and the division of work within the bridge team.

Radar settings made it difficult to distinguish 311 KAZANETS from stationary objects on the radar and was not identified as a target, until there were only a few minutes left to decide on a manoeuvre to avoid the collision. Due to uncertainties about 311 KAZANETS' course and intentions, the master hesitated to make a large course alteration. As neither ICE ROSE nor 311 KAZANETS made any large course alteration, the collision was not avoided.

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Introduction

Start of the investigation

On the morning of 23 September 2020, DMAIB was notified that a merchant ship registered in the Marshall Islands had collided with another ship in the Sound, Denmark, near Drogden Lighthouse. Two investigators were deployed to gather data on both ships, but en route to the ships DMAIB received confirmation that one of the ships was a Russian warship which DMAIB does not have jurisdiction to investigate. The Russian warship was later identified as the anti-submarine ship 311 KAZANETS. DMAIB received a statement of fact from 311 KAZANETS, but was not able to collect any data from the ship nor interview the crew. 311 KAZANETS left Danish waters, before DMAIB arrived at the scene of the accident. The investigation hence concentrated on ICE ROSE, and DMAIB was limited to clarifying the circumstances of the accident on only one of the ships involved in the collision.

The initial investigation on ICE ROSE was carried out while the ship was at anchor south of Drogden Lighthouse close to the scene of the accident, and further investigation was carried out when the ship was at shipyard for repairs.

The aim of the initial investigation was to reconstruct the course of events on ICE ROSE prior to, during and after the collision. For this purpose, the involved crewmembers were interviewed, VDR recordings were obtained, bridge layout and damages to the ship were documented, and shore-based radar surveillance data was retrieved.

Narrative

Reading note

The course of events is presented from the perspective of the involved persons on ICE ROSE to give insights into how the events were perceived before the accident became evident. The narrative is based on interviews with a selected group of crewmembers on ICE ROSE, VDR recordings, log-book records, photos taken of the damages after the accident and shore-based radar surveillance.

How the events unfolded on 311 KAZANETS is not included in the narrative, because DMAIB was unable conduct an investigation including interviews on 311 KAZANETS.

The course of events covers a period from ICE ROSE approached Drogden Lighthouse at 0830 LT in the morning of 23 September 2020 until the ship was at anchor approximately 15 minutes after the collision with the Russian warship 311 KAZANETS at 1000 LT.

Background

ICE ROSE was a refrigerated general cargo ship (figure 1) in worldwide trade mainly carrying frozen food products. The ship was manned with 22 crewmembers.

On 21 September 2020, the ship departed from Saint Petersburg, Russia, in ballast heading for Falmouth, UK. The plan was to cross the Baltic Sea and enter Danish waters via the Sound heading for Skagen Roads, Denmark, where the ship was to bunker fuel oil before heading for Falmouth awaiting orders.

Figure 1: ICE ROSE
Source: DMAIB

Course of events

In the morning of 23 September, the third officer was on watch as ICE ROSE was on a westerly course approaching the southern part of the Sound (figure 2). The weather was good with a gentle breeze and calm seas. After having had breakfast, the master came to the bridge to assist the third officer with the navigation. The Sound is a narrow strait with dense traffic and thus difficult to navigate, but the master had experience navigating through the Sound. Shortly after arriving on the bridge at 0830, the master called Sound Vessel Traffic Service (Sound VTS) and reported that the ship was westbound.

Half an hour later, the ship changed from a westerly course onto a northerly course heading for the Sound. When the ship changed course, the visibility suddenly decreased to approximately one nautical mile (nm), as the ship encountered patches of dense fog. The third officer and master had to rely on the radars while continuously assessing the deteriorating visibility by looking out of the front windows. As the ship was approaching the narrow waters of the Sound, an AB was called to the bridge to act as lookout and helmsman. The third officer was told to turn on the echo sounder.

The third officer mainly stood by the radar and ECS (Electronic Chart System) on the starboard side of the bridge monitoring the traffic and the progress of the route (figure 3, next page). Meanwhile, the master continuously moved around by the front windows, regularly assessing the visibility and occasionally monitoring the radar and ECS. There was some small talk between the third officer and the master, and the atmosphere was positive.

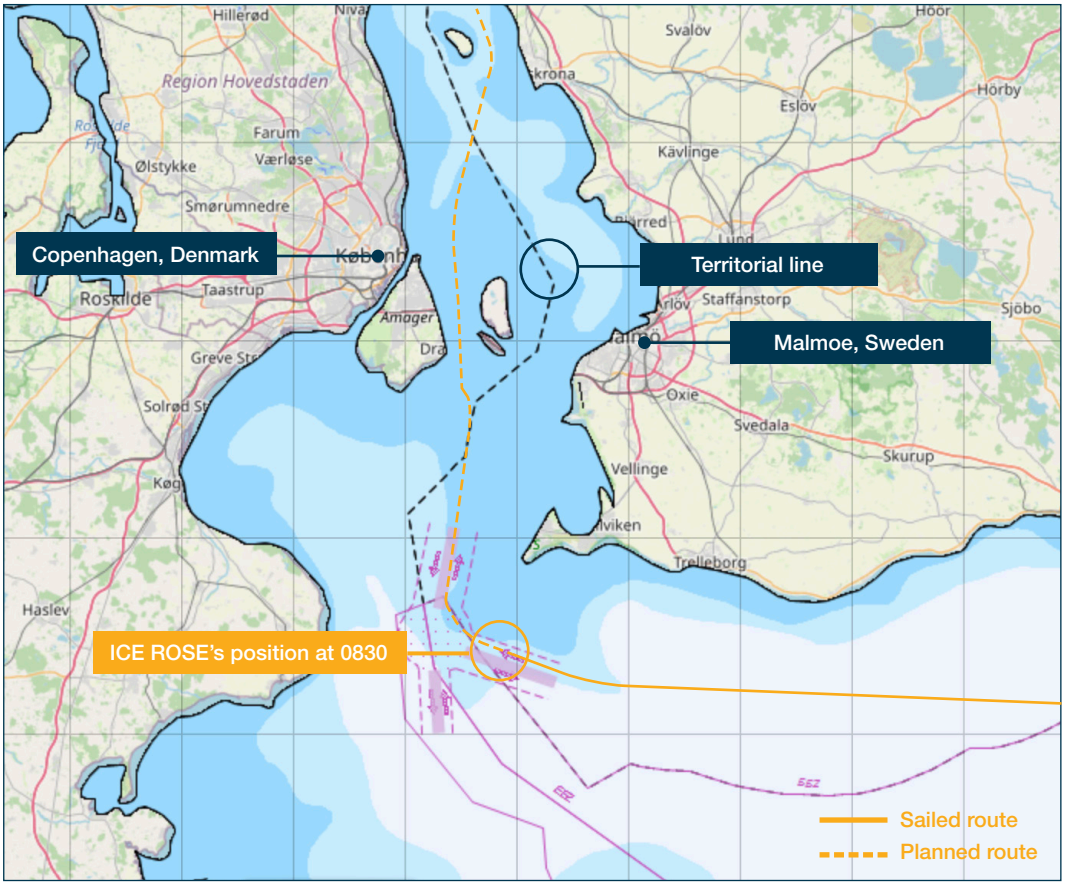

Figure 2: ICE ROSE's route through the Sound
Source: © Made Smart Group BV 2021; C-Map Norway AS 2021; © Open Street Map contributors /DMAIB

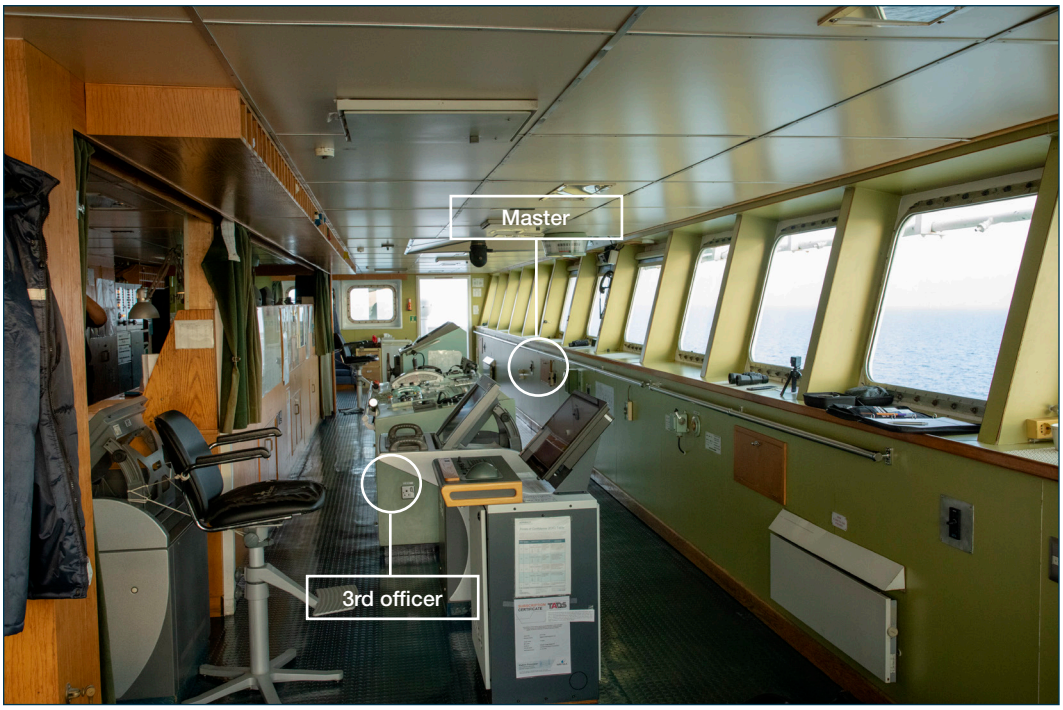

Figure 3: The bridge on ICE ROSE
Source: DMAIB

As the ship proceeded on the northerly course, the fog densened, and the visibility decreased to less than one nm. The master reduced the speed to 14 knots and told the lookout to take the helm and steer the ship manually.

Half an hour later, at 0940, the master and third officer noticed a ship on the radar which did not transmit an AIS signal. It was on a south-westerly course about to cross ahead of ICE ROSE from starboard side at a distance of approximately one nautical mile. As the ship passed ahead of them, they noticed that it was a Russian warship. The master stood by the windows on port side and observed it visually while trying to assess the visibility. Suddenly, the visibility decreased to about 50 metres.

The third officer observed another approaching ship on the radar coming from the starboard. He voiced his observation, and the master headed back to the radar. While the master walked to the radar, the third officer noticed that this ship also did not transmit an AIS signal. He plotted the target on the radar, and it quickly became apparent for the master and the third officer that the ship was on a collision course with ICE ROSE. The time of the closest point of approach was within a few minutes.

As the other ship came closer, the master hesitated to turn hard to starboard, because he was concerned ICE ROSE would hit the approaching ship when turning. On the other hand, he did not want to turn to port, because that would not resolve the situation in the event that the other ship altered course to starboard. The master gave orders to activate the sound signal. The visibility was close to zero, and the approaching vessel was still out of sight. Unsure of the other ship's course and intentions, the master decided to attempt to increase the CPA to the other ship by ordering the helmsman to change the course a few degrees to starboard to 010°. He monitored the radar to see the effect of the new course. The other ship did not change its course, and the small course alteration did not have any effect. He then told the helmsman to alter the course a few degrees to port to 005°.

Suddenly, the other ship appeared abeam and slammed into ICE ROSE's starboard side by the accommodation. The master and third officer saw that the ship was a Russian warship similar to the one that had passed ahead a few minutes earlier. The time was 0946.

Immediately after the collision, the master stopped the propulsion and called the bosun to make the anchors ready. He then activated the general alarm and ordered the third officer to change the navigational lights to 'not under command'. While the crew mustered on the bridge and in the engine room, the master called Sound VTS and notified them about the collision and that he intended to stop the ship and drop anchor one nm south of Drogden Lighthouse.

Within a few minutes, the engine room personnel reported that the damage was 3-4 metres above the waterline and there was no risk of pollution. The damages to the ship were isolated to one compartment containing a workshop and the refrigeration plant. Shortly after, at 1015, ICE ROSE dropped anchor one nm south of Drogden Lighthouse.

In the meantime, the Russian warship was adrift and was assisted by the other warship which had returned to the area. The master had a short conversation on the VHF with the Russian warship which was identified as 311 KAZANETS. Sound VTS called the 311 KAZANETS, but did not receive a reply. In the early afternoon, the warships proceeded southwards out of Danish waters.

Investigation

Scope and method description

The course of events showed that ICE ROSE collided with 311 KAZANETS while the ships were on crossing courses in dense fog one mile south of Drogden Lighthouse, and that the bridge team on ICE ROSE did not recognise and react to the risk of collision until a few minutes before the ships made impact. Furthermore, it was evident that the actions initiated to avoid the collision did not have sufficient effect to remedy the close quarter situation.

The investigation therefore focused on answering two questions:

- Why did the bridge team on ICE ROSE not recognise the risk of collision before the ships were already at close quarters?
- Why did the master on ICE ROSE not succeed in avoiding the collision?

To answer these questions, DMAIB established a timeline of the events leading up to the collision. This timeline established the movements of the ships, the activities on the bridge and the information available on ICE ROSE as the events unfolded.

Based on findings emerging from the timeline, DMAIB identified several factors that influenced the bridge team's ability to recognise and react to the risk of collision with 311 KAZANETS. These factors where closely related to the ship's navigational practises.

To shed light on the navigational practises, descriptions of the bridge layout, work division in the bridge team, radar settings and COLREG will be presented.

Scene of the accident

The ships collided in the southern part of the Sound – a strait that separates the Danish and Swedish waters and connects the Baltic Sea with Kattegat and the North Sea (figure 4). Dense traffic can be encountered in the trait with approx. 35,000 ships per year passing the strait. There are recommendations on the navigation through the Sound including that certain ships make use of the pilotage services in the Sound, established by the governments of Denmark and Sweden. Neither 311 KAZANETS nor ICE ROSE were within the scope of that recommendation.

The ships collided in an area at the entrance and exits of two dredged channels in the southern part of the Sound (figure 4). At the time of the collision ICE ROSE was approaching the western channel, while 311 KAZANETS had just exited the eastern channel. The planned track of ICE ROSE and 311 KAZANETS' intended track can be seen on figure 5, next page.

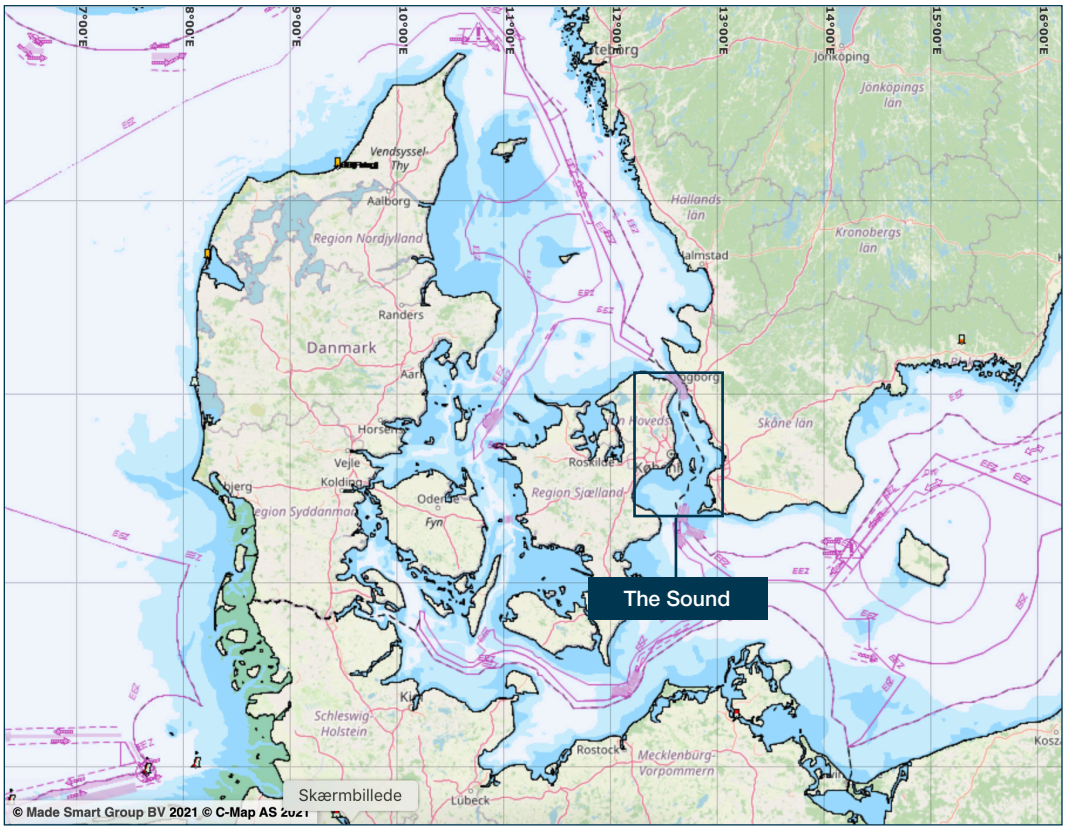

Figure 4: Area of the collision
Source: © Made Smart Group BV 2021; © C-map Norway AS 2021/DMAIB

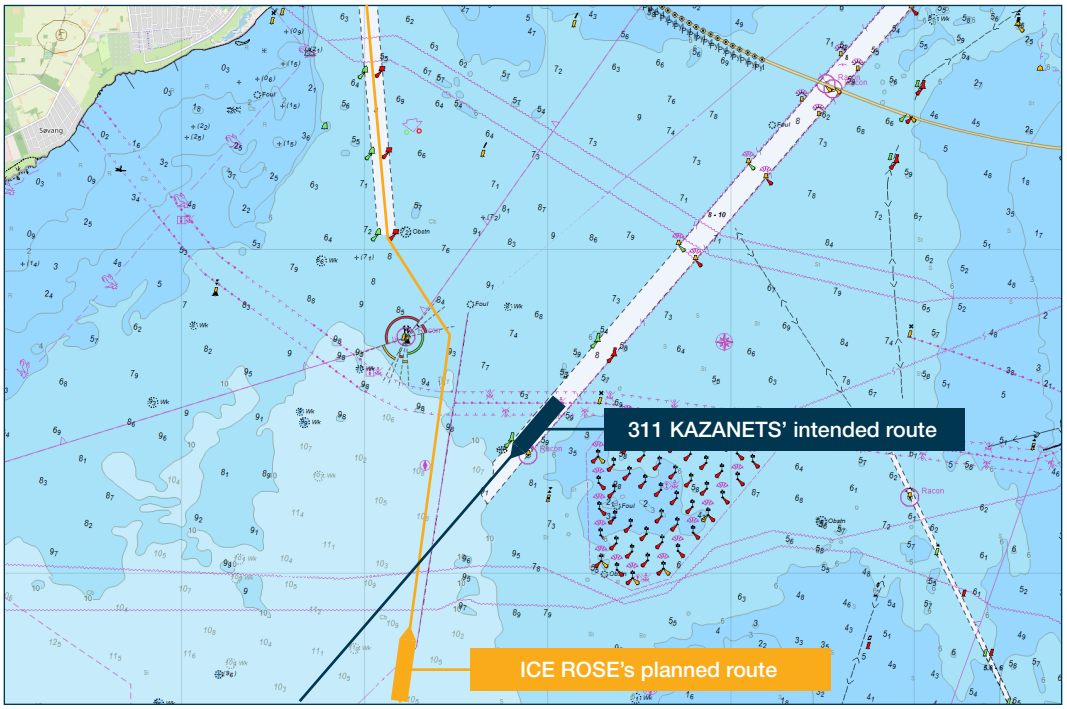

Figure 5: Area of the collision
Source: © Made Smart Group BV 2021; © C-map Norway AS 2021/DMAIB

DMAIB did not have access to 311 KAZANETS' voyage plan, but other ships observed 304 URENGOY and 311 KAZANETS navigating in formation through the northern part of the Sound following the same track with a distance of approx. 1 nm between them. 311 KAZANETS' intended track on figure 5 is thus based on 304 URENGOY's track after it exited the channel. 304 URENGOY and 311 KAZANETS were southwest bound in the eastern channel on an approx. course 222°. The channel had a depth of 8 m, and the water depth outside the channel was within a 10 m depth contour with scattered areas of shallow water of 3-5 m. The draught of the warship was unknown to DMAIB.

ICE ROSE was on a northerly course of approx. 009° and had a draught of 7.1 m. The distance from ICE ROSE's track to the 10 m depth contour was approx. 0.3-0.5 nm and the next contour was 6 m. It was thus to be expected that unsafe water could be encountered within the 10 m contour. A course alteration to starboard was thereby restricted by the 10 m contour. ICE ROSE's planned track took into account passing Drogden Lighthouse on ICE ROSE's port side to align the ship with Drogden Channel. Southbound traffic could be expected to pass west of Drogden Lighthouse.

Timeline of events

To gain an understanding of the events leading up to the collision, DMAIB established a timeline based on the various data gathered from ICE ROSE (interviews with selected crewmembers, VDR recordings, records from logbooks, etc.). Additionally, the timeline included radio communication and VTS radar images from Sound VTS that were analysed along with VDR radar recordings from another ship passing by at the time of the collision. The ships' damages were mapped to establish the angle of impact and shed light on the ships' manoeuvres moments before the collision.

Three months after the collision, DMAIB received a master's statement of fact from the Russian Navy. The information from the statement of fact was included in the timeline analysis. However, the statement contained several inconsistencies. As DMAIB did not have access to carrying out an investigation and interviews on 311 KAZANETS, DMAIB was not able to verify the information from the statement. Mainly two inconsistencies complicated the mapping of events. Firstly, the statement of time, e.g. the time of the collision, did not coincide with the recordings from Sound VTS and from ICE ROSE's VDR recordings. Secondly, the actions taken with regards to change of speed and course did not coincide with the VTS and VDR recordings. Therefore, the statement of fact from 311 KAZANETS is only referenced sporadically.

0935 11 minutes before the collision

ICE ROSE proceeded on a northerly course with a speed of 14 knots approaching Drogden Lighthouse. The visibility was restricted to about 1 nm due to fog. The radar was set on 6 nm range with an approximately four nm offset. The third officer stood by the radar and monitored the traffic. The master was at the front of the bridge looking out the windows assessing the visibility. Occasionally, the master glanced at the ECS and the X-band radar.

The anti-submarine ships proceeded in a south-westerly course in Flinterenden. The ships proceeded in a column formation with a distance of 1 nm between the ships with 304 URENGOY in the front. DMAIB tracked the movement of the warships by using data from VTS radar recordings, the VDR radar recordings from ICE ROSE and the VDR radar recordings from another ship passing by at the time of the collision. At 0935, the distance from ICE ROSE to the first anti-submarine ship in the formation was about 4 nm (figure 6).

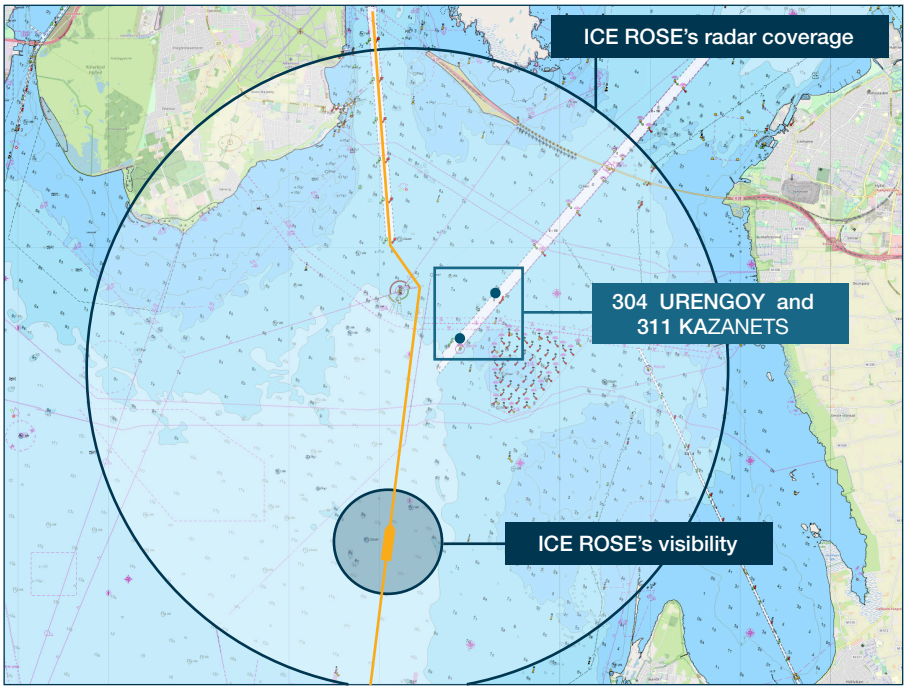

Figure 6: ICE ROSE's approximate radar coverage and visibility at 0935.
Source: © Made Smart Group BV 2021; © C-map Norway AS 2021/DMAIB

The X-band radar image from ICE ROSE at 0935 is shown on figure 7. The anti-submarine ships were passing in a fairway marked by buoys and their echoes are displayed close to line of echoes formed by the buoys. The anti-submarine ships did not transmit an AIS signal, so they were not readily identifiable on the ECS and radar display on ICE ROSE.

In figure 7, 304 URENGOY and 311 KAZANETS are marked by DMAIB. From interviews and radar images from ICE ROSE's VDR it was established that neither anti-submarine ship had been observed as a target at this point.

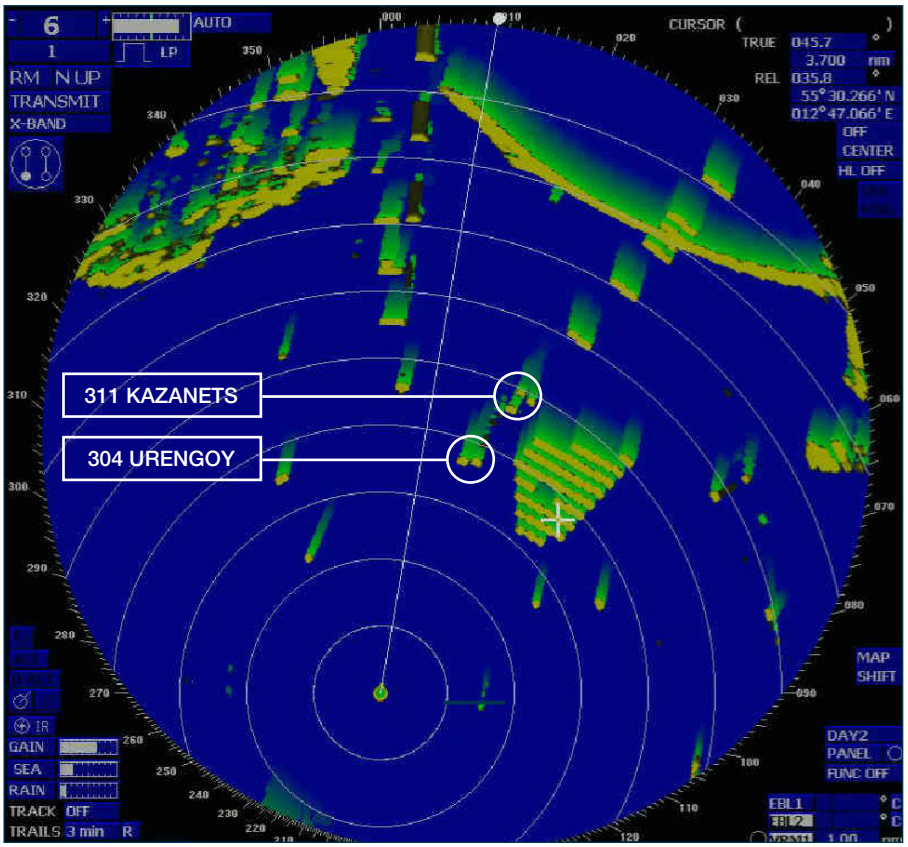

Figure 7: ICE ROSE's radar image at 0935.
Source: ICE ROSE/DMAIB

0938 8 minutes before the collision

The third officer on ICE ROSE changed the trails on the X-band radar from relative motion to true motion, which resulted in the trails being reset. It can be observed that the reset of the echo trails made the individual echoes stand out more isolated from the others on the radar image, e.g. the anti-submarine ships from the buoys in the channel (figure 8).

In the radar image in figure 8, 304 URENGOY's echo is displayed outside the channel, while 311 KAZANETS had not yet left the channel. 304 URENGOY's echo was on ICE ROSE's starboard bow at a distance of approximately 2 nm, and 311 KAZANETS' echo was at a distance of approximately 3 nm. Neither of the anti-submarine ships' echoes were acquired on ICE ROSE's radar. Interview data suggests that no crewmember in the bridge team had noticed the echoes at this point.

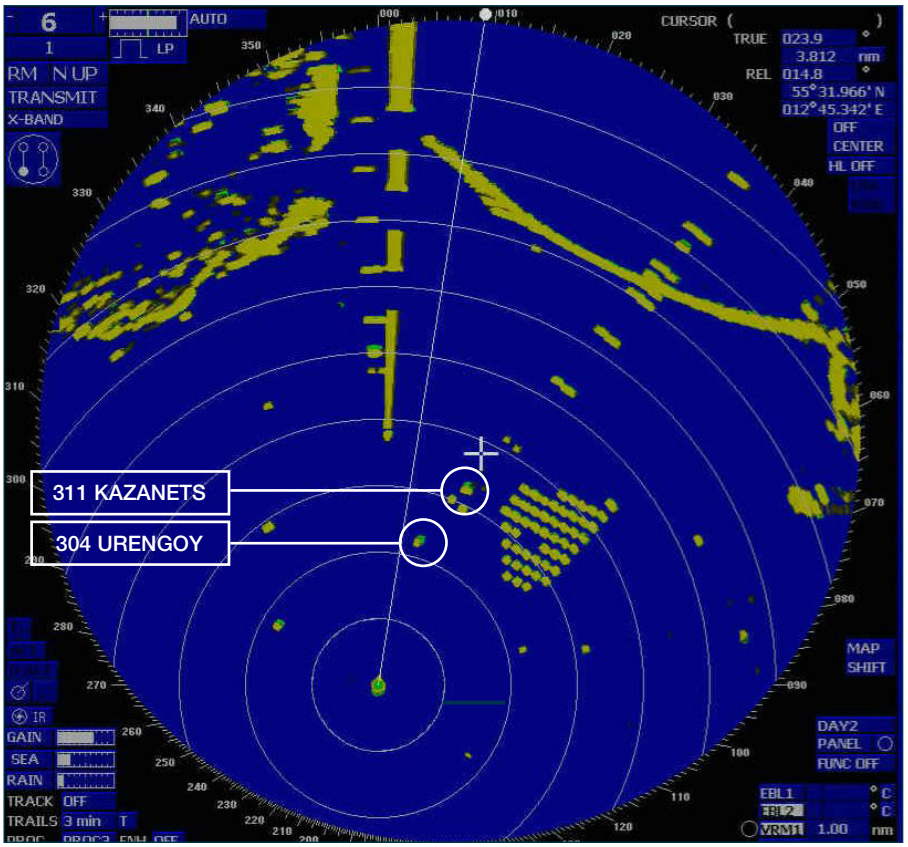

Figure 8: ICE ROSE's radar image at 0938.
Source: ICE ROSE/DMAIB

0940 6 minutes before the collision

311 KAZANETS' ship's control centre received a report from the duty radio operator of the navigation radar about a surface target on bearing 195° at a distance of 24 cables (2.4 nm). The surface target was ICE ROSE.

0941 5 minutes before the collision

The third officer on ICE ROSE changed the radar range to 3 nm, and the trails were changed from true to relative (figure 9). He acquired 304 URENGOY's echo as a target and placed the cursor on 311 KAZANETS. The target 304 URENGOY was at this time not selected, and no target information was thus available on the radar display. 304 URENGOY was at this point passing ahead of ICE ROSE at a distance of 1 nm.

The master kept lookout at by the windows and continuously assessed the visibility. As 304 URENGOY passed ICE ROSE on port side at a distance of approximately one nautical mile, the ship's contours became visible to the master in the fog. At this time, a voice can be heard on the VDR recording stating: "Lovely day!" indicating a positive atmosphere on the bridge. According to interview data, visibility decreased to 50 metres shortly after URENGOY passed.

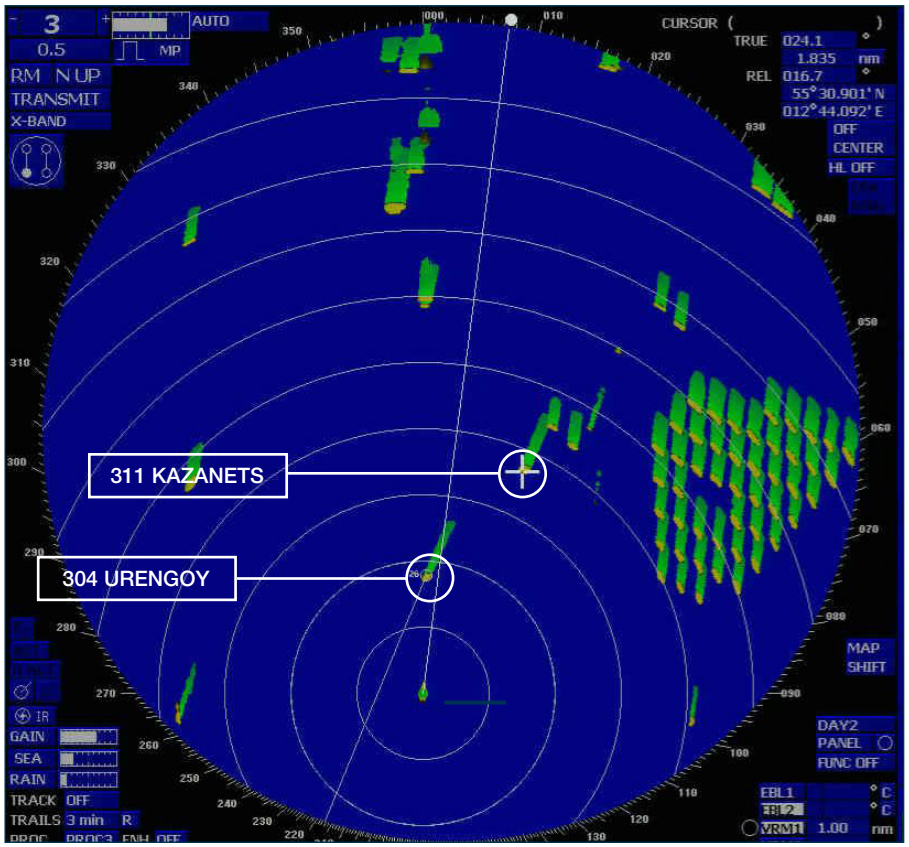

Figure 9: ICE ROSE's radar image at 0941.
Source: ICE ROSE/DMAIB

0941 5 minutes before the collision

The radio officer on 311 KAZANETS reported to the duty officer that a dangerous target was approaching on bearing 194 at a distance of 21 cables (2.1 nm). The target was identified as ICE ROSE by use of the AIS.

0942 4 minutes before the collision

304 URENGOY's ARPA target was cancelled, and 311 KAZANETS' was acquired and selected showing the closest point of approach (CPA) of 0.02 nm (figure 10).

On the VDR recordings, the third officer calls out to the master standing on the port side of the bridge that "the next ship is coming in three minutes". While walking back to the radar located on the starboard side of the bridge, the master asked to have the message repeated. According to interview data, the master had not seen the 311 KAZANETS's target before this point, but now recognised a risk of collision.

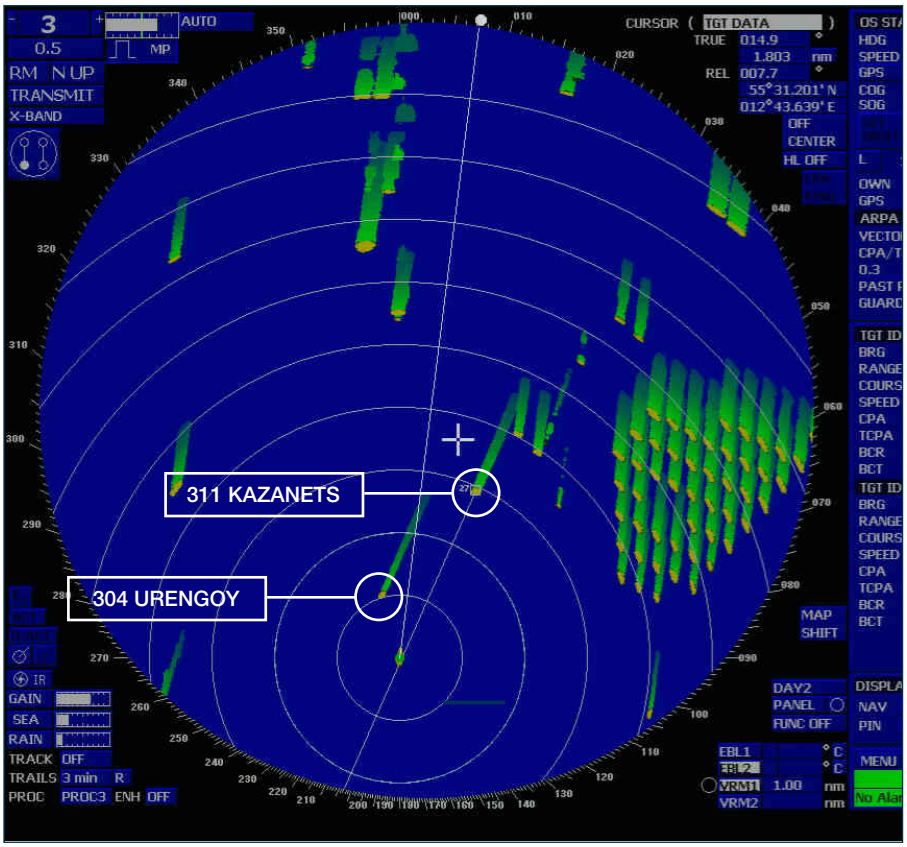

Figure 10: ICE ROSE's radar image at 0942.
Source: ICE ROSE/DMAIB

On the VDR recordings, the master asks the helmsman what the course was, and he replied 007. The master then ordered a course alteration to 010°, reduced the speed from 14 to 13 knots and activated the sound signal for restricted visibility. When the helmsman verified that the course was steady on 010°, the master ordered a new course 005°. By then 2-3 minutes had passed.

0945 1 minute before the collision

The CPA alarm activated on the X-band radar on ICE ROSE, and target information indicated that the time for collision was less than one minute. The distance between ICE ROSE and 311 KAZANETS was 0.55 nm (figure 11).

The master ordered course 000. 10 seconds later a sound signal from 311 KAZANETS could be heard on the VDR recording and then noise from the impact. The time of impact was 0946.

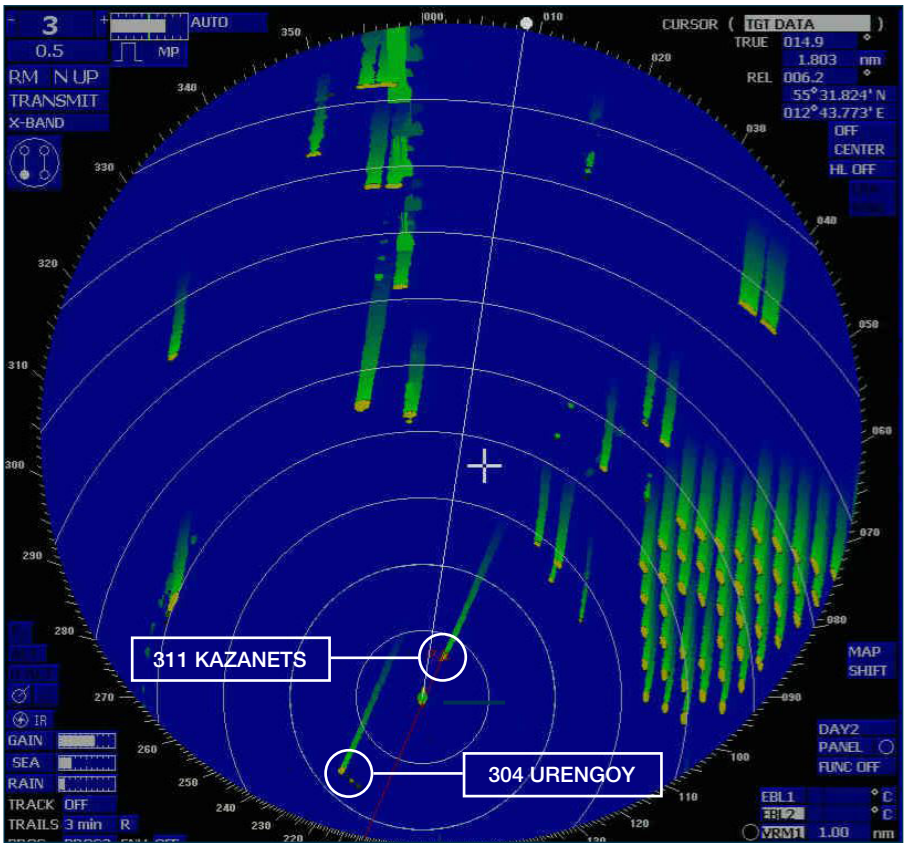

Figure 11: ICE ROSE's radar image at 0942.
Source: ICE ROSE/DMAIB

0946 Collision

FINDINGS: TIME LINE ANALYSIS

- The master on ICE ROSE primarily kept his attention towards assessing the visibility by looking out the windows. The third officer's attention was primarily directed towards monitoring the traffic on the radar. The collaboration between the master and third officer was thus instrumental for the master's overview of the oncoming traffic. Further investigation into the circumstances influencing the bridge team collaboration was thus deemed relevant.

- Though continuously monitoring the X-band radar, the third officer did not recognise that 311 KAZANETS posed a risk of collision until 3-4 minutes before the collision. Further investigation into the configuration of the X-band radar was therefore deemed relevant.

Angle of impact

Based on data from ICE ROSE's VDR and the recording from Sound VTS, the course and speed of 311 KAZANETS and ICE ROSE immediately before the collision could be determined. ICE ROSE's heading was 006° and the speed was 13 knots. 311 KAZANETS' heading was 224° and the speed was 12 knots. The angle of the impact was thus approximately 38° as illustrated on figure 12.

The external damages on ICE ROSE can be seen in figure 13. On the starboard side the ship had suffered a hull penetration extending approximately 13 metres longitudinally at 3-4 metres above the waterline. Inside the ship, an oil lubricant tank and various auxiliary systems were damaged. The black longitudinal smudging seen on the hull forward of the indentations did not originate from the collision.

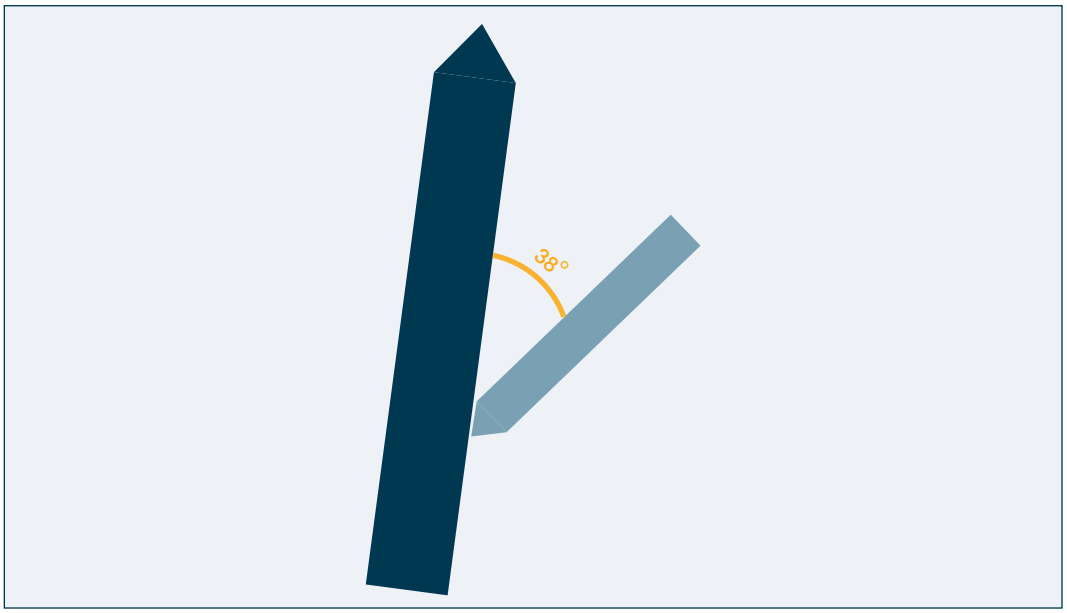

Figure 12: Angle of impact
Source: DMAIB

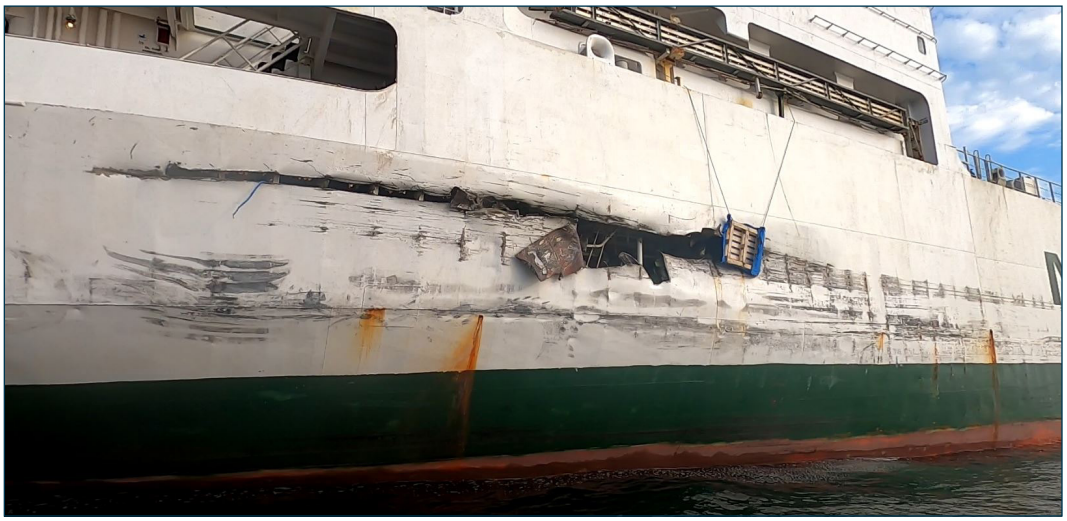

Figure 13: ICE ROSE's damages
Source: DMAIB

DMAIB was unable to board 311 KAZANETS during the investigation but has reviewed photos taken after the collision (figure 14).

The visible external damage extended from the bow and several metres abaft on the starboard side. Some of the main deck plating had been buckled upwards and inwards indicating that a part of the bow penetrated the hull of ICE ROSE (figure 15). Debris from 311 KAZANETS' bow was found inside ICE ROSE's workshop/refrigerant plant compartment (figure 16). There was no smudging or indentations seen aft of the structural damage which indicates that the impact damages were mainly located on starboard bow.

Figure 14: 311 KAZANETS' damages
Source: Private photo

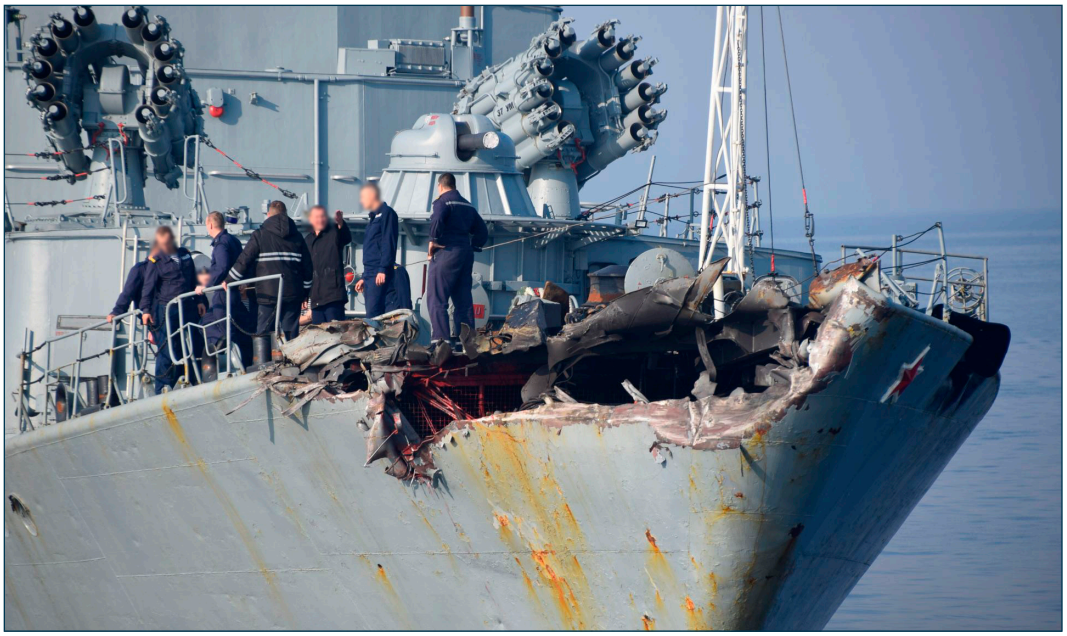

Figure 15: 311 KAZANETS' damages
Source: Private photo

Figure 16: Debris found in ICE ROSE
Source: DMAIB

From 0942 when 311 KAZANETS was acquired as target on ICE ROSE's radar until impact at 0946, no change of course or speed could be observed in 311 KAZANETS' target information. Additionally, from 311 KAZANETS' relative trails there was no visible change of course or speed. This is supported by the recording from Sound VTS. Comparing the ships' headings prior to the collision and the angle of the impact on figure 13 with the damages seen on ICE ROSE and 311 KAZANETS, it is likely that 311 KAZANETS did not make a hard turn to neither port nor starboard before the collision. If 311 KAZANETS had made a significant turn to port, then the damage would be extended further aft. If 311 KAZANETS had made a significant turn to starboard, then the damage would have extended to the port side of the bow.

FINDING: ANGLE OF IMPACT

The radar data and the ship's damages indicate that 311 KAZANETS made no course alterations or speed adjustments from the time the risk of collision was recognised on the ship. ICE ROSE initiated minor course and speed alterations when the risk of collision was identified a few minutes before the collision. As neither of the ships succeeded in taking actions to avoid the collision, it was deemed relevant to identify the applicable COLREG rules for this situation.

Bridge collaboration on ICE ROSE

Division of work in bridge team

Based on VDR data, the logbook records and the interviews, DMAIB established that no formal handover was performed between the master and the third officer, when the master came to the bridge as the ship approached the Sound. Nonetheless, it was evident from interviews and VDR recordings that the master was in command, and the third officer undertook a supporting role. In this role the third officer plotted the ship's position in the paper chart, made entries in the logbook and supplied the master with information from the X-band radar and ECS. Meanwhile, the master moved around on the bridge and kept lookout while occasionally monitoring the route on the X-band radar and ECS.

When the visibility decreased below 1 nm, the third officer's attention was entirely directed to the X-band radar and the ECS, and the master was preoccupied with looking out the windows assessing the visibility. Occasionally, he looked on the X-band radar and ECS to verify the information provided by the third officer. It was thus mainly the third officer's view of the traffic on the radar and the information he communicated to the master that dominated the master's perception of the navigational situation.

In addition to general small talk on the bridge, there was only sporadic conversation between the master and the third officer. This indicates that the third officer did not have concerns about the oncoming traffic and did not have much to report to the master when 304 URENGOY passed ahead of ICE ROSE. Once the third officer recognised that 311 KAZANETS was on a crossing course and there was about four minutes until collision, he notified the master. When the risk of collision was apparent to the master there was no communication between the master and the third officer about the situation. The master was in command and had the initiative to take action.

Bridge layout

ICE ROSE was equipped with two radar control stations located on the starboard side of the bridge, one in front of the other. The forward radar was an X-band radar which was used most by the bridge team. The X-band radar was conveniently located next to the ECS and alongside the engine controls, VHF radio and auto-pilot (figure 17). From this location the watchkeeping officer was in line of sight of the helmsman and the rudder indicator enabling the watchkeeping officer to verify that rudder and course commands were carried out correctly. The S-band radar was located aft of the X-band radar. It was mainly used if there was interference on the X-band radar which made it difficult to detect relevant targets. It was not actively and continuously used, because the paper chart table was located next to the aft radar behind a curtain which blocked the view of the front and port side windows, making it difficult to keep visual lookout. Additionally, when standing by the radar the watchkeeping officer had a poor overview of the bridge, e.g. ECS, helmsman, rudder indicator, etc.

During the interviews and the reconstruction of events it became evident that this layout of the bridge influenced the collaboration and division of work between the master and third officer. The master and third officer shared the X-band radar and ECS, but the location of the X-band radar and ECS did not provide adequate room for the master and third officer to comfortably stand by the same display. Therefore, they rarely monitored the same display simultaneously.

Though the third officer mainly stood by the X-band radar, he configured the settings in accordance with the master's preferences.

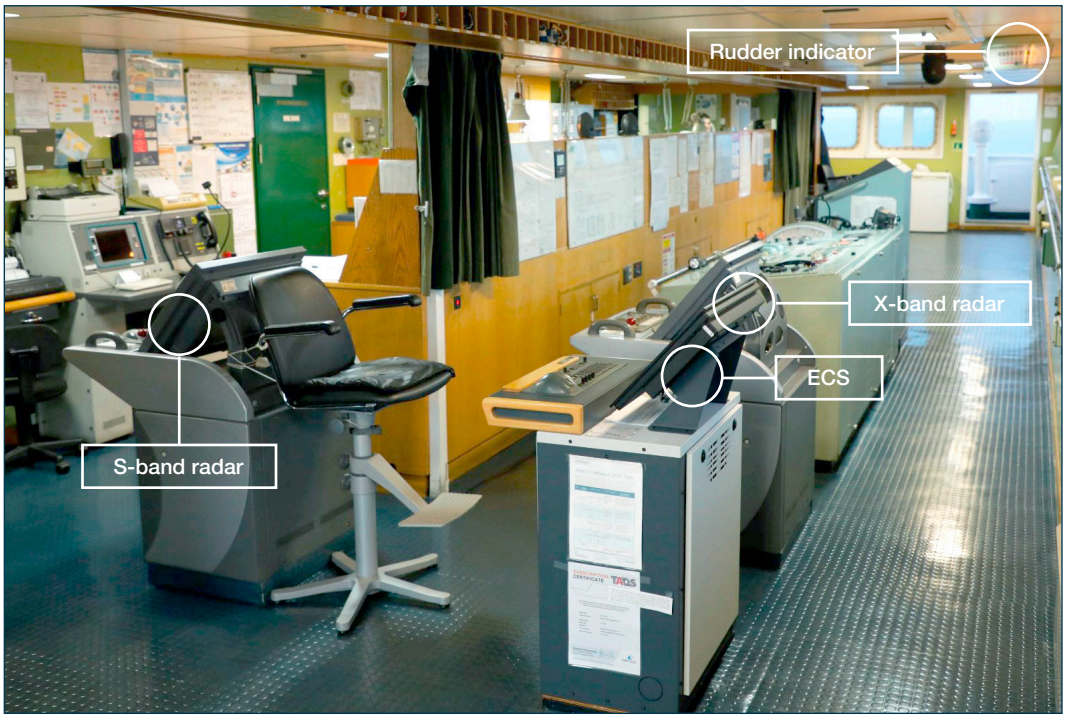

Figure 17: ICE ROSE bridge layout.
Source: DMAIB

FINDING: BRIDGE COLLABORATION

The master on ICE ROSE did not actively and continuously keep lookout on the radar. It was thus the third officer's view of the traffic that determined the master's perception of the navigational situation. The layout of the bridge influenced this division of work between the master and third officer.

Configuration and use of radar

The X-band radar was the only radar actively used prior to the collision, and it was the only radar recorded by the VDR. The X-band radar was mainly used for monitoring the traffic and verifying the validity of the GPS position plotted on the ECS. Based on investigation on the ship, interviews and the recorded radar images, there is no data that suggests any malfunction on the radar prior to the accident. The echo of 311 was visible on all radar images, when it came within ICE ROSE's radar range. Therefore, DMAIB focused the investigation on the configuration of the radar and the practice of use.

Figure 18 shows the X-band radar's screen at 0935 LT as ICE ROSE is proceeding northbound towards Drogden Lighthouse. The radar configuration can be seen in the table next page.

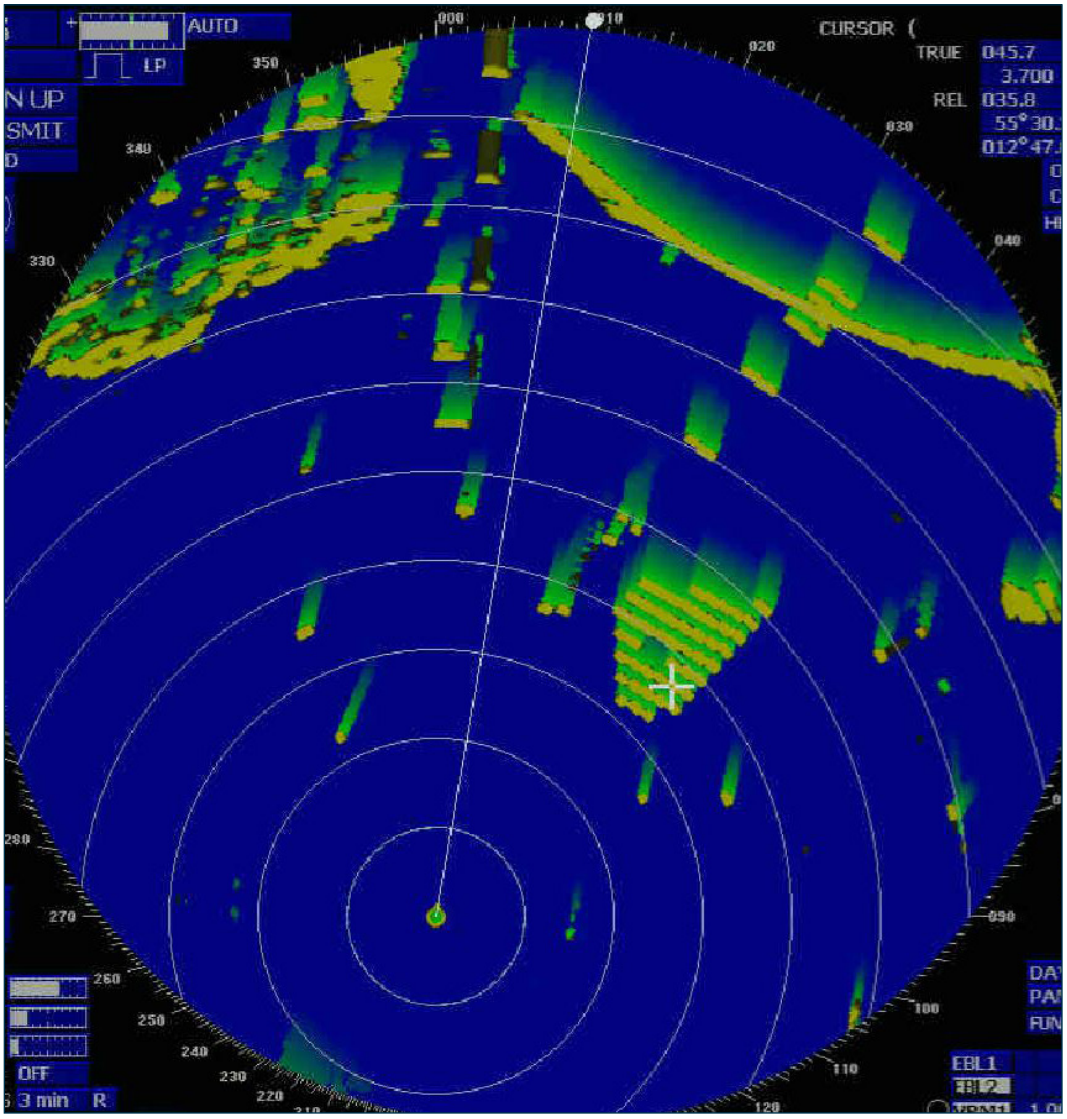

Figure 18: ICE ROSE's radar configuration at 0935.
Source: ICE ROSE/DMAIB

Range ring:	1.0 nm	**Range:**	6 nm
Trails:	Relative 3 minutes	**CPA:**	0.3 nm
Vectors:	Relative 60 minutes	**TCPA:**	1 minute

For collision avoidance purposes, the master and third officer used 3 minute relative trails, 60 minute relative vectors and 1 nm range rings. The relative trails and vectors do not represent the true motion of a target, but its relative relation to own ship. This means that a target with its relative trail or vector directed at own ship is to be considered a dangerous target. This configuration of the radar was normally used by the third officer and master when the ship navigated in restricted waters where the traffic was expected to increase.

The reasoning for this configuration was that the relative direction of the trails gave an early visual indication of close quarter situations. If the trails showed a target's relative motion towards own ship, then the target would be acquired, and the 60 minute relative vector would give an early visual indication whether there was a risk of collision, and the range rings gave an approximate visual indication of the CPA. Therefore, they found no need for having CPA and TCPA alarm settings that would give an early warning about a close quarter situation. In fact, the CPA and TCPA settings were already applied before the third officer arrived on the bridge on the morning of the collision. This practise also meant that there was no general acquisition of echoes to verify whether or not they were moving objects. DMAIB was not able to determine whether these settings were generally used by the other bridge officers.

This configuration and operation of the radar had both advantages and disadvantages. The advantage of using relative trails and 60 minute relative vectors in conjunction with 1 nm range rings was that the CPA of targets could be assessed at a glance without interrogating the target information in the radar menu. Additionally, by selecting targets based on the relative trails it was not necessary to acquire all potential targets on the screen which could cause a clutter of vectors. The master and third officer were thus mainly relying on visual cues and did have to rely on selecting the various targets and interpreting the values of CPA, TCPA, etc.

There were mainly two disadvantages of this configuration and operation of the radar. Firstly, echoes from approaching ships could be concealed in the clutter from other moving or stationary objects which could delay the target acquisition. Secondly, getting information about potentially dangerous targets could be delayed when considering that the vector may not reach a given level of accuracy until three minutes or more have passed after target acquisition. Even if three minutes or more have passed, the vector may include an error depending on the tracking conditions[1].

From interviews with the third officer and master it was evident that they had not observed the anti-submarine ships at 0935 LT. The third officer might not have detected the anti-submarine ships, because they were hidden in the clutter of the buoys in Flinterenden, even though he was continuously monitoring the radar. The constant monitoring of the radar was verified by observing the VDR recording where a continuous movement of the cursor can be seen. The third officer first became aware of the anti-submarine ships after the trails were reset at 0938, and the ships had exited Flinterenden and were thus distinguishable from the buoys.

1 Information about the level of accuracy was described in the on-board radar manual.

The third officer acquired the first ship in the formation, 304 URENGOY. When it was apparent that there was no risk of collision, and the ship had passed the bow, the target was deleted. A few minutes later, when the third officer became aware of the second ship, 311 KAZANETS, he acquired it and notified the master. Time had now passed, and there was only 3-4 minutes until impact or even less, if time for calculating accurate vector data is taken into account.

Neither 304 URENGOY nor 311 KAZANETS transmitted an AIS signal, and they would thus not be visible on the ECS. It is debatable what importance AIS transmissions have in de-conflicting traffic and collision avoidance. However, when the majority of ships transmit an AIS signal, then the absence of an AIS on some ships can influence the interpretation of the information provided by the radar. DMAIB has not found any evidence or indications that the absence of AIS transmissions from the anti-submarine ships had an influence on the collision.

FINDING: RADAR CONFIGURATION AND USE

The practise of using relative 3 minutes trails and only acquiring targets that showed trails directed at own ship delayed the detection of 311 KAZANETS.

COLREG[2]

COLREG's steering and sailing rules provide a regulatory framework for collision avoidance. It is thus relevant to outline the basic applicable rules for the situation that ICE ROSE and 311 KAZANETS were in. It should, however, be noted that the purpose of DMAIB's investigation was not to apportion blame or responsibility. Consequently, no judgement will be made whether the ships adhered to the rules.

ICE ROSE and 311 KAZANETS were power-driven vessels that were under way. Both vessels were navigating in restricted visibility (COLREG 3(l)) and were not in sight of each other (COLREG 3(k)) until moments before the collision. ICE ROSE used a sound signal in restricted visibility (COLREG rule 35(a)). It is uncertain whether 311 KAZANETS used such a sound signal, and whether the sound signal heard on ICE ROSE was a warning signal.

The ships were therefore to adhere to COLREG rule 19 about the conduct of vessels in restricted visibility. This meant that there was no stand-on vessel, and both vessels were thus required to take action to avoid a close-quarters situation and/or collision. Rule 19 about conduct of vessels in restricted visibility is used in conjunction with rules 4-10 and rule 35.

2 Convention on the International Regulations for Preventing Collisions at Sea, 1972, as amended.

In general, COLREG leaves the watchkeeping officer a discretionary space for determining the ship's risk of collision in relation to a variety of factors such as safe speed (rule 6) and due regard to the prevailing circumstances (rule 19(c)). This discretionary space is dependent on the specific context, such as navigating in open waters or narrow channels, the amount of traffic and the normal practices in certain types of ships, e.g. tugs, fishing vessels or passenger ship trade navigating across channels. The application of COLREG is, therefore, to some extent based on heuristics and how the watchkeeping officer's experience shapes the perception of risk, and within the discretionary space the watchkeeping officer can and should depart from the rules in special circumstances to avoid immediate danger (rule 2). It is expected that the watchkeeping officer can take into due regard all dangers of navigation and to any special circumstances (rule 2). This indicates that the underlying thinking in COLREG is that all dangers are visible and can be taken into account and mitigated. Whether or not due regard has been shown can only be based on an evaluation of the events after the outcome is known.

However, hindsight evaluation provides little information about the actual circumstances in which the heuristics were applied and what difficulties the watchkeeping officer were presented with in the given situation. Therefore, the cause of the collision cannot be explained through this analytical approach.

Analysis

Understanding the collision

ICE ROSE and 311 KAZANETS collided while underway in restricted visibility in a narrow geographical area constricted by shallow waters. Based on the investigation of the course of events leading up to the collision, it could be established that the crew on neither of the ships identified the other ship as a target until a few minutes before the collision occurred and that neither ship managed to take actions that could prevent the collision once the risk of collision was recognised. During the investigation, DMAIB did not find any indication that either ship experienced instrumentation malfunction or difficulty in manoeuvring. Instead, the collision happened as a result of the navigational practises on both ships on that day.

DMAIB visited and collected data from ICE ROSE, but only received a formal written statement from the master of 311 KAZANETS, which proved insufficient for an analysis of the events unfolding on 311 KAZANETS prior to the collision. The investigation therefore focused on the navigational circumstances on ICE ROSE. The analysis will focus on the circumstances leading to late detection of the risk of collision with 311 KAZANETS, though the echo was displayed and available on the radar, and 311 KAZANETS did make course alterations. Furthermore, the analysis focuses on circumstances that formed the master's strategy of avoidance once the risk of collision was evident.

Late recognition of risk of collision

After the visibility was reduced to about one nm, the third officer monitored the X-band radar display continuously which the moving cursor, observable on the VDR recordings, indicated. He was only interrupted when he plotted the ships' positions on the paper chart and while he monitored the ECS. Meanwhile, the master occasionally monitored the same radar. The investigation did not with certainty uncover why the master and third officer did not pick up on the visual cues presented on the X-band radar which could indicate the risk of collision earlier than four minutes before the collision. DMAIB did, however, identify several interacting factors which impeded the master's and third officer's lookout.

The watchkeeping officer did not have a complete overview of the bridge and windows when he stood by the S-band radar. Therefore, only the X-band radar was used. Arguably, it would not be important to have an overview of windows, if the ship was navigating in restricted visibility, but even in restricted visibility the officers were prone to direct their attention to the windows to assess the visibility. More importantly, the X-band radar was near the ECS which was used in combination with the radar. Therefore, the division of work between the master and third officer was such that the third officer was using the X-band radar, and the master kept an overview of the navigational situation by moving around on the bridge occasionally monitoring the radars, the ECS, the auto pilot, kept an eye on the helmsman, looked out the windows, etc. In this role he was dependent on the third officer's overview of traffic on the X-band radar. It was thus the third officer's view of the traffic and his communication to the master that determined the master's perception of the navigational situation.

Once the visibility became restricted, the third officer's view of the traffic situation was

determined by the radar settings which configured the radar for a particular way of identifying and acquiring targets. The investigation showed that this particular configuration of the radar was such that moving objects could be overlooked among stationary objects. Additionally, only moving objects were acquired which meant there was no general acquisition of echoes to verify whether or not they were moving objects. This practise was likely contributory to the third officer not recognising that 311 KAZANETS posed a risk of collision. When the third officer did not pick up on the presence of 311 KAZANETS, there was no communication to convey to the master until 3-4 minutes before the collision.

Collision avoidance

Early detection and traffic deconflicting in restricted visibility is essential because the ARPA functionalities are not accurate enough to provide reliable information about the risk of collision in close-quarters situations. The information provided by the radar will not give a clear indication of how the other ship is turning, which can cause uncertainty about the most effective manoeuvre to avoid collision.

Once the master on ICE ROSE was made aware of the risk of collision, four minutes before impact, the master did not have a visual spatial reference to 311 KAZANETS to confidently make a decision on how to manoeuvre the ship out of the situation. This short time frame narrowed the master's perception of which options he had for avoiding the collision. In this time critical situation, the decision making was centred on the master, and the third officer kept silent.

The master observed on the X-band radar that 311 KAZANETS seemingly kept its course and speed. Although he was aware of the ideal response according to COLREG, he hesitated to make a large course alteration to starboard when the ships were at close quarters. He was concerned that ICE ROSE would turn into 311 KAZANETS, if he initiated a hard starboard turn. That ICE ROSE's position was in the vicinity of shallow waters did not contribute to that hesitation. Therefore, he chose to make a small course alteration to port. He deliberately did not make a hard port turn in the event that 311 KAZANETS was about to make a starboard turn which would result in a collision. The small manoeuvres that followed proved inadequate for avoiding the collision.

The radar data and the ship's damages indicate that 311 KAZANETS did not alter course or change speed from it exited Flinterenden until the collision.

Conclusion

Conclusion of the investigation

ICE ROSE and 311 KAZANETS collided while underway in restricted visibility in a narrow geographical area constricted by shallow waters. The crew on both ships therefore relied on navigating by instrumentation only. During the investigation DMAIB did not find any information which suggested that either ship experienced instrumentation failures or mechanical malfunction which impeded the ships' manoeuvrability. The collision thus happened as a result of the navigational practises on both ships on that day.

DMAIB visited and collected data from ICE ROSE, but only received a formal written statement from the master of 311 KAZANETS, which proved insufficient for an analysis of the events unfolding on 311 KAZANETS prior to the collision. The investigation therefore focused on the events on ICE ROSE.

On ICE ROSE several coinciding factors contributed to the bridge team not recognising the risk of collision until 311 KAZANETS was at close quarters. Those factors included the layout of the bridge, the configuration of the X-band radar and the division of work between the master and third officer. Those factors resulted in only one person monitoring the radar, and when he missed the visual cues on the radar there was only a few minutes left to decide on a manoeuvre to avoid the collision.

Once the ships were at close quarters, a quick decision had to be made based on uncertain information about 311 KAZANETS' course and, more importantly, its intentions. That uncertainty caused the master to hesitate to make a large course alteration, and when 311 KAZANETS did not make a clear course alteration, the collision was a reality.

Preventive measures

Actions taken by ICE ROSE's operator

The operator of ICE ROSE has informed DMAIB that the company has issued a fleet circular acknowledging the inexpedient positioning of the radars on some of the company's vessels. However, the company has found that the problems associated with the ergonomics of the bridge can be mitigated by instructing the bridge watchkeepers on specific practices regarding watchkeeping in confined waters, which includes rearranging the division of work among the bridge watchkeepers and how the radars are used.

Appendix

SHIP PARTICULARS

Name of vessel:	ICE ROSE
Type of vessel:	Refrigerated Cargo Ship
Nationality/flag:	Marshall Islands
Port of registry:	Majuro
Call sign:	V7YT9
IMO no.:	8311106
DOC company:	Maestro Shipping SA
Classification society:	Lloyd's Register
Year built:	1985
Shipyard/yard number:	Hyundai Heavy Industries Co Ltd – Ulsan/Yard no.: 287
Length overall:	144.630 m
Breadth overall:	23.650 m
Draught max.:	10.002 m
Gross tonnage:	12,401
Engine rating:	7,061kW
Servicefart:	18.00 kts
Hull material:	Steel
Hull design:	Single hull

VOYAGE DATA

Port of departure:	Saint Petersburg, Russia
Port of call:	Off Falmouth for orders
Voyage type:	International
Cargo information:	In ballast
Manning:	22
Pilot on board:	No
Number of passengers:	0

WEATHER DATA

Wind – speed, direction:	5 m/s
Wave - height, direction:	0.5 m/s
Current - speed, direction:	Unknown
Visibility:	50 m
Weather conditions:	Fog
Light/dark:	Daylight

MARINE CASUALTY INFORMATION

Type of marine casualty:	Collision
IMO classification:	Serious
Date and time:	23 September 2020 0946 LT
Location:	One nautical mile south of the Sound, Denmark
Position:	55°30.249' N 012°42.985' E
Ship's operation:	Underway using engine, midwater
Place on board:	Starboard side above waterline
Human factor data:	Yes
Consequences:	Hull breached above waterline into engine room.

SHORE AUTHORITY INVOLVEMENT AND EMERGENCY RESPONSE

Involved parties:	None
Resources used:	None
Speed of response:	N/A
Actions taken:	N/A
Results achieved:	N/A

RELEVANT CREW

Master:	58 years old. Had been employed by the company for 23 years and had served on ICE ROSE for one week.
Chief officer:	25 years old. Had been employed by the company and served on ICE ROSE for three months.