Danish Maritime Accident Investigation Board

SUMMARY REPORT

December 2014

KARLA C

Allision on 13 April 2014

The Danish Maritime Accident Investigation Board
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Front page: KARLA C, Source: DMAIB

The summary report is available from the webpage 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 that carries out investigations as an impartial unit which is, organizationally and legally, independent of other parties. The board investigates maritime accidents and occupational accidents on Danish and Greenland merchant and fishing vessels 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 separate from the criminal investigation without using any 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. FACTUAL INFORMATION

1.1 Photo of the ship

Figure 1: KARLA C
Photo: Juan Dominguez

1.2 Ship particulars

Name of vessel:	KARLA C
Type of vessel:	General cargo ship
Nationality/flag:	United Kingdom
Port of registry:	Cowes
IMO number:	9558012
Call sign:	2DNZ4
DOC company:	Carisbrooke Shipping Ltd
IMO company no. (DOC):	0003376
Year built:	2010
Shipyard/yard number:	Jiangsu Yangzijiang Shipbuilding Co Ltd/2008-897
Classification society:	Bureau Veritas
Length overall:	106.07 m
Breadth overall:	15.5 m
Gross tonnage:	4151
Deadweight:	6795.18 t
Draught max.:	8.15 m
Engine rating:	1980 kW

Service speed:	10.30 knots
Hull material:	Steel
Hull design:	Single hull

1.3 Voyage particulars

Port of departure:	Amsterdam, the Netherlands
Port of call:	Port of Vordingborg (West Harbour), Denmark
Type of voyage:	International
Cargo information:	Ballast condition
Manning:	9
Pilot on board:	Yes
Number of passengers:	0

1.4 Weather data

Wind – direction and speed:	West 10-16 m/s
Wave height:	0.3 m
Visibility:	Good
Light/dark:	Dark
Current:	East 1.5-2.5 knots

1.5 Marine casualty or incident information

Type of marine casualty/incident:	Allision
IMO classification:	Serious
Date, time:	13 April 2014 at 2247 LT
Location:	Masnedsund, Denmark
Position:	54 59.83’ N - 011 53.34’ E
Ship’s operation, voyage segment:	Arrival
Place on board:	Ship side and aft deck
Human factor data:	Yes

1.6 The relevant ship’s crew

Master	63 years old. He had been at sea for 37 years and had worked for the company for the last 16 years. He had served on board KARLA C for 2-3 months.
Chief Officer	59 years old. He had been at sea for 37 years and had worked for the company for about 1 year. He had served on board KARLA C for approximately 2 months.
Chief Engineer	59 years old. He had been at sea for 42 years and had worked for the company for 2-3 months.
Pilot	39 years old. He had been a pilot for 6 years and 3-4 years in Port of Vordingborg.

1.7 Scene of the accident

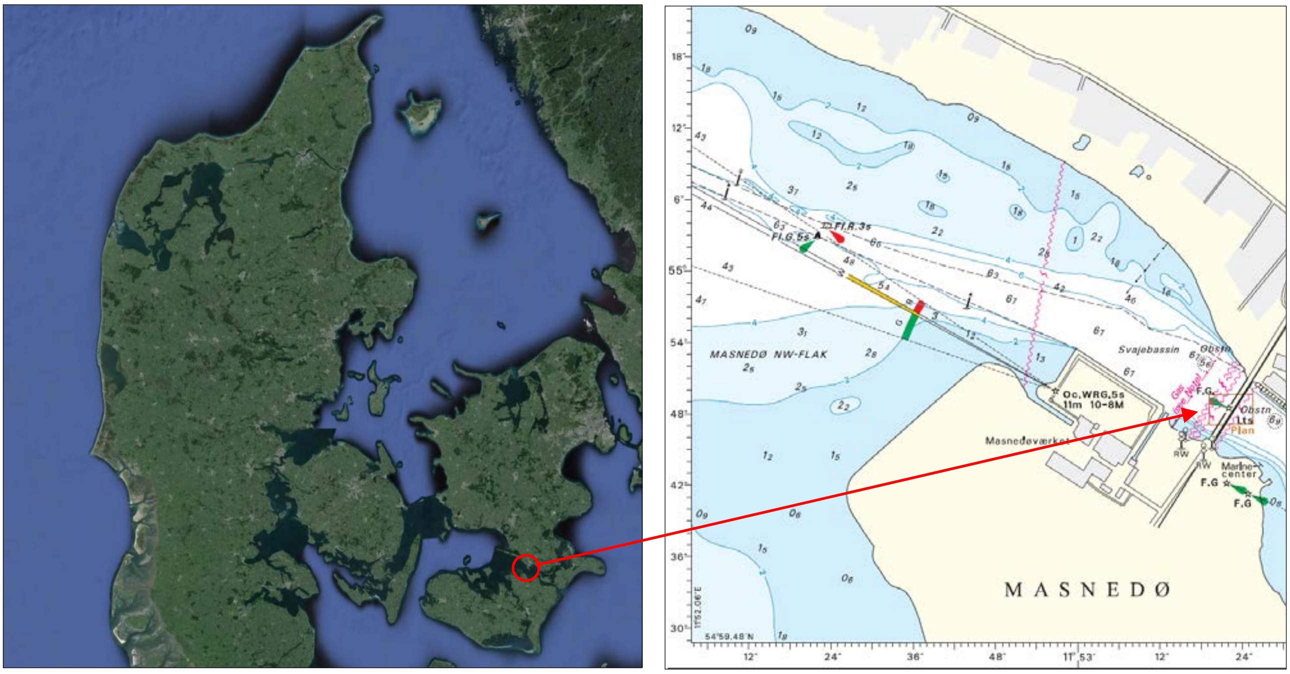

Figure 2: Scene of the accident. Masnedø, Denmark
Source: Google Earth and the Danish Geodata Agency

2. NARRATIVE

2.1 Preface

On 13 April 2014, the general cargo ship KARLA C allided with the Masnedsund Bridge causing severe damage to the ship and minor damage to the bridge and railway. The DMAIB has investigated the circumstances of the accident, and this report is a summary of the findings.

2.2 Background

2.2.1 KARLA C

KARLA C was one of ten sister ships within the company and it was tramp trading primarily in Northern Europe and the Mediterranean carrying break bulk and regular bulk such as steel and grain. Neither the ship nor the master had called at the Port of Vordingborg before, but this was not considered a significant challenge, because the ship tended to call at smaller ports of a similar size in channels and rivers that are less accessible for other larger ships.

The nine crewmembers had seven different nationalities. They were not relieved simultaneously, but usually one or two at a time. Therefore, at any given time a senior officer in each department was familiar with the operation of the ship.

2.2.2 The Masnedsund Bridge

The Masnedsund Bridge that connects the islands of Zealand and Masnedø was built in 1937, is 215 metres long and has a width of 8.8 metres. It is a combined bascule bridge with a single-track railway and a road. It has five supporting pillars and a height between 4 and 5 metres from the water surface to the spans.

On the seabed on the western side of the bridge where the port is situated there are power cables and pipelines for sewage, gas and district heating.

The bridge is usually manned daily, except during the hours of the night unless otherwise agreed with a ship requesting a scheduled passing. Approximately 2,000 ships of varying sizes pass the bridge annually.

In 2002, a risk analysis was made of the scenarios in which a ship might allide with the bridge pillars and/or the steel structure. The analysis concluded that the bascule supporting pillars should be able to withstand the impact of a ship with a range of displacement of 6,400-7,800 t if the bridge pillars were to be considered as belonging in a high safety class. Furthermore, the steel beams between the pillars should be able to withstand the impact of a ship with a range of displacement of 1,500-4,700 t if the steel beams were to be considered as belonging in a high safety class. In the above calculations, a total structural collapse was assumed in 5% of the allision events.

As reference, KARLA C has a winter displacement of 8,641.40 t with a draught of 6.5 metres.

In the channel of Masnedsund, the current changes regularly depending on the weather conditions and can reach up to 3-4 knots. During periods of adverse weather conditions, the current can have the same direction for several days reaching up to 5 knots. On the day of the accident the current near the bridge was estimated to approx. 2.5 knots.

2.3 Sequence of events

After having completed discharging in Amsterdam, the Netherlands, KARLA C departed at 0250 on 13 April 2014. During departure after approximately 30 minutes of operation, the bow thruster shut down due to overheating, which was a problem that the crew had not experienced before. Subsequently, the ship corresponded with the company during the voyage to Port of Vordingborg about how to identify the technical fault causing the bow thruster to shut down after indications of overheating. The company sent a list of items to be checked, which the crew did en route to Port of Vordingborg. A closer inspection and test of the thruster was planned once the ship had arrived alongside at the Port of Vordingborg.

KARLA C departed from the Kiel Canal on 13 April 2014, and the canal pilot left the ship at 1336 when the ship preceded towards Port of Vordingborg, Denmark. The draught was 3.1 m forward and 4.5 m aft, which meant that it was not necessary to sail in the deep water route when approaching the pilot station.

KARLA C arrived at Bredegrund Pilot station, where the pilot boarded at 2155. There were westerly winds of force 5 (approx. 8 m/s) and the current was moving east at a speed of approximately 1.5 knots. The port was in a channel that narrowed towards the bridge (figure 2) and therefore it was expected that the current would be stronger the closer the ship got to the bridge. Before boarding the pilot boat, the pilot went to the port to observe the current. It was only possible to approximate the current as it would vary significantly from the berth to the middle of the port basin and increased as the channel narrowed towards the bridge.

Once the pilot arrived on the bridge, a master/pilot information exchange checklist was completed and signed by the master and the pilot. On the checklist it was noted that the bow thruster was overheating after 30 minutes of operation. The pilot advised that he wanted a light turned on in order to visually observe the buoys in the channel because they were not fitted with lights.

The ship was to be berthed with starboard side alongside. This was requested by the shipper because this would be more expedient for loading the cargo. Therefore, it was not intended to turn the ship upstream in the harbour basin.

The pilot was giving engine and rudder orders, the master was at the controls and the chief officer was the helmsman. Ratings were ready on the forecastle for mooring operations and letting go the anchors in an emergency.

As KARLA C approached the berth at a speed of approximately 2-3 knots using the main propulsion and rudder, the pilot realized that the engine manoeuvres, current and wind were affecting the ship more than expected, and that it would be better to turn the ship around and bring it alongside with the bow heading up wind and current. Therefore, the master set the propulsion to astern to stop the ship and turned the rudder to hard starboard while using the bow thruster to assist in turning the ship around by starboard side. Halfway in the turn the thruster overheated after having been operated for a few minutes, malfunctioned and stopped (figure 3).

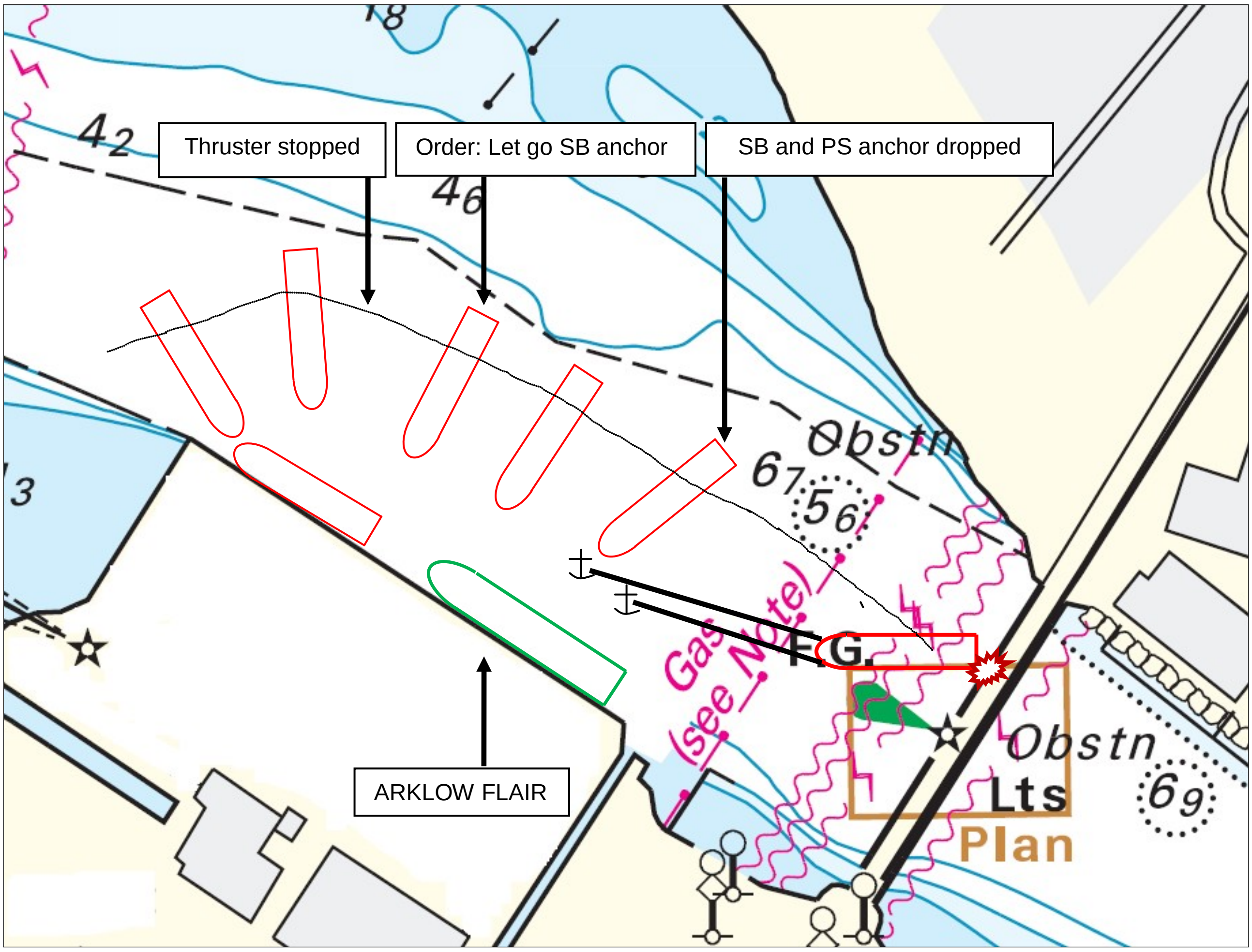

Figure 3: Approximate positions of KARLA C
Source: DMAIB

In order to avoid colliding with the ship (ARKLOW FLAIR), which was moored alongside approximately 20 metres from the bow, the master set the propulsion to full astern to stop the forward momentum of the ship, but the master believed that the manoeuvre moved the ship too fast towards the northern part of the channel and eventually had to be stopped – otherwise the ship would run aground on the bank on the other side of the port. It was not possible to use the main engine and rudder to manoeuvre the ship out of the situation because the ship was too large and was equipped with pitch propellers that would not respond quickly enough. The distance to the bridge was approximately 200-300 metres.

As the ship approached the bridge, and the risk of an allision with the bridge became evident, the pilot and master ordered the crewmembers on the forecastle to drop the starboard anchor. There was a delay in the execution of the order which made the master repeat the order several times. The anchor was eventually dropped with two shackles in the water and the ship started to turn to starboard, but the length of the anchor chain was insufficient for preventing the ship from drifting towards the bridge. The master ordered the crew on the forecastle to let the port anchor go and it was let go shortly after. Thereafter, the ship stopped drifting.

Meanwhile, the engine department called the bridge and notified the master that the bow thruster was ready for operation. However, it was too late for the master to use the thruster to stop the vessel.

Once both anchors had been dropped, the ship swung to port (heading to starboard) so the bow turned heading into the current. At 2247, the aft part of the ship allided with bridge pillar no. 2 and shortly after allided with the duc d'alpe west of the centre support structure (figure 4). The anchors were holding the ship upstream heading in a westerly direction and the situation was stabilized.

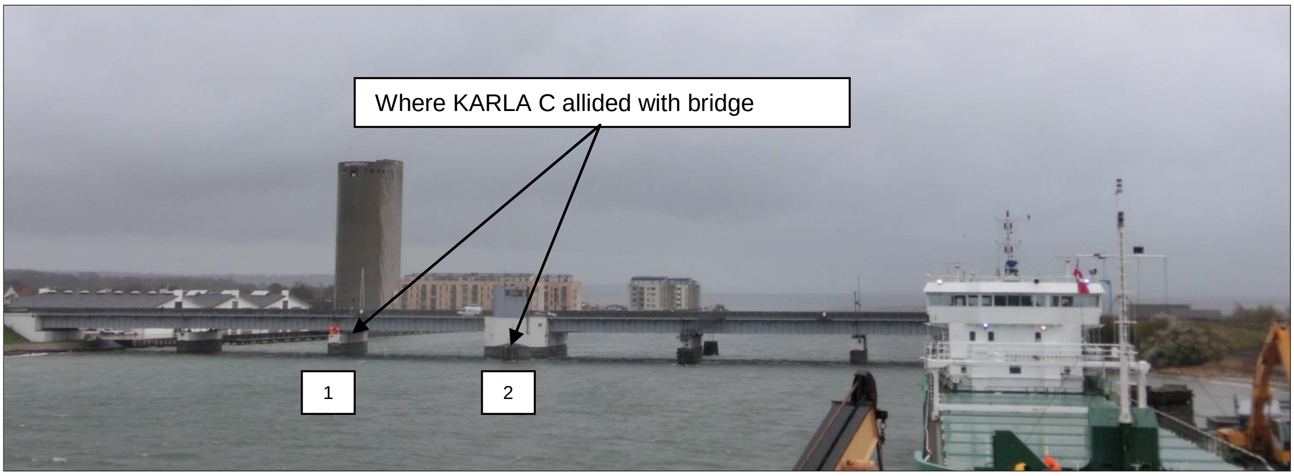

Figure 4: Overview of Masnedsund Bridge
Source: DMAIB

After the collision the master ordered the anchors to be weighed – first the port side and then the starboard side, because the winch hydraulics were not powerful enough to pick up both anchors at the same time. Afterwards the ship proceeded to the berth and was moored with port side alongside.

The pilot called the Admiral Danish Fleet, Maritime Assistance Service (MAS), when the ship was in the process of being moored and informed them about the allision. MAS told the pilot that they would notify the police and Rail Net Denmark as the bridge was unmanned at the time. The bridge was immediately closed for traffic until it had been inspected after which the road was reopened, but remained closed for trains for a few days until the damage to the tracks had been repaired and an overall evaluation of the bridge structure had been concluded.

When the police arrived on KARLA C, they took an alcohol test of the bridge team, which was negative.

2.4 Events related to the bow thruster

The chief engineer had recently been hired by the company and this was his first contract with the ship. He had considerable experience as a chief engineer, but did not know the ship's engine room systems in detail.

The bow thruster motor control panel was situated in the bow thruster room under the forecastle. In the engine room, there was only a common alarm indicator informing the engineers when a problem had arisen, but which did not inform about the nature of the fault. It would be necessary for the engineer to go to the bow thruster room for resetting or otherwise for remedying a problem. The alarm panel in the bow thruster room indicated an “integrated alarm”, which meant little to the engineer. There was no alarm on the “main motor high temperature”. After had been reset, the thruster functioned normally.

The name plate on the thruster motor indicated that the motor was not to be operated continuously for more than 30 minutes at full load. Even though the thruster was started in the early stages of the manoeuvre, it did not operate at full load for 30 minutes before it malfunctioned.

An investigation into the malfunction of the bow thruster has shown that the thruster stopped because of a faulty thermistor protection on one of the three phases. The part was replaced and the motor proven to be in good order.

2.5 Damage to the ship and bridge

KARLA C suffered considerable damage to the hull on the port quarter, the gangway and the life boat davit. Furthermore, the port side fresh water tank was penetrated and was nearly emptied (figure 5).

Figure 5: Damage to KARLA C
Source: DMAIB

The bridge was struck on the western side where the footpath and road were situated. The railway was on the eastern side. There was damage to the duc d’alpe west of the centre pillar and the bridge construction including the footpath, light mast, bridge support structure and railway (figure 6). The spans had shifted approximately 10-15 mm.

Figure 6: Damage to bridge
Source: Rail Net Denmark

When the tracks had been repaired temporarily, it was recommended that the trains continue their regular service at reduced speed until the supporting structures had been permanently repaired.

A train passed southbound approximately 6 minutes before the collision. There was no significant risk of the train derailing if it had passed after or during the accident. It should be noted that in a derailing scenario, it is highly unlikely that the train would move beyond the barriers mounted on the side of the tracks and move of the bridge.

2.6 Navigation near Port of Vordingborg (West Harbour)

No legislation specifically addresses general navigation in the vicinity of the bridges, but only passage through bascule bridges[1]. However, there are local regulations and descriptions in The Danish Harbour Pilot[2] and Admiralty Sailing Directions, Baltic Pilot Volume 1. The descriptions in the Danish Harbour Pilot are not mandatory and subject adaptation to specific circumstances.

The Port of Vordingborg is primarily used for loading grain. There is no mandatory requirement to use a pilot when passing the bridge or approaching the port, but there is normally a restriction on the size, limiting the length to 115 metres and the draught to 6.5 metres, but larger ships are also permitted. It is not mandatory to use tugs and it is normally not recommended.

2.7 ANMAR-S on 19 August 2014

On 19 August 2014 at 1107, the Dutch general cargo ship ANMAR-S allided with the Masnedsund Bridge centre pillar at the bridge control house while approaching the Port of Vordingborg. The ship and pillar only suffered minor damage.

ANMAR-S lost propulsion due to a stuck fuel rack when it was approximately 300-400 metres from the bridge on an easterly course heading directly towards the bascule at a speed of 6 knots. The master had only approximately 2 minutes to decide on a plan of action. There was no pilot on board.

Any attempt to restart the main engine was abandoned and the starboard anchor was let go at 1106 in order to reduce the speed as much as possible before impact. At this point there was no doubt that the ship would allide with the bridge and the master decided to use the rudder and bow thruster to turn the ship towards the centre supporting pillar to avoid creating substantial damage to the bascule span.

The bridge suffered minor damages to lighting and the supporting pillar.

A northbound train passed the bascule at 1104.

3. ANALYSIS AND CONCLUSION

3.1 The accident

KARLA C's allision with Masnedsund Bridge was the result of several factors that accumulated into an uncontrollable situation. The decision to approach the berth by the starboard side was deemed to be unproblematic until the ship was in the basin where an alternative approach to the berth was decided due to the unfavourable weather situation and the easterly current. During the approach to the port, there was nothing that indicated to the master or the pilot that the situation was unsafe.

[1] Order no. 961 of 7 December 1992 on navigation through specific bridges in Danish waters.
[2] http://www.danskehavnelods.dk/

The weather situation was within limits of the normal parameters when berthing ships at this particular port.

The size of the ship, the length in particular, made it difficult to use the propulsion and rudder to turn the ship as the clearance aft and forward was too small. Therefore, the success of the manoeuvre relied fully on the bow thruster – and when it malfunctioned, only the anchors were left to stop the ship from drifting uncontrollably into the bridge. The malfunction of the thruster was caused by a faulty thermistor protection on the thruster motor.

With a distance to the bridge of approximately 200-300 metres and an easterly current of 1.5-2.5 knots, there would be only approximately 4-6 minutes before the ship would allide with the bridge. During that time span, the master and pilot were to decide on what action to take in order to avoid the allision or to limit the structural damage if nothing could be done to effectively stop the ship. It was decided to drop the anchors, but there was a small delay in the release of the anchor. Such delays are not uncommon and were in this instance caused by the crewmembers on the forecastle requiring confirmation of the order, as they did not realize that the ship was in an emergency until the master told them. The crewmembers also had to remove the riding chock and release the brake.

Once the starboard anchor had been dropped, the port anchor was released without delay.

At this point in time, the margins for safe operation were diminished and an allision with the bridge became unavoidable as the ship swung upstream. Any speculation about whether or not the anchors should have been dropped 1 minute earlier is in this context a symptom of the narrow safety margin that exists when large ships are manoeuvring in the vicinity of the Vordingborg Bridge.

The accident involving the ship ANMAR-S also describes how a rather simple technical fault can potentially result in severe damage. In this accident the anchors were also instrumental in limiting the consequences. In both cases there were concerns about the cables and pipe lines positioned on the seabed, west of the bridge, that could have been damaged in the attempts the stop the ships.

The risk analysis, which was made with the purpose of mapping bridge’s risk exposure, was based on the assumption that smaller ships would pass the bridge and not operate in the vicinity of the bridge. These accidents indicate that it can be problematic to determine the risk exposure to Masnedsund Bridge by quantitative methods only.