



Bundesstelle für Seeunfalluntersuchung
Federal Bureau of Maritime Casualty Investigation
Bundesoberbehörde im Geschäftsbereich des Bundesministeriums
für Verkehr, Bau- and Wohnungswesen

Investigation Report 213/02

Marine Casualty:

Collision

CMV P&O NEDLLOYD GENOA
and
MT EBRO

on 19 December 2002
on the River Elbe between Buoys 78 and 80

10 May 2004

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1 Summary of the maritime casualty

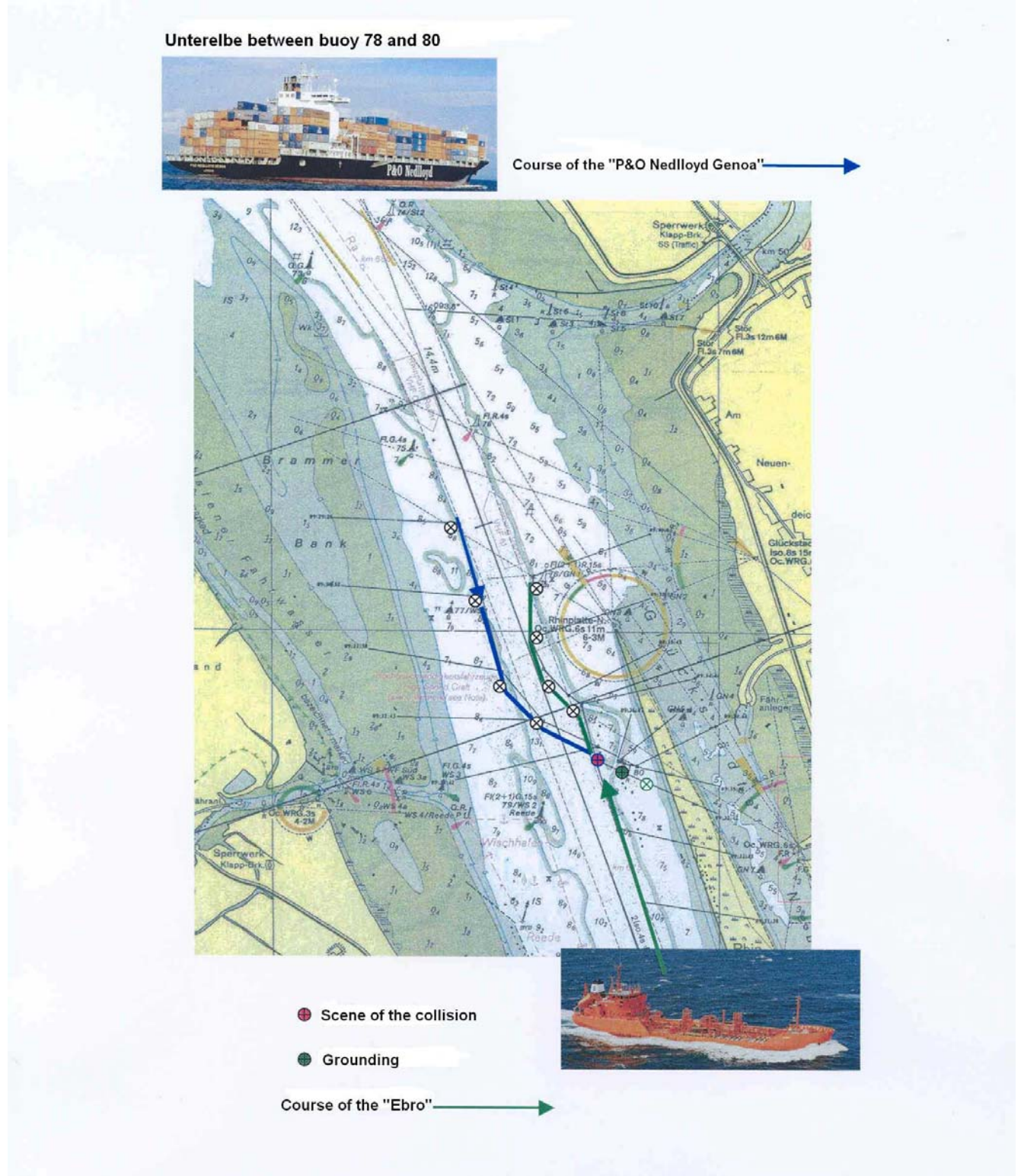
At visibilities of less than 500 m and dense fog the British container vessel P&O NEDLLOYD GENOA travelling upstream along the River Elbe, coming from Rotterdam, collided at about 09.32 h CET on 19 December 2002 with the Portuguese chemical tanker EBRO, travelling downstream along the River Elbe, coming from Bützfleth, between buoys 78 and 80. MT EBRO struck CMV P&O NEDLLOYD GENOA on its aft starboard side in the stern area at a height approx. 6 m above the water line, over a length of approx. 25 m and a width of approx. 2 to 3 m. The damage consisted of heavy paint abrasion and denting, as well as minor holes in the hull on a level with the frames.

As a result of the collision the container vessel became stranded on a level with buoy 80 at river kilometre 675.5. After it came free again with rising tide at about 11.25 h CET, the vessel was able to continue its voyage to Hamburg and reached the port of Hamburg, Burchardkai 6, at 14.45 h CET.

On MT EBRO the starboard bulwark was set in over a length of 10 to 12 m. Furthermore, two frames in the foreship area were cracked / torn. The vessel continued its voyage down the River Elbe up to Brunsbüttel South Roads.

No personal injury was sustained on the two vessels. There was no water inrush. No tanks were damaged and there was no environmental pollution. Only property damage was sustained, the amount of which has not yet been published.

2 Scene of the accident



3 Vessel particulars and photos

3.2 Vessel particulars CMV P&O NEDLLOYD GENOA



Name of vessel:	MV P&O NEDLLOYD GENOA
Operator:	Sovereign Financial Services/Manchester/UK
Port of registry:	London
Nationality/flag:	British
IMO-No.:	9168219
Ship's call letters:	MYMX5
Type of vessel:	Container vessel
Crew:	21 + 1 pilot
Classification	Germanischer Lloyd
Class:	+ 100A NAV1 ICE - CLASS 1D
Year built:	1998
Building yard:	Kvaerner / Rostock
Length overall:	210.1 m
Width:	32.2 m
Max. draft:	10.8 m
Gross tonnage:	31,333
Deadweight:	37,842 t
Main engine:	DMR MAN 8K 80 MC C
Engine rating:	28,880 kW
Speed:	22.5 kn

3.3 Vessel particulars MT EBRO



Name of vessel:	MT EBRO ex EBERHARDT ESSBERGER
Operator:	Ostsee Tank Reederei/DAL Hamburg
Port of registry:	Lisbon
Nationality / flag	Portuguese
IMO-No.:	8513168
Ship's call letters	CSEP
Type of vessel:	Chemical tanker Type 2
Crew:	Not advised + 1 pilot
Classification:	Germanischer Lloyd
Class:	+ 100 A5 M E3 MC AUT
Year built:	1986
Building yard:	J.J. Sietas / Hamburg
Length overall:	81.01 m
Width:	14.30 m
Max. draft:	5.90 m
Gross tonnage:	2,238
Deadweight:	2,898 t
Main engine:	6 R 32 Oy Wärtsilä AB / Finnland
Engine rating:	2.005 kW at 720 rpm on the shaft
Speed:	12.5 kn
Propeller:	Left-handed adjustable propeller and right-handed effect
Bow thrusters:	Bow thruster
Rudder:	Conventional, with max. 35° rudder angle

4 Course of voyage / course of accident

4.1 Voyage of the vessels

4.1.1 CMV P&O NEDLLOYD GENOA

The British container vessel P&O NEDLLOYD GENOA was proceeding upstream up the river Elbe from Rotterdam on 19 December 2002 with Hamburg as port of destination. The vessel was under the command of the Master. In addition to the Master, the Third Officer, one sailor as helmsman and one sailor as lookout were on the bridge. At 08.36 h CET the advising pilot came on board the vessel. The vessel had a draft of 9.70 m forward and 10.80 m aft.

The bridge of CMV P&O NEDLLOYD GENOA was equipped in accordance with regulations. The equipment included two radar sets of make STN ATLAS MARINE ELECTRONICS, Type: ATLAS 9600 ARPA-S-Band, and ATLAS 9600 ARPA-X-Band, as well as an electronic sea chart system.

The pilot operated the starboard radar system. He had set the system to True Motion (TM) display in the 1.5 sm range off-centre, so that a visibility of 2.5 sm ahead was available.

In view of the poor visibility conditions the vessel's command and the pilot of CMV P&O NEDLLOYD GENOA used the radar advisory service of the Vessel Traffic Services (VTS) Brunsbüttel on the relevant VHF channels for the sections concerned.

Figure 2: Bridge control console from starboard



Figure 3: Bridge control console from port



4.1.2 Master's statement

The Master's statement was translated from English into German by an official translator.

The Master declared in his statement that CMV P&O NEDLLOYD GENOA proceeding up the River Elbe from Rotterdam to Hamburg on 19 December 2002 had taken the pilot on board at 08.36 h CET.

After information had been exchanged with the pilot about leaving the river estuary, the pilot took over the command of the vessel under the control of the Third Watch Officer and the overall supervision of the Master. A sailor had been deployed as helmsman and a further sailor as lookout.

At 09.28 h CET, on passing buoy 75, the Third Watch Officer had informed the Master that the vessel was very close to the southern side of the navigation channel. Thereupon he, the Master, checked the vessel's position on the electronic sea chart (ECDIS) and ascertained that although the vessel had been located in the southern part of the navigation channel, there had still been sufficient water depth for navigation there. At this time the echo sounder indicated a depth of 7.70 m below the keel. Furthermore the vessel had been on a good course of 160°. The centre line of the navigation channel here had run at 160.5°.

Shortly after that the pilot had stated that the vessel was being influenced by the bank effect. Thereupon the pilot had reduced speed to "slow ahead".

At 09.30 h CET, on passing buoy 77, the pilot had then instructed the helmsman to steer a course of 170°.

He, the Master, had informed the pilot that he had changed the course in the wrong direction. The pilot had then reacted with the rudder command "hard to starboard". He, the Master, had realised here that the pilot must have lost his sense of orientation and ordered the rudder "hard to port".

The vessel had turned further to starboard and reached the course 165°. After reaching this point the vessel had then very quickly started to turn to port. When the vessel had reached the course 160°, the Master had ordered the rudder "hard to starboard". However this had only had a slight influence on the turning motion of the vessel. The Master had realised that it would no longer be possible to stop the turning movement in time to pass MT EBRO, running downstream along the River Elbe, on the port side.

He, the Master, had instructed the pilot to inform the MT EBRO that they could only pass "starboard to starboard". The Master said that he had understood that the pilot had passed on this information in German.

The vessel had moved further to port up to the course ahead of 135°. From this point on the vessel had slowly turned to starboard again.

Shortly after 09.34 h CET there had been a sliding contact in the area of the starboard superstructures of CMV P&O NEDLLOYD GENOA with the starboard stem of TM EBRO. At this time the engine had been stopped, the rudder had been left "hard to starboard", and the display of the echo sounder had moved in the direction of zero. The speed had been reduced from 6 kn to zero. The vessel appeared to have stranded at the position 53° 47.5'N 009° 23.3'E. A bearing had been taken on buoy 80 at 142° with a distance of 0.2 sm.

The Master had immediately all tanks and holds checked. No leaks had been ascertained. At 11.20 h CET the vessel had come afloat again without any external assistance and had been able to continue its voyage to Burchardkai in Hamburg.

4.1.3 Statement by the Third Watchkeeping Officer

The statement by the Watch Officer was translated from English into German by an official translator.

The Third Officer stated that the vessel had made good progress from Brunsbüttel (about 08.36 h CET) to the change of course at Rhinplatte Nord (at 09.24 h CET). The pilot had issued the rudder commands and operated the starboard radar set (10 cm). The port radar set (3 cm) had been influenced by ice on the river.

Figure 4: Control console looking at the radar sets



Following the change of course at 09.24 h CET in the navigation channel running along the Rhinplatte, the vessel had come slightly off course to starboard. The VTS had informed the vessel at this time of another vessel approaching from ahead. With his orders and rudder commands the pilot had directed the vessel further to the starboard side of the navigation channel. However, the officer had been concerned about the fact that the CMV P&O NEDLLOYD GENOA could come too far against the starboard limit of the navigation channel. She had the impression that the pilot had lost his sense of orientation. That is why she asked the pilot what the problem was and drew the Master's attention to the fact that the vessel was close to the starboard limit of the navigation channel.

On approaching navigation channel buoy 77 the pilot had ordered a further change of course to starboard in order to react to a bank effect (suction action drawing the vessel to the river bank), which according to the statement by the pilot had reportedly influenced the manoeuvring behaviour of the vessel.

When the pilot ordered the rudder "hard to starboard" at 09.32 h CET, the Master in turn had ordered the rudder "hard to port". He had come to the conclusion that the pilot must have lost his sense of orientation.

The vessel had already turned to starboard, but had come back into the navigation channel without running aground on the west side. Now "hard to starboard" had been ordered, but although the rudder had reacted quickly, the turn to starboard had been too slow. At this time the approaching MT EBRO had already been very close and the Master had asked the pilot to agree with the pilot on the MT EBRO that they would have to pass "starboard to starboard".

When the Third Officer turned round in order to go to the bridge wing, she heard a loud noise at 09.34 h CET and saw how MT EBRO bounced off the starboard superstructure of CMV P&O NEDLLOYD GENOA. She thereupon reported the collision to the Master. The engine had been set to "stop". Her own vessel had lost speed. The echo sounder had dropped to zero. The vessel had run aground on Rhinplatte Nord. Work immediately commenced on ascertaining any damage. The vessel had come afloat again without any external aid at 11.26 h CET.

4.1.4 Statement by the pilot/P&O NEDLLOYD GENOA

The pilot stated that he had joined CMV P&O NEDLLOYD GENOA at about 08.30 h CET on 19 December 2002. The vessel had been equipped with two modern radar sets and an electronic sea chart system. All the systems had been in order and as far as could be seen had worked without any limitation. The bridge had been properly staffed and communication between the vessel command and the pilot had been without any problem.

During the pilotage up the River Elbe the tide had been running out strongly. Low water in Glückstadt had been announced for 09.33 h CET. Visibility had been limited due to dense fog and was less than 200 m. The radar advice from the VTS had been running on all VHF channels.

The pilot had observed the starboard radar set that had been set in the 1.5 sm range "off centre" with visibility ahead of approx. 2.5 sm. However, due to drifting ice on the River Elbe it had been difficult and partly impossible to locate the buoys in the close range (about 5 cables).

At about 09.24 h CET a change in course between buoys 71 and 75 had been ended. The vessel had been running on the new course (true 160 °), with the portside just 40 m south of the radar line of the VTS. Speed over ground had been 14 knots. On the way between buoys 75 and 77 he had noted that the vessel was setting southwards.

He had recommended to the vessel command that the course should be changed to 155° and had observed on the rudder position indicator that the helmsman had carried out the instruction properly with a rudder angle of about 5° to port. He observed on the compass how the vessel turned, but ascertained that the southerly tendency was continuing.

The radar advisor (VHF channel 5) had informed the pilot that another vessel, MT EBRO, was approaching from ahead. The vessel was easily visible in the radar display unit. The pilot had noticed that CMV P&O NEDLLOYD GENOA was moving further away from the radar line to the south and must already have been close to the edge of the channel. He thereupon recommended that speed be reduced to "dead slow ahead" and that a new course of 170° be steered in order to keep the stern free of the navigation channel edge.

The pilot stated that his recommendation had been executed immediately by the vessel's command. However he had observed that the helmsman had partly needed a starboard rudder angle of 15° to keep the vessel on course. The Master, probably fearing that the vessel would run aground at the southern edge of the navigation channel, now ordered the rudder "hard to port". While the rudder ran from starboard 15° to mid-ships, CMV P&O NEDLLOYD GENOA suddenly turned hard to port.

He, the pilot, had immediately ordered the rudder "hard to starboard", but had noted that it would no longer be possible to stop the movement to port.

The pilot had therefore requested a passage "green to green" via VHF channel Radar Rhinplatte (channel 5). At about 09.32 h CET, CMV P&O NEDLLOYD GENOA had then run aground below buoy 80 on the north side, and directly after or on grounding, MT EBRO had collided with the stern of his vessel. At about 11.30 h CET the vessel was able to come free again under its own power with the first rising tide by shedding ballast.

Figure 5: Damage to CMV P&O NEDLLOYD GENOA, starboard side, aft ship 1



Figure 6: Damage to CMV P&O NEDLLOYD GENOA, starboard side aft ship 2



4.1.5 MT EBRO

The Portuguese MT EBRO had left the DOW Chemical pier in Bützfleth at 8.45 h CET on 19 December 2002 with 2529 t caustic soda, travelling upstream along the River Elbe with destination Maydown (Northern Ireland). The vessel had a draft of 5.15 m forward and 5.95 m aft.

In addition to the Master who was manning the control console, the pilot, who had joined the vessel in Bützfleth at 08.35 h CET and one sailor as outlook were on the bridge. A further sailor was on the forecastle on standby.

Low water (Cuxhaven) was at 07.25 h CET. The next high water had been predicted for 12.48 h CET. The weather was calm. Visibility in dense fog was between 100 and 500 m. Because of the dense fog MT EBRO was using the radar advisory services of VTS Brunsbüttel on the VHF channels 68 (Brunsbüttel Elbe Traffic) and 5 (Rhinplatte Radar).

The communication with the VTS was carried out by the pilot in German. The Master and the pilot communicated in English.

The bridge of MT EBRO was equipped with the "Optimal-Bridge" system from SIETAS. The equipment included two radar sets of the make Kelvin Hughes that were both in operation (type Nukleus 2 5000 A ARPA and series 1600). There were two GPS navigation systems from Koden (type KGP-912, connected with the ARPA radar set and KGP-930) on the bridge.

4.1.6 Statement by the Master of MT EBRO

The Master, who had taken over the command on board MT EBRO in 1999 and had commanded other chemical tankers for the same operator for several years before this, described the course of the incident in his report as follows:

After casting off the pilot had manned the port radar set while he, the Master, had observed the starboard radar set. The First and Second Engineers had been in the engine room.

Due to the SIETAS bridge console layout he and the pilot had been able to observe both the radar sets and the traffic ahead. He and the pilot had both been able to manoeuvre the vessel with the joystick or the automatic pilot, and in the event of emergency by the takeover joystick. The engine control lever had been located on the right-hand side of his seat.

After the vessel had left her berth and was proceeding down the river on course on the specified side of the navigation channel, the pilot had ordered the engine "full speed ahead" (12 kn). The pilot had steered the vessel using the automatic pilot. The Master had monitored the situation with the starboard radar set the entire time.

He and the pilot had been using both radar sets in the off-centre mode, one in the 1.5 sm range and the other in the 3 sm range. Consequently they had had a radar image of about 2.5 sm ahead effectively on the radar set in the 1.5 sm range.

The starboard radar, which was connected with the GPS (Koden KGP-912), had also displayed the vessel speed. The Master had entered the following buoy passing times in the standard passage plan and in the logbook:

- at 08.53 h passed lighthouse Pagensand
- at 09.05 h passed buoy 94
- at 09.12 h passed buoy 90
- at 09.23 h passed buoy 84
- at 09.28 h passed buoy 82
- at 09.45 h passed buoy 76

Roughly about the time he passed buoy 82 he had observed a vessel on the radar approaching MT EBRO from ahead on MT EBRO's side of the navigation channel. The pilot had informed him that the VTS had warned him that another vessel coming towards them, CMV P&O NEDLLOYD GENOA, had come off course to the north and that the VTS was not in a position to reach the vessel via the VHF channel.

The Master stated that he could no longer remember what the distance between the two vessels had been at this time. Nor did he know any longer what radar range he had set at this time. However, he was certain that the distance from the oncoming vessel had been more than 1 sm. He had immediately moved the engine telegraph to "half-speed ahead", which corresponded to a speed of 9 kn, and had taken over steering of the vessel by hand.

He and the pilot had observed the other vessel constantly on the radar display screens and ascertained that it was moving further to north. For this reason and because the pilot had been informed by the VTS that there was still no radio contact with CMV P&O NEDLLOYD GENOA, the Master and the pilot of MT EBRO had undertaken a first change of course to starboard in order to give the vessel that was in difficulty more space. However, he could no longer remember how great the change in course had been. Nor could he remember any more what the distance between the two vessels was at this time. He had concentrated more on the effects of the change of course.

He and the pilot had decided to reduce speed further. The VTS had also advised them to reduce speed further. The Master had moved the engine telegraph to less than "dead slow ahead", to the minimum speed necessary for steering. The speed had thereupon been reduced substantially, but he could no longer remember the exact speed.

Since CMV P&O NEDLLOYD GENOA had been continuing on a course crossing MT EBRO's course, the Master, in consultation with his pilot, had finally moved the engine lever to "full astern". As far as he remembers, the distance between the two vessels at this time had been about 0.5 sm. CMV P&O NEDLLOYD GENOA was observed continuing its course to port unchanged.

The Master states that he could no longer remember what course was being steered at this time and that this had not been recorded; he had concentrated on nothing but the relative movements of the two vessels to each other.

A little later the approaching CMV P&O NEDLLOYD GENOA had come into sight optically on the port side ahead. It had been on a course crossing from port to starboard. Its foreship ran almost directly into the bow of MT EBRO. The estimated distance between the two vessels had been about 50 m, perhaps a little less. The Master had immediately moved the rudder "hard to port" in order to reduce the impact of the collision. At 09.35 h CET the starboard bow of MT EBRO had collided with the starboard aft ship of CMV P&O NEDLLOYD GENOA at an estimated angle of 30°. As a consequence of the impact of the collision MT EBRO had moved strongly to port and then subsequently back to starboard.

Directly after the collision the Master had recorded the following position with his starboard radar set: latitude 53°47.77'N and longitude 009°23.01'E. This had been very close to the northern edge of the navigation channel marked with red buoys.

He had immediately ordered the sailor on watch to the foreship in order to ascertain the extent of the damage. Shortly after this the Chief Mate had come onto the bridge and they had brought MT EBRO back onto course again with "dead slow ahead". After this the Master himself had gone forward to monitor the extent of the damage.

The further communication via VHF had been conducted by the pilot in German while the Master had informed the owner of the vessel. They had continued the journey downstream and had anchored off Brunsbüttel Roads.

4.1.7 Statement by the pilot of MT EBRO

The pilot reported the course of the accident as follows:

At 08.45 h CET the vessel had cast off without tug assistance with "slow ahead" against the outgoing tide. Before this radar advisory services had been requested from VTS Brunsbüttel. Visibility had been between 200 and 300 m.

Both radar sets on the bridge had been in operation, one had been set to centre in the 0.75 sm range and the other had been off-centre in the 1.5 sm range with greater visibility ahead. At 08.48 h CET they had proceeded to speed "full ahead".

During the period 8.50 h CET to 8.53 h CET MT EBRO had been in the northern half of the navigation channel running downstream along the River Elbe with a course of 345°, constantly along the radar line or a little to the north of it. The engine had been running at a speed of 13.5 kn over ground and radar advisory services had been used.

During the traffic situation report at 09.05 h CET the pilot had been informed of various matters including the fact that CMV P&O NEDLLOYD GENOA was coming towards MT EBRO and had just passed buoy 65. At 09.28 h CET, MT EBRO passed buoy 82 at approx. 50 to 100 m north of the radar line. Expecting the announced approaching vessel, the vessel had navigated with a slight tendency to the north. At this time information from Rhinplatte Radar (VHF channel 05) to CMV P&O NEDLLOYD GENOA had also been heard on board MT EBRO. CMV P&O NEDLLOYD GENOA was informed that it was north of the radar line. On board MT EBRO this information caused enhanced attentiveness of the Master and the pilot.

After learning from Rhinplatte Radar that CMV P&O NEDLLOYD GENOA was not yet being advised on channel 05, the speed on board MT EBRO was set to "half speed ahead" and the Master changed over to manual steering of the vessel.

MT EBRO was advised via VHF radiotelephone to reduce speed and take evasive action to starboard. No confirmation was received in response to the pilot's enquiry to the radar advisory services on channel 05 whether it would not be better for MT EBRO to pass to the south. Thereupon the engine was set to minimum speed ahead and the rudder was shifted to "hard to starboard". At a distance of approx. 0.5 sm to CMV P&O NEDLLOYD GENOA the engine was set to "full astern".

When CMV P&O NEDLLOYD GENOA first came into sight (approx. 50 to 100 m ahead of the bow of MT EBRO) the pilot had realised that a collision could only be avoided, if at all, by a "hard to port" rudder manoeuvre. This manoeuvre had been initiated at once.

The vessel passed the bow of CMV P&O NEDLLOYD GENOA, that had shifted to starboard, on the starboard side at an angle of approx. 130°. The course of MT EBRO had been in the range of 000° to 010°. At 09.35 h CET the starboard side of MT EBRO's bow had collided with the starboard aft ship of CMV P&O NEDLLOYD GENOA.

After the collision MT EBRO had turned off to port; the engine had been stopped and a little later changed to "slow speed ahead". MT EBRO had informed the VTS Brunsbüttel and the radar advisor immediately of the collision, any recognisable damage, and the watertight integrity of MT EBRO. After this the vessel was brought back onto course and continued its voyage up to the South Roads off Brunsbüttel.

Figure 7: Damage to MT EBRO, foreship



Figure 8: MT EBRO, starboard bulwark



Figure 9: MT EBRO, deformed bulwark



Figure 10: MT EBRO hawse in the bulwark



4.2 Documentation VHF - radio traffic and traffic situation

4.2.1 Audio documentation VHF – Channel 61

Freiburg Radar

R Freiburg Radar
N CMV P&O NEDLLOYD GENOA
L MV LINAH

Time (CET)	Speaking	Text
09:07	N	P&O NEDLLOYD GENOA is now on channel 61, K. here, hello.
09:07	R	Good morning Captain K., here is H., H., have recognised you clearly. Your portside is on the radar line, you are passing buoy 65, you have free passage here on this screen. No-one running with you, nothing coming from ahead, and tide level 8 cm Brunsbüttel still rising slightly and just under a mile to the interface at "67".
09:10	R	And that is now P&O NEDLLOYD GENOA coming up the River Elbe, Mr.K., portside on the radar line, 300 m up to the interface at the "67", you can swing in slowly there already.
09:11	R	And coming up the River Elbe are P&O NEDLLOYD and at the portside at the intersection.
09:12	R	And Mr. K. has changed his course wonderfully there, is on the long leg with his portside, in the direction of Stöhr, no oncoming vessels.
09:16	R	And Mr. K. is running excellently parallel to the radar line, with the starboard side 100 m south of the radar line, is passing buoy "69", still 2700 m up to the intersection Hollerwettern, no oncoming vessels.
09:18	R	P&O NEDLLOYD GENOA is running up the Elbe.
09:19	R	P&O NEDLLOYD GENOA upstream on the Elbe, Mr. K., starboard side is 100 m south of the radar line, distance from buoy "71" still 600 m, intersection Hollerwettern 1400 m.
09:20	R	1000 m up to the intersection P&O NEDLLOYD GENOA, and oh the starboard side is 100 m south, passing buoy. "71".

09:21	R	P&O NEDLLOYD GENOA is running up the Elbe, Mr. K., the starboard side is 100 m off the radar line, just under 300 m up to the intersection, you can edge over slowly now, Mr H...
09:22	R	Excellent, course changed, the CC, no, not that, P&O NEDLLOYD GENOA, portside between the radar line, or rather starboard side, no, the starboard side is 100 m south of the radar line, distance from "73" still 500 m.
09:24	R	P&O NEDLLOYD GENOA running up the River Elbe, Mr. K., with starboard side 80 m south of the radar line, still 500 m up to the intersection off Stöhr. Now the first oncoming vessel, here still above the "78", is right in the north there.
09:26	R	So, NEDLLOYD GENOA has now edged off a bit already, that's good, the starboard side is still about 100 m south of the radar line. The intersection is now athwart ship. And the oncoming vessel right in the north, on the "78" is a free-running LINAH.
09:27	L	Freiburg Radar, hello, LINAH has just switched in.
09:27	R	Have recognised LINAH clearly. Watch out Captain, you are 120 m north of the radar line, buoy "78" aft, coming ahead a vessel that is now still below buoy "75", coming towards you there in the south.
09:27	R	Speed up a little LINAH, it's nearly the end of our working shift.
09:27	L	Ok, will do, will do. We want to get back again tonight.
09:27	R	Yes, that's right.
09:28	R	P&O NEDLLOYD GENOA is running up the River Elbe, starboard side is 100 m south of the radar line, buoy "75" now being passed, you can switch over, J. H. in the next lot will carry on Mr.H., "Bon Voyage"!
09:28	N	Yes, Ok, have a good watch, get home safely

4.2.2 Audio documentation VHF-Channel 05

Rhinplatte Radar

E TS "EBRO"
N CMV "P&O NEDLLOYD GENOA"
R Rhinplatte Radar
L MV "LINAH"
? Other radio traffic

Time (CET)	Speaking	Text
09:25:00		
09:26:20	R	And running down the river "LINAH" Captain you are now 150 m north of the radar line, passing buoy 78. Then please switch over to channel 61, will carry on there.
09:26:20	L	Yes, have a good watch, I am switching over.
09:26:30	R	Yes, bon voyage, bye bye. And running up the River Elbe "EBRO" with Mr. W., he's on the radar line with his portside, distance before passing buoy 82 is another 1000 m.
09:28:10	N	Rhinplatte Radar from P&O NEDLLOYD GENOA.
09:28:20	R	Yes here is er Rhinplatte Radar, Mr. K. with "P&O NEDLLOYD GENOA", caught you. You are 50 m south of the radar line, distance before passing buoy 77 is still 800 m. Two vessels coming towards you, the first is the "LINAH" which will be passing you right now, and the next, the following, is "EBRO". It is engaged.
09:29:10	R	Running up the Elbe "EBRO", Mr. W., you are 80 m north of the radar line there. On my radar screen you are still moving to the north. You are passing buoy 82. "P&O NEDLLOYD GENOA" is running down the Elbe with Mr. K., 100 m south of the radar line now. Distance to passing buoy 77 is 300 m.
09:29:40	R	For "GENOA", "P&O NEDLLOYD GENOA" I have no other approaching vessels up to Bützfleth.
09:30:50	?	Yes, Okay. Thank you Norbert. I am doing my best. That's right, bye Norbert, until this evening.
09:31:20	R	Running down the River Elbe "EBRO" Mr. W., 100 m north of the radar line. Distance to passing buoy 80, 500 m. Running up the Elbe, "P&O NEDLLOYD GENOA" with Mr. K. Now 150 m south of the radar line. Distance before passing buoy 79, 1100 m.
09:32:30	R	Special announcement for "P&O NEDLLOYD GENOA". According to my display you are tending to the north. You are now 50 m south of the radar line.

Time (CET)	Speaking	Text
09:32:50	R	"P&O NEDLLOYD GENOA", please come for Rhinplatte Radar, Mr. K.
09:33:00	R	„EBRO" from Rhinplatte Radar.
09:33:00	E	"EBRO" hears.
09:33.10	R	Yes, as you can perhaps see in the radar, "P&O NEDLLOYD GENOA" is coming increasingly up to the north here. It is now on the radar line, coming ever further north. You have to slow down and I haven't had any contact with him yet.
09.33.20	N	He's made a steering error here. We'll have to see that we get back onto the radar line, shouldn't we?!
	R	He's made a steering error just now and wants to get back onto the radar line "P&O NEDLLOYD GENOA".
09:33:30	N	Starboard to starboard would be best.
	R	The colleague has just said from "NEDLLOYD GENOA", starboard to starboard please for "EBRO".
09:33:50	R	"EBRO" from Rhinplatte Radar.
	E	We can see him, we have him directly in front of our bow. We're going over to port and will probably just be okay.
09:34:00	R	"EBRO" going over to port.
	E	I'm going over to port and should just about manage to clear him.
	R	"EBRO" goes to port, "P&O NEDLLOYD GENOA", "EBRO" is going over to port.
09:34:00	E	"P&O NEDLLOYD GENOA" just touched at the stern, set in. Everything still okay.
	N	Yes, we have grounded.
09:34:20	R	Everything okay with you, yes. Have you passed now, or what has happened?
	N	He made a complete steering error, we didn't manage to catch him any more.
09:34:30	R	And "P&O NEDLLOYD GENOA" has made a steering error, is now aground, or where are you now? Can you still ...?
09:36:40	N	So, Rhinplatte Radar from "P&O NEDLLOYD GENOA".
	R	Rhinplatte Radar hears.
09:36:50	N	So, er, the Captain asked, there was a slight crunching sound here. Was that a collision?
	R	Well "EBRO" has just told us that there must have been slight denting just now on their ship. So there must have been contact.

Time (CET)	Speaking	Text
09:37:10	N	Yes there was contact, okay, everything in order. We shall try to come free here. We have a rising tide behind us. We'll try and get free here and then carry on our voyage.
09:37:30	R	Yes, I shall just have to speak to the Nautical Watch officer. Okay, first you want to try and get clear again, okay.
09:37:40	R	So, and now running down the Elbe we have "EBRO", Mr. W. 50 m, you are just under 50 m north of the radar line. A further 200 m before you pass the 78.
09:38:00	E	Have understood you. We are continuing our voyage slowly and will contact the River Police first.
09:38.10	R	Have you contacted 68 yet, with the Nautical Watch officer?
	E	Yes, that's right, they have heard from us, we are continuing our voyage.
	R	Yes, okay, all well.
09:39:10	R	So, and running down the Elbe the "EBRO", Mr. W. 100 m north of the radar line. According to my display you are moving further north. You must be passing buoy 78 very soon.
09:39:20	N	So, now we have "P&O NEDLLOYD GENOA" here.
09:39:30	R	"P&O NEDLLOYD GENOA" is being heard by Rhinplatte Radar.
09:39:30	N	Yes, here we are. We have not ascertained any major damage and I should like to know what the traffic looks like.
09:40:00	R	Yes, I've nothing going out at the moment and nothing coming in, so everything is free.
09:40:00	N	Yes, okay.

4.2.3 Audio documentation VHF-Channel 68

Brunsbüttel Elbe Traffic (VTS-BB)

V VTSC - Brunsbüttel Elbe Traffic
E TS "EBRO"

Time (CET)	Speaking	Text
09:31:10	V	OOCL Neva - Barbara
09:32:20	V	P&O NEDLLOYD GENOA from Brunsbüttel Elbe Traffic.
09:32:30	V	"EBRO", „EBRO“, from Brunsbüttel Elbe Traffic.
09:32:30	V E	"EBRO", "EBRO" from Brunsbüttel Elbe Traffic. "EBRO" hears.
09:32:40	V	"P&O NEDLLOYD GENOA" is coming towards you, it's coming over the radar line now. I don't know what he's planning to do.
09:32:40	E	Yes, I understand. I'll go over a little further.
09:32:50	V	„P&O NEDLLOYD GENOA“, "P&O NEDLLOYD GENOA" from Brunsbüttel Elbe Traffic.
09:34:50	V	"EBRO" from Brunsbüttel Elbe Traffic.
09:35:00	E	Brunsbüttel Elbe Traffic from "EBRO".
	V	Yes, I wanted to hear was that okay? Or what has happened?
09:35:10	E	Yes, with our starboard side on the bow. "EBRO" hit on the portside at the stern. We can still float, dented, probably also a very little damage to "NEDLLOYD" and we are going now, we are continuing our voyage first of all, we'll go back over onto the green side.
09:35:30	V	Yes "EBRO", but despite this both will have to be examined, we have to do this. "GENOA" is going to Hamburg, there won't be any problem there, but you have to make contact with the River Police.
09:35:40	E	Yes, "EBRO", we'll continue our voyage first, or should we stay here?
09:35:50	V	No, if you are both okay and don't have to help each other then it will be okay for you to come down further here. The vessel wants to go on to sea. I'll inform the River Police in the meantime and they will then contact you to discuss where they go alongside.
09:35:50	E	Yes, understood. We'll continue our voyage and then contact the River Police.
09:36:00	V	Yes, okay. I've understood.

4.2.4 Table of the estuary radio traffic

(Status: 19 December 2002, 09.20 h CET)

Tabelle Revier/Reedenbelegung Revier 1 - Stand: 19.12.02 09:20

KZ	RZ	NAME	L	BR	T	BH	K	L	B	R	POS / W	G	H	REE
M6	DF2065	HAI	18	39	10	HBG	1	O	-	-	641 / E	53		
L2	DHIN	MATADOR	21	70	15	WED	2	O	+	-	643 / E	116		
I8	PHJB	SCOUT MARIN	75	95	18	HBG	2	O	+	-	652 / E	10		TWI
Q7	LANC4	TRANS SCANDIC	116	177	60	BUF	2	Z	-	-	658 / E	42		
S7	CSEP	EBRO	81	143	59	SEE	2	L	+	-	670 / E	129		
O2	DC7928	LINAH	86	95	14	BBE	2	O	+	-	675 / E	98		
C7	MYMX5	P&O NEDLLOYD GENO	210	322	108	HBG	2	P	-	-	681 / E	156		
P0	P3JA5	LAURA HELENA	91	138	39	HBG	2	P	+	-	696 / E			SUE
S4	EQPH	IRAN ADL	186	284	64	HBG	2	P	-	-	697 / E	51		
R9	EQVZ	IRAN HESABI	168	260	85	SEE	2	L	+	-	697 / E	92		
C5	V2KH	KIEFERNWALD	88	138	55	NOK	2	H	-	-	699 / E	32		
L0	J8B2235	SOLVITA	73	131	35	NOK	2	P	-	-	699 / E	21		
N7	PECD	LEONIE	81	111	36	NOK	2	O	-	-	700 / E	52		
8	DQKY	OSTSEE	95	177	60	BBE	2	O	+	-	704 / E			NFB
R5	DIWX	TAUCHER O. WULF 10	80	183	21	BBL	6	O	+	-	705 / E			NFB
O7	V2PI9	TINA	106	195	60	SEE	2	L	+	-	705 / E	142		

4.2.5 Table of recording data, Radar Station Rhinplatte

Tabelle Recording-Daten

Verkehrszentrale: BRUNSBUETTEL

Radarstation: RHINPLATTE

Datum	Zeit	KZ	X [km]	Y [km]	Kurs [°]	Geschwindigkeit [kn]
19.12.2002	09:25:08	<u>S7</u>	- 1.1031	+ 0.5038	342	14.1
19.12.2002	09:26:10	<u>S7</u>	- 1.2145	+ 0.9228	346	13.9
19.12.2002	09:27:19	<u>S7</u>	- 1.3364	+ 1.3948	345	13.9
19.12.2002	09:28:25	<u>S7</u>	- 1.4717	+ 1.8482	344	14.0
19.12.2002	09:29:26	<u>C7</u>	- 2.9433	+ 5.4041	162	15.6
(Position 1)		<u>S7</u>	- 1.5936	+ 2.2672	345	13.9
19.12.2002	09:30:32	<u>C7</u>	- 2.8054	+ 4.9586	164	14.6
(Position 2)		<u>S7</u>	- 1.7236	+ 2.6994	343	13.8
19.12.2002	09:31:39	<u>C7</u>	- 2.6914	+ 4.5158	164	13.0
(Position 3)		<u>S7</u>	- 1.8747	+ 3.1475	341	14.0
19.12.2002	09:32:43	<u>C7</u>	- 2.4501	+ 4.2267	135	11.7
(Position 4)		<u>S7</u>	- 2.0206	+ 3.5850	343	14.0
19.12.2002	09:33:42	<u>C7</u>	- 2.1346	+ 4.0809	113	11.7
(Position 5)		<u>S7</u>	- 2.1478	+ 3.9987	342	15.1

Tabelle Recording-Daten

Verkehrszentrale: BRUNSBUETTEL

Radarstation: RHINPLATTE

Datum	Zeit	KZ	X [km]	Y [km]	Kurs [°]	Geschwindigkeit [kn]
19.12.2002	09:34:44	<u>s7</u>	- 2.2274	+ 4.3222	347	7.9
		<u>c7</u>	- 1.9065	+ 3.9642	115	8.9
(Position 6)						
19.12.2002	09:35:45	<u>s7</u>	- 2.3016	+ 4.3805	317	5.4
		<u>c7</u>	- 1.9808	+ 3.9801	281	2.2
(Position 7)						
19.12.2002	09:36:47	<u>s7</u>	- 2.4475	+ 4.5370	319	6.6
		<u>c7</u>	- 2.0153	+ 3.9934	313	0.7
19.12.2002	09:37:53	<u>s7</u>	- 2.5270	+ 4.7120	342	5.3
		<u>c7</u>	- 1.9940	+ 3.9987	225	0.0
19.12.2002	09:38:58	<u>s7</u>	- 2.5244	+ 4.8949	3	5.9
		<u>c7</u>	- 1.9967	+ 4.0013	225	0.0
19.12.2002	09:40:04	<u>s7</u>	- 2.5085	+ 5.0859	4	5.6
		<u>c7</u>	- 2.0020	+ 3.9907	225	0.0

**Courses and distances sailed by CMV "P&O NEDLLOYD GENOA"
from position 1 to position 7**

Position 1 to position 2

Position 1 (09:29:26 h CET): 53° 48' 23.73"N 009° 22' 20.94"E

Position 2 (09:30:32 h CET): 53° 48' 09.30"N 009° 22' 28.34"E

Course and distance from position 1 position 2: 163°, d = 0.25 sm

Position 2 to position 3

Position 2 (09:30:32 h CET): 53° 48' 09.30"N 009° 22' 28.34"E

Position 3 (09:31:38 h CET): 53° 47' 54.96"N 009° 22' 34.44"E

Course and distance from position 2 to position 3: 166°, d = 0.25 sm

Position 3 to position 4

Position 3 (09:31:38 h CET): 53° 47' 54.96"N 009° 22' 34.44"E

Position 4 (09:32:43 h CET): 53° 47' 45.57"N 009° 22' 47.54"E

Course and distance from position 3 to position 4: 140.5°, d = 0.2 sm

Position 4 to position 5

Position 4 (09:32:43 h CET): 53° 47' 45.57"N 009° 22' 47.54"E

Position 5 (09:33:42 h CET): 53° 47' 40.8" N 009° 23' 04.73"E

Course and distance from position 4 to position 5: 115°, d = 0.19 sm

Position 5 to position 6

Position 5 (09:33:42 h CET): 53° 47' 40.8" N 009° 23' 04.73"E

Position 6 (09:34:44 h CET): 53° 47' 36.98"N 009° 23' 17.16"E

Course and distance from position 5 to position 6: 117.5°, d = 0.14 sm

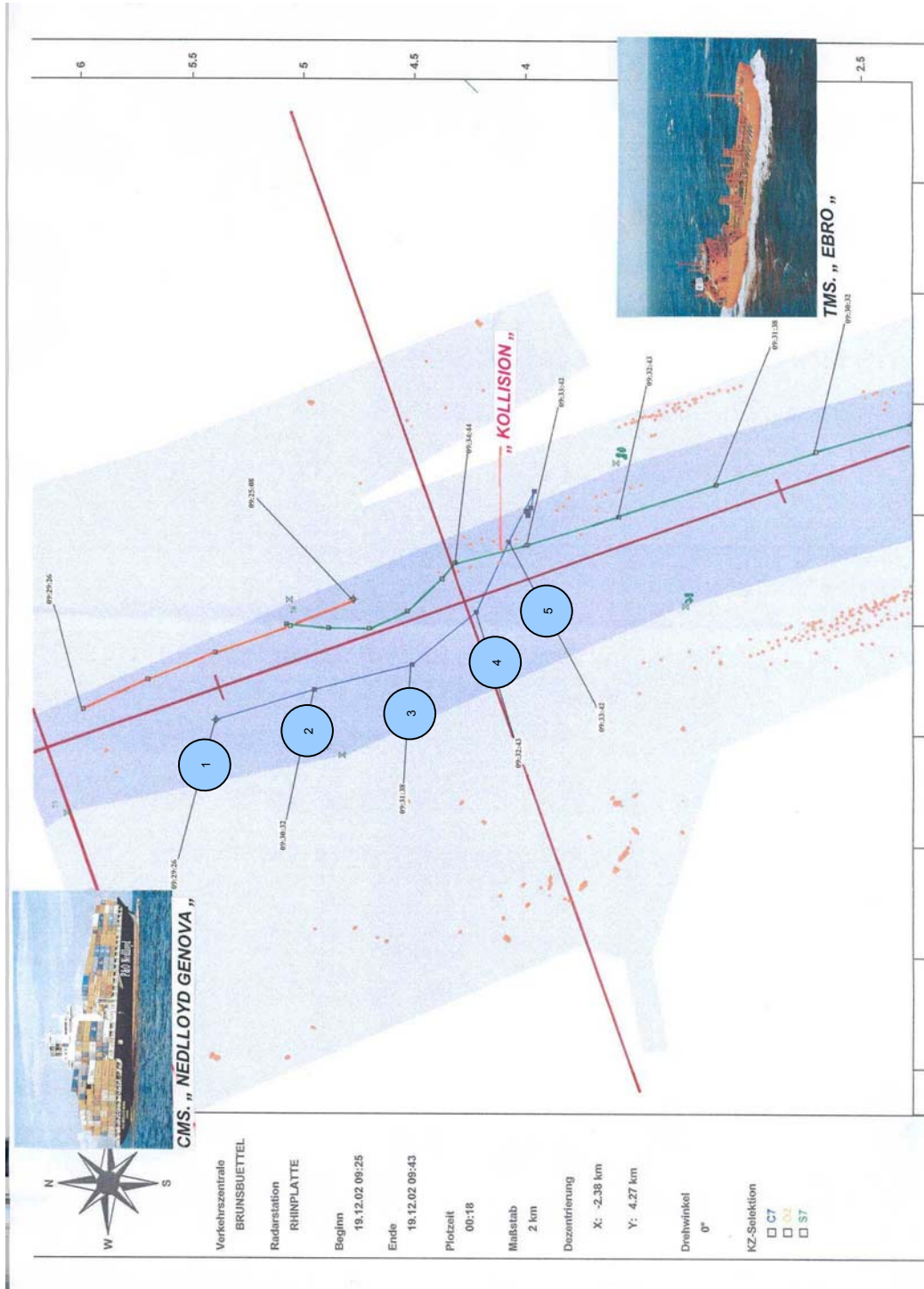
Position 6 to position 7

Position 6 (09:34:44 h CET): 53° 47' 36.98"N 009° 23' 17.16"E

Position 7 (09:35:45 h CET): 53° 47' 37.51"N 009° 23' 13.10"E

Course and distance from position 6 to position 7: 102.5°, d = 0.04 sm

4.2.6 Plot print of Radar Station Rhinplatte



5 Analysis

5.1 Summary of the accident occurrence

CMV P&O NEDLLOYD GENOA proceeded upstream along the River Elbe under very poor visibility conditions of less than 500 m and dense fog with a speed of approx. 14 kn overground on 19 December 2002.

The very experienced Master and the also experienced pilot with his local expertise, who had joined the vessel at 08.36 h CET, had brought the vessel well as far as Rhinplatte Nord. On the River Elbe they navigated with support from the radar advisory service of VTS Brunsbüttel.

The bridge was properly manned with the Master, the Navigation Officer on watch duty, a helmsman, the outlook and the pilot, in accordance with regulations. There was drifting ice on the Elbe. That was why the navigation channel buoys were difficult to make out optically because of the fog in some cases, even with the two radar sets ready for operation.

At 09.28 h CET the radar advisory service changed from Freiburg Radar station (channel 61) to Rhinplatte Radar station (channel 5), after the pilot on board had properly reported on and off at the relevant radar advisory services.

At the same time the vessel passed buoy 75 and the Third Officer on watch duty informed the Master that CMV P&O NEDLLOYD GENOA was very close to the southern edge of the navigation channel. The Master checked the information and ascertained that although the vessel was in fact in the southern part of the navigation channel, the water was still sufficiently deep for safe navigation. At this time the echo sounder showed 7.70 m under the keel according to the Master, which with a mean vessel draft of 10.8 m represents a water depth of 18.5 m. According to the statements by the Master and the pilot, which coincide, the steered course was 160° thus corresponding to the ideal course line of the navigation channel segment to be passed.

Despite the course of 160° set, the vessel drifted further to the south on the way from buoy 75 to buoy 77. The pilot informed the Master that the vessel was being influenced by the bank effect and had the speed reduced to "slow ahead".

The further progress of events is described differently by the pilot and the vessel command of CMV P&O NEDLLOYD GENOA:

The pilot reported that he initially reacted to the bank effect with a recommended course of 155°, which was properly executed. It was only when he noticed that with this measure it was not possible to prevent the tendency to drift southwards that he had the speed reduced to "dead slow ahead" and recommended 170° as a new course, in order to keep the stern clear from the navigation channel

edge in this way. The vessel command executed this recommendation immediately too. The helmsman had only been able to keep the new course with a starboard rudder angle of 15°.

By contrast with this the Master and the Watch officer stated that the pilot immediately (!) had the course changed to starboard after passing buoy 77 as a reaction to the bank effect ascertained and recommended setting the rudder to 170°. As a result of this measure the Master and the Watch officer suspected that the pilot must have lost his sense of orientation. In response to the remark by the Master that the pilot was steering the vessel in the wrong direction, the pilot had reacted with the order "rudder hard to starboard". Now the Master in turn had the rudder changed "hard to port". The vessel had first moved further to starboard and then very quickly turned to port following a course ahead of 165°.

It was not possible to clarify within the framework of the investigation whether the pilot did actually issue the course recommendation of 155° first of all and whether the corresponding command was executed, or whether a course of 170° was recommended immediately after the bank effect was ascertained.

However, in response to subsequent questioning the pilot confirmed that the Master had evidently not shared the pilot's opinion that the bank effect had to be compensated by shifting the rudder to starboard, and had ordered the rudder "hard to port".

The further course of the accident is described in agreement by the parties again: Since the port turn of the vessel could no longer be absorbed by the rudder command "hard to starboard" again, and accordingly a collision with the Motor Tanker EBRO travelling upstream along the Elbe was threateningly imminent, it was decided on the bridge of CMV P&O NEDLLOYD GENOA, to ask MT EBRO for a passage "starboard to starboard" (green to green). The corresponding information was forwarded by the pilot to the radar advisor (channel 5). The radar advisor notified MT EBRO at 09.33 h CET.

Directly after the decision to pass "starboard to starboard" there was a sliding contact between the starboard foreship of MT EBRO and the starboard side of the stern of CMV P&O NEDLLOYD GENOA. Roughly at the same time the latter ran aground below buoy 80 on the northern navigation channel. At about 11.30h CET, CMV P&O NEDLLOYD GENOA succeeded in coming free again with the rising tide.

That same time, at 08.35 h CET, MT EBRO had taken the pilot on board at the DOW chemical pier in Bützfleth and started the voyage down the River Elbe.

The bridge was crewed with the Master, the pilot and a sailor as lookout. A further sailor was on the forecastle in standby position. Because of the dense fog MT EBRO had reported to the radar advisory service. The vessel was steered by automatic pilot and its joystick. The speed over ground was 13.5 kn with outgoing tide.

Within the framework of the traffic situation report at 09.05 h CET, MT EBRO was informed that CMV P&O NEDLLOYD GENOA was approaching it. At about 09.31. h CET Rhinplatte Radar reported the actual positions to both vessels on VHF channel 5. According to this MT EBRO was 100 m north of the radar line and had about 500 m to go before passing buoy 80. CMV P&O NEDLLOYD GENOA was 150 m south of the radar line and had about 1100 m to go before passing buoy 79.

About one minute later MT EBRO heard via Rhinplatte Radar (channel 5) a special announcement for CMV P&O NEDLLOYD GENOA. The latter was informed that it was tending to north and was about 50 m south of the radar line.

This led the command of MT EBRO to pay increased attention.

Directly after the special report from Rhinplatte Radar EBRO was notified at approx. 09.33 h CET via VTSC Brunsbüttel (channel 68) that CMV P&O NEDLLOYD GENOA had crossed the radar line. There was reaction on the MT EBRO bridge to the special announcement (channel 5) and the subsequent warning of VTSC Brunsbüttel. The bridge changed over to hand steering, reduced speed to "half speed ahead", started a first change of course to starboard in order to give the oncoming vessel that was in difficulties more space. VTSC Brunsbüttel (channel 68) was informed of the change of course to starboard with the announcement "... I'm going a bit further over".

A few seconds after the warning to MT EBRO via channel 68 Rhinplatte Radar also called MT EBRO directly and pointed out that CMV P&O NEDLLOYD GENOA was tending to the north, was on the radar line, and continuing to tend to north. MT EBRO was recommended to slow down.

The statement by the MT EBRO pilot in his report submitted to the BSU that they had received the recommendation via VHF to take evasive action to starboard was not however confirmed by the analysis of the radio records of VHF channels 5 and 68. The alleged enquiry by the pilot to Rhinplatte Radar whether MT EBRO should not better pass on the south side is not documented either. Since there was no confirmation of this suggestion in any case, the speed according to the statements of both the Master and the pilot was reduced to "less than dead slow ahead" and according to the pilot the rudder was set "hard to starboard".

At a distance to CMV P&O NEDLLOYD GENOA of approx. 0.5 sm the engine was finally set to "full reverse". A few seconds after this Rhinplatte Radar reported to MT EBRO that CMV P&O NEDLLOYD GENOA had made a steering error.

Directly after this CMV P&O NEDLLOYD GENOA again addressed MT EBRO via Rhinplatte Radar with a request for passage "starboard to starboard". Simultaneously with this radio call the foreship of CMV P&O NEDLLOYD GENOA came into sight on the EBRO bridge on a course crossing theirs at a distance of less than 100 m. In view of the immediately threatening collision risk the rudder was set "hard to port". However, according to the information supplied by the Master and pilot of MT EBRO, this measure was not a specific reaction to the request by CMV P&O NEDLLOYD GENOA for a passage "starboard to starboard", but instead a last moment manoeuvre in line with Rule 17 letter b Collision Prevention Rules.

The bow of CMV P&O NEDLLOYD GENOA was passed shortly after this just on starboard. After this the collision already described occurred. MT EBRO remained afloat and could be brought back on course and initially continued its voyage.

5.2 Causes of the accident

The starting point for the accident occurrence was formed by navigational errors on board CMV P&O NEDLLOYD GENOA. In particular insufficient attention was paid to start with to the impacts of the bank and squat effect occurring when a vessel travels along a shallow navigation channel limited at the sides, such as the River Elbe. After this the vessel was only manoeuvrable to a very limited extent and shifted increasingly further to the edge of the navigation channel. (See point 5.2.1. below). The manoeuvres initiated by the pilot and later by the Master as a reaction were characterised by evidently diverging opinions on the measures necessary to return CMV P&O NEDLLOYD GENOA to a safe course. (See point 5.2.2.).

5.2.1 Impacts of bank effect and squat

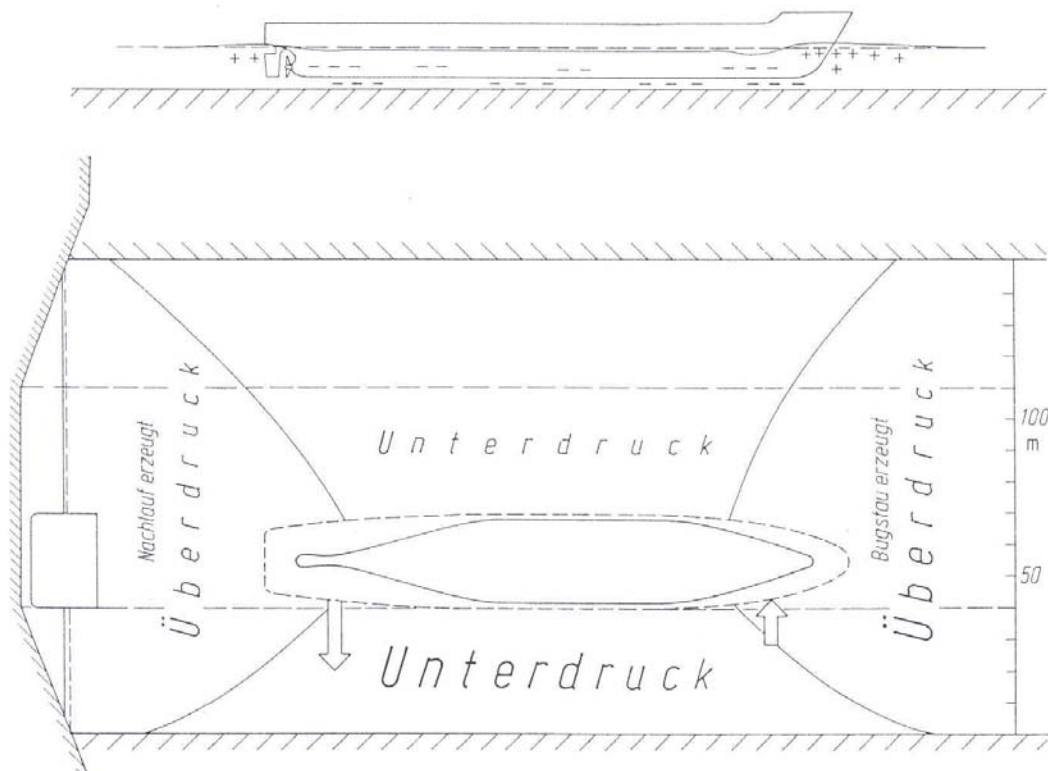
5.2.1.1 General

When a vessel proceeds along a navigation channel limited at the sides there is a characteristic pressure distribution due to the displacement flow generated around the hull of the vessel. This is characterised by an increase in pressure in the area of

the bow (damming up of water) and an under-pressure area (lowering of the water level) in the mid-ship area. The water is dammed up in the stern area like it is at the bow, but this is superimposed by the pressure distribution from the propeller flow.

As long as a vessel proceeds along the middle of a symmetrical channel, the pressure distribution described above results uniformly on both sides of the vessel, so that no lateral forces and moments become effective. However, if the vessel proceeds along a non-symmetrical channel and/or is located off-centre in the channel, then in the narrower off-flow cross section here (nearby shore) the damming up of the water at the bow is much greater by comparison with the larger off-flow cross section in the middle. (See Figure 11).

Figure 11: Schematic representation of the pressure conditions at the vessel's hull



As a result of the differences in water level developing along the vessel, which increase the faster the ship travels, hydrodynamic transverse forces and moments act on the vessel's hull, and their total and direction are influenced very strongly by the speed of the vessel, the cross sectional relations, and the vessel's closeness to the edge of the navigation channel on one side.

In the lower speed range these forces are directed to the nearby shore at both the bow and the stern. As the ship's speed increases, the bow forces reverse and are

now directed towards the middle of the navigation channel, while the stern forces retain their direction and increase continuously as the ship's speed increases.

The bank effect described above (also called a suction effect) is influenced and superimposed additionally during sailing in shallow navigation channels by the squat effect that then occurs.

The squat effect is due to the fact that the water displaced by the moving vessel in the narrow cross section between the vessel and the limited remaining ground clearance has to flow back. Consequently this causes a lowering of the water level alongside to the vessel, which in turn involves an additional limitation of the remaining cross section. (See Figure 12).

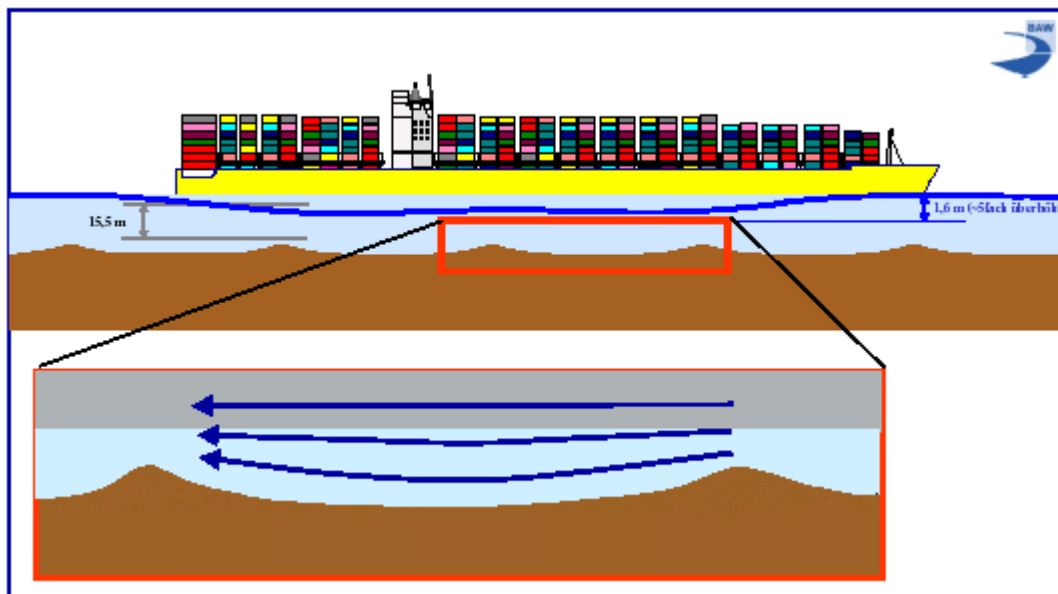


Figure 12: Principle of hydrodynamics over transport bodies

(example here of a future mega-jumbo container vessel ($d = 15.5$ m); Flügge/Uliczka/Hansa 2001)

If the volume of water displaced by the vessel cannot pass off completely between the vessel and the remaining cross section of the navigation channel, a damming up wave develops that is pushed ahead in front of the vessel. The vessel trim then changes and becomes down by stern. There is a resulting limitation of ground clearance.

The hydrodynamic effects described are magnified as the vessel picks up speed. They change constantly depending on the profile and depth of the navigation channel. It is therefore all the more important that when passing through waters that are limited at the sides and/or in depth, larger ships especially should maintain a safe distance from the edge of the navigation channel and adjust to the specific hydrographic features.

5.2.1.2 Consequences for P&O NEDLLOYD GENOA

The analysis of the audio documentation of Rhinplatte Radar showed that during the time from 09.28 h CET to 09.31 h CET the radar advisor drew attention to the increasing drift of the vessel to the south. According to this CMV P&O NEDLLOYD GENOA was initially (at 09:28:20 h CET) 50 m, half a minute later 100 m, and finally at 09:31:20 h CET 150 m south of the radar line. At this time the speed over ground was approx. 14 kn.

The transfer of the vessel positions co-plotted by Rhinplatte Radar during the above period into the water level plan of the WSA Hamburg confirms that the mean water depth available decreased from approx. 15.5 m to 11 m, so that when the Master initiated the "hard to port" manoeuvre CMV P&O NEDLLOYD GENOA with its mean draft of 10.80 m must have been directly on the verge of ground contact, in view of the squat effect described above.

When assessing the tendency to drift southwards it should be taken into account that on passing buoy 77 (approx. 09:30:30 h CET) the pilot magnified the drift of the vessel to the southern edge of the navigation channel by his order to the helmsman of 170°.

However, the pilot initiated this manoeuvre, which will be discussed in more detail below (see 5.2.2), against the background of reacting to the bank effect ascertained before.

On the basis of the statements by the pilot, the Master and the Third Officer on watch, that coincide here, there is no doubt regarding the tendency of the vessel to set southwards already on the way from buoy 75 to buoy 77 under the steered course of 160°. As already mentioned, Rhinplatte Radar also registered the tendency of the vessel to move towards the south.

Accordingly CMV P&O NEDLLOYD GENOA drifted increasingly further to the edge of the navigation channel between buoy 75 and buoy 77, even though the course it was steering corresponded to the ideal course line (160°). A compass error can be ruled out as cause. This was revealed by an inspection of the compass log by the BSU. According to this compass controls had been carried out regularly on board CMV P&O NEDLLOYD GENOA, especially before and after the accident too. No significant compass error was ascertained here. The fact that the course deviation noted was instead due to the bank effect described above is also confirmed by the pilot's statement, according to which he observed that the helmsman was only able to keep the vessel on course with a starboard rudder angle of 15°.

As already explained above, the bank effect means that as of a certain vessel speed the stern of a vessel is drawn towards the shore bank, while at the bow forces develop in the opposite direction.

In accordance with the pilot's observation as described, the bank effect consequently meant that only high starboard rudder angles could prevent the bow from breaking out to the north towards the centre of the navigation channel.

5.2.2 Measures initiated to correct the course

5.2.2.1 Pilot's recommendations

The Third Watch Officer and the Master initially reacted to the vessel's increasing drift to the south by notifying the pilot accordingly. However, it can be assumed that on the grounds of his knowledge of the area and his observation of the steering behaviour of the vessel, the pilot had recognised the deviation from course already independently of these warnings. This assumption is supported in particular by the fact that the pilot responded immediately to the warnings of the vessel's command with his reference to the existing bank effect.

The pilot states that he first reacted to the drift to south by changing course to port, to 155°.

It was only after the vessel continued to drift to the south despite this measure that he recommended steering 170° and reducing speed to "dead slow ahead". The pilot states that he initiated these measures in order to keep the vessel stern free of the edge of the navigation channel. At the same time with these manoeuvres he wanted to react to the oncoming MT EBRO, that Rhinplatte Radar had informed him of and that he could see clearly on his radar screen.

When assessing the pilot's recommendation to the vessel's command prior to the maritime accident, it is necessary to distinguish between the measures he suggested before the bank effect became noticeable (a), and those he recommended in order to counteract its negative effects (b).

(a) It has been described above (point 5.2.1) that both the bank effect impairing the steerability of a vessel and the squat effect responsible for the reduction of ground clearance depend significantly on the speed of the vessel. The bank effect is additionally influenced by the distance (on one side) from the shore.

Knowing and considering these premisses, it is to be assumed that the speed of approx. 14 kn at which CMV P&O NEDLLOYD GENOA was travelling up the River Elbe was evidently too high, since this promoted both the suction effect at the stern towards the bank and the reduction of the ground clearance in the river section that was relatively shallow in any case.

However, due to the topographic features and in order to ensure a safe passing distance from oncoming vessels, the pilot was basically unable to recommend the desirable passage through the relevant navigation channel section with a greater distance from the shore. It would therefore have been all the more important to reduce speed in good time.

Independently of the positive effect on the manoeuvring behaviour of CMV P&O NEDLLOYD GENOA that would have been achieved by reducing speed, the speed should have been adjusted too because of the reduced visibility (cf. Rule 19 letter b Collision Prevention Rules).

(b) In view of the contradictory statements here it was not possible to clarify whether the pilot did actually react to the bank effect first of all with a course change to 155°. Ultimately, however, this is not of crucial importance. Even assuming that this course change was in fact recommended and executed, it is clear that this manoeuvre did not effectively counteract the bank effect.

On the other hand the pilot's recommendation to steer 170° did have considerable impacts on the following accident occurrence - even though indirectly.

First of all is to be ascertained that the pilot's idea of counteracting the bank effect effectively and at short notice by changing course to starboard was fundamentally correct.

As explained above (point 5.2.1) the impact of the bank effect is that the vessel is exposed to forces directed towards the shore at its stern, while the bow of the vessel tends towards the middle of the navigation channel. Consequently, from the navigational point of view, there were no objections to counter-steering against this with the recommended change of course to starboard.

Admittedly, as he conceded in later questioning by the BSU, the pilot ultimately took into account that the vessel might run aground in the shallow edge area of the navigation channel. On the other hand, it is plausible that he balanced the risks and in case of doubt preferred to risk grounding rather than a collision with an oncoming vessel, especially when this was a chemical tanker carrying cargo.

Thus to summarise it can be said that the pilot's recommended change of course to starboard was fundamentally correct and with this measure, if it had not been overridden by the Master, the subsequent collision with MT EBRO would certainly have been avoided.

However, a point of criticism is that the pilot evidently did not manage to make it clear to the vessel's command what his intention was in changing the course to starboard. Despite this it must be taken into account in his favour that on the one hand he was forced to take action at very short notice, and that in addition to this he could assume that the English Master - as an experienced mariner - would assess the pilot's measures correctly following the latter's reference to the "bank effect".

5.2.2.2 Measures by the Master

As already stated above, in his report the Master did not confirm the change of course to 155° in the meantime, which was ultimately unsuccessful, but instead only pointed out what he considered to be a wrong change of course to 170° on passing buoy 77. Since he assumed that the pilot had lost his sense of orientation, he intervened in the action with his order "hard to port".

At first glance the pilot's recommendation to react to the drift towards the edge of the navigation channel with a further change of course to starboard does indeed appear to be erroneous. However, it has already been explained that this measure was navigationally correct as a reaction to the bank effect, and that furthermore it was taken especially as a result of a plausible balancing of risks. The Master had evidently underestimated the influence of the bank effect. Otherwise he would have realised that his "hard to port" rudder order would necessarily lead to the vessel immediately breaking out towards the centre of the navigation channel, a movement that could subsequently no longer be corrected.

The "hard to port" order by the Master of CMV P&O NEDLLOYD GENOA was thus the cause of the accident leading to the collision with the gas tanker EBRO. Under the prevailing massive bank effect the vessel could no longer be corrected by rudder and shot across the River Elbe into the navigation channel leading down the river.

5.2.3 Attempt to avert the collision

The decision by the Master and the pilot to ask the MT EBRO for a passage "starboard to starboard" when it became clear that it was no longer possible to stop the vessel turning to port in time was admittedly risky, but under the given circumstances represented the sole remaining possibility of averting the threatening collision with MT EBRO. However, this request came too late for a regular and proper execution of the relevant passage. The statements by the Master and pilot of MT EBRO agree that the course change to port taken there was a last moment manoeuvre when the oncoming CMV P&O NEDLLOYD GENOA came into sight optically at a distance of less than 100 m. As a result it was no longer possible to prevent the collision, but at least the consequences could be reduced to a minimum.

5.2.4 The measures on board EBRO

Navigation was carried out properly on the MT EBRO bridge. However, here too it should be noted that the initial speed of 13.5 kn over ground was not adjusted to the existing visibility conditions, taking Rule 19 letter b KVR into account. However, MT EBRO reduced its speed distinctly when the problems of the oncoming CMV P&O NEDLLOYD GENOA became clear on the basis of its own radar observations and the corresponding warnings by the Traffic Services. The vessel steered expecting that the oncoming vessel would initially pursue a course with a northerly tendency. The statement made by the MT EBRO pilot in his report that he addressed a suggestion to the radar station Rhinplatte (channel 5) that the vessels pass "starboard to starboard" could not, however, be confirmed by the audio documentation of the relevant radio traffic submitted to BSU.

Independently of this, however, the necessary port manoeuvre was initiated on board MT EBRO when CMV P&O NEDLLOYD GENOA came into view and so a serious collision was averted at the last moment.

6 Recommendation

The maritime accident examined made it clear that bank and squat effects in shallow, narrow navigation channel sections limited at the sides, such as are encountered on the River Elbe, greatly restrict the manoeuvrability of larger vessels especially. These effects occur to differing extents depending on the form and draft of the underwater hull and depending on the relevant profile of the navigation channel. They cannot be calculated precisely and can therefore only be taken into account by pilots and vessel commands to a very restricted and rough extent when navigating.

The only way of countering the negative consequences of these effects effectively and in time is to consistently reduce the ship's speed. However, here it must also be taken into account that especially vessels with a large draft can only use the River Elbe in a relatively limited tidal window. In conclusion, therefore, the BSU draws attention to the fact that within the framework of future development of marine traffic with ever-larger vessels on the River Elbe from and to Hamburg, the importance and impacts of hydrodynamic effects will continue to increase. These must therefore be taken into account within the framework of responsible traffic planning by all decision makers comprehensively and in good time.

7 Sources

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- Bundesamt für Seeschifffahrt und Hydrographie Hamburg/Rostock (BSH) Excerpts from the sea chart D46 / INT 1453 – "The Elbe from the Oste to Brunsbüttel and Krautsand", scale 1:30000 (54°), with minor correction 4 VII 03, status calendar week 47 / 03
- Water level forecast service of the BSH
- Photos of the vessels (pages 6 and 7) were kindly made available to the BSU by the vessel operators.

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 24 June 2002. According to this the sole objective of the investigation is to prevent future accidents and malfunctions. The investigation does not serve to ascertain fault, liability or claims.

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