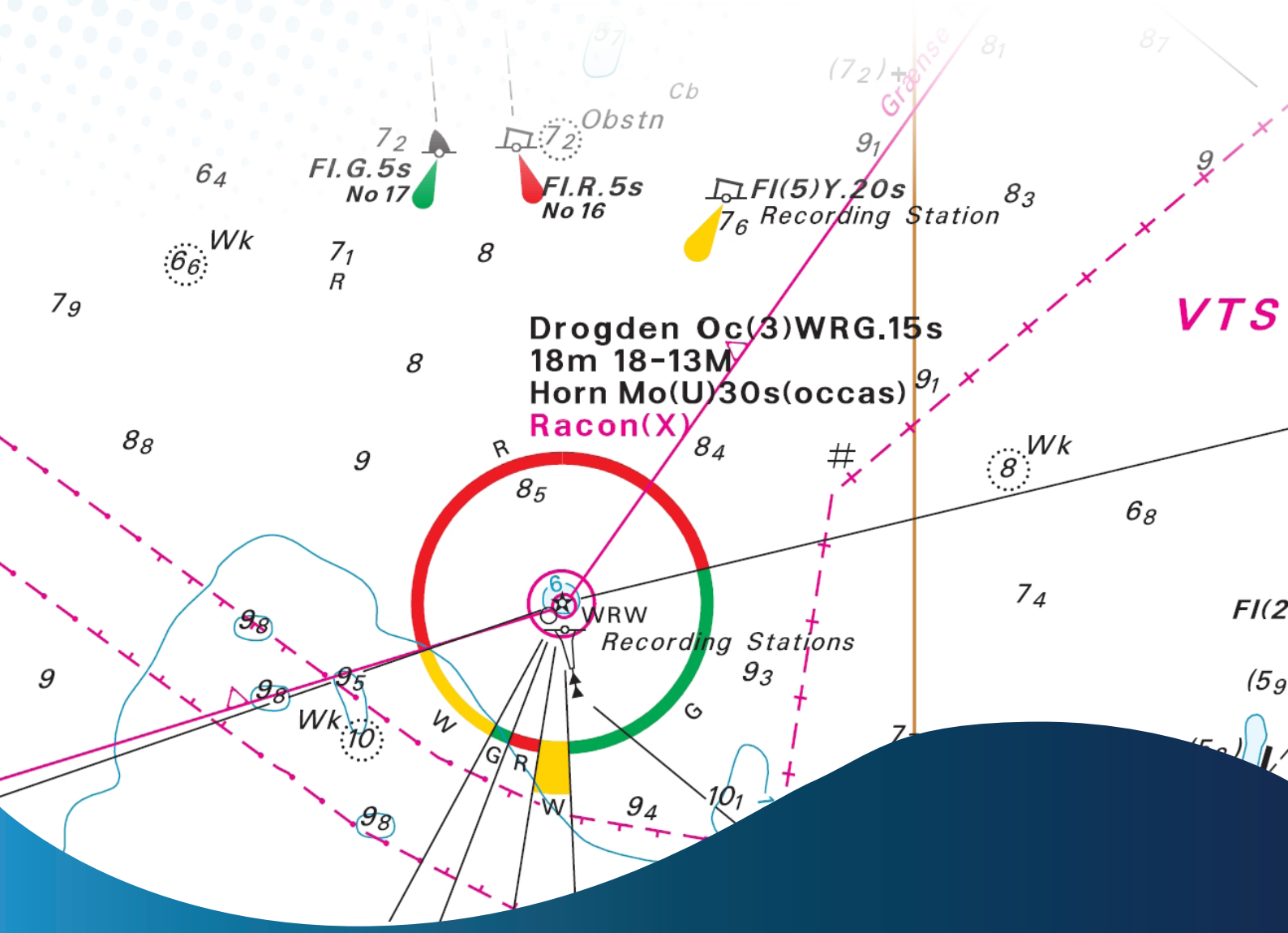
Danish Maritime Accident Investigation Board

MARINE ACCIDENT REPORT
July 2015



ATLANTIC LADY and KRASLAVA
Collision on 1 November 2014

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This marine accident report is issued on 2 July 2015.

Front page: Chart no. 133, Danish Geodata Agency.

This marine accident report is available from the website of the Danish Maritime Accident Investigation Board (www.dmaib.com).

The Danish Maritime Accident Investigation Board

The Danish Maritime Accident Investigation Board is an independent unit under the Ministry of Business and Growth. It carries out investigations as an impartial unit that is, organizationally and legally, independent of other parties. The board investigates maritime accidents and occupational accidents on Danish and Greenland merchant and fishing ships, as well as accidents on foreign merchant ships in Danish and Greenland waters.

The Danish Maritime Accident Investigation Board investigates about 140 accidents annually. In case of very serious accidents, such as deaths and losses, or in case of other special circumstances, either a marine accident report or a summary report is published, depending on the extent and complexity of the events.

The investigations

The investigations are carried out separately from the criminal investigation, without having used legal evidence procedures and with no other basic aim than learning about accidents with the purpose of preventing future accidents. Consequently, any use of this report for other purposes may lead to erroneous or misleading interpretations.

Contents

1. SUMMARY

On 1 November 2014, the Marshall Islands-registered chemical/products tanker KRASLAVA collided in restricted visibility with the St. Kitts & Nevis-registered refrigerated cargo ship ATLANTIC LADY in the Drogden Channel in the southern part of the Sound, Denmark.

The bridge team on each ships was aware of the other ship's presence in the channel, but both misjudged their own and the other ship's position. When the actual situation was acknowledged on both ships, it was too late to manoeuvre to avoid the collision.

In this report, the Danish Maritime Accident Investigation Board (DMAIB) focuses on three main topics in the investigation of the collision: Navigational and collision avoidance measures, geographical properties of the southern area of the Drogden Channel, and the application of COLREG in a close-quarters situation with restricted visibility.

The DMAIB concludes that the collision happened as several coinciding factors were present within a narrow geographical area and occurred within a very short span of time. This reduced the margin for failure to an extent that was not recognized by either of the bridge teams.

A prior analysis of the navigation in the southern approach to the Drogden Channel proved the area difficult to navigate within, and initiatives to improve the flow of traffic were recommended in order to avoid future groundings and allisions with buoys. The DMAIB emphasizes that this accident shows that these initiatives could also mitigate the risk of collision.

2. FACTUAL INFORMATION

2.1 Photos of the ships

Figure 1: KRASLAVA
Photo: Ulf Kornfeld

Figure 2: ATLANTIC LADY
Photo: Lars Brunkman

2.2 Ship particulars

KRASLAVA

Name of vessel:	KRASLAVA
Type of vessel:	Chemical/products tanker
Nationality/flag:	Marshall Islands
Port of registry:	Majuro
IMO number:	9314844
Call sign:	V7LI7
DOC company:	Scorpio Handymax Tanker Pool Ltd.
IMO company no. (DOC):	5545017
Year built:	2007
Shipyard/yard number:	Hyundai Mipo Dockyard Co. Ltd./KRS086
Classification society:	Lloyd's Register
Length overall:	182.55 m
Breadth overall:	27.385 m
Gross tonnage:	23,315
Deadweight:	37,258 t
Draught max.:	11.2 m
Engine rating:	9,488 kW
Service speed:	14.5 knots
Hull material:	Steel
Hull design:	Single hull

ATLANTIC LADY

Name of vessel:	ATLANTIC LADY
Type of vessel:	Refrigerated cargo ship
Nationality/flag:	St. Kitts & Nevis
Port of registry:	Charlestown
IMO number:	8500630
Call sign:	V4JY2
DOC company:	Refrybflot Shipping Co
IMO company no. (DOC):	5375140
Year built:	1986
Shipyard/yard number:	Gdansk Sa, Stocznia/POL002
Classification society:	Russian Maritime Register
Length overall:	139.69 m
Breadth overall:	19.99 m
Gross tonnage:	8,864
Deadweight:	6,333 t
Draught max.:	7.4 m
Engine rating:	6.549 kW
Service speed:	18.00 knots
Hull material:	Steel
Hull design:	Single hull

2.3 Voyage particulars

KRASLAVA

Port of departure:	Tenerife, Spain
Port of call:	St. Petersburg, Russia
Type of voyage:	International
Cargo information:	In ballast
Manning:	22
Pilot on board:	Yes
Number of passengers:	0

ATLANTIC LADY

Port of departure:	St. Petersburg, Russia
Port of call:	Fishing grounds near Bear Island, Norway
Type of voyage:	International
Cargo information:	In ballast
Manning:	23
Pilot on board:	No
Number of passengers:	0

2.4 Marine casualty or incident information

KRASLAVA

Type of marine casualty/incident:	Collision
IMO classification:	Serious
Date, time:	1 November 2014 at 1319 (UTC)
Location:	The Sound, southern part, Denmark
Position:	55 32.0' N 012 42.5' E
Ship's operation, voyage segment:	Mid-water
Place on board:	Bow and forecastle
Human factor data:	Yes
Consequences:	Breach of hull and substantial damage to anchor and forecastle area

ATLANTIC LADY

Type of marine casualty/incident:	Collision
IMO classification:	Serious
Date, time:	1 November 2014 at 1321(UTC)
Location:	The Sound, southern part, Denmark
Position:	55 32.0' N 012 42.5' E
Ship's operation, voyage segment:	Mid-water
Place on board:	Superstructure and hull
Human factor data:	Yes
Consequences:	Substantial damage to accommodation and deck areas.

2.5 Relevant crew

KRASLAVA

Master:	Certificate of competency STCW II/2. 31 years old. Had been at sea for 10 years and had worked 8 years for the shipping company, thereof 3 years on KRASLAVA. This was his second contract as a master.
2nd officer:	Certificate of competency STCW II/2. 30 years old. Had been at sea for 9 years and had worked 8 years for the shipping company, thereof approximately 1 year on KRASLAVA.
Pilot:	Certificate of competency STCW II/2. 43 years old. Had been at sea for 16 years and had 10 years of experience as a pilot.

ATLANTIC LADY

Master:	Certificate of competency STCW II/2. 58 years old. Had been at sea for approximately 40 years and had served 10 years on ATLANTIC LADY.
Chief officer:	Certificate of competency STCW II/2. 56 years old. Had been at sea for approximately 30 years and had served 3 years on ATLANTIC LADY. Had been employed by the shipping company for 11 years.

2.6 Shore authority involvement and emergency response

Involved parties:	Naval Home Guard
Resources used:	CARINA MHV-802 HVIDSTEN MHV-907
Speed of response:	One hour
Actions taken:	Oil spill observations. None observed.

2.7 Weather data

Wind – direction and speed:	Southerly 5 m/s
Wave height:	0.5 m
Visibility:	100 m
Light/dark:	Light
Current:	North-easterly 2.0 knots

2.8 Scene of the accident

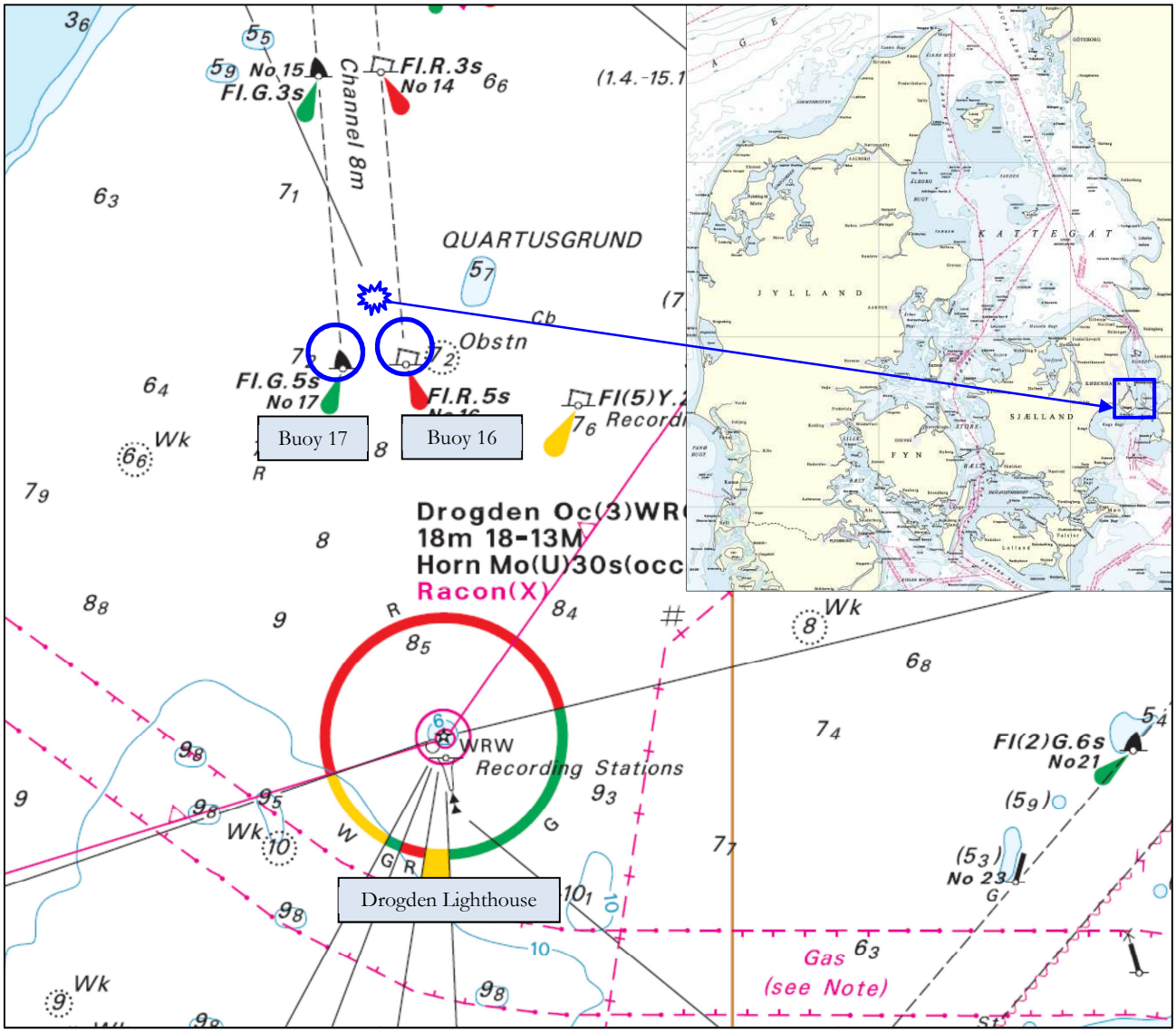

Figure 3: Scene of the collision. Southern part of the Sound, Denmark
Source: Chart no 133, Danish Geodata Agency

3. NARRATIVE

3.1 Background KRASLAVA

KRASLAVA was on a world-wide charter, mainly carrying gas oil and heavy fuel oil between various European ports.

On KRASLAVA there were three navigational officers apart from the master. The bridge watch was a 4-hours-on and 8-hours-off watch schedule.

Statements of time in this report are given in local time in Denmark (UTC+1), unless otherwise specified.

3.2 Sequence of events on KRASLAVA

The following events are based on the accounts and perspectives of the bridge team members on KRASLAVA.

On 25 October 2014 at 0406 LT, KRASLAVA departed Tenerife, Spain, after having completed discharging, and proceeded in ballast to St. Petersburg, Russia, where it was to load heavy fuel oil.

During the morning of 1 November 2014, KRASLAVA was proceeding southward in the Kattegat, Denmark, heading for the sound between Denmark and Sweden (the Sound), where an "In the Sound" pilot was to be embarked for piloting the ship through the Sound. The master arrived on the bridge at 1030 and assumed command of the ship. From then on, the master manned the bridge together with the navigational officer and the helmsman.

The pilot station had notified the bridge team on KRASLAVA one hour earlier that the boarding speed for picking up the pilot was 8-9 knots and that the visibility in the Sound was approximately 1 nm.

At 1054, the pilot boarded the ship at Elsinore pilot station. Immediately after arriving on the bridge, the master and pilot exchanged information about the ship's particulars, course and speed. The ship's draught was noted to be 5.90 metres forward and 6.80 metres aft. Thereafter, the pilot signed the pilot information exchange card.

KRASLAVA proceeded southbound through the Sound at full speed due to the strong head wind (southerly, force 5). The speed was 12-13 knots over the ground.

During the passage, the pilot was standing at the port side radar and the ECDIS[1], but was using his own ECS[2] on his laptop. The master was standing at the starboard side radar and ECDIS, and the helmsman was at the helm, steering the ship manually. The navigational officer was continuously plotting the positions in the paper chart using GPS and terrestrial navigation.

[1] Electronic Chart Display & Information System.
[2] Electronic Chart System.

Early on, the pilot notified the master about the coming navigation and that dense fog could be expected in some areas. Therefore, the fog signal was activated. During the passage there was a continuous exchange between the pilot and the master about how to navigate in the different areas and which route to use. The master requested the pilot to give 15 minutes' notice before he asked for a speed reduction for disembarking.

At approximately 1150, the 2nd officer came to the bridge to relieve the 3rd officer.

At 1342, before entering the Drogden Channel, the pilot recommended that the AIS[3] output was set to "constrained by draught".

As KRASLAVA was approaching the Drogden Channel, the fog became increasingly dense and the visibility was reduced to approximately 100 metres. The pilot gave 15 minutes' notice for reducing the speed due to the restricted visibility, the forthcoming navigation in the narrow channel and the increasing squat effect due to the shallow water in the channel.

At 1352, after having entered the Drogden Channel, the speed was reduced to about 9 knots over the ground. Meanwhile, on deck, an able seaman (AB) and the bosun prepared the starboard side combination ladder and proceeded to the forecastle to prepare the anchors, and to stand by if the ship lost steering and/or propulsion.

While in the northerly part of the channel, KRASLAVA passed a ship port-to-port on opposite courses at a distance of approximately 100 metres. The passing ship was not in sight from KRASLAVA.

As KRASLAVA proceeded to the exit of the Drogden Channel, ATLANTIC LADY was noticed on the radar approaching Drogden Lighthouse, south of the Drogden Channel (figure 3). The bridge team assumed that ATLANTIC LADY's intention was to pass the lighthouse on the port side and then make a starboard turn to enter the Drogden Channel, passing close to buoy no. 16. The pilot had seen ATLANTIC LADY before, while piloting ships in the sound, and was therefore familiar with it. The pilot did not observe anything irregular about ATLANTIC LADY's approach to the Drogden Channel, which seemed to be in accordance with normal practice when navigating in the area.

Simultaneously, the pilot boat DANPILOT STELLA POLARIS was approaching KRASLAVA's starboard side preparing to embark the pilot.

When KRASLAVA was approaching buoys 16 and 17 (figure 3), ATLANTIC LADY was seen on the radar passing close to buoy 16, presumably with the intention of turning to starboard after having passed the buoy. At this time was the visibility from the bridge on KRASLAVA approximately 70 metres.

After ATLANTIC LADY had passed close to buoy 16, it did not turn as expected, but proceeded towards KRASLAVA. Twenty seconds before the collision, the master on KRASLAVA expressed his concerns to the pilot about ATLANTIC LADY's intentions.

[3] Automatic Identification System.

At 14:19:38, the bridge crew could visually observe ATLANTIC LADY approaching from the port side and crossing ahead of KRASALVA at close quarters. At this stage, it was too late to avoid the collision, and no attempt was made to turn the ship. Immediately after, KRASLAVA's starboard bow collided with ATLANTIC LADY's starboard side.

The bridge team on KRASLAVA, including the pilot, was convinced that ATLANTIC LADY had passed across the channel towards the western part of the channel ahead of KRASLAVA as illustrated below in figure 4.

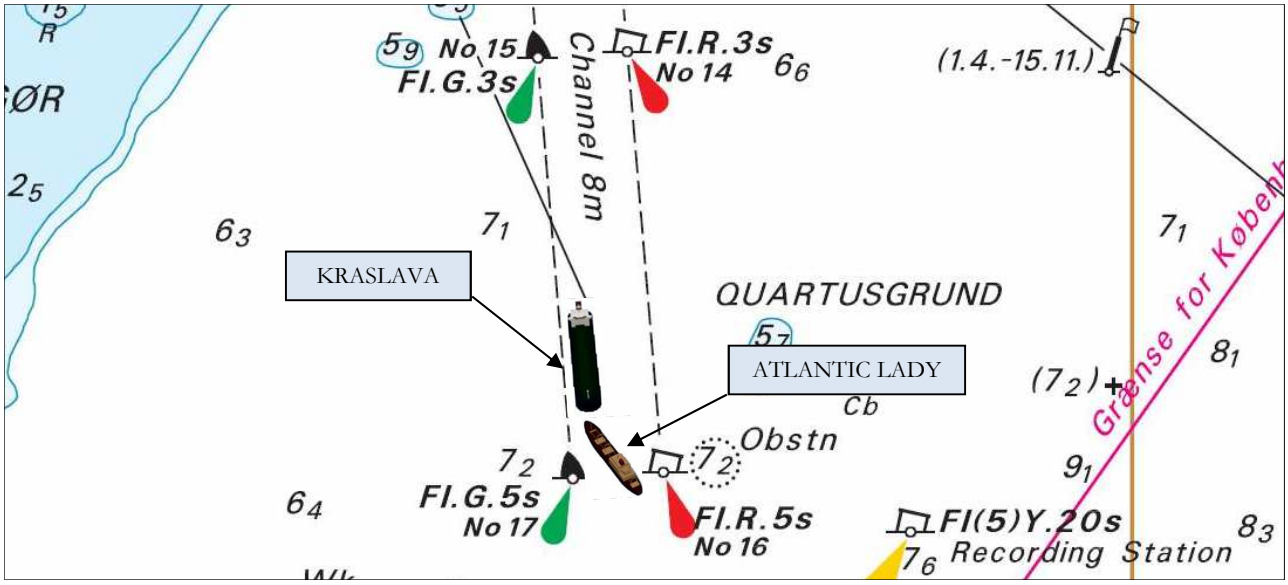

Figure 4: Perception of the collision – KRASLAVA bridge team perspective (not to scale)
Source: DMAIB/Chart no 133, Danish Geodata Agency

After the collision, the bridge team was immediately concerned about the crewmembers on the forecastle and tried to contact them by radio, but there was no reply. Fearing the worst, the 2nd officer went to the forecastle and met the bosun, who informed her that he had had to jump from the forecastle to the main deck, and had therefore lost his radio.

Immediately after the collision, the pilot called the Sound VTS and reported the collision. The VTS replied that they would advise the Admiral Danish Fleet about the accident.

The speed was reduced to 5 knots, and the crew immediately started to assess the damage. After the situation had stabilized, KRASLAVA anchored off Dragoer, Denmark, which was near the position of the collision

During the subsequent investigation by the DMAIB, no deficiency was found on the ship's steering.

3.3 Background ATLANTIC LADY

ATLANTIC LADY was on a regular trade between Russian ports and the Barents Sea, carrying packaging material to fishing ships and carrying frozen fish in refrigerated cargo holds on the return voyage.

ATLANTIC LADY had three navigational officers apart from the master. The bridge watch was a 4-hours-on and 8-hours-off watch schedule.

3.4 Sequence of events on ATLANTIC LADY

The following events are based on the accounts and perspectives of the involved crewmembers on ATLANTIC LADY.

On 30 October 2014 at 1700 (UTC), ATLANTIC LADY departed St. Petersburg, Russia, heading for the fishing grounds near Bear Island, Norway. It was carrying a small quantity of packaging material for a Russian fishing ship and was therefore in ballast condition.

The voyage through the Baltic Sea was considered routine. The bridge crew on ATLANTIC LADY had frequently been in Danish waters, and the bridge team was experienced in navigating the waters of the Sound, Denmark. As the master and chief officer had frequently navigated the Sound before, without any incidents, they did not consider it necessary to use a pilot.

On 1 November 2014, during the passage of the Sound, the bridge was manned with the master, chief officer, 2nd officer and helmsman. The ship's draught was 4.7 metres forward and 6.8 metres aft, and the ship was therefore constrained by the draught, and had to stay within the boundaries of the Drogden Channel.

The master was in command and was standing close to the helmsman at the centre of the bridge. The 2nd officer was standing at the portside conning station, and the chief officer was standing at the starboard conning station.

As ATLANTIC LADY approached the Drogden Lighthouse south of the Drogden Channel (figure 3), there was a dense fog, and the visibility was significantly reduced. The reduced visibility was not considered to pose a significant risk, because there was only sparse traffic in the area.

KRASLAVA was observed on the ECS/AIS and on the radar passing buoy no. 10 in the Drogden Channel. Based on the master's experience, he presumed that KRASLAVA would hold a position on the westerly side of the channel, thereby allowing ATLANTIC LADY to turn into the eastern side of the channel. Simultaneously, a pilot boat was observed approaching KRASLAVA.

The plan was to pass close to buoy 16 and then turn northwards, holding a position on the eastern side of the channel.

The chief officer, standing on the starboard side, notified the master that buoy no. 16 had been passed at approximately 30 metres from the starboard side. Within seconds, the chief officer observed KRASLAVA ahead of ATLANTIC LADY's starboard bow. The master immediately ordered a hard starboard turn. The turn was initiated too late to avoid the collision, and the bow of ATLANTIC LADY passed KRASLAVA on a crossing course. At 1419, ATLANTIC LADY's accommodation and deck area made contact with KRASLAVA's starboard bow and anchor.

The master and chief officer were convinced that KRASLAVA was positioned too far to the east as illustrated below in figure 5.

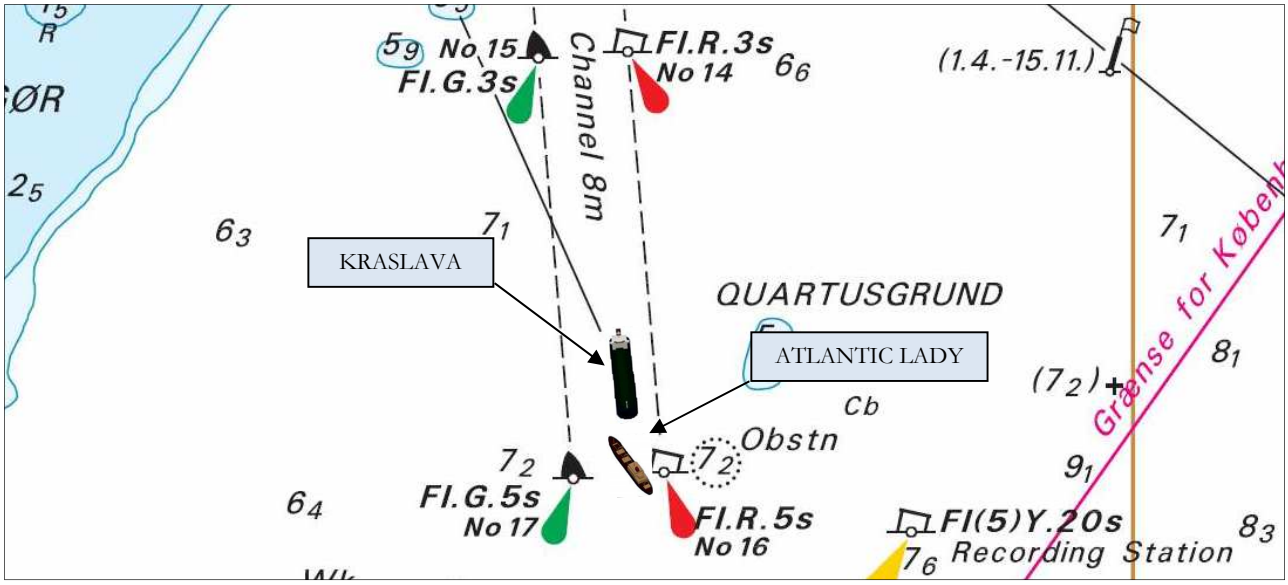

Figure 5: Perception of the collision – ATLANTIC LADY bridge team perspective (not to scale)
Source: DMAIB/Chart no 133, Danish Geodata Agency

Sound VTS contacted ATLANTIC LADY and was notified about its intention to anchor off Copenhagen. The masters on ATLANTIC LADY and KRASLAVA had a brief conversation to exchange information about ship particulars and contact information.

After the collision, ATLANTIC LADY continued approximately 10 nm north and anchored at Copenhagen anchorage, while assessing the damage on the hull to determine if there was any water ingress.

During the subsequent investigation by DMAIB no deficiency was found on the ship's steering.

3.5 Damage

3.5.1 KRASLAVA

KRASLAVA was mainly damaged on the starboard side of the bow and forecastle, with indentations starting from under the hawse pipe and proceeding aftwards (figure 6). Several frames in the forepeak tank and bosun store under the forecastle were bent, and the hull had been penetrated in a horizontal line of 3-4 metres, approximately 7 metres above sea level. The damage to the anchor and anchor hawse was 10-12 meters above sea level. The anchor chain stopper locking pin was bent (figure 7), indicating that the anchor had been pulled when it made contact with ATLANTIC LADY.

Figure 6: Damages on KRASLAVA
Source: Danish Naval Home Guard

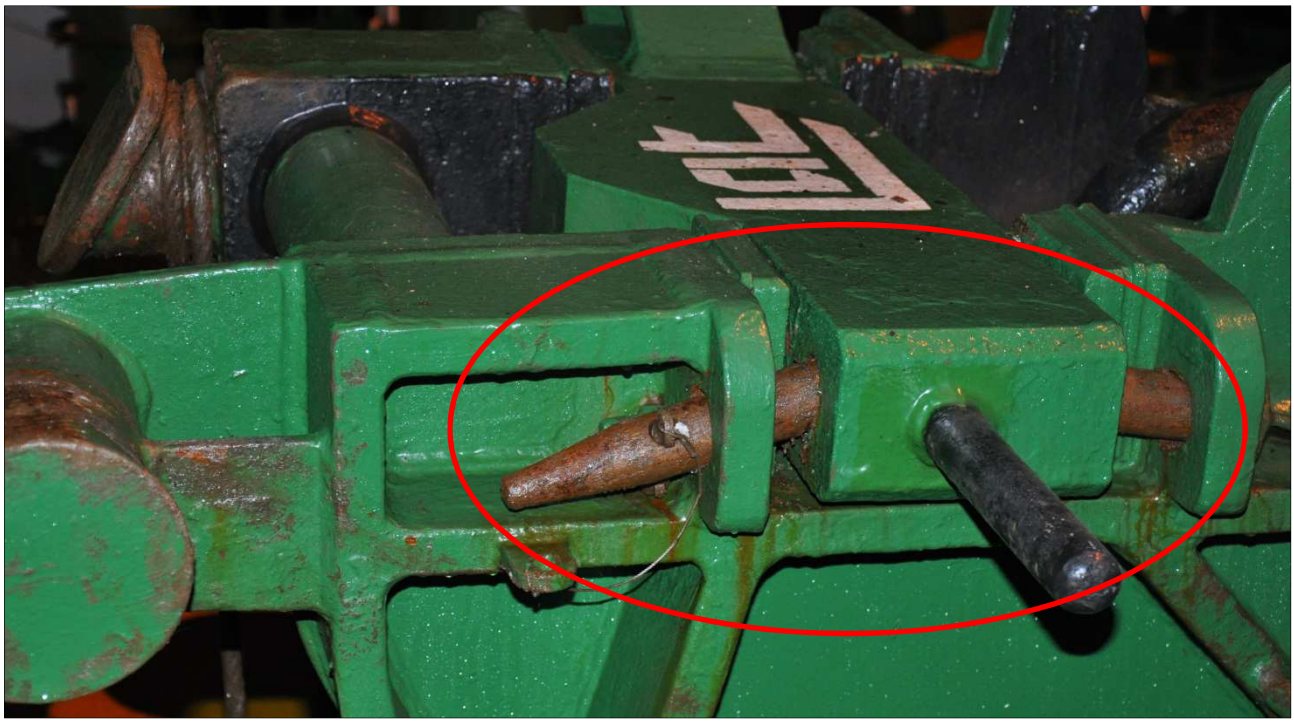

Figure 7: Bent chain stopper locking pin
Source: DMAIB

3.5.2 ATLANTIC LADY

The hull of ATLANTIC LADY on the starboard side was damaged from amidships to aft of the accommodation (figure 8). There were only minor penetrations of the hull amidships and by the gangway, which was torn off. The accommodation had suffered extensive damage 10-12 metres above sea level, from the upper deck up to the deck below the bridge. Specifically, three cabins on the deck above the upper deck were substantially damaged (figure 9). No crewmembers were in the cabins at the time of the collision, because it occurred during normal working hours.

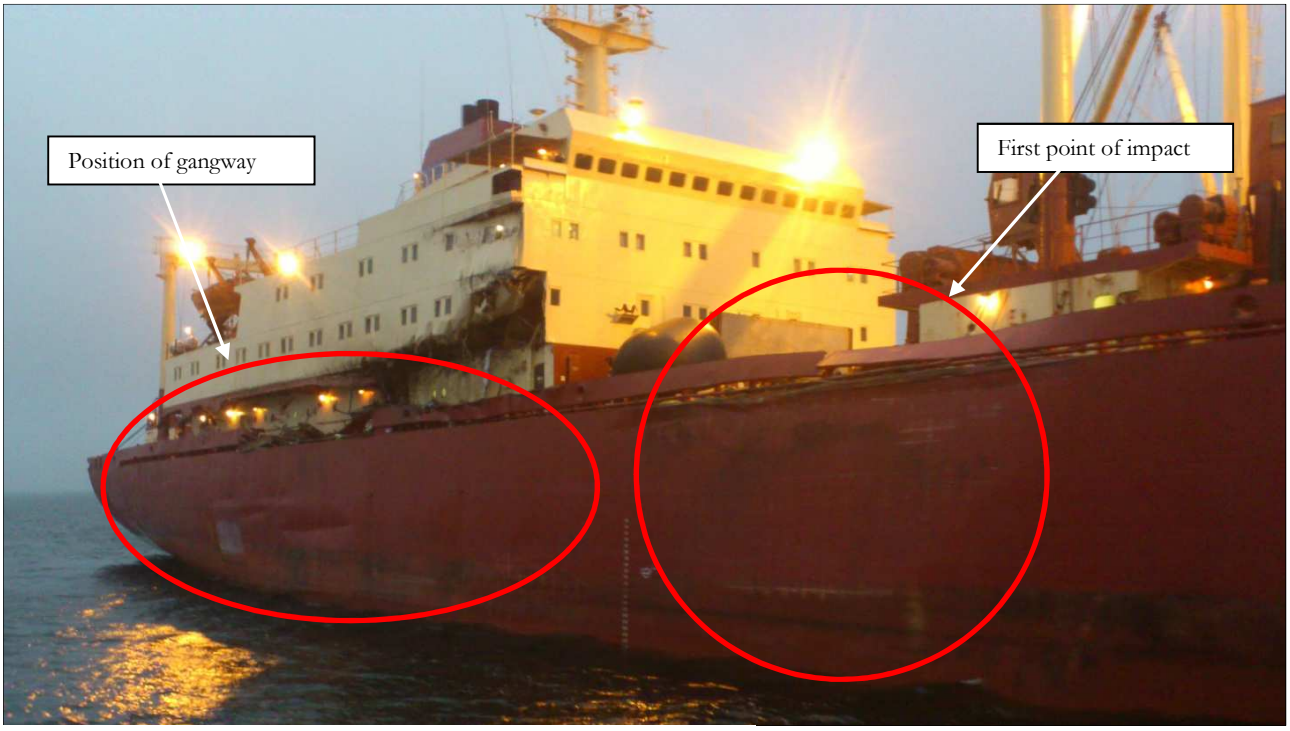

Figure 8: Damage on ATLANTIC LADY
Source: Danish Naval Home Guard

Figure 9: Damage on ATLANTIC LADY
Source: Danish Naval Home Guard

3.5.3 The impact and damage

At the time of the collision, KRASLAVA had a heading of 180°, and ATLANTIC LADY had a heading of 332°. The angle of collision was therefore approximately 28°, which meant that the collision was in an acute angle that to some extent deflected the impact. The initial impact on ATLANTIC LADY was at the hull amidships, which caused surface damage to the hull but no penetration of the plating. Because KRASLAVA did not have a bulbous bow, the damage to the hull was limited.

After the initial impact, both ships still had a forward momentum. The heading of both ships changed to almost the opposite direction, so the anchor and anchor hawse on KRASLAVA came into contact with the accommodation on ATLANTIC LADY. The anchor on KRASLAVA was 10-11 metres above the water surface, which is consistent with the damage to ATLANTIC LADY's accommodation, which was about 10-12 metres above sea level.

Neither of the ships lost manoeuvrability, and they were therefore able to proceed to safe anchorage.

3.6 Automatic Identification System (AIS) data from KRASLAVA and ATLANTIC LADY

KRASLAVA and ATLANTIC LADY were equipped with AIS. The quality of the retrieved AIS data from both ships has been deemed to be valid, because the AIS transmissions were found to be consistent over several hours. The data have been considered credible, because they are concordant with other collected data.

The navigation of both ships in the period leading up to the collision could therefore be re-constructed from the true course and speed transmitted by the AIS.

At the time of the accident, the current in the area was north-north-east 2.0 knots and the wind was 7-8 m/s from south-south-east. The wave height was 0.4 metres from south-south-east. The visibility varied, but was approximately 100 metres, measured from the bridge of both ships.

In figures 10 and 11 below, the AIS tracks from KRASLAVA and ATLANTIC LADY are illustrated from approximately 14:16:00 until 14:18:30, when the collision occurred. It should be noted that the ships in the screenshots (1-3) are not to scale in relation to the chart. KRASLAVA had a length of 182 metres, and ATLANTIC LADY 139 metres.

The distance between the red buoy no. 16 and green buoy no. 17 at the southern entrance/exit to the Drogden Channel was approximately 300 metres (figure 10).

Screenshot 1: Both ships were approaching the southern entrance/exit to the Drogden Channel. The pilot boat DANPILOT STELLA POLARIS was positioned alongside KRASLAVA, while assessing the conditions for bringing the pilot on board.

Screenshot 2: ATLANTIC LADY was approaching buoy 16 on the starboard side at a distance of approximately 20-30 metres. The intention was to initiate a starboard turn after the buoy was in sight and abeam.

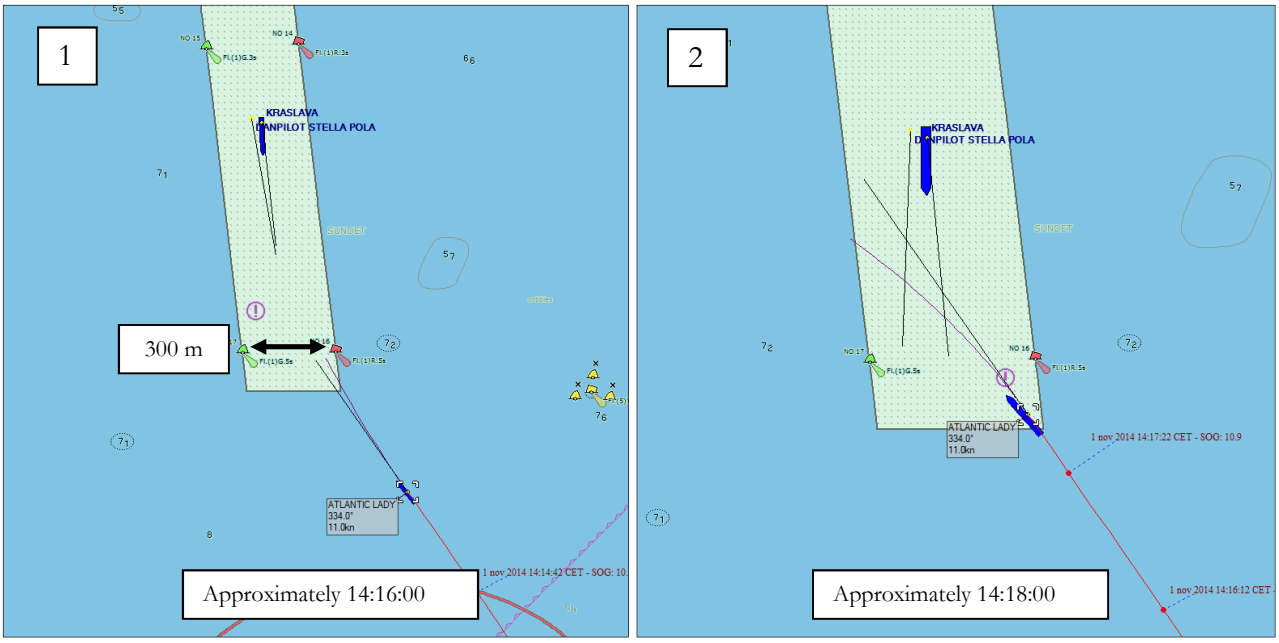

Figure 10: AIS tracks of KRASLAVA and ATLANTIC LADY prior to the collision
Source: Danish Maritime Authority

Screenshot 3. On both ships the perception was that they were positioned on the outward outer part of the channel, and that the other ship was on the wrong side of the channel. As it is seen on screenshot 3 below, the collision occurred more or less in the middle of the channel.

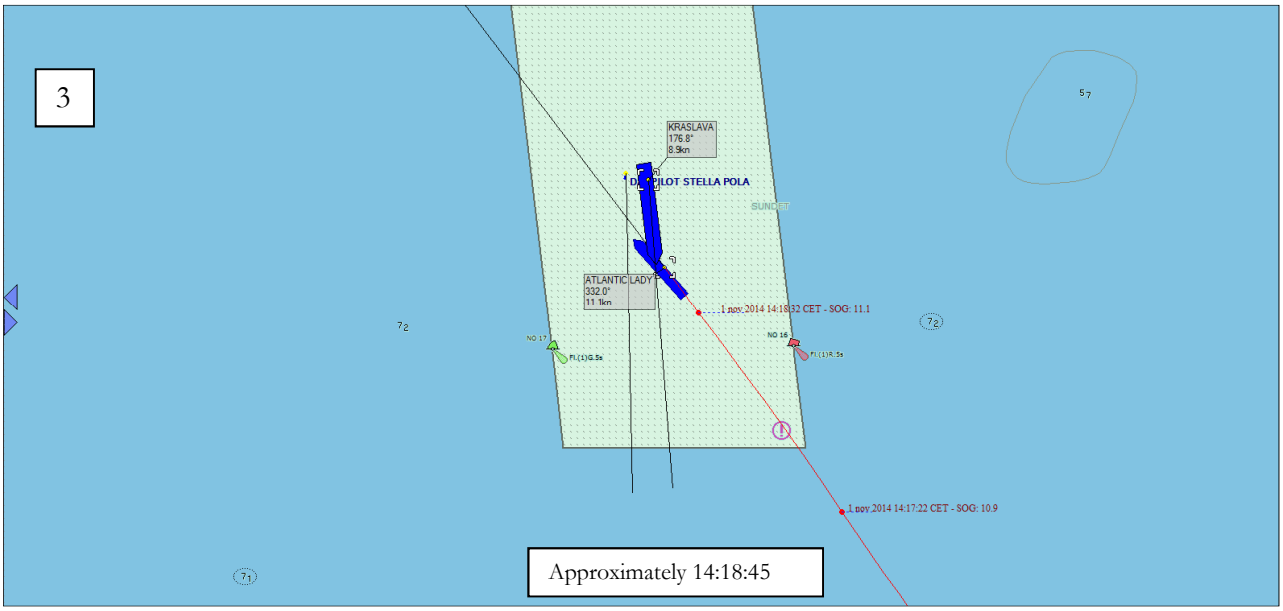

Figure 11: AIS tracks of KRASLAVA and ATLANTIC LADY at the time of the collision
Source: Danish Maritime Authority

3.7 Navigation and collision avoidance on KRASLAVA

During the voyage through Danish waters, the pilot was positioned at the port side conning station (figure 12) and the master was on the starboard side. Both conning stations had an ECDIS and a radar display. The 2nd officer was moving around on the bridge, tasked with plotting positions on the paper chart, and was not involved in the monitoring of the other ship's manoeuvres.

Figure 12: Bridge on KRASLAVA
Source: DMAIB

The navigation on KRASLAVA was based primarily on the ECDIS and, secondly, on paper charts, where the positions were plotted continuously by the 2nd officer during the pilotage. The positions on the paper charts were plotted by using both terrestrial navigation and GPS positions. Although the VDR confirmed that the ECDIS displayed the ship's position accurately, then the screen would not have been sufficiently zoomed in to give full recognition of the ship's position of in the channel, taking the small distances into account. Focus was on the forthcoming navigation when exiting the channel and disembarking the pilot.

During the passage of the Sound and Drogden Channel, the pilot mainly used the port side radar for navigation and to some extent his own ECS that was connected to the ship's GPS. On the day of the accident, the buoys were not visible due to the fog, and the pilot was concerned about getting too close to them. This may have contributed to the ship being positioned further to the centre of the channel.

In figure 13 below is a screenshot from the X-band radar extracted from the VDR[4], which was the only radar configured in the VDR.

[4] Voyage Data Recorder.

The time shown in the screenshot from the radar is 1318 UTC, i.e. approximately 30 seconds before the collision. KRASLAVA is seen on a southerly course and ATLANTIC LADY on a north-westerly course. KRASLAVA's heading was 180.4° and the course over the ground was 176.7°. The range was set to 1.5 nm with 0.25 nm distance rings.

The buoys no. 16 and 17 in the southern entrance/exit from the Drogden Channel are marked with red circles.

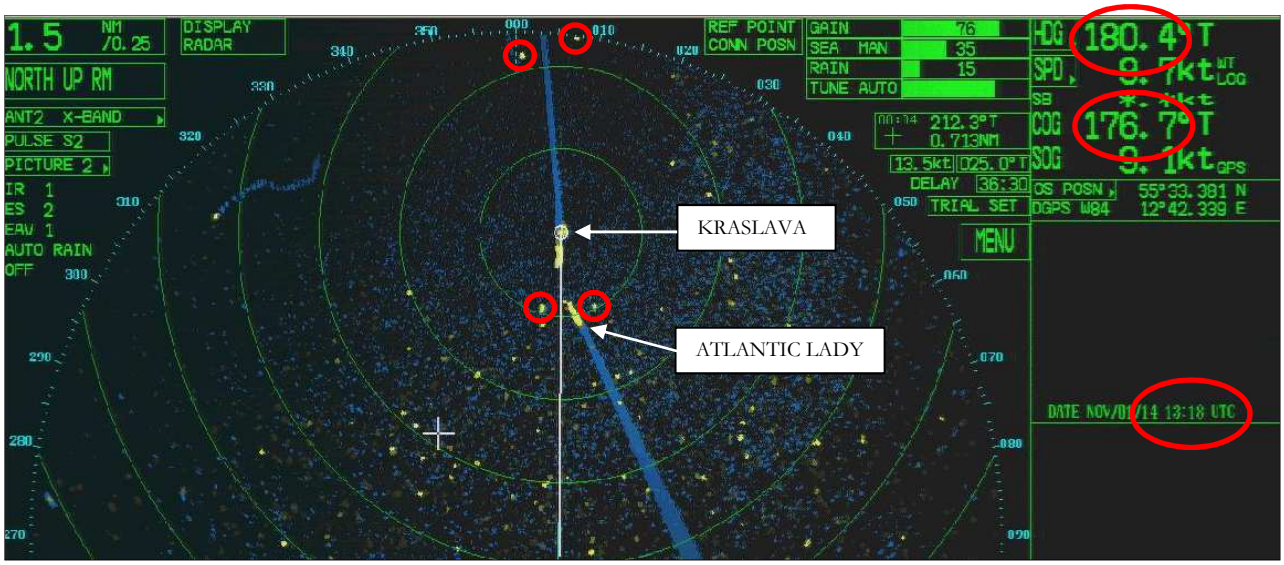

Figure 13: Extract from X-band radar on KRASLAVA
Source: DMAIB

On KRASLAVA the difference between the steered and true course, mainly caused by the north-easterly current, to some degree affected the navigation. In the minutes before the collision, there was a continuous difference of 3-5 degrees between KRASLAVA's steered course and true course.

A course over the ground of 175-177 degrees kept KRASLAVA approximately parallel with the buoys and in the centre of the channel. The pilot boat is not seen in the screenshot, because it is alongside KRASLAVA and is therefore below the radar's coverage.

KRASLAVA's speed was reduced to 8-10 knots due to the navigational circumstances, and was furthermore the usual speed for disembarking pilots "In the Sound".

The X-band radar was fitted on the port side conning station, where the pilot was standing. He did not plot ATLANTIC LADY. Plotting the radar echo of ATLANTIC LADY would in these circumstances not have been useful for determining the risk of collision, because the ARPA[5] function is not accurate enough to give reliable information about the risk of collision in close-quarters situations. Furthermore, ATLANTIC LADY was about to manoeuvre, which would further increase the uncertainty of the ARPA data.

[5] Automatic Radar Plotting Aid.

From the VDR voice recording it could be established that the pilot and the master had a common understanding of the situation at hand. From the moment the master expressed concerns about the intentions of ATLANTIC LADY, the pilot responded immediately with similar concerns.

3.8 Navigation and collision avoidance on ATLANTIC LADY

Navigation was based on paper charts, supported by one ECS display slightly off centre to the port side of the bridge (figure 14). There were two radars, one on each side of the bridge operated by the officer of the watch and the chief officer. The chart table was situated aft of the conning stations and behind a wall with small windows. These provided a limited view out of the bridge front end windows while standing at the chart table.
Even though ATLANTIC LADY was fitted with a VDR, no data were available from the time of the accident.

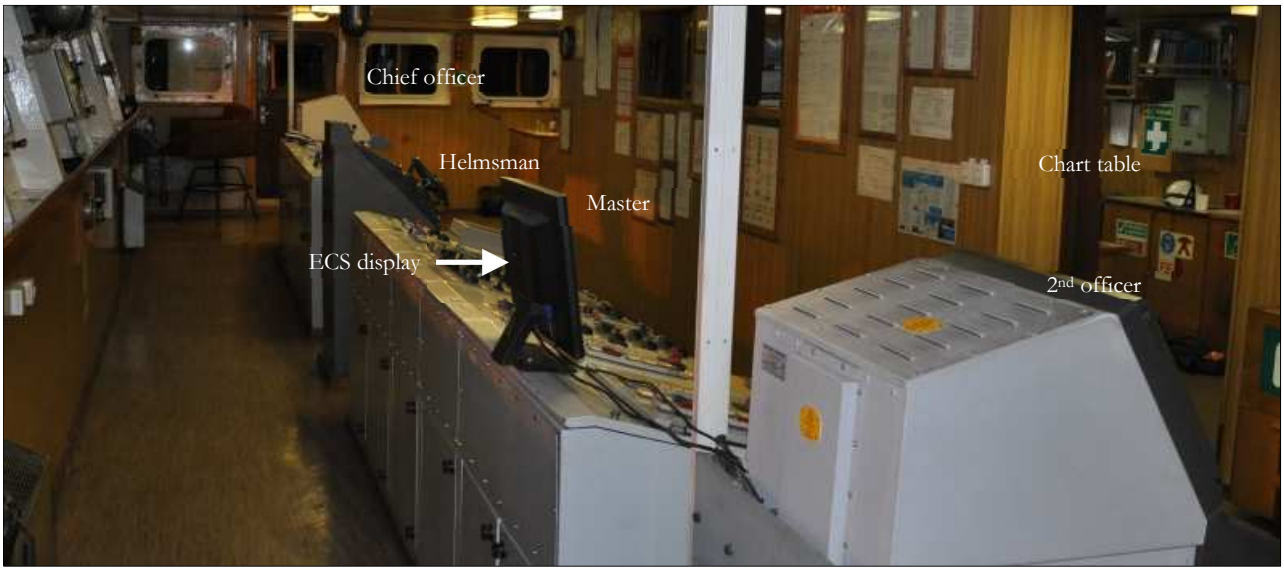

Figure 14: Bridge on ATLANTIC LADY
Source: DMAIB

The approach to the entrance of the Drogden Channel was east of the planned route in order to enter the canal close to buoy 16. This enabled the ship to be turned onto a northerly course while being on the easterly side of the channel (figure 15). After having passed Drogden Lighthouse, ATLANTIC LADY's course was aligned with buoy no. 16, so it could be used as a turning point when entering the Drogden Channel. The speed during the approach was approximately 11-12 knots.

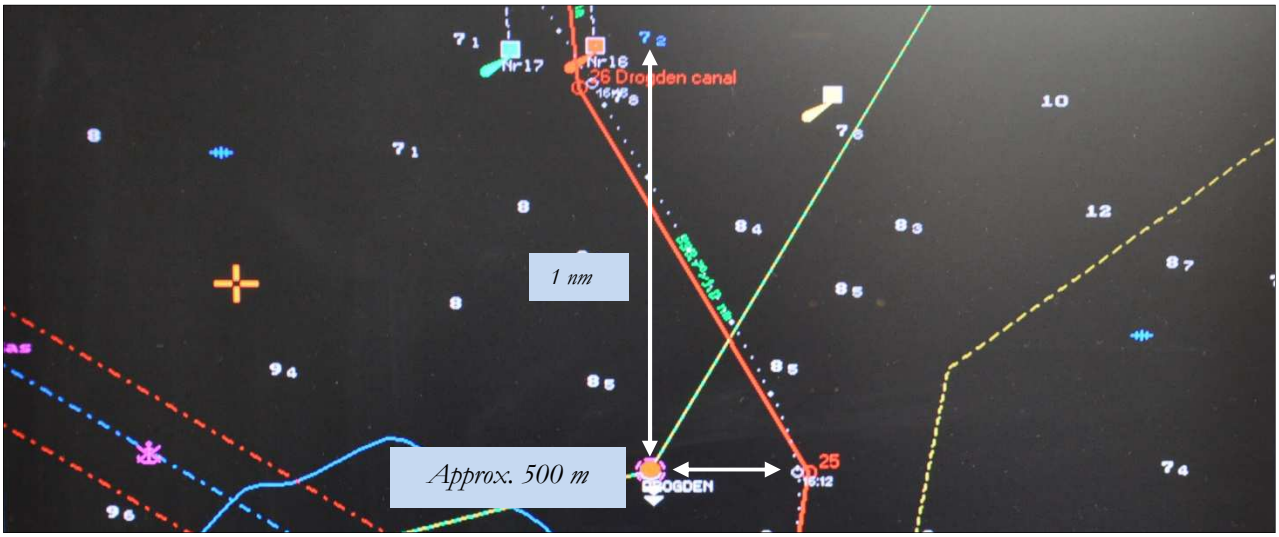

Figure 15: AIS track and planned course – ATLANTIC LADY
Source: DMAIB

The position of Drogden Lighthouse made it necessary for ATLANTIC LADY to manoeuvre in such a way that the turn into the Drogden Channel could only be started after having visually observed and passed buoy no. 16 at the entrance to the channel. At a speed of 11 knots, the late turn would bring the ship closer to the centre line of the channel. It was not possible for ATLANTIC LADY to align the course with the Drogden Channel earlier, because Drogden Lighthouse was positioned 1 nm south of the channel, as seen in figure 15 above.

ATLANTIC LADY continued to the western perimeter of the channel due to the impact from the collision.

3.9 Navigation in the Drogden Channel

The traffic separation scheme "In the Sound", between Denmark and Sweden, regulates the shipping route in the northern part of the Sound. This route is one of the two major passages to and from the Baltic Sea. In Ships' Routing, Part C - Deep-water routes, Section 1 - Baltic Sea and adjacent waters, there are recommendations on the navigation through The Sound. It is recommended that certain ships make use of the pilotage services in the Sound, established by the governments of Denmark and Sweden. Neither KRASLAVA nor ATLANTIC LADY was within the scope of that recommendation.

The southern part of the Drogden Channel and the Drogden Lighthouse are seen in figure 14 below. Approximately 30,000 ships pass the channel southbound or northbound annually. Northbound ships usually navigate east of the lighthouse and enter the Drogden Channel close to buoy no. 16. There have been frequent allisions with buoy 16[6], because northbound ships, approaching the channel east of Drogden Lighthouse, have difficulty positioning themselves properly before entering the channel when there is a north-easterly current. The number of allisions has, however, been significantly reduced. In the period 2008-2014 where there were 9 allisions due to various initiatives.

[6] Risk and cost-benefit analysis (2006). Ramboll, Virum.

The western approach to the channel is typically used when there is no immediate southbound traffic in the channel, because the course alignment with the Drogden Channel is more expedient.

The pilot normally disembarks just south of the entrance to the channel, i.e. south of buoy no. 17 (figure 16).

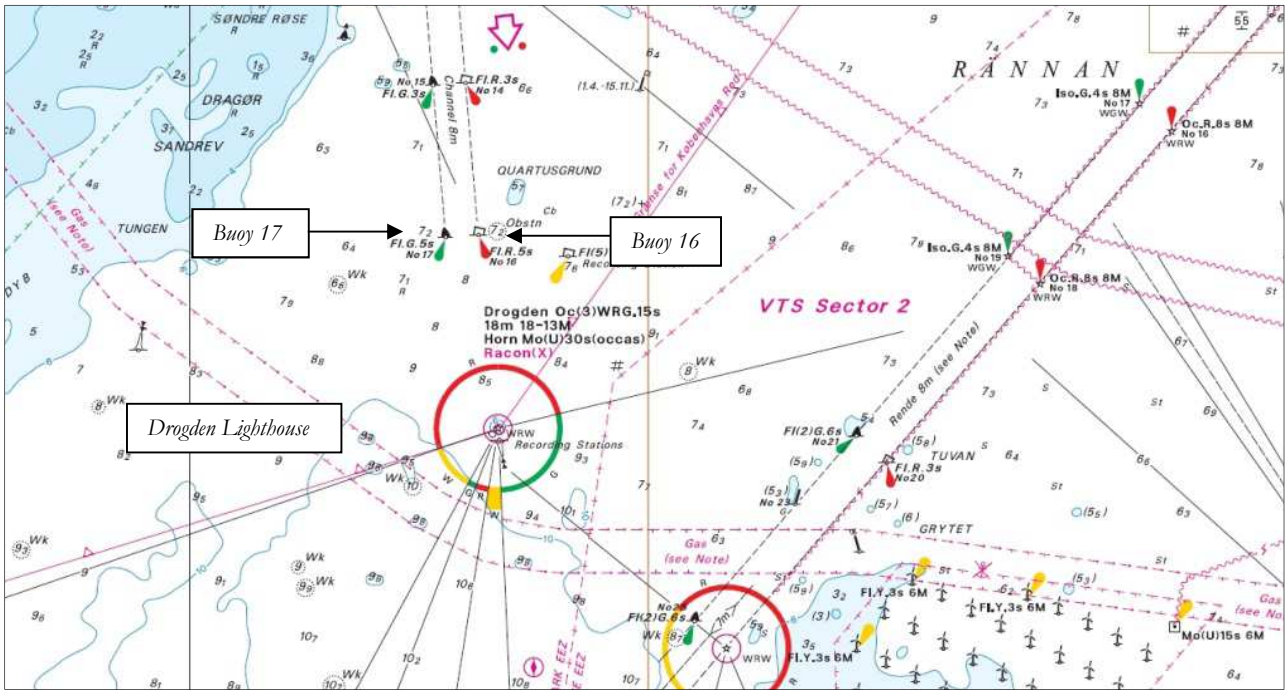

Figure 16: Drogden Channel and Drogden Lighthouse. Extract from chart 133
Source: Danish Geodata Agency

In 2009, the Danish Maritime Safety Administration[7] made a qualitative analysis of navigation in the Drogden Channel. The analysis was made with three different ships of varying size.

It was observed that an approach to the channel from the south could be hazardous, resulting in allision with Drogden Lighthouse, the light buoys and grounding. The hazards were related to the predominant north-easterly current, which made an approach to the channel from east of Drogden Lighthouse problematic. This was because it affected the ships in such a way that it was necessary to have a relatively high speed and perform a large course alteration (20 degrees) just before entering the channel. At a low speed, the ships were affected more by the current, necessitating an even larger course alteration.

The report recommended, among other initiatives, that Drogden Lighthouse should be replaced with a light buoy, and a funnel should be marked on the sea chart aiding the flow of north and south-bound traffic.

[7] In 2011, the Danish Maritime Safety Administration was abolished, and the different areas of responsibility were transferred to the Danish Maritime Authority, Ministry of Defense, Danish Geodata Agency, Ministry of Climate, Energy and Building.

3.10 COLREG[8]

KRASLAVA and ATLANTIC LADY were power-driven vessels that were under way and constrained by their draught (COLREG rule 3(h)), i.e. the ships had to navigate within the boundaries of the Drogden Channel due to the shallow waters outside the channel.

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. Only KRASLAVA used a fog signal (COLREG rule 35(a)).

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 therefore 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.

4. ANALYSIS

4.1 The collision

The collision between KRASLAVA and ATLANTIC LADY was the result of a conjunction of circumstances that occurred within a short time span in a narrow geographical area. Each ship was aware of the other ship's presence, but had misjudged its own and the other ship's position in the channel. Once the actual situation was acknowledged on both ships, it was too late to manoeuvre to avoid the collision.

Both ships anticipated to have the closest point of approach at the southern exit/entrance to the channel, which was 300 metres wide and where there was little or no visibility. During the approach to buoys no. 17 and no. 16, both ships assumed that the other ship would position itself in the outermost part of the channel. At the time of the collision, the bridge teams on both ships were convinced that the other ship was on the wrong side of the channel and that their own ship was in the outer perimeter; when in fact, both ships were approximately in the middle of the channel.

KRASLAVA was proceeding at a speed of 8-9 knots and had a pilot boat alongside, while the pilot was on the bridge preparing for disembarking. The bridge team on KRASLAVA had the perception that the ship was at the western limit of the channel. The pilot and the master were expecting that ATLANTIC LADY would manoeuvre in such a way that the ships would pass port-to-port. The situation was considered to be normal until 13 seconds before the collision when the master expressed his concerns to the pilot. Within that timeframe, there was not enough time to act to avoid the collision. A variety of factors contributed to the perception that the ship was not in the centre of the channel. Firstly, the narrowness of the channel meant that the ECDIS' display would have had to been zoomed in to such an extent that the chart would have been rendered useless for determining the forthcoming navigation. Secondly, the restricted visibility meant that the buoys were not visible and there was therefore

[8] Convention on the International Regulations for Preventing Collisions at Sea, 1972, as amended.

no visual indication of the ship's position. Thirdly, the pilot mainly used the radar for navigation, and it did apparently not provide the pilot with a clear indication of the ship's position in the channel.

Under the given circumstances, it seems inexpedient that the pilot boat, DANPILOT STELLA POLARIS, was alongside KRASLAVA while she was navigating in the channel. It did, however, not affect the outcome of the close quarter situation. The pilot on KRASLAVA was still on bridge monitoring the progression of the navigation, and voice recording from the VDR suggests that the bridge team was not preoccupied by the pilot boat being alongside.
Simultaneously, ATLANTIC LADY was about to turn into the Drogden Channel at a speed of 11-12 knots. Before the turn into the channel, the bridge team on ATLANTIC LADY positioned the ship by observing buoy no. 16 visually. The distance to the buoy was estimated to be less than half of the actual distance. It was expected that the passage would be at close quarters to KRASLAVA, but the ship's manoeuvring made the radar's ARPA functions ineffective and unable to give ample warning about the immediate risk of collision. The master and chief officer expected and depended on the fact that KRASLAVA would position itself on the outermost western part of the channel.

The bridge team on ATLANTIC LADY had the perception that the ship was turning into the eastern part of the channel, but as the turn was initiated after passing buoy no. 16, the ship would not be able to complete the turn until it was in the middle of the channel. Only a few seconds passed from when the situation went from normal to abnormal, because the bridge team only realized the risk of collision when the chief officer visually saw KRASLAVA at close quarters ahead, too late to avoid the collision.

In this close-quarters situation, the instrumentation was insufficient to predict the risk of collision, and, without any visibility, the bridge teams on both ships fully relied on assumptions about the other ship's actions.

Examining the factual circumstances on each ship provides a description of *how* the collision happened as described above. It does not, however, explain *why* the bridge teams on both ships did not recognize the risks associated with the situation, i.e. a close-quarters passing in restricted visibility, navigating mainly by instrumentation, while manoeuvring and preparing to disembark the pilot.

This collision illustrates that the margin for safe navigation is not necessarily visible as events unfold. None of the bridge team members voiced any concerns about the risks associated with the close-quarters situation until or after the collision. On the contrary, the bridge teams considered the situation to be normal until a minute before the collision. After the accident, the bridge teams were bewildered by the seemingly wrong position of the other vessel.

It was necessary, thus normal, to navigate at close quarters in the Drogden Channel in conditions of both good and restricted visibility. On KRASLAVA the pilot was experienced in navigating these waters in restricted visibility and was used to navigating with a small margin for failure, i.e. close to other ships and in narrow waters. The master and chief officer on ATLANTIC LADY were also experienced in navigating these waters and may not have recognised that the margin between success and failure was becoming smaller, i.e. how the additional risk factors made the close-quarters situation more hazardous than usual. Acceptance of these conditions could have been based on the necessity of the situation and lack of other desirable alternatives.

KRASLAVA was still in the channel and did not have the opportunity to deviate from the set course and the speed was adjusted to circumstances of the current while having the pilot boat alongside.

During the approach to the entrance of the Drogden Channel, ATLANTIC LADY had to navigate around Drogden Lighthouse and turn into the channel. Such an approach to the channel has in the past proved to be challenging, which has been indicated by the frequent allisions with buoy no. 16, and as shown in the navigation analysis made by The Danish Maritime Safety Administration in 2009. The main challenge is that Drogden Lighthouse is in a position where northbound ships have to make large turning manoeuvres in a relatively strong current before entering the channel. In restricted visibility, it will be inexpedient to lower the speed significantly, because the ship will be set to the north-east with the risk of alliding with the buoy or grounding. Furthermore, at a lower speed, steering will be significantly impaired on a large ship with a larger turning radius, thereby rendering it difficult to execute the turn into the Drogden Channel.

The prevailing north-easterly current in the area, and the dense fog, left the bridge team on ATLANTIC LADY with limited safer alternatives than proceeding towards the entrance of the channel, such as reducing speed significantly, anchoring or taking alternative routes.

Under these circumstances, ATLANTIC LADY's starboard turn to enter the Drogden Channel, and the lack of alternatives or abortion options, made the close-quarters situation unstable, and thereby became the decisive factor for why the collision happened.

4.2 COLREG

The bridge teams on KRASLAVA and on ATLANTIC LADY were aware of the forthcoming close-quarters situation, which was necessary for navigating in the channel. Thereby, an appraisal of the risk of collision was made and found acceptable. That neither ship applied COLREG to an extent to which it would avoid the collision is a factual circumstance that does not in itself provide an explanation of why the collision occurred. Understanding why COLREG was ineffectively applied is essential for explaining the collision.

In the following, focus will be on rule 6 about safe speed and rule 19 about the conduct of vessels in restricted visibility.

Keeping a safe speed in restricted visibility is essential, because low speed provides time to recognize the risk of collision and to take action to avoid collision, but the choice of speed also depends on other factors such as ensuring effective manoeuvrability and mitigating the effects of the current. Therefore, the master in collaboration with the bridge team determines what constitutes safe speed under the given circumstances.

On KRASLAVA the speed was adjusted to the requirements made by the pilot and was not considered to be excessive taking the current (NE 2 knots) into consideration. During the approach the pilot, who was experienced in navigating the area, did not consider the speed on either ship to be out of the ordinary, under the given circumstances.

On ATLANTIC LADY the north-easterly current of 2 knots made the bridge team reluctant to lower the speed with the risk of alliding with buoy no. 16. Furthermore, a lower speed would have necessitated a larger correction of the heading to keep the intended course, which would require the starboard turn into the Drogden Channel to be larger and therefore more difficult. The speed was, therefore, considered necessary to turn the ship effectively to port around Drogden Lighthouse, and later to starboard when entering the channel.

In general COLREG leaves the navigator with a discretionary space for determining the ship's risk exposure 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 navigator's experience shapes the perception of risk, and within the discretionary space, the navigator can and should depart from the rules in special circumstances to avoid immediate danger (rule 2).

It is expected that the navigator can take *due regard to all dangers of navigation and to any special circumstances* (rule 2). This indicates that the underlying thinking must be that all risk is visible and can be taken into account and mitigated. Whether or not due regard has been made 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 navigators were presented with in the given situation. Therefore, the cause of the collision cannot be explained by this analytical approach.

5. CONCLUSIONS

ATLANTIC LADY and KRASLAVA collided in the Drogden Channel on 1 November 2014 at 1419 in dense fog. The collision was the result of several factors that coincided within a short timeframe that created a risk of collision, which was not recognized by the bridge teams on either ship until within a minute of the collision. These factors included restricted visibility, navigating in a narrow channel, the north-easterly current, a pilot boat being alongside KRASLAVA, and ATLANTIC LADY making a large course alteration. Individually these factors did not constitute a recognizable significant risk, but in conjunction they created a small margin between success and failure; a safety margin that was based on whether the ships were positioned 50-100 metres to each side of the channel.

Passing at small distances is usually not problematic in channels when the ships are on opposite courses, but in this instance, when both ships were impaired by restricted visibility and one of the ships was to make large course alterations, then the situation became unstable, because they could not rely on instrumentation alone due to the ships' close proximity to each other.

The factor instrumental in the collision was thus that ATLANTIC LADY's approach to the Drogden Channel, in the absence of other better alternatives, necessitated a large turning manoeuvre. Due to the

north-easterly current and the restricted visibility, which delayed the start of the turn until buoy no. 16 was abeam, the turning manoeuvre brought the ship into the centre of the channel, where it crossed ahead of KRASLAVA.

An analysis of navigation in the southern approach to the Drogden Channel made in 2009 by The Danish Maritime Safety Administration showed that the area was difficult to navigate in, and recommended initiatives to improve the flow of traffic in the area; primarily for avoiding groundings and allisions with the buoys. This accident shows that risk of collisions can also be mitigated by these initiatives.

6. PREVENTIVE MEASURES TAKEN

Ship management for KRASLAVA, LSC Shipmanagement SIA has reported to the flag State taking several preventive actions:

> *"Arranging for KRASLAVA's Master at the time of the collision to attend additional Bridge Team Resource Management Training.*
> *Conducted a fleet wide navigation safety campaign, which included ship board discussions of the KRASLAVA and ATLANTIC LADY collision and measures to prevent similar collisions in the future.*
> *Conducted a review of ship board risk assessments as well as ship management's navigation procedures for sailing in narrows, restricted visibility and with a pilot on board; and,*
> *included a review of the ship management's investigation report in the pre-appointment briefing program for on-signing officers".*

The Danish Maritime Authority has reported the following to The Danish Maritime Accident Investigation Board:

> *"The marine accident report supports all the risk analyses that have reached the conclusion that safety of navigation could be improved considerably by removing Drogden Lighthouse.*
>
> *The Danish Maritime Authority is striving to achieve this solution, but a final decision to remove the lighthouse requires clarification of economic issues".*