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

Investigation Report 102/11

Serious Marine Casualty

Collision between the TMV ZAPADNYY and a floating dock moored on the bank of the River Weser belonging to the Fr. Lürssen shipyard after an overtaking manoeuvre involving the TMV RHONESTERN and the TMV ZAPADNYY on 5 April 2011

15 August 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 in the version applicable prior to 30 November 2011.

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 the aforementioned version of art. 19 para. 4 SUG.

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

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1 Summary

At 0804[1] on 5 April 2011, the Belize-registered TMV ZAPADNYY was proceeding with pilot advice and collided with the front end of a floating dock, which was firmly moored on the northern bank of the River Weser and belonged to the Fr. Lürssen shipyard, off Bremen-Vegesack. The collision was preceded by an overtaking manoeuvre by the TMV RHONESTERN, which was sailing under the flag of the Isle of Man and also manned by a pilot, after which the ZAPADNYY's ability to steer was almost certainly compromised due to hydrodynamic effects.
Due to the force of the collision on the dock, its various shore anchoring points tore off across a wide area. The river flow then caused the front end of the empty floating dock, which was affected by the collision, to part from the quay wall. Following that, the still buoyant ZAPADNYY – whose bow had become wedged together with the front end of the dock – and the dock itself moved crossways to the direction of flow, thus blocking the traffic on the River Weser for some two hours. The shipyard workers employed on the floating dock were able to move to safety before the accident occurred. Since there was also no crew members situated on the forecastle of the ZAPADNYY – which was primarily affected by the collision – at the time of the accident, nobody came to physical harm.
The TMV ROHNESTERN was not affected by the effects of the overtaking manoeuvre and continued her journey towards the next port of destination without interruption. There was no environmental pollution.

[1] All times shown in this report are local = CEST = UTC + 2 hours.

2 SHIP PARTICULARS

2.1 Photo of the TMV ZAPADNYY

Figure 1: Photo of the TMV ZAPADNYY

2.2 Vessel particulars TMV ZAPADNYY

Name of vessel:	ZAPADNYY
Type of vessel:	Tanker
Nationality/flag:	Belize
Port of registry:	Belize City
IMO number:	8711837
Call sign:	V3MT6
Owner:	Yugreftransflot, Sevastopol (Ukraine)
Year built:	1988
Shipyard/yard number:	Shipbuilding & Shiprepairing Yard 'Ivan Dimitrov' Rousse (Bulgaria) / 467
Classification society:	Russian Maritime Register
Length overall:	77.53 m
Breadth overall:	14.34 m
Gross tonnage:	1,896
Deadweight:	3,297 t
Draught (max.):	5.34 m
Engine rating:	885 kW
Main engine:	SKL four-stroke engine 8NVD48A-2U
(Service) speed (max.):	10.2 kts
Hull material:	Steel
Minimum safe manning:	13

2.3 Voyage particulars

Port of departure:	Bremen
Port of call:	Aabenraa (DK)
Type of voyage:	Merchant shipping/international
Manning:	14
Draught at time of accident:	5.34 m
Pilot on board:	Yes

2.4 Photo of the TMV RHONESTERN

Figure 2: Photo of the TMV RHONESTERN

2.5 Vessel particulars TMV RHONESTERN

Name of vessel:	RHONESTERN
Type of vessel:	Tanker
Nationality/flag:	Isle of Man
Port of registry:	Douglas
IMO number:	9183831
Call sign:	ZQFZ3
Owner:	Rigel Schiffahrts GmbH & Co KG
Year built:	2000
Shipyard/yard number:	Stocznia Gdynia SA, Gdynia (Poland)/8189-3
Classification society:	Germanischer Lloyd
Length overall:	162.16 m
Breadth overall:	27.18 m
Gross tonnage:	14,400
Deadweight:	21,871 t
Draught (max.):	8.80 m
Engine rating:	7,878 kW
Main engine:	MAN B&W two-stroke engine 6S46MC-C
(Service) speed (max.):	15.0 kts
Hull material:	Steel
Minimum safe manning:	20

2.6 Voyage particulars

Port of departure:	Bremen
Port of call:	Kiel
Type of voyage:	Merchant shipping/international
Manning:	20
Draught at time of accident:	5,65 m
Pilot on board:	Yes

2.7 Marine casualty information

Type of marine casualty:	Serious marine casualty Collision between the TMV ZAPADNYY and a moored floating dock
Date, time:	05/04/2011, 0804
Location:	River Weser off Bremen-Vegesack
Latitude/Longitude:	φ 53°10.4'N λ 008°35.8'E
Ship operation and voyage segment:	Harbour mode
Consequences:	Material damage to the TMV ZAPADNYY Material damage to the floating dock belonging to the Fr. Lürssen shipyard Shipping could not pass for two hours

Section from ENC DE 521650 Ed. 2.0, BSH[2]

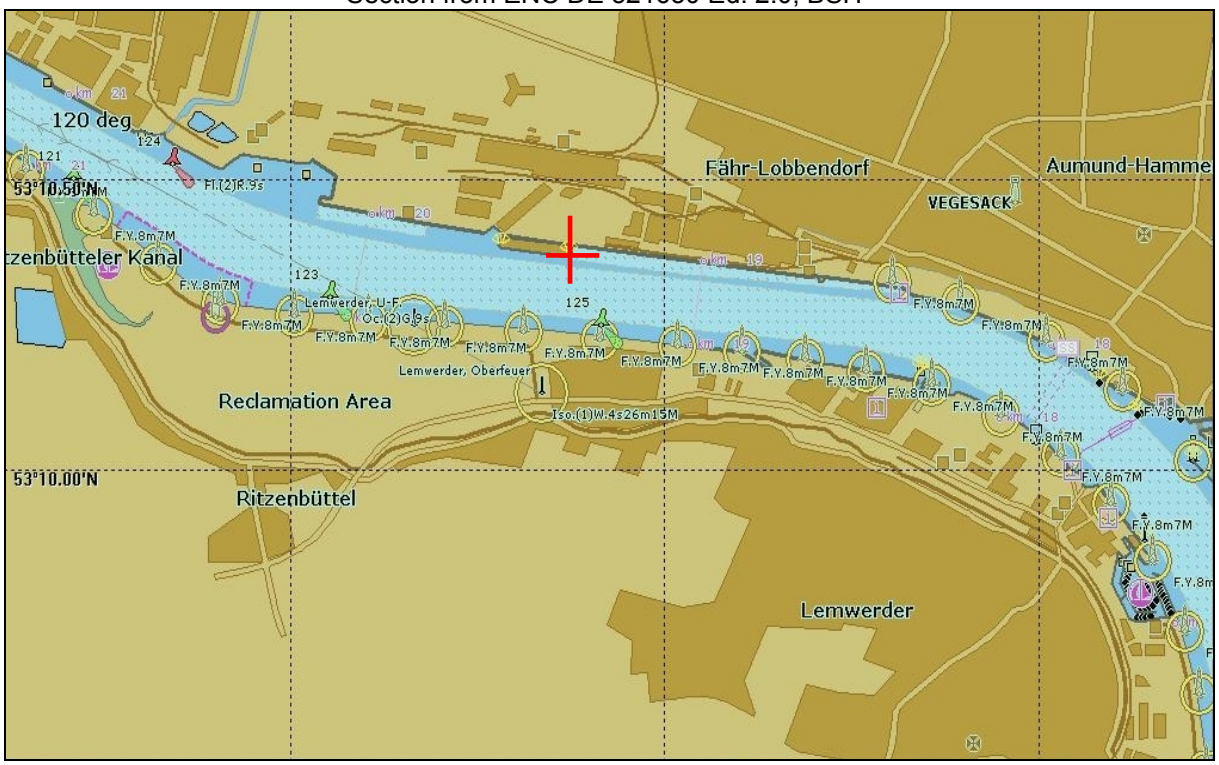


Figure 3: Scene of the accident

2.8 Shore authority involvement and emergency response

Agencies involved:	Local fire brigade, waterway police
Resources used:	3 assistant tugs
Action taken:	Dock towed to the original mooring and ZAPADNYY towed to the quay wall
Results achieved:	Material damage, no injuries, no damage to the environment

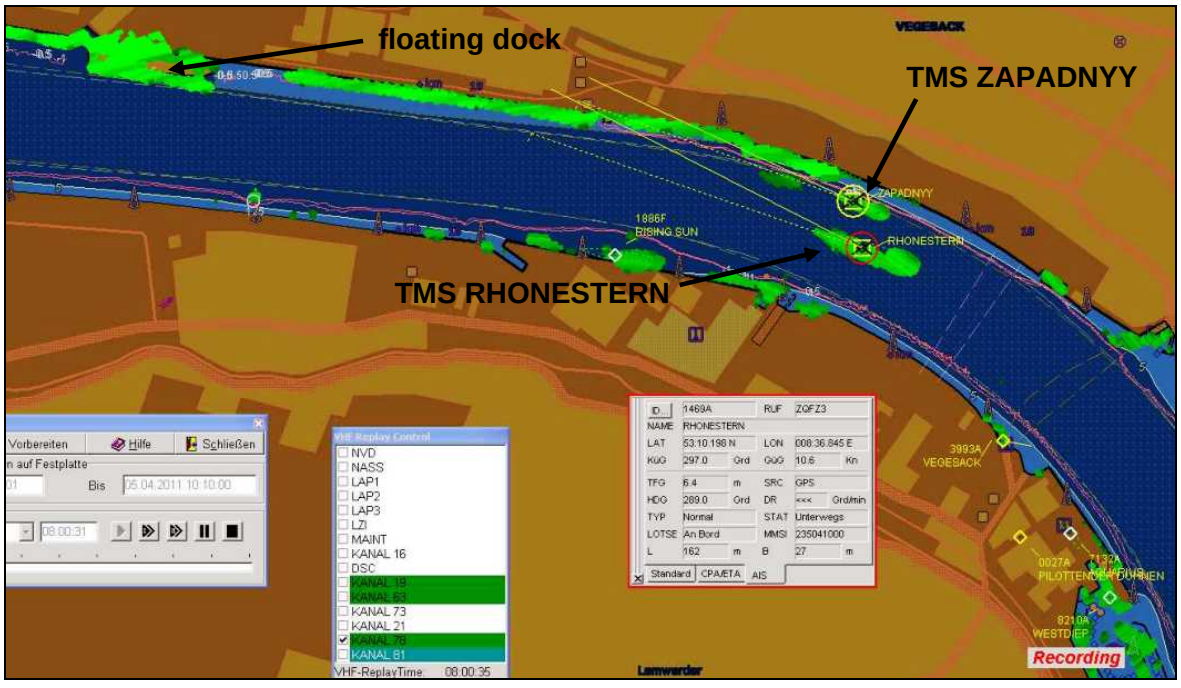
[2] BSH = Federal Maritime and Hydrographic Agency.

3 COURSE OF THE ACCIDENT AND INVESTIGATION

3.1 Course of the accident

The TMV ZAPADNYY, laden with 3059 t molasses, and the TMV RHONESTERN each left her berth in the port of Bremen on the morning of the accident and proceeded on the River Weser in good visibility, calm weather and moderate traffic volume. They were navigated by their master with pilot advice and steered by a helmsman towards the North Sea. High tide was at 0458 and the next low tide was predicted[3] for 1208, meaning that at the time of the accident the vessels were proceeding at about half tide, i.e., a maximum ebb stream of 1.5 to 2 kts. The speed of the RHONESTERN was approximately 14.5 kts up until about 10 minutes before the accident (**0754**). The ZAPADNYY was proceeding ahead of her at 'full ahead' (river speed, approximately 10.5 kts).[4] Due to her speed surplus, the RHONESTERN was continuously gaining on the ZAPADNYY. At this point, the distance between the two vessels was still about 0.21 nm.[5] The RHONESTERN subsequently reduced her speed. She overtook the ZAPADNYY at between approximately **0758 and approximately 0803** at about 10.5 kts and with a steadily decreasing lateral distance[6], which was ultimately considerably less than 50 metres (see **Fig. 4 f**). The stern of the RHONESTERN passed the superstructure of the ZAPADNYY in the area of the exit of the bend at Vegesack (known in Germany as the 'Vegesacker Kurve').

Figure 4: AIS/Radar of VTS Bremen at 080031[7]



[3] Reference point: Bremen Oslebshausen.
[4] In each case, the speed data refers to the SOG; source: AIS data from the TMV RHONESTERN's VDR.
[5] Distance between antenna positions; source: AIS data from the TMV RHONESTERN's VDR.
[6] See footnote 5.
[7] The dotted vector ahead of the vessels signifies the course steered (heading) and the continuous vector the course over ground (floating dock and vessels labelled by the author of this report).

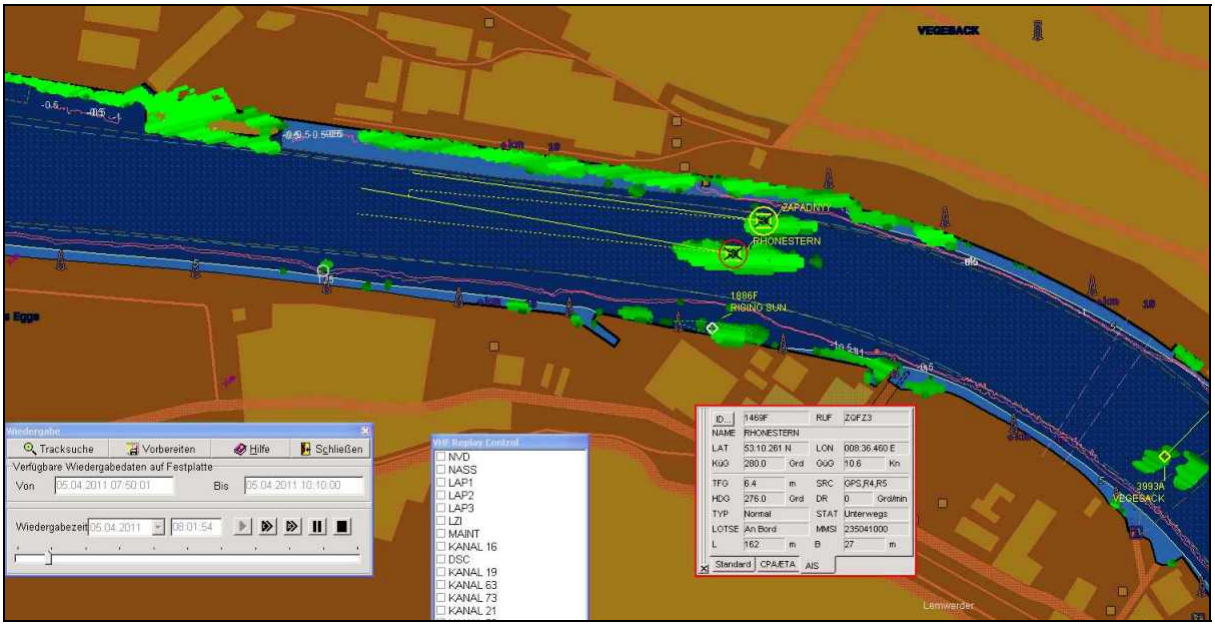


Figure 5: AIS/Radar of VTS Bremen at 080154

The ZAPADNYY did initially not alter her rate of speed. Nevertheless, her speed over ground decreased – apparently as a result of hydrodynamic interaction between overtaking and overtaken vessel in the course of the overtaking manoeuvre – to a minimum value of 8.0 kts (**0801**) and then increased to a maximum of 12.1 kts (**0803**) within about 2.5 minutes. Due to this acceleration, which resulted in the ZAPADNYY moving faster than the overtaking RHONESTERN temporarily, the sterns of the two vessels levelled out again (see **Fig. 6 f**). The fact that the ZAPADNYY was, temporarily, actually faster than the RHONESTERN before the collision gave rise to erroneous accounts in the initial witness statements given by shipyard workers after the accident, which indicated that the ZAPADNYY had reportedly overtaken the RHONESTERN.

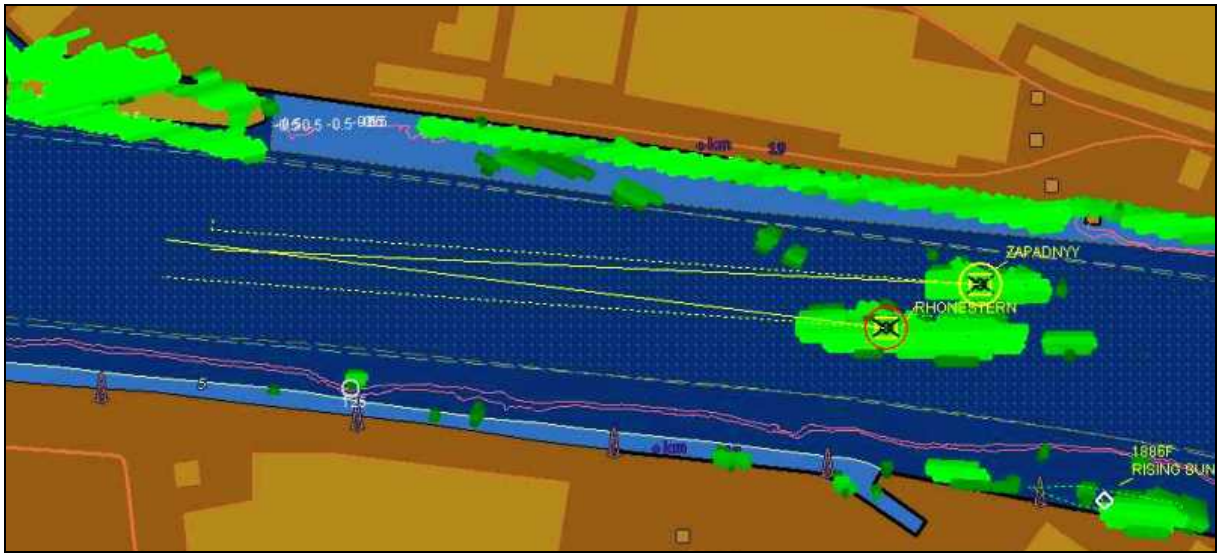


Figure 6: AIS/Radar of VTS Bremen at 080237

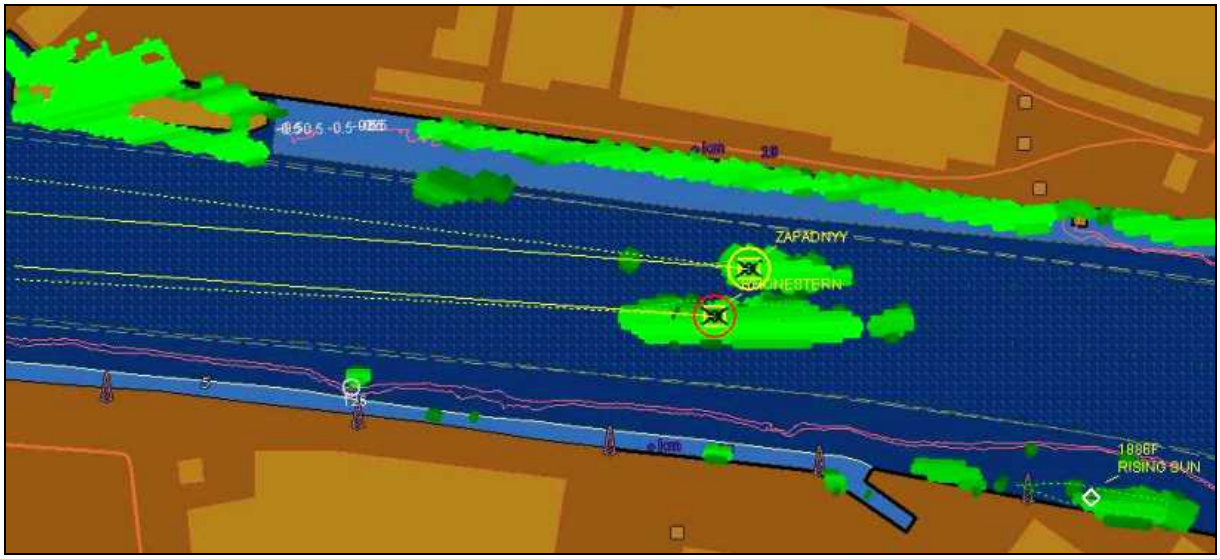


Figure 7: AIS/Radar of VTS Bremen at 080307

According to witness accounts the speed of the ZAPADNYY was reportedly reduced to 'half ahead', after having discerned the aforementioned acceleration effect. In the period that followed, the ZAPADNYY reportedly started to turn to starboard despite contra-rudder. Neither the subsequent hard to port rudder manoeuvre nor an increase in the speed of the ZAPADNYY to 'full ahead' caused the vessel to respond noticeably or helped to prevent her from straying towards the northern bank (see **Fig. 8 f**).

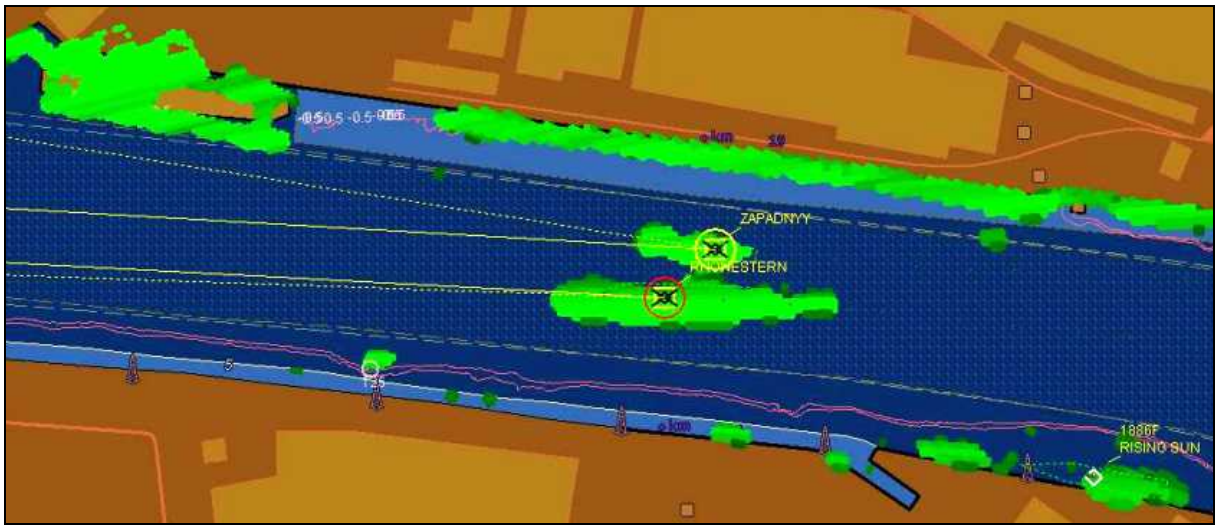


Figure 8: AIS/Radar of VTS Bremen at 080343

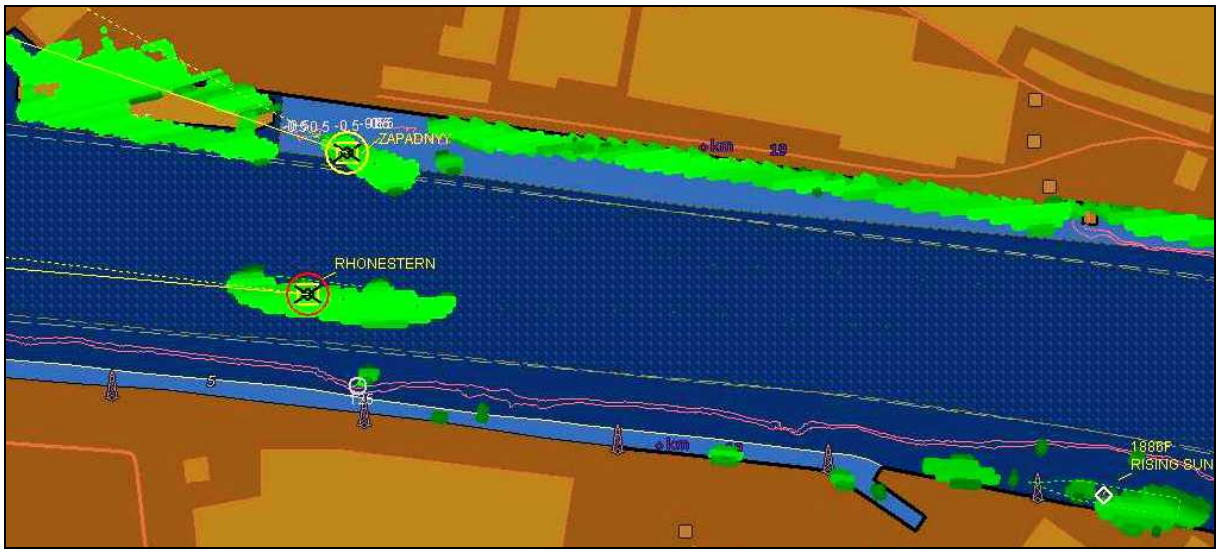


Figure 9: AIS/Radar of VTS Bremen at 080413

Finally, the engine was reportedly set to 'full astern' to at least soften the collision with the floating dock, which was no longer avoidable. At about 080425, the forecastle of the ZAPADNYY collided with the front end of the floating dock, which was moored on the bank of the River Weser and belonged to the Fr. Lürssen shipyard (see **Fig. 10**).

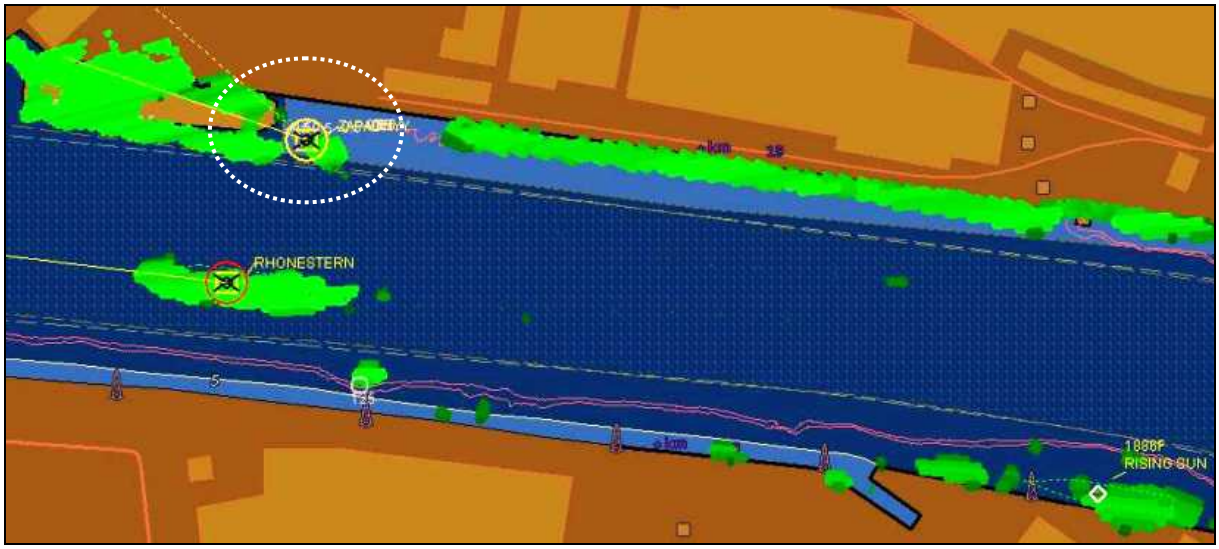


Figure 10: AIS/Radar of VTS Bremen at 080425[8]

The RHONESTERN was not directly affected by the event playing out 'abeam of her' and therefore initially continued her voyage without further ado. The collision-induced forces acting on the floating dock caused the line anchoring points and various supply lines to tear off across a wide area. One side of the dock veered out together with the ZAPADNYY, whose forecastle had ploughed into the front end of the dock, and then blocked the course of the River Weser for about two hours (see **Fig. 11 ff**).

[8] Collision area outlined in white by the author of the report.

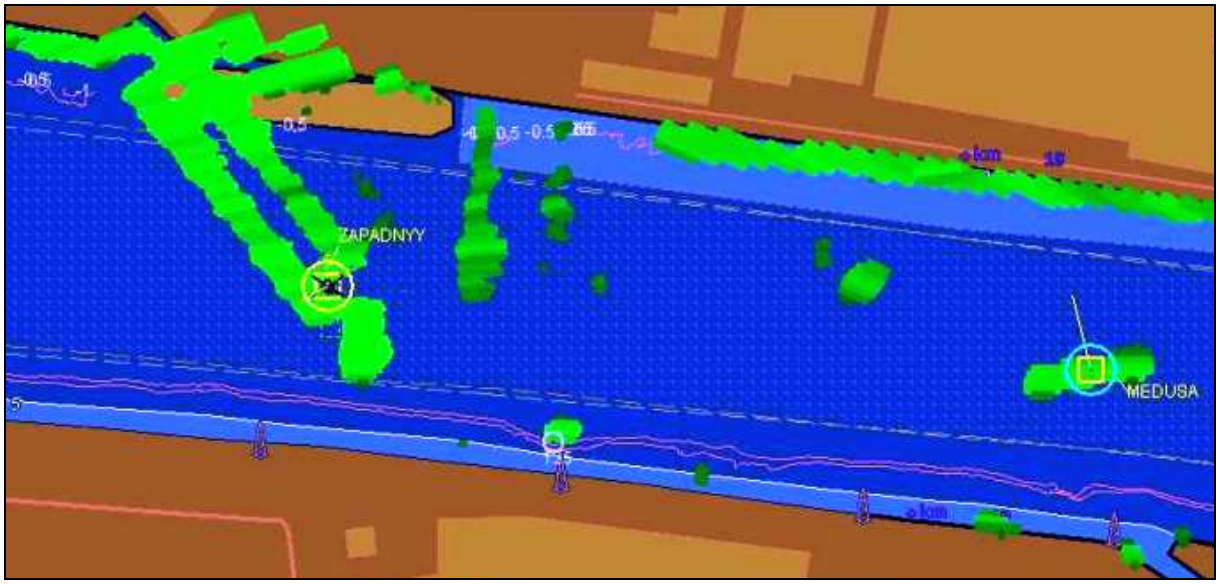


Figure 11: AIS/Radar of VTS Bremen at 080919

Figure 12: Floating dock lying crossways to the river[9]

[9] The ZAPADNYY is visible to the left at the front end of the dock (see also the following close-up).

Figure 13: Front end of floating dock wedged into forecastle of the ZAPADNYY (1)

Figure 14: Front end of floating dock wedged into forecastle of the ZAPADNYY (2)

The River Weser had to be temporarily closed to transiting shipping by Vessel Traffic Service Bremen. With the help of three tugs and by means of her own engine, it was possible to release the ZAPADNYY from the dock and tow her to the nearest pier. Water ingress occurred in the area of her forecastle. This could be brought under control by means available on board. Previously additional pumps, supplied by the fire brigade were made ready for operation. However, they were not required. The dock was also manoeuvred back to its original position with tug assistance.

3.2 Consequences of the accident

3.2.1 Personal injuries/Damage to the environment

The workers employed on the dock had observed the ZAPADNYY steering towards the floating dock and were able to move to safety in time. As nobody was on the forecastle of the ZAPADNYY at the time of the accident, there were no casualties on board the vessel, either. The environment was not affected by the accident. There was no spill of harmful substances.

3.2.2 Material damage to the TMV ZAPADNYY

The forecastle of the ZAPADNYY was severely damaged above and below the waterline due to the collision with the dock (see **Fig. 15 f**). The vessel took on water. However, the buoyancy of the vessel was not significantly impaired.

Figure 15: Damage to the forecastle of the TMV ZAPADNYY (1)

Figure 16: Damage to the forecastle of the TMV ZAPADNYY (2)

3.2.3 Material damage to the floating dock

Since there was not vessel in the dock at the time of the accident, the material damage was limited to the empty floating dock. The damage to the dock's floating body was relatively low (see **Fig. 17 f**). The damage in the course of the various shore connection points being torn off (see **Fig. 19 ff**) was significant (to the operational readiness of the dock), however. Furthermore, several access points to the dock, inclusively a crossing bridge and its foundation, were affected.

Figure 17: Damage to the floating dock (1)

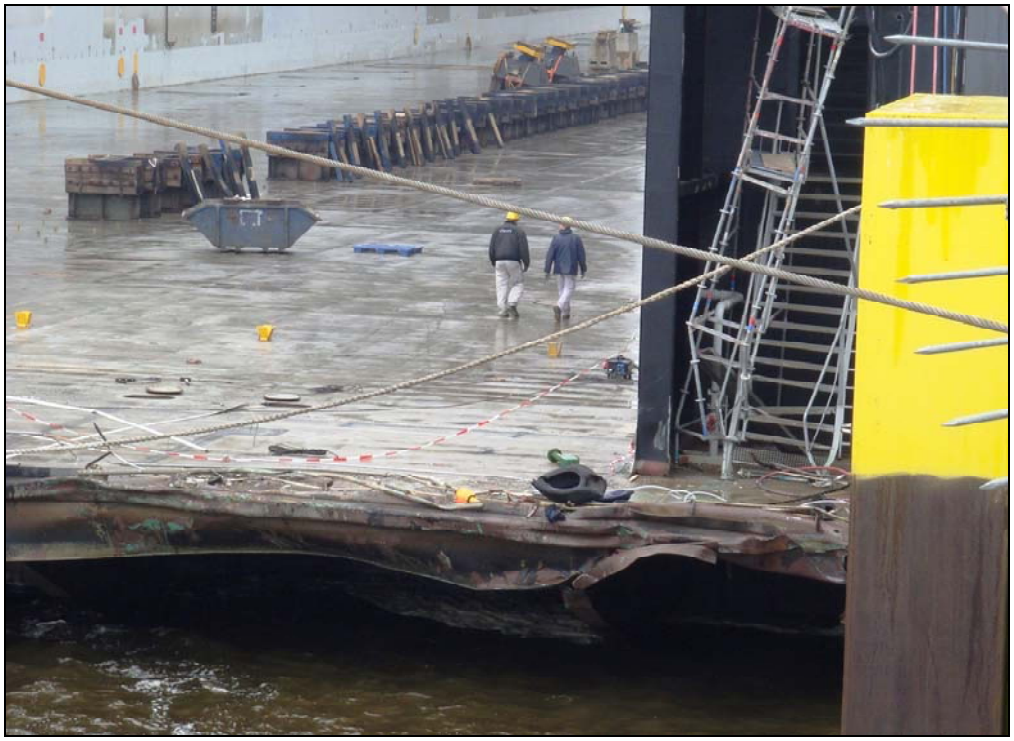


Figure 18: Damage to the floating dock (2)

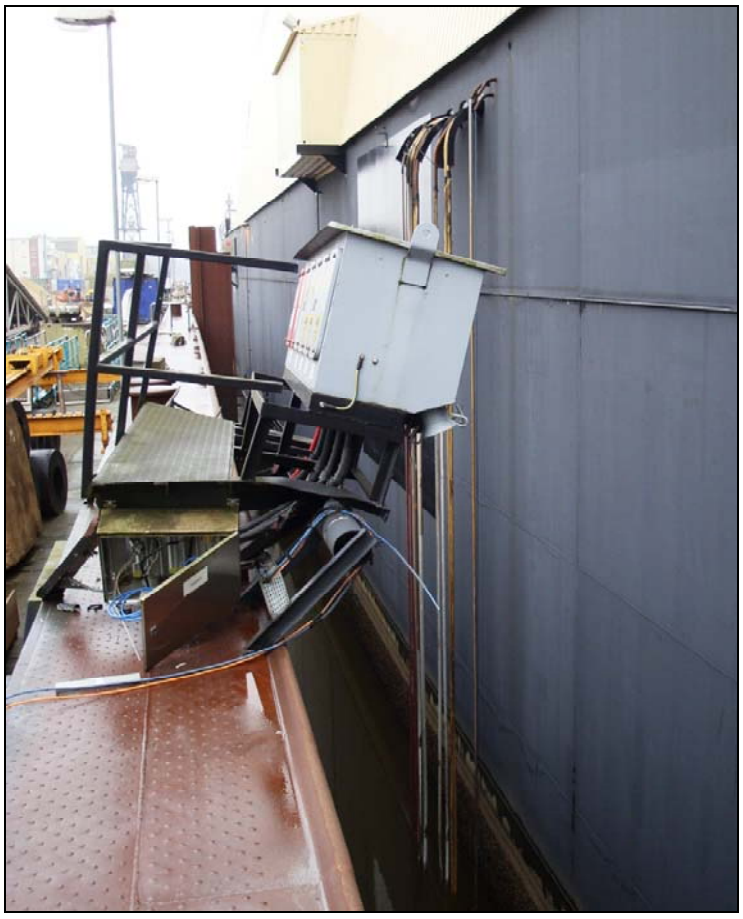


Figure 19: Damage to the shore connection points (1)

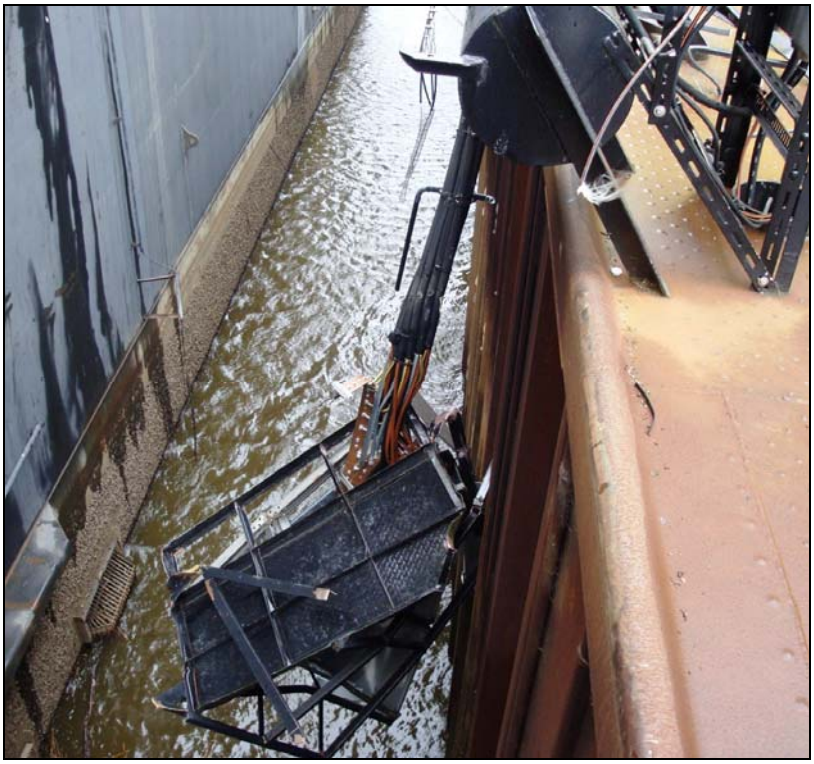


Figure 20: Damage to the shore connection points (2)

Figure 21: Damage to the shore connection points (3)

3.2.4 Economic losses

The Lürssen yard suffered essential economic losses by the loss of the dock and the associated disturbance of the yard operation.

3.3 Investigation

3.3.1 VDR recording of the TMV RHONESTERN

Of particular importance to the reconstruction of the accident was the analysis of the screenshots of the X-band radar, which were saved at 15-second intervals in the VDR[10] belonging to the RHONESTERN and, in particular, the AIS[11] data of the two vessels, which were also obtained from the VDR of the RHONESTERN. In addition, the VDR audio data provided information about the communication between the involved pilots.

3.3.1.1 X-band radar

In all likelihood, the radar image did not play a decision-critical role in terms of aiding navigation on the bridge of the RHONESTERN on the day of the accident, at least in terms approaching and overtaking the ZAPADNYY. The accident occurred in daylight and good visibility, meaning it can be assumed that the pilot and ship's command were making key decisions based solely on visual observation. Nevertheless, **Figs. 22 ff** below, which were selected as examples, were included in the investigation report because they illustrate the course of the accident very well.

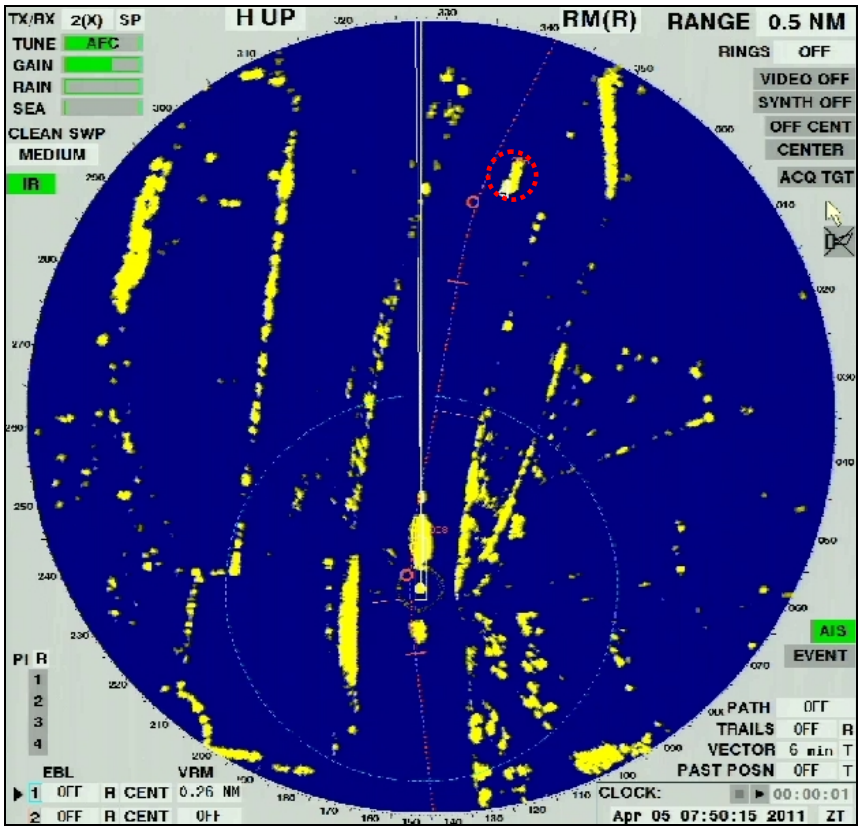


Figure 22: Traffic situation at 075015[12]

[10] VDR = **v**oyage **d**ata **r**ecorder; carriage requirement on vessels of 3,000 GT and above; system for gathering data after an accident to make it possible to determine and analyse the causes thereof.
[11] AIS = **a**utomatic **i**dentification **s**ystem.
[12] TMV ZAPADNYY outlined in red in this and the following figures.

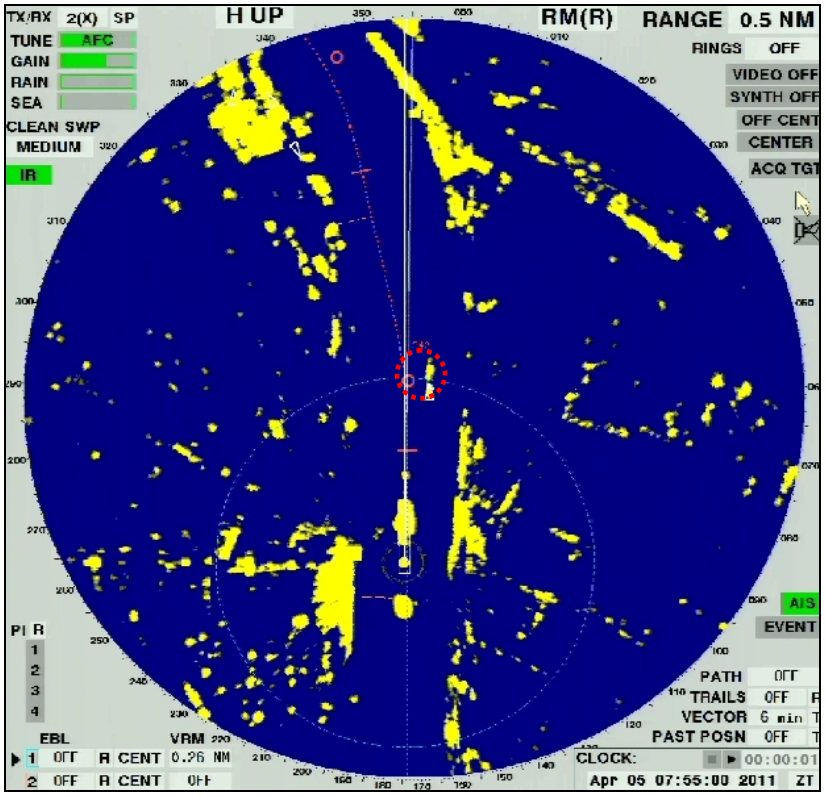


Figure 23: Traffic situation at 075500

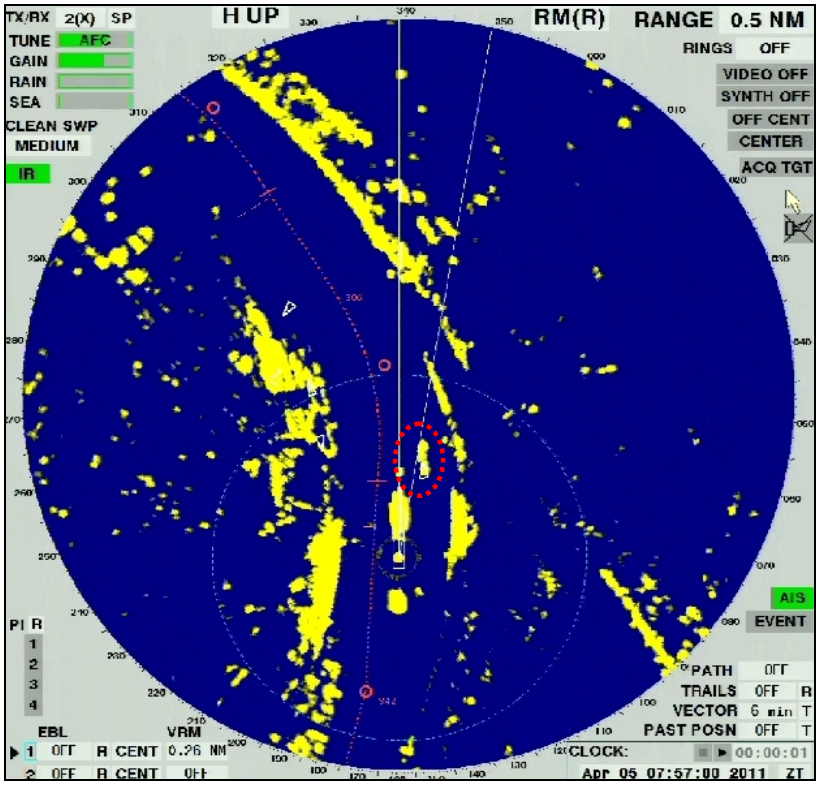


Figure 24: Traffic situation at 075700

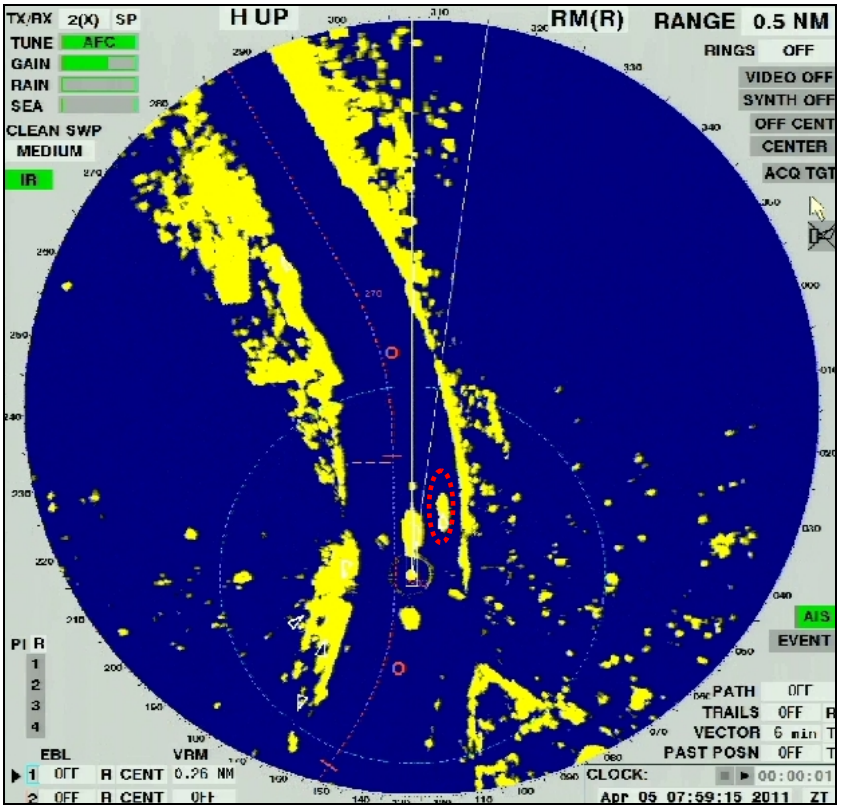


Figure 25: Traffic situation at 075915

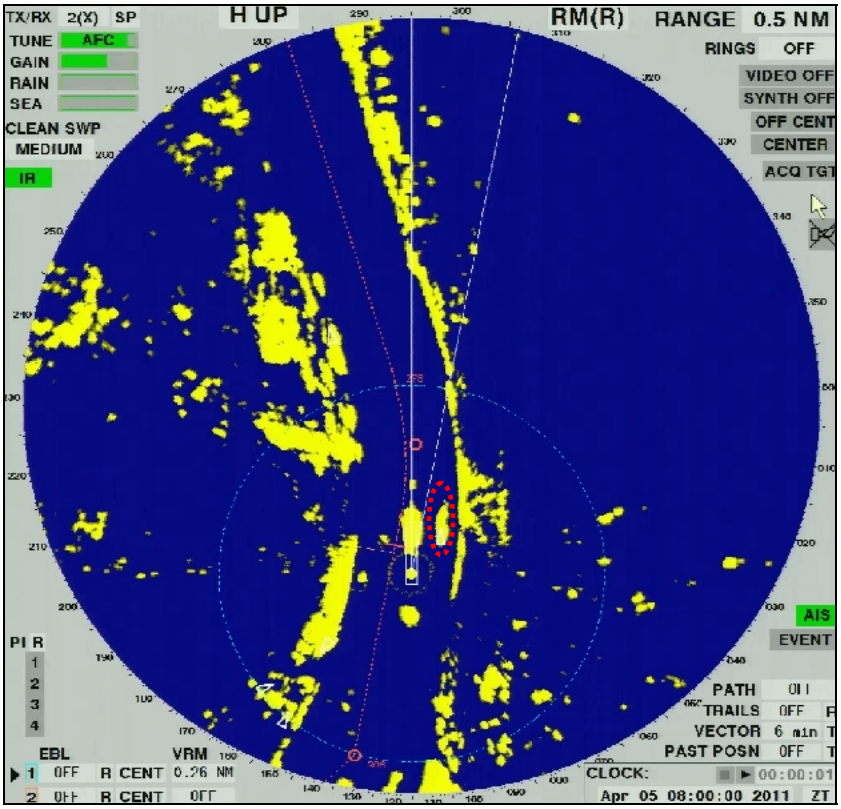


Figure 26: Traffic situation at 080000

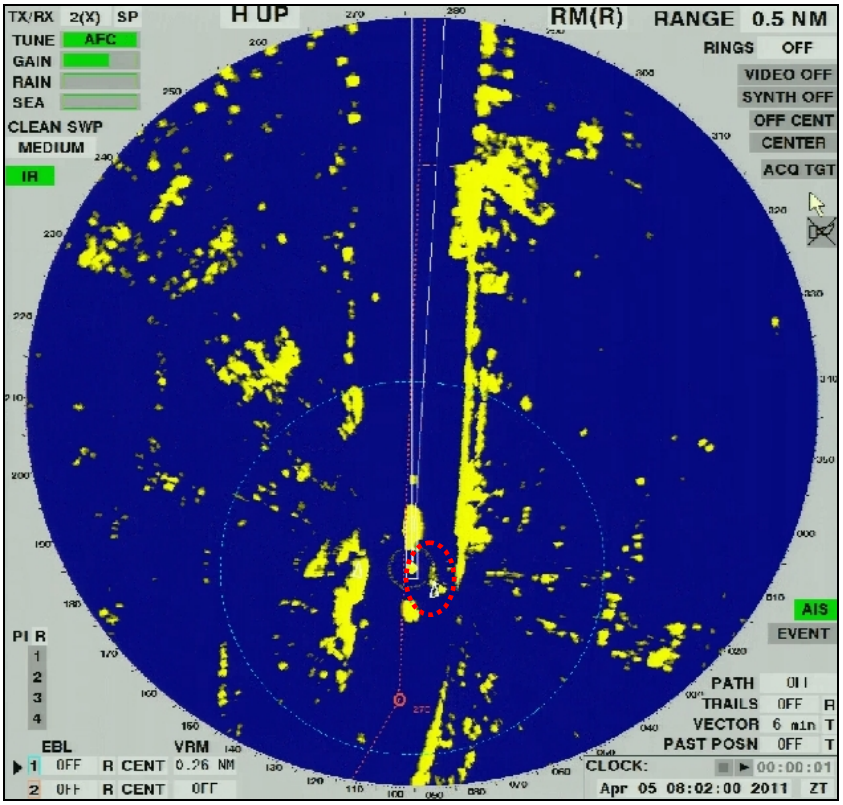


Figure 27: Traffic situation at 080200

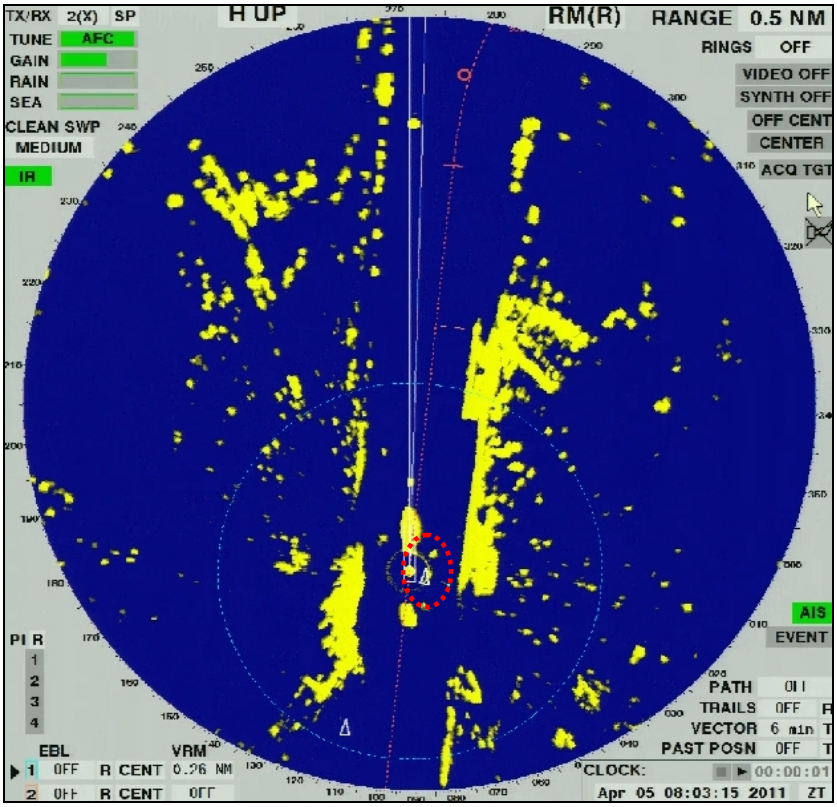


Figure 28: Traffic situation at 080315

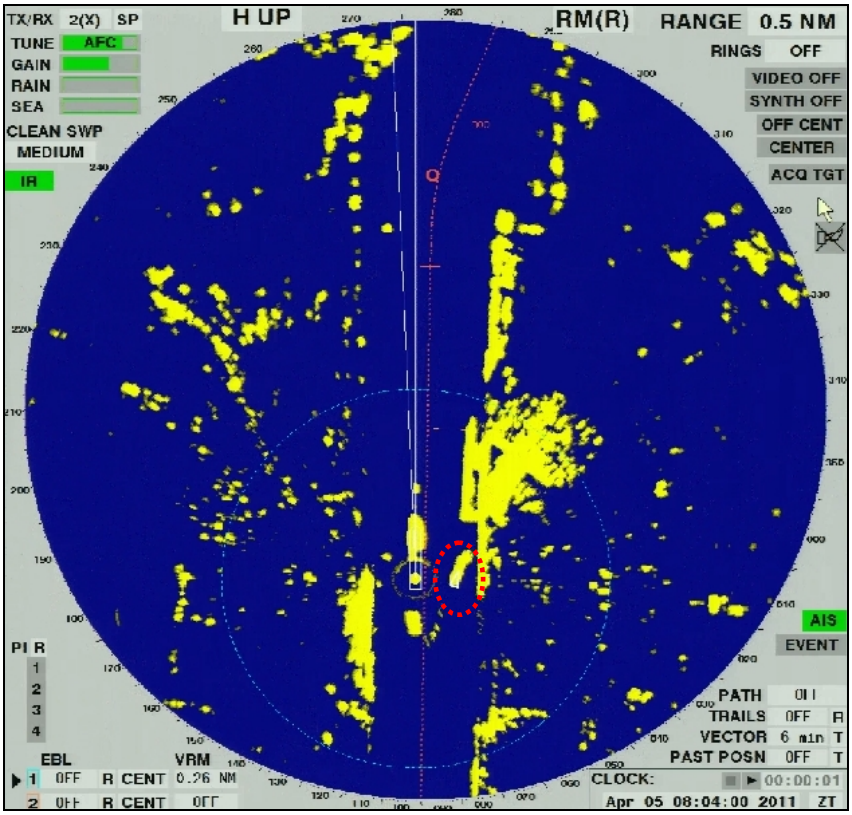


Figure 29: Traffic situation at 080400

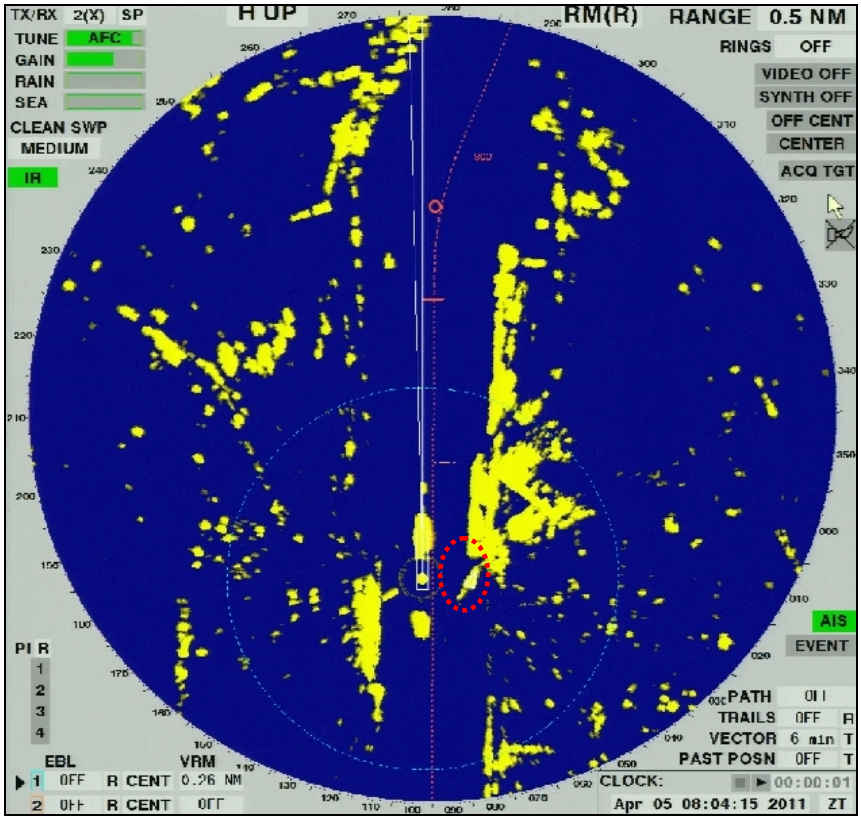


Figure 30: Traffic situation at 080415

The selected radar images show how the RHONESTERN converges with ZAPADNYY. The representation of the radar echoes of the two vessels in **Figs. 27, 28** and **29** implies that the overtaking manoeuvre must actually have been almost completed when the ZAPADNYY was suddenly accelerated to port in the direction of the RHONESTERN, before she veered off, apparently out of control, to starboard towards the bank of the river shortly after. Moreover, when looking at the course of the fairway visible on the radar, it also becomes, in particular, very clear that the overtaking manoeuvre was initiated in the area at which the bend at Vegesack starts, that it was executed throughout the radius of the bend, and that the ultimate development of the subsequent accident began at the exit of the bend.

3.3.1.2 AIS data

The courses and speeds of the two vessels stored in the RHONESTERN's VDR make it possible to reproduce the course of the accident even more convincingly than the radar images. The author of this report extracted the GPS-based courses and speeds of the RHONESTERN and the ZAPADNYY in the update intervals available for the relevant period under observation from the AIS data, which can be displayed in tabular form using the replay software of the VDR (see **Fig. 31** for example), for that purpose.

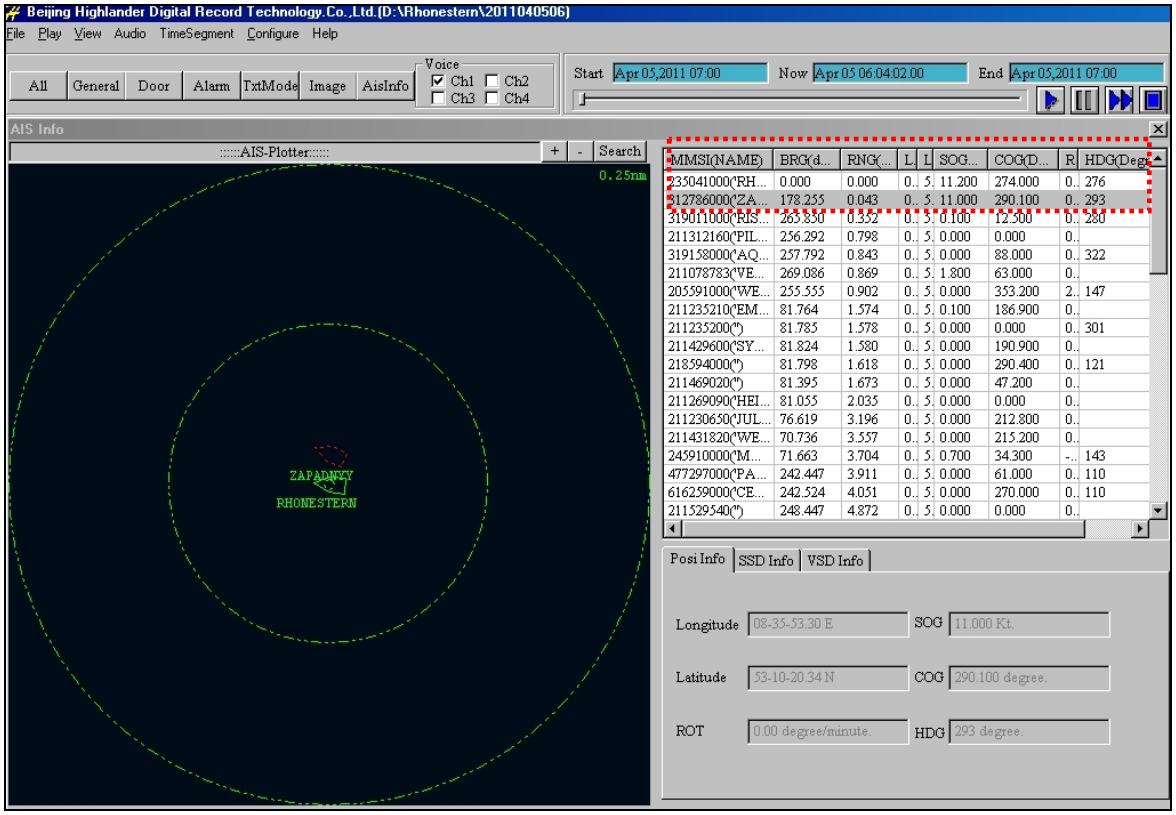


Figure 31: AIS data window from the VDR of the RHONESTERN at 080402 (example)[13]

[13] In the area in the right section of the exemplary image (so-called screenshot) outlined in red by the author of this report, inter alia (and selected here), the distance between the two vessels (RNG), the speed over ground (SOG), the course over ground (COG) and the course steered (HDG = heading) are displayed for the RHONESTERN (RH) and the ZAPADNAYY (ZA).

It was also possible to read the changing distances between the two vessels from the AIS window in question (see RNG = range value in nm in the outlined area of **Fig. 31**). However, it should be noted that this refers to the antenna, respectively, system position of each vessel. Therefore, the location and configuration of these positions in relation to each other result in distance values between the side of each vessel, which may be significantly lower or significantly higher than the 'RNG values' displayed. Nevertheless, the 'RNG values' were also included in the following table because they provide evidence in relation to the convergence, parting and re-convergence of the vessels without a 'correction'.

Time	RNG (nm)	TMV RHONESTERN			TMV ZAPADNYY		
		SOG (kts)	COG (deg.)	HDG (deg.)	SOG (kts)	COG (deg.)	HDG (deg.)
075300	0.30	14.6	347	348	10.6	357	357
075308	0.30	14.7	347	350	10.5	356	357
075319	0.29	14.8	348	352	10.5	356	357
075328	0.28	14.8	351	354	10.4	356.5	357
075338	0.27	14.8	353	355	10.5	357	357
075347	0.24	14.8	354	356	10.5	357	357
075358	0.24	14.7	355	355	10.5	356.5	357
075406	0.23	14.6	356	355	10.5	356.5	357
075415	0.22	14.5	356	355	10.5	356.5	357
075424	0.22	14.5	355	355	10.5	356.5	357
075432	0.21	14.4	355	354	10.4	356.5	357
075449	0.21	14.3	355	354	10.5	357	358
075458	0.20	14.3	355	354	10.5	357	356
075507	0.20	14.2	354	355	10.5	354.5	354
075517	0.17	14.1	354	356	10.5	354.5	354
075536	0.15	13.8	356	356	10.4	354	353
075546	0.15	13.7	357	355	10.3	352.5	352
075556	0.14	13.5	356	354	10.1	351	349
075605	0.13	13.4	355	353	10.1	349.5	349
075615	0.13	13.3	355	352	10.0	349	347
075624	0.12	13.1	355	351	10.1	347	344
075634	0.12	12.9	354	348	10.0	343.5	341
075644	0.11	12.7	353	345	9.9	342	340
075653	0.11	12.4	351	342	9.9	339.5	336
075702	0.10	12.2	349	340	9.9	337	334
075713	0.09	11.8	346	335	9.9	335	331
075722	0.09	11.5	343	332	10.0	330.5	329
075731	0.09	11.2	340	329	9.8	330	328
075740	0.09	10.9	335	328	9.9	328	325
075749	0.09	10.8	332	326	9.9	326	323
075759	0.08	10.7	332	324	9.9	324	321
075818	0.07	10.3	328	318	9.8	318	316
075828	0.09	10.2	324	317	9.8	315	314

Time	RNG (nm)	TMV RHONESTERN			TMV ZAPADNYY		
		SOG (kts)	COG (deg.)	HDG (deg.)	SOG (kts)	COG (deg.)	HDG (deg.)
075837	0.08	10.2	322	315	9.7	313.5	312
075847	0.06	10.2	321	313	9.7	313.5	312
075856	0.07	10.2	318	311	9.7	312.5	309
075907	0.06	10.2	316	309	9.6	309.5	304
075915	0.06	10.2	315	308	9.6	309.5	304
075923	0.06	10.3	313	306	9.5	304	300
075932	0.06	10.3	312	304	9.4	302.5	299
075941	0.06	10.3	310	301	9.3	301	298
075949	0.06	10.4	309	299	9.3	300.5	297
075957	0.05	10.4	307	297	9.1	298.5	295
080011	0.05	10.5	302	293	8.9	297	294
080021	0.05	10.6	299	291	8.6	296.5	292
080030	0.04	10.6	297	289	8.3	295	290
080038	0.04	10.7	296	287	8.2	292	287
080047	0.03	10.7	294	285	8.2	292	287
080057	0.03	10.7	292	283	8.0	286	283
080107	0.03	10.7	290	280	8.2	284.5	283
080117	0.03	10.6	286	278	8.2	284.5	283
080127	0.04	10.6	283	278	8.8	282	279
080137	0.04	10.6	281	277	9.2	280	277
080147	0.05	10.5	280	277	9.2	280	277
080158	0.05	10.5	279	276	9.8	275	273
080207	0.03	10.5	279	275	10.3	273	273
080216	0.05	10.5	277	275	10.3	273	273
080225	0.05	10.5	277	275	10.6	272	273
080235	0.05	10.5	277	274	11.0	272.5	274
080245	0.04	10.4	276	273	11.3	273	276
080255	0.04	10.4	274	272	11.7	275	277
080303	0.03	10.3	274	272	12.0	274	276
080314	0.03	10.3	273	272	12.1	273.5	279
080323	0.02	10.3	272	272	12.1	277	284
080333	0.02	10.4	272	272	12.0	283	289
080343	0.03	10.7	271	274	11.6	288	293
080353	0.04	11.0	272	276	11.3	290	293
080402	0.04	11.2	274	276	11.0	290	293
080413	0.05	11.5	275	277	10.6	289	299
080422	0.06	11.7	277	277	10.0	293.5	311
080432	0.06	11.9	277	277	1.4	226.5	317
080441	0.08	12.2	276	278	1.4	217.5	319
080451	0.10	12.3	276	280	1.3	211.5	320
080501	0.13	12.3	277	281	1.3	213	321
080511	0.16	12.1	279	281	1.2	211	322
080521	0.19	11.9	280	281	1.2	210	323

The SOG table values for the two vessels unequivocally prove the initial speed surplus of the RHONESTERN as compared to the ZAPADNYY of approximately 4 knots and speed reduction to an average of 10.5 knots of the RHONESTERN, which started about 10 minutes before the accident and finished about 5 minutes before the accident.
The speed curve of the ZAPADNYY with a constant initial speed averaging approximately 10.5 knots, the most probably purely hydrodynamically-induced slight reduction in speed to a minimum value of 8 knots at about **0801** during the first half of the RHONESTERN's overtaking manoeuvre, and the abrupt and certainly purely hydrodynamically-induced acceleration to a maximum value of 12.1 knots at about **0803** also become very clear.[14]

3.3.1.3 Audio recording

The analysis of the audio recording of the VDR (type Highlander HLD-S2, manufacturer BEIJING HIGHLANDER DIGITAL RECORD TECHNOLOGY CO., LTD) was difficult. The conversations on the bridge of the RHONESTERN recorded by the microphones could only be reproduced in a poor, ultimately unusable quality using the replay software provided by the manufacturer. However, it was possible to reproduce the relevant language files in a relatively clear and easily understandable quality by using standard audio software and bypassing the replay software.

The audio recordings show that the pilots of the two vessels 'coordinated' the overtaking manoeuvre at least very roughly via VHF before the accident with the announcement of the pilot of the RHONESTERN “X”[15] "I am going to pull past you," and the confirmation of the pilot of the ZAPADNYY "You are pulling past." Prior to this the pilot of the RHONESTERN had notified VTS via VHF that he intends to pass ZAPADNYY. Furthermore he asked if there was any “bigger” oncoming traffic. The VTS subsequently confirmed that there was no oncoming traffic. The pilot passed on this information in English language to the master of RHONESTERN.

In a communication conducted via mobile phone about 4 minutes before the accident the pilot of the RHONESTERN told the pilot of the ZAPADNYY , that he would not have been able to do 'that' (in all likelihood referring to the decision to overtake in the bend at Vegesack) with another (specifically named) colleague of the Lotsenbrüderschaft (Brotherhood of Pilots [sic]).

About 2 minutes prior to the accident the VHF communication between the pilots of ZAPADNYY and the RHONESTERN could be heard. The pilot of ZAPADNYY requested: “Y”[16], I think you must increase speed a bit”. No reply could be deduced from the audio recordings. After meanwhile having issued 2 helm commands the pilot of the RHONESTERN, instead of responding, asked the pilot of ZAPADNNY approx. 20 seconds later via VHF “What happened with you, X? The pilot of ZAPADNYY immediately responded: “Running out of rudder”.

[14] Remark: With respect to the expressiveness of the courses and speeds gained by means of AIS it is to be noted, that the dead reckonings carried out for this purpose by the system are based on GPS-data acquired in the past. Moreover onboard specific device settings as well as external disturbances can lead to inaccuracies.
[15] “X” does stand for the first name of the pilot of ZAPADNYY.
[16] “Y” does stand for the first name of the pilot of RHONESTERN.

It ultimately follows from a phone call between the pilot of the ROHNESTERN and the Lotsenbrüderschaft after the accident that the pilots conversed via phone during the overtaking manoeuvre and found that it was actually reportedly too early for the 'meeting'.

Apart from the discussed clearly audible elements of the conversation transmitted by the pilot of the RHONESTERN and his helm commands, each of which were acknowledged by the vessel's helmsman, no further communication, for example, between the pilot and ship's command of the RHONESTERN, can be derived from the audio recordings.

3.3.2 Description of the scene of the accident

The collision between the ZAPADNYY and the floating dock happened at river kilometre 19.5 on the Weser navigable maritime waterway. The width of the fairway in the section concerned (the so called bend at Vegesack, including the entrance and exit of the bend) has, on average a width of about 150 and at most 205 m. The floating dock belonging to the Fr. Lürssen shipyard is located on the northern bank of the River Weser outside the curved stretch and narrows the fairway to about 40 metres.

The bend at Vegesack is not a 'narrow area' or 'concealed bend' within the meaning of art. 23 para. 3 (2) of the German Traffic Regulations for Navigable Waterways (SeeSchStrO), meaning a general prohibition on overtaking is not in place in this section.
However, oncoming traffic is subject, inter alia, to restrictions in the area of the River Weser relevant in this case, which provide for the special nature of the relatively narrow course of the fairway. A general prohibition on encounters was laid down in the relevant Regulation No. 8.2.4 on oncoming traffic on the River Weser in the Notices of the Waterways and Shipping Directorate Northwest[17] for the area of the bend at Vegesack for vessels that exceeded a total length of 390 metres and breadth of 65 metres when added together.

Several berths are located on the southern bank of the bend at Vegesack, which belong to the Abeking & Rasmussen and the Fr. Lürssen shipyards. In addition, the Bremen-Vegesack/Lemwerder ferry operates on the apex of the bend. Moreover, the north-eastern area of this stretch of the River Weser is characterised by the mouth of the Lesum (a tributary) and the Vegesack marina.
This discussed particularities give rise to transiting shipping being requested to show particular consideration within the stretch in question by the Vessel Traffic Service at regular intervals in the situation reports. The primary focus is an effort to limit the suction and wash effects on the sensitive bank area by reducing speed while navigating the bend.

3.3.3 Human factor

Apart from the seafaring and thus human aspects of the development of the accident discussed in the following section, 'Analysis', the investigation revealed no evidence

[17] Note: The Announcements with respect to the modalities for the oncoming traffic on the Weser were remitted on the basis of §§ 24 Para. 2, 60 Para. 1 SeeSchStrO.

of other human factors that facilitated the accident in relation to the ship's commands responsible or the advising pilots. In particular, everybody involved was sufficiently qualified and possessed the requisite knowledge of the operating area. Fatigue and/or alcohol can be eliminated as factors relating to the accident.

4 ANALYSIS

4.1 Hydrodynamic interaction

The AIS data shown above, in particular, the sudden increase in speed by the ZAPADNYY – which had previously been proceeding at a full rate of speed – about two minutes before the collision recorded therein provide vivid and unequivocal evidence of the fact that hydrodynamic interactions must have taken place between the vessels involved before the collision. Moreover, since there is no evidence to suggest a technical failure of the propulsion and/or steering system on board the ZAPADNYY, it can be assumed that the hydrodynamically-induced suction effect towards the RHONESTERN triggered by the overtaking manoeuvre was also the starting point for the ZAPADNYY's uncontrolled veering to starboard after the acceleration to port and subsequent collision with the floating dock belonging to the Fr. Lürssen shipyard.

In the course of the large-scale investigation of the collision between the large container vessel COSCO HAMBURG and the feeder vessel P&O NEDLLOYD FINLAND on the River Elbe on 1 March 2004, the Federal Bureau of Maritime Casualty Investigation arranged for the problematic nature of hydrodynamic interaction during overtaking to be examined in great detail with the extensive involvement of a number of scientific institutions both numerically and with experiments.[18]

The above collision has interesting similarities, but also differences to the course of the accident presently under investigation; it also involved the approach of a much larger vessel (COSCO HAMBURG, size ratio approximately 2:1) with a moderate speed surplus to a vessel about to be overtaken in a laterally confined fairway. During the overtaking manoeuvre, the P&O NEDLLOYD FINLAND behaved just as passively as the ZAPADNYY did in the present case. In other words, the vessel to be overtaken changed neither course nor speed to support the overtaking manoeuvre in both cases. Furthermore, in both cases the speed of the vessel to be overtaken initially decreased during the course of the overtaking manoeuvre without the intervention of the ship's command, before an involuntary and abrupt increase in speed subsequently occurred. However, while this increase in speed resulted in contact between the forecastle of the vessel being overtaken and the stern of the overtaking vessel in the COSCO HAMBURG/P&O NEDLLOYD FINLAND case, the ZAPADNYY escaped the suction of the RHONESTERN in the last moment.

The action taken on the bridge of the ZAPADNYY, according to the corresponding statements supplied by the bridge crew to achieve this (reduction in speed and

[18] Cf. BSU, Investigation Report 45/04 dated 1 February 2006.

change of course to starboard)[19] was excessive in that it caused the ZAPADNYY to then ultimately veer out of control towards the bank of the River Weser in spite of the stated counter-measures (=increase in speed and setting the helm hard to port).

In addition to the consequences of the accident, there are two main differences between the two accident scenarios.

(1) The hydrodynamic determined forces induced by the RHONESTERN, sailing in ballast, can only be compared with the forces induced by COSCO HAMBURG (with a draught of 14 m and proceeding with significantly higher speed) at that time, to a limited extent as regards their magnitude and impact.
(2) In contrast to the COSCO Hamburg, the RHONESTERN started the overtaking manoeuvre in the course of a bend and actively reduced her speed just before the beginning of the overtaking manoeuvre.

On the merits of the case, these factors gave the specific course of the accident its special character.

The particularities mentioned under (2), especially the experience of the BSU gained while investigating the collision on the Elbe, which cast light on the complexity and only very limited computability and predictability (in the sense of practical usability) of hydrodynamic phenomena, justify the decision to make an evaluation of the (preceding) activities on the bridges of the vessels involved the focus of the analysis rather than focusing once again on the hydrodynamic interaction of the vessels, which was undoubtedly the ultimate cause of the present accident.

4.2 De facto and legal classification of the overtaking manoeuvre

4.2.1 Persons responsible

Both the RHONESTERN and the ZAPADNYY were proceeding on the River Weser with pilot advice; however, in the formal sense, responsibility for commanding the vessel remained with the master present on the bridge of each vessel at all times.
Regardless of this scenario, which applies almost without exception in global maritime shipping, many indications point to the fact that in accordance with common practise – which is also almost globally applicable – and the legal options[20], it was quite definitely the advising pilots who directly determined the course of the voyage for the vessels they were piloting. With regard to the RHONESTERN, this is substantiated by the audio recordings of her VDR. Aside from helm commands by the pilot to the helmsman, who acknowledged and executed these immediately, there is absolutely no evidence of communication between the pilot and the master before, during or after the overtaking manoeuvre.

[19] It was not possible to verify the testimonies by means of technical recordings. In this regard the AIS-recordings available, lack, inherent to the system, sufficient expressiveness (cf. above note in footnote 14). VDR data which could provide additional, objective information about the activities on the bridge of the ZAPADNYY do not exist due the lack of a carriage requirement for the vessel to carry such a system.

[20] See relevant German rules in art. 23 para. 2 Seelotsgesetz (maritime pilot act): the master may permit the maritime pilot to issue orders (to the helmsman) relating to the navigation of the vessel independently, but remains responsible for commanding the vessel.

The direct, short acknowledgement of the pilot of the ZAPADNYY – which arguably conformed to practise – in response to the announcement of the pilot of the RHONESTERN that he wished to 'pull past' supports the assumption that there was also no detailed consultation on the ZAPADNYY between the pilot and master of the vessel.
However, this assumption is contradicted by the corresponding statement made by the pilot of ZAPADNYY, who was said to have indeed discussed the upcoming passage with the vessel's master and recommended, to navigate as far as possible at the right side in order to facilitate the overtaking manoeuvre of the RHONESTERN.

The discrepancy between legal and de facto responsibility for the decisions taken on the bridge of each vessel in connection with the overtaking manoeuvre will not be addressed in more detail at this point. On the one hand, establishing personal fault and/or liability in relation to a marine casualty is not part of the legal mandate of the BSU; on the other hand, it appears indisputable that the (advisory) actions of the pilot evidently had an equal effect on the course of the voyage of both vessels, meaning consideration of these actions – irrespective of the ultimate responsibility of the masters of the vessels involved – should, without further ado, clearly be an overriding part of the analysis of the accident.

The Vessel Traffic Service (VTS) is not responsible for the development of the accident; therefore, there is no requirement to investigate its behaviour further. Legislation provides that a regular task of the VTS is limited to monitoring the traffic situation and advising shipping on any special occurrences. Exerting influence on the manoeuvring of a specific vessel, the more so if the vessel in question is, in principle, not violating any traffic rules, is normally excluded because it must be assumed that ship's commands and pilots at the scene are in a much better position to assess the situation. Therefore, in accordance with its mandate, the VTS responded to the request made by the pilot of the RHONESTERN vis-à-vis oncoming traffic before the start of the overtaking manoeuvre, while at the same time not having cause to comment on or even prohibit the emerging overtaking manoeuvre during the further course of events. The fact that the very small passing distance between the vessels involved in the accident became gradually clear in the course of the traffic monitoring, does not change this appraisal. The nautical officers on duty in the VTS were not aware of the fact that a hazardous situation would develop out of this with high probability, prompting them to intervene on the basis of their obligatory task as shipping authority. Their only source of information was radar images which were roughly resolved.

4.2.2 Legal requirements for shipping

Art. 23 SeeSchStrO is the central national provision for overtaking on the River Weser. In conjunction with art. 2 para. 1 (1) SeeSchStrO, this standard reflects and puts into specific form for German navigable maritime waterways the requirements of Rule 9 of the International Regulations for Preventing Collisions at Sea (COLREGs), which provides for conduct in 'narrow channels' and to that extent governs, inter alia, overtaking. Quoted verbatim, art. 23 SeeSchStrO states, inter alia:

"Article 23 Overtaking

(1) The left side should generally be used when overtaking. The right may be used when overtaking if so required by the circumstances of the case.

(2) With due regard to Rule 9 (e) and Rule 13 of the Regulations for Preventing Collisions at Sea, the vessel intending to overtake shall reduce her speed, respectively, maintain a lateral distance from the vessel ahead to the extent that dangerous suction is not generated and there is no risk to oncoming traffic at any time during the overtaking manoeuvre. The vessel ahead shall do everything in her power to support the overtaking manoeuvre.

(3) Overtaking is prohibited
1. in the vicinity of a non-self-propelled ferry in operation;
2. in narrow areas or concealed bends;
3. …
4. within stretches and between vessels made known in accordance with art. 60 para. 1.

(4) If safe overtaking is possible in a fairway only with the cooperation of the vessel to be overtaken, then overtaking is permissible only if the vessel to be overtaken has clearly agreed to this in response to a corresponding enquiry or indication by the overtaking vessel. By way of derogation from Rule 9 (e) (i) of the Regulations for Preventing Collisions at Sea, the overtaking vessel may use VHF radiotelephony to communicate her intention to overtake to the vessel to be overtaken if
1. the communicating entities are clearly identified;
2. it is possible to consult clearly using VHF radiotelephony;
3. it is ensured that preferably all other vessels are able to listen in to VHF-based coordination via selection of the VHF channel, and
4. the traffic situation permits it.

By way of derogation from Rule 34 (c) (ii) of the Regulations for Preventing Collisions at Sea, if the vessel to be overtaken is in agreement, then it may transmit this using VHF radiotelephony and take action to ensure safe passing. If the conditions for coordination using VHF radiotelephony are not met, then Rule 9 (e) of the Regulations for Preventing Collisions at Sea applies exclusively.

(5) … ."

4.2.3 Implementation of legal requirements

A comparison of the cited standard with the actual course and outcome of the passing manoeuvre shows on the one hand that, at least viewed benevolently, the 'organisational' constraints in connection with the implementation of the passing manoeuvre were complied with to some degree (4.2.3.1), but, on the other hand, it is clear that not enough attention was given to the duty of care laid down in the standard (4.2.3.2).

4.2.3.1 Communication in connection with the overtaking manoeuvre

The pilot of the RHONESTERN indicated his intention to overtake to the pilot of the ZAPADNYY pursuant to art. 23 para. 4 SeeSchStrO quoted above with the message "RHONESTERN – I am going to pull past you," and the pilot of the ZAPADNYY approved this announcement at least tacitly with the answer "ZAPADNYY – You are pulling past."
As already indicated above, it is no longer possible to verify whether this arrangement was agreed with the master of each vessel.

It cannot be deduced from the audio recordings analysed that agreements were made in the course of the overtaking manoeuvre: information from the

RHONESTERN that she had reduced her own speed immediately before the overtaking manoeuvre and therefore requested a corresponding action by the ZAPADNYY, for example. Moreover, it is evident that a possible request by the ZAPADNYY that the RHONESTERN increase the passing distance was also not made. However, the pilot of ZAPADNYY requested the pilot of RHONESTERN approx. 2 minutes prior to the collision to increase speed. (It is insofar to be noted that following this request would not have reduced the suction effect already effective. To the contrary, it would probably have enforced the suction effect).

Ultimately, it is to be mentioned that, due to the lack of sufficient understanding of the German language, neither the Polish vessel's command of the RHONESTERN nor the UKRAINIAN vessel's command of the ZAPADNYY were involved in the respective exchange of information by solely overhearing the communication of the pilot's of the vessel's with each other and with the VTS, respectively.

4.2.3.2 Execution of the overtaking manoeuvre

4.2.3.2.1 RHONESTERN

The available radar and AIS recordings and, in particular, the suction effect caused by the RHONESTERN that can be derived from them show that the requirements of art. 23 para. 2 SeeSchStrO were not met with an acceptable degree of effectiveness on the bridge of the vessel.
Indeed, the RHONESTERN reduced her own speed by almost 5 knots before the start of the overtaking manoeuvre. However, on the merits of the case and in light of the relevant information on the area, it is certain that the primary reason for this action was to prevent the effects of suction and wash caused by excessive speed on the sensitive bank at the bend at Vegesack.
On the other hand, that an equal or even greater reason for this action was to ensure a safe overtaking manoeuvre can be largely excluded. It is quite obvious that the combination of a reduction in passing speed to a level that is almost equal to the speed of the vessel to be overtaken together with the selection of only the right half of the left turn of a laterally confined fairway as the position of the overtaking manoeuvre was counterproductive as regards the execution of a safe overtaking manoeuvre.

In this connection it has to be emphasized that the requirements for the overtaking vessel to avoid dangerous suction by reducing speed *or* maintaining sufficient lateral passing distance as laid down in § 23 Art. 2 S. 1 SeeSchStrO cannot be seen, contrary to the text of the regulation which in this respect reads somewhat ambiguously, as *alternative* options for action which would have to be considered in isolation. In addition to other factors, on the merits of the case, speed of overtaking and passing distance constitute two essential variables accounting for determining the risk of suction effects. This leads inevitably to the consequence of always choosing speed *and* passing distance *cumulative* when overtaking in order to avoid dangerous suction effects.

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4.2.3.2.2 ZAPADNYY

Although both national[21] and international[22] legislation states that primary responsibility for the safe execution of an overtaking manoeuvre rests with the overtaking vessel, this does not absolve the vessel to be overtaken from her obligation to cooperate.

In this connection the legislature differentiates – in this respect deviating from the requirements of the Colregs – between the basic obligation of the vessel to be overtaken, "to facilitate" the overtaking manoeuvre as far as possible in the meaning of the above cited § 23 Art. 2 S. 2 SeeSchStrO and an apparently increasing "obligation to cooperate" in the meaning of § 23 Art. 4 SeeSchStrO. This obligation to cooperate is only to be effected if a safe overtaking without contribution of the vessel to be overtaken is not feasible. The differentiation mentioned has a significant importance, since the consent of the vessel to be overtaken as regards the overtaking procedure is only mandatory in case of an obligation to cooperate.

In practise the basic problem arises where to draw the line between the obligation to facilitate the overtaking procedure as far as possible and an indispensable obligation to cooperate. Moreover it is doubtful if, and to what extent, a differentiation between "facilitating" and "cooperative" action can be made in actuality. In both cases, the vessel to be overtaken can only cooperate to the successful execution of the overtaking manoeuvre by choosing course and/or speed. A factual (qualitative) differentiation is only conceivable by the degree of the cooperation.

Clarifying the question of whether an overtaking manoeuvre requires a contribution exceeding the mere facilitation in the meaning of § 23 Art. 4 SeeSchStrO the BSU considers the following criterion relevant for the assessment of individual cases[23]:

- Characteristics of the fairway (particularly dimension of the fairway section available (length, width, depth, curve radius)
- Weather, current and visibility conditions
- Traffic situation (particularly distance and speed of the vessel proceeding ahead, traffic volume in total)
- Possible endangerment of the oncoming traffic
- Manoeuvre characteristics of the vessels involved in the overtaking procedure

Translated to the circumstances prevailing at the time of the overtaking manoeuvre it is to be noticed that there was indeed no oncoming traffic impeding the overtaking manoeuvre. However, the fairway conditions (bent, laterally limited fairway section) as well as the traffic situation in relation to the ZAPADDNY, sailing negligible slower at the beginning of the overtaking procedure, and her suboptimal manoeuvring characteristics, argue for a formal obligation of ZAPADDNY to cooperate in the meaning of § 23 Abs. 4 SeeSchStrO, taking into account a necessary risk assessment in case of doubt.

[21] Cf. § 23 Para 2 phrase 1 SeeSchStrO.
[22] See Rule 9 and Rule 13 COLREGs, in particular.
[23] Cf. – similar in the outcome – explanations to § 23 Para 4 SeeSchStrO in Graf/Steinicke, Seeschifffahrtsstraßen-Ordnung, commented text edition.

ZAPADDNY should have reduced her speed prior to the start of the overtaking manoeuvre in order to support the speedy overtaking procedure of the RHONESTERN, since there were very limited possibilities for a further manoeuvre to give space at the northern fairway edge.

The possible argument by the ZAPADNYY that a reduction in speed would have adversely affected her ability to steer cannot have an exonerating effect. On the one hand, it is hardly realistic and, moreover, would throw considerable doubt on the properly classified seaworthiness of the ZAPADNYY by an international approved classification society, if it would be claimed that the vessel – especially in unproblematic environmental conditions – could reportedly only manoeuvre safely at full speed. On the other hand, and particularly it must be remembered that if the pilot of the ZAPADNYY actually assumed that he could reportedly not reduce the speed for reasons of safety, then he should not have consented to the passing manoeuvre in the first place.
He would at least have had the obligation to expressively advise the overtaking vessel of the difficult steerability of the low motorized ZAPADNYY. It is logical that the “obligation to cooperate” in the meaning of § 23 Art. 4 SeeSchStrO of the vessel to be overtaken can only be met by course alterations (providing room) and/or speed reductions. If neither option is feasible, then consenting to an overtaking manoeuvre in a confined fairway is questionable.

However, the consent was not entirely unreasonable at any event. As with the pilot of the RHONESTERN, the pilot of the ZAPADNYY knew that the overtaking manoeuvre was not opposed by oncoming traffic. Therefore, he was, in any way initially, entitled to assume that by a temporary, and in this respect not only admissible, but necessary deviation from the adherence to the basic regulation to use the right side of the fairway[24], the RHONESTERN would choose a passing distance that would render supporting actions by the ZAPADNYY, exceeding the utilization of the edge of the fairway, unnecessary. The pilot of ZAPADDNY could not predict the fact that the RHONESTERN, sailing in ballast, would reduce speed significantly in view of the prevention of suction and wake, affecting the shore, by exceeding the obligation to reduce speed and thus prolonging the period of time planned for the overtaking manoeuvre.

Since there are no corresponding technical recordings available from on board the vessel and the existing AIS data are not sufficiently meaningful, in retrospect, it is no longer possible for the BSU to reliably establish whether the action taken on the bridge of ZAPADNYY in response to the increasingly apparent suction effect was appropriate or whether alternative action would have prevented the collision with the floating dock.
It should be noted that the accident would have probably been facilitated if the speed of the ZAPADNYY was actually temporarily reduced after the onset of the suction effect. A reduction in speed inevitably leads to a loss in the ability to steer and is thus fundamentally counterproductive after the onset of hydrodynamic interaction.

[24] Cf. § 2Para 1 No. 1 SeeeSchStrO, Regulation 9 letter (a) KVR.

Despite this theoretical deliberations the BSU does recognise the fact, that, in retrospect, it is almost impossible to make a statement with sufficient certainty as to whether a decision to increase or reduce speed after the onset of a hydrodynamic effect in this single case under consideration, would in fact have had limited the impact of the accident. This applies the more at the time of the action taken. The BSU does therefore abstain from a critical judgement.

4.3 Hydrodynamic aspects of the accident

It has already been noted that hydrodynamic interaction in the course of an overtaking manoeuvre is a very complex subject and that experience gained during the investigation of the collision between the COSCO HAMBURG and P&O NEDLLOYD FINLAND in the years 2004 to 2006 shows that another extensive study of this phenomenon in the course of the present investigation would be inappropriate. For all the differences, there are very compelling similarities between the two accidents. Therefore, the key theoretical statements and findings of that investigation report can easily be translated to the accident on the River Weser and have – as the accident confirms – lost nothing in topicality.

To that end, this part of the investigation report is limited to reiterating the translatable key theoretical statements of the investigation report on the collision between the COSCO HAMBURG and the P&O NEDLLOYD FINLAND as well as the main points of the safety recommendation derived from it at the time.

4.3.1 General statements[25]

- *The investigations conducted so far do not make it possible to provide improved (in other words more concrete) recommendations on overtaking of seagoing ships in limited navigation channels.*
- *In consideration of the growing size of vessels, improved recommendations are absolutely necessary.*
- *The publications that have appeared to date chiefly examined the forces crossways to the track and yawing moment that the vessels exert on each other. However, it appears equally important to take into account the forward-directed longitudinal force on the overtaken vessel towards the end of the overtaking operation. (The bow of the overtaken vessel is then in a "trough" that the overtaking vessel generates alongside itself, while the stern floats in less disturbed water or even at a water level raised above the level of rest behind the "trough". The "slope take-off force" thus acting on the overtaken vessel, directed forwards, reduces this vessel's propeller load and thus its rudder effectiveness. Furthermore, it can accelerate the initially slower vessel up to the speed of the overtaking vessel and thus make an overtaking operation actually impossible due to the resulting "surfing effect". There is then a danger that the ship's command will reduce the pitch/speed of the propeller with a view to ending the "surfing along", which in turn will reduce the effectiveness of the rudder even further. This necessarily increases the risk that it is no longer possible to compensate the turning of the bow towards the stern of the overtaking vessel (yawing moment).)*
- *The difference in speed during overtaking is just as important as sufficient transverse distance. (At the start of the overtaking operation the difference in speed between the vessels must be so great that the overtaken vessel is not accelerated to the speed of the overtaking vessel if the speed/propeller pitch on the overtaken vessel are kept constant.)*

[25] See p. 100 ff Investigation Report BSU 45/04 dated 1 February 2006.

- *Safe distances presuppose that the overtaken vessel remains steerable, in other words the rudder angle necessary to hold a course is less than the maximum rudder angle.*
- *When elaborating generally valid recommendations on determining safe passing distances, unrestricted suitability for practise has top priority. When specifying safe distances, a passive course behaviour of the overtaking vessel should therefore mainly be presumed. Instructions concerning various rudder manoeuvres to be carried out by the vessel to be overtaken at various phases of the overtaking operation, for instance, would not be very practicable and would not mean any perceptible gain in safety.*
- *Generally valid recommendations providing information, for instance, for certain estuaries depending on the vessels involved (with distinctions on the basis of dimensions, fullness, draught), the navigation channel widths and depths available and the vessel speeds, on what passing distances and/or speed differences are to be observed in order to ensure a safe overtaking manoeuvre require extensive investigations into many cases with a widely scattered variation of the above and other parameters (e.g. construction of the steering and propulsion facility, bottom topography).*
- *Training in overtaking operations on vessel command simulators is extremely important. However, in this respect it must be ensured that the corresponding systems map the forces and moments actually occurring at the relevant situations very close to reality. The objective of scientific investigations must therefore primarily be to optimise the computing programs for the simulation facilities in this respect.*

…

The above considerations lead to the following aspects for ship's commands and pilots of overtaking vessels:

- *When specifying a safe overtaking speed, the speed through water is particularly relevant, as in addition to the lateral distance, the forces and moments between the vessels are critically determined by this "type of speed".*
- *GPS-based speed data that are regularly very important for navigation as so-called speed over ground (made good) do not provide a sufficient basis for selecting the safe overtaking speed when considered in isolation, but must first of all be adjusted for any current and wind effects.*
- *When proceeding against the current[26], one particular difficulty is that on the one hand a sufficient difference in speed is necessary between the vessels in order to reduce the time required for the overtaking operation. On the other hand the forces arising are exponentiated when the speed through water is increased and thus promote the development of unmanageable situations.*

4.3.2 Safety recommendations of the BSU dated 1 October 2004[27] (extracts)

The accident occurrence prompts us to draw the attention of ship's commands and pilots to the following:

Hydrodynamically conditioned suction effects that act during overtaking, especially when large vessels overtake smaller vessels, may not under any circumstances be underestimated. Passing distances during overtaking or encounters must always be dimensioned in such a way that no dangerous suction results. In this connection the Federal Bureau of Maritime Casualty Investigation (BSU) draws attention to the fact that it is no longer fundamentally possible to maintain the opinion held in the past by the German Seeämter (maritime casualty investigation authorities), the Bundesoberseeamt (higher maritime casualty investigation authority) and a few courts that no suction effect occurs any

[26] Not relevant.
[27] Confirmed by Investigation Report BSU 45/04 dated 1 February 2006 (see ibid. p. 113 ff).

more at a passing distance of 100 m, or that at any rate such a suction effect can be mastered.

Taking today's traffic situation as a basis (increasingly larger, faster vessels with a greater draught), it is to be assumed that dangerous suction effects cannot be ruled out even at passing distances of well over 150 m.

The BSU is currently checking whether concrete quantity recommendations can be issued in future for safe passing distances. However, it is to be considered that such recommendations will be dependent on many factors (size, draught, speed and manoeuvring properties of the vessels, water depth, navigation channel effects) and accordingly it appears very difficult to stipulate these generally, at any rate at present.

That is why in view of the lack of concrete standard values for passing distances during overtaking communication between the participating ship's commands and in particular support of the overtaking manoeuvre by the vessel to be overtaken are extremely important in avoiding suction effects. In this connection the BSU reminds participants of the statutory obligation in federal German waterways for the vessel to be overtaken to facilitate the overtaking process as far as possible (cf. art. 23 para. 2 SeeSchStrO). Under international aspects too there is a legally binding rule that the overtaken vessel must take measures for safe passage (cf. Rule 9 (e) COLREGs).

That is why it should also be noted when selecting the appropriate measures in the spirit of the above remarks that

- *during encountering and overtaking between a large and a small vessel (e.g. length ratio 2:1) the large vessel does not sheer substantially from its course, while the small vessel is at risk of running out of the rudder,*
- *the forces that occur affecting a small vessel during the passing operation depend primarily on the speed of the larger vessel through the water and only slightly on the speed of the smaller vessel,*
- *the speed difference between the vessels is not crucial as regards the forces acting.*

All this leads to a need for the overtaken vessel to reduce speed prior to the start of an overtaking manoeuvre if the probable (or possible) passing distance is such that occurrence of suction forces cannot be ruled out safely. On the one hand this has the advantage that the effective duration of the suction forces building up between the vessel hulls can be minimised. Furthermore the vessel to be overtaken will thus be enabled to increase its steerability during a later phase of the passing operation by briefly increasing its rate of speed to counteract any suction effects occurring effectively.

However, it is to be stressed that the small vessel should definitely avoid reducing speed at a time at which a suction effect is already starting to make itself noticeable, since reducing speed basically has a negative influence on steerability. Furthermore, depending on the execution of the vessel screw(s) (fixed/variable pitch propeller, left-hand/right-hand) the direct and indirect steering effects, especially during reverse manoeuvres, can promote turning towards the potential other party in a collision.

4.3.3 Sufficient knowledge about problematic manoeuvre characteristics

It was noticed (cf. p. 38) that the hydrodynamic interactions in it's precise characteristics and adverse consequences were, inter alia, and owing to circumstances, superimposed and caused by the problematic manoeuvre characteristics of the relatively low motorized ZAPADNYY, respectively. As regards this accident aspect, the federation of the sea and harbour pilots pointed to the introduction of the so called Portable Pilot Units (PPU). This pilot–aid does, inter alia, comprise a dynamic ship database which the pilot can enter into so called "soft" ship's data such as manoeuvre characteristics and ship induced particularities. Every entry is automatically online available for the participating pilots, as soon as the entry was saved on the server with the PPU.

4.4 Prohibition of an overtaking manoeuvre in the bent at Vegesack?

The BSU included safety recommendations in the draft report addressed to the pilot brotherhood Weser I and the Federal Waterways and Shipping Directory (WSD) Northwest, responsible for the administrative regulation of the traffic on the Weser. The subject of two safety recommendations directed to the addressees mentioned were a future abandonment of overtaking manoeuvres in the "bent at Vegesack". In this respect, the WSD was recommended to review the necessity of a prohibition to overtake in this area.

The statements submitted by the pilot brotherhood and the WSD deal with the actions considered. They agreed upon the fact that a general prohibition to overtake in the "bent at Vegesack" would not serve the safety and ease of the traffic, but instead be counterproductive.

Especially the statement submitted by the WSD deal with the width and distances in the "Bent at Vegesack", relevant for overtaking manoeuvres, in detail. The following is explained:[28]

"The "Bent at Vegesack" comprises the section between Weser-km 16,0 to Weser-km 18,6 on the Lower Weser. The fairway extends from about Weser-km 16,0, from 150 successively to a width of a maximum of 205 m. From about Weser-km 17,6 it falls again below and reaches the given-value of 150 m at Weser-km 18,6. The lowest curve radius in the fairway axis is 1350 m.

In order to establish if a prohibition of overtaking is required it is to be determined if

a) The space available is sufficient for a safe overtaking and
b) Which consequences does an overtaking manoeuvre have in view of the safety and ease of the traffic

[28] Extract of the statement of the WSD Northwest dated 29.05.2012 regarding the draft investigation report 102/11.

Traffic area/width/passing distances

The necessary fairway width is basically made up of the sum of the individual traffic widths of the measurement vessels and of the passing distances between the vessels and the lateral distances to the fairway edges and the embankments, respectively. (Note: all measurements were rounded to a point after the comma).

The guidelines of the PIANC-IAPH Working Group II-30 for sea port entrances (annex to the bulletin No. 95 (1997)) are taken as a basis for the determination of safe lateral distances. The guideline serves the preliminary measurement of fairways and, in this connection, defines, amongst others, also lateral passing distances of oncoming traffic. It is recommended to enhance these values to 50% for overtaking manoeuvres. Furthermore the recommendation for lateral distances (made there) to the fairway edges and the embankments, respectively, are to be taken into account.

a) *The lateral passing distance between two vessels is, according to this guideline and depending on the ship's speed, made up of a basic distance and an additional distance (depending on the traffic density) (s. also handbook Nautic II, page 348-350, determining the safe passing distance)*

A basic distance for oncoming traffic of ship's width x factor 1,4 as well as an additional distance due to "middle density of oncoming traffic" of ship's width x factor 0,2 is recommended for vessels speed between 8 and 12 kn in sheltered inner areas of a fairway (as in the area of the bent at Vegesack). Relevant ship's width is the one of the bigger one of the oncoming vessels. The total amount ship's width x factor 1,6 is to be magnified by 50% of ship's width x factor 2,4, in order to minimize hydrodynamic interactions of both vessels in relation to each other.

b) *Lateral distances to fairway restrictions*
are depending on ship's speed and nature of (underwater) embankment and the shore respectively, to be included. With analogous approach (s. a.) ship's speed 8-12 kn (= "middle") and sheltered inner area a factor, for each, of 0,5 x ship's width to be chosen for the shore of the fairway edges such as embankments and embankments/shelf plates. This applies to the shore of the bent at Vegesack.

c) *Traffic widths*
In 1976 nature measurements for determining navigations characteristics of seagoing vessels in the area of the "bent at Vegesack" were carried out. The measurements resulted in a mean derivation angle in the area of the lowest curve radious of 7,5°.

The measurement vessel for the planned Lower Weser adjustment for the section Brake-Bremen has a length of 195 m and a width of 23,3 m. This vessel dimension takes a traffic width of 64,0 m during the passage through the bent, when e.g. an above mentioned derivation angle is taken as a basis.

Computation for the overtaking manoeuvre TMV "RHONESTERN"/"TMV "ZAPADNYY"

Taking an derivation angle of 7,5° as a basis during the passage of the bent, the TMV RHONESTERN (L: 162,16 m; W: 27,18 m) used a traffic width of 52,8m, the TMV "ZAPADNYY" (L: 77,53, W: 14,34) a width of 25,5 m.

Fairway width	*205,0 m*
Traffic width "RHONESTERN"	*- 52,8 m*
Recommended passing distance (27,18x24)	*- 65,2 m*
Traffic width "ZAPADNYY"	*- 25,5 m*
Lateral distances (32,2 x 0,5 + 14,34 x 0,5)	*- 23,3 m*
Remaining fairway width	***= 38,2 m***

Result: *The computation proves that there was sufficient traffic space for a safe overtaking manoeuvre with respect to the overtaking manoeuvre under review.*

Impact of a prohibition to overtake on the safety and ease of maritime shipping

It must be ensured that particularly bigger seagoing vessels can proceed with a safe minimum speed on the maritime navigable waterway. For maintaining the rudder effect and thereby the steerability of the vessel, it is absolutely compelling, even by taking into consideration wind and the effect of the tide current in a narrow channel, to keep this minimum speed through the water. The minimum speed varies thereby depending on the technical engine equipment as well as the individual ship's design. Seagoing vessels must have the possibility to overtake very slow vessels such as inland vessels, smaller seagoing vessels or tug and tow, proceeding with speed falling below the required minimum speed of the seagoing vessel throughout the complete fairway section. This does particularly apply to the area of the "bent at Vegesack", which was explicitly extended in the past for this reason.

Conclusion

The "bent at Vegesack" was expanded and extended to a fairway width of 205 m in order to allow for encounters and overtaking manoeuvres. With respect to safe overtaking manoeuvres it provides sufficient traffic area for the vessels mentioned here.

Since the scene of the collision in the "bent at Vegesack" is neither a narrow channel nor an unclear bending in the meaning of § 23 Art. 3 S. No. 2 SeeSchStrO, there is no general prohibition to overtake.

Within the framework of it's safeguarding responsibilities the WSD Northwest, in virtue of §§ 24, Art 2, 60, Art. 1 SeeSchStrO, announced a strict prohibition to encounter for vessels exceeding 390 m in their added ship's length for the area of the "bent at Vegesack". With 239,69 m added length the vessels involved fell far below the ship's length's relevant for a prohibition to encounter.

…

Due to technical and environmental influences (e.g. wind and tide effects), precise minimum speeds cannot be undercut. The introduction of further prohibitions to overtake and encounter, respectively, is, due to the above explained basic conditions (width's of vessel and traffic area) not deducible from a nautical perspective and would lead to a constraint of the safety and ease of the maritime shipping on the section Bremen-Brake. However, it is pointed out, that the Announcements concerning the SeeSchStrO within the framework of quality management as well as on changes of traffic are subject to continuous validation."

5 CONCLUSIONS

The marine casualty under investigation vividly demonstrates the potentially dangerous consequences of an overtaking manoeuvre when sufficient attention is not given to the risk of hydrodynamic interaction between the vessels. It also becomes clear that the related consequences may not ('only') affect the vessels immediately involved, but also other parties that are, as such, unconnected.

The marked importance of communication between overtaking and overtaken vessel, which under certain circumstances should not stop at the mere announcement of the manoeuvre by the overtaking vessel and possibly hasty approval of the overtaken vessel and, as the case maybe, a mere acknowledgement of the notification by the overtaking vessel.

Every conceivable risk factor must be carefully weighed up when deciding whether an overtaking manoeuvre is actually safe at the position under consideration. This obligation applies to both parties involved in the overtaking manoeuvre. In addition to considering whether the area or any oncoming traffic permits an adequate passing distance, the overtaking vessel must also take into account the current route and any alterations in course and/or speed arising from that. In addition, the overtaking vessel should also consider or ascertain whether it is actually possible or reasonable for the vessel to be overtaken to facilitate the overtaking manoeuvre at the intended position sufficiently. For their part, having regard to their own options for manoeuvring and assisting as well as the special nature of the route, the pilot and the ship's command of the vessel to be overtaken should also make forward looking considerations with respect to whether the manoeuvre can be consented to without risk.

The investigation does ultimately emphasize the necessity of a continuous exchange of information between the vessel’s command, formal responsible for the safe course and speed of the vessel, and the “merely” advising pilots. The latter is indeed much more aware of the local conditions, but does rely on the vessels commands expertise as regards the appraisal of the manoeuvring characteristics of the vessel to be piloted and their consideration when giving recommendations. Inversely, the vessel’s command is responsible for advising the pilot about the characteristics of the vessel and possible particularities and experiences made in detail and inquiring his recommendations in a critical manner if justified.

The BSU abstains from a general prohibition to overtake in the “bent at Vegesack”, meanwhile considered, after having deliberated the argumentative convincing statements supplied relating to this matter. The abandonment of a general prohibition to overtake does certainly not absolve the vessel’s commands and pilots from the obligation to thoroughly consider in every single case if an overtaking manoeuvre, planned and deemed necessary, respectively, has inevitably and preferably, to be carried out in the area of the “bent at Vegesack”.

6 SAFETY RECOMMENDATIONS

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

Lotsenbrüderschaft Weser I (Brotherhood of Weser I Pilots [sic])

6.1 Overtaking manoeuvre in the bend at Vegesack

The Federal Bureau of Maritime Casualty Investigation recommends that the Lotsenbrüderschaft Weser I advise the pilots under its control to carry out overtaking manoeuvres in the area of the “bent at Vegesack” after having thoroughly checked all risk factors.

6.2 Advisory role of pilots

The Federal Bureau of Maritime Casualty Investigation recommends that the Lotsenbrüderschaft Weser I use the accident as an opportunity to raise the awareness of the pilots under its control with regard to the need to coordinate their advisory activities with the ship's command sufficiently.

6.3 Communication between the pilots

The Federal Bureau of Maritime Casualty Investigation recommends that the Lotsenbrüderschaft Weser I emphasise to the pilots under its control that any information concerning pilotage should be exchanged via the designated VHF channels, and not via mobile phone.

7 SOURCES

- Findings and photos of Waterway Police (WSP) Bremen
- Recordings by Vessel Traffic Service Bremen
- Recordings by the TMV RHONESTERN's voyage data recorder
- Electronic nautical chart, Federal Maritime and Hydrographic Agency (BSH)
- Photo of the TMV ZAPADNYY, Hasenpusch Photo-Productions and Agency, Hamburg
- Witness accounts
- Statements relating to the draft-report
- Investigation Report 45/04 of 1 February 2006 on the collision between CMV COSCO HAMBURG and CMV P&O NEDLLOYD FINLAND on 1 March 2004 on the Lower Elbe/off Buoy 91 with the Death of one Seaman, with further references.
- Kurt Graf (Ed.), Dietrich Steinicke (Ed.); Seeschifffahrtsstraßenordnung, commented text edtion with Collision Prevention Regulations, including IMO-explanations and all other traffic regulations, 4. edition, Delius Klasing, Bielefeld, 2009