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

Investigation Report 168/09

Serious Marine Casualty

Collision between the HÖEGH LONDON and three vessels moored on the Weser on 26 May 2009

15 January 2011

www.bsu-bund.de

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

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

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

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

Issued by:
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1 Summary of the marine casualty

The car carrier HÖEGH LONDON, which was flying the flag of Norway, was scheduled to sail from Bremerhaven on the afternoon of 26 May 2009. Two harbour pilots were assigned to the vessel because of her size. The vessel cast off from her berth with the assistance of a forward tug and an aft tug as well as one other tug and sailed initially into the Nordschleuse (north lock) in order to subsequently enter the Weser from there. This manoeuvre unfolded without incident.
Wind forces with gusts of up to 9 Bft had already been observed as a weather front passed over the berth of the vessel.
The sea pilot, who was to take over from the harbour pilots on the Weser, also arrived at the vessel in the lock.
Consultation with the pilots of two other vessels took place before and while sailing out of the lock. One of these was the HYPERION, which was still moored at the container pier; the second was the incoming MSC MALIN, which was scheduled to moor at the container pier. It was agreed with the HYPERION that she would remain at the pier until the two other vessels had passed. MSC MALIN was initially held at the western edge of the fairway.
When the vessel sailed out of the lock and turned on the Weser an ebb stream prevailed and the wind, meanwhile having decreased considerably, gained strength up to 9 Bft again.
A forward and aft tug assisted in the turning manoeuvre. After further consultation with the pilot of the MSC MALIN, a decision to pick up speed and pass the waiting MSC MALIN was made on the HÖEGH LONDON.
The aft tug was released after the MSC MALIN was passed. Subsequently, the vessel was unable to maintain the course made good of 331°. Due to the wind, which now acted upon the vessel from abeam at 9 to 10 Bft, the vessel was set in an easterly direction towards the pier. This ultimately led to a collision with three vessels moored at the northern container pier. Their deck cranes received partly heavy damage, the vessels and cargo received partly serious damage.
It was not possible to stop the HÖEGH LONDON off the container pier and she therefore collided with two fairway buoys and a groyne buoy north of the pier. One of the buoys jammed between the rudder and propeller and the HÖEGH LONDON was therefore not under command.
After an emergency anchor manoeuvre, the vessel was shifted to a new berth with the support of four tugs.

There were no personal injuries during the course of the accident. The BSU was not made aware of any pollution. The HÖEGH LONDON sustained, inter alia, damage to the shell plating and the fan cowls on the starboard side due to the collision with other vessels.

2 SHIP PARTICULARS

2.1 Photo

Figure 1: Photo of the HÖEGH LONDON

2.2 Ship particulars

Name of vessel:	HÖEGH LONDON
Type of vessel:	Car carrier
Nationality/flag:	Norway
Port of registry:	Oslo
IMO number:	9342205
Call sign:	LADG7
Owner:	Leif Höegh & Co Shipping Limited
Operator:	Höegh Fleet Services AS
Year built:	2008
Shipyard:	Daewoo Shipbuilding & Marine Engineering Co., Geoje
Classification society:	Det Norske Veritas
Length overall:	228.70 m
Breadth overall:	32.26 m
Lateral windage area:	Approx. 6,700 m² at the time of the accident
Gross tonnage:	67,364
Deadweight:	27,100 t
Draught (max.):	10 m
Engine rating:	13,062 kW
Main engine:	B&W 7S60MC
Propeller type:	Fixed pitch
Bow thruster performance:	1,800 kW, equates to bollard pull of 27 t at 232 min^{-1}
(Service) Speed:	13.7 kts (when manoeuvring)
Hull material:	Steel

2.3 Voyage particulars

Port of departure:	Bremerhaven
Port of call:	Antwerp, Belgium
Type of voyage:	Merchant shipping
Cargo information:	Cars and other rolling cargo
Draught at time of accident:	D_f: 7.55 m, D_m: 7.63 m, D_a: 7.70 m
Manning:	24
Pilot on board:	Yes (two harbour pilots, one sea pilot)
Canal helmsman:	No
Number of passengers:	None

2.4 Marine casualty or incident information

Type of marine casualty/incident:	Serious casualty/collision with three other vessels
Date/Time:	26 May 2009/1830[1]
Location:	Weser, km 73.5
Latitude/Longitude:	φ 53°35.8‘N λ 008°31.0‘E
Ship operation and voyage segment:	Estuary trading
Consequences:	HÖEGH LONDON: Damage to superstructure, torn hull at the stern on starboard side, rudder and propeller blocked by buoy following collision therewith; MAERSK NEWARK: Damage to hull and superstructure on starboard side, all three deck-mounted cranes damaged or destroyed, 11 containers damaged or lost; MAERSK BINTAN: Damage to hull on starboard side, gangway torn off; HUSKY RACER: Damage to hull on port side, both deck-mounted cranes damaged.

[1] Unless otherwise stated, all times are local = UTC + 2 hours.

Excerpt from nautical chart 4 (INT 1457), BSH, 1:25.000

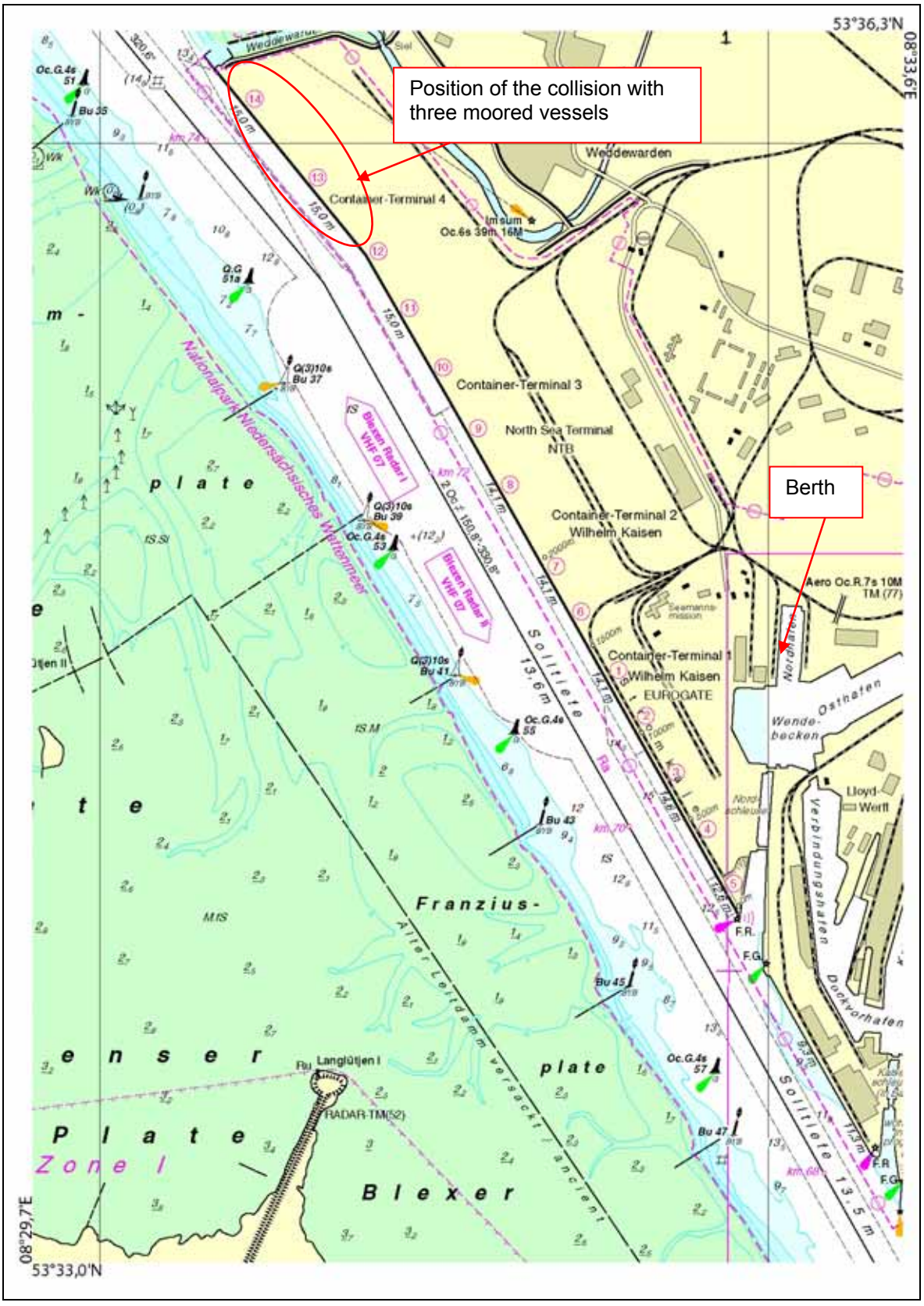


Figure 2: Nautical chart showing the berth and scene of the accident

2.5 Shore authority involvement and emergency response

Who was involved:	a) WSA Bremerhaven[2]
	b) WSP Bremerhaven[3]
Resources used:	a) Buoy tender BRUNO ILLING
Actions taken:	a) Damaged fairway buoys secured
	b) Initial investigations
Results achieved:	a) Restoration of traffic safety

[2] WSA Bremerhaven – Waterways and Shipping Office Bremerhaven
[3] WSP Bremerhaven – Waterway Police Bremerhaven

3 COURSE OF THE ACCIDENT AND INVESTIGATION

3.1 Course of the accident

3.1.1 Course of the accident from the perspective of the ship's command HÖEGH LONDON

The HÖEGH LONDON, which was flying the flag of Norway, reached Bremerhaven on 26 May 2009 at 0348. After passing through the Nordschleuse, the vessel made fast in the Nordhafen (north harbour) on the West Pier.

By all accounts, the Philippine master obtained information about the weather from the pilot while entering and was told that a storm had reportedly been forecast for the afternoon and evening. It was reported that the pilot also advised him of Bremerhaven Weser Traffic, from which a weather forecast can reportedly be obtained at all times on VHF Channel 7. Due to the weather forecast and his own experience, the master reportedly decided to make the vessel fast using six bow lines, two bow springs, two aft springs and five stern lines.

Loading was reportedly completed at about 1343. Departure was reportedly initially planned for 1500; however, it was postponed to 1630 by the port. At about 1530, the master is said to have entered the bridge, where he reportedly found that the wind had reportedly increased to about 40 kts from the west. By all accounts, he also noticed that the vessel had reportedly moved about 1 to 2 m away from the edge of the quay because of the wind. Following that, he reportedly immediately contacted the agents and ordered a tug to push the HÖEGH LONDON back to the pier and keep it there. This was then carried out by the tug RT INNOVATION, which maintained the pressure until the vessel cast off.

By all accounts, the two harbour pilots reportedly boarded the vessel at about 1618, at which time the wind was reportedly blowing from the west at 7 to 10 kts. The master is said to have used the standard rules and check lists of the operator as a basis for briefing the pilots on the characteristics of the HÖEGH LONDON. In the process, he was reportedly informed by the pilots that they would encounter two incoming vessels in the fairway of the Weser.
The pilots and the port authority reportedly expressed no concerns about the weather and its effect on the departure. Nevertheless, due to weather forecast reported by the pilots and in consultation with them, a third tug was ordered for the departure.

In addition to the pilots, the master, chief officer and an able bodied seaman (helmsman) were reportedly situated on the bridge at the time of casting off. All the equipment, the main engine and steering gear were reportedly operable.
The HÖEGH LONDON reportedly moored in the Nordschleuse at about 1718. She was reportedly assisted by the forward tug RT SPIRIT, the aft tug RT INNOVATION and the tug SVEZIA when she proceeded to the lock.
While waiting at the lock, the wind reportedly increased to about 25 kts. By all accounts, the sea pilot boarded the vessel at about 1734.
The pilots reportedly spoke to each other and with the tugs in German. However, any important information was reportedly communicated to the master in English and he

reportedly inquired in English. Neither pilots nor port authority evidently saw a problem in leaving the lock in the prevailing weather conditions.
The vessel reportedly left the lock at about 1800. After sailing out of the lock, the tug SVEZIA reportedly left the HÖEGH LONDON. The tidal stream reportedly flowed at about 3 to 3.5 kts when the HÖEGH LONDON turned into the river. While turning in, the wind reportedly increased to about 35 kts from westerly directions. The turning manoeuvre to put the vessel onto her direction was reportedly completed at 1812. At the same time, the wind reportedly increased to about 45 kts. However, by all accounts both the harbour pilots and the master were satisfied that the vessel was reportedly still manoeuvrable under these circumstances. The HÖEGH LONDON was reportedly still accompanied by two tugs. A course of 318° was reportedly steered in order to obtain some scope due to the vessel's windage area. After the turning manoeuvre, the vessel was reportedly situated halfway between the middle of the fairway and the quay. The wind then reportedly dropped to 35 to 40 kts.
At about 1814, the incoming MSC MALIN was reportedly passed at 'dead slow ahead' at a distance of about 200 m. After the passing manoeuvre, the speed was reportedly slowly increased to 'full ahead'. The course made good was reportedly 331°. However, about 319° was reportedly steered to compensate for the influence of the wind. In addition, different helm commands were reportedly given.
Since the navigable width of the river is reportedly about 500 m, the master reportedly did not want to risk moving further to port for he was reportedly anxious about going into the shallows located to the west if the wind suddenly decreased.
The aft tug, RT INNOVATION, was reportedly released at about 1818. The tug continued to follow the vessel in order to collect the harbour pilots subsequently. At that time, the radar units, which had been switched off for passing the lock, were also reportedly put back into operation. The X-Band device was reportedly operated in the 1.5 nm range and the S-Band device in the 0.75 nm range. Both radar units were reportedly operated in the 'relative motion' mode and switched to 'north up'.
The pilot reportedly advised the master about the helm and engine commands. The master reportedly passed these on to the chief officer, who in turn reportedly passed the helm commands on to the helmsman or operated the engine telegraph personally.

The wind force was reportedly about 35 kts while the HÖEGH LONDON reportedly continued to proceed downstream at a speed over ground of about 12 kts.

When the vessel was reportedly situated close to buoy 53 at about 1820, the pilot reportedly gave the command 'rudder hard to starboard' directly to the helmsman. Reportedly, the pilot then unexpectedly ordered the engine telegraph to 'stop'. Neither command was reportedly given via the master. By all accounts, the vessel had reached the last container terminal by that time and the master reportedly identified several moored vessels.
The master reportedly assumed that the harbour pilots had reduced the speed in order to leave the vessel after transferring to the sea pilot.
The chief officer reportedly repeated the two commands previously given by the pilot and stopped the engine. However, the master reportedly immediately cancelled the commands of the pilot by ordering that the engine be set back to 'full ahead' because reportedly he did not want to stop in the fairway. The master then reportedly ordered that the rudder be set to 'starboard 30' followed by 'amidships'. The master assumed

that the engine was back to 'full ahead' one minute after the stop. The HÖEGH LONDON reportedly picked up speed and continued her voyage.
About one minute later, the wind reportedly increased suddenly to about 60 kts. The vessel reportedly heeled a few degrees to starboard and was then reportedly forced sidewards in the direction of the quay facilities. The wind then reportedly blew exactly from abeam on the port side with maximum strength. Reportedly, the master was situated in the starboard wing as before, from where he reportedly noticed that the RT INNOVATION had reportedly come to the starboard side and was pushing, reportedly in an attempt to prevent the stern from drifting further to starboard. Meanwhile, the RT SPIRIT reportedly tried to pull the bow of the HÖEGH LONDON to port.

As the distance to the vessels moored at the pier reportedly decreased, the RT INNOVATION was reportedly instructed by the pilot to leave her position. About one minute later, the wind reportedly dropped to about 35 kts. However, the effect of the preceding gusts of wind, which acted upon the vessel, reportedly persisted and therefore the HÖEGH LONDON reportedly continued to drift in the direction of the moored vessels. The master reportedly feared colliding with the MAERSK NEWARK. He therefore reportedly ordered that the rudder be set to 'amidships' in an attempt to make his vessel as parallel as possible to the other vessel when the collision occurred in the hope that her hull would not be torn open.

Two other vessels were reportedly moored behind the MAERSK NEWARK at the end of the pier. The master reportedly continued in his attempt to keep the angle of impact with the MAERSK NEWARK as low as possible. The chief officer reportedly tried to warn the other vessels by sounding the tyfon.
At about 1824, the main engine was reportedly ordered to 'stop'. At about 1825, the HÖEGH LONDON reportedly collided with the MAERSK NEWARK at a speed of approx. 12 kts over ground. By all accounts, the movement ahead reportedly continued and therefore the HÖEGH LONDON then reportedly collided with the MAERSK BINTAN and the HUSKY RACER. In the process, all four vessels were reportedly damaged. However, reportedly there were neither personal injuries nor pollution of the environment.

3.1.2 Course of the accident from the perspective of the pilots

The two harbour pilots took turns in advising the ship's command in the usual manner, i.e. one harbour pilot was responsible for advising from the berth to the lock and the other harbour pilot was responsible for advising from the lock up to the point at which the turn over to the sea pilot took place. In each case, the second pilot played a supporting role.
After the accident, the pilot responsible at the time of departure from the lock completed a report about the pilotage for the Hafenlotsengesellschaft (association of harbour pilots). Inter alia, it states: "Start of pilotage assignment: 1750; location: Nordschleuse; end of pilotage assignment: 1820; location: Weser (middle of the fairway); wind: SW – W'erly 6-7/gusts later." The following was stated with regard to the course of the accident: "MV HOEGH LONDON cast off in the Nordschleuse at 1750 at wind force 5 under tug assistance and then turned into the Weser fairway heading for the sea. The incoming MSC MALIN was passed in the normal manner. Following that, the aft tug was released in consultation with the master. From that

point, the master navigated the vessel personally. Advice was sought from neither the sea pilot nor myself. Extreme gusts of wind blowing from the west occurred suddenly and unexpectedly. Despite every attempt by the master to gain height, a collision with the [...] vessels and pier could not be avoided."

3.1.3 Subsequent events

After colliding with the three moored vessels, the HÖEGH LONDON continued to run ahead and passed the northern end of the quay. After passing, an emergency anchor manoeuvre was carried out. Following that, the vessel collided with fairway buoys 52 and 50 located to the north of the Stromkaje as well as the intermediate groyne buoy 20. Thereby, the three buoys received partly serious damage. Buoy 50 jammed between the rudder and propeller and therefore the HÖEGH LONDON was not under command.

A line connection was maintained with the forward tug throughout the entire sequence of events. The RT INNOVATION continued to follow. The attempt to establish a towing connection with the stern by the RT INNOVATION failed to begin with. This was because in contrast with the corresponding signal, the messenger line had evidently been belayed on board the car carrier rather than the forerunner of the towing line.
A line connection was established at about 1850. The two tugs initially held the HÖEGH LONDON in the fairway. At 1940, the RT INNOVATION moved to the bow of the HÖEGH LONDON and made fast there on the port side. Two other tugs, the ZP MONTALI and the ZP CAYMUS, made fast on the stern. Shortly afterwards, they began to tow the car carrier to the Columbus pier, where the vessel moored at about 2120.

3.1.4 Damages

During the incident there were neither personal injuries on the vessels involved nor on shore. The BSU was not made aware of any pollution due to the collision.

The collision with the three other vessels caused damages to the starboard side of the HÖEGH LONDON's superstructure. In the process, fan cowls were torn off or destroyed, the fixed awning in the wing damaged and the hull dented. The shell plating on the stern was torn open (see Figures 3 to 5).

Figure 3: Destroyed fan cowls and damaged awning on the wing

Figure 4: Stern of the HÖEGH LONDON

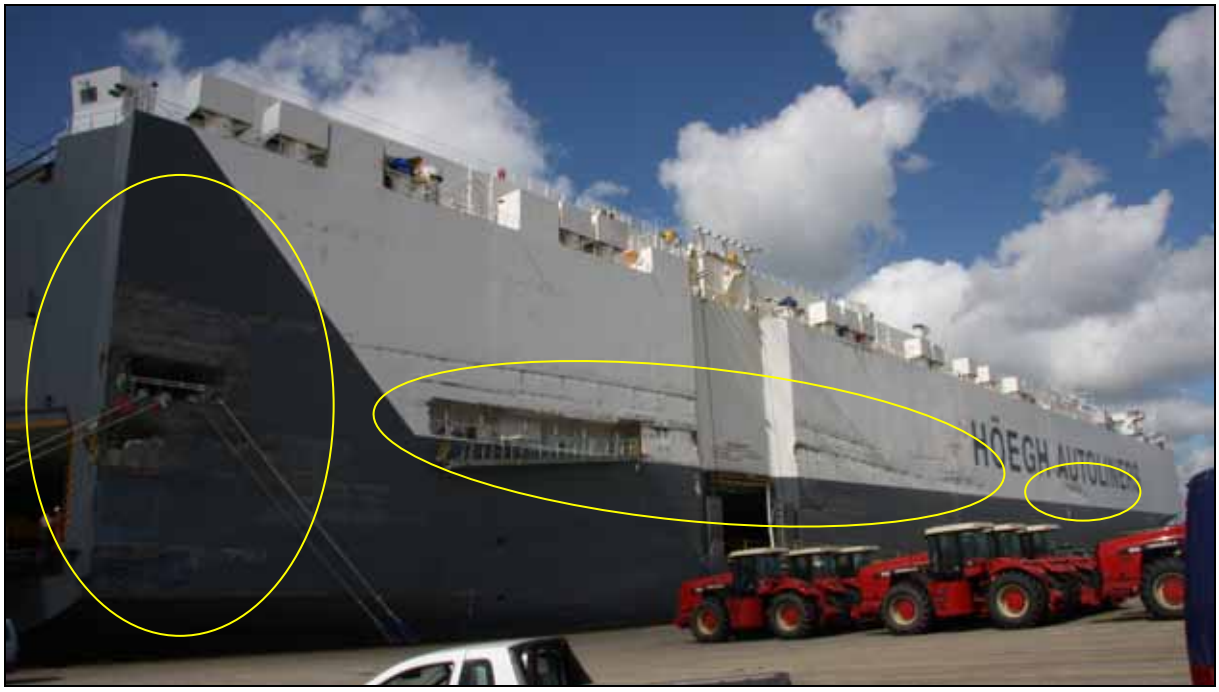


Figure 5: Side view of the HÖEGH LONDON with dents

The MAERSK NEWARK sustained damages to the hull and the superstructure on the starboard side. Since the deck cranes obstructed loading by container gantry cranes, they were turned seawards. During the passage of the HÖEGH LONDON the crane jibs were caught and turned to the side. All three deck cranes were damaged or destroyed. Eleven of the deck cargo containers were damaged or fell into the water (Figures 6 and 7).

Figure 6: MAERSK NEWARK, damaged hull, twisted and damaged cranes

Figure 7: MAERSK NEWARK, crane jib of crane number 1 torn off and damaged container

The MAERSK BINTAN sustained damage to the hull and superstructure (Figure 8). The extended gangway was torn off.

Figure 8: MAERSK BINTAN

The hull of the HUSKY RACER was torn open on the port side. Both deck cranes were damaged as they too had been turned seawards (Figure 9).

Figure 9: HUSKY RACER, damaged hull, twisted crane

Fairway buoy 52 was only slightly damaged due to the collision. Fairway buoy 50 jammed between the rudder and propeller of the HÖEGH LONDON. Apparently, the chain and ground weight of the buoy did not tear off until the HÖEGH LONDON re-entered the lock. It then obstructed the outer gate of the Nordschleuse.

3.2 Investigation

The HÖEGH LONDON was visited by a team from the BSU on 28 May 2009. The master was interviewed and the vessel, including bridge, was surveyed during the visit. The crew submitted copies of a large number of documents.

3.2.1 Weather

Upon request, the crew submitted a weather forecast in written form and a printout of a wind map to the investigators. This printout came from a computerised system for wind forecasts on board the HÖEGH LONDON, which displayed wind data on a monitor in graphic form. The computer system made it possible to zoom in (see Figures 10 and 11). The displayed wind data only made a broad overview of the situation possible and contained much lower wind forces.

The written weather forecast was issued by the UK Met Office on 26 May 2009 at 0800 UTC. It contained the 'High Seas Bulletin for Metarea 1' and thus did not include the area of the German Bight resp. the Weser. Metarea 1 contained the wind data for sea areas west of the UK.

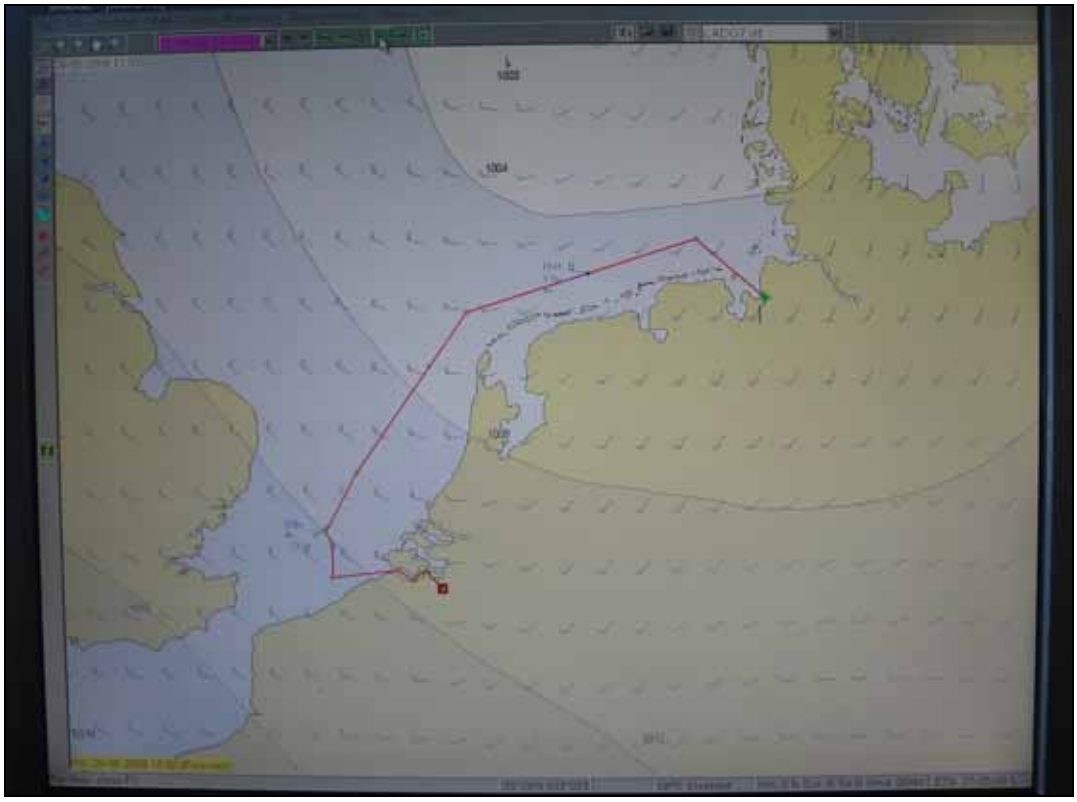


Figure 10: Wind data for 26 May 2009, 1200 UTC – Forecast; photo of the screen display on the bridge of the HÖEGH LONDON

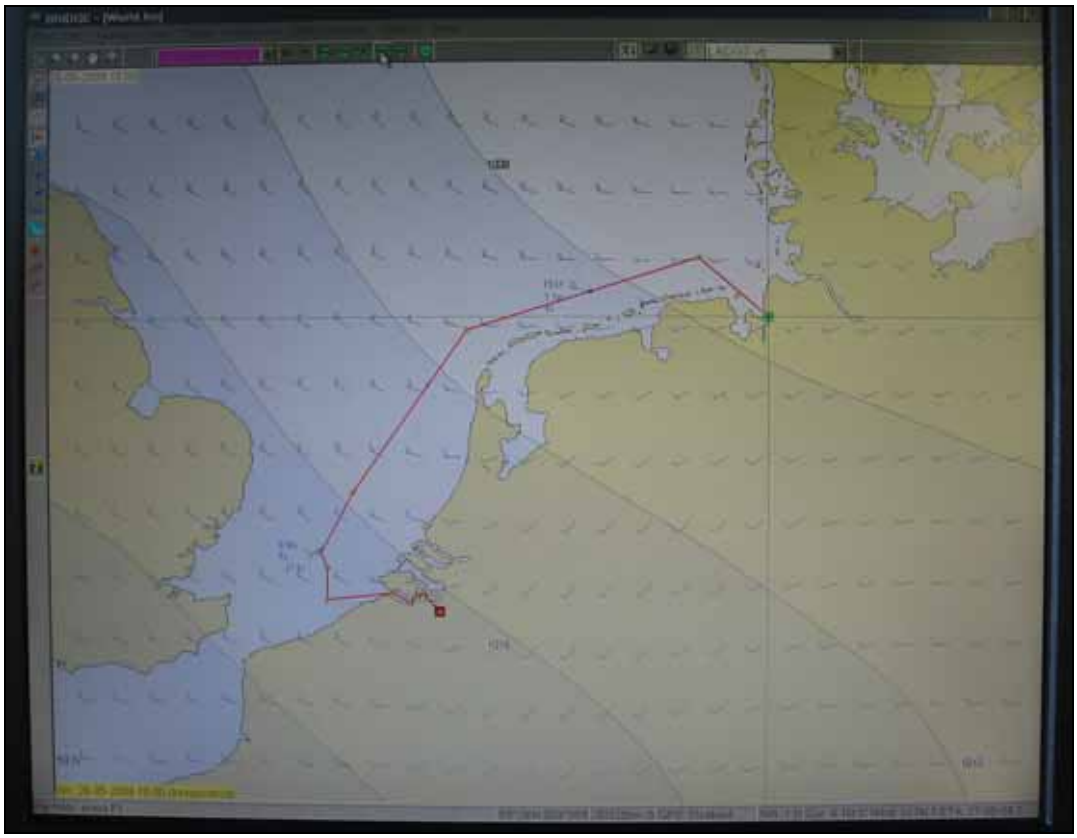


Figure 11: Wind data for 26 May 2009, 1800 UTC – Interpolated; photo of the screen display on the bridge of the HÖEGH LONDON

The ship's command of the HÖEGH LONDON also had other information at its disposal on the day of the accident. For example, the following messages pertaining to weather were transmitted via NAVTEX[4] on 26 May 2009:

```
<26.05.2009 07:01:28> 260700 NAVTEX-HAMBURG (NCC)
WEATHERFORECAST FOR GERMAN BIGHT UNTIL 27.05.2009 00 UTC:
SOUTHEAST TO SOUTH 4 TO 5, LOCALLY 6, SHIFTING SOUTHWEST,
LATER WEST TO NORTHWEST ABOUT 6, PARTLY SEVERE THUNDERY
GUSTS, AT TIMES POOR VISIBILITY, SEA 1 TO 2 METRE.

OUTLOOK UNTIL 27.05.2009 12 UTC:
WEST 6, BACKING A LITTLE.


<26.05.2009 10:11:43> ZCZC PB65
NETHERLANDS COASTGUARD
GALE WARNING NR. 65 261010 UTC MAY
ISSUED 26 MAY 0951 UTC
HUMBER GERMAN BIGHT FISHER DOGGER FORTIES
NORTHWEST 7

OTHER DISTRICTS
NO WARNING
```

The following forecast was issued by the DWD[5] on 26 May 2009[6]:

Shipping forecast of 26/05/2009, 0800 LT,
issued by Maritime Weather Service Hamburg:

In the next 12 hours strong wind or storm
is to be expected in all forecast areas.

Weather situation of today, Tuesday, 05 LT:
Low 994 north-west Russia weakening, slight movement to north-east.
High 1021 Ukraine, moving slowly east. Low 991 dense
south-west of Iceland, weakening somewhat, moving slowly east.
Secondary low 998 North Cape moving east. Undulating cold front 1012
Bay of Bothnia, 1007 Viking, 1020 Biscay swinging east.
Azores high wedge 1020 northern Spain expanding east. Storm low
1008 western Germany intensifying, moving north-east, Wednesday
Midday 990 northern Sweden.

Forecast until midnight today:
German Bight:
South-east to south 4 to 5, locally 6, shifting southwest,
later west to northwest about 6, partly severe thundery gusts,
at times poor visibility.

Maritime Weather Service Hamburg

The bold part of the forecast in German language corresponded with the NAVTEX-text in English language.

[4] NAVTEX – NAVigational TEXt Messages
[5] DWD – Deutscher Wetterdienst - Germany's National Meteorological Service
[6] The following text was translated from German.

Severe thundery gusts signify wind forces from25 m/s to 28 m/s, respectively 48 kts to 55 kts or 10 Bft.

The expertise prepared by Germany's National Meteorological Service on behalf of the BSU is based on wind data from the meteorological observatory in Bremerhaven (Chart 1) and the wind speeds measured on the Outer Weser (Chart 2).

Excerpt from the weather expertise:
Weather situation – *On 26 May 2009, a low pressure system moved from the western German Bight along the west coast of Jutland to the Skagerrak and to southern Norway. In the process, it decreased from 1003 hPa in the morning (0800 CEST) to 994 hPa in the evening (2300 CEST). During the passage of the frontal system in the first half of the day, thunderstorms with gale gusts occurred. In the afternoon, a second cold front with showers crossed the Lower Weser and both the mean wind and the gusts increased strongly.*

Weather conditions – *According to the records on hand from the meteorological observatory in Bremerhaven, the strongest gust occurred at 1628 CEST and was 20.6 m/s (9 Bft). The wind direction was still south-west. At 1820 CEST, a mean of 15.0 m/s (7 Bft) was reported. The strongest gust between 1800 and 1900 CEST was 19 m/s (8 Bft). From 1800, the wind blew from the west. In the process, the mean wind force was 6 Bft. It should be noted that the measurements from the meteorological observatory are taken at the mole in Bremerhaven at a height of 10 m*[7]*. At a greater height at the quay (30 to 40 m) one should certainly allow for higher wind forces (1 to 2 Bft more).*

Visibility was not impaired due to the weather. Sunset was at 2137 on the day of the accident.

[7] On the southern mole of the Geeste estuary.

Station: **Bremerhaven**
Period: **26/05/2009, 1600 - 1900 CEST**
10-minute values for wind direction and wind speed
DDff: mean wind direction according to the 360-degree wind rose
FF: mean wind speed in m/s
DDfx: wind direction according to the 360-degree wind rose at the time of peak wind
FX: peak wind speed in m/s

Times in UTC

STATION NAME	MEASURE_DATE	DDff	FF	DDfx	FX
Bremerhaven	26/5/09 1400	230	13.1	230	16.5
Bremerhaven	26/5/09 1410	230	12.5	220	15.8
Bremerhaven	26/5/09 1420	230	12.2	240	15.6
Bremerhaven	26/5/09 1430	240	13.9	230	20.6
Bremerhaven	26/5/09 1440	240	11.7	250	16.3
Bremerhaven	26/5/09 1450	220	10.5	230	14.3
Bremerhaven	26/5/09 1500	210	9.1	210	11.8
Bremerhaven	26/5/09 1510	220	10.4	230	13.9
Bremerhaven	26/5/09 1520	220	10.9	220	14.3
Bremerhaven	26/5/09 1530	240	11.4	270	15.9
Bremerhaven	26/5/09 1540	260	12.2	260	16.0
Bremerhaven	26/5/09 1550	260	11.7	260	16.0
Bremerhaven	26/5/09 1600	260	12.2	250	19.3
Bremerhaven	26/5/09 1610	260	14.0	260	18.9
Bremerhaven	26/5/09 1620	260	15.0	270	19.4
Bremerhaven	26/5/09 1630	260	13.4	260	17.6
Bremerhaven	26/5/09 1640	270	11.7	270	16.5
Bremerhaven	26/5/09 1650	270	11.8	260	16.2
Bremerhaven	26/5/09 1700	270	12.2	270	16.0
Bremerhaven	26/5/09 1710	270	10.3	270	13.4
Bremerhaven	26/5/09 1720	270	10.9	260	14.5
Bremerhaven	26/5/09 1730	270	10.8	270	13.8
Bremerhaven	26/5/09 1740	270	8.8	270	12.7
Bremerhaven	26/5/09 1750	270	8.6	260	10.8
Bremerhaven	26/5/09 1800	270	8.3	260	11.5

Chart 1: Wind data[8] of the meteorological observatory in Bremerhaven, times are UTC

[8] 15 m/s is equal to 7 Bft, 19.4 m/s is equal to 8 Bft.

Wind measurements on 26 May 2009
(10-minute mean, gusts in the last hour)

Alte Weser Lighthouse:

UTC	Wind Direction (degrees)	Mean Force (kts)	Gusts (kts)
14	220	25	35
15	260	19	33
16	250	39	47
17	270	33	45
18	260	31	39
19	260	31	37
20	260	31	39

Unmanned Lightship German Bight

UTC	Wind Direction (degrees)	Mean Force (kts)	Gusts (kts)
14	220	19	33
15	240	23	27
16	260	25	33
17	280	23	33
18	250	23	29
19	260	21	27
20	260	19	25

Chart 2: Wind data[9] Alte Weser Lighthouse and buoy German Bight, times are UTC

At the time of accident a type 1800 Voyage Data Recorder (VDR) made by JRC was installed on board the HÖEGH LONDON. This also recorded the wind speed in m/s and the wind direction of the apparent wind as a relative bearing. The measuring instrument for that was situated on the port side of the compass bridge about 2 m above deck level and thus about 35 m above the water line.
The investigators exported and made a graphical presentation of the VDR's NMEA data[10] for the wind (see Figures 12 to 15).

[9] 39 kts is equal to 8 Bft, 47 kts is equal to 9 Bft.
[10] NMEA – National Marine Electronics Association; transmission standard in the maritime sector

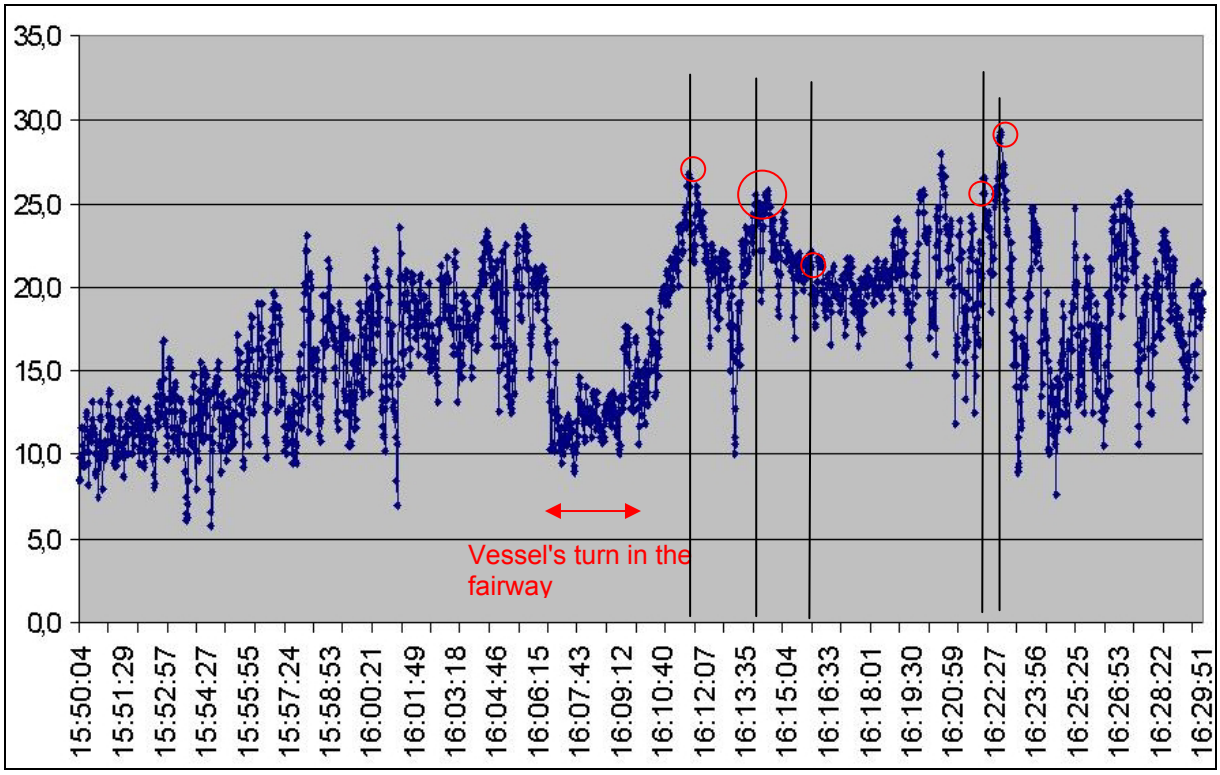


Figure 12: VDR of the HÖEGH LONDON, recording of the wind force of the apparent wind [m/s] over time (VDR system time, equal to UTC)

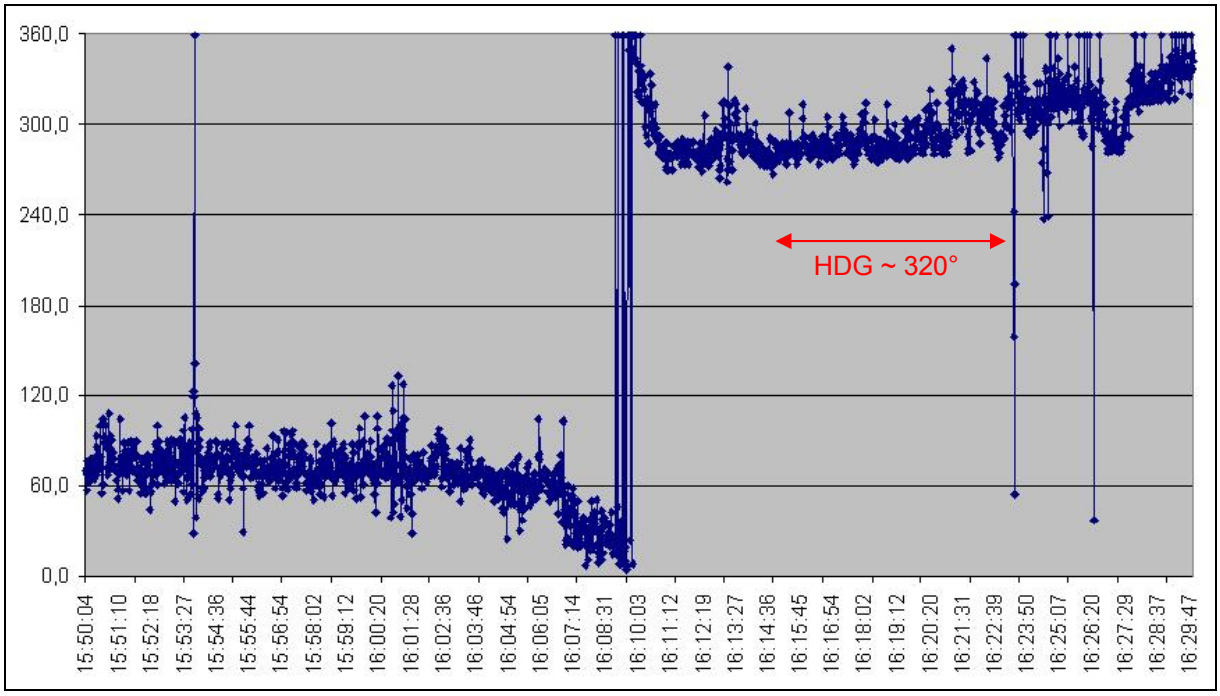


Figure 13: VDR of the HÖEGH LONDON, recording of the wind direction of the apparent wind as a relative bearing [°] over time (VDR system time)

Figure 14 illustrates the wind forces during the period relevant to the accident. Here it is recognisable that the wind was relatively constant and blew with 8 Bft[11] apparent wind between 1815 and 1819.

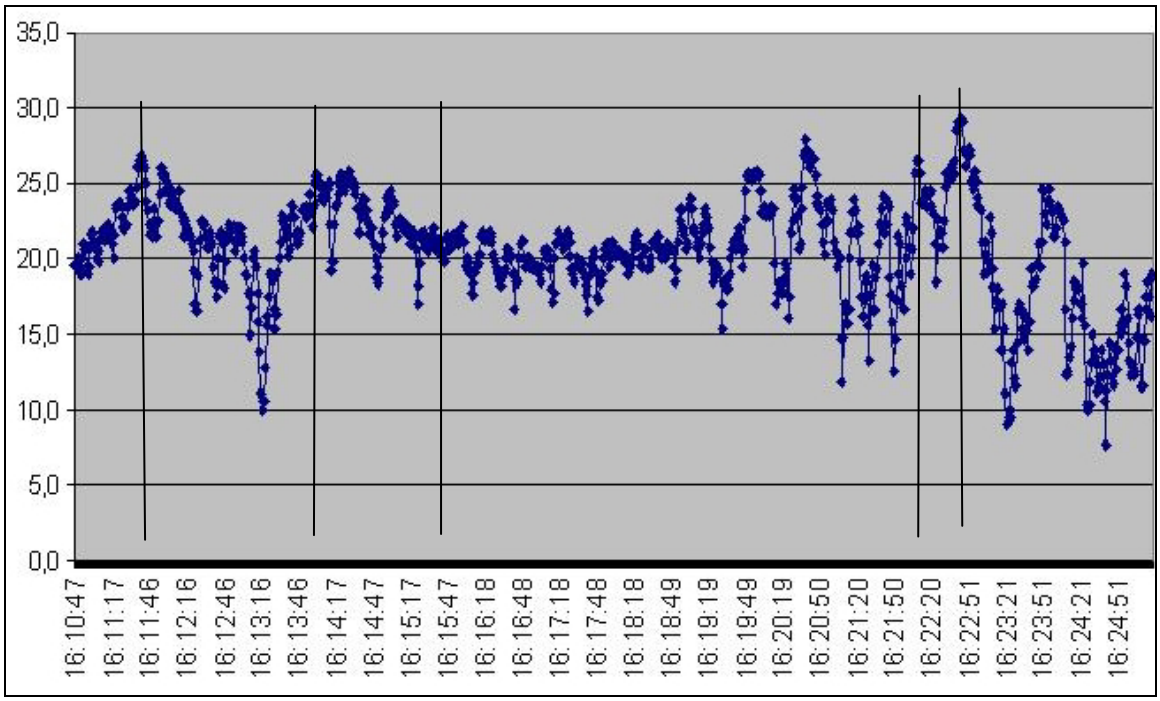


Figure 14: VDR of the HÖEGH LONDON, excerpt from the recording of the wind force of the apparent wind [m/s] over the time (VDR system time) for the accident period

Depending on the speed of the vessel, that results in the following true wind speeds for the times selected:

	Apparent wind	True wind
181142	27 m/s from 240°	27.5 m/s (10 Bft) from 235°
181352	25 m/s from 250°	24.5 m/s (10 Bft) from 240°
181541	21 m/s from 240°	22 m/s (9 Bft) from 230°
182200	26.5 m/s from 270°	24 m/s (9 Bft) from 257°
182250	29 m/s from 290°	24.5 m/s (10 Bft) from 280°

The diagram of the wind direction over time is shown in Figure 15, from which it becomes clear that the apparent wind turned by about 40° in the period shown.

[11] 17,2 m/s to 20,7 m/s equal to 8 Bft

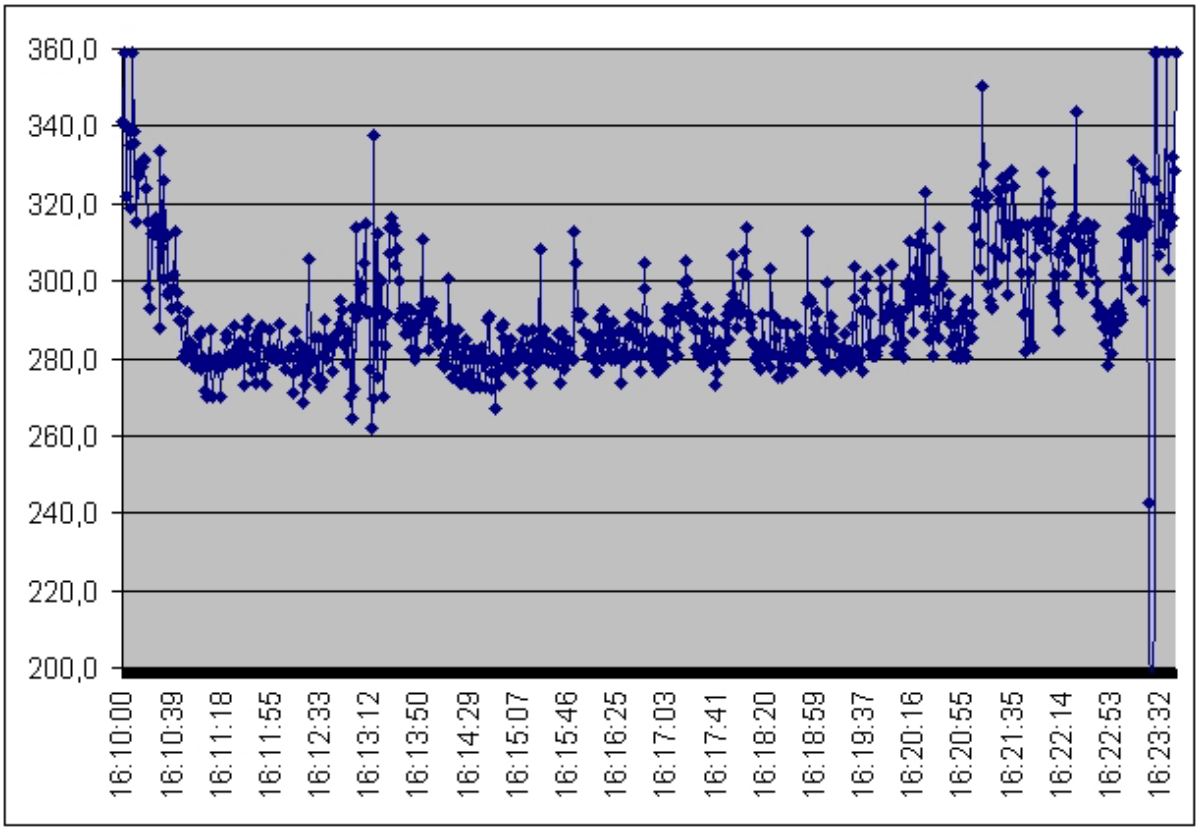


Figure 15: VDR of the HÖEGH LONDON, excerpt from the recording of the wind direction of the apparent wind [°] over time (VDR system time) for the accident period

3.2.2 Current

WSP Bremerhaven requested a current expertise from WSA Bremerhaven. Basically, it should be noted that the expertise is not based on data measured on the day of the accident because of the lack of permanent sensors. Instead, previous measurements were applied, which were then converted to the phase of the ebb stream at the time of the accident. The measurement points were at km 71 (off groyne 41) and 74.5 (off the northern end of the Stromkaje). The expertise stated that the prevailing conditions at the time of the accident were as follows:

> *The time of the accident [...] from 1800 to 1845 is about 2:30 – 3:15 hours after the onset of the 2nd high tide level at the Bremerhaven water gauge. The period is in a phase in which the velocity of the ebb stream, which would have probably peaked at about 1845, is still rising.*
>
> *Having regard to all the data, the velocity of the current in the middle of the fairway at the beginning of the accident at 1800 was about 3.3 knots on the surface and about 2.5 knots at a depth of 2 m below MLWL[12]. At the end of the Stromkaje in the eastern part of the fairway, the velocity at 1820 was about 3.5 knots on the surface and about 3.0 knots at a depth of 2 m below MLWL. The maximum velocity of the current at about 1845 at the end of the 'accident section' was about 4.0 knots on the surface and about 3.5 knots at the measurement level below.*

[12] MLWL – Mean low water level

On being questioned, the originator of the expertise advised that it is reportedly likely that the current runs parallel to the edge of the quay up to km 73. It is possible that the current swings slightly towards the pier further to the north.

3.2.3 Course of the voyage of the HÖEGH LONDON

3.2.3.1 Recording of Vessel Traffic Service Bremerhaven

After casting off from her berth, the HÖEGH LONDON reached the Nordschleuse without incident and made fast there.
The recordings of the vessel's VDR and those of Vessel Traffic Service (VTS) Bremerhaven were available for the investigation of the further course of the voyage. The following data were made available by the VTS:

- a recording of VHF Channel 7, the operating channel of the Vessel Traffic Service in this area;
- a radar plot from Radar Station Tetten in tabular and graphical form;
- a recording of the radar image from Radar Station Tetten in the form of an electronic file with an interval of about one minute.

To display the course of the voyage, the electronic recording of the radar image from VTS Bremerhaven was first analysed.

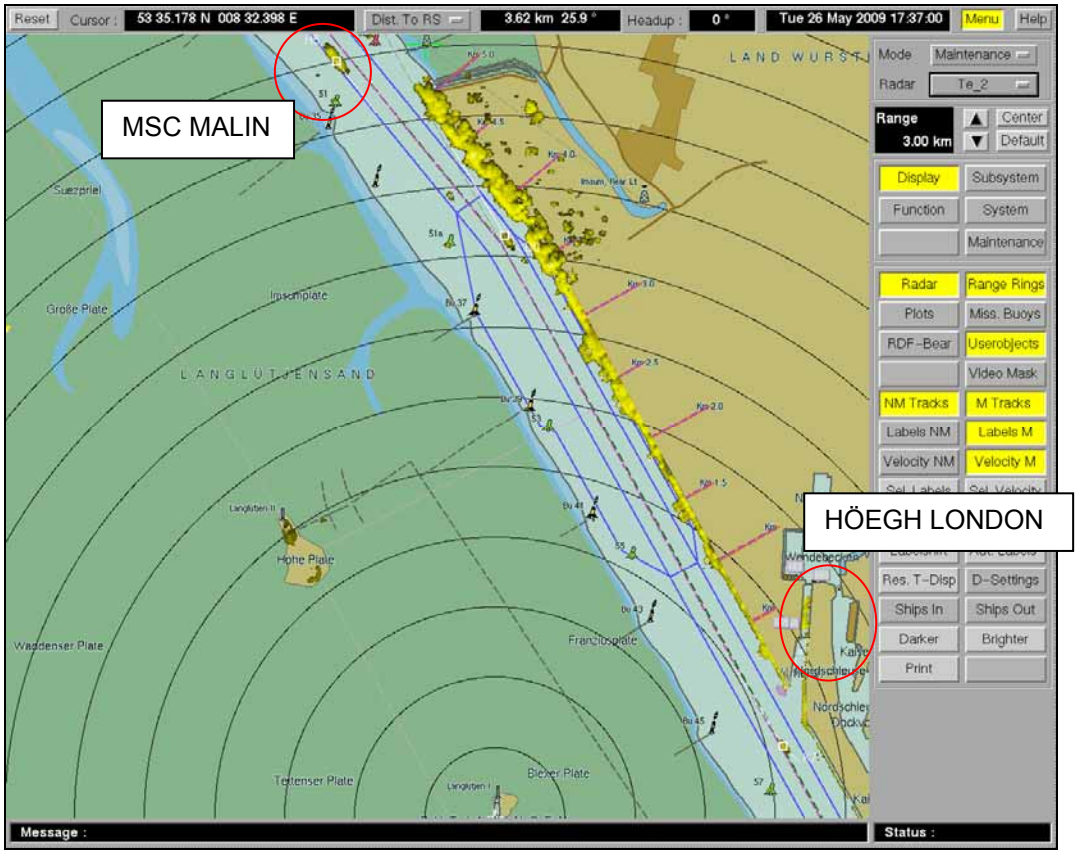


Figure 16: 1737, MSC MALIN appears on the radar image, HÖEGH LONDON is in the Nordschleuse

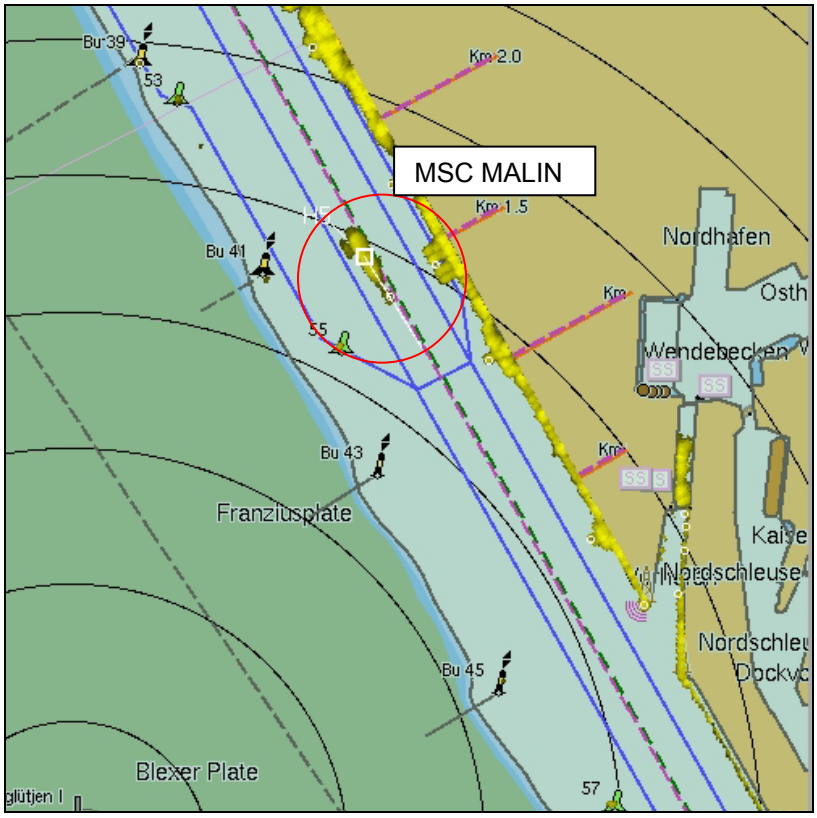


Figure 17: 1756, HÖEGH LONDON begins to proceed from the lock

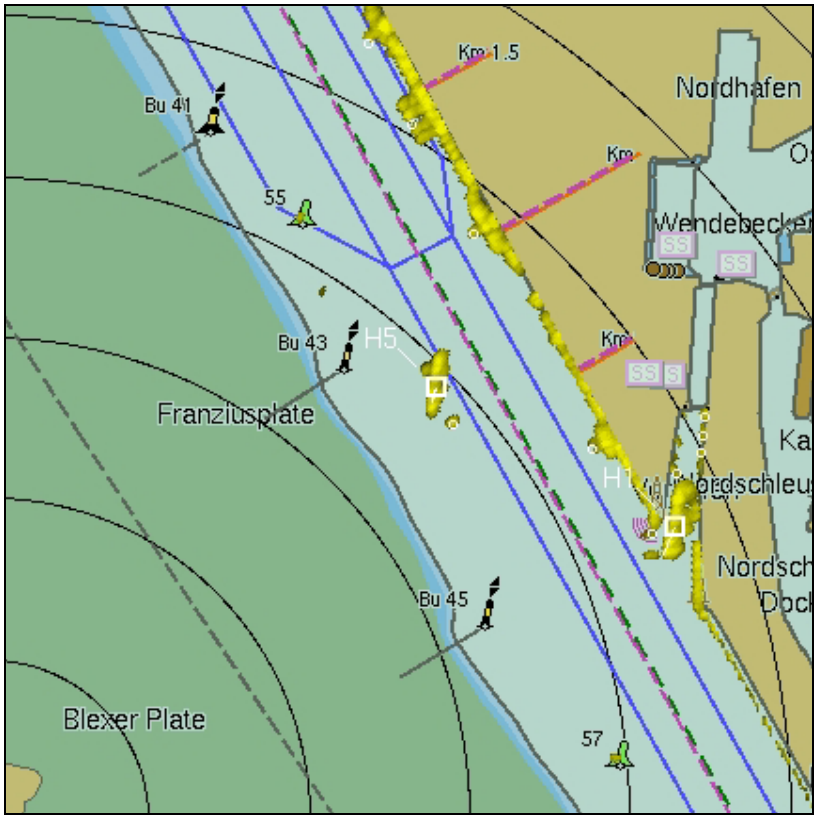


Figure 18: 1804, HÖEGH LONDON leaves the Nordschleuse basin, MSC MALIN abeam with the intended berth

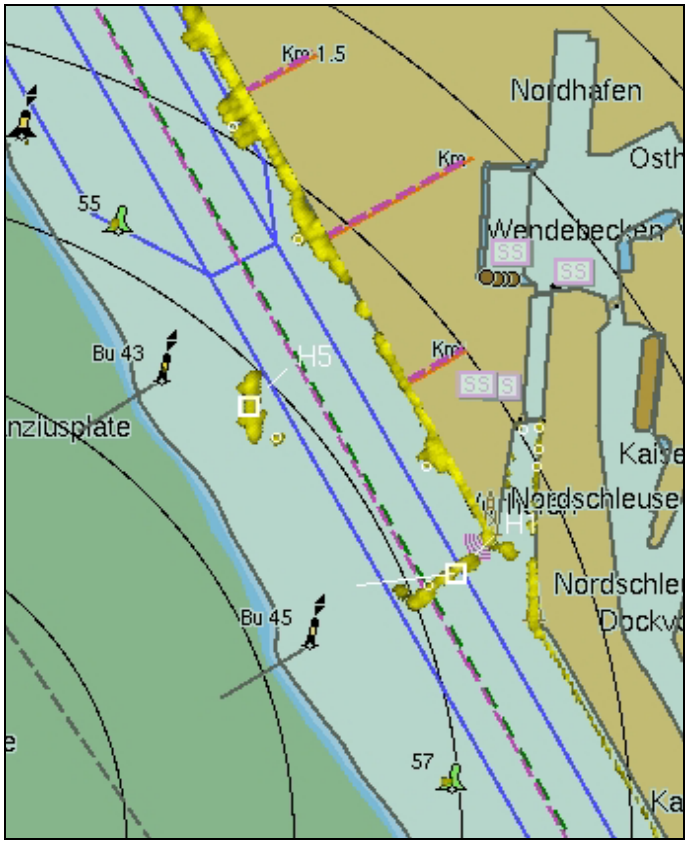


Figure 19: 1809, HÖEGH LONDON has left the basin and begins to turn to starboard. Request to MSC MALIN (H5) regarding the possibility of passing

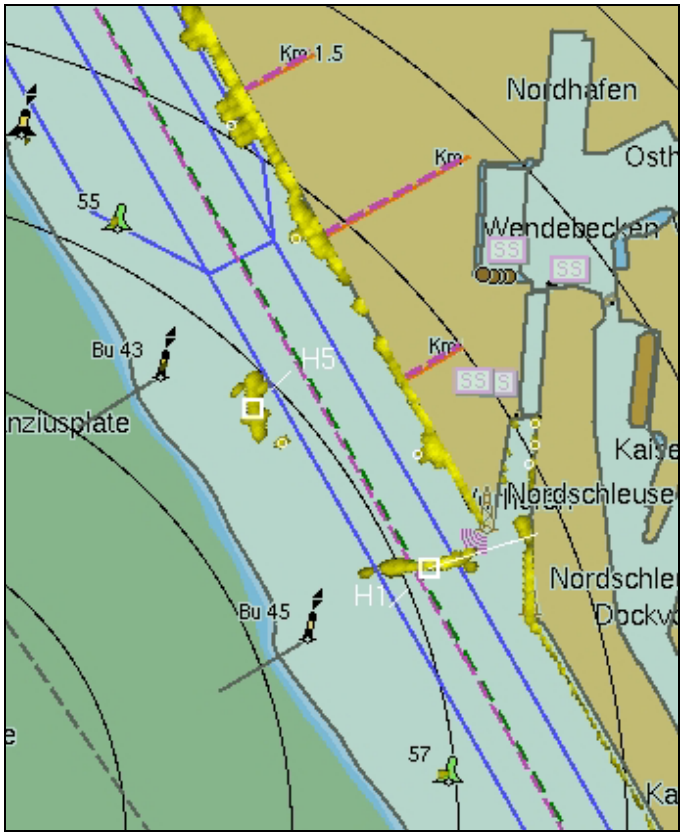


Figure 20: 1810, decision to pass the MSC MALIN

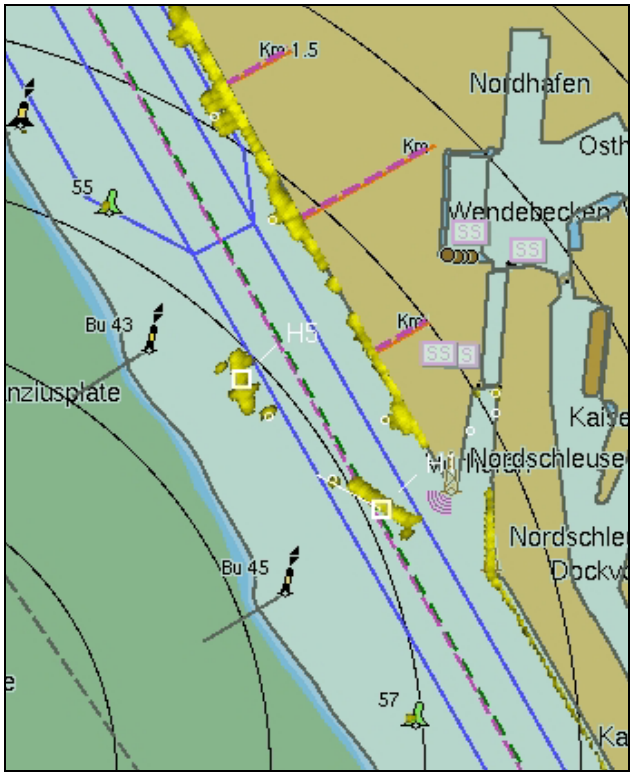


Figure 21: 1811, HÖEGH LONDON, HDG[13] = 315°, COG[14] = 347°, SOG[15] = 3.9 kts

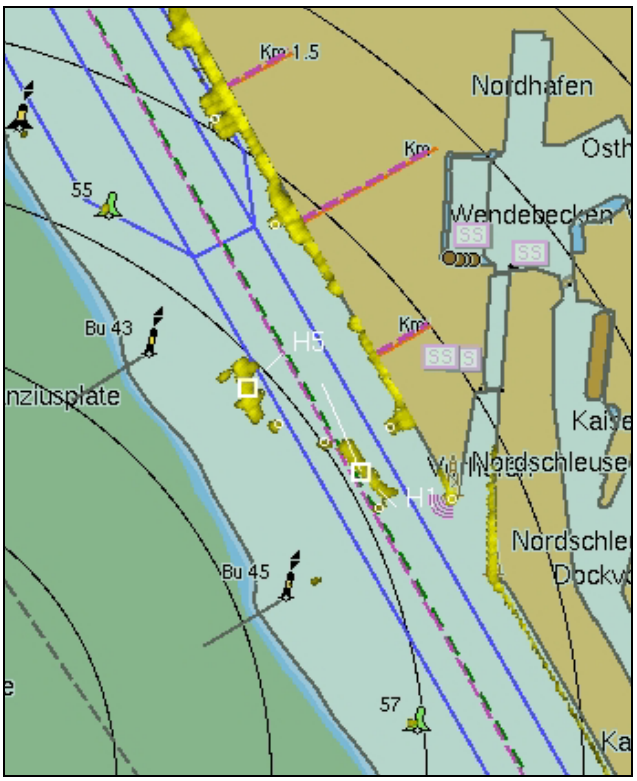


Figure 22: 1812, HÖEGH LONDON, HDG = 318.7°, COG = 337°, SOG = 6.1 kts

[13] HDG – Heading; all values from the Voyage Data Recorder (VDR)
[14] COG – Course over ground; all values from the VDR
[15] SOG – Speed over ground; all values from the VDR

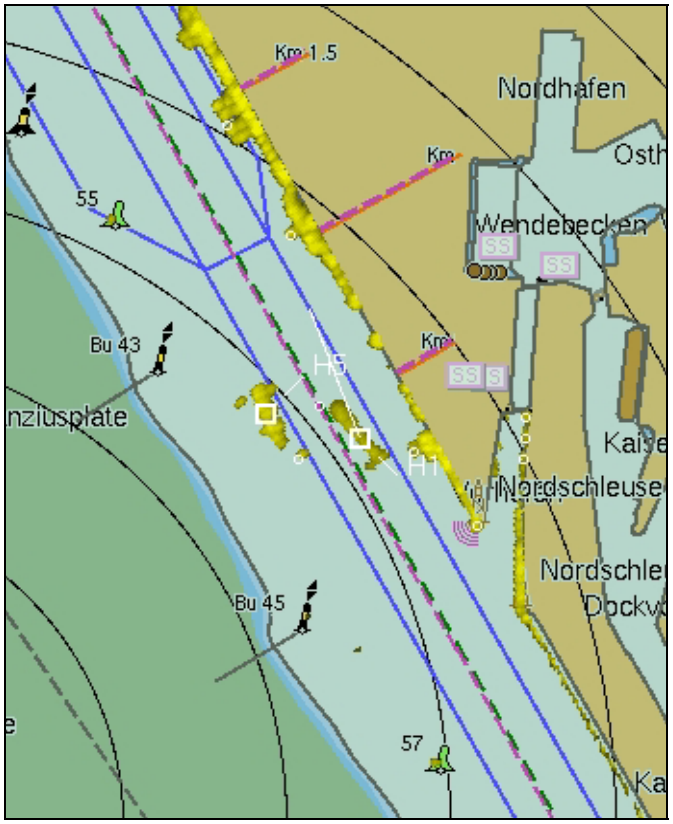


Figure 23: 1813, HÖEGH LONDON, HDG = 316.3°, COG = 330°, SOG = 7.4 kts

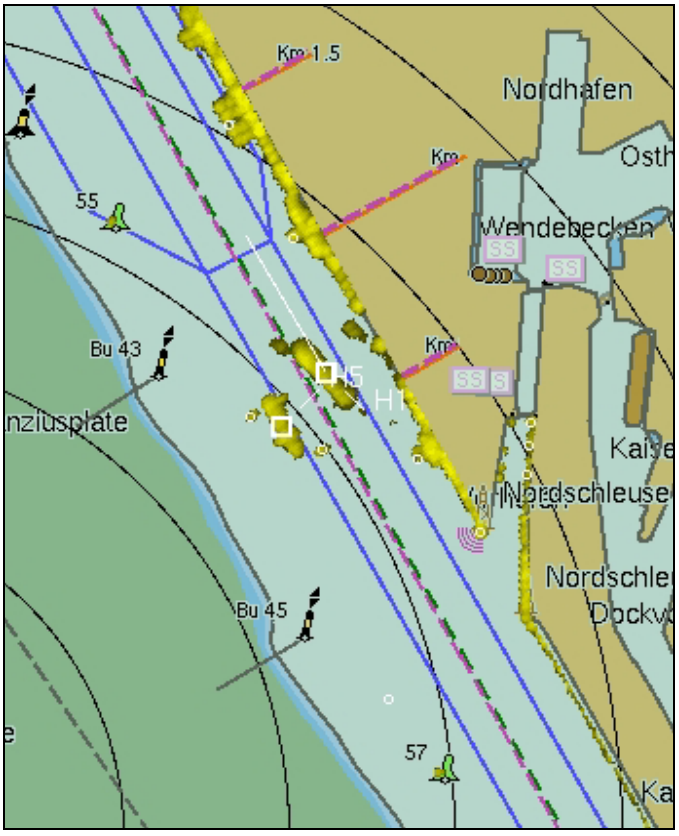


Figure 24: 1814, HÖEGH LONDON, HDG = 318°, COG = 328°, SOG = 8 kts

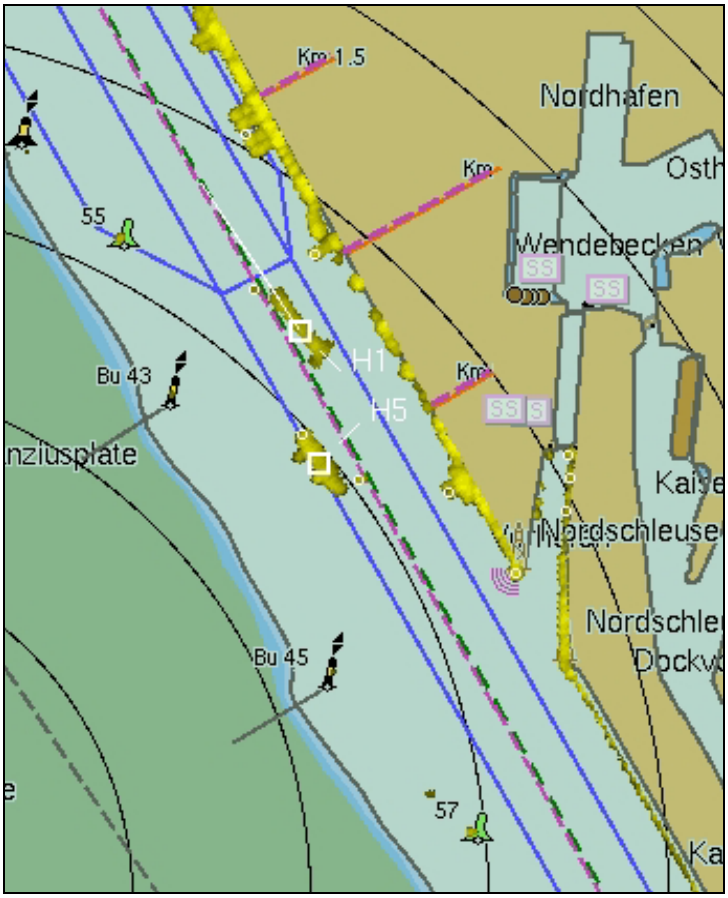


Figure 25: 1815, HÖEGH LONDON, HDG = 319.1°, COG = 330°, SOG = 8.5 kts; aft tug is cast off (181525)

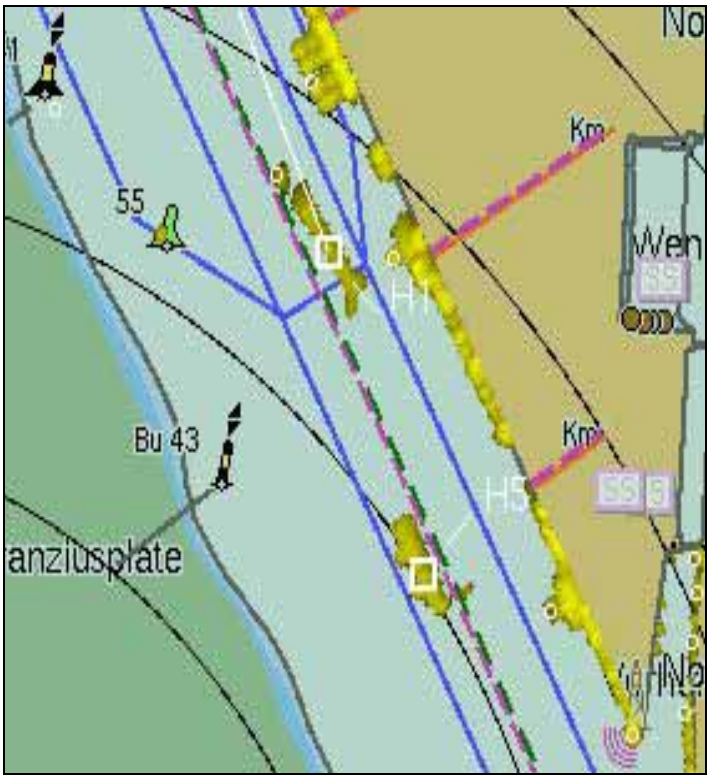


Figure 26: 1816, HÖEGH LONDON, HDG = 319°, COG = 334°, SOG = 8.1 kts

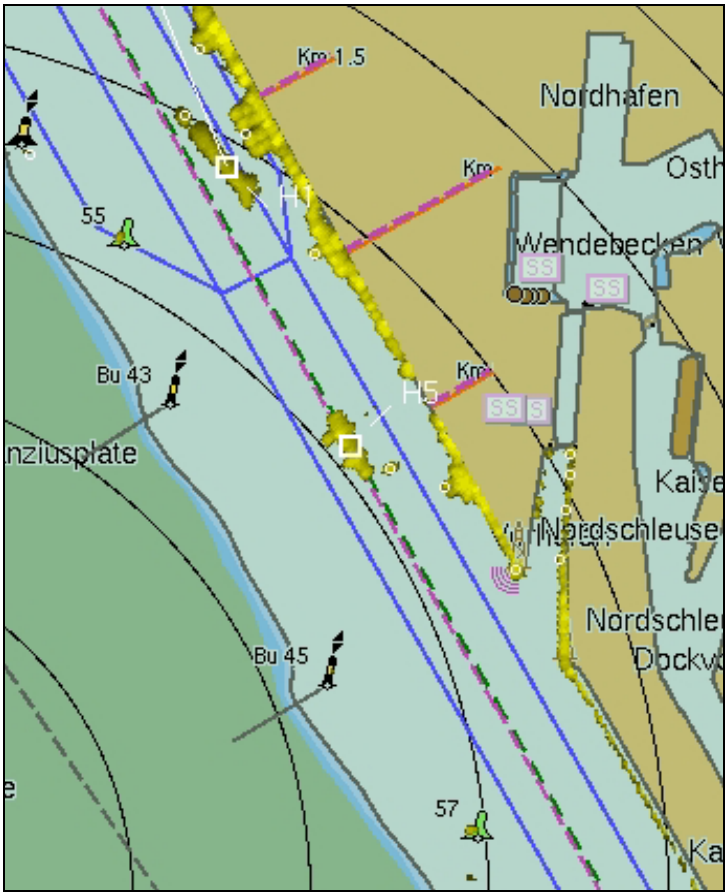


Figure 27: 1817, HÖEGH LONDON, HDG = 316.7°, COG = 333°, SOG = 7.8 kts

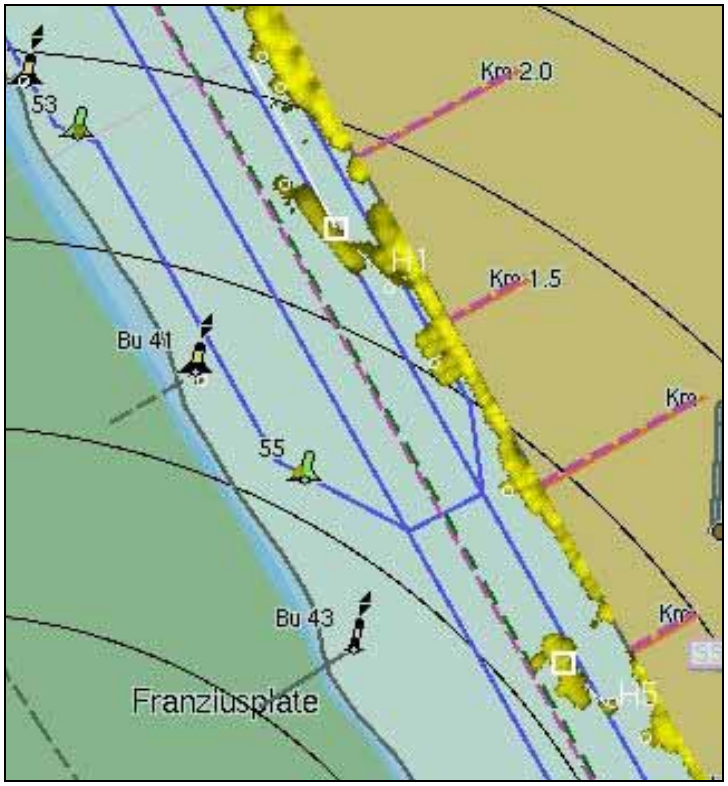


Figure 28: 1819, HÖEGH LONDON, HDG = 326°, COG = 334°, SOG = 9 kts; engine briefly set to 'stop'

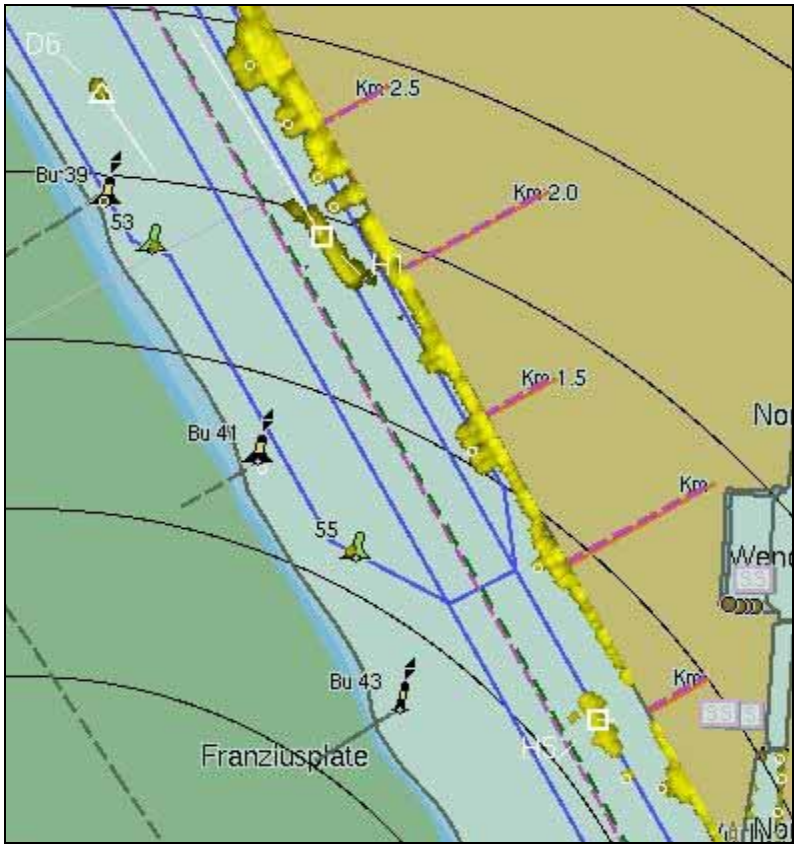


Figure 29: 1820, HÖEGH LONDON, HDG = 324.3°, COG = 333°, SOG = 9.6 kts; RT INNOVATION pushes from astern

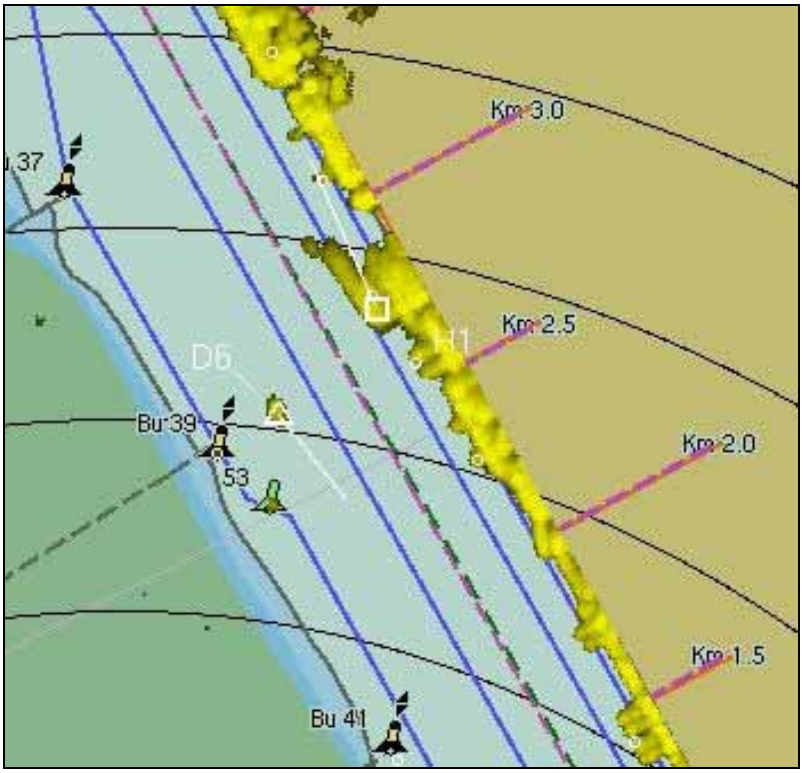


Figure 30: 1822, HÖEGH LONDON, HDG = 324.5°, COG = 330°, SOG = 12 kts

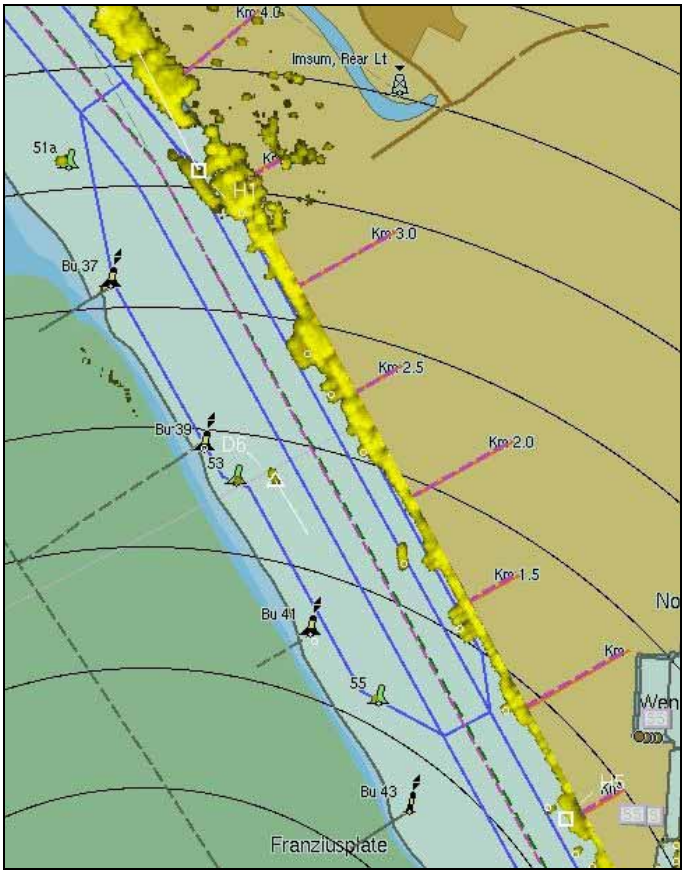


Figure 31: 1824, HÖEGH LONDON, HDG = 323.5°, COG = 329°, SOG = 13.6 kts; MSC MALIN at her berth

To once again illustrate the passing manoeuvre between the HÖEGH LONDON and the MSC MALIN and the onward course of the HÖEGH LONDON's voyage differently, the data of the radar plots listed tabularly from VTS Bremerhaven were transferred to a plan drawing of WSA Bremerhaven (Figure 32).

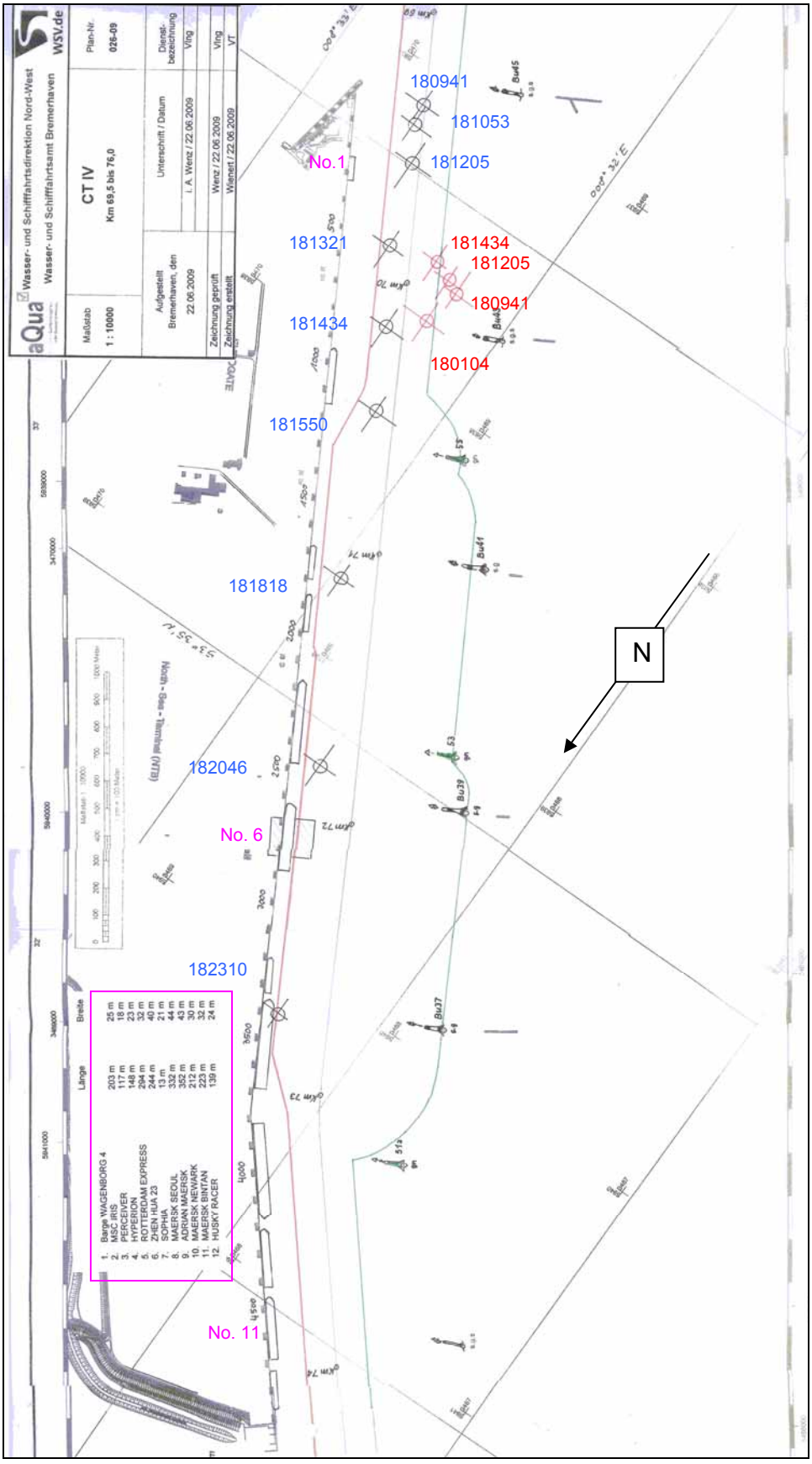


Figure 32: Radar plots for the HÖEGH LONDON and the MSC MALIN from VTS Bremerhaven, transferred to plan drawing of WSA Bremerhaven; with distribution of the vessels on the pier.

3.2.3.2 VDR of the HÖEGH LONDON

The BSU was provided with the VDR data from 26 May 2009, 0730 UTC.

The following chart, which contains the values taken from the VDR recording of the radar image of the HÖEGH LONDON, assists in illustrating her courses and speeds.

Time	HDG	Speed	COG	SOG
180900	270	1.7	334	3.5
181030	291	1.9	356	3.7
181100	315	3.3	347	3.9
181130	318	4.8	338	5
181200	318.7	5.9	337	6.1
181230	317.4	6.6	334	6.9
181300	316.3	7.2	330	7.4
181330	316.3	7.6	327	7.6
181400	318	7.9	328	8
181430	319.5	8.2	330	8.5
181500	319.5	8.3	332	8.5
181530	320.6	8	335	8.3
181600	319	7.8	334	8.1
181630	317.2	7.5	334	7.8
181700	316.7	7.5	333	7.8
181730	317.4	7.6	334	7.9
181800	318.3	7.6	333	7.9
181830	319.8	8.1	333	8.3
181900	326	8.9	334	9
181930	327.8	9	333	9.1
182000	324.3	9.6	333	9.6
182030	324.7	10.1	332	10.1
182100	325	10.7	331	10.8
182130	323.5	11.2	329	11.3
182200	324.5	11.9	330	12
182230	326.7	12.4	331	12.3
182300	323.3	12.8	332	12.8
182330	323	13.1	328	13.1
182400	323.5	13.5	329	13.6
182430	319.8	13.7	326	13.8
182500	320.4	13.7	324	13.8
182530	31807	13.5	324	13.6
182600	319.5	13.3	320	13.3
182630	320.8	12.1	323	12.1
182700	318.5	12	324	12.1
182730	308.3	11.2	320	10.8
182800	300	9.8	316	10.1

Chart 3: Data of the HÖEGH LONDON taken from the radar

The following charts 4 to 8 were prepared using data recorded with the VDR of the HÖEGH LONDON. Thereby, the technical data are shown in relation to the bridge or radio communication and respective position of the vessel.

The investigators also used the recordings of the VDR for the analysis of radio traffic with the tugs. These were difficult to understand for the most part because the advising pilot spent most of his time together with the master in the wing of the vessel from where exterior noise impaired the quality of the recording. The most important commands to the tug are part of the events recorded in tabular form.
These tables also include remarks by the people working on the bridge which the investigators felt were important.

Based on a witness note concerning a third person in the wing of HÖEGH LONDON an extensive audio editing of the audio files of the mentioned period (three minutes from 181744) was carried out with the assistance of the German Federal Bureau of Aircraft Accident Investigation. The resulting amendments were included into the following charts.

The following notes aim to facilitate a better understanding of the tables:

- The information shown in metres in the 'position' column in charts 4 to 8 relate to the kilometre posts on the pier (see Figures 2 and 32). The kilometre posts start at Metre 0 on the northern mole of the Nordschleuse basin.
- The helm and engine commands are recommended by the pilot from the beginning to 181907 and transmitted by the master to the officer on the bridge on his handheld transceiver.
- The depiction of the conning display in the replay of the VDR also contains the vessel's speed over ground (SOG). This information refers largely to the log, which was displayed separately during the replay.
- The data 'Speed (Radar)' and 'SOG (Radar)' were taken directly from the replay of the radar at the times stated. The display in the replayer was switched from 'Conning' to 'Radar' for that purpose.
- The data for the 'Heading' were either taken from the conning display of the replayer or the replay of the radar. At times, slight differences were observed.
- P(A) stands for the responsible pilot, P(B) stands for the supporting pilot, P(C) stands for the sea pilot.
- Due to the audible accent the third person is called “Scandinavian”.

Ship time	Position	Engine command	Helm command	SOG (log) [kts]	Speed (Radar) [kts]	SOG (Radar) [kts]	Heading [°]	COG (Radar) [°]	Event
180900				1.2	1.4	2.5	232	291	
180912				1.3	1.5	3.2	239	302	P(A): "SPIRIT stop." "Pull as much as you can, SPIRIT to the west."
180917				1.3	1.5	3.2	239	302	
180925					1.5	3.2	246	308	P(C): "He (VTS) just wanted to know what the problem is because he cannot raise MSC MALIN either. Up to 45 knots in gusts."
									"(Inaudible), ... for your information MSC MALIN is on Channel 9."
180946					1.4	3.2	252	316	P(A): "Ask whether we can pass to the east. Whether he can hold her like that long enough."
181013									P(B): "X (pilot of the MSC MALIN) says he can just manage to hold her like that."
									P(A): "Say again please."
									P(B): "X just said he can hold her like that."
181017					1.5	3.4	278	334	P(A): "Okay, be careful, we will pass now then."
									P(B): "I did not understand."
									P(A): "We are passing now."
181024									P(B): "Okay, we are passing now."
181027		SA	Rudder is amidships	0.9	1.7	3.5	285	343	
181043									P(A): "To the west, full."
181053									P(A) to pilot (B): "We will past by the MSC MALIN then."
181057				1.1	2.2	3.7	306	356	P(A): "Stop the INNOVATION."
181115	Stern abeam groyne 45	HA		2.1	2.7	3.7	314	355	
181130									Crew member: "Very windy."
181137									P(C): "46 kts."
181139		SA		3	4.1	4.5	317	342	Bow moving at 2.7 kts to starboard (according to conning display).
181159			Stb 10	4	5.5	5.8	318.5	338	
181212									P(A): "SPIRIT, pull as much as possible."
181230	Stern at 100 m		Stb 20	5.7	5.9	6.1	318.7	337	
181242				5.9	6.3	6.5	318.2	336	P(A): "INNOVATION, also to the west as much as possible."
181257									P(A) to the tug: "Towards the west, full ahead."

Chart 4: HÖEGH LONDON, VDR recording from 180900 to 181257

Ship time	Position	Engine command	Helm command	SOG (log) [kts]	Speed (Radar) [kts]	SOG (Radar) [kts]	Heading [°]	COG (Radar) [°]	Event
181314	Stern at 300 m		Stb 60	6.4	6.9	7.1	316.5	332	P(A) comes from the wing into the bridge. Bow moving at 1.9 kts to stb.
181318									P(B): "She is now going 330 over ground." This was confirmed by P(A).
181338									P(B): "328."
181342		DSA		7.1	7.4	7.5	316.3	329	Engine command issued directly by the pilot.
181352									P(B): "327."
181354	Stern at 500 m			7.3	7.6	7.6	316.5	327	Bow moving at 1.6 kts to starboard
181417				7.5	7.7	7.8	317	327	P(A) to the tug INNOVATION: "... Let us know when we have passed the MSC MALIN."
									INNOVATION: "(Inaudible)"
181420									P(A): "We have passed now, okay."
181431				7.7	7.9	8	318	328	P(A): "Keep going right to the west."
181439				7.8	8.1	8.1	319.1	330	P(B): "Comes back again."
181456									P(A) to P(B): "We are dropping again."
181515	Stern at 750 m			8.2	8.3	8.5	319.1	331	Bow moving at 1.7 kts to starboard, radar is switched on again. P(A) to P(B): "332."
181525									Command to aft tug to cast off.
181607	Stern at 1,000 m					8.1	319	334	P(C): "335."
									P(C): "I do not understand a word."
									INNOVATION: "Inaudible"
181616		SA		8.3	7.9	8.1	320	335	starboard.
181628									P(A): "SPIRIT, come ahead."
181639		HA		8	7.7	8	318	334	P(A): "Half ahead." Master: "Half ahead."
181701	Stern at 1,200 m			7.8	7.5	7.8	317	334	P(C) to P(B): "334."
181711									P(A) to P(B): "I cannot turn her, ..."
181740		FA		7.7	7.5	7.8	316.8	334	P(A) to master: "Full ahead." Master repeats and passes on.
181744									P(A): "SPIRIT, we are going full. You go with as long as you can."
181752									M: "Again, starbord 60."
									P(A): "Yes."

Chart 5: HÖEGH LONDON, VDR recording from 181314 to 181752

Ship time	Position	Engine command	Helm command	SOG (log) [kts]	Speed (Radar) [kts]	SOG (Radar) [kts]	Heading [°]	COG (Radar) [°]	Event
181800	Stern at 1,500 m			7.6	7.6	7.9	317.4	334	Bow moving at 2.2 kts to starboard.
181802									door slamming
181804									"Man is that windy."
181810									Info to P(A): "8 kts, 334."
181814									P(A): "SPIRIT, pull as much as possible ... as much as possible to the west."
181821									SPIRIT: "West."
181822									M: "(Inaudible)"
181827									M: "(Inaudible) we need starbord 10, Sir."
									P(A): "35"
181830			Stb 35	7.6	7.8	8.1	319.7	334	M: "Starbord 35." Master ordered the rudder to "Starbord 35".
181839									A Scaninavien talks English at the wing.
181843									P(A): "SPIRIT, if you can cross try to push so good as you can."
181847									P(A): "Listen."
181848									P(A): "Listen."
181849		HA		7.7	8.1	8.3	320.8	333	P(A): "Half, Half Ahead." Master passes on. P(C): "333, 8.3"
181852									P(A): "It's going well, it's going well."
									A discussion happen in the background. The Scandinavien takes a part.
181900	Stern at 1,750 m								M: "Ok, stop the engine."
									Scaninavien. "(Inaudible)"
181906									P(A): "Stop the engine."
		Stop							M: "Ok, Stop the engine!" passes via VHF into the bridge.
181910									P(A): "SPIRIT full to the west. All what is possible. Full power."
									Obvius a discussion about the further action at the wing. All in all inaudible.
181915			Amidships						M: "... Midships, Go Ahead." Both commands were then given immediately together. It is difficult to understand and only "amidships" is understood on the bridge.
181921									M: "Full Ahead, Full Ahead." Is not passed into the bridge.
181922									P(A): "Stop engine."
									M. "No, no (inaudible) port."
181932		FA							Master orders the engine to "full ahead." Other inaudible commands follow.
181944			Hard starboard	8.9	9	9	327.8	333	This and all further commands are made by the master.
181953			Amidships						
									Chief Mate: " Is slow Ahead now."
181958									M: "Full Ahead."

Chart 6: HÖEGH LONDON, VDR recording from 181800 to 181958

Ship time	Position	Engine command	Helm command	SOG (log) [kts]	Speed (Radar) [kts]	SOG (Radar) [kts]	Heading [°]	COG (Radar) [°]	Event
182004	Stern at 2,000 m		Starboard 10	9	9.3	9.3	325.4	333	
182023									P(B): "Now only a miracle can help us."
									P(B): "The tug cannot do any more anyway."
182045			Starboard 5						
182050			Amidships						
182056	Stern at 2,350 m		Port 10	9.7	10.1	10.1	326.3	332	Bow moving at 1.2 kts to starboard.
182110			Amidships						
182124			Starboard 10						
182144			Starboard 10						P(B): "331!"
182154			Amidships						

Chart 7: HÖEGH LONDON, VDR recording from 182004 to 182154

Ship time	Position	Engine command	Helm command	SOG (log) [kts]	Speed (Radar) [kts]	SOG (Radar) [kts]	Heading [°]	COG (Radar) [°]	Event
182201	Stern at 2,700 m			10.5	11.2	11.3	323.5	329	Bow moving at 1.0 kt to starboard.
182205			Port 5						
182215			Amidships						
182217			Starboard 10						
182225			Starboard 5	10.8	11.9	12	324.5	330	
182235			Amidships						
182246			Port 5						
182307			Starboard 5						
182311			Starboard 10						
182316									P(C): "332, he cannot get hold of her."
182327			Starboard 15						
182334									P(B): "Bremerhaven Weser Traffic – HÖEGH LONDON, (name of the pilot)"
182339			Starboard 10						P(B): "Yes, Mr Y. We are having a problem holding the vessel." We are now at the northern end of Stromkaje, close to the bend.
182346			Starboard 5						We cannot gain height with the vessel and may have to go alongside here next to the vessels."
182359			Port 5	11.6	13.1	13.1	323	328	"Yes, thanks for the info."
182404	Stern at 3,500 m								P(B): "One long blast!"
182407			Amidships						
182414			Starboard 5						
182420			Amidships						Tyfon begins to sound.
182425			Starboard 10						
182445			Amidships						
182448			Port 5						
182450			Starboard 10						Bow moving at 1.1 to 1.2 kts to starboard.
182510	Stern at 3,800 m		Starboard 20	12.4	13.7	13.8	319.8	326	The other commands are inaudible because of the continuous sounding of the tyfon.
182528									First collision.

Chart 8: HÖEGH LONDON, VDR recording from 182201 to 182528

3.2.3.3 Statement of the pilot responsible for advising

The pilot responsible for advising on the HÖEGH LONDON answered a number of questions by the BSU in written form together with his solicitor. The answers are summarised below. The pilot stated that the characteristics of the vessel, the area and the weather had reportedly been discussed with the master. In particular, also how that should be reportedly responded to. Reportedly, the master did not provide a wind load table. However, that was reportedly not necessary because both pilots were reportedly familiar with this vessel and the HÖEGH LONDON would not have displayed any unusual qualities as compared with other large car carriers. Based on this knowledge, two tugs with a bollard pull of 75 t and one tug with a bollard pull of 40 t were reportedly ordered. These three tugs and the bow thruster of the vessel were reportedly sufficient for a safe departure.

According to the weather forecast, wind forces of 5 to 6 Bft with gusts of 8 to 9 Bft from W to NW could reportedly be expected during the departure. The wind force was reportedly 5 to 6 Bft on leaving the Nordschleuse. The pilot reportedly also recorded the wind reports and weather forecasts in the situation reports of Bremerhaven Weser Traffic and Bremerhaven Port. However, the actual wind forces were reportedly not predicted.

During the departure from the Nordschleuse, the tug SVEZIA reportedly only pushed resp. was reportedly on standby. At this time the wind forces were reportedly favourable and the pilot of the MSC MALIN had assured that he was able to keep his vessel on the green buoy line, therewith it was reportedly enough space between MSC MALIN and the eastern edge of the channel. A decision to sail the HÖEGH LONDON out of the basin was reportedly made in consultation with the master. Since the forward and aft tugs were well capable of holding the HÖEGH LONDON in the basin and the third tug was only on standby or had no effect from a speed of 4 kts in any case, they were reportedly able to do without her. She then reportedly sailed to the MSC MALIN.

After leaving the basin, the HÖEGH LONDON was reportedly hit by a particularly strong ebb stream. The MSC MALIN was reportedly passed without incident at a safe distance.

After the passing manoeuvre a very freshening wind reportedly acted upon the HÖEGH LONDON. This, combined with the strong ebb stream, reportedly necessitated a vigorous increase in speed and vigorous helm manoeuvres, initially to keep the stern clear of the pier in order to then move further westwards.

After passing the MSC MALIN, the wind reportedly increased to 11 Bft. Together with the perceived ebb stream of up to 4 kts and in spite of the necessary drift correction angle, the vessel was reportedly set towards the pier.

Reportedly, the use made of the manoeuvring aids on the HÖEGH LONDON, i.e. forward tug pulls to port, rudder angle 'starboard 60', does not conform to standard practise. Nevertheless, under the given circumstances it was reportedly the correct manoeuvre to keep the loss of westward direction as low as possible and edge the stern away from the pier.

However, at an assumed direction of pull of 2 to 3 points to port and a speed over ground of 8 kts, the pilot estimated the effect of the forward tug to be low.

The pilot stated that as of PP 500 (Metre 500), the master of the HÖEGH LONDON forwent advice and steered the vessel alone.

In particular, the master reportedly issued various helm and engine commands, which were reportedly not discussed between the pilot and master. For example, at

approximately abeam of groyne buoy 43, a 'full ahead' was reportedly changed to 'stop' and the rudder angle was reportedly changed from 'hard starboard' to 'amidships'. Following that, the vessel reportedly left the agreed track course and reportedly came closer and closer to the pier. At the same time, the wind reportedly increased to 11 to 12 Bft. After the position of PP 3770 (Metre 3,770), the movement towards the pier reportedly increased because its course bends westward at this point by 10°.
The forthcoming collision was reportedly evident from position PP 3770. Since the master reportedly forwent additional advice, there was reportedly no alternative to the ensuing course.
With regard to the assignment of tasks between the advising and the assisting pilot, it was stated that the assisting pilot was reportedly mainly responsible for communicating with the VTS and other vessels, except the tugs. Both pilots would act as a team and in the accident involving the HÖEGH LONDON there was reportedly no problem within the team. The master was reportedly also aware of the assignment of tasks and the change in responsibility while waiting at the lock.
It was reportedly planned that the vessel would be turned over to the sea pilot after passing the MSC MALIN. However, that reportedly did not happen due to the master breaking off further consultation. That a conventional transfer manoeuvre would not exist remained to be noted. Indeed, an attempt would be made to turn over the vessel after she had turned in line with the fairway on the Weser; however, the actual procedure would be dependent on the traffic situation, the prevailing current and the wind conditions.

In a second report the pilot responsible for advising stated:
After having passed the MSC MALIN he reportedly planned to take the ship further to the west by increasing the speed and by means of the port-helm. After the command to cast off the line to the stern tug the helm had remained in the starboard position in order to protect the tug manoeuvring close to the stern from the propeller wash and by then and furthermore keep the stern clear of the pier as far as possible. By all accounts no message was given until 181815 about the stern tug being clear. At the same time a superintendent of the vessel operator travelling on the ship reportedly entered the wing and vigorously talked to the master. Thereupon the master reportedly reduced the rudder angle to starboard 35 and shortly afterwards the speed to “half ahead”.
At 1819:07 the wind had freshened significantly. At the same time the master reportedly ordered the main engine to “stop”. By all accounts, the main engine was possibly stopped to enable the stern tug to take in the wire. Shortly afterwards the master reportedly revised the engine manoeuvre and again ordered the main engine to ahead. In the further course the master dispensed with the pilots advice.

The message given to the VTS by the assisting pilot as regards a “going alongside” did not mean that a berthing was planned or had been recommended by the pilot.

3.2.3.4 Ship's command of the HÖEGH LONDON

The master of the HÖEGH LONDON began his career as an officer after ten years of seagoing service in 1987 as third officer. He has been a master since 1999. He joined Höegh in 2000 and since then has served on various car carriers of this shipping company. His first contract on the HÖEGH LONDON began in April 2008. At the time of the accident, he was undertaking his second voyage as master on this vessel. This contract began in December 2008. He stated that during his career he has reportedly called into Bremerhaven more than 20 times.

In preparation for the departure, the master briefed the pilots using the pilot card (Figures 33 and 34). According to Bridge Check List No. 3, the wheelhouse poster was also brought to their attention. Pilot card and wheelhouse poster conformed fully to the Resolution[16] of the International Maritime Organisation (IMO), but contained no additional information on the vessel's windage area therewith.

[16] IMO Resolution A. 601 (15)

PILOT CARD

DEPARTURE

PORT BREMERHAVEN Voy.No. 8/9

Ship's name HÖEGH LONDON Date 2009.05.26

Nationality NORWEGIAN

Call sign LADG7 IMO Number 9342205 Year built 2008

Draught Fwd 7.55 mtrs Draught Mean 7.63 mtrs

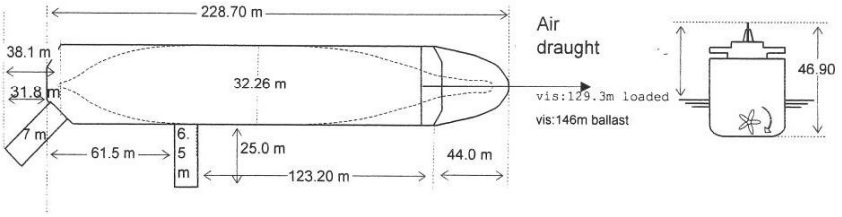
Draught Aft 7.70 mtrs

SHIP'S PARTICULARS

Length overall 228.70 m Anchor chain: Port 13 shackles, Starboard 13 shackles,

Breadth 32.26 m Stern nil shackles,

Bolbous bow Yes (1 shackle = 27.5 m/ 15 fathoms

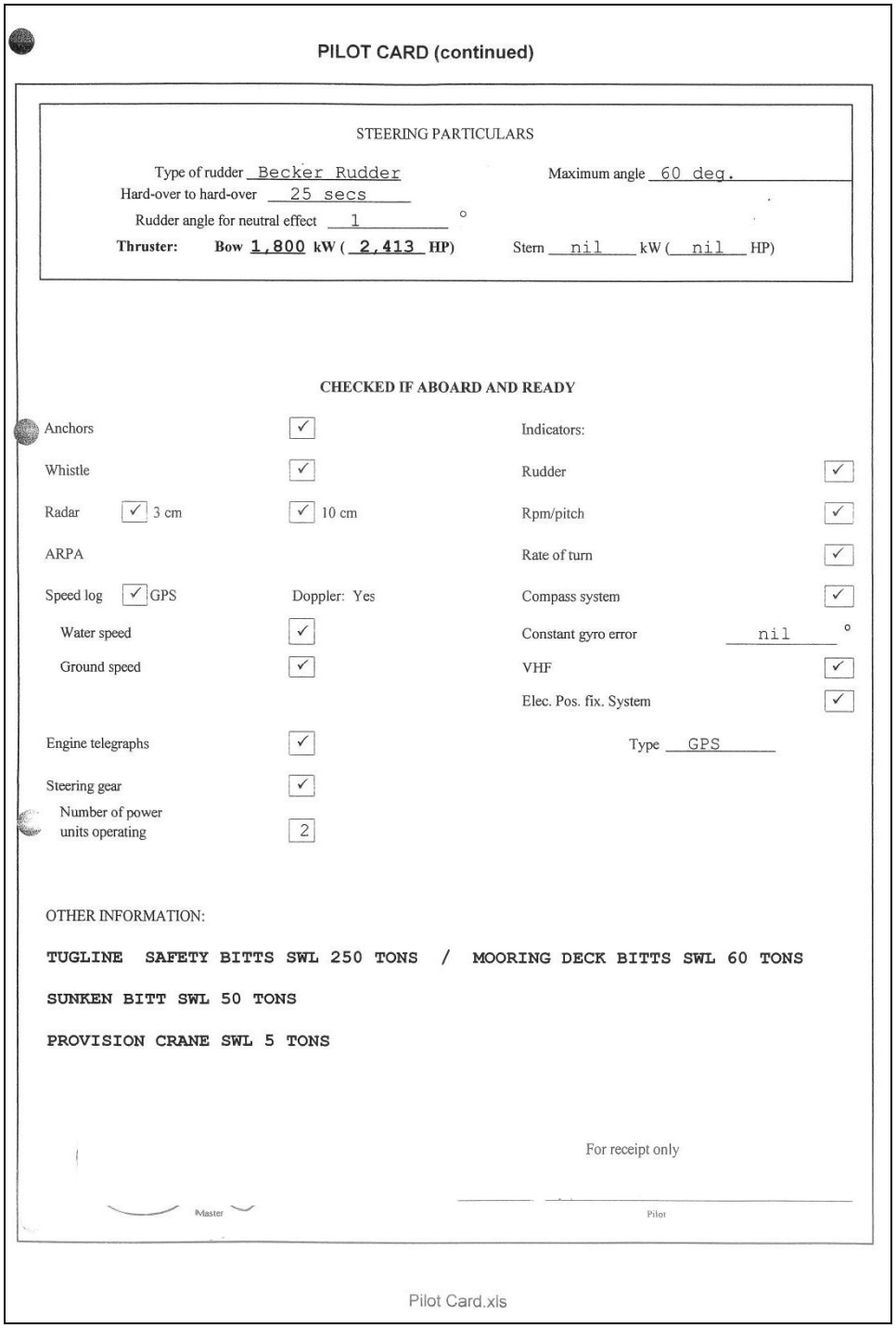


Type of engine B&W 7S60MC Maximum power 19,460 BHP x 105.0 RPM

Manoeuvring engine order	Rpm/pitch	Speed (knots) Loaded	Ballast
Full ahead	74	13.7	13.5
Half ahead	56	10.6	10.3
Slow ahead	38	7.4	7.2
Dead slow ahead	27	4.9	4.8
Dead slow astern	27	Time limit astern	0 min
Slow astern	38	Full ahead to full astern	8 m 59 s
Half astern	56	Max. no. of consec. starts	15 times
Full astern	74	Min. RPM 25	3.2 knots
		Astern power 70	% ahead

Pilot Card

Figure 33: Pilot card of the HÖEGH LONDON from the day of the accident, front



PILOT CARD (continued)

STEERING PARTICULARS

Type of rudder Becker Rudder — Maximum angle 60 deg.
Hard-over to hard-over 25 secs
Rudder angle for neutral effect 1 °
Thruster: Bow 1,800 kW (2,413 HP) Stern nil kW (nil HP)

CHECKED IF ABOARD AND READY

Anchors	✓	Indicators:	
Whistle	✓	Rudder	✓
Radar ✓ 3 cm	✓ 10 cm	Rpm/pitch	✓
ARPA		Rate of turn	✓
Speed log ✓ GPS	Doppler: Yes	Compass system	✓
Water speed	✓	Constant gyro error	nil °
Ground speed	✓	VHF	✓
		Elec. Pos. fix. System	✓
Engine telegraphs	✓	Type GPS	
Steering gear	✓		
Number of power units operating	2		

OTHER INFORMATION:

TUGLINE SAFETY BITTS SWL 250 TONS / MOORING DECK BITTS SWL 60 TONS

SUNKEN BITT SWL 50 TONS

PROVISION CRANE SWL 5 TONS

For receipt only

Master Pilot

Pilot Card.xls

Figure 34: Pilot card of the HÖEGH LONDON from the day of the accident, back

The investigators also assessed the submitted check lists for the bridge of the HÖEGH LONDON. On the day of the accident, all check lists were worked through by various nautical officers and signed by the master.
During the assessment, it was found that Bridge Check List No. 3 – Pilot/Vessel Exchanging Information – also contained no information on the windage area. Here only the direction of the heading, speed, machine settings relating to draught, height of the vessel above water and the underkeel clearance were discussed and confirmed as such.

While investigating Bridge Check List No. 4 – Preparing for Departure – the following point was particularly noticeable:

- No. 25: External conditions checked and found to be satisfactory for departure: Yes.

With regard to this point, the investigators found that:

- No. 25: At least, the documents submitted did not offer a full picture of the actual weather and wind situation. However, due to the computer-aided system in particular, they could leave the ship's command with the impression that no hazard was posed by the wind during the departure.

The executed Bridge Check List No. 8 – Navigating in Coastal Waters and Traffic Separation Schemes – is interesting in connection with the above:

- No. 2: Are local warnings or those concerning the coast monitored on NAVTEX or similar receivers? Yes.
- No. 5: Were the following factors taken into account while preparing the voyage plan?
  - 7. Methods and intervals of position fixing: Yes.
  - 11. The manoeuvring characteristics of the vessel: Yes.

During the course of the accident, the master and pilot responsible spent most of their time in the starboard wing. The control elements installed there were not used after proceeding on the Weser. A handheld transceiver was used to transmit all commands relating to the helm and engine telegraph to the bridge, where they were received by the chief officer and if necessary passed on, for example, to the helmsman. No electronic nautical chart was available in the wing.

The chief officer was obviously located at the middle of the control panel because that is where the engine telegraph is situated. Furthermore, he was able to see the displays of the radar units, the conning display and the electronic nautical chart display from there (see Figure 35). It was not possible to determine the extent to which information on the position or the course of the voyage was passed on to the master. At least, no corresponding communication in English can be found in the VDR recording.

It can be assumed that the second harbour pilot stayed near the chief officer and so it’s was possible to provide the pilot responsible for advising with the relevant information.

Furthermore, no communication between the pilots regarding the vessel's actual position on the fairway can be found in the recording. Since the HÖEGH LONDON did not sail under radar assistance, she was not continuously advised of the distance to the radar reference line. The pilot situated in the wing was apparently dependent solely on the impression he gained visually. The only aids available to him were the Hofe leading light line ahead and the Fischereihafen leading light line astern. Their bearings are 150.8° and 330.8°.

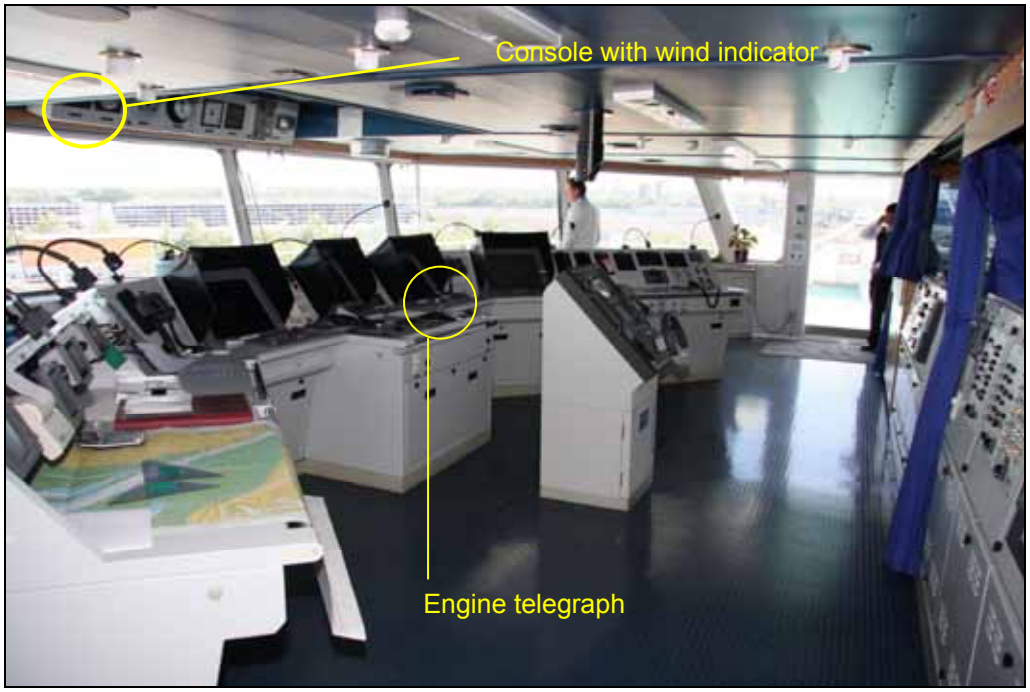


Figure 35: Bridge of the HÖEGH LONDON

An approved electronically chart system (ECDIS[17]) was used for navigating. Furthermore the current and amended Chart 3621 of the UK Hydrographic Office was available. It contained only three positions relevant to the accident period. Two of these positions were incorrectly entered (see Figure 36). A detailed chart contained one additional position, but no time was added to it.

[17] ECDIS - Electronic Chart Display and Information System

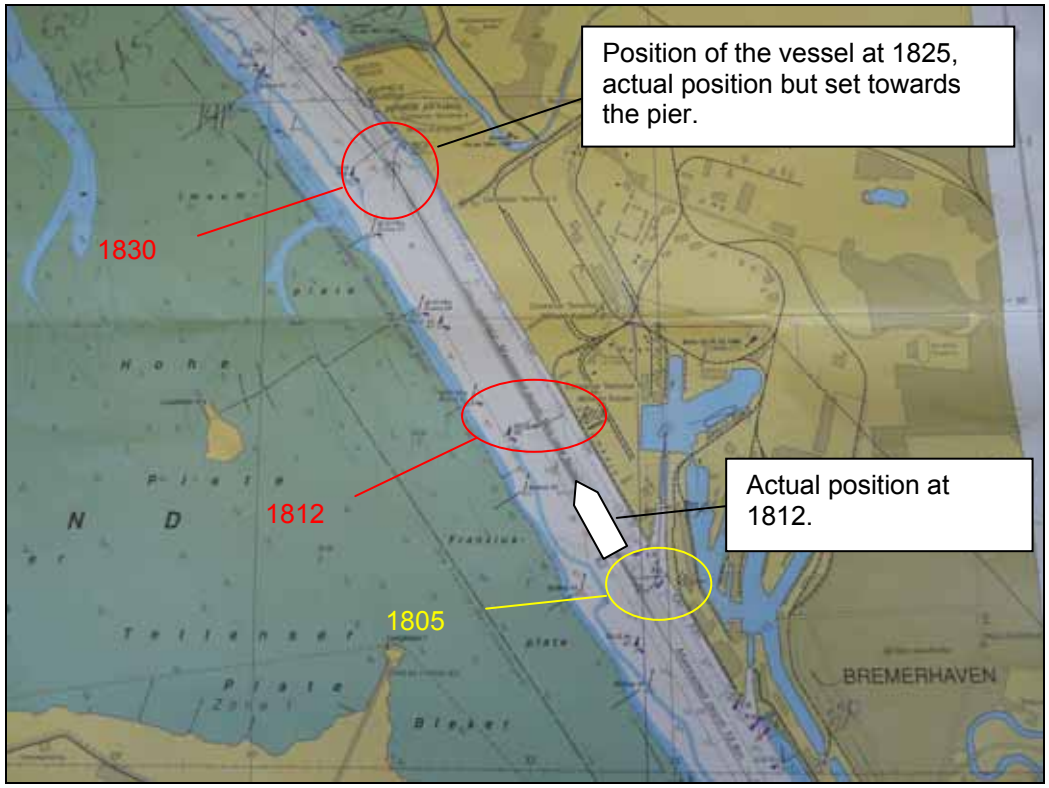


Figure 36: Photo of the HÖEGH LONDON's nautical chart with two incorrect positions (red) and one correct position (yellow)

The voyage had also been prepared on the electronic nautical chart. The planned track course was established with tracks which widened in the course of the voyage. The middle of the track was situated on the radar reference line. From Waypoint 002, the first waypoint on the Weser abeam the exit of the Nordschleuse basin, to Waypoint 003, off buoy 53a, the width of the track was 0.1 nm. The width of the track then increased to 0.2 nm. The planned track was also displayed on the radar unit. Based on the available vectors for the course over ground, the track which emerged from the planned track was visible on both units. The track planned in the electronic chart also contained a safety contour alarm. This was enabled at the time of the accident.

The times specified by the radar unit, electronic nautical chart and main engine's manoeuvre printer are UTC. Operations on the bridge and thus the entry of time in the logs are carried out in ship time, which in this case corresponded with local time.

Preparation for the voyage also included the creation of a tidal diagram. The level specified in this tidal diagram was correct. The time axis contained no information concerning the reference time. High tide was at 1430 and therefore deviated from local time resp. UTC by one hour in each case.

3.2.3.5 Vessel's speed and rudder angle

The HÖEGH LONDON's pilot card contains the subsequent revolutions per minute and thus attainable speeds for the corresponding speed adjustments:

Engine order	Revolutions per minute	Speed (loaded) [kts]
Full ahead	74	13.7
Half ahead	56	10.6
Slow ahead	38	7.4
Dead slow ahead	27	4.9

Chart 9: HÖEGH LONDON, engine orders, relating revolutions of the main engine and speeds

The HÖEGH LONDON is fitted with a balance rudder with flaps made by Becker Marine Systems. This rudder should lend the vessel very good manoeuvrability at slow speed. For this purpose, the rudder angle can be set to 60° on either side. In the case of helm commands issued on the HÖEGH LONDON, distinction was made for the maximum rudder angle. 'Hard ...board' thus meant that the rudder angle is to be set to 35°. A rudder angle of 60° would be stated resp. ordered explicitly.
Hydrodynamically, a balance rudder with flaps behaves like a conventional rudder at higher speeds, i.e., a stall occurs at a rudder angle of more than 35° and the rudder ceases to have any effect.

3.2.3.6 Forces on the vessel

The investigators performed a rough appraisal to obtain an impression of the forces acting on the HÖEGH LONDON.
To begin with, the wind loads were calculated for different wind speeds.
On the basis of the largest forces occurring at exactly abeam the wind, only these were considered. It should be noted that this was also the mean direction of effect recorded on the day of the accident.

The wind force per 1,000 m² was roughly calculated using the formula $v^2 \div 18$[18]. This results in the following wind load values for the HÖEGH LONDON's windage area of 6,700 m²:

- at 7 Bft /17 m/s) → 107 t
- at 8 Bft (19 m/s) → 134 t
- at 9 Bft (22 m/s) → 180 t
- at 10 Bft (24.5 m/s) → 223 t
- at 10 Bft (27 m/s) → 271 t

The thus obtained values are somewhat lower than those calculated using the formula from the simulation study[19] and can be seen as a conservative approach. This is also true in comparison with the diagram of Hensen[20]. Here the resulting values are listed below. Although they include a safety factor of 20%, the thus

[18] Rowe, RW: The Shiphandler's Guide. The Nautical Institute. London, 2nd Edition, 2007, p. 43
[19] Von Morgenstern, Hermann: Simulation study: Simulationen Aussenweser und Bremerhaven, Band WSA-1, Revierfahrten und Hafenmanöver (Simulations Outer Weser and Bremerhaven, Volume WSA-1, estuary trading and harbour manoeuvres). Concluding report. 2005.
[20] Hensen, Henk: Tug use in Port. The Nautical Institute, London, 2nd Edition, 2008, p. 70, Figure 5.1

determined tow-rope pull capacities were higher even after this factor had been deducted:

- at 8 Bft (19 m/s = 37 kts) → 170 t
- at 9 Bft (22 m/s = 42.7 kts) → 240 t
- at 10 Bft (24.5 m/s = 47.6 kts) → 290 t
- at 10 Bft (27 m/s = 52.5 kts) → 360 t

The company of the HÖEGH LONDON handed over the Maneuvering Information Booklet[21] (H.NO 4453) later. Among other things this excerpt contained calculations over wind forces [t] in dependence of the wind acting angel and the loading condition (fully loaded and in ballast condition). Following a part of the chart of the fully loaded case is quoted exemplary.

Wind (m/s)	Wind Direction (Deg.)										
	0	20	40	60	80	90	100	120	140	160	180
15	0,0	-36,5	-80,5	-100,9	-92,5	-74,6	-92,5	-100,9	-80,5	-36,5	0,0
20	0,0	-64,8	-143,0	-179,4	-164,4	-132,6	-164,4	-179,4	-143,0	-64,8	0,0
25	0,0	-101,3	-223,5	-280,4	-256,8	-207,2	-256,8	-280,4	-223,5	-101,3	0,0

Chart 10: Calculation of the wind forces at different wind acting angels

For further consideration the wind load values calculated by the BSU were used, because these referred to the draft of the day of the casualty and the apparent wind came from 90° at the beginning of the voyage. By the veer of the wind of 50°, due to the veering of the true wind and the increasing ships speed, the circumstances for the HÖEGH LONDON effectively worsened from approximately 1822.

The wind load values were then placed in a simplified relationship to the other forces acting on the vessel (Figure 37).
In the process, the calculations for the propeller of the HÖEGH LONDON were made in the following manner:
The output of 17,510 bhp (NCR)[22] at 101 $^{1}/_{min}$ is equal to 175 t tow-rope pull at 'full sea ahead'. According to Rowe[23] and Krüger[24], the output with short thrusts at 'full ahead' is around 45% of the above tow-rope pull, i.e. 79 t.
An even higher value may be achieved by the Becker rudder.
The following values were presupposed for the forward tug: with this type the direct bollard pull at v = 0 kt is 78 t. At a speed of 6 kts ahead and depending on the angle of pull, a bollard pull of 100% at a 90° angle of pull to the heading of the tow to a minimum of 50% at about a 45° angle of pull to the tow should, according to Hensen[25], be assumed for the almost comparable ASD Tugs[26]. The actual angle of pull could not be established in retrospect. The calculation was based on a favourable value, i.e. in consideration of the somewhat different drive concept with three rudder propellers, 80% bollard pull was applied, which equates to 62 t.

[21] Produced by Daewoo Shipbuilding & Marine Engineering CO., LTD.
[22] NCR – Nominal continuous rating
[23] Rowe, RW: The Shiphandler's Guide. The Nautical Institute. London, 2nd Edition, 2007, p. 43-47
[24] Krüger, Stefan: Manövriereinrichtungen (manoeuvring devices). In: Meier-Peter, Hansheinrich/Bernhardt, Frank (publ.): Handbuch Schiffsbetriebstechnik (ship operating technology manual), Hamburg, 2006.
[25] Hensen, Henk: Tug use in Port. The Nautical Institute. London, 2nd Edition, 2008 p. 59
[26] ASD – Azimuth Stern Drive

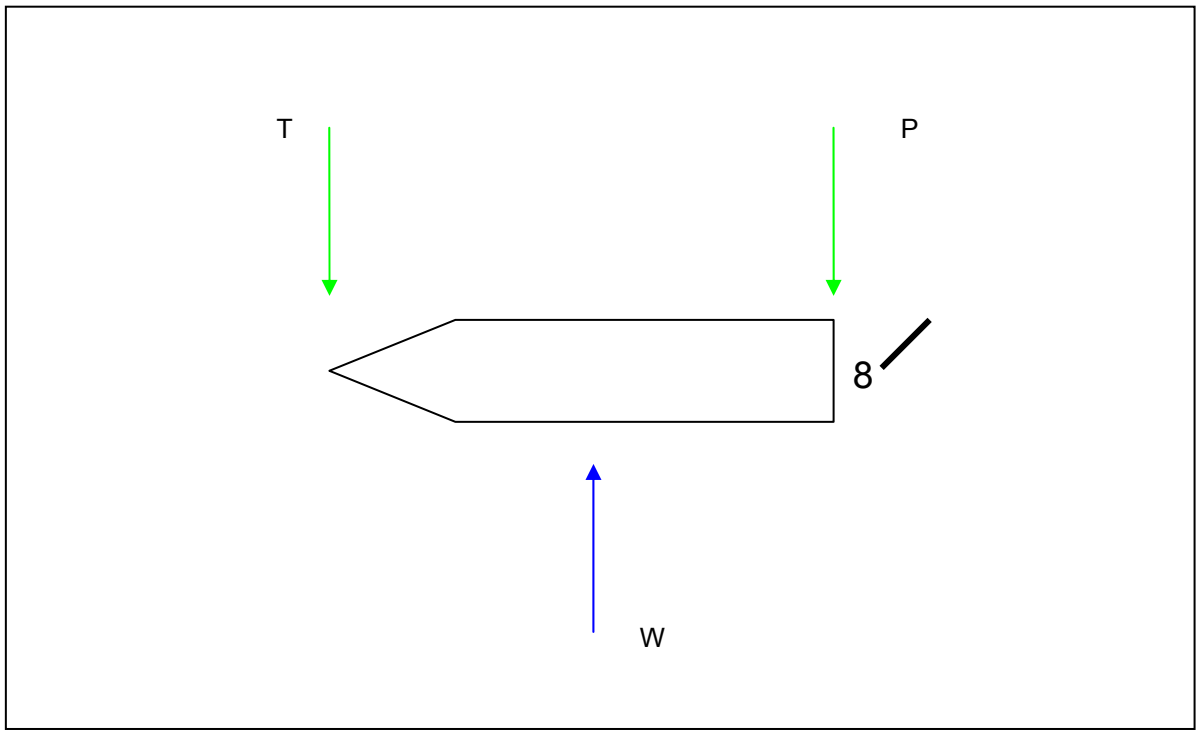


Figure 37: Forces on the vessel in schematic form; W – Wind, T – Tug, P – Propeller

Establishing the bollard pull for the aft tug is more complicated. The attainable values are highly dependent on the direction of pull and operating principle. The maximum value in the above mentioned diagram is 67%. This would correspond to a bollard pull of about 52 t bollard pull for the RT INNOVATION with a direction of pull of 130° to 150° to the heading of the vessel. This value would drop to 50% very quickly for all other directions of pull.

Assuming there was no or only marginal headway, no bow thruster and only one tug, that leads to the following results:

	Wind load	In relation to	Propeller + Tug power	Difference
8 Bft (19 m/s)	134 t	↔	79 t + 62 t = 141 t	+ 7 t
9 Bft (22 m/s)	180 t	↔	79 t + 62 t = 141 t	- 39 t
10 Bft (24.5 m/s)	223 t	↔	79 t + 62 t = 141 t	- 82 t
10 Bft (27 m/s)	271 t	↔	79 t + 62 t = 141 t	- 130 t

In order to examine a further approach, the torque of the forces applied was then looked at. At the same time, it was assumed that while moving ahead the point of rotation resp. pivot point is $^1/_4$ of the total length (see Figure 38). The sometimes very long lever arms can produce large torques.

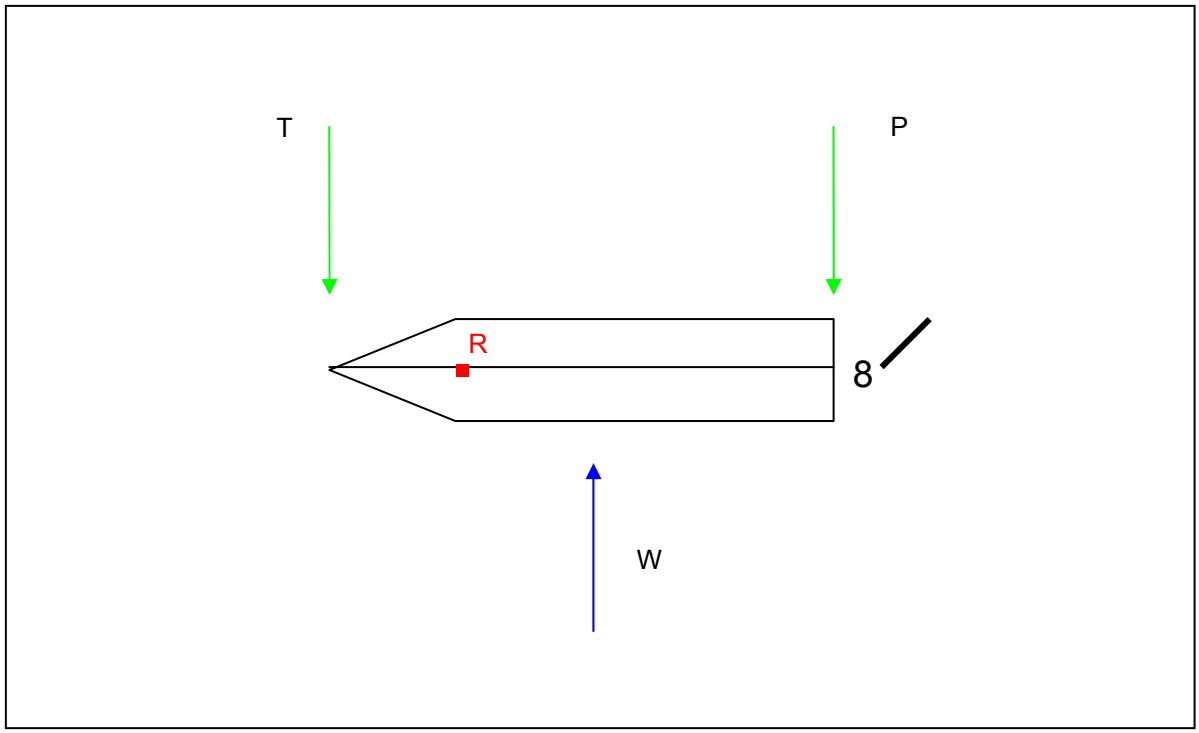


Figure 38: Torques on the vessel in schematic form; R – Point of rotation, W – Wind, T – Tug, P – Propeller

In the case of this deliberation, it was also initially assumed that the bollard pull of the tug was 62 t and that only one tug was used on the vessel.
At 9 Bft this results in the following torques:

	Force [t]	Lever [m]	Torque	
			Port	Starboard
Wind	180	60	10,800	
Propeller	79	170		13,430
F. tug	62	56	3,472	
Σ			14,272	13,430

Chart 11: Calculation of the torques at the ship at wind force 9 Bft and one tug

On the assumption of the tug's bollard pull being 50 t or a slight increase in the effect of the propeller, the forces would have been almost balanced.

The following relative forces would result for the period in which two tugs were used on the vessel (at 9 Bft):

	Force [t]	Lever [m]	Torque	
			Port	Starboard
Wind	180	60	10,800	
Propeller	79	170		13,430
F. tug	62	56	3,472	
A. tug	52	170		8,840
Σ			14,272	22,270

Chart 12: Calculation of the torques at the ship at wind force 9 Bft and two tugs

3.2.3.7 Space requirement

The entire width of the fairway from the green buoy line to the edge of the pier is about 520 m at buoy 55 and increases to about 600 m at buoy 53. Further widening to about 650 m occurred from buoy 53 to the vicinity of buoy 51a. From buoy 51a the available width decreased to about 520 m (see Figure 2).
A dredged channel is located in the fairway and in the area of buoys 51a to 55 the turning basin. The channel and turning basin have a nominal depth of 13.5 m and 13.6 m respectively. The channel is about 220 m wide upstream of buoy 55.
The middle of the channel is marked by the leading light line. At the same time, the leading light line upstream of buoy 55 also marks the middle of the fairway.

Off the Nordschleuse, i.e. about 7.5 cbl south of buoy 55, the HÖEGH LONDON basically had water area of about 520 m at her disposal on the Weser as due to her draught she was not dependent on keeping to the channel.

MSC MALIN was located outside the western edge of the channel when she was passed by the HÖEGH LONDON. Therefore, the HÖEGH LONDON had about 360 m of water area as room for manoeuvre without safety margins. However, downstream on the Weser this area became smaller because the MSC IRIS was located between Metre 950 and Metre 1,150 and more vessels were moored to the north of that (see Figure 32).

Accordingly, at a width of 32.26 m the HÖEGH LONDON, which was sailing with a drift correction angle of 10°, had a resulting space requirement on the water of about 68 m. At the same time, the stern deflected by about 28 m. Had the drift correction angle changed to 20° due to a port rudder angle, the space requirement would have increased to about 103 m. The stern would have then deflected by a further 25 m to 53 m. The point of rotation was again assumed to be a ¼ of the length of the vessel.

3.2.4 Course of the voyage of the MSC MALIN

The course of the voyage of the MSC MALIN can be derived initially from Figures 16 to 31. In addition, the statement of the harbour pilot is summarised below. The turn over of the vessel from sea pilot to harbour pilot took place approximately off buoy 51a. The vessel was reportedly moving at 'dead slow ahead' on the western edge of the channel[27] and was said to be easy to manoeuvre. During an attempt to reduce the high headway at this rate of speed, the vessel reportedly turned abruptly to starboard. It was reportedly not possible for the aft tug to pull against that at this point. Therefore, the rate of speed was reportedly initially returned to 'dead slow ahead'. The vessel was then reportedly stopped in line with the proposed berth. Both tugs were reportedly well capable of holding the vessel in this position. The harbour pilot estimated the wind force to be 6 Bft with gusts of 7 to 8 Bft at this time.
Shortly after assuming responsibility for advising the ship's command of the MSC MALIN, the pilot reportedly made contact with the pilots of the HÖEGH LONDON. It was reportedly agreed that the MSC MALIN would keep well to the west until she reached her berth. The HÖEGH LONDON would reportedly wait in the Nordschleuse basin until the MSC MALIN was in place. When the MSC MALIN was abeam the

[27] Channel – dredged channel resp. dredged turning area; depth of water at least 13.5 m. See also Figure 2.

berth, the pilot of the MSC MALIN was reportedly asked by the second pilot of the HÖEGH LONDON if the vessel could reportedly be held in this position. The pilot of the MSC MALIN reportedly assured this was feasible. Following that, he was reportedly requested by the pilots of the HÖEGH LONDON to remain at this position and allow the HÖEGH LONDON to pass. At the request of the master of the MSC MALIN, he reportedly requested a third tug from the tug operations control station. The HÖEGH LONDON then reportedly passed in the normal (red/red) manner.
The pilot of the MSC MALIN was not aware of the reason why the pilots of the HÖEGH LONDON deviated from the first agreement. He stated that there was no static or fixed procedure for vessels passing one another due to the constantly changing conditions.

The MSC MALIN moored at her berth ten minutes after the HÖEGH LONDON passed at 1824.

3.2.5 Radio traffic

The radio traffic recorded by VTS Bremerhaven was not of particular importance to the investigation of the marine casualty. On the one hand, this was due to the fact that the VHF channels used by the pilots are not recorded. On the other hand, only little accident-related communication occurred on the usual traffic channel (7) of VTS Bremerhaven (call sign: Bremerhaven Weser Traffic).
A transcript of the radio traffic, which was prepared by WSP Bremerhaven for the file of the public prosecutor's office and is only moderately edited by the BSU[28], follows.

Log of the audio recording of VTS Bremerhaven, VHF Channel 7:

Definitions:

WT	Vessel Traffic Service Bremerhaven Weser Traffic
HL	HÖEGH LONDON
MSC M	MSC MALIN
Hyp	HYPERION
Fried	FRIEDERIKE
Bug	Tug BUGSIER 6
UR	UNION RUBY

Seq. File No./ Duration	Time	Caller	Text
1 (2m:31s)	**172114**	**WT**	Situation report (excerpt): Wind: Alte Weser LH: WSW 7 wind warning W – W 6 to 7, gusts of 9
2 (1m:32s)	**174515+ 0:06**	**HL**	Bremerhaven Weser Traffic Mr (name), this is (name) on the HÖEGH LONDON.
	+0:08	**WT**	HÖEGH LONDON, Bremerhaven Weser Traffic Mr (name), good evening again
	+0:12	**HL**	We are located at the Nordschleuse, intend to proceed shortly, at 7.55 m, 24 people, bound for Antwerp
	+0:23	**WT**	Yes, we know, you have no reported traffic from above, we now have two incomers, the first is casting off now, is starting now, HYPERION, is now ... yes, it is difficult for me to recognise, she is probably sailing close under the pier now, at 15 hundred, going further upstream to Bremen, no ..., she is still under the pier, she wanted to cast off at 18 hundred, going

[28] The editing serves purely to facilitate a better understanding of the text.

			to Bremen, the HYPERION, and incoming between 51 alpha and 53, that is the MSC MALIN, she is going to the southern end of the Stromkaje at position, yes, 380 580, with port side to the wall
	+1:09	**HL**	MSC MALIN, er, 51, goes to the southern end with port side to the wall and HYPERION, cast off 18 hundred, bound for Bremen
	+1:15	**WT**	Yes, correct
	+1:17	**HL**	Understood, thank you Mr (name), good watch
	+1:21	**WT**	Good watch to you too, see you later then, bye
	+1:22	**HL**	Bye
3 (2m:38s)	**174914**	**Bug**	Bremerhaven Weser Traffic, tug BUGSIER 6
	+0:09	**WT**	Tug BUGSIER 6, Bremerhaven Weser Traffic, good evening
	+0:13	**Bug**	Yes, good evening, I have just left the Nordschleuse and intend to continue to Wilhelmshaven with 3 men
	+0:21	**WT**	Yes, er, the HYPERION wanted to cast off, you must, that is, HYPERION wanted to cast off at any time now and namely position 18 hundred, she reported in just now, I do not know how far she is now, you will have to monitor, I have the MSC MALIN incoming
	+0:37	**Bug**	Yes, okay, I will keep an eye on it
	+0:40	**Hyp**	Bremerhaven Weser Traffic, HYPERION
	+0:42	**WT**	HYPERION, Weser Traffic
	+0:45	**Hyp**	Yes, I will wait for both of them and then cast off, because the wind is pushing me on to the Stromkaje
	+0:50	**WT**	Yes, I thought so, you are not afloat yet, yes, as said, [...], allow MSC MALIN to pass, the tug and then another one in the Nordschleuse has reported in, she will be leaving at any time now, that is the HÖEGH LONDON, the HÖEGH LONDON, that is, when both have passed and you can get away from there, you must therefore, yes, er, then also move quickly to the west
	+1:14	**Hyp**	Yes, we will do that when both have passed
	+1:18	**WT**	Okay, all clear, we know, good watch then, bye
	+1:23	**HL**	Yes, Bremerhaven Weser Traffic again (name), (name), HOEGH LONDON
	+1:27	**WT**	HÖEGH LONDON, Weser Traffic
	+1:28	**HL**	Yes, can you let me know what HYPERION is doing now
	+1:31	**WT**	HYPERION is waiting, she is now, the wind is now pushing her on, she is allowing the MSC MALIN to pass first and when the MSC MALIN has passed the tug will have also passed and then she will keep right to the west, that is approximately off groyne 41
	+1:44	**HL**	Yes can you hold, er, tell them that they should keep well clear of us, er, we have to, er, hard navigate in this, er, wind here and she should report on Channel 8 if she wants to pass by our bow
	+1:58	**WT**	Yes, I will send him on Channel 8 again right away, I will tell him, he also knows that he should keep right to the west, I will still send him on Channel 8 in any case
	+2:06	**HL**	Yes, all right, thank you Mr (name)
	+2:08	**WT**	Yes, welcome, HYPERION Weser Traffic
	+2:10	**Hyp**	Yes HYPERION is also on 8
	+2:13	**WT**	Yes, please call the harbour pilot of the HÖEGH LONDON on Channel 8, they must also, when they get out of there, hard

			navigate, so they should also keep well to the west, that is, you have to sail right on the green buoys, call the harbour pilot of the HÖEGH LONDON on Channel 8 please
	+2:26	**Hyp**	Yes, will do
	+2:28	**WT**	Thank you
4 (16s)	**175810**	**WT**	HÖEGH LONDON, Bremerhaven Weser Traffic ***(no answer!)***
5 (1m:33s)	**175826**	**WT**	HÖEGH LONDON, Weser Traffic ***(no answer!)***
	+0:06	**WT**	MSC MALIN, Bremerhaven Weser Traffic
	+0:12	**Fried**	Bremerhaven Weser Traffic, FRIEDERIKE
	+0:14	**WT**	FRIEDERIKE, please standby, MSC MALIN, Weser Traffic
	+0:21	**WT**	FRIEDERIKE, Weser Traffic
	+0:23	**Fried**	Yes, we are now out of Fedderwarder Siel again and back to Bremerhaven in Fischereihafen
	+0:29	**WT**	Yes please send call sign...(subsequently irrelevant)
			…
	+0:58	**Fried**	We are sitting here behind the wall, that is, still at CT 4
	+1:03	**WT**	I see, yes I see, you wanted to, all right, okay, er, then please keep right to the west because a big car garage is just leaving the Nordschleuse, the HÖEGH, er, the HÖEGH LONDON, please keep right to the west
	+1:22	**Fried**	I am going over to the green side now
	+1:23	**WT**	Okay
6 (16s)	**180148**	**WT**	HÖEGH LONDON, Bremerhaven Weser Traffic ***(no answer!)***
7	**180330**	**Fried**	Bremerhaven Weser Traffic, FRIEDERIKE
	+0:09	**WT**	FRIEDERIKE, Weser Traffic
	+0:11	**Fried**	Yes, we are in the area
	+0:13	**WT**	Yes, that is there, take it very slowly, because I think, there is an MSC steamer, she is right on the western side, one is coming out of the Nordschleuse, I cannot raise them, er, I do not know what is going on now, er please, er, please proceed very slowly
	+0:26	**Fried**	Yes, we are moving very slowly here anyway against the tide, it, it will take some time
	+0:32	**WT**	Okay
8 (50s)	**180417**		
	+0:13	**WT**	HYPERION, Weser Traffic
	+0:16	**Hyp**	HYPERION receiving
	+0:17	**WT**	Yes, you see, in front of the southern end of the Stromkaje, MSC MALIN is right to the west there, I cannot raise her, please wait at the pier until the situation calms down
	+0:28	**Hyp**	Yes, I had intended to do that anyway, because I am also having problems getting away from here, but I will wait until MSC MALIN is ready and the HÖEGH LONDON is er, er, out and has passed me
	+0:38	**WT**	All right, thank you very much
9 (25s)	**180716**		
	+0:04	**WT**	HÖEGH HOLLAND, HÖEGH HOLLAND, Weser Traffic
	+0:12	**WT**	HÖEGH LONDON, HÖEGH LONDON, Bremerhaven Weser Traffic ***(no answer!)***

10 (52s)	**180812**	**HL**	Weser Traffic, HÖEGH LONDON
	+0:06	**WT**	HÖEGH LONDON, Weser Traffic, I er, this is (name), I believe that the MSC MALIN has a problem, I cannot raise her at present, she is right to the west beyond the western edge of the channel
	+0:19	**HL**	Mr (name), this is (name), yes, our two harbour pilots here on the HÖEGH LONDON are also very busy, they have now sent another tug from us to MALIN, engine running, at least smoke is coming out of the MALIN and, er, the harbour pilots seem to be in control
	+0:36	**WT**	Yes, thanks for the info, all right Mr (name), okay, thank you
11 (2m:12s)	**182155**	**WT**	Situation report (excerpt): [...] Wind at the Alte Weser Lighthouse west force 8, wind warning: W – NW 6-7, gusts of 9 [...]
	+1:06	**Hyp**	Bremerhaven Weser Traffic, HYPERION
	+1:09	**WT**	HYPERION, Weser Traffic
	+1:11	**Hyp**	Yes, we have cast off and are going over to the green side
	+1:14	**WT**	The FRIEDERIKE is sailing upstream, you see her, no?
	+1:19	**Hyp**	Yes.
	+1:26	**Fried**	Who called the FRIEDERIKE?
	+1:29	**WT**	FRIEDERIKE negative
	+1:30	**Fried**	Yes, thank you
	+1:34	**Hyp**	FREDERIKE the dredger, I see her
	+1:38	**WT**	Okay
	+1:39	**HL**	Bremerhaven Weser Traffic, HÖEGH LONDON (name) hello Mr (name)
	+1:43	**WT**	HÖEGH LONDON, this is Weser Traffic (name), evening
	+1:46	**HL**	**Yes, we are having a few problems here holding the vessel, are at the northern end of the Stromkaje right next to the bend, we cannot gain any height into the vessel and, er, yes, er, we may have to go alongside, here next to the vessels**
	+1:58	**WT**	Yes, thanks for the info
	+2:02	**HL**	(Inaudible)
12 (52 s)	**182613**		
	+0:04	**HL**	Bremerhaven Weser Traffic, this is HÖEGH LONDON again
	+0:06	**WT**	HÖEGH LONDON, Weser Traffic
	+0:09	**HL**	**(Inaudible)... the HÖEGH LONDON has gone alongside next to the three northerly vessels here, yes and yes, in a moment** (largely inaudible due to strong interference and ambient noise)
	+0:19	**WT**	Er, you have now gone alongside at the northern end, okay, we are aware, there was some noise, so I did not understand everything, northern end is okay. You have moored
	+0:32	**HL**	(Partially inaudible) **... we are most likely to run aground here at the northern end of the Stromkaje in a moment**
	+0:40	**WT**	Yes, we have understood, okay
13 (1m:6s)	**183011**		
	+0:04	**HL**	Bremerhaven Weser Traffic, HÖEGH LONDON
	+0:07	**WT**	HÖEGH LONDON, Weser Traffic
	+0:09	**HL**	Mr (name), this is (name), we are going to slow down a bit,

			cast anchor in a moment, and then we will stay here on the position for the time being
	+0:19	**WT**	Yes, you are going to slow down the speed and, er, make an anchor manoeuvre and stay on the position for the time being; the traffic situation is, I have the next incomer at buoy 37, one minute, that is the UNION RUBY, and outgoing I have no reported traffic from above at present
	+0:45	**HL**	Okay, no reported traffic, so we cannot do any more now then, we are positioned here at anchor outside the fairway then, and, er, she is also a little inside I have just seen, yes all right Mr (name), know the score, thank you
	+0:55	**WT**	You are welcome
14 (29s)	**183135**	**HL**	(Name) HÖEGH LONDON again
	+0:09	**WT**	HÖEGH LONDON, Weser Traffic
	+0:12	**HL**	Yes, HÖEGH LONDON again, the master would like to let go the anchor now (inaudible), as we are now, in this position, in this position
	+0:18	**WT**	Yes, you are letting go the anchor now, okay
15 (57s)	**184701**	**HL**	Bremerhaven Weser Traffic, HÖEGH LONDON again
	+0:06	**WT**	HÖEGH LONDON, Weser Traffic
	+0:09	**HL**	Yes, the current and wind are now pushing us crossways here into the fairway, we have been assigned a berth by Bremerhaven Ports, we are now tying up the tugs and will have an additional one to push at any moment now, and then we want to shift to the northern end of the Colpier[29]
	+0:25	**WT**	Yes, we are aware, I will inform the shipping, UNION RUBY is incoming between, er, 41 and 43 now, so, yes, I will inform her, but you will then proceed, no
	+0:39	**HL**	Well, it is very slow at the moment, but we will try our best Mr (name)
	+0:44	**WT**	Yes, all clear, we are aware, okay, thank you
16 (49s)	**184805**	**UR**	Weser Traffic, this is UNION RUBY on Channel 7
	+0:09	**Weser**	Bremerhaven Weser Traffic, tug WESER
	+0:10	**WT**	Tug WESER standby please, er, Mr (name), yes from the UNION RUBY, er, HÖEGH LONDON now has two tugs belayed, is lying across the fairway, everything is proceeding very slowly, er, she is destined for the northern end of the Columbuspier, no, everything is proceeding very slowly, she is trying her best
	+0:30	**UR**	Yes okay, we will hit the brakes as soon as we have passed the dredger and then we will monitor the situation
	+0:34	**WT**	Yes, super, when you have passed the dredger you will hit the brakes, all right, thanks
17 (1m:10s)	**185904**	**HL**	Bremerhaven Weser Traffic, HÖEGH LONDON
	+0:07	**WT**	HÖEGH LONDON, Weser Traffic
	+0:11	**HL**	Yes (name) again, so we have 2 shackles on deck, will then heave up the anchor, tugs are made fast and then we will shift to Colpier
	+0:19	**WT**	Yes, two shackles on deck, tugs are made fast, you are then shifting to Colpier, yes, the vessel behind you between 45 / 47

[29] Columbuspier

			has reduced speed, that is the UNION RUBY
	+0:31	**HL**	Yes, I will get back to you in a moment when we are underway
	+0:34	**WT**	Yes, okay, we are aware, thank you
	+0:38	**WT**	UNION RUBY, Weser Traffic
	+0:42	**UR**	Yes Mr (name)
	+0:43	**WT**	Yes, they are heaving up the anchor, second shackle on deck, the HÖEGH LONDON that is, tugs are made fast, they will let us know when they get underway
	+0:52	**UR**	Yes, okay, I just spoke with Mr (name), perhaps he will allow me through, as I said, we are keeping right to the west
	+0:58	**WT**	You are keeping right to the west for now, thank you
18 (1m:9s)	**191047**	**HL**	Bremerhaven Weser Traffic, HÖEGH LONDON
	+0:09	**WT**	HÖEGH LONDON, Weser Traffic
	+0:12	**HL**	Yes, we are proceeding, but have no engine and no rudder at the moment, it looks as if we have taken buoy 50 with us, er, between the rudder and propeller, and we, er, are now proceeding with the tug towards the Colpier, and yes, the GARD RUBY has just passed, er, the UNION RUBY has just passed
	+0:30	**WT**	Yes, we have on the screen, you have no engine, also no rudder, you probably have buoy 50 between, er, in the propeller, yes, okay, you are moving very slowly to Columbuspier now, that is correct

Chart 13: Log of the audio recording of VTS Bremerhaven, VHF Channel 7

3.2.6 Deployed tugs

The deployed forward and aft tugs RT SPIRIT and RT INNOVATION are identical vessels fitted with a Schottel drive. These tugs, which are called rotor tugs by the operating company, have three azimuthal rotating rudder propellers. That enables each of them to achieve a bollard pull of 78 t[30]. The operating company describes them as being particularly suitable for operations with VLCCs and vessels susceptible to wind.
The third tug assigned to the HÖEGH LONDON, the SVEZIA, is also a Schottel tug. She is capable of a bollard pull of 40 t.

The tug masters of the RT SPIRIT and RT INNOVATION were interviewed as witnesses by the waterway police. In addition, they each submitted a statement of facts. A summary of the comments of the master of the aft tug, RT INNOVATION, follows:

- After the tug cast off, she reportedly moved up to the stern of the HÖEGH LONDON to collect the pilot and make lee.
- As the tug master reportedly noticed the HÖEGH LONDON setting towards the east, he reportedly moved at full engine power to the forward half of the vessel in order to push from there.
- The tug therefore reportedly started to push on the starboard side on her own initiative, which was reportedly observed by the pilot.
- The effect of this pushing reportedly abated with the increase in speed and the tug reportedly slid on the HÖEGH LONDON's shell plating towards the stern.

[30] According to http://www.kotug.nl/www/fileLib/Spirit.pdf

- As the passing distance to MAERSK SEOUL was reportedly less than 50 m, the pilot reportedly requested her to move away. During this manoeuvre, she reportedly collided with one of the moored vessels and the tug was reportedly damaged.

The testimony and statement of facts of the master of the aft tug, RT SPIRIT, are summarised below but are limited to aspects which differ from the other statements:

- The tug SVEZIA was reportedly sent to the MSC MALIN by the advising harbour pilot.
- The RT INNOVATION was reportedly ordered to go to the starboard side of the HÖEGH LONDON by the advising pilot after casting off to provide support.

3.2.7 Pilotage service

Two pilotage services operate in the area of the Weser relevant to the accident. The first is the Lotsenbrüderschaft Weser II/Jade. Their pilots advise ship's commands in the lower course of the Weser, i.e. below the Geeste estuary. The pilots belonging to this organisation are referred to in the report as sea pilots. The second is the Hafenlotsengesellschaft (association of harbour pilots) Bremerhaven. Their pilots, the harbour pilots, advise ship's commands of vessels which sail into our out of the ports of Bremen or manoeuvre in them or sail into or out of the ports of the Bremerhaven Hafen Group.

The HÖEGH LONDON was not turned over to the sea pilot during the marine casualty in which she was involved.

3.2.7.1 Pilot training

The appointment and training of the Bremerhaven harbour pilots is governed by the Lotsenordnung für das Hafenlotsenwesen (pilot ordinance for harbour pilotage) in Bremerhaven[31]. Trainee pilots undergo a training programme which lasts at least six-months in which they *"familiarise themselves with all existing legislation for* [the] ... *operational area of a pilot, nautical, climatic and hydrological conditions, service regulations and the characteristics of the port*[32]*."* In the process, they participate in pilotage assignments in all parts of the port and on vessels of all sizes under the supervision of a harbour pilot.
Hafenlotsengesellschaft Bremerhaven stated that trainee harbour pilots participate in at least 600 pilotage assignments during training. Training reportedly focuses on the car carrier. The training concludes with an examination. After the first appointment, the pilots progress through levels of experience, which involves the possible size of the vessels to be piloted increasing at set intervals.
After training, all harbour pilots are expected to participate in five days of ongoing training each year. Ship-handling simulators are also used for the basic and ongoing training of pilots. In the process, scenarios which include the most adverse conditions, i.e. strong crosswinds and aft currents, are also practised.

[31] Dated 28 November 1979, adopted on the basis of the Bremischen Hafenbetriebsgesetzes (Bremen port operations act).
[32] Article 12 Lotsenordnung für das Hafenlotsenwesen (pilot ordinance for harbour pilotage) in Bremerhaven, 28 November 1979.

Two pilots are assigned to car carriers of more than 180 m in length and more than 30 m in width.

The harbour pilot responsible for advising at the time of the accident is an experienced pilot. He asserted in his written statement that in 2007 he had reportedly already advised on 320 car carriers of all sizes as a trainee under supervision. Since his appointment, he reportedly regularly advises on vessels, also those of 260 to 300 m. Prior to his appointment as a harbour pilot, he reportedly worked for ten years as a master on passenger vessels with a windage area of a similar magnitude and for a period of three years as a sea pilot. During the entire time he has reportedly successfully participated in several simulator courses.

3.2.7.2 Simulator training

To gain an insight into the procedures for transferring from the harbour pilots to the sea pilot, two BSU investigators attended a ship handling simulator course for sea pilots at the Nautical Science Department of the University of Applied Sciences Bremen on 22 March 2010. This involved the above procedure being practised with the simulated model of a car carrier. This model is also used as a reference for the '200 m-vessel'. The 200 m-vessel is a training model for vessels of between 180 m in length and the next stage with vessels of up to 210 m in length. The data of the car carrier RIGOLETTO are applied for the model. The data of the RIGOLETTO are:

- Gross tonnage: 43,487
- Length overall: 190 m
- Breadth overall: 32 m
- Draught (max.): 9.2 m
- Lateral windage area: 3,300 m².
- Engine rating: 12,800 kW
- Year built: 1977

Due to participating in the course and the conversations held at this time, the following key points were identified as regards the pilot transfer:

- For the transfer of the vessel from the harbour pilot to the sea pilot, the harbour pilot takes the vessel to a prearranged position at which the sea pilot is prepared to take over the vessel. The vessel is "not turned over until there is no further danger attached to continuing without tug support and the sea pilot considers it safe to take over the vessel. The turn over takes place when the vessel is on course and after all tugs have been released[33]."
- Depending on wind force, this position may be at the western edge of the fairway. This is also because the harbour pilot often has to walk a long way to the pilot ladder and during this period the vessel can only gather moderate speed and thus may begin to drift severely.
- The harbour pilot is usually collected by the forward tug. The aft tug may take up a position in front of the forward tug under certain circumstances so as to give the forward tug an element of lee protection.
- When sailing out of the Nordschleuse, the pilot transfer usually takes place abeam this lock, which means that the vessel does not need to slow down again subsequently.

[33] Quoted from the statement of the Hafenlotsengesellschaft Bremerhaven.

3.2.8 Traffic volume

To gain an impression of the traffic volume in relation to car carriers in Bremerhaven, the investigators contacted bremenports GmbH, which provided a summary of the car carrier movements in 2009. 760 vessel movements were counted in the area of Bremerhaven. 246 (32.4%) of these were vessels of ≥ 200 m. 152 of these vessels were in the range of ≥ 200 m to < 220 m and 69 in the range of ≥ 220 m to < 230 m. Eleven vessels were 240.5 m in length. No larger car carriers moored in Bremerhaven in that year.

To get an approximate idea of the existing lateral windage area, the side height from keel to upper deck (H.b.O.) was multiplied by the vessel's length and assessed in relation to a draught of 7.5 m:

- FALSTAFF L.o. = 199.0 m H.b.O. = 31.50 m Area = 4,776 m²
- TURANDOT L.o. = 199.1 m H.b.O. = 32.98 m Area = 5,073 m²
- HÖEGH LONDON L.o. = 228.7 m H.b.O. = 32.59 m Area = 5,738 m²
- TAMESIS L.o. = 240.5 m H.b.O. = 32.45 m Area = 6,003 m²

The TAMESIS is described by the operator as a 4th generation Ro/Ro vessel. She is one of the largest vessels that currently calls into Bremerhaven.

3.2.9 Vessel Traffic Service Bremerhaven

Vessel Traffic Service Bremerhaven is an organisational unit of the Waterways and Shipping Office Bremerhaven and is responsible for those tasks typically associated with a vessel traffic service. It provides a 24 hour service in shifts and has the following objectives:

- the prevention of threats to the safety and efficiency of vessel traffic;
- the prevention of risks originating from the shipping industry, including those to the marine environment and
- maintaining waterways in the condition necessary for shipping.[34]

VTS Bremerhaven covers the area of VTS Weser (1), which stretches from buoy pairs 3a/4a resp. A1/A2 up to buoys 93/96.
To perform its tasks, monitoring of the area of responsibility takes place. This involves the radar surveillance of a total of some 105 river kilometres[35]. Radar assistance is carried out under certain conditions and on request.
The AIS data of the vessels are covered and displayed in the VTS. Environmental data are also covered.
Various VHF channels are specified for communication within the VTS and its sections. A reporting obligation exists for vessels over a certain size. Amongst other things, the radar and AIS data as well as the VHF channels used for the VTS and the radar assistance are recorded for accident investigations.
The VHF channels used for pilot/pilot and pilot/tug communication are not recorded.

A shift is manned by a nautical supervisor (Nautiker vom Dienst – NvD) and nautical assistants (NA) placed under his authority. All recorded data and information assist the personnel on duty in creating an overview of the situation.

[34] Article 2 of Administrative Agreement VV-WSV-2408.
[35] From the flyer: The Vessel Traffic Service - Bremerhaven Weser Traffic, 2006

"To identify potential risks and disruptions, the overall situation must be continuously evaluated having regard to the traffic data, area data and environmental data as well as the following marginal conditions:

- quality of the radar information;
- availability and quality of other technical aids;
- manoeuvrability of the vessels involved;
- communication problems;
- discernible deficiencies in the ship's command;
- legal requirements;
- enactments, orders and administrative provisions."[36]

The principle decision about sailing with a vessel, therefore also berthing and unberthing under adverse conditions lay at all times in the responsibility of the ships command. It should be noted that also the port operator leaves this decision completely to the ships command.

The personnel on duty take a staged approach in a type of control cycle when responding to a detected inconsistency by providing information and warnings as well as advices or instructions.

"[...] there is basically a need for action by the Vessel Traffic Service in relation to liner traffic [on the Weser] if:

- traffic regulations are infringed;
- safe passage cannot be expected due to the particular conditions;
- the berthing or casting off manoeuvre is not possible without consideration for other traffic;
- vessels reliant on the tide are in the area;
- vessels with special status are in the area which require consideration;
- any other behaviour which deviates from the norm is identified."[37]

A situation report is transmitted at regular intervals to provide vessels transiting in the area with an overview. At minimum, it contains information on the traffic and weather situation.

As one of the largest car carriers calling at Bremerhaven, the HÖEGH LONDON was, inter alia because of her shallow draught, subject to no restrictions or conditions based on the size of the vessel. Furthermore, she was unable to claim the status of a right of way vessel for that reason[38]. The windage area plays no role in the stipulation of specific conditions.

Waterways and Shipping Directorate (WSD) North West replied to a questionnaire from the BSU. The core statements are summarised below:

- Car carriers are comparable with container vessels in terms of lateral area. Due to their "often unfavourable windage area to submerged area ratio or the

[36] Article 18 VV-WSV-2408.
[37] Article 20 VV-WSV-2408.
[38] Article 2 para. 1 German Traffic Regulations for Navigable Waterways (SeeSchStrO) in conjunction with No. 2 and 3 of the Notice to the SeeSchStrO of WSD North West.

unfavourable mass in relation to the available propulsion systems," they are relatively difficult to manoeuvre. In isolated cases, risks may arise from the increased space requirement of car carriers in multi-vessel traffic conditions.

- WSD North West is the opinion that this particular marine casualty was an isolated case. It sees no need for further considerations, such as restrictions on entry and departure or the introduction of a wind force restriction, because risks or hazards can never be excluded in a dynamic traffic situation.
- In particular, WSD North West believes it is the duty of the ship's command and advising pilots to take the necessary action to ensure vessels can manoeuvre safely. That must be reportedly carried out by:
  - taking into account the number of tugs, their manoeuvrability and bollard pull output;
  - taking into account the manoeuvrability of each vessel in relation to, for example, lateral area, trim and load;
  - taking into account the prevailing environmental conditions.

  This could mean that manoeuvres are postponed or aborted in individual cases.
- The question as to whether within the Shipping Administration calculations existed for the bollard pull tugs should be able to achieve in relation to car carriers was answered by a reference to the wind load charts from the simulation study of 2005[39].

[39] Von Morgenstern, Hermann: Simulation study: Simulationen Aussenweser und Bremerhaven, Band WSA-1, Revierfahrten und Hafenmanöver. Concluding report. 2005, Appendices, p. A 13.

4 Analysis

4.1 Wind

The weather report and the DWD forecast, respectively, for 0800 on 26 May 2009 indicated that the expected mean wind was 6 Bft. However, there were also warnings of heavy squalls, i.e. gales of wind force 10.
In the situation report of the VTS Bremerhaven at 1721, the wind at the Alte Weser Lighthouse was identified as 7 Bft. At 1821, 8 Bft was reported from there. Both situation reports warned of force 9 gusts.
The difference between the wind warning from 10 Bft to 9 Bft results from the fact that the VTS falls back at especially for her region produced forecasts from the DWD.
These wind forces predicted were also actually reached. For example, the wind station on the mole in Bremerhaven recorded gusts of force 8 Bft in the period relevant to the accident. However, experts from the DWD assumed that due to the low altitude of the measuring station, the actual values at an altitude of 30 m to 40 m would be 1 to 2 Bft more than that.
It should be noted that Bremerhaven Mole Measuring Station is at the mouth of the Geeste and thus located some 2 nm away from the Nordschleuse. Furthermore, in contrast to the total length of the container pier, a certain amount of shelter is offered by the land there in the case of west wind conditions.

The harbour pilots on the HÖEGH LONDON also observed wind forces of 8 to 9 Bft true wind while they were on the bridge and prior to casting off from the pier.

The values measured by the DWD resp. the VTS were confirmed by the wind data recorded on the HÖEGH LONDON. However, here the apparent wind actually acting on the vessel was measured.
Accordingly, wind forces of around 10 Bft true wind were measured only in the period of proceeding on the Weser until passing the MSC MALIN (for example 181142 and 181352). The apparent wind gust at 182250 of 29 m/s (11 Bft) was at the lower edge of 10 Bft in terms of the true wind.

After passing the MSC MALIN (1815), the wind force of the true wind and the apparent wind was 20 m/s (8 Bft) on average and prolonged until 1819.

The witnesses noted partly very high wind speed (gusts up to 12 Bft) in their statements. This indicates a complicated investigation to a certain extent. On the one hand only true wind speeds can be used as a base for consideration, since only they allow for a comparison. On the other hand the wind acts on the vessel with his apparent force, that is the force resulting from head wind and true wind. Ships command and pilots have to take this fact into account and may not be surprised by this.

4.2 Current

The expert established the velocity of the current in the southern area under consideration as being 2.5 kts. There are no data on the actual current velocities on the day of the accident because continuous measurement does not take place. For all further considerations, as the events that facilitated the accident took place in the southern area, this investigation presupposes the stated 2.5 kts.
The possible offset in direction to the pier up to km 73 was not further examined during the investigation as the collision with the three ships northerly of km 73 was unavoidable and independent from that.

4.3 Course of the accident

The summary of the course of the accident is based on the analysis of the VDR data by the investigators.

4.3.1 First part of the voyage

Analysis of the HÖEGH LONDON's VDR began with the data from 1520 onwards. At this point, the wind blew at about 3 to 4 Bft from 230°. At 1541, the master of the vessel requested a tug from Bremerhaven Port to push the vessel against the pier.
The mean wind speed was 6 Bft at the time. The wind-measuring instrument on the HÖEGH LONDON recorded gusts of 8 Bft.

At 1626, the harbour pilots arrived on the bridge of the HÖEGH LONDON. The master was informed by one of the pilots that a third tug had already been ordered by the pilots for manoeuvring in the lock. This was confirmed by the master. In addition, the usual briefing was carried out by the master. Since the wind had now increased to up to 9 Bft in gusts, one of the pilots ordered the tug INNOVATION, which was already alongside and pushing, to set to full power: "INNOVATION full." The observed wind force resp. the display on the bridge was discussed by the pilots: "That is an 8, finish!" and "41[40] in gusts now." This fact was also part of a message to Bremerhaven Port: "Bremerhaven Port – HÖEGH LONDON. We will not be able to leave on time. We still have no tug here and a front is crossing at the moment. Delay will certainly be twenty minutes."

Within just ten minutes, the wind had dropped to 5 Bft. The tugs made fast and at 1702 casting off from the berth began. In the interim, the wind had continued to decrease to 3 Bft.

The vessel was made fast in the lock by 1725. While waiting, the wind indicator on the ceiling in the middle of the bridge, which displayed the value '62.2' in the field 'Max Speed' in the top right corner (see Figure 46), was discussed. At the same time, it was discovered that the next weather front was approaching.

At 1740, the sea pilot was on the bridge. The handing-over of the advice from the harbour pilots to the sea pilot should happen at a later time.

[40] Knots are being referred to here. The display on the bridge of the HÖEGH LONDON deviates from that of the VDR because here the wind force is specified in m/s.

At 1745, the pilots on the HÖEGH LONDON had established radio contact on VHF Channel 8, the communication channel for pilots and tugs, with the pilot of the MSC MALIN. The beginning of the conversation was inaudible. In the course of the conversation, the assisting pilot on the HÖEGH LONDON said: "[...] only close in, we will come out as soon as we can see you properly."
At 1748, coordination between the sea pilot and the harbour pilot took place on the side of disembarkation.

At 1752, the wind was blowing at up to 7 Bft, the pilots on the HYPERION (Hyp) and HÖEGH LONDON (HL) coordinated with one another on the pilot channel following a request by the VTS:

(Inaudible)
HL: "Are you waiting until we are out of the lock?"
Hyp: "Yes, how far are you?"
HL: "Yes, we have not set off yet because we were waiting for you."
(Inaudible)
Hyp: "The MALIN is now abeam of me."
(Inaudible).

Figure 39: Display of the wind force and direction on the bridge of the HÖEGH LONDON at the time of the survey by the BSU; display of the wind force in knots (slightly backlit)

4.3.2 Second part of the voyage

As already explained in No. 3.2.3.2, and included in the charts 4 to 8, the VDR audio recording gives the impression of a third person, staying in the starboard bridge wing with the master and the pilot, and neither directly affiliated with the ships command nor the pilots. The later identified person stated only having stayed in the vicinity of the bridge wing. Despite intensive endeavours the reproach of this person having influenced the master could neither be verified nor ruled out, since the quality of the audio recordings by the bridge microphones installed on the bridge wings was poor. However, it can be assumed that the third person and the master talked to each

other. It could not be clarified it these conversations took already place before 181839.

At 175344[41], the main engine was set to 'dead slow ahead' and they began to leave the lock.

From 1754, a recurring alarm was audible on the bridge of the HÖEGH LONDON. One of the crew members, apparently the chief officer, explained to the sea pilot that the safety contour alarm was the cause. From 1759, the sea pilot took over acknowledgement of the alarm, i.e. the alarm was not switched off in the electronic chart system.

From 1758, the wind increased to 9 Bft.

At 1759, the vessel was out of the lock and then proceeded slowly through the basin on to the Weser. The turning manoeuvre on the Weser was carried out only by the forward and aft tugs without the support of the helm or engine.

At 1809, the radar reference line was reached. The midship of the HÖEGH LONDON was now situated in the middle of the dredged channel and she began to turn.

From 1809 to 1810, communication with the MSC MALIN as regards holding her position took place. The agreement with the MSC MALIN and the decision to pass her occurred at a time when the HÖEGH LONDON was still not in line with the fairway. This decision led to the vessel not being moved further westwards, for doing so would have been counter-productive for the intended manoeuvre. The voyage of the HÖEGH LONDON thus began with the vessel located to the east of the radar line, which also corresponds to the middle of the channel.
At 181139, the vessel picked up speed with a drift correction angle of about 13°. At the same moment, the harbour pilots noted that the wind speed was 46 kts (see also figure 14). At that point, the vessel was located at Metre 100[42], or about 2 cbl away from the MSC MALIN with her bow.
The two tugs were ordered to 'pull to the west' one minute prior to that.

The vessel approached the MSC MALIN at low rates of speed and starboard rudder angles. In the process, the HÖEGH LONDON was already heavily influenced by the wind, i.e. the course over ground (COG) was more than 331°, the general course resp. course made good on this section of the fairway.

The rudder was set to 'starboard 60°' at 181314 (stern at Metre 300) at the moment that they were leeward of the MSC MALIN, which proved successful, the COG dropped to less than 331° and the HÖEGH LONDON was able to gain height to west (1815, see Figure 27, HÖEGH LONDON with her bow on the radar reference line; distance to the pier approx. 170 m).

[41] Time corrected to manoeuvre printer by 1 min 22 s.
[42] Refers to the position of the stern.

The rudder angle of 60° was then maintained until 181830 resp. Metre 1,600. At the same time, the speed of the vessel increased from 7.1 kts over ground to 8.1 kts over ground.

MSC MALIN was passed at a distance of about 150 metres. In the process, the stern of the HÖEGH LONDON was on the eastern edge of the channel and the distance to the pier was about 150 m.

Figure 16, where in some cases the wind drops significantly between 1812 and 1814, also possibly illustrates passing through the lee of the MSC MALIN.

At 181318, the harbour pilots confirmed that the vessel is reportedly steering a course over ground of 328°.

At 181420, the HÖEGH LONDON had passed the MSC MALIN.

At 181525, the aft tug received the order to cast off.

After passing the MSC MALIN at 181420 and due to the onset of the influence of the wind again, the values for the COG climbed back and exceeded that of the general course of 331° continuously from 1816.
After passing the MSC MALIN, the HÖEGH LONDON moved steadily towards the eastern edge of the channel. The ship's command responded by gradually increasing the speed from 'dead slow ahead' to 'full ahead' between 181616 and 181740.

From 1816, the HÖEGH LONDON passed a section on which no vessels were moored for a distance of 500 m. About 2 minutes were needed for that at a speed of 8 kts.

During the entire course of events, the pilots repeatedly stated among themselves that the course over ground had not changed resp. had remained at more than 332° since 1816. After passing the MSC MALIN, the heading was between 317° and 321°.

At about 1817, the stern crossed the eastern edge of the channel. The distance from the stern to the pier was then about 150 m again.

At 181750, the forward tug apparently received the order to accompany for as long as it was reportedly possible in terms of speed.

At 181752, the master reassured himself about the chosen rudder angel (starboard 60) by asking the pilot.

At 181827, the advising pilot and the master agreed on the rudder angle. The master wanted to lay the rudder to “starboard 10”. The pilot advised after that “starboard 35”. The master implemented this recommendation with a corresponding order.

At 181907, approximately 1,000 m after passing the MSC MALIN, the stern was located at Metre 1,750, the harbour pilot responsible for advising recommended, after a discussion which started at 181852, apparently to bring about a change in

approach, the stop of the engine. This recommendation was implemented by the master with a corresponding order.
As the situation unfolded and after a discussion between the pilot and the master in the wing, this was apparently no longer supported by the master and after that all commands were made directly by the master without advice from the pilot.

With the engine set back to 'full ahead' at 181932, the master attempted to rectify the situation with frequent and rapidly changing rudder angles. In the process, courses over ground of slightly less than 331° were achieved. However, since the general course changed to 320.5° from Metre 3,770, a collision with the pier and the vessels moored there was unavoidable. The distance to the pier was approx. 0,8 cbl at this time. Therewith the ship lay at the right edge of the planned track. From 1819 the wind speed increased again.

At 1821, the HÖEGH LONDON practically plunged through below the container gantry cranes loaded as deck cargo on the ZHEN HUA 23.

At 182147, the engine was set to the even higher rate of speed 'navigation ahead'. However, the rated speed did not exceed 78 ^{1}/min.

At 182339, VTS Bremerhaven was informed about the situation by one of the pilots.

On the recommendation of a pilot, the crew sounded the tyfon at 182420 to warn the ships moored alongside the pier of the forthcoming collision.
At 182528, the first collision took place.

At 182550, the engine was set to 'stop' and at 182712 to 'emergency manoeuvre astern'.

4.4 Ship's command, navigation and communication

Analysis of the submitted check lists from the bridge of the HÖEGH LONDON revealed several notable issues:

- Bridge Check List No. 4 – Preparations for Departure:
  - Para. 18. 'Ship clocks synchronised' – After examining the data of the manoeuvre printer of the engine, this paragraph was apparently not fully implemented.
  - Para. 25. 'External conditions checked and found to be satisfactory for departure' – In his statement, the master asserted that the port authority had not reportedly forbidden him to proceed and that also the pilots reportedly expressed no concerns. The environmental conditions were reportedly thus surely acceptable.

The pilots were not prepared by the master for the forthcoming voyage with respect to wind load data. However, the pilots did not deem this to be necessary as they felt sufficiently familiar with the vessel size.

During the departure, navigation in the true sense did not take place on the HÖEGH LONDON, i.e. there was no documented position fixing. The track of the ship could be traced with the help of the displayed track in the electronic chart system. The

positions entered in the paper nautical chart did not correspond to the actual position of the vessel. Apparently they served only for a rough overview.
Although the proposed track was prepared on the electronic nautical chart and the paper nautical chart contained the general courses, preparation with respect to the safety contour alarm was incomplete. Consequently, immediately after leaving the Nordschleuse a recurring audible alarm started, which needed to be acknowledged each time. To begin with, this occupied the chief officer, who in addition to his actual work also had to constantly acknowledge the alarm. Subsequently, it was taken over by the sea pilot.

The chief officer and the assisting pilot, who were located on the bridge, were able to see the current situation, i.e. the contour of the vessel and the track of the vessel, using the display of the electronic nautical chart.
In contrast, the master and the pilot responsible for advising did not have a display of the vessel's position on the fairway at their location in the wing. The only resources at their disposal were the Hofe and Fischereihafen leading light lines. In the current situation, i.e. with the prevailing visibility and daylight, that provided them with a means of assessing the vessel's position.

Communication within the ships command and between the pilots was low. At least the discussions which could be understood, regarding the track of the vessel held in German and English, only included information about the vessel's speed over ground and course over ground as well as the observed wind speeds.

The exchange of information between the master and pilot responsible for advising cannot be evaluated due to poor audio recording.

4.5 External communication

Communication between the HÖEGH LONDON, the other vessels and the VTS, which was carried out by the pilots, was clear and understandable. The misunderstanding with the HYPERION occurred due to the previous communication on VHF Channel 7. The arrangements made there and information could give the impression that the HYPERION would cast off before the HÖEGH LONDON sailed out of the lock. Communication between the pilot of the HÖEGH LONDON and the VTS illustrates that the pilots were aware of the situation and, in particular, the prevailing winds. For example, the VTS was requested to emphasise to the ship's command of the HYPERION that she should reportedly keep far to west after casting off because they themselves reportedly intended to 'hard navigate'.

4.6 Forces on the vessel

From the simplified comparison of the forces on the vessel[43], it can be seen that with its output of 27 t tow-rope pull, engagement of the bow thruster would have been insufficient in excess of 9 Bft. The pilots accounted for that by using two tugs with 78 t and one with 40 t bollard pull for direct manoeuvring up to the Weser and beyond. This would have probably compensated for the wind forces resulting from a wind speed of between 24.5 m/s and 27 m/s (both equal to 10 Bft).

[43] At the basis of the forces calculated by BSU

The ratio changed with the increase in the HÖEGH LONDON's speed. Although two tugs were working on the vessel, the wind increased to 10 Bft at the same time. On the assumption that the aft tug achieved the bollard pull output stated in para. 3.2.8, the vessel would have been subjected to the following forces:

W (271 t) ↔ P (79 t) + T (62 t) + T (52 t) = 193 t

The wind forces were thus clearly predominant and, in fact, it was not possible to hold the vessel against the wind.

The situation after the wind fell to 9 Bft is more difficult to consider. Theoretically, the relative forces would have now been sufficient to hold the vessel against the wind with two tugs:

W (180 t) ↔ P (79 t) + T (62 t) + T (52 t) = 193 t.

However, the forces applied by the aft tug in particular are difficult to determine.
The situation was clear again when the aft tug cast off, the wind forces were predominant.
It remains to be noted that it would have been hardly possible to make headway towards the west even at wind force 8 Bft with only the forward tug and selected rudder angle (starboard 60°):

W (134 t) ↔ P (79 t) + T (62 t) = 141 t.

Mathematically, it would only have been possible to gain height up to a wind force of 7 Bft[44] with one tug:

W (107.5 t) ↔ P (79 t) + T (62 t) = 141 t.

Taking the manoeuvring information booklet supplied by the vessel operator (s. No. 3.2.3.6) and the data about wind forces at different wind acting angles listed there as a basis, a higher wind force must be assumed at a deviation of 90° wind acting direction. Accordingly the factor for the fully laden condition in the most unfavourable case (wind acting direction 60° and 120° respectively) is approx. 1.353. The factor for the ballast condition is approx. 1.153. The factor was averaged since not further data was available and resulted in the value 1.253.

Based on this factor it would mathematically not have been possible to gain space with a wind force of 18m/s[45] (corresponds to 120.6 t wind load at 90°), since a wind load of 151 t (120.6 t x 1.253) results from 120° wind acting angle

For the examination of the torque with an attached forward tug, the actual behaviour of the HÖEGH LONDON confirmed the assumption of the forces acting on the vessel. At a steady rudder angle (60°) practically no change in heading and course over ground was observed.

After the stern tug was released, she first moved to the starboard side of the forward half of the HÖEGH LONDON. According to Hensen[45], the forces applied by the pushing tug could have been 80% of the bollard pull. However, here the presumed

[44] 17 m/s
[45] Hensen, Henk: Tug use in Port. The Nautical Institute. London, 2nd Edition, 2008, p. 58, Figure 4.20

angle of pressure would be 90° to the direction of the vessel, which was probably not the case. On the assumption that the tug would have been capable of applying 50% of her bollard pull, the relative forces would be as follows:

W (180 t) ↔ P (79 t) + T (62 t) + T (39 t) = 180 t.

In fact, the pressure applied by the aft tug could not prevent a further shift to the east. Moreover, due to the small distance to the turning point, only low torque could be applied. Subsequently, the aft tug slid along the starboard side of the HÖEGH LONDON and achieved hardly any effect.

With the increase of the HÖEGH LONDON's speed, the potential bollard pull of the forward tug reduced further and thereby decreased the possibility of making headway to the west with the vessel.

4.7 Vessel's speed and rudder angle

The rapidness with which the speed of the HÖEGH LONDON increased after the 'starboard 60°' rudder angle was cancelled is notable.
After being set to 'full ahead' at 181740, the speed only increased to 0.5 kts up to 181850. In contrast, with a rudder angle of not more than 15°, the speed increased by about one knot per minute from 181932. This may be an indication of the enormous forces on the Becker rudder at a 60° rudder angle.

This investigation does not assume that the HÖEGH LONDON came to a stall as the speed over ground was no more than 8.5 kts and thus about 6 kts through the water during the period at which the rudder was set to 'starboard 60°'.

It is assumed for investigation purposes that stopping the main engine at 181906 had no influence on the further course of events, since “full ahead” was already applied again at 181932.

4.8 Pilot training

Participation by the investigators in a simulator exercise provided an insight into the exercises carried out on the simulator, but of course not an evaluation of the training in general.

The vessel used for the simulator model has a windage area of 3,300 m². Her windage area is thus only about 50% of that of the HÖEGH LONDON. Therefore, it must be assumed that the behaviour of the model vessel differs significantly from that of the HÖEGH LONDON.

The University of Applied Sciences Bremen has another model vessel available, the 260 m vessel. It was developed for the expansion of the lock in Bremerhaven and is used as a comparison and training vessel for the largest currently existing or planned car carriers. The model of this vessel is used only in a special training course. In fact, these vessels do not or only very rarely call at Bremerhaven.

4.9 VTS Bremerhaven

During the period of the accident, the information exchanged between the VTS and the vessels HÖEGH LONDON, MSC MALIN and HYPERION was conducted by one of the nautical assistants. The exchange of information did not reveal any particularities. The nautical assistant endeavoured to provide the vessels with the necessary information and/or obtain information. The latter was not possible to some extent, especially when the MSC MALIN was held off the berth while the HÖEGH LONDON entered the Weser, turned there and the pilots of both vessels were heavily involved in manoeuvring the vessels.
The HYPERION was told to keep very close to the green buoy line after casting off as the HÖEGH LONDON also intended to move far to the west following departure and therefore the space available would be very limited.

The VTS did not involve itself in the close-quarters situation between the MSC MALIN and the HÖEGH LONDON. Moreover, the approach to the pier was not questioned. On reflection, in the prevailing wind conditions it is difficult to understand why the passage of the two vessels was not rated as a dangerous situation[46].

According to a statement of the WSD North West, the WSA Bremerhaven avails of a wind load diagram contained in a simulation study[47] as a working paper in addition to technical publications when dealing with facts subject to authorisation. This simulation study was assessed for the investigation. Very large container vessels with lengths of 350 m and 394 m were used for the simulation, which was, inter alia, intended to develop a decision making aid for the expansion of the turning area off the container pier in Bremerhaven. The study contained the wind load charts for such vessels. However, the data used here are hardly comparable with that of the HÖEGH LONDON:

- the 350 m model vessel possesses a windage area of 9,100 m²;
- the engine rating of this vessel is 91,000 kW. (The HÖEGH LONDON possesses 20% of this rating.) According to the calculation discussed in para. 3.2.3.6, that results in a tow-rope pull output of 409 t and would theoretically be sufficient to compensate for the wind load on this vessel at a wind force of 10 Bft;
- the vessel is fitted with a bow thruster with a tow-rope pull output of 30 t and two stern thrusters with 30 t tow-rope pull in total.
- the study assumes, that the wind load values reach their maximum at 90°. This did not apply to HÖEGH LONDON.

[46] Within the meaning of art. 20 VV-WSV-2408.
[47] Von Morgenstern, Hermann: Simulation study: Simulationen Aussenweser und Bremerhaven, Band WSA-1, Revierfahrten und Hafenmanöver. Concluding report. 2005.

5 CONCLUSIONS

5.1 Wind

The wind speeds of 8 Bft and 9 Bft should have surprised neither the ship's command nor the pilots of the HÖEGH LONDON. But also wind force 10 was in the realm of possibility according to the general weather forecast. The wind speeds were also predicted in English via NAVTEX by means of the transmitted weather forecasts of the DWD and the situation report of the VTS and would have been therefore accessible to the ship's command of the HÖEGH LONDON as well. Knowing that such forecasts can even be exceeded locally is also part of basic seamanship.

The wind values indicated on the HÖEGH LONDON by the anemometer were those of the apparent wind. This value depends on the direction and force of the true wind and the speed of the vessel. The display of the wind indicator on the HÖEGH LONDON allowed no conclusions as to the displayed wind type. In this respect, an exchange of information between the ships command and the pilots about the type of display would have been helpful.

5.2 Course of the accident

It was pointed out in the statements that the voyage of the vessel started at the right side of the fairway and that a safe passage distance to the MSC MALIN was provided. Apart from further events, existing and forecasted wind conditions, this point of view is understandable.
The investigators consider the decision to pass the MSC MALIN taken by the ship's command and the pilots as the initial cause for the accident. This decision led to the HÖEGH LONDON under neglect of the prevailing circumstances not being taken as far to the west as possible, which meant she started to proceed from an unfavourable position. The vessel was thus unable to manoeuvre freely across the entire width of the fairway. The situation at the beginning of the voyage was aggravated by the simultaneous onset of an increase in wind speed. However, the vessel would not have been able to follow her track without complications even at lower wind speeds with the chosen rudder angel and one bow tug. That is demonstrated by the estimations of the forces on the vessel and the track course after passing the MSC MALIN (1815 to 1819) were the vessel drifted to the east at wind forces of 8 Bft.

The decision to start the voyage to the east of the radar reference line resulted in the selection of the extreme starboard rudder angle. With it and the use of the tugs, the ship's command apparently intended to traverse the vessel, i.e. move to the west. This was unsuccessful because the forces generated by vessel and tug were insufficient to prevail against the wind. Subsequently, the HÖEGH LONDON approached so close to the pier that it apparently no longer seemed advisable to the ship's command to change the approach, because with a port rudder angle they considered a collision with the pier or the vessels moored there to be the inevitable result.

Overall, the course of the accident is marked by the fact that the force or effective duration of the wind was misjudged and spontaneous decisions and approaches were pursued for too long. The onset of the drift to the east after passing the MSC

MALIN was already evident at 1816 and should have led to a change at this point. The necessary space would be also available for that at the pier for a short period after 1816.

Under the given circumstances, a pilot transfer which was safe for the vessel was no longer feasible after the beginning of the voyage and especially after the aft tug was released. In the prevailing wind conditions off the container pier, the vessel was unable to reduce her speed without beginning to drift immediately. Since only one other tug was available, it would not have been possible to hold the vessel. That also applies to the assumption that the ship's command and pilots attempted to keep to the intended track by implementing other manoeuvres or rudder angles after passing the MSC MALIN. It follows that the best time to change pilots would have been immediately after turning the vessel on the Weser. While making hardly any headway in any case, it would have been possible to initially hold the vessel there using tugs, bow thruster and propeller. However, this course would have made it necessary to deviate from the usual manoeuvre during the pilot turn over. The vessel could have been initially held and it would then have been necessary for the tug to be released under the guidance of the sea pilot. The early release of the third tug was without consequence after the decision on the start of the voyage. However, in the case of a pilot turn over immediately after turning on the Weser, this tug would have been very useful.

5.3 Ship's command, navigation and communication

The master and the pilots discussed the basic characteristics of the vessel before starting the voyage. They limited their discussion to the standard information contained in the pilot card. This contained no information on the wind loads from the “Maneuvering Booklet” on the HÖEGH LONDON. The investigators believe that precisely for such large car carriers the pilot card should include more information. A good example can be found in Nash[48].

On the one hand, the master actively participated in the management of the vessel. When he felt that the advice he was receiving from the pilots was no longer sufficient, he broke off further consultation and navigated the vessel alone. On the other hand, he initially followed the advice of the harbour pilots unreservedly in spite of the fact that he was presumably perfectly familiar with the manoeuvring behaviour of his vessel under the prevailing wind conditions. Nevertheless, he considered neither the passing of the MSC MALIN nor the subsequently proposed manoeuvre 'starboard rudder 60°' to be critical.

From point of view of the investigators the cooperation among the bridge team was insufficient. First, only a one-sided position fixing was carried out because the position of the ship and the track was only readable at the electronic chart. See also STCW Code Section AVIII para. 47[49]. Second, the information provided on the electronic nautical chart and the distance information available on the radar was apparently not forwarded to the master or the pilot responsible for advising.

[48] Nash, Nick: The optimum 'quick bridge manoeuvring guide'. In: Seaways, 2009, September, p. 8-12.
[49] Excerpt from para. 47 – Coastal and congested waters: “[…] Fixes shall be taken at frequent intervals, and shall be carried out by more than one method whenever circumstances allow.

Therefore, both individuals only had the Hofe and Fischereihafen leading light lines at their disposal. See also STCW Code Section AVIII para. 49[50].
A well-organised bridge team must maintain a constant flow of information at all times regardless of visibility. In the prevailing weather conditions information on the track course and distance to the pier would have been absolutely necessary. Such an exchange of information should be a matter of course even in better conditions as only continuous practical application brings about safety and routine.

5.4 Pilot training

The pilots assigned to the HÖEGH LONDON were experienced and due to practise familiar with the size of vessel. Nevertheless, they advised the ship's command of the HÖEGH LONDON such that the vessel was put into an unfavourable situation from which it was not possible to manoeuvre out of subsequently. This marine casualty can be seen as an isolated case. However, precisely this accident should be used for training to establish what is feasible, and what is not.
The vessel used for the simulation model should be supplemented by another model which corresponds more with the average car carrier of today.

5.5 VTS Bremerhaven

WSD North West made reference to the aforementioned wind load chart with respect to a basis for assessing the movement of car carriers by WSA Bremerhaven. Precisely against the background of the statement of WSD North West regarding the comparatively poor manoeuvrability of car carriers, reference to this wind load chart is difficult to understand as both classes of vessel are incomparable. Real wind load data from on board the current vessels or simulations with a current model vessel would be more helpful in the assessment of traffic situations by WSA Bremerhaven. It is possible that these data or simulations will also lead to the recording of the windage area as a criterion for the assessment or imposition of certain conditions of the maritime police for these vessels.

[50] Excerpt from para. 49 – Sailing with a pilot on board: "[...] The master and/or the officer in charge of the navigational watch shall co-operate closely with the pilot and maintain an accurate check on the ship’s position and movement."

6 Safety recommendations

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

6.1 Ship's command and operator of the HÖEGH LONDON

The Federal Bureau of Maritime Casualty Investigation recommends that the ship's command of the HÖEGH LONDON and the operator of the vessel review the accident as part of their safety management. In particular, the wind loads and corresponding responses of the ship's command should be addressed as part of this.

6.2 Ship's command of the HÖEGH LONDON

The Federal Bureau of Maritime Casualty Investigation recommends that the ship's command of the HÖEGH LONDON make improvements in terms of preparing for a voyage, especially as regards the weather, the pilot card and the equipment on the bridge. Moreover, improvement in the cooperation among the bridge team in terms of position fixing, tracking and communicating the facts identified while doing so is recommended.

6.3 Bremerhaven harbour pilots

The Federal Bureau of Maritime Casualty Investigation recommends that the harbour pilots review the accident as part of their quality management. In particular, the wind loads on modern car carriers and corresponding responses of the bridge team, but also the corresponding tug should be addressed as part of this. It is recommended that a simulation model which corresponds to current car carriers is used for basic and ongoing training. At the same time, the quality of communication within the pilot team should be critically scrutinised.

6.4 WSA Bremerhaven

The Federal Bureau of Maritime Casualty Investigation recommends that the WSA Bremerhaven use more appropriate wind load data for the assessment of facts related to car carriers. Simulation runs with a current model of a car carrier could be useful in assessing the manoeuvring behaviour of and potential risks originating from car carriers in certain wind forces.

7 SOURCES

- Investigations by the waterway police Bremerhaven
- Written statements
  - Ship's command
  - Lotsenbrüderschaft Weser II/Jade and Hafenlotsengesellschaft Bremerhaven
  - Tug masters
  - WSD North West
- Witness accounts
- Expertise by the WSA Bremerhaven on the current on the Weser
- Nautical charts, Federal Maritime and Hydrographic Agency (BSH)
- Official weather expertise by Germany's National Meteorological Service (DWD)
- Radar recordings, Vessel Traffic Service Bremerhaven
- Images: the photos at Figures 6 and 8 were taken on board the tug RT SPIRIT. The photos at Figures 7 and 9 originate from on board the BRUNO ILLING. The photo at Figure 36 was taken by WSP Bremerhaven. All other photos were taken by the BSU.