



Bundesstelle für Seeunfalluntersuchung
Federal Bureau of Maritime Casualty Investigation
Federal Higher Authority subordinated to the Ministry of Transport,
Building and Urban Development

Investigation Report 140/10

Marine Casualty

**Contact with the embankment by
the MV SONORO and
collision between the MV SONORO
and MT SÜLLBERG
on the Kiel Canal (NOK)
on 18 April 2010**

16. January 2012

The investigation was conducted in conformity with the law to improve safety of shipping by investigating marine casualties and other incidents (Maritime Safety Investigation Law - SUG) of 16 June 2002.

According to said act, the sole objective of this investigation is to prevent future accidents and malfunctions. This investigation does not serve to ascertain fault, liability or claims.

This report should not be used in court proceedings or proceedings of the Maritime Board. Reference is made to art. 19 para. 4 SUG.

The German text shall prevail in the interpretation of this Investigation Report.

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1 Summary

The SONORO, which sails under the flag of Gibraltar, was transiting westward on the Kiel Canal (NOK) on the night of 17 to 18 April 2010. After the pilot change in Rüsterbergen at about 0050¹, visibility deteriorated during the remainder of the voyage. The bridge was at first manned by the pilot, the master and the second officer. The master left the bridge at 0227. At 0300, the second officer was relieved by the chief officer. Meanwhile, visibility had decreased to between 100 m and 150 m.

At 0304, an unusual course change to port took place on the southern side of the canal level with the Hohenhörn ferry. It was possible to return the vessel to her course shortly after. A little later, at about 0309, she passed the oncoming MARIDA PATEA. During this passing manoeuvre, the SONORO ran out of rudder to starboard and it was not possible to put her back on course even with full rudder position to port. This finally led to contact with the embankment on the northern side level with canal kilometre 23. The crew managed to free the SONORO unaided and the vessel continued her voyage at 0321.

The Dückerwisch siding was left at 0359. The master was back on the bridge and in command of the vessel, which was steered by the chief officer.

At 0405, a collision occurred with the oncoming SÜLLBERG, which was also sailing under the flag of Gibraltar. The pilot of this vessel had called the SONORO 42 seconds earlier on VHF to request that she change course to the northern side of the canal. After the collision, the SONORO ran into the embankment again level with kilometre 19.

Despite the damage sustained, both vessels were able to proceed to each end of the canal, where they moored and were visited by the authorities.

During the incident, nobody came to physical harm on either vessel and no environmentally hazardous substances escaped.

¹ Unless stated otherwise, all times shown in this report are local = Central European Summer Time (CEST) = Universal Time Coordinated (UTC) + 2 hrs.

2 SHIP PARTICULARS

2.1 Motor Vessel SONORO

2.1.1 Photo



Figure 1: Photo of the SONORO

2.1.2 Particulars

Name of vessel:	SONORO
Type of vessel:	Mini-bulker
Nationality/flag:	Gibraltar
Port of registry:	Gibraltar
IMO number:	9199397
Call sign:	ZDEN9
Operator:	Q-Shipping B.V.
Year built:	2000
Shipyard/yard number:	Severnav S.A./162
Classification society:	Lloyds Register
Length overall:	99.95 m
Breadth overall:	16.30 m
Draught (max.):	4.60 m
Gross tonnage:	3,244
Deadweight:	4,110 t
Engine rating:	2,880 kW, controllable pitch propeller
Main engine:	Krupp MaK 6 M 32
(Service) Speed:	12.5 kts
Hull material:	Steel
Hull design:	Double bottom, double hull
Minimum safe manning:	7

2.1.3 Voyage particulars

Port of departure:	Koverhar, Finland
Port of call:	Ablasterdam, Netherlands
Type of voyage:	Merchant shipping/international
Cargo information:	Steel
Manning:	8
Draught at time of accident:	D _f : 4.58 m, D _a : 4.75 m
Pilot on board:	Yes
Canal helmsman:	No
Number of passengers:	None

2.2 Motor Tanker SÜLLBERG

2.2.1 Photo



Figure 2: Photo of the SÜLLBERG

2.2.2 Particulars

Name of vessel:	SÜLLBERG
Type of vessel:	Tanker
Nationality/flag:	Gibraltar
Port of registry:	Gibraltar
IMO number:	9100114
Call sign:	ZDIC3
Operator:	Vega-Reederei Friedrich Dauber GmbH & Co. KG
Year built:	1994
Shipyard/yard number:	Barkmeijer Stroobos B.V./271
Classification society:	Germanischer Lloyd
Length overall:	89.95 m
Breadth overall:	12.50 m
Draught (max.):	4.90 m
Gross tonnage:	1,969
Deadweight:	3,280 t
Engine rating:	1,235 kW, fixed pitch propeller
Main engine:	Klöckner-Humboldt-Deutz AG, SBV 6 M 628
(Service) Speed:	10 kts
Hull material:	Steel
Hull design:	Double bottom
Minimum safe manning:	7

2.2.3 Voyage particulars

Port of departure:	Hamburg
Port of call:	Rostock, Germany
Type of voyage:	Merchant shipping/international
Cargo information:	Heavy fuel oil
Manning:	8
Draught at time of accident:	D _f : 4.90 m, D _a : 4.90 m
Pilot on board:	Yes
Canal helmsman:	No
Number of passengers:	None

2.3 Marine casualty or incident information

2.3.1 Ground contact by the SONORO

Type of marine casualty/incident:	Marine casualty, grounding of the SONORO
Date, time:	18 April 2010, 0310
Location:	Kiel Canal, km 23
Latitude/Longitude:	φ 54°03.25'N λ 009°18.40'E
Ship operation and voyage segment:	Estuary trading
Human factors:	Yes, human error
Consequences (for people, vessel, cargo, the environment and other):	Damage to the embankment at km 23, damage to the bottom shell of the vessel

2.3.2 Collision between the SONORO and SÜLLBERG

Type of marine casualty/incident:	Marine casualty, collision with the MT SÜLLBERG
Date, time:	18 April 2010, 0405
Location:	Kiel Canal, km 19
Latitude/Longitude:	φ 54°0.15'N λ 009°17.90'E
Ship operation and voyage segment:	Harbour mode
Human factors:	Yes, human error
Consequences (for people, vessel, cargo, the environment and other):	SONORO: Damage to the bow, respectively, the bottom shell, damage to the embankment and a ramp at km 19; SÜLLBERG: Damage to the bow as well as a walkway and the wing on the port side

Excerpt from Chart 42, Federal Maritime and Hydrographic Agency (BSH)

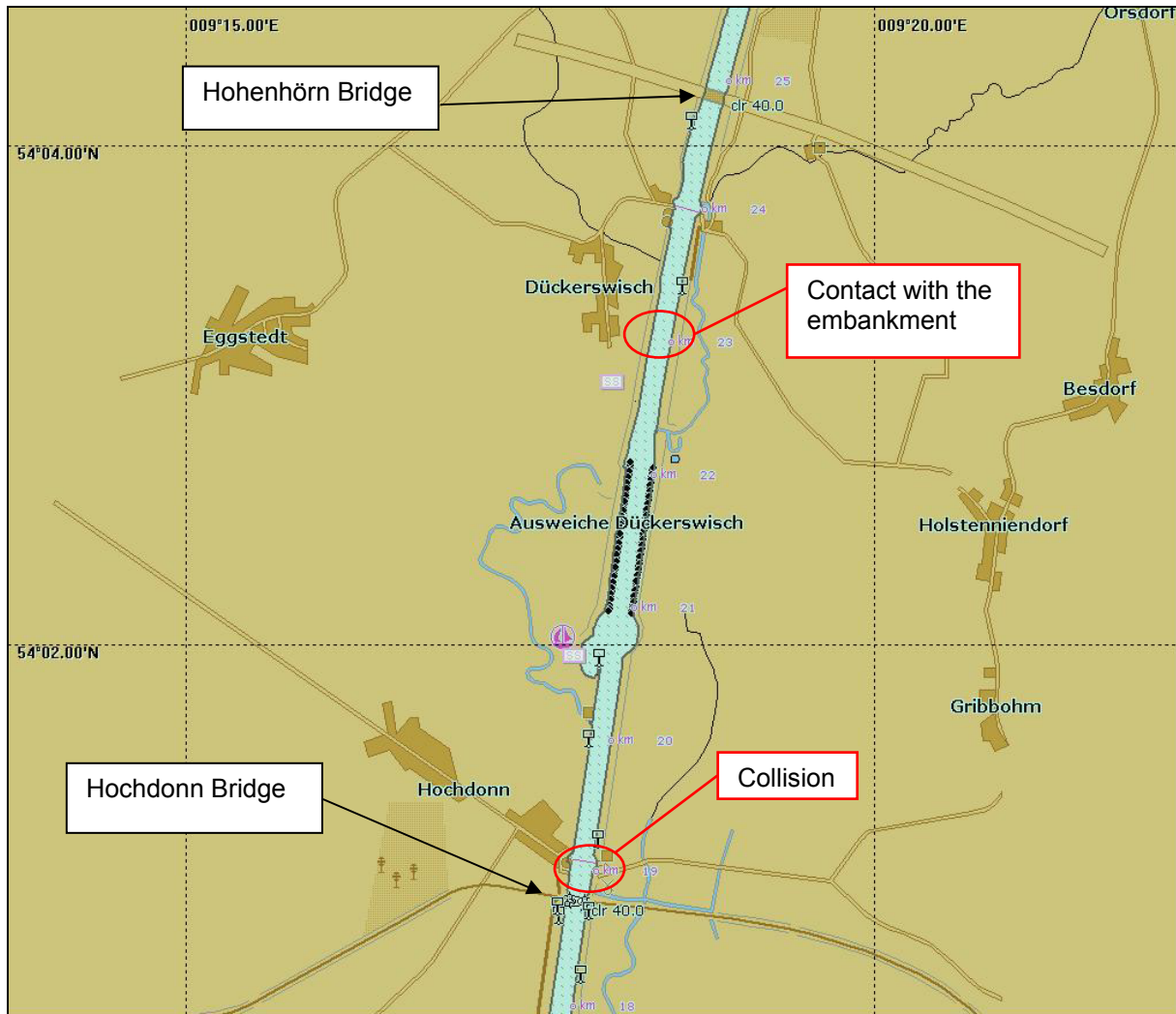


Figure 3: Nautical chart showing the scene of the accident

2.4 Shore authority involvement and emergency response

Agencies involved:	Vessel Traffic Service (VTS) Brunsbüttel, Waterway Police (WSP) Brunsbüttel
Resources used:	None
Actions taken:	Establishment of the facts, temporary detention order by the WSP in Brunsbüttel until class survey
Results achieved:	Report

3 COURSE OF THE ACCIDENT AND INVESTIGATION

3.1 Course of the accident

3.1.1 Course of the voyage – SONORO

Entries in the bridge log book as well as statements by the master and chief officer (C/O) formed the basis for the account of the course of the voyage of the SONORO. The written statement of the advising pilot was also considered.

The motor vessel SONORO was transiting westwards on the Kiel Canal (NOK) on the night of 17 to 18 April 2010. The vessel had taken on steel in Koverhar, Finland, and was en route to Ablasserdam, Netherlands. Prior to the pilot change in Rüterbergen, the ship's command was assisted by a pilot and a canal helmsman.

From Rüterbergen, the ship's command was only advised by a pilot. At about 0050, the pilot entered the bridge and was briefed on the controls by the master. 'Slow ahead' at 5 kts and 'half ahead' at 8.5 kts were the rates of speed given for the vessel, which was equipped with a controllable pitch propeller.

Visibility was good and there was practically no wind when the pilotage began. The second officer was controlling the helm. Both radars were turned on and the sea radar on the port side was set to the display mode head-up, off-centre at a range of 0.75 nm. The second device, a river radar, is situated near the helm. This was set to the same mode. The pilot was using the port radar, which he alternated between ranges of 0.25 nm and 0.75 nm.

The SONORO had to wait for oncoming traffic in the Oldenbüttel siding and therefore stopped at 0200.

After passing the bridge at Grünental, visibility deteriorated to about 500 m.

At 0300 (0400 ship time), the C/O relieved the second officer on the bridge. The pilot made a mental note of the fact that the C/O did not steer the planned course as accurately as his predecessor. Consequently, the pilot was forced to devote greater attention; in one bend, he had to intervene.

During the course of the voyage, visibility deteriorated to between 100 m and 150 m. The pilot ordered that the vessel be steered by compass and monitored the radar on the port side.

After passing the bridge at Hohenhörn, the vessel suddenly started to turn to starboard. There was a danger of her running into the northern embankment and it was only through the intervention of the pilot that she could be brought under control and gradually returned to the canal course. In the meantime, the MARIDA PATEA was encountering the SONORO. The SONORO kept well to the northern side, was running at about 6 kts and steered a true course of about 191°. The northern side of the canal was about 40 m away; the southern side was out of sight. The helm was controlled by the pilot. First of all, the SONORO took the usual turn to starboard as the MARIDA PATEA passed.

However, as the passing manoeuvre unfolded, even a fullrudder position to port was not enough to stop the starboard turn and it increased as the stern of the MARIDA PATEA was passing. The SONORO then ran into the embankment on the northern side at km 23 at 0305. The vessel was able to free herself under her own steam with a astern manoeuvre and continued on her voyage after the tanks had been sounded.

A log book entry indicates that the bow thruster was started five minutes before contact with the embankment occurred and the pilot had assumed control of the helm in manual mode. The engine was set to 'slow ahead' in order to pass the MARIDA PATEA and wait for the oncoming convoy in the next siding. As the MARIDA PATEA passed, it was evident that the distance to her was insufficient because the SONORO was being sucked in. Even a hard to port rudder angle and rate of speed increase to 'full ahead' by the pilot could not prevent contact with the embankment.

The SONORO waited for the oncoming convoy in the Dückerswisch siding. Furthermore, the GRIMM had positioned herself ahead of the SONORO. At about 0340, the vessel got under way again. The C/O was still at the helm. The master remained on the bridge.

The oncoming SÜLLBERG was detected by the pilot by radar at 0345 west of the Hochdonn Bridge at a distance about 1 nm. The SÜLLBERG kept to her right. At this point, the SONORO was running at about 6.5 kts and positioned to the right of the middle of the fairway. The pilot anticipated a clear passage. Visibility was unchanged at 100 m to 150 m.

The master and the officer on watch were having a lively conversation at the time. As helmsman, the C/O was keeping the vessel on course reasonably well. The pilot recommended a course of 191° in order to move further to the right. On the northern side of the canal, the pilot was able to make out the inland waterway vessel JEANNY, which was moored there. The southern side was out of sight. The pilot then saw how the radar echo of the SÜLLBERG merged with the echo of the bridge on the radar. The echoes had still not parted as the SÜLLBERG appeared at a distance of about 20 m close to the port bow, whereupon the pilot ordered 'hard to starboard'. The two vessels collided with port forecastle at about 0350. Shortly after that, the port forecastle of the SONORO collided with the port wing of the SÜLLBERG. The SONORO's momentum then caused her to run into the embankment on the northern side again.

At 0405 (0505 ship time), visibility stood at 100 m according to an entry in the SONORO's log book. The C/O steered in accordance with the instructions of the pilot. The masthead light of a vessel suddenly appeared ahead. Several seconds later, a collision occurred with this vessel. This caused the SONORO to turn to starboard. The master took the helm, set it to 'hard to port' and was able to keep the vessel in the middle of the canal. The starboard anchor was then lowered by 1 shackle. At 0440, the inspections of the vessel were completed. At 0510, the vessel weighed anchor and continued her voyage.

3.1.2 Course of the voyage – MARIDA PATEA

The vessel left the Dückerwisch siding at reduced speed at about 0300. At this point, visibility of about 100 m prevailed. The MARIDA PATEA encountered the SONORO in the canal section shortly after leaving the siding. The pilot had already noticed that the SONORO had come very close to the northern embankment prior to that. Therefore, he monitored the vessel closely and stayed at reduced speed. The speed of the SONORO had already stabilised on the northern half of the canal before the encounter. Since the MARIDA PATEA was well south of the middle of the canal, the passage was normal and without incident. The SONORO's contact with the embankment was not noticed.

3.1.3 Course of the voyage – SÜLLBERG

Statements by the master, the officer in charge of the navigational watch and the pilot formed the basis for the account of the course of the voyage of the SÜLLBERG.

The pilot boarded the SÜLLBERG at about 0240 in the lock at Brunsbüttel. At this point, circular winds of 1 Bft prevailed. Visibility was restricted. The SÜLLBERG was fully loaded and belonged to Traffic Group (TG) 3. Both radars were operating at a range of 0.5 nm in the head-up, off-centre display mode.

The lock was left at about 0255. From Kudensee, visibility was no more than 250 m. From the Burg ferry, the speed of the vessel stood at about 7 kts. The two vessels sailing ahead of the SONORO, the BARBARA (TG 4) and the GRIMM (TG 3), were passed west of the bridge. The SONORO was detected by radar shortly after canal kilometre 18.5. The distance stood at about 8 cbl. At this point, the SONORO was clearly south of the middle of the canal, whereupon the speed was reduced further. The pilot called the SONORO on VHF channel 73 and requested that she move to the northern side. After passing the bridge, the pilot saw on the radar that the SONORO had not changed her course south of the middle of the canal appreciably. He therefore ordered a course change to 012° (true) and another reduction in speed in the narrow section at Hochdonn. The pilot called the SONORO again and pointed to the impending collision. Shortly after, the SONORO came into view close to the port bow. A collision was no longer avoidable. The pilot ordered that the vessel be turned to starboard and set the engine to 'full astern'. A collision then occurred level with the ferry route.

After the collision, the SÜLLBERG was brought to a halt level with kilometre 19.25. Shortly afterwards, the vessel shifted to the dolphins in the Dückerwisch siding. No personal injuries or damage to the environment were found. At about 0600, the voyage towards Kiel was continued.

The C/O of the SÜLLBERG was at the helm at the time of the collision because the helmsman had left the bridge to wake the replacement and do a safety round.

3.1.4 Subsequent events

The SONORO moored on the south quay in Brunsbüttel at 0615. At 0645, Waterway Police Brunsbüttel boarded the vessel. The vessel then remained in Brunsbüttel for repairs.

After leaving the NOK, the SÜLLBERG initially moored in the Scheerhafen (Kiel), where she too was boarded by the waterway police.

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The classification society permitted the vessel to proceed to the port of discharge under certain conditions.

3.1.5 Damage

The SONORO sustained damage on the port side of her forecastle due to the collision.



Figure 4: Damage to the bow of the SONORO

The SÜLLBERG was damaged on the port side of her bow, on her hull in the area of the bulwark and on her superstructure.



Figure 5: Forecastle of the SÜLLBERG



Figure 6: Port walkway of the SÜLLBERG

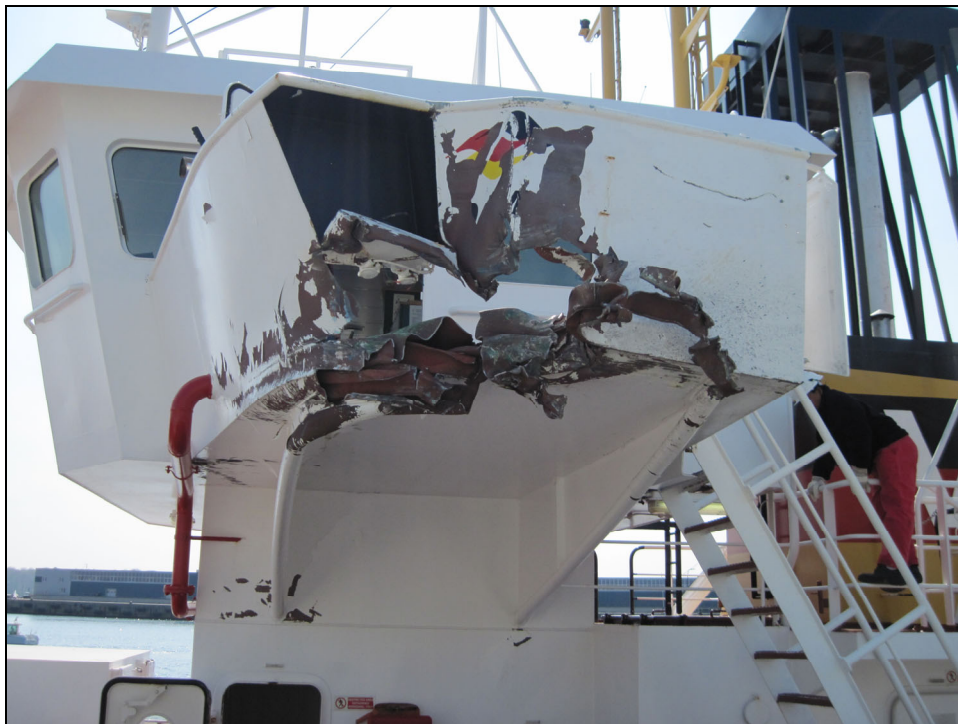


Figure 7: Port wing of the SÜLLBERG

A so-called NATO berth, which is a paved ramp that leads into the water, was damaged when the SONORO ran into the embankment after colliding with the SÜLLBERG.

No human came to harm and there was no leakage of environmentally hazardous substances during the two incidents.

3.2 Investigation

3.2.1 Analysis of the VDR and AIS

On 23 April 2010, an investigation team from the Federal Bureau of Maritime Casualty Investigation boarded the SONORO in Brunsbüttel. VDR data were secured on board the vessel.

At the time of the accident, the SONORO was equipped with an NW 4400 S-VDR² made by the company Netwave. The following data sets were shown when displaying the recorded data on the company's own replayer:

- data from the gyro compass;
- course information from the GPS;
- speed from the GPS;
- position and time from the GPS;
- audio recording on 4 channels (both wings on one channel, bridge microphone at the helm, bridge microphone at the radar position, VHF);
- AIS data from other vessels;
- raw NMEA³ data.

The scope of the data recorded thus corresponded to the minimum requirements of the standard⁴. Data of interest for an investigation, such as the requirement to change the rate of revolution of the engine and its response or the requirement to change the rudder angle and the rudder's response to that, were not available as NMEA data and also not otherwise displayed by the replayer. On the other hand, the NMEA data included a value for the rate of turn, but this was not displayed on the replayer.

The VDR recording spanned the period 17 April 2010 at 1709 to 18 April at 0854. The period from 18 April 2010 at 0030 to 18 April 2010 at 0500 was analysed for the investigation.

While playing the VDR recording on the replayer, there were repeated errors in the presentation of data from the gyro compass due to the data stream 'hanging-up'.

² S-VDR – Simplified voyage data recorder with reduced performance requirements

³ National Marine Electronics Association

⁴ Maritime navigation and radiocommunication equipment and systems - Shipborne voyage data recorder (VDR) - Part 2: Simplified voyage data recorder (S-VDR) - Performance requirements, methods of testing and required test results (IEC 61996-2:2007)

In addition, the audio data recorded by the S-VDR, i.e. the instructions or recommendations given on the bridge as well as conversations and radio traffic, were analysed. The quality of the audio recording was poor to very poor because it was impaired by considerable interference. The radio, which was switched on at 0228 at the request of the pilot, had an adverse effect on the intelligibility of the recording due to the additional background noise.

The recording of the AIS data transmitted by the other vessels was also available for the investigation of the accident via the Shipping Administration.

Based on all the above data, the course of the voyage of the SONORO and the collision with the SÜLLBERG were reconstructed.

On 18 April 2010 at 0050, the assignment of the pilot and helmsman, who had accompanied the vessel to the pilot station at Rüsterbergen, ended and they left the bridge. At this point, the vessel was proceeding at 7.2 kts. The speed was decreasing.

At 0053, the pilot for the western section of the NOK reached the bridge of the vessel. The speed of the vessel was now 5.8 kts. After being welcomed, the pilot received a briefing on the controls from the master. Here, a pilot card signed by the pilot was submitted by the ship's command during the investigation. The pilot then began to give advice and the speed was increased. The second officer was also on the bridge of the SONORO and controlling the helm.

At 0104, the pilot requested that the steering gear be switched from autopilot to manual.

In the further course of the pilotage, no helm commands were recorded on the audio channels of the S-VDR until 0353. The average speed of the vessel stood at 9 kts.

Based on the report of the traffic situation of 0118 by Vessel Traffic Service Brunsbüttel (VTS Kiel Canal West), call sign 'Kiel Canal II', the pilot informed the ship's command about the fact that the vessel was to wait for oncoming traffic in the Oldenbüttel siding.

The investigators assume that the second officer handed the helm over to the pilot at 0141. The pilot had the master explain to him how the bow thruster was operated a little later and the speed of the vessel was reduced.

At about 0200, the oncoming vessels BRANDGANS and ALEXANDER B passed the SONORO, after which she increased her speed again. At 0208, the second officer took over the helm again.

At 0226, the SONORO sailed into the Fischerhütte siding.

At 0227, the master left the bridge of the vessel. The master and pilot had previously calculated that there was about two hours remaining until Brunsbüttel.

At 0238, the vessel passed the Grünental Bridge. The speed was still more than 9 kts.

At 0255, the eastbound BELLATRIX reported a deterioration of visibility to 500 m from the Burg ferry (km 15).

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At about 0300, the C/O relieved the second officer. Shortly after, the pilot told the officer that a longer stay lay ahead in the next siding. Soon after the C/O took over the watch, a discussion concerning the helm was held between the pilot and the officer at 0303. The content was unintelligible on the audio recording.

During the sudden change of course to port (figure 9) and the approach with the MARIDA PATEA, there was no communication between the bridge crew except for the request of the pilot to turn on the bow thruster at 030730. Hence, neither helm commands nor recommendations regarding controlling the engine were given. Only at 0310, immediately after contact with the embankment, did the pilot request that the master be informed.

The encounter with the MARIDA PATEA and subsequent contact with the embankment are shown below based on the AIS recording of VTS Brunsbüttel (Figures 8 to 16).

The MARIDA PATEA, which was classified to Traffic Group 5, had already left the area of the Dückerwisch siding. During the approach of the two vessels, the SONORO moved onto the wrong side of the fairway. The SONORO returned to the middle of the fairway just before the two vessels passed.

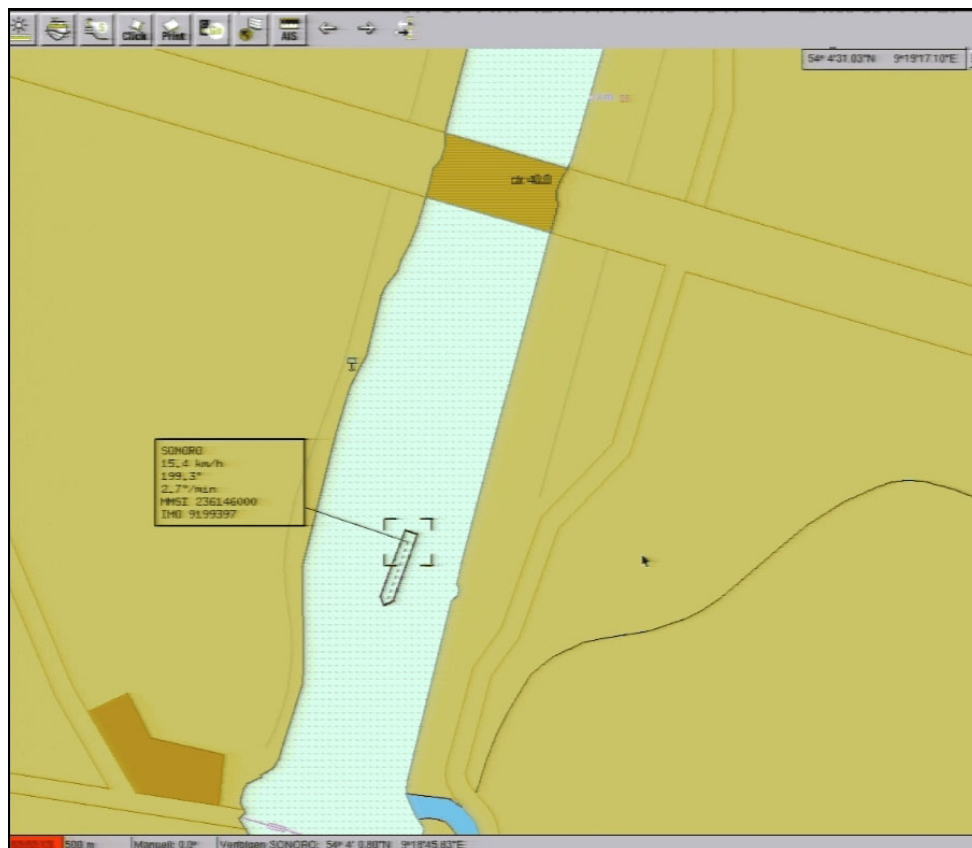


Figure 8: Time: 030313, the SONORO has passed the Hohenhörn Bridge

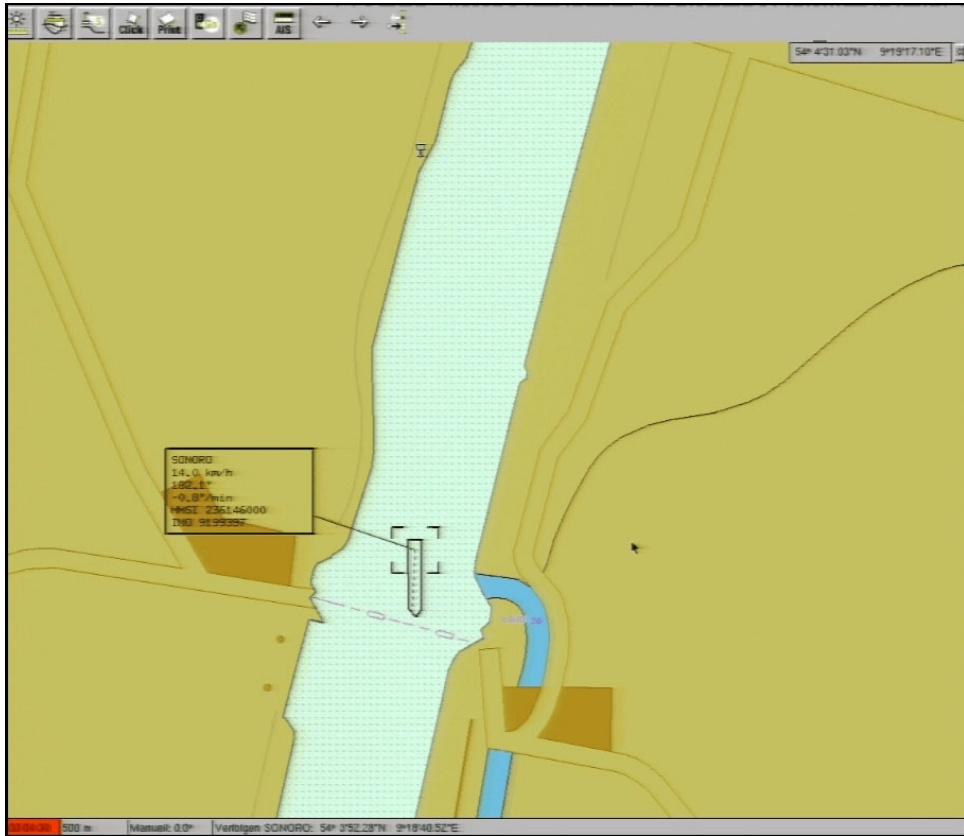


Figure 9: Time: 030430, the SONORO is level with the Hohenhörn ferry

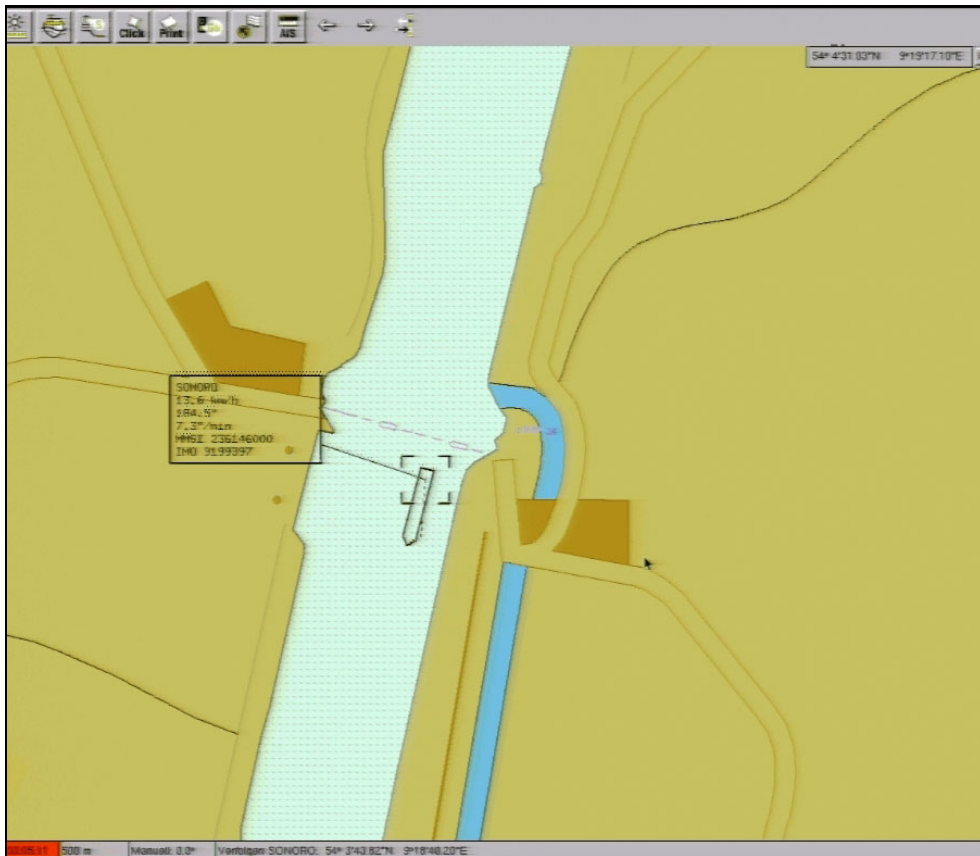


Figure 10: Time: 030511

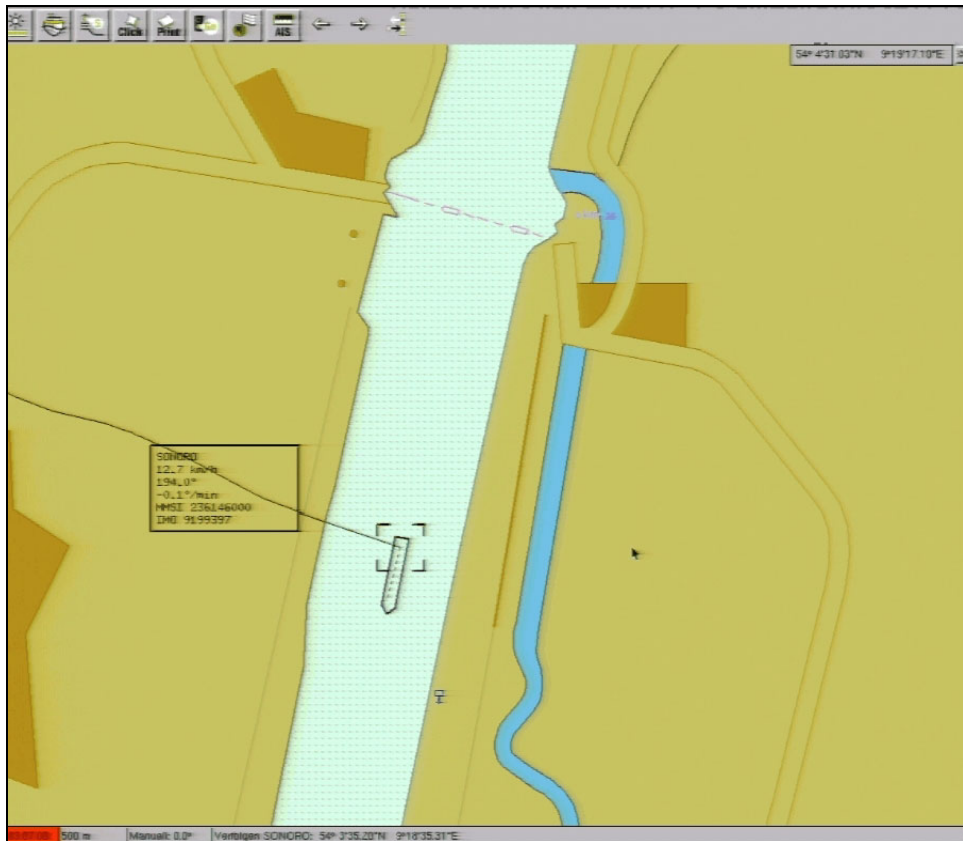


Figure 11: Time: 030700, the SONORO is in the middle of the canal

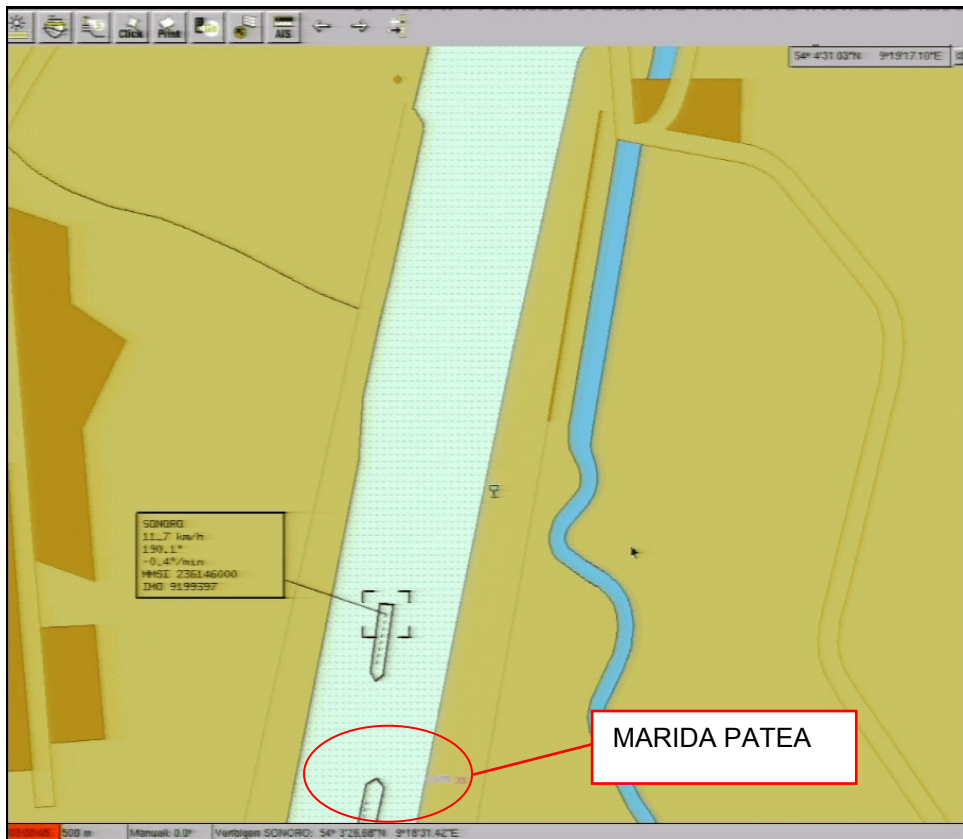


Figure 12: Time: 030845, the SONORO and the MARIDA PATEA converge

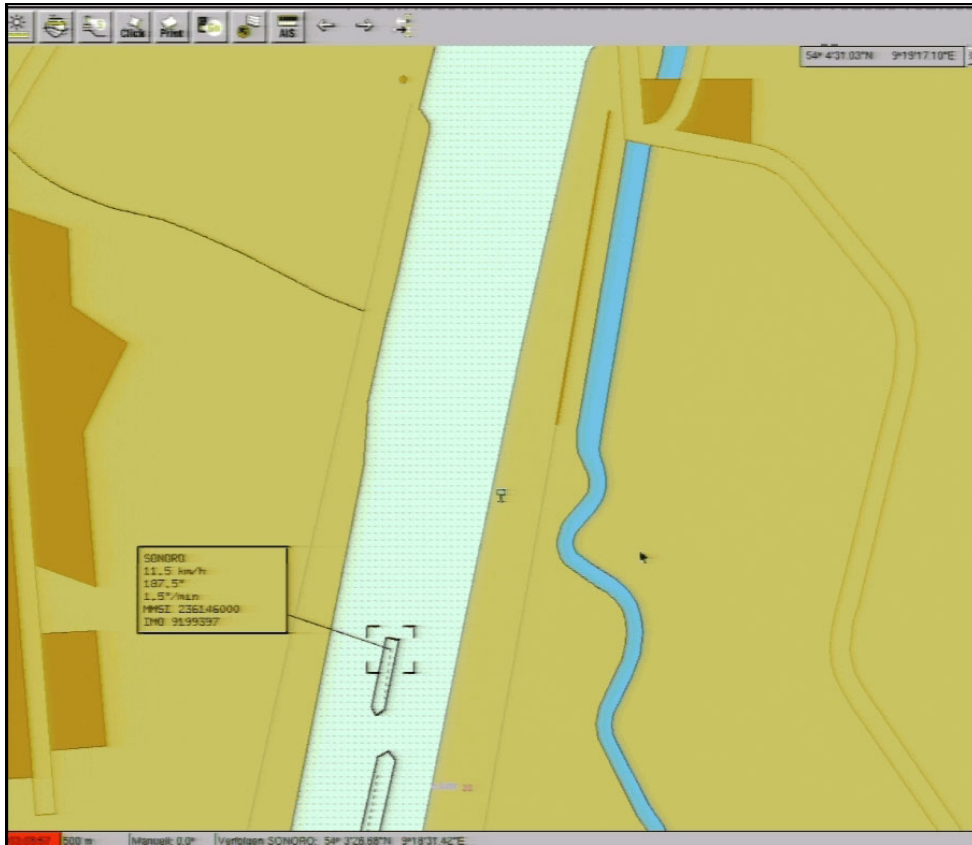


Figure 13: Time: 030857

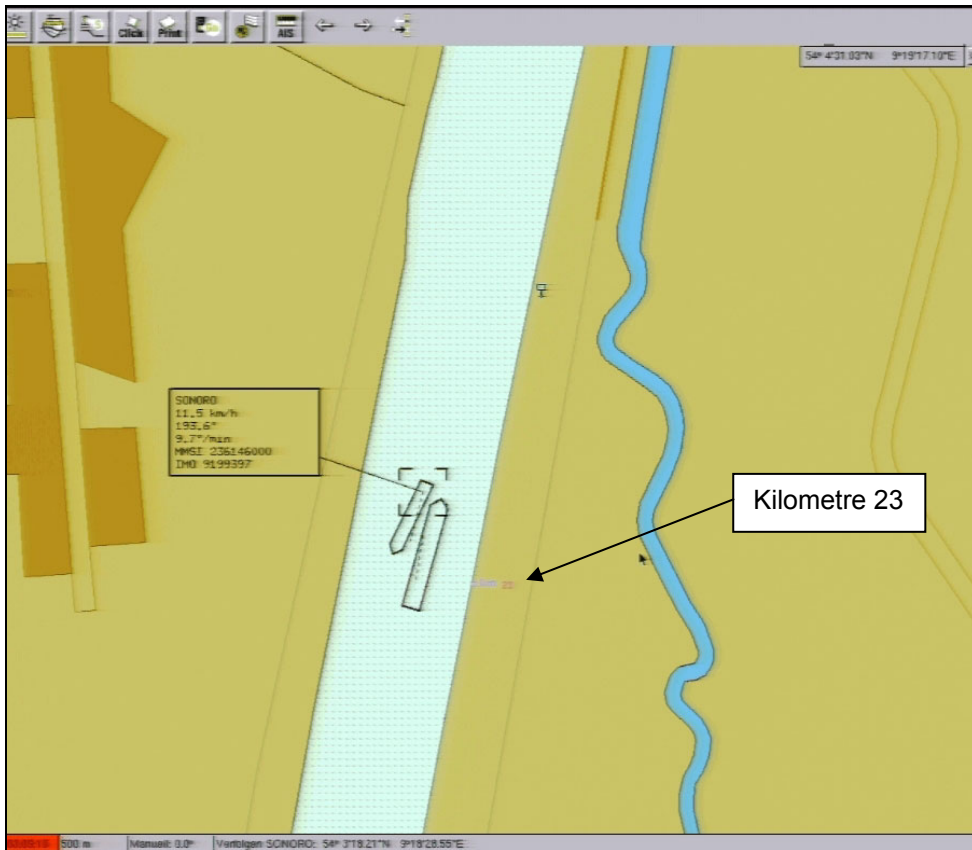


Figure 14: Time: 030915, the SONORO begins to turn to starboard

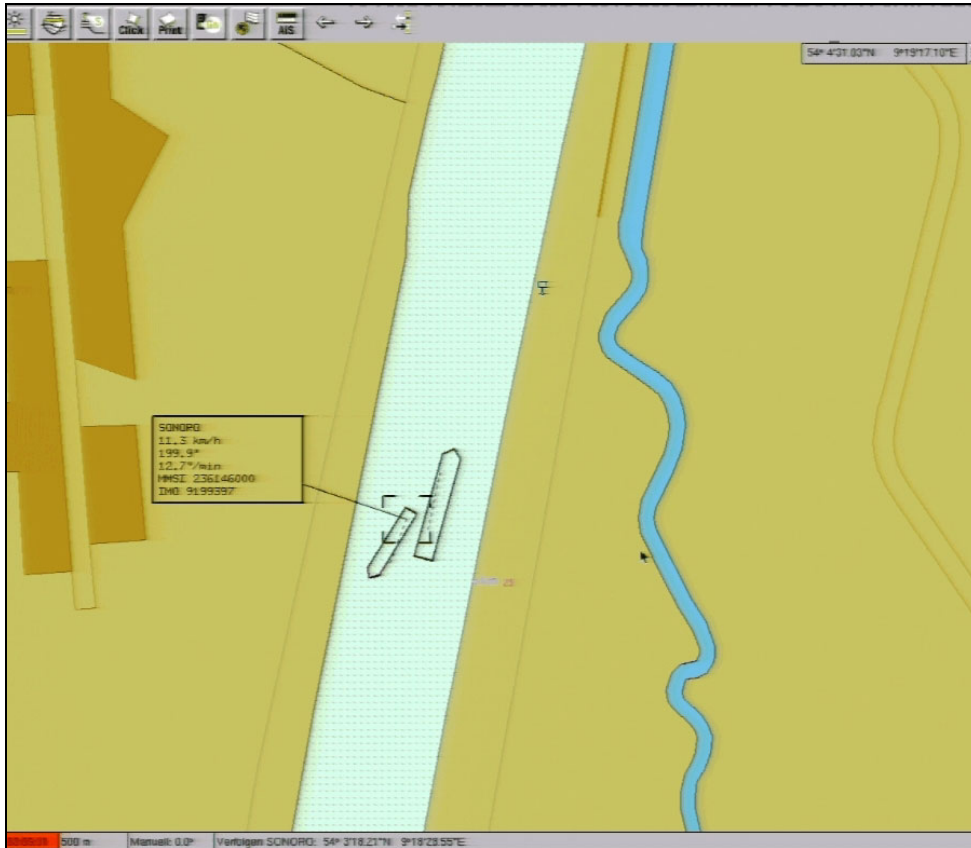


Figure 15: Time: 030931

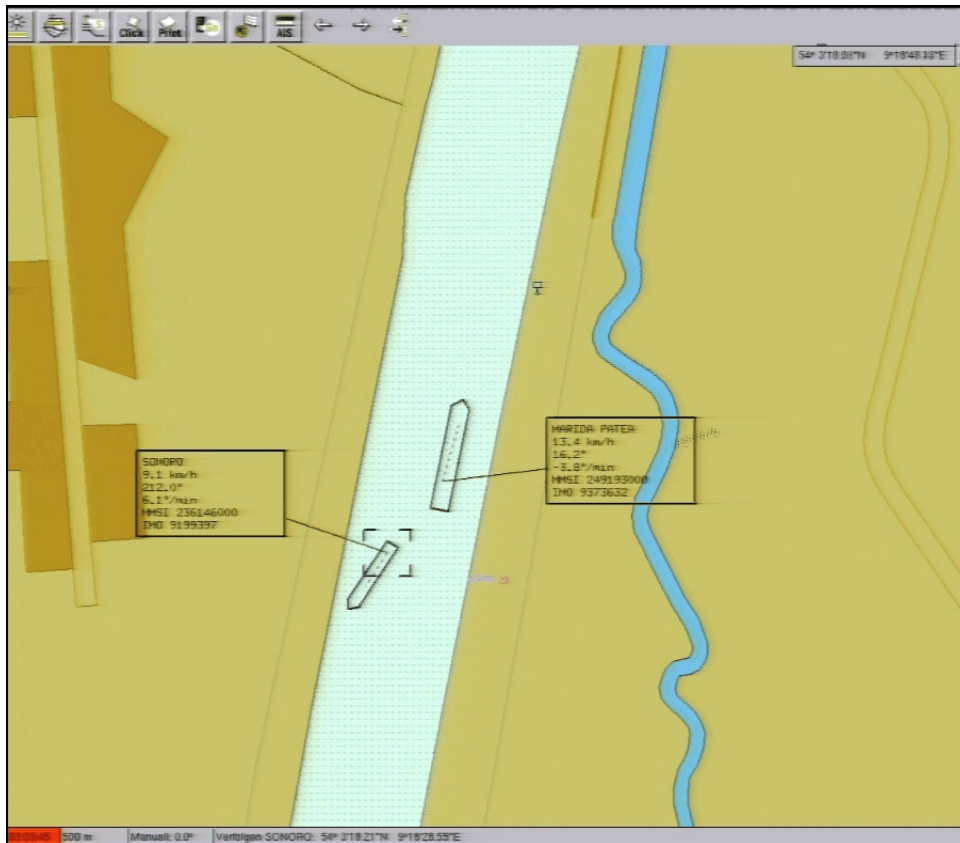


Figure 16: Time: 030945, the SONORO runs into the embankment

The master was called to the bridge after contact with the embankment. The pilot informed him that he had reportedly set the helm to 'hard to port', but reportedly the SONORO did not return to the proper course due to being sucked in by the MARIDA PATEA. At 0310, the pilot informed the Vessel Traffic Service about the grounding on the embankment. The VTS informed the vessels in the immediate vicinity of the incident in response to this. Shortly after, the pilot was requested by the VTS to give an account of personal injuries and the condition of the vessel. He stated that reportedly nobody was injured and that the tanks needed to be sounded first. He also stated that visibility stood at 100 m. At 0316, the VTS informed the other shipping about the incident. During the next situation report, the VTS announced the following levels of visibility in the area of the canal:

- Burg: 500 m
- Hochdonn: 400 m
- Hohenhörn: 200 m

The SONORO was free at 0321 and continued her voyage.

At 0331, just as the SONORO was sailing into the Dückerwisch siding, she consulted with the GRIMM, which was following, about her pass in the siding. The pilot asked the ship's command of the SONORO to turn on the deck lighting in the aft section to make her more visible from astern.

At 0336, the master of the SONORO was informed that all tanks were reportedly in good working order. This information was immediately passed on to the VTS, which had prohibited the vessel from leaving the Dückerwisch siding until information about her condition and the cause of the accident had been given. As regards the cause, the pilot gave the VTS to understand that the SONORO 'pushed apart' while passing the MARIDA PATEA, turned with her bow towards the northern bank and no longer responded to the helm. On being asked specifically about a technical failure, this was ruled out. The pilot simply stated that reportedly the "... rudder is not sufficient ...". He was then requested to ask the ship's command to re-test the rudder and to passover the full range. Following that, he was to report the result to the VTS before proceeding. At 0354, the SONORO was already under way again and was in the middle of the siding, the VTS asked about the rudder test, whereupon the pilot confirmed that no problems were found.

Shortly before, at 0353, the pilot issued the first rudder angle command to the C/O, who was at the helm.

At 0359, the SONORO left the Dückerwisch siding at a speed of 7 kts.

At 040026, the pilot issued the helm command "185" in English. At 040028, the helmsman had set this course.

At 040030, the master of the SONORO and the pilot began to discuss the content of his log book entry regarding the previous contact with the embankment. This discussion lasted until 040320.

At 040327, the helm command "187" was issued. This course was set at 040341.

Ref.: 140/10

At 040451, the SONORO was called by the SÜLLBERG on the VHF channel used by the pilots. This call was difficult to understand since it was not recorded directly on the VDR. Here, the recording was made indirectly via the bridge microphones. Essentially, the call contained the request to the SONORO to move to the correct side. The call was evidently not made in the usual form and the name of the vessel making the call was not stated.

The second call, essentially stating that a collision would occur any minute now, was made on the pilot channel at 040515.

The audio recording registered the first collision at 040523 and the second at 040532.

At 040623, the SONORO ran into the embankment again.

The SONORO initially anchored directly in front of the bridge at Hochdonn for the inspection of the damage to the vessel. Since no leaks could be found and the control and manoeuvring equipment were not affected, the vessel was able to proceed in consultation with VTS Brunsbüttel. She moored on the south quay in Brunsbüttel at about 0600.

The collision with the SÜLLBERG and subsequent contact with the embankment are shown below based on the AIS recording of VTS Brunsbüttel (Figures 17 to 25).

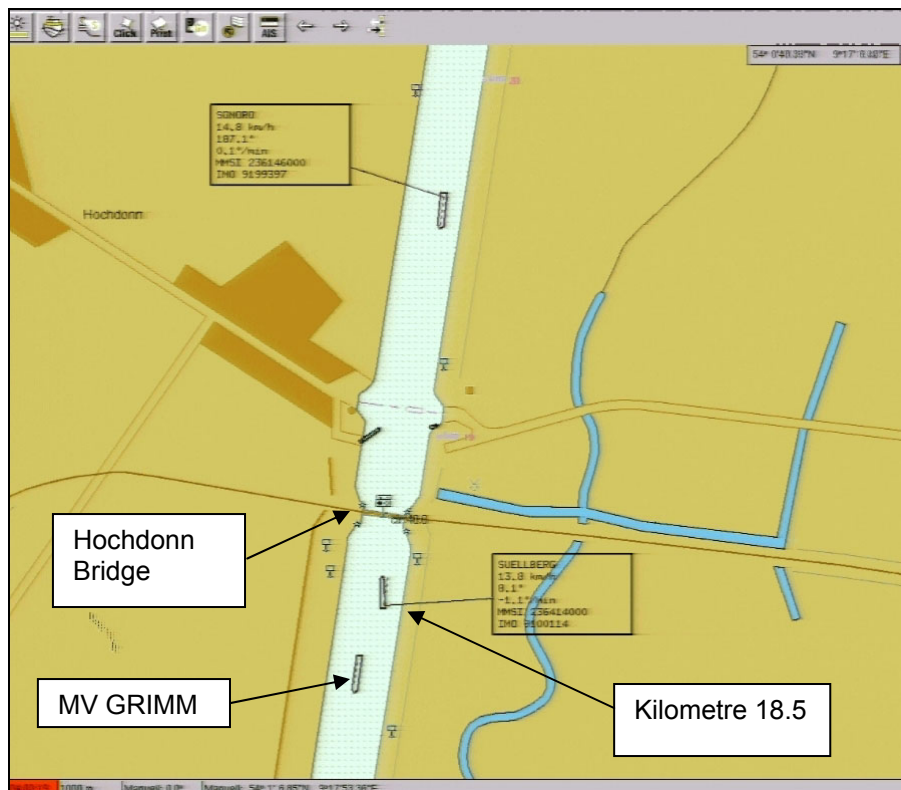


Figure 17: Time: 040319

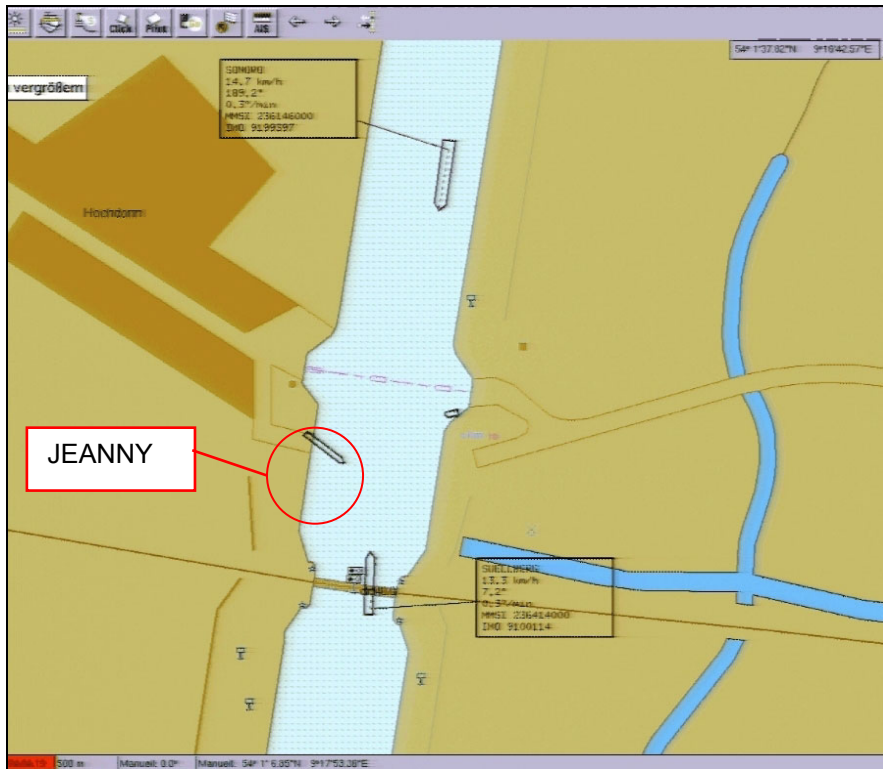


Figure 18: Time: 040419, motor vessel JEANNY⁵

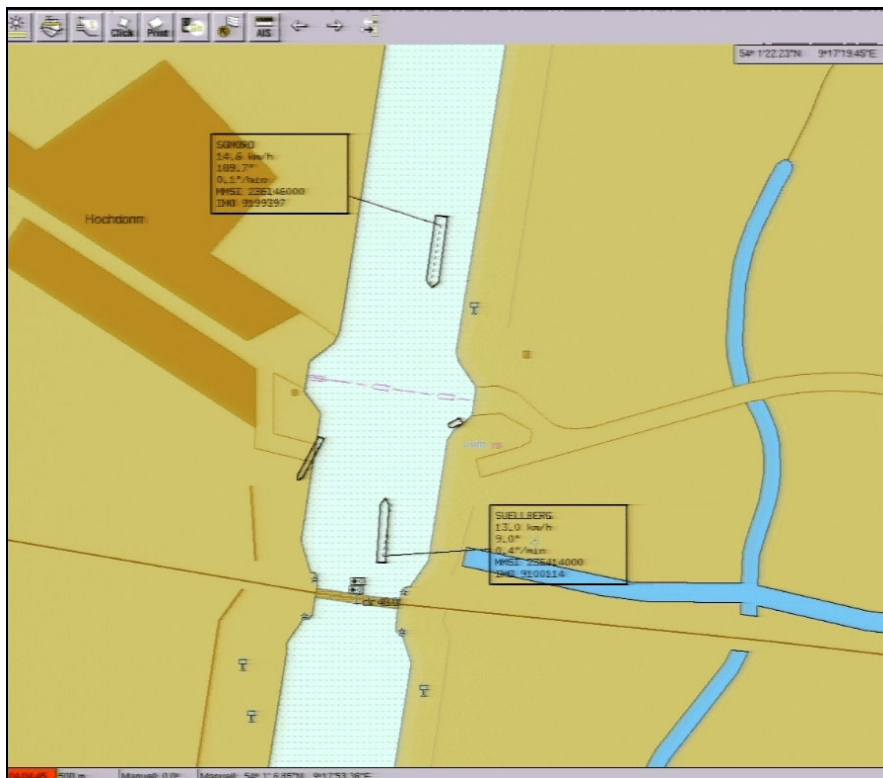


Figure 19: Time: 040445

⁵ The AIS signal of the JEANNY is shown here in Figures 17 to 25. This vessel was moored alongside the pier there for the whole of the incident. It was not affected by the collision. The changes in the presentation of the vessel are purely the result of jumps in the GPS position.

Ref.: 140/10

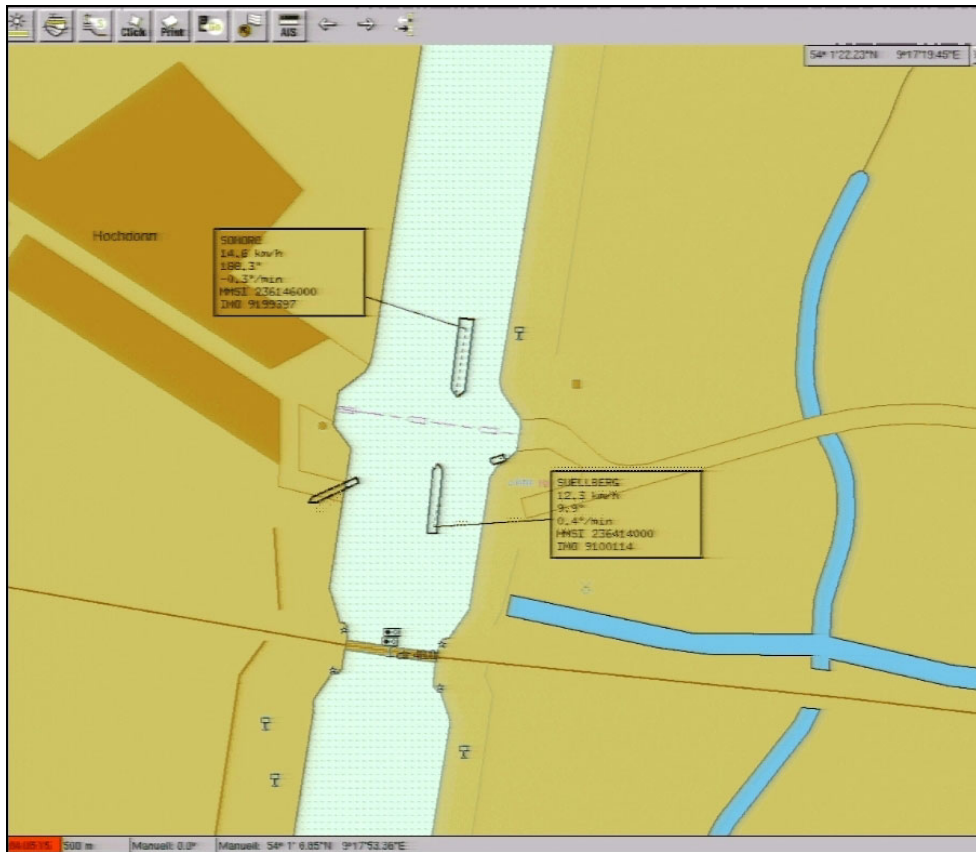


Figure 20: Time: 040515

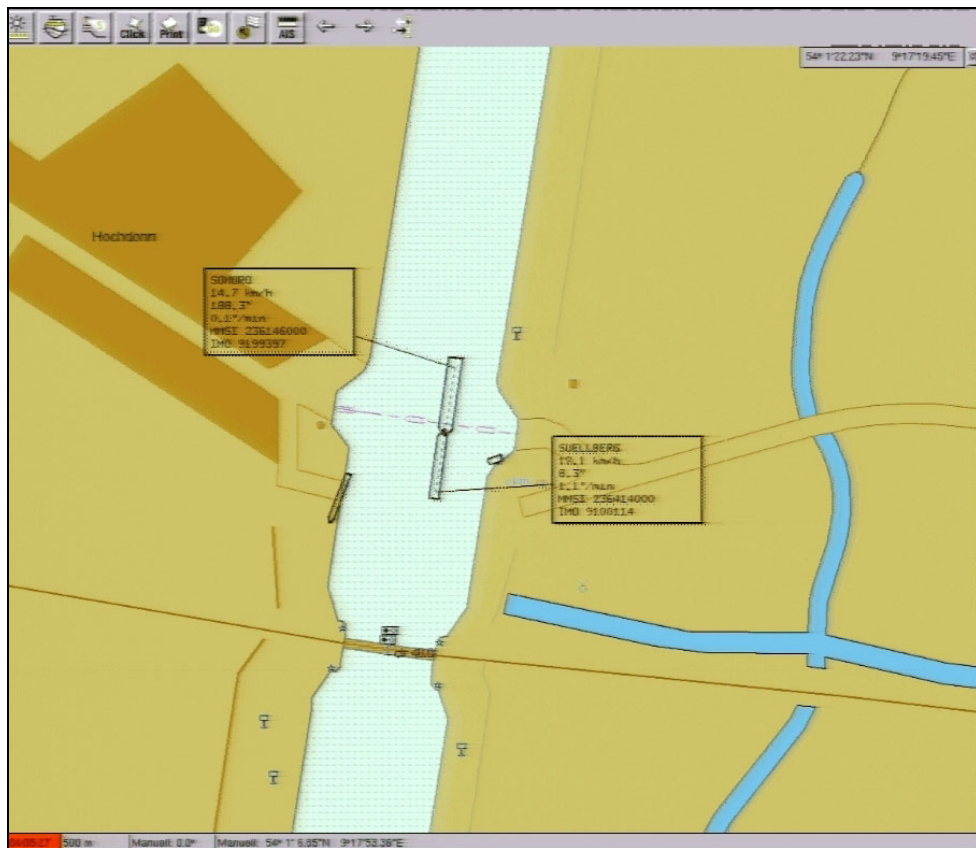


Figure 21: Time: 040527

Ref.: 140/10

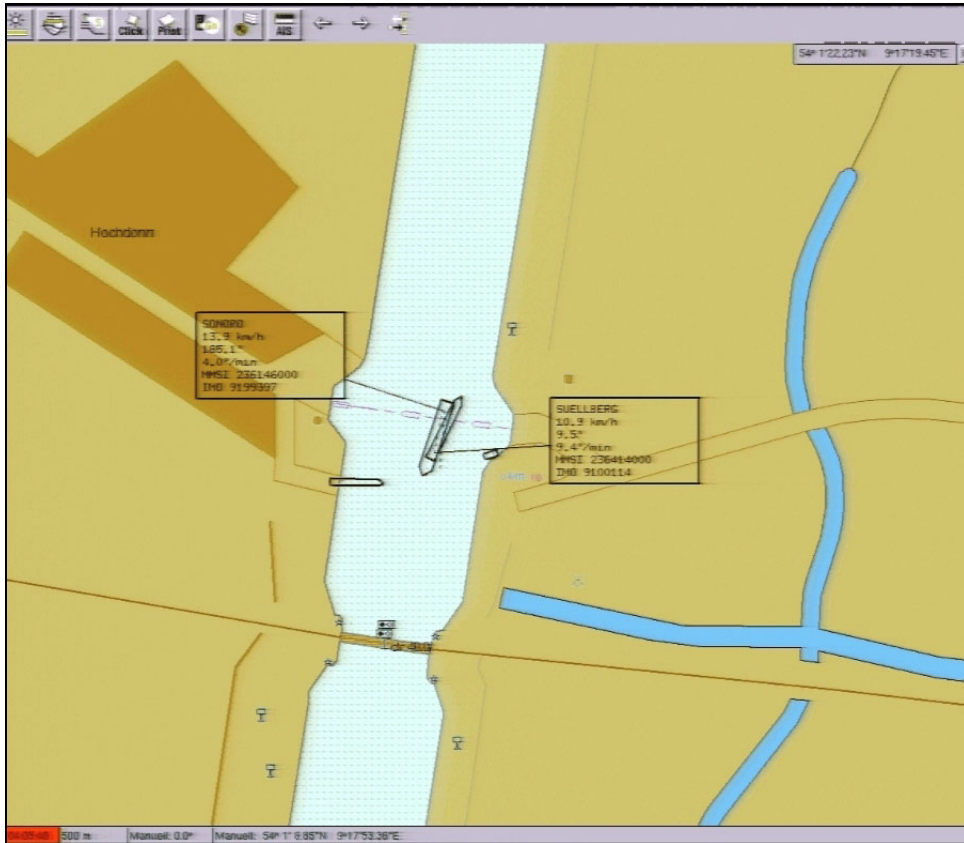


Figure 22: Time: 040540

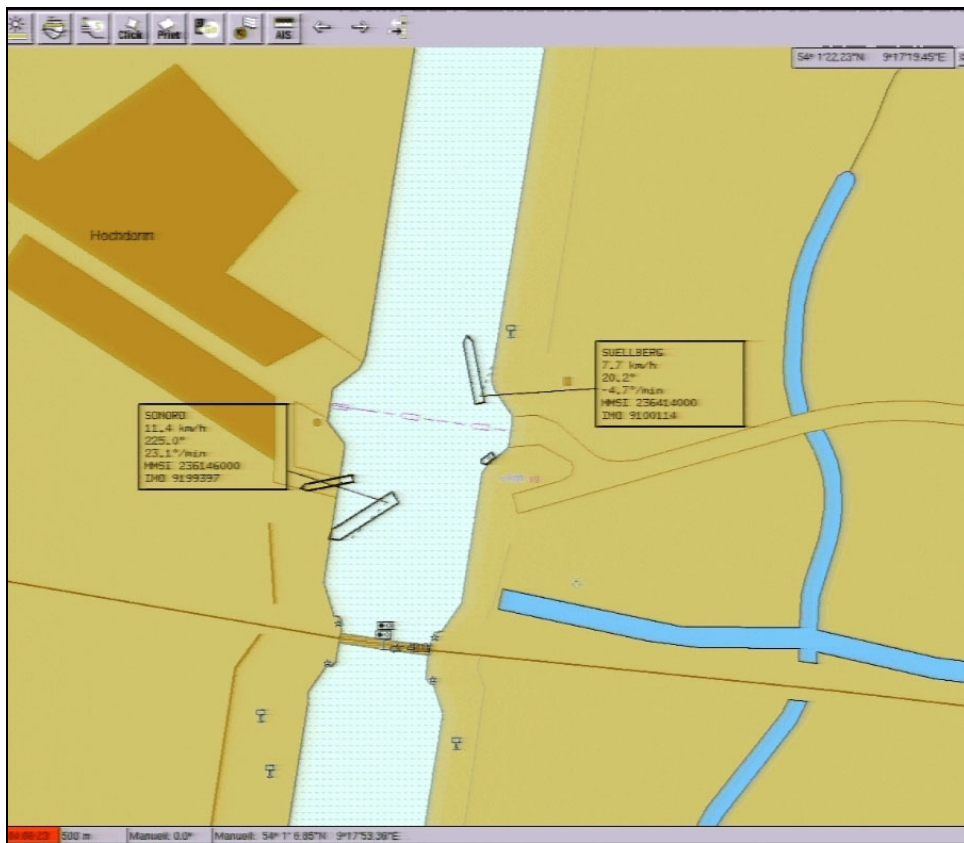


Figure 23: Time: 040623

Ref.: 140/10

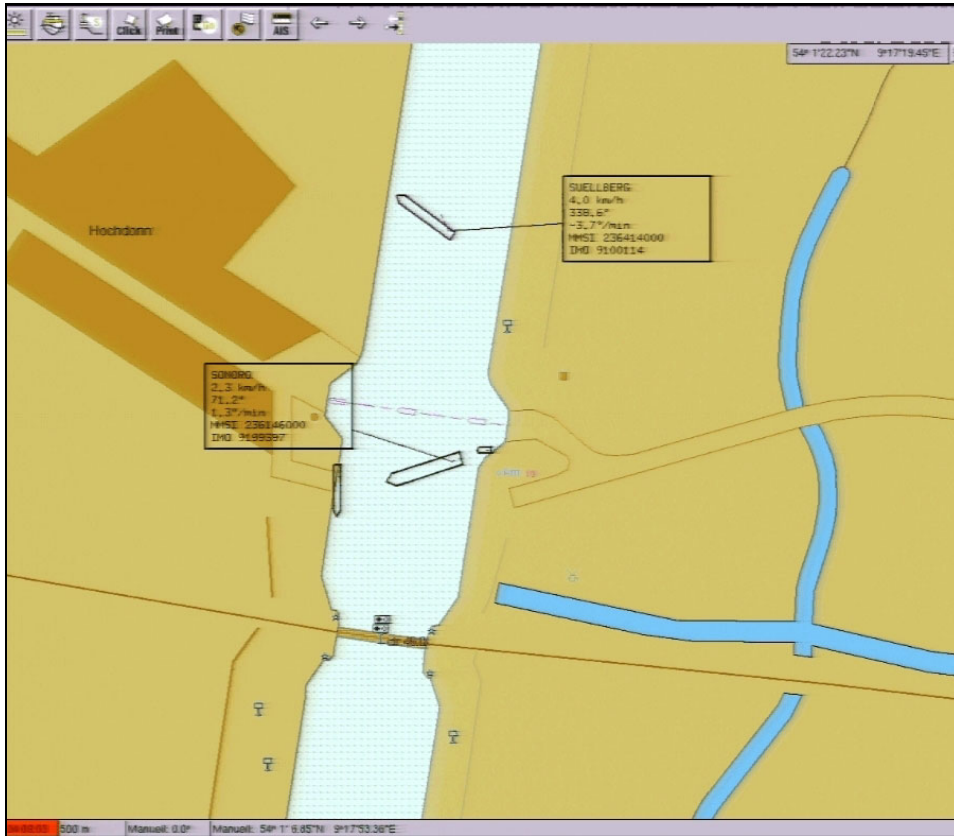


Figure 24: Time: 040900

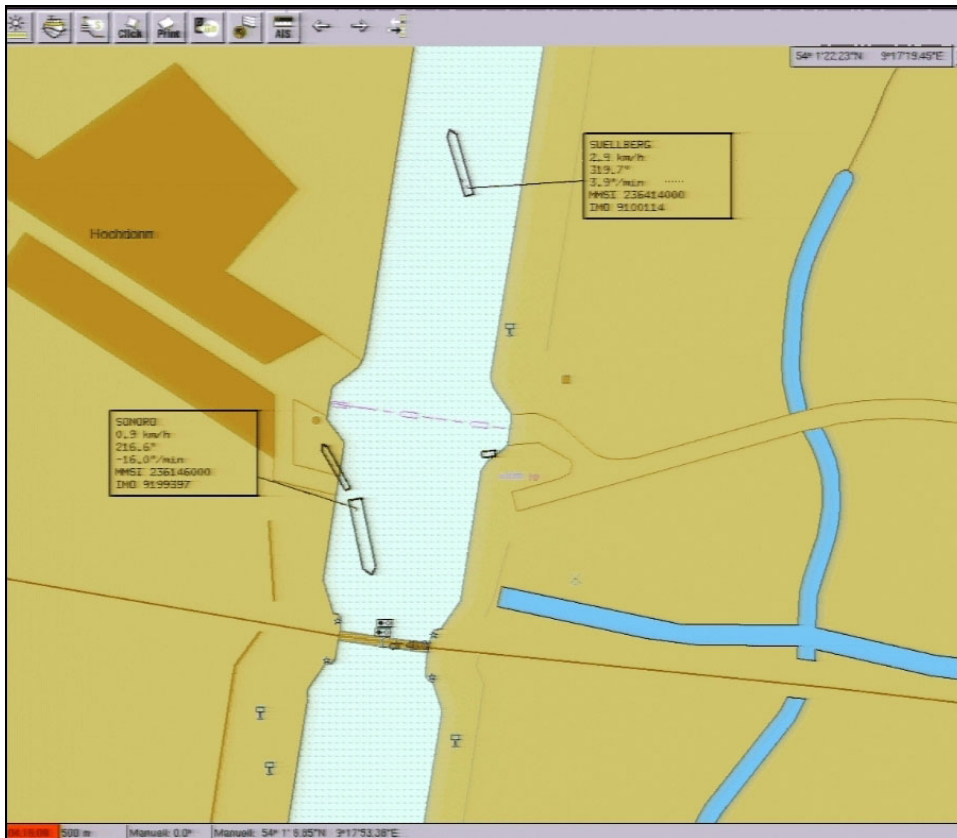


Figure 25: Time: 041600

WSA Brunsbüttel created speed diagrams for the SONORO and the SÜLLBERG using data generated from the GPS and transmitted by the AIS.

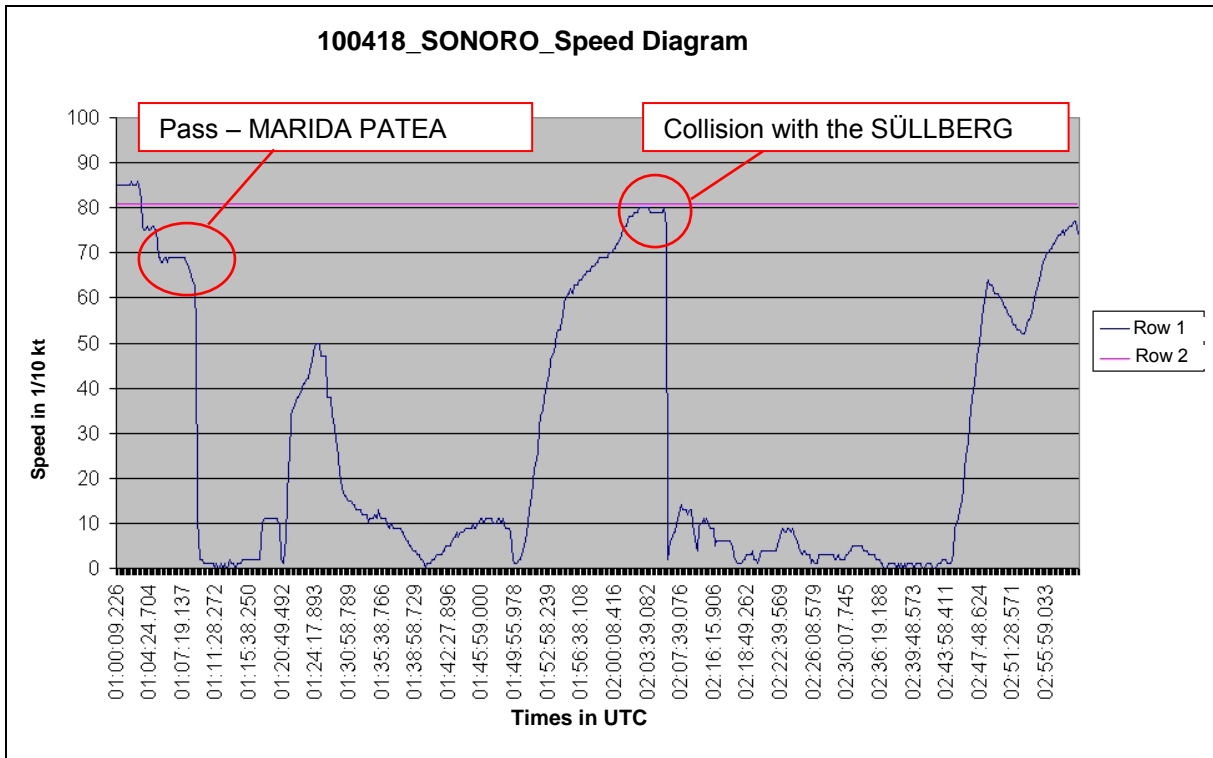


Table 1: Speed of the SONORO from 030009 to 045559, row 1 = speed of the vessel, row 2 = maximum permitted speed

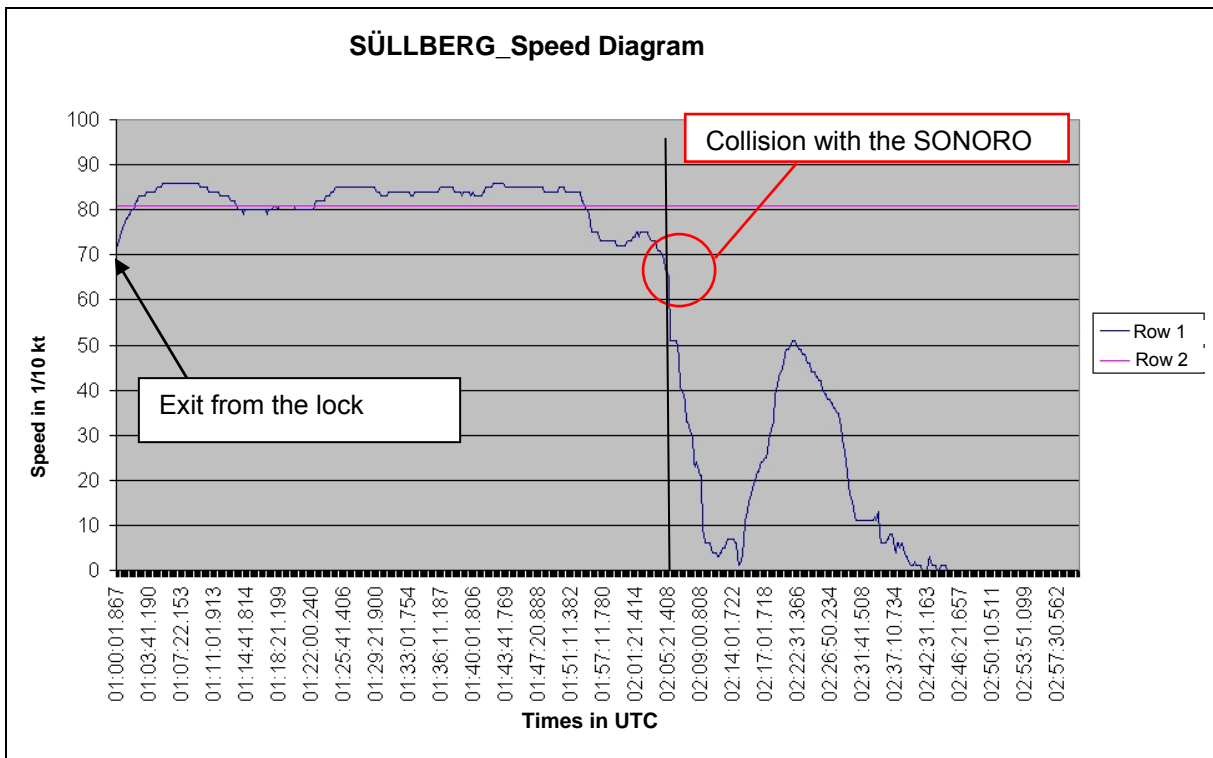


Table 2: Speed of the SÜLLBERG from 030001 to 045730, row 1 = speed of the vessel, row 2 = maximum permitted speed

Therewith the SÜLLBERG exceeded the maximum permitted speed by 65 % of the duration of the journey from the log to the collision.

The following levels of visibility were recorded by equipment of VTS Brunsbüttel in the area of the Dückerswisch siding.

Ergebnis der Wetterdaten-anforderung Wetterdatenerfassung am NOK				
Zeitpunkt	Sichtweite [m]			
18 04 2010 2:30	1000			
18 04 2010 2:33	1000			
18 04 2010 2:36	1000			
18 04 2010 2:40	1000			
18 04 2010 2:43	904			
18 04 2010 2:46	377			
18 04 2010 2:49	1000			
18 04 2010 2:52	980			
18 04 2010 2:55	1000			
18 04 2010 2:58	505			
18 04 2010 3:01	374			
18 04 2010 3:04	620			} Pass – MARIDA PATEA
18 04 2010 3:07	127			
18 04 2010 3:10	103			
18 04 2010 3:13	112			
18 04 2010 3:17	89			
18 04 2010 3:20	91			
18 04 2010 3:23	106			
18 04 2010 3:26	105			
18 04 2010 3:29	115			
18 04 2010 3:32	116			
18 04 2010 3:35	99			
18 04 2010 3:38	89			
18 04 2010 3:41	74			
18 04 2010 3:44	106			
18 04 2010 3:47	90			
18 04 2010 3:50	93			
18 04 2010 3:54	117			
18 04 2010 3:57	162			
18 04 2010 4:00	99			
18 04 2010 4:03	107			
18 04 2010 4:06	99			
18 04 2010 4:09	109			
18 04 2010 4:12	92			} Approach with the SÜLLBERG

Table 3: Visibility at Dückerswisch at 18/04/2011 from 0230 to 0412, times are local

3.2.2 Weather

WSP Brunsbüttel requested a report on the weather conditions at the time of the accident from Germany's National Meteorological Service. Excerpts of the report of 20/04/2010 are reproduced here:

"At 2-5 kts (1-2 Bft), the wind was very weak and came predominantly from the south. Due to nocturnal radiation, wide-spread, partly dense but shallow vertical fog prevailed at the time of the accident. Visibility was between 100 and 300 metres. The station at Itzehoe reported that the sky was visible at times in spite of the fog, which is an indication of typical, low-lying ground fog, (...).

Air temperature stood at 1 degree Celsius; however, minus 2 degrees at ground level (5 cm height). Since the dew point temperatures in the area were measured at 0 degrees, it can be assumed that there was heavy condensation at ground level, which will have restricted the reported visibility even more in places.

There was no rain at the time of the accident."

3.2.3 Witnesses

The AUDORF ferry was on the northern side of the NOK at the time of the accident and her two-member crew became aware of it due to two noises made by the collision. Both stated that visibility stood at 150 to 200 m. The skipper immediately informed the VTS about the collision. As they were looking out for the vessels, they noticed a light and a smoke signal in the water. The crew of the ferry cast off immediately in order to provide any necessary assistance. However, they only found a life ring of the SÜLLBERG and a smoke distress signal at the scene. The ordinary seaman of the ferry boarded the JEANNY a little later to search for damage. He could not find anything. The damage to the embankment on the northern side was only found later by other people.

4 ANALYSIS

4.1 Traffic regulations

In the area of the NOK, the German Traffic Regulations for Navigable Waterways (SeeSchStrO) in conjunction with the Notice of the Waterways and Shipping Directorate (WSD) North apply. The Notice puts the regulations for the NOK into specific form.

The vessels are classified into traffic groups. Classification is based on the length, breadth, draught and the type of cargo⁶. The traffic group affects the control and flow of traffic because on certain sections the sum-total of the traffic groups that encounter each other may not exceed eight. On the other sections, it may only be six⁷. Restrictions of this kind also exist when overtaking⁸. Sidings are exempted from these restrictions.

The SONORO and the SÜLLBERG belonged to Traffic Group (TG) 3; therefore, they were permitted to encounter one another on any part of the canal. With a length of 144.2 m and a breadth of 23 m, the MARIDA PATEA belonged to TG 5. The permissible sum-total for traffic groups on the section of the NOK on which the SONORO and the MARIDA PATEA encountered each other was eight. Therefore, it was admissible for the two vessels to encounter outside a siding. However, section 24 para. 4 SeeSchStrO also states: *"When a vessel of vessel categories 4 to 6 is involved, way shall be given to such vessel"*. The AIS recording indicates that the SONORO did not comply with this requirement. Figure 13 shows that the SONORO was proceeding in the middle of the fairway and that the MARIDA PATEA was on the assumed centreline of the canal with her port side.

The maximum speed on the NOK is also laid down. It is 15 km/h, respectively, 8.2 kts⁹ over ground for the vessels being considered here. Both the SONORO and the SÜLLBERG were exceeding the maximum permitted speed during the passage of the NOK until the casualty. The SONORO exceeded this considerably at times (see sub-para. 3.2.1).

The SONORO had a helmsman on board on the stretch between Kiel-Holtenau and the pilot station at Rüsterbergen. Due to her size, she was required to¹⁰; however, this requirement did not exist for the stretch from Rüsterbergen to Brunsbüttel.

Changing to manual control at 0104 was consistent with the regulations since automated steering systems may be used only by TG 1 and TG 2 vessels¹¹.

⁶ Sec. 2 para. 1 sub-para. 18a SeeSchStrO in conjunction with Part A, sub-para. 5 of the Notice

⁷ Sec. 24 para. 4 SeeSchStrO in conjunction with Part A, sub-para. 11 of the Notice

⁸ Sec. 23 para. 5 SeeSchStrO in conjunction with Part A, sub-para. 9 of the Notice

⁹ Sec. 26 para. 3 SeeSchStrO in conjunction with Part A, sub-para. 12.13.1.2) of the Notice

¹⁰ Sec. 42 para. 5 SeeSchStrO in conjunction with Part A, sub-para. 25.2 in conjunction with 25.4 of the Notice

¹¹ Part A, sub-para. 24.1 of the Notice

All the vessels considered in this investigation were required to accept a pilot¹². The possible exemptions could not be applied.

4.2 Principles to be observed for watchkeeping

The members of the ship's command were in possession of the necessary licences and thus sufficiently qualified.

The documents submitted do not give rise to assumptions of any impairment of the SONORO's ship's command or pilot due to fatigue.

The STCW Code¹³ governs watchkeeping on seagoing vessels.

The manning of the bridge during the passage of the vessel is dealt with in Section A-VIII/2, Part 3, para. 9 and para. 12. This states that the master is not required to navigate the vessel for the entire duration of the voyage. He may assign the navigational watch to one of the deck officers:

9¹⁴ The master of every ship is bound to ensure that watchkeeping arrangements are adequate for maintaining a safe navigational watch. Under the master's general directions, the officers of the navigational watch are responsible for navigating the ship safely during their periods of duty, when they will be particularly concerned with avoiding collisions and stranding.

12¹⁵ The officer in charge of the navigational watch is the master's representative and is primarily responsible at all times for the safe navigation of the ship and for complying with the International Regulations for Preventing Collisions at Sea, 1972¹⁶.

On the SONORO, the master handed the navigational watch over to the second officer at about 0227.

At the time contact with the embankment happened after passing the MARIDA PATEA, the C/O had been on watch for nine minutes according to the watchkeeping roster.

The bridge of the SONORO was manned by only the officer in charge of the navigational watch and the pilot at the time of the first accident.

At the time of the collision with the SÜLLBERG, the master, the C/O and the pilot were on the bridge.

¹² Art. 6 Lotsverordnung (pilot ordinance) Kiel Canal/Kiel Firth/Trave/Flensburg Firth

¹³ STCW Code – Code on Standards of Training, Certification and Watchkeeping for Seafarers – set in italics below.

¹⁴ Section A-VIII/2 – Watchkeeping Arrangements and Principles to be Observed (Part 3 – Watchkeeping at Sea)

¹⁵ Part 3-1 – Principles to be Observed in Keeping a Navigational Watch.

¹⁶ Regulations for Preventing Collisions at Sea (COLREGs)

No further consideration was given to the MARIDA PATEA during the investigation. The investigators are of the opinion that she had no influence on the SONORO's contact with the embankment after the two vessels passed. The pilot on the MARIDA PATEA was assisted by a canal helmsman.

On the SÜLLBERG, the officer in charge of the navigational watch and the pilot were on the bridge at time of the accident.

As a rule, a lookout must be posted on the bridge when the vessel is under way:

13 A proper lookout shall be maintained at all times in compliance with rule 5 Regulations for Preventing Collision at Sea, 1972 (...).

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

The exemptions in paragraph 15, which state that the officer on watch may also perform the role of lookout simultaneously, are basically limited to daylight and, inter alia, only when visibility permits. The two marine casualties considered here occurred during the night and in restricted visibility.

A lookout was not posted on the bridge of the SONORO or that of the SÜLLBERG at the time of collision. During the interview, the ship's command of the SONORO stated that the designated crew member was on standby in the superstructure. However, there was no indication of the presence of another crew member in the relevant audio recording between pilot transfer and collision.

An explanation was given for the absence of the lookout on the SÜLLBERG (see sub-para. 3.1.3).

According to para. 17, a definition of the composition of the navigational watch must be made. In conjunction with para. 35.1, the officer on watch shall review the need to have a helmsman on the bridge so as to be able to comply with international requirements at all times. If there is such a need, then the helmsman may not be used simultaneously as a lookout.

15 The duties of the lookout and helmsperson are separate and the helmsperson shall not be considered to be the look-out while steering (...).

A specially designated helmsman was not on the bridge of the SONORO. Prior to the pilot transfer at Rüsterbergen, this task was carried out by the canal helmsman who boarded with the pilot. Following that, this position was not manned by another crew member. However, the manning of the helm by officers of the navigational watch shall be regarded as an equivalent solution when the master is present. An additional helmsman was not called to the bridge after the master of the SONORO left it.

Apparently, this task was shared between the pilot and the officer in charge of the navigational watch, where the pilot took over the helm during critical phases.

No helm commands were issued until the pilot took over the helm. It is possible that until then visibility was such that the respective officer in charge of the navigational watch was able to steer by sight. Data on visibility in Table 3 are at least an indication of that.

The investigators assume that an automated steering system was not made use of since this is prohibited on the NOK (see footnote 11).

The tasks to be performed during a watch are also described in the STCW Code:

24¹⁷ During the watch the course steered, position and speed shall be checked at sufficiently frequent intervals, using any available navigational aids necessary, to ensure that the ship follows the planned course.

29 In cases of need, the officer in charge of the navigational watch shall not hesitate to use the helm, engines and sound signalling apparatus. (...)

31 A proper record shall be kept during the watch of the movements and activities relating to the navigation of the ship.

During the canal passage of the SONORO, positions were entered in the log book at larger intervals. It appears that the speed of the vessel was not monitored further by the ship's command because the maximum permissible speed was exceeded at times.

45 When restricted visibility is encountered or expected, the first responsibility of the officer in charge of the navigational watch is to comply with the relevant rules (...) (COLREGs), with particular regard to the sounding of fog signals, proceeding at a safe speed and having the engines ready for immediate manoeuvre. In addition, the officer in charge of the navigational watch shall:

- .1 inform the master;*
- .2 post a proper lookout;*
- (...).*

The investigators assume that by the time the bridge at Hohenhörn was passed at the latest, visibility had deteriorated to such an extent that one had to refer to it as restricted.

The onset of restricted visibility did not lead to the posting of a lookout on the SONORO. There was no indication that the master was notified by the officer on watch.

Moreover, an additional lookout was not called after the speed was increased in Dückerwisch when the master, officer on watch and pilot were on the bridge.

¹⁷ Performing the navigational watch.

Since the C/O was performing the task of helmsman, that would have been necessary, however.

4.3 Cooperation between the pilot and officer on watch

With regard to cooperation with the pilot, the STCW Code states the following:

49 Despite the duties and obligations of pilots, their presence on board does not relieve the master or the officer in charge of the navigational watch from their duties and obligations for the safety of the ship. The master and the pilot shall exchange information regarding navigation procedures, local conditions and the ship's characteristics. The master and/or the officer in charge of the navigational watch shall cooperate closely with the pilot and maintain an accurate check on the ship's position and movement.

50 If in any doubt as to the pilot's actions or intentions, the officer in charge of the navigational watch shall seek clarification from the pilot and, if doubt still exists, shall notify the master immediately and take whatever action is necessary before the master arrives.

The pilot was briefed on the controls of the vessel.

Apparently, during the absence of the master of the SONORO, the helm was controlled by the respective officer in charge of the navigational watch.

Further information on cooperation between pilots and ship's commands can be found in IMO Resolution A.960(23)¹⁸. Here, Annex 2 (6.3) states the following:

When a pilot is communicating to parties external to the ship, such as vessel traffic services, tugs or linesmen and the pilot is unable to communicate in the English language or a language that can be understood on the bridge, the pilot should, as soon as practicable, explain what was said to enable the bridge personnel to monitor any subsequent actions taken by those external parties.

The pilot informed the ship's command of the SONORO about changes in the course of the voyage and, in particular, about the planned stay in the sidings and oncoming vessels. He had been informed about these changes previously by the situation reports of the VTS, which are transmitted only in German.

Operation of the engine telegraph was also considered by the investigators. It was not possible to determine precisely who the telegraph was operated by. This is especially true for those periods in which the respective officer in charge of the navigational watch was alone on the bridge with the pilot.

¹⁸ Recommendations on Training and Certification and on Operational Procedures for Maritime Pilots other than Deep-Sea Pilots.

The pilot has a duty to advise the ship's command¹⁹. Such advice includes assisting the ship's command in complying with traffic regulations²⁰. Therefore, the pilots of the SONORO and the SÜLLBERG would have been obliged to inform the respective ship's command if the maximum permissible speed was exceeded or take positive steps to comply with the permitted speed if the ship's command had granted them the power to issue orders independently.

4.4 Course of the voyage prior to the first accident

After the pilot transfer, the voyage initially passed without incident. Moreover, when analysing the VDR, no peculiarities were found after the master left the bridge at 0227 with the exception of the above circumstances (helmsman, lookout). Furthermore, no evidence could be found for the cause of the sudden change of course to port made by the vessel level with the Hohenhörn ferry. Indeed, there was a gyro data-related display error on the VDR replayer at this time; however, it transpired that this was a replayer error as all the gyro data were included in the raw NMEA data.

The 'running out of rudder' while passing the MARIDA PATEA was interpreted differently by the ship's command and the pilot. According to the log book, the ship's command believed this was caused by passing the MARIDA PATEA too closely. It appears that the pilot felt that it was due to the vessel's inadequate response to the 'hard to port' rudder angle.

The speed of the SONORO was 11.5 km/h when she passed the MARIDA PATEA. The MARIDA PATEA was proceeding at 13.4 km/h. Here, the speed of the SONORO was reduced before the encounter.

4.5 Course of the voyage prior to the second accident

The master of the SONORO stayed on the bridge after the contact with the embankment. The pilot began to specify the required courses when the vessel started pick up speed at 0353 in the Dückerswisch siding. The master was in command of the vessel and the C/O was controlling the helm. Therefore, with the exception of the absent lookout, the level of manning on the bridge was normal while under pilotage.

During the immediate approach to the SÜLLBERG, the speed of the SONORO varied between 14.6 km/h and 14.8 km/h. The AIS plot does not reveal any considerable reduction in speed prior to the collision.

The speed of the SÜLLBERG was 13.3 km/h when she passed the bridge at Hochdonn. This was evidently due to the deterioration in visibility and passing through the narrow section under Hochdonn Bridge. The speed then continuously decreased to 12.3 km/h.

¹⁹ Art. 23 para 1 (1) Seelotsgesetz (maritime pilot act)

²⁰ Art. 4 para. 2 SeeSchStrO and art. 4 para. 2 VOKVR (ordinance pertaining to the COLREGs)

According to the AIS recording, the SONORO was clearly on the wrong side of the fairway at 040319. At this point, the SÜLLBERG was at kilometre 18.5 and a maximum of 6 cbl away. Until the collision 2 minutes and 8 seconds remained. At 040327, the helm command "187" was possibly made in reaction to the position of the vessel on the canal.

The first call by the SÜLLBERG was made when the two vessels were a maximum distance of 2 cbl apart. Until the collision 42 seconds remained. Since the SONORO was still clearly on the wrong side at this point, the investigators believe that the collision was no longer avoidable. That the call by the SÜLLBERG went unheard on the bridge of the SONORO was due to the brevity and form in which it was made as well as the prevailing distraction. It seems that the collision with the SÜLLBERG was a complete surprise. It is possible that on the SONORO, too, the radar echo of the SÜLLBERG may have been influenced by the bridge.

5 CONCLUSIONS

5.1 SONORO

The speed of the vessel was not monitored adequately by the ship's command or by the pilot. Consequently, the maximum permissible speed was exceeded for long distances. However, the accident was not caused by excessive speed.

The position of the vessel in the canal and the traffic were not monitored, respectively, not considered adequately by the ship's command. For example, the SONORO was moving on the wrong side for a long period before colliding with the SÜLLBERG. This fact was not discussed with the pilot. The encounter with the SÜLLBERG was uncontrolled and therefore the risk of a collision was not noticed by the ship's command of the SONORO. Prior to the collision, there was no reduction in the speed of the vessel.

The pilot did not devote enough attention to the position of the vessel, the approaching SÜLLBERG or the pilots' VHF channel. Since the vessel's position in the fairway did not change appreciably before the collision with the SÜLLBERG, the response to proceeding on the wrong side was inadequate. Environmental factors that would affect the handling of the vessel were not recorded.

At no time was a lookout posted on the bridge of the SONORO. Moreover, the onset of deteriorating visibility did not lead to the posting of a lookout. The corresponding requirement of the STCW Code was not met.

An additional crew member was not assigned the role of helmsman. This task was carried out for long distances by the respective officer in charge of the navigational watch. Therefore, he was unable to perform his particular tasks of navigating the vessel in the absence of the master and cooperating closely with the pilot properly. This is especially true for those periods in which restricted visibility prevailed, as the officer on watch had to pay particular attention to steering the vessel. The requirement of the STCW Code regarding the use of a helmsman was not met.

The investigators are aware of the inherent problem vessels such as the SONORO and their small crews face, since transiting the canal requires a high level of manning. However, this problem could be met to some extent by the voluntary acceptance of a canal helmsman on the western stretch.

The direct duties of the pilot do not include the exertion of influence on the crew of a bridge. However, as part of his general responsibility for the safety of shipping²¹ and in accordance with good seamanship, he should have made every effort to ensure that the bridge was properly manned.

The investigators are aware of the method practised on occasion, where pilots navigate vessels independently without a canal helmsman. However, the BSU is of the view that this goes beyond the "maritime pilot making independent arrangements regarding the navigation of the vessel" as permitted by art. 23 para. 2 Seelotsgesetz. When shortcomings in the manning of the bridge are detected, rather than pilots

²¹ Art. 8 para. 2 (1) Allgemeine Lotsverordnung (general pilot ordinance)

accepting the conditions found on board and seeking to compensate these through own additional work, this would require them to work actively towards changing the situation.

The investigators are aware of the fact that ships such as the SONORO and their limited levels of manning pose a problem, since the canal transit is associated with a high level of manning. This problem is complex. On the one hand the limited manning level is based on the requirements for a safe manning stipulated by the respective flag state as minimum manning. In addition the ships operator could determine that in special areas more crew is required. On the other hand the situation could be improved by the ships command by voluntarily accepting a canal helmsman on the western stretch of the canal. Finally the pilot could jointly decide with the VTS that one of the usual actions (e.g. upgrading of the traffic group, suspension of the sailing) are taken when deficits are recognised. Last but not least it would possibly be in terms of the administration when the selected regulation regarding the acceptance of a canal helmsman on the western stretch of the canal would be critically considered again.

5.2 SÜLLBERG

A lookout was not posted on the bridge of the SÜLLBERG at the time of collision and therefore the corresponding requirement of the STCW Code was not met.

Here too, the speed of the vessel was not monitored adequately by the ship's command or by the pilot. Consequently, the maximum permissible speed was exceeded for long distances. However, the accident was not caused by excessive speed.

Although radar visibility can be severely restricted when passing a bridge, the SÜLLBERG was just behind canal kilometre 18.5 when she detected the SONORO. It was apparent to the ship's command of the SÜLLBERG that the SONORO was proceeding on the wrong side of the fairway. Consequently, the speed was reduced and the SONORO made aware of her irregular behaviour. The first call on the pilots' VHF channel was late and due to the manner in which it was made not given the appropriate attention by the SONORO.

5.3 VDR

Only an S-VDR was installed on the SONORO. The reduced performance requirements associated with that were fully met by the device. Due to the lower requirements as well as the poor quality of the audio recording, the scope for analysis during the investigation was limited, however.

6 SAFETY RECOMMENDATIONS

The following safety recommendations do not constitute a presumption of blame or liability in respect of type, number or sequence.

6.1 Ship's command and operator of the SONORO

The Federal Bureau of Maritime Casualty Investigation recommends that the ship's command of the SONORO and the operator of the vessel review the accident as part of their safety management. Here, the principles to be observed in keeping a navigational watch, conduct in restricted visibility and heavily used, narrow waters as well as navigating with pilot advice should be addressed, in particular.

6.2 Ship's command and operator of the SÜLLBERG

The Federal Bureau of Maritime Casualty Investigation recommends that the ship's command of the SÜLLBERG and the operator of the vessel review the accident as part of their safety management. Here, the principles to be observed in keeping a navigational watch and navigating with pilot advice should be addressed, in particular.

6.3 Lotsenbrüderschaft NOK I (Brotherhood of NOK I Pilots [sic])

The Federal Bureau of Maritime Casualty Investigation recommends that the Lotsenbrüderschaft NOK I review the accident as part of their quality management. The segregation of duties between the crew and pilots, navigating in restricted visibility and the execution of vessel encounters in adverse conditions should receive special attention.

6.4 Manufacturer of the S-VDR

The BSU recommends that Netwave Systems optimise the hardware and software on board the SONORO so that after marine casualties the recorded data are available in sufficient quality and can be analysed.

7 SOURCES

- Investigations by WSP Brunsbüttel, WSP Rendsburg and WSP Kiel
- Written statements
 - Ship's commands
 - Pilots
- Witness accounts
- Log book of the SONORO
- Charts, Federal Maritime and Hydrographic Agency
- Official weather report by Germany's National Meteorological Service
- AIS recordings and analyses thereof by VTS Brunsbüttel
- VHF recording of VTS Brunsbüttel
- Figure 4 by WSP Brunsbüttel, Figures 5 to 7 by WSP Kiel