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

Investigation Report 564/06

Very serious marine casualty

Foundering of the Fishing Vessel HOHEWEG on 8 November 2006 in the Alte Weser area, western Nordergründe

15 March 2008

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 200.

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

This report is not to be used in court proceedings or proceedings of the maritime court investigation. Reference is made to § 19 Paragraph 4 SUG.

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

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Table of Contents

List of Figures

1 Summary of the marine casualty

The Fishing Vessel HOHEWEG with four crew members on board was on a voyage from the River Weser to the River Elbe estuary when at about 20.44 h[1] on 8 November 2006 approx. 1.5 nm north of the Alte Wester navigation channel buoy "A6" the radar echo as well as the AIS target[2] of HOHEWEG disappeared from the screen. The first distress message from HOHEWEG was transmitted by the EPIRB[3] at 20:44:45 h without stating a position, whereupon search and rescue measures were initiated.

After a targeted search by the Wreck Search Vessel ATAIR, the wreck of FV HOHEWEG was located at position 53°55,46'N and 008°02,47'E in approx. 8 m water depth on the Nordergründe on 15 November 2006. BSH (Federal Maritime and Hydrographic Agency) divers went down for the first time on 17 November 2006.

The corpse of the 38-year-old deckhand was washed ashore in the fore-tide terrain off Pellworm on 7 December 2006 and the corpse of the 47-year-old helmsman was washed ashore at Kaiser-Wilhelm-Koog on 8 December 2006. The 18-year-old apprentice was only discovered off Heligoland on 10 June 2007 and the 27-year-old master is still missing.

The wreck of HOHEWEG was salvaged on 23 July 2007 and taken to Bremerhaven, where after completion of the BSU investigations the fishing vessel was scrapped.

[1] All time data relate to Central European Time (CET) = Universal Time (UTC) + 1 hour
[2] AIS = Automatic Identification System,
[3] EPIRB = Emergency Position Indicating Radio Beacon

2 Scene of the casualty

Type of event:	Very serious marine casualty, 3 fatalities and 1 missing person
Date/time:	8 November 2006, approx. 20:44 h
Location:	River Weser, on the Nordergründe at buoy “A 6”
Latitude/longitude:	φ 53°55.46’N λ 008°02.47’E

Section from chart 3014, sheet 14 Federal Maritime and Hydrographic Agency

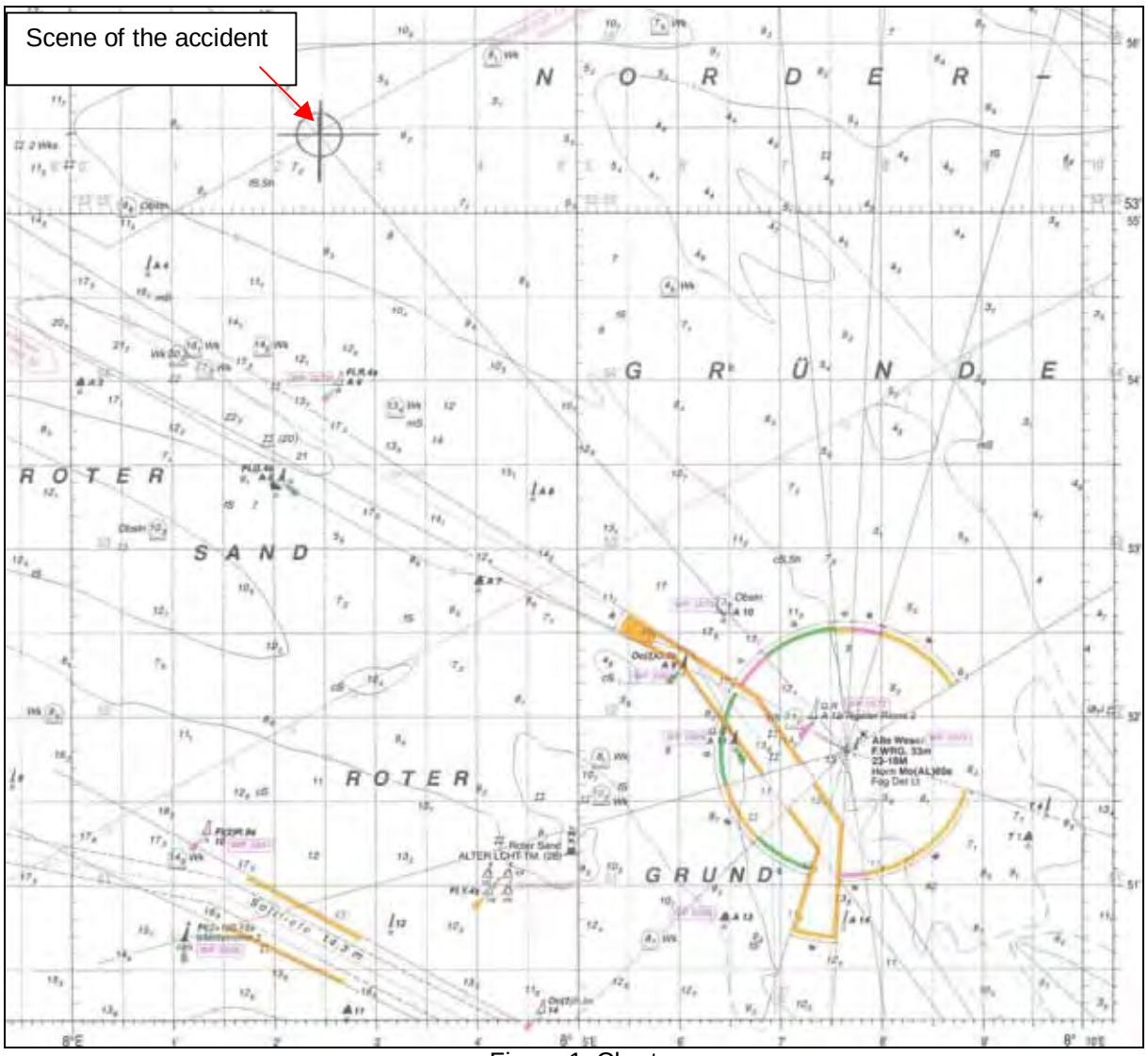


Figure 1: Chart

3 Vessel particulars

3.1 Fishing Vessel HOHEWEG

Figure 2: FV HOHEWEG

Older photo prior to conversion 2003/2004 (Photo : Hasenpusch)

3.2 Main particulars

Name of vessel:	HOHEWEG
Type of vessel:	Fishing vessel
Nationality/flag	German
Port of registry	Brake
IMO number:	7349481
Call sign	DEOY
Fisheries code	NB1
Vessel operator:	Hullmann Seefischerei OHG
Year built:	1974
Building yard/location:	Julius Diedrich Schiffswerft, Oldersum
Classification:	Germanischer Lloyd
Length over all:	26.60 m
Length between perpendiculars:	23.00 m
Width over all:	6.64 m
Side height:	3.58 m
Draft at the time of the casualty:	approx. Df = 2.05 m, Dm = 2.81m Da = 3.58 m
Gross tonnage:	122
Displacement at the time of the casualty:	Approx. 213 t
Service speed:	10 kn
Engine rating:	Installed: 412 kW, throttled to 221 kW
Main engine:	Deutz, Typ SBA 8M528
Propeller:	Fixed propeller, 4 blades and Kort nozzle
Number of crew	4

4 Course of the accident

At approx. 12.10 h on 8 November 2006 Fishing Vessel HOHEWEG with four crew members on board left the lock in Brake and proceeded downstream along the River Weser. Together with the Fishing Vessel ROTESAND from the same vessel operator, the vessel was on a transfer voyage to the Baltic Sea in order to catch codfish there. Already shortly after leaving the lock, nearby the Sandstedt ferry, the propulsion shaft of FV ROTESAND turned hot as a result of an unbalance. FV HOHEWEG thereupon took FV ROTESAND in tow to return to the lock for repair in Brake. The tow line was detached in front of the lock entrance and FV ROTESAND proceeded into the lock under its own power as the shaft had cooled down in the meantime. At about 13.10 h HOHEWEG headed towards the sea on its own. The vessel made an intermediate stop in Bremerhaven from approx. 15.30 h to 17.30 h to take three tonnes of vessel ice on board that was loaded loose into the fish holds using a loading "trunk". At about 17.44 h the vessel left the Small Chamber of the double lock in the Fischereihafen Basin in Bremerhaven to proceed downstream the River Weser towards the sea.

As HOHEWEG was not obliged to make any notifications or reports since it fell below the length limits for such vessels, FV HOHEWEG did not notify the VTS Bremerhaven that it was leaving, so that the radar echo was not given any so-called tracking sign on the screen of the VTS. The Motor Coaster Vessel HELGOLAND that had reported to the VTS because of its size was proceeding shortly aft of HOHEWEG and was given the tracking sign C9.
At approx. 18.50 h MV HELGOLAND overtook FV HOHEWEG between buoys 32 and 34. At about 20.30 h MV HELGOLAND carried out a 90° change of course to starboard shortly after passing buoy "A4" in order to proceed towards the Elbe navigation channel with a north-easterly course. According to the radar records, at this time FV HOHEWEG was approx. 2 nm behind HELGOLAND at buoy "A6". According to the radar and AIS data, FV HOHEWEG altered its course by approx. 50° to starboard approx. 0.5 nm after buoy "A6" in order to proceed towards the Elbe navigation channel too. At 20..43 the radar echo could no longer be recognised distinctly, and at 20.44 h the AIS signal disappeared too. The first distress message from the floated up EPIRB was received without any situation report at 20:44:45 h.

According to the situation report of VTS[4] Bremerhaven Weser Traffic at 20:18 h, a south-westerly wind of force 6 to 7 Bft was blowing and a wind warning for winds from west turning to northwest with gusts of 9 Bft had been announced.

[4] Vessel Traffic Services

5 Investigation

The Federal Bureau of Maritime Casualty Investigation (BSU) was notified of the casualty by fax at 06.10 h on 9 November 2006 by the Waterway Police (WSP) Cuxhaven and started the investigation immediately.

5.1 History of the vessel

The vessel was built in 1974 at the Schiffswerft Joh. Dietrich yard in Oldersum, East Friesland, as Fishing Vessel ROSWITHA, BX 758, under newbuilding number. 123. The principal and owner up to 1990 was Captain F. Jarchau. The vessel was designed and operated as a side-set trawler motor fishing vessel, with the trawl boards run on the two “gallows” located on the main deck on the starboard side. Major conversion work such as the installation of a fixed Kort nozzle to increase the thrust of the propeller and the mounting of an aluminium weatherguard on the port side of the main deck with roofing over half the main deck were ordered by Captain Jarchau in 1980 under the supervision of GL and/or the See-BG (Marine Insurance and Safety Association) at a shipyard. The vessel fished in the North Sea up to the Faröe Isles and west of the Shetlands. Wind forces of around 10 Bft were quite normal. During this time no major damage or stability problems occurred.
After the death of the first owner the vessel passed into the ownership of Hullmann Seefischerei OHG in Brake on 25 January 1990. In the year 2003/2004 major conversions and renewals by comparison with the construction and outfitting condition of the vessel dating from the year 1974 were carried out without the supervision of a classification society or the See-BG by a steel construction firm at the pier in Brake. Contrary to the obligation pursuant to § 13 Para. 1 No. 1 of the Ship’s Safety Regulation, neither the See-BG nor the classification society were informed of the conversions.

Figure 3: Fitting out condition 9 June 2006

With this work Fishing Vessel HOHEWEG was re-equipped from a side trawler to a "stern trawler"[5]. Basically, with this altered catching method fishing is carried out with three trawl warps and two nets instead of only two trawl warps and one net. For this purpose a net winch with two rollers including the launch device, chains and rollers was installed on the poop deck directly aft of the wheelhouse. The trawl boards were stowed above poop deck height on the port and starboard sides aft on the railing on newly installed massive holders. The old trawl warp winch with two warp drums and a net roller stood on the main deck in the fore-and-aft line of the vessel and was replaced by a winch arranged crossways on the vessel with three drums, a hydraulic system and foundations. The changed catching method made it necessary to install additional rollers and guide pulleys on steel foundations on the forecastle deck for the catching gear. Behind this, on a level with the main deck, a heavy steel rail mounted in approx. 1980, running all round and used as a towing carrier was removed, as well as the fish-processing material installed on the main deck after the heeling test in 1974 and the slaughtering machine. In the way of the fish hatches beneath the weatherguard on the port side, the new fish-processing installation consisting of conveyor belts, washing drum, water container and slaughtering table was installed. All wooden boards of the fish pounds were also taken from on board the vessel. In order to not to have to carry so much dry ice when running out, a cooling aggregate and cooling coils were installed in fish hold number 2 under the forecastle.
The poop deck was extended, the bulwark on the starboard side was welded closed with a steel plate, and the aft trawl board gallows now no longer required was removed. The railing on the poop deck was covered with plates and the liferaft was relocated from the poop deck to the weather-protection deck above the wheelhouse. The inflatable boat that had originally been stored on the poop deck had already been stowed on the compass bridge at this time.
A survey of the vessel was carried out by the responsible surveyor of the See-BG in 2003 prior to the conversion, and in 2005 after the conversion, without anything about the conversion work being noted in the files. The questions as to whether any conversion work had been carried out since the last survey was expressly negated by the vessel command as demonstrated in the survey files of the See-BG.

5.2 Weather and sea conditions

5.2.1 DWD Weather Expertise

On 28 November 2006 Germany's National Meteorological Service (DWD) produced an official expertise on the weather and sea conditions on behalf of BSU.

The weather situation on 8 November 2006 was determined by several areas of low pressure over the North-East Atlantic, a marginal atmospheric disturbance over the northern part of the North Sea and an area of high pressure extending from the Azores to Greece. During the second half of the day the marginal atmospheric disturbance developed over the northern part of of the North Sea to become a low

[5] In this type of vessel the net with the catch is still hauled in midships to the catch deck on the starboard side and over the bullwark, by contrast with a stern opeerating trawler that hauls in its nets via a hauling-up facility at the stern.

pressure system, and with pressure falling further it moved towards the southern part of Sweden. The front system of this low pressure area crossed the German Bight from the northwest in the evening.

The weather and sea conditions were such that the sky was mainly heavily clouded and in the evening it rained from time to time. The horizontal visibility during the day was between 3 and 7 km, and in the evening hours visibility conditions improved to visibilities of more than 10 km. In the early afternoon the air temperature was 9°C and continued to rise up to a peak of 13°C for the day close to midnight. The water temperature in the southern German Bight was between 10°C and 12°C.

The sun set at about 16.41 h and the moon rose at 17.58 h. The waning moon was in its first quarter. On 8 November 2006 high water in Bremerhaven, Alte Weser Lighthouse, was at 13.48 h, and low water at 20.30 h.

In the relevant sea area in the southern region of German Bight, a fresh to strong wind from the southwest with a mean force of 5 to 6 Bft was blowing in the afternoon of 8 November 2006; gusts of up to 7 Bft were reported in the afternoon. After the front passed through in the evening, the wind changed to west and freshened up to 7 to 8 Bft on average, with gusts of up to 9 Bft. (The wind force figures stated relate to the 10 min-average of the wind speed measured at a height of 10 m.)

In undisturbed deep water conditions, a wind force of 5 to 6 Bft with a stable direction sustained for over six hours can generate a wind sea with significant wave heights of around 2 m. In the evening of 8 November 2006 the wind freshened up to an average of 7 to 8 Bft, turning slightly to the west, so that the significant wave heights may have been close to 3 m. This is confirmed by the recordings of the measuring buoy “Elbe” located at position 54°1.00’N and 008°6.83’E.

With the west-southwest wind direction prevailing at about 19.00 h, it can be assumed that deep water conditions were found in the Alte Weser area with the significant wave height of the wind sea being between 3 m and 3.5 m. At the same time a swell of 1 m ran up from west-northwest. The resulting overall seaway will have been 3.5 m. The directions from which the wind sea and swell came differ by about 90°, so that at least for a time a cross sea could form. As soon as sea from deep waters runs up against shallow water areas (here in the sea area Nordergründe with water depths of between 5 m and 10 m), it changes its characteristics in that wave height, wave length and wave speed become lower and the wave steepness initially increases. As soon as the wave movement reaches down to the sea bottom it is possible for Ground swells to develop.

5.2.2 Sea measuring station Alte Weser Lighthouse

The Alte Weser Lighthouse is located approx. 5 nm southeast of the position of the casualty. A sea measuring device of the WSA (Waterways and Shipping Office) Bremerhaven is installed on it intended for operational purposes of the WSA and chiefly meant to optimise the operation of WSA vessels in the Outer Weser. The measuring equipment installed is not calibrated and the measurements recorded lay no claim to scientific precision due to the measurement recording technique and sensor arrangement on a protruding carrier arm on the tower platform. The following

data sheets show that the measuring device is suitable for estimating the sea conditions at Alte Weser Lighthouse and the closer surrounds.

In the following figures the greenish continuous curve shows the tide curve, the upper bluish curve shows the wave period in seconds, the reddish curve the maximum wave height in centimetres, and the lower dark-blue curve the significant wave height also in centimetres. It can be seen from the representations that at the time of the casualty, an average wave height of 2 m and a maximum wave height of 3 m were measured at Alte Weser Lighthouse. The tide curve shows rising water and a wave period of one wave every 5 seconds.

The wave length is not recorded at Alte Weser Lighthouse. According to the Nordsee Handbuch (North Sea Sailing Directions) of the BSH (Federal Maritime and Hydrographic Agency), Eastern Part, for a wave period of about 5 sec. a wave length of 25 m to 40 m is stated. In literature (BARTHEL 1979, DIETZE 1989), the wave length is stated with mathematical functions with which the wave length can be roughly calculated on the basis of the wave period. For the Outer Weser there are the two equations: $L\ [m] \approx T^2\ [sec]$ and $L\ [m] \approx 1.56 \times T^2\ [sec]$. The application of these two functions leads to a result comparable with the BSH (Federal Maritime and Hydrographic Agency) North Sea Sailing Directions.

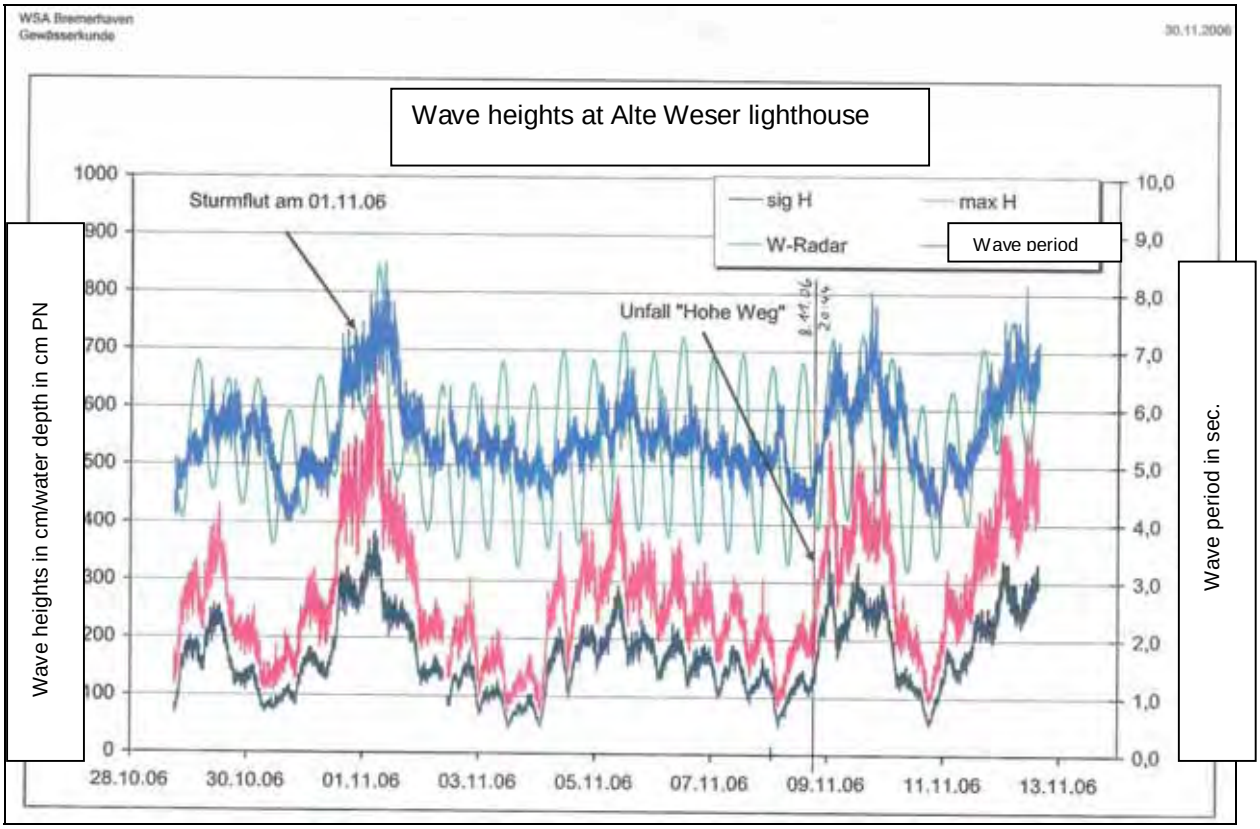


Figure 4: Overall situation at Alte Weser Lighthouse

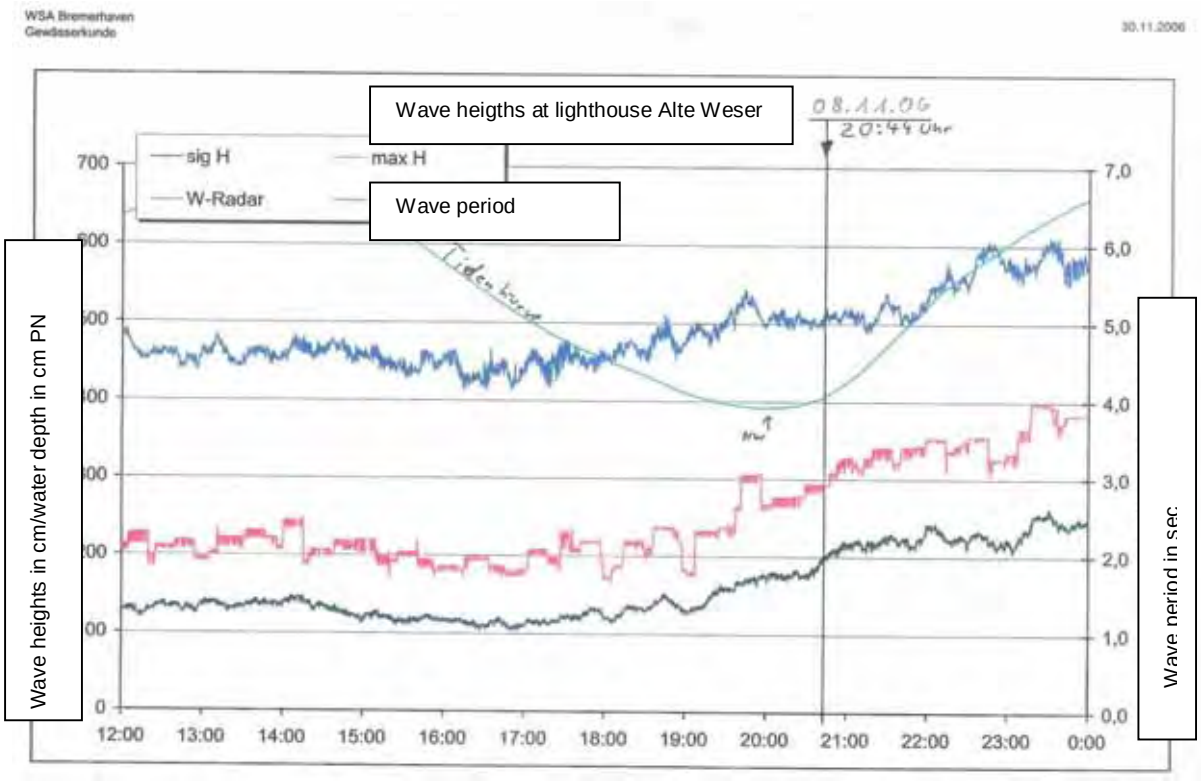


Figure 5: Wave heights on 8 November 2006 at Alte Weser Lighthouse

In addition to the wave data, the wind data too are recorded at Alte Weser Lighthouse. The sensor for recording the wind data is located at a height of approx. 35 m and the recorded measurements, like the wave data, are not calibrated for scientific purposes. The curves shown in the following diagram represent the wind direction in degrees (red curve) and the wind speed in metres per second (blue curve).
Related to the time of the casualty at 20.44 h, a wind direction of 243 degrees can be read off at Alte Weser Lighthouse. The wind force was between 17.5 m/s and 19.5 m/s, corresponding to a wind force of 8 Bft.

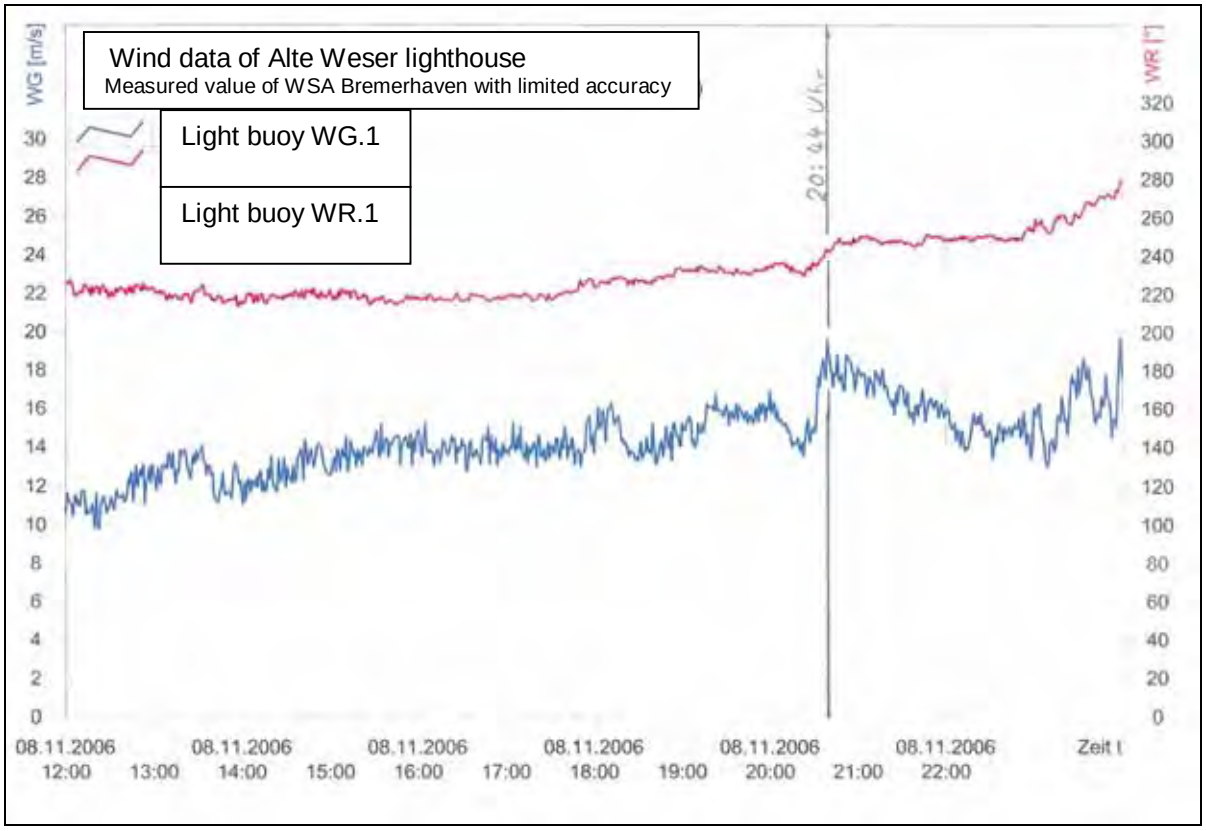


Figure 6: Wind direction and force at Alte Weser Lighthouse

5.2.3 Summary of weather and sea

The DWD weather expertise is identical with the data recorded at Alte Weser Lighthouse. At Nordergründe the weather and sea conditions were probably similar to those at Alte Weser Lighthouse. At the time of the casualty at 20.44 h the wind thus came from a direction of approx. 240° at a force of max. approx. 20 m/s (Bft 8). At a water depth of 8 m the wave height was approx. 3.5 m and the wave length between 25 m and 40 m. Ground swells cannot have occurred with these values under the assumptions made above.

According to the statements by the Master of MV HELGOLAND who had passed close by the scene of the subsequent foundering about 5 minutes earlier, the weather data recorded were confirmed. According to his statement the weather/sea were admittedly poor, but did not give rise to concern. Wind from a westerly direction prevailed with an approx. 3 m high sea.

5.3 Crew

The crew of FV HOHEWEG consisted of four persons. The vessel was commanded by the 27-year-old Master and son of the owner. The Master had held a BKü[6]-certificate of competence since September 2000. On the basis of a BKw[7] ticket dated 2001 a BK[8] ticket was issued on 11 August 2006. He had signed on as Master on board HOHEWEG on 3 February 2004.
The 47-year-old First Mate had held a BK certificate of competence since 1991 and joined the vessel on 27 June 2005.
A 38-year-old fishing seaman had been sailing as deckhand since 1 September 2006.
The fourth crew member, an 18-year-old apprentice fishing seaman, had been listed in the crew list of HOHEWEG since 1 July 2006.

[6] BKü = Master on fishing vessels up to Gross tonnage of 75 GRT/GT 150 in coastal fishing
[7] BKW = Nautical ship's officer on fishing vessels in small high-sea fisheries
[8] BK = Captain on fishing vessels in small high-sea fisheries

5.4 Recordings on the marine casualty

There are no survivors and eye witnesses for the marine casualty. No distress call was transmitted by radio and the distress signalling appliances were not used. The last visible contact occurred at approx. 20.00 h from the Shrimp Vessel CHRISTINE. This vessel was also in the Alte Weser navigation channel and the vessels met at buoy “16A”. The master of CHRISTINE could make out the navigation lights and the lighting of the accommodation distinctly through the bull’s eyes. In a 10 to 15 minute telephone conversation between the masters from approx. 19.40 h until shortly before 20.00 h talk was only of catch quotas and the like, but not about the weather or any special features or occurrences on board. There was a final telephone conversation shortly after this with the brother of the master of HOHEWEG that was ended at approx. 20.08 h without any indications of anything irregular on board. The weather and sea were not mentioned in this conversation either.
The course of the accident could therefore only be reconstructed on the basis of the recordings of the VTS Centres and the stored AIS signals on board the Shrimp Vessel CHRISTINE.

5.4.1 Vessel Traffic Services

On the basis of its size, FV HOHEWEG was not announced to VTS Bremerhaven and was therefore not issued with any tracking sign. After the event, the recordings were evaluated and set out as follows. The final recording from radar station Alte Weser of VTS Bremerhaven was accordingly registered at 20.42 h.

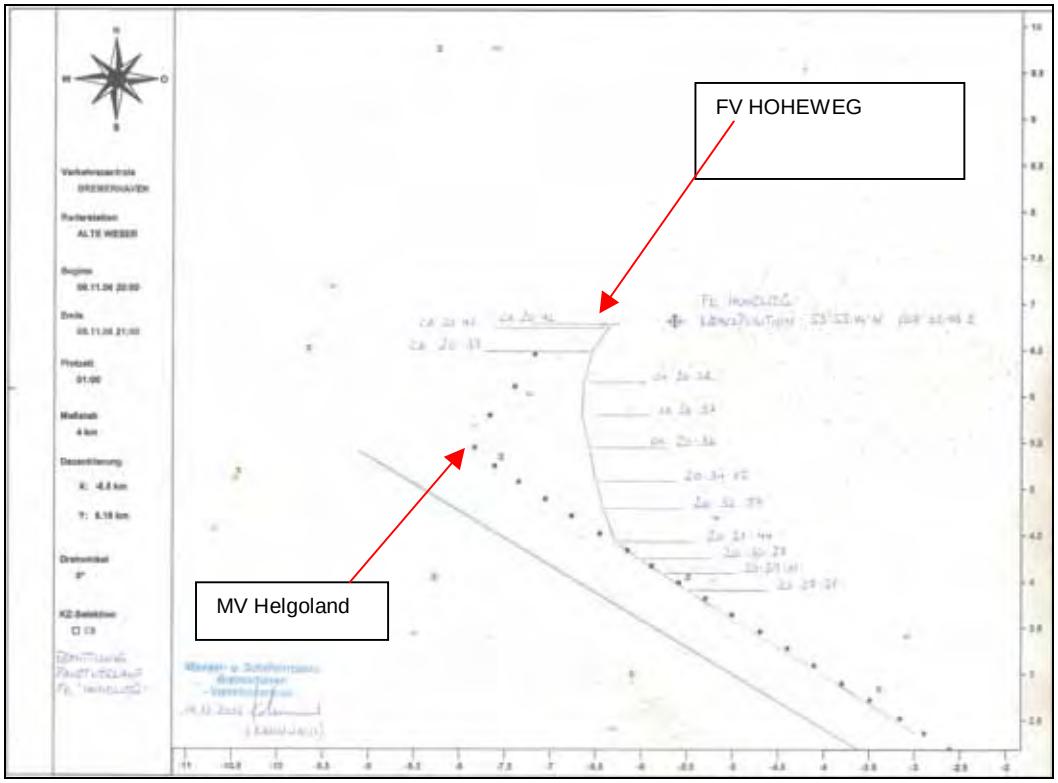


Figure 7: VTS data course of voyage

The overall traffic situation is evident from the following plot of VTS Cuxhaven. Here too the echo is lost at 20.42 h.

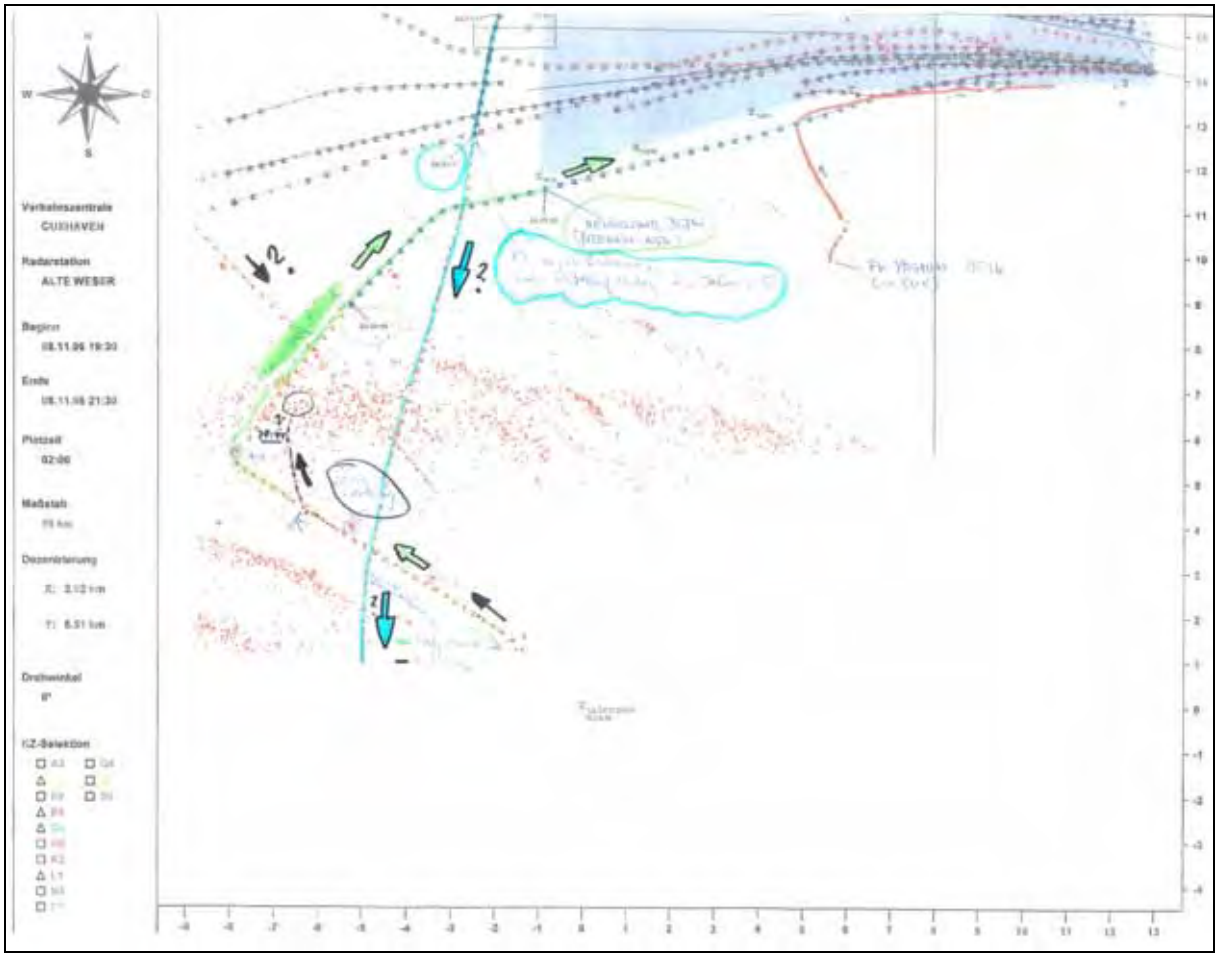
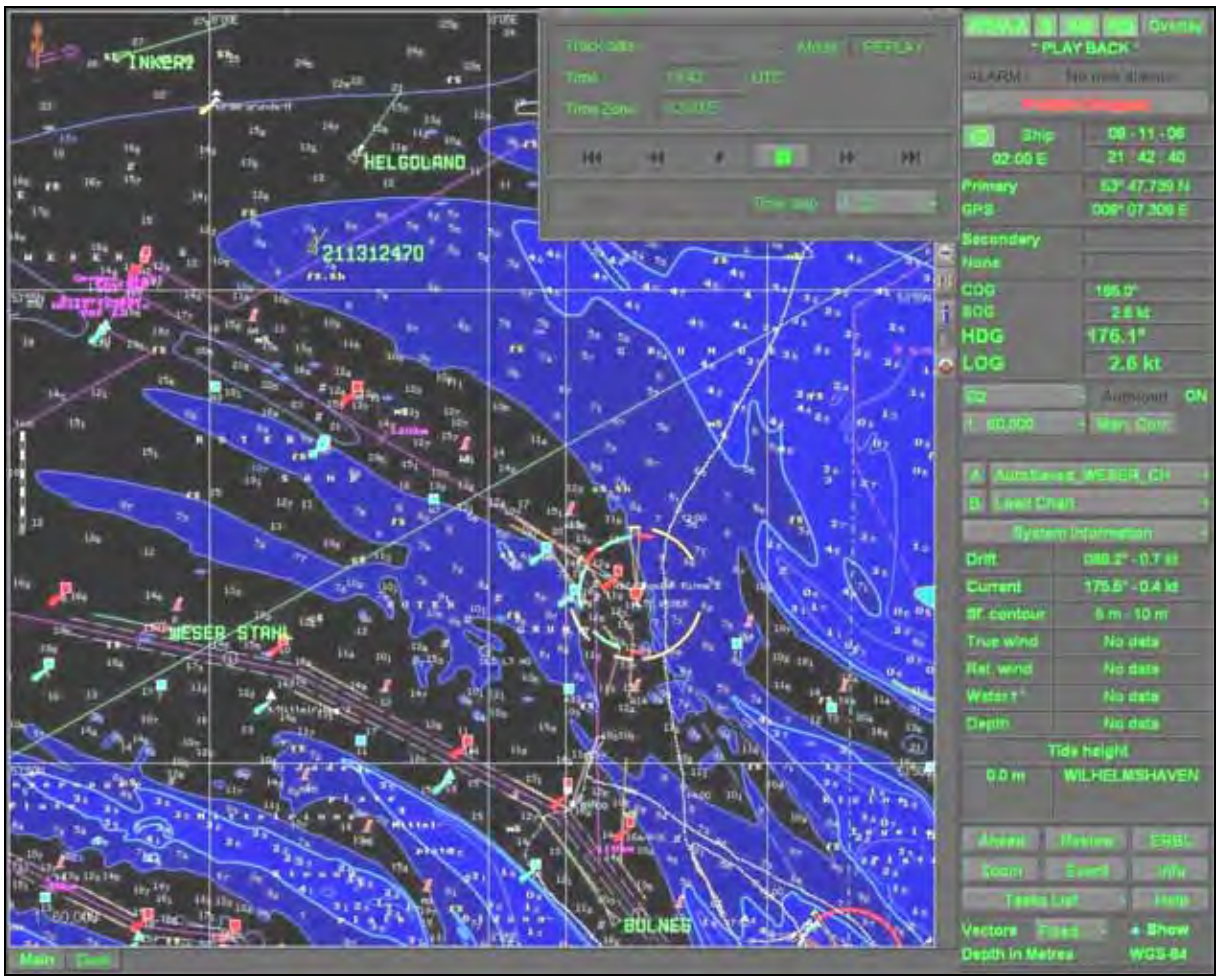


Figure 8: VTS Cuxhaven – overall traffic situation

5.4.2 AIS Data

The AIS data transmitted from HOHEWEG were secured as a track by the Shrimp Vessel CHRISTINE and represented on the electronic sea chart, system Transas "Navifisher 3000" that was present on board. The system time on board CHRISTINE was one hour ahead, i.e. the time of the accident is CET + 1 hour or UTC + 2 hours. The following image shows one of the last signals at 20:42:40 h MEZ (21:42:40 h on the display) shortly before the AIS signal disappeared.



5.4.3 Summary of the final minutes

The positions and speeds of the VTS radar data and AIS data are identical. The WSP Bremerhaven and the BSU carried out a precise analysis of the last manoeuvres and positions on board FV CHRISTINE with the AIS data of HOHEWEG in the port of Fedderwardersiel with the following results:

Explanation of the AIS data from the ECS[9] system (electronic chart system) of Fishing Vessel CHRISTINE:

CPA = Closest point of approach
TCPA = Time to closest point of approach
COG = Course over ground
SOG = Speed over ground
HDG = Heading
BRG = Bearing
RNG = Range

The first data (COG, SOG, HDG) are data transmitted by FV HOHEWEG. These HOHEWEG data originate from a satellite compass, a THD[10], type NAVISTAR, from

[9] ECS = Electronic Chart System

Messrs. Sperry Marine. With this THD, for instance, the true course is calculated via a GPS antenna system consisting of two GPS receivers using doppler frequency shift. These data were then transmitted further via an interface to the AIS transmitter, type FA-150 from Messrs. Furuno and transmitted every 2 seconds to 3 minutes depending on the vessel's speed.

The further data (CPA; TCPA; BRG and RNG) are the values related to the system's own vessel, Shrimp Vessel CHRISTINE. The vessel is not shown in the picture here.

Fig. No. 1

On Fig. No. 1 FV HOHEWEG (here simply displayed with the MMSI No. 211312470) can be seen at 20:37 h turning from the Alte Weser navigation channel towards the north. The important data here are:

COG = 347.2°
SOG = **9.0 kt**
HDG = 345°

[10] THD = Transmitting Heading Device

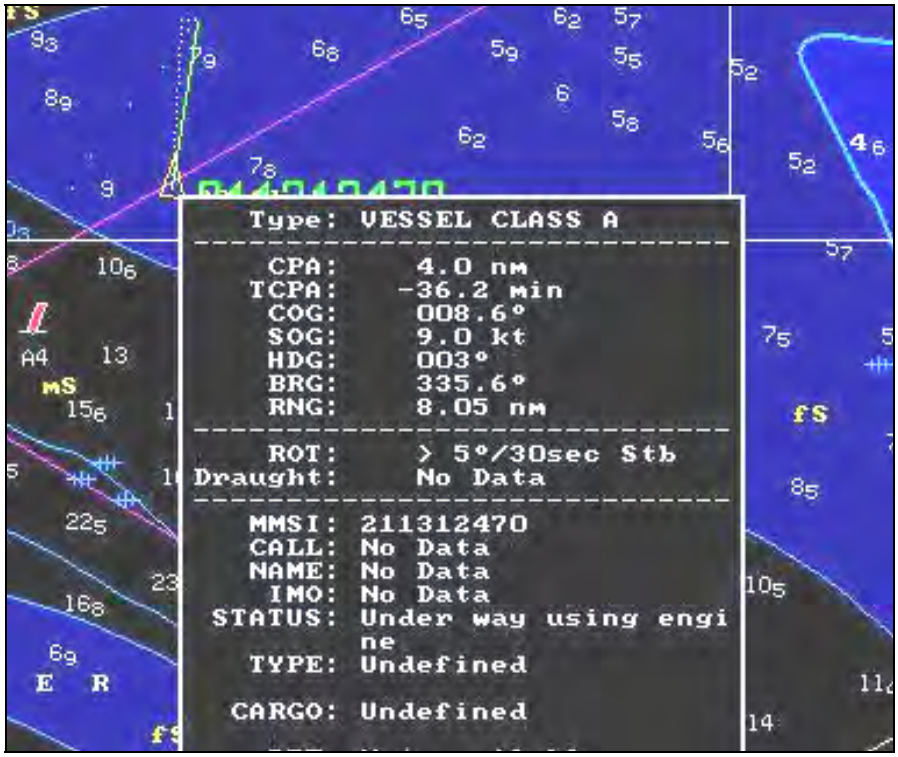


Fig. No. 2

On Fig. No. 2 the FV can be seen at 20.40 h with the following data:

COG = 008.6°
SOG = **9.0 kt**
HDG = 003°

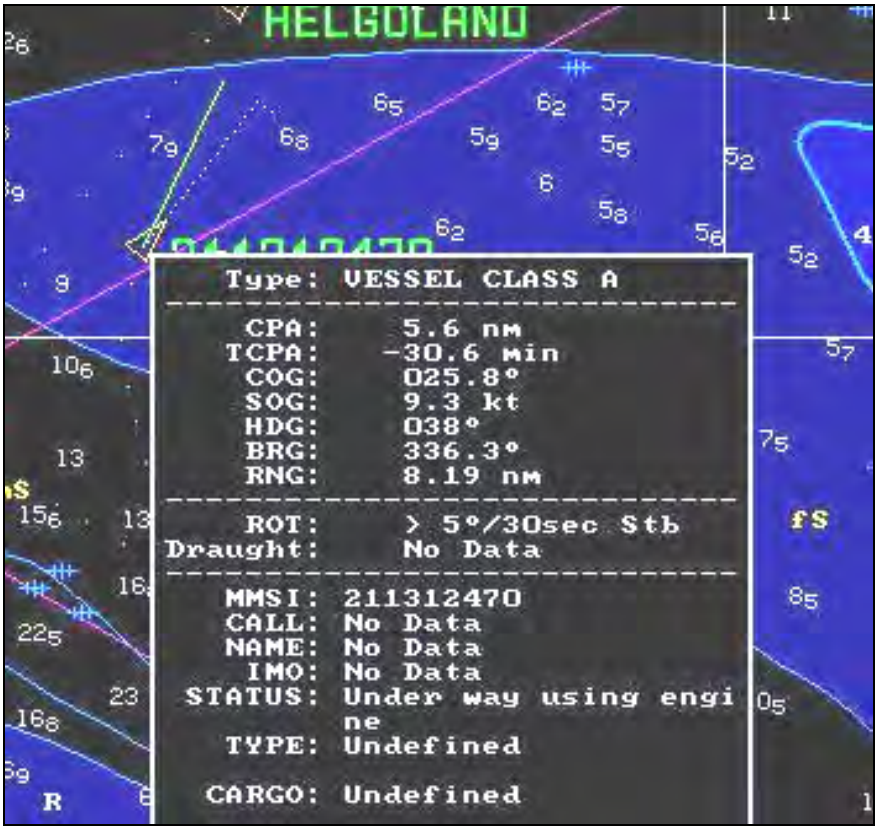


Fig. No. 3

On Fig. No. 3 the FV can be seen at 20.41 h with the following data:

COG = 025.8°
SOG = **9.3 kt**
HDG = 038°

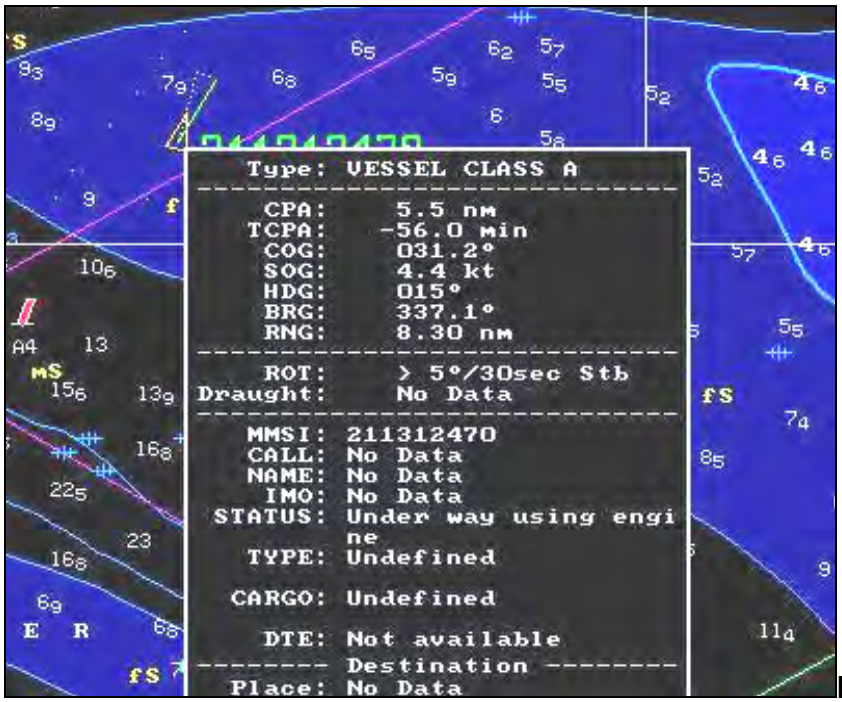


Fig. No. 4

On Fig. No. 4 the FV can be seen at 20.42 h with the following data:

COG = 031.2°
SOG = **4.4 kt**
HDG = 015°

Here a distinct reduction in the speed of travel from 9.3 kn (kt) on Fig. No. 3 to now 4.4 kn can be seen.

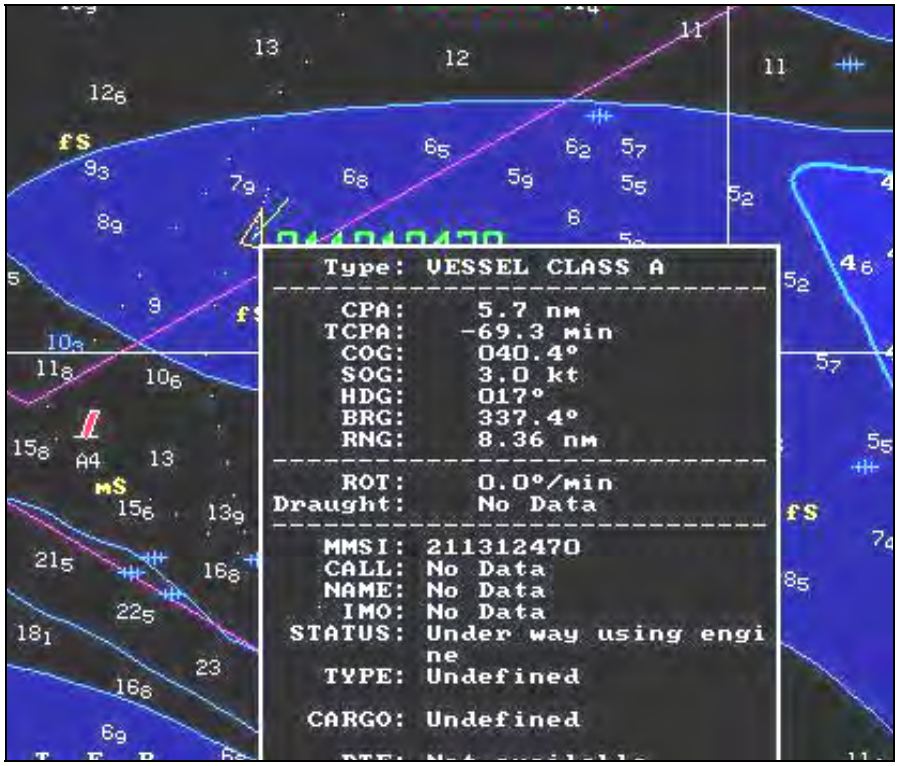


Fig. No. 5

On Fig. No. 5 the FV can be seen at 20.43 h with the following data:

COG = 40.4°
SOG = **3.0 kt**
HDG = 017°

A distinct change in the gyro compass course (HDG headway course) can now be seen. On the next image at 20.44 h the signal of the fishing vessel is no longer there. At this time MV HELGOLAND was approx. 1 nm to 2 nm ahead of HOHEWEG at position 53°56.59'N and 008°02.8'E with a course of 35° and a speed of 10.3 kn.

The course of the voyage determined from the AIS data from 20.30 h with reduction of speed from 20:41 h can be seen from the following summary:

Time CET	Speed over ground in kn	Course over ground	Lati-tude φ	Longi-tude λ	Remark
20:30:00	8,0	303,6°	53°53,80'	008° 02,6'	Abeam buoy 6 Course change to starboard
20:31:00	7,7	303,6°	53°54,01'	008° 02,3'	
20:32:00	7,7	303,6°	53°54,12'	008° 02,0'	
20:33:00	8,5	320°	53°54,21'	008° 01,9'	
20:34:00	8,6	330°	53°54,31'	008° 01,82'	
20:35:00	8,6	344°	53°54,46'	008° 01,72'	
20:36:00	9,1	346°	53°54,59'	008° 01,68'	
20:37:00	9,0	347,2°	53°54,75'	008° 01,62'	
20:38:00	8,8	350°	53°54,85'	008° 01,59'	
20:39:00	9,1	2°	53°55,02'	008° 01,60'	
20:40:00	**9,0**	**8,6°**	**53°55,19'**	**008° 01,6'**	
20:40:45	9,1	21,9°			
20:41:00	**9,3**	**25,8°**	**53°55,31'**	**008° 01,67'**	
20:41:15	8,1	26,5°			
20:41:30	6,8				
20:41:45	5,6				
20:42:00	**4,4**	**31,2°**	**53°55,42'**	**008° 01,83'**	
20:42:15	4,0				
20:42:30	3,7				
20:42:45	3,3	37,2°			Voyage, course and position almost unchanged
20:43:00	**3,0**	**40,4°**	**53°55,452'**	**008° 01,84'**	
20:43:15	3,0	40,4°			
20:43:30	3,0	40,4°			
20:43:45	3,0	40,4°			
20:43:59	**3,0**	**40,4°**	**53°55,482'**	**008° 01,9'**	
20:44:00	**kein Signal**	**mehr**	**gesendet**		

Figure 9: Summary of the AIS data

The values from 20:43:00 h onwards must be considered with caution and can indicate that the transmission intervals of the AIS data have increased. At a speed of over 3 kn the transmission intervals are 10 sec. and below 3 kn and at anchor every 3 min.

No AIS signal was transmitted any more from 20:44:00 h onwards, which means that at this time the AIS trnsmitter or GPS receiver on board no longer had any power supply.

5.5 Search and rescue

The casualty was first noted after the EPIRB, activated automatically after the sinking, sent off the first distress message at 20:44:45 h. MRCC[11] Bremen first called FV HOHEWEG on channel 16 at 21.02 h, Cuxhaven Elbe Traffic at 21:07 h also on channel 16 and Bremerhaven Weser Traffic at 21.08 h on channels 2, 4 and 22. At 21.43 h on 8 November 2006 MRCC Bremen sent out the first Mayday Relay. The last known position of FV HOHEWEG was stated as position 53°58'N 008°10.6'E and shipping was requested to keep a lookout for a 26 m long vessel with a blue hull.

The master of the Shrimp Vessel CHRISTINE had heard the call over channel 16 from Cuxhaven Vessel Traffic Services and tried to reach HOHEWEG by mobile telephone at approx. 21.08 h. Initially he heard an engaged signal, but shortly afterwards it was no longer possible to build up any connection at all.

Due to the EPIRB signal received, the position of the casualty was calculated automatically as 53°58'N and 008°10.6'E approx. 6 sm northeast of the place where the wreck was subsequently found, and thereupon SK[12] HERMANN HELMS, HERMANN MARWEDE and HANNES GLOGNER were dispatched to this position. The Fisheries Protection Vessel MEERKATZE, SUBS[13] NEUWERK and the Police Boats BÜRGERMEISTER BRAUER, BREMEN 2 and a SAR[14] helicopter also set out to the stated position. The search and rescue measures were coordinated on site by SK HERMANN MARWEDE (OSC)[15].

At 22:48 h gas-oil was perceived at position 53°55.8'N, 008°7.8E. At 23.00 h a bearing was taken on the bearing transmitter sending on frequency 121.5 MHz and the flashing light signal of the EPIRB. This buoy was subsequently taken up at position 53°53.6'N, 008°09.7'E by SK HERMANN HELMS.
The gas-oil and the fishing boxes later found were discovered approx. 3 sm east of the wreck position.

At 01.40 h on 9 November 2006 a bag with distress munition from a liferaft was found at the Robinsbalje entrance, approx. 1.5 sm west of Grosser Knechtsand, and at 01.53 h a ring life buoy lettered "BRAKE" was found. At 03.30 h the red inflatable boat of HOHEWEG filled approx. 75% with air was spotted in almost the same position hanging on the drag anchor with four oars on board.

[11] MRCC = Maritime Rescue Coordination Center
[12] SK = Rescue Cruiser
[13] SUBS = Harmful substances accident combat vessel
[14] SAR = Search And Rescue
[15] OSC = On-Scene-Coordinator

At 10.16 h the liferaft was found in the mud flats off Spieka-Neufeld at position 53°47.49'N, 008°31.96'E and was recovered from the shore.

In the course of the day sundry parts originating from the fishing vessel were found, such as for example several fish boxes, fishing net balls, fishing nets and rope, fenders, life jackets, a second ring life buoy, shoes and sweaters.

At 13.30 h on 9 November 2006 the search was ended for all participating assigned forces, as in view of the sea water temperature of 10.5° C it was no longer to be presumed that persons from FV HOHEWEG could still be recovered alive.

The assignment report on the distress case FV HOHEWEG by the MRCC Bremen for 8 November 2006 and 9 November 2006 is printed completely in the Annex (the BSU has made personal data anonymous).

5.5.1 Finding of the crew members

During the search action on 9 November 2006 a helicopter crew issued the message PIW[16], (person in water) at 11.50 h at position 53°47.31'N, 008° 26.6'E (approx. 0.6 nm north of the buoy R4/WE8, Robinsbalje). Neither the rescue cruisers at the scene nor the SAR helicopter found any person. Only items of equipment and nets were discovered there.

About 4 weeks after the foundering of FV HOHEWEG the first corpses were washed ashore. The first crew member was found at approx. 13.00 h on 7 December 2006 in the fore-tide terrain off Pellworm. It was the corpse of the 38-year-old deckhand. The second corpse, that of the 47-year-old helmsman, was discovered at Kaiser-Wilhelm-Koog on 8 December 2006. The third crew member, the 18-year-old apprentice was found dead off Heligoland on 10 June 2007, over 7 months later. The 27-year-old Master is still missing. (Status 01.01.2008).

5.5.2 EPIRB general information

FV HOHEWEG was equipped with an EPIRB (emergency call beacon). An EPIRB is a radio transmitter with the help of which rescue forces can be alerted via satellite and guided to the scene of the casualty. The EPIRB is operated manually by pushbutton, or triggered automatically, for example by water pressure when the vessel sinks. After an emergency signal is sent out, this is received by satellites and conveyed onwards via the ground stations (LUT)[17] to the Rescue Coordination Centre (RCC)[18]. The Rescue Coordination Centre analyses these signals and initiates the search and rescue measures. In Germany MRCC at DGzRS[19] in Bremen is responsible for this. In accordance with the state of the art there are various distress call systems due to the historical development. On board FV HOHEWEG there was an EPIRB that worked with the COSPAS/SARSAT system that started

[16] PIW = Person In Water
[17] LUT = Local User Terminal
[18] RCC = Rescue Coordination Center
[19] DGzRS = Deutsche Gesellschaft zur Rettung Schiffbrüchiger – German Maritime Search and Rescue Service

operation in 1980. The COSPAS/SARSAT system comprises inter alia six weather satellites orbiting the poles (LEOSAR)[20] that receive the 406 MHz emergency frequency. These satellites require about 100 minutes for one orbit and on the basis of this circulating frequency and their own movement in relation to the transmitting EPIRB it is possible to determine the position of the scene of the casualty with the aid of the frequency shifting (doppler effect) by carrying out several measurements. However, the nature of the system means that inaccuracies and time delays cannot be avoided.

Most EPIRBs also transmit a weak bearing signal on 121.5 MHz (homing signal) in addition to the 406 MHz signal, so that a bearing can be taken on the transmitter by other vessels.

In addition to the satellites orbiting the poles, since 1997 there have also been geostationary satellites (GEOSAR)[21], that can also catch distress signals on 406 MHz. As these GEOSAR satellites do not move themselves in relation to the EPIRB, they cannot determine the position of the distress-call transmitter by frequency shifting like the LEOSAR satellites orbiting the poles can. It is only possible to determine the position if a GPS receiver is integrated in the EPIRB. When the EPIRB is activated, the current exact position of the EPIRB is also transmitted without any time delay.

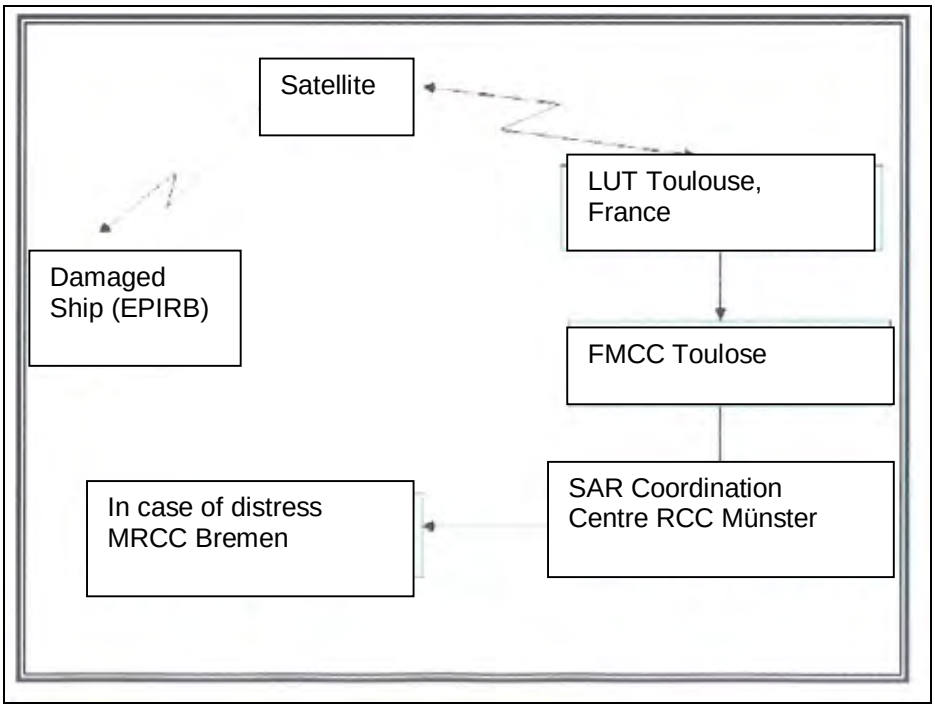
FV HOHEWEG had a COSPAS/SARSAT-EPIRB, type E3, from Messrs. McMurdo on board. This watertight and floatable EPIRB was only equipped with the transmission of a distress signal on the 406 MHz frequency. By contrast with this, the somewhat more expensive version, type G4, with a GPS receiver continuously transmits the current GPS positions in the event of a distress situation too.

The EPIRB of HOHEWEG was equipped with a water-pressure trigger for automatic triggering and was mounted on the compass bridge, approx. 0.7 m from the middle of the vessel on the port side. This point only enters the water after the vessel has inclined 98.9° to starboard.

[20] LEOSAR = Low Earth Orbiting Search And Rescue
[21] GEOSAR = Geostationary Search And Rescue

5.5.2.1 Course of the message following the EPIRB alarm

The first distress signal of the EPIRB from FV HOHEWEG was transmitted at 20:44:45 h on emergency frequency 406 MHz. The progress of such a message is set out on the following image:



This first distress signal was picked up by the geostationary system GEOSAR and passed on via LUT France, RCC Münster to MRCC Bremen, but without stating any position, as due to the design this was not transmitted by the EPIRB on HOHEWEG.

The pole-orbiting satellite system LEOSAR recorded altogether 5 overflights by two satellites during the period 20.00 h to 24.00 h.

	Satellite	Message No.	Overflight time in CET	Message to RCC-Münster CET	Latitude	Longitude
1.	SARSAT 9 (LEOSAR)	nein	20:17-20:27	nein	EPIRB not yet activated	
	MSG 1 (GEOSAR)	9040	Stationär	20:44:45	EPIRB cannot send GPS position	
2.	SARSAT 6 (LEOSAR)	9054	20:58-21:11	21:10	53°58,0' N	008° 10,6'E
3.	SARSAT 9	9072	21:55-22:08	22:05	53°55,2' N	008° 06,1' E
4.	SARSAT 6	9097	22:40-22:51	22:51	53°54,5'N	008° 07,9' E
	MSG-1 (GEOSAR)		Stationär	23:10	Last signal received	
5.	SARSAT 9	9146	23:38-23:48	23:48	No further signal transmitted	

Figure 10: Satellites in the distress area

The first overflight occurred from 20.17 to 20.27 h, in other words shortly before the first activation of the EPIRB, and the second overflight from 20.58 to 21.11 h. This first automatically calculated position was approx. 6 sm northeast of the place of foundering.

The third overflight occurred from 21.55 to 22.08 h. The calculated position of the EPIRB was 2 sm eastwards, near to the place of foundering. Here the odour of gasoil was noticed at 22.48 too. The fourth overflight during the period 22.40 to 22.51 h produced a calculated position approx. 3 sm away from the wreck position.

The EPIRB was then recovered at approx. 23.00 h and the distress signal deactivated.

The course of a COSPAS-SARSAT distress meassage is represented in the following message:

```
Le 27/11/2006 08H35 -- Recherche sur numeros messages
Numeros messages :  9097     0     0     0     0  Nbre de suivants :   0


RES:R    FLAG:1ET    NINT:93474                    No 1
CORRES:ETRAYCYX

ZCZC ZOS415
SS ETRAYCYX
082152 LFIAZSZX$$$$$
1.  DISTRESS COSPAS-SARSAT
    POSITION RESOLVED ALERT
2.  MSG NO 09097 FMCC REF NO 34143
3.  DETECTED AT 08 NOV 06 2145 UTC BY SARSAT 6
4.  DETECTION FREQUENCY 406.024 MHZ
5.  COUNTRY OF BEACON REGISTRATION 211/GERMANY
6.  USER CLASS - MARITIME/SHIP STATION IDENTITY 211312470/0
7.  EMERGENCY CODE - NIL
8.  POSITIONS
        RESOLVED  - 53 54.5N 008 07.9E
        DOPPLER A - 53 54.5N 008 07.9E PROB 94
        DOPPLER B - 46 02.6N 033 08.8W PROB 06
        ENCODED   - NIL
9.  ENCODED POSITION PROVIDED BY NIL
10. NEXT PASS TIMES
        DOPPLER A - UNKNOWN
        DOPPLER B - UNKNOWN
11. HEX ID  9A69075929C34D1     HOMING SIGNAL  121.5
12. ACTIVATION TYPE UNKNOWN
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO. 0
14. OTHER ENCODED INFORMATION
        NIL
15. OPERATIONAL INFORMATION
        TECHNICAL QUALITY: GOOD
16. REMARK
        NIL

FM:FMCC COSPAS/SARSAT TOULOUSE
TO:ETRAYCYX
END OF MESSAGE
```

Figure 11: Distress message at 21.45 (UTC)

With the position at which the wreck was found (which only became known later) and the position at which the EPIRB was recovered and deactivated, and with the aid of the drift direction due to wind and waves, it is evident that from the position data of message 9072 at 22.05 h and message 9097 at 22.51 h the location of foundering can be determined relatively precisely.
The first position of the message 9054 at 21.10 h is quite distant from the point of foundering.

5.6 Search and salvage

5.6.1 Searching for wreck and diving operations

After the search for survivors had been discontinued, the search for the wreck of the fishing vessel was started in the area of Alte Weser/Nordergründe. The search area was restricted to the area of the last known position and the finding of the EPIRB.

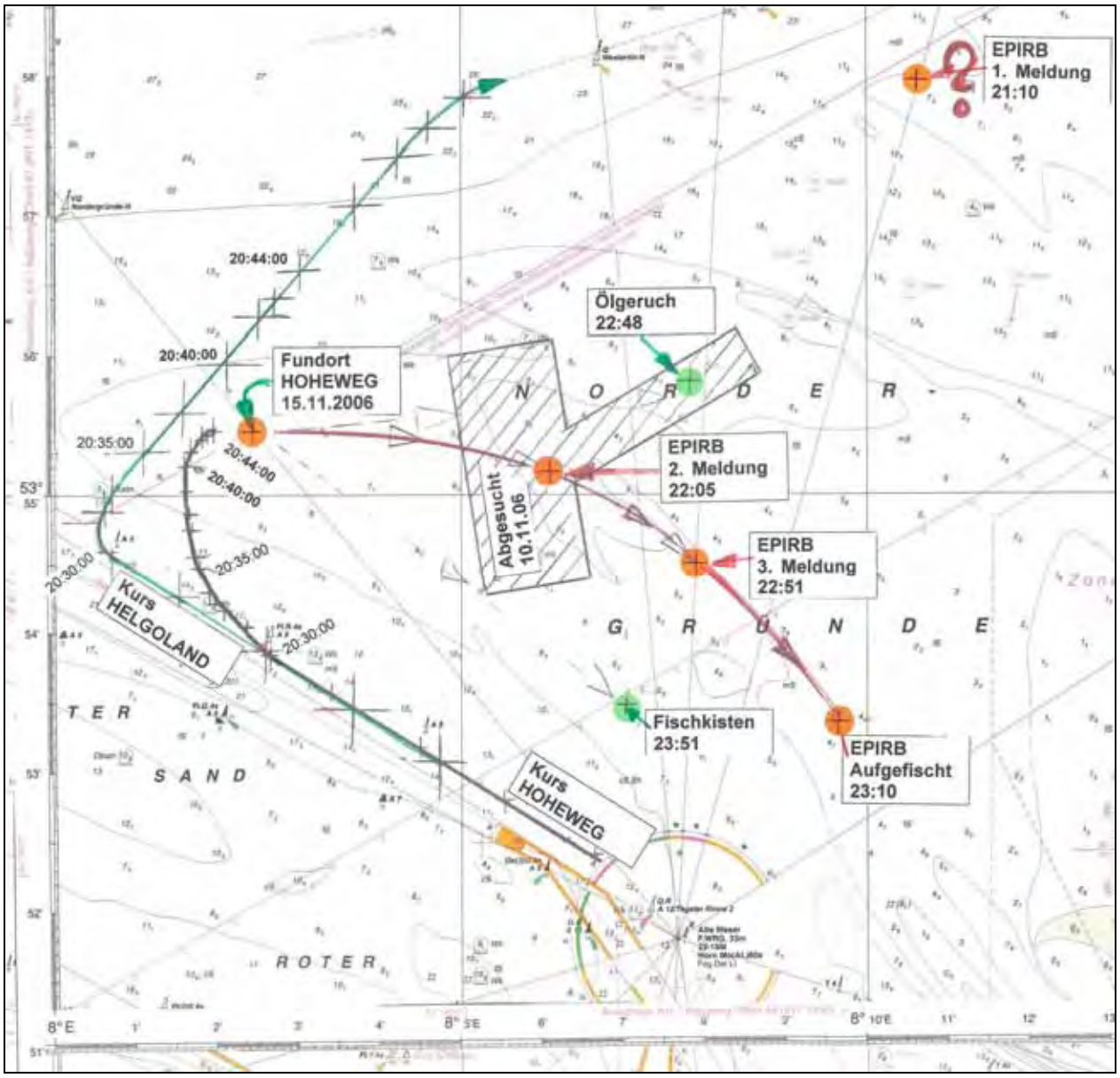


Figure 12: Search area

The VWFS[22] ATAIR of the BSH (Federal Maritime and Hydrographic Agency) equipped with sonar equipment was charged with searching for the wreck. In view of the increase of wind and sea it was necessary to discontinue the search from time to time.
The wreck was located on 15 November 2006 at position **53°55.4'N, 008°02.5'E**. A north cardinal buoy was set out here later as a wreck buoy.

Also because of the weather it was not possible to send down divers at once to examine the wreck more closely. The first and second diving assignment thus only took place on 17 November 2006 at under-water visibilities of 10 cm to 50 cm. The vessel was reported to be lying at a water depth of approx. 7 m on its starboard side with the stem in 280° and the stern in a direction of 100°. No damage could be ascertained on the hull, superstructures and rudder blade. The rudder was lying at approx. 15° to starboard. The fore mast with the stays was intact. The trawl board on the port side aft and the anchor on the port side forward were missing.

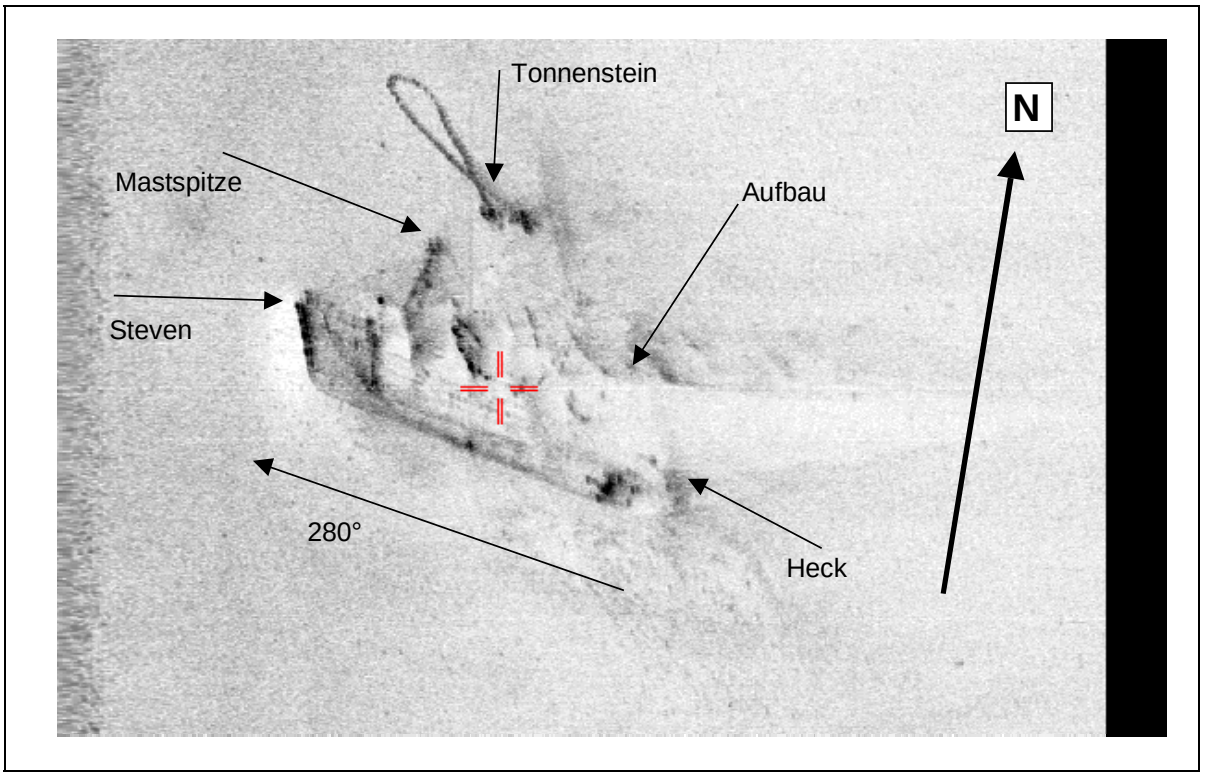


Figure 13: Side-Scan-Sonar image

Positions		
Buoy stone	53° 55,467'	008° 02,452'
Tip of the mast	53° 55,467'	008° 02,474'
Stem	53° 55,464'	008° 02,461
Stern	53° 55,458'	008° 02,487'

[22] VWFS = Vermessungs- Wracksuch- und Forschungsschiff – Surveying. Wreck Search and Research Vessel

The upper deck was free of fish boxes and the empty holder of the liferaft with lashing straps could be seen midships on the weatherguard. The windows of the wheelhouse were intact. In the area of the wheelhouse, net material and lines floated up so that access to the wheelhouse and the crew accommodations was not possible without endangering the divers. Because of the poor visibility, only a small part of the wheelhouse could be seen through the windows. None of the missing crew members could be discovered behind the windows. None of the subsequent diving operations produced any findings about the missing crew members either.

5.6.2 Removal of the wreck

As the HOHEWEG wreck represented a danger to the safety of shipping and an environmental hazard, the vessel operator as owner received a letter from the WSA Bremerhaven on 21 November 2006 calling upon him to remove the wreck. The vessel operator replied through a lawyer that the wreck would not be removed and that the owner would give up the wreck.
Due to the danger for shipping – the lowest depth above the wreck was sounded at 4.2 m – and the danger of subsequent spillage of harmful substances in the form of the approx. 20 t fuel still on board, the responsible WSA Bremerhaven put out recovery of the wreck to tender and awarded the contract to the firm Taucher Otto Wulf from Cuxhaven.
The recovery began at 11.45 h on 22 July 2007 with the Floating Crane SAMSON. After sundry previous preparatory diving operations, the wreck was lifted to the surface of the water at about 18.55 h, hanging in a sloping position in two wire slings, by the floating crane.

Figure 14: Wreck on the surface

On the surface of the water the vessel was turned into the horizontal floating position. In doing this the fore mast with the derrick broke out of its foundation.
Due to the search for the missing master a first inspection was conducted by a WSP officer and by an lead investigator from the BSU on board.
First of all it could be seen that the vessel hull and superstructures showed no visible signs of any damage that occurred before or during the casualty. The damage to the bulwark and the wheelhouse and the forward trawl board gallows evidently occurred during foundering, when the bottom was touched, and during the long time in which the boat was lying under water.
The fish hatches were not watertight. The access doors to the forecastle and the crew accommodations were open. The emergency exit door from the engine room was no longer there.
The significance of the black tube hanging tight over board on the port side was only noticed after the subsequent docking.

Figure 15: Wreck turned in the floating crane

At about 20.18 h the floating crane SAMSON set off in the direction of Bremerhaven with the wreck hanging in the slings and made fast in the Grosse Kammer (Large Chamber) of the Fischereihafen double lock at about 05.30 h on 23 July 2007.

5.7 Survey of the vessel

The first detailed survey of the vessel was conducted in Fischereihafen I, Labradorpier, in Bremerhaven on 23 July 2007. The wreck was still hanging in the floating crane and was accessible via the Tug OTTO WULF 8 made fast at the pier.

At about 15.00 h on 23 July 2007 the wreck was lifted into the lowered floating dock at Messrs. Bredo, Bremerhavener Dock GmbH.
The further investigations were carried out in the dock after the wreck had been dried.

The investigation at the scene was carried out accompanied by the WSP, as it was still suspected that the corpse of the master was in the wreck.

Figure 16: Docking operation

5.7.1 Superstructures and bridge

The superstructures, the bridge and the hull showed no signs of damage indicating a collision or ground contact as a result of ground swells. The damages on the starboard side, especially on the compass bridge, the bulwark and the forward trawl board gallow as well as aft on the poop deck only occurred after sinking.

The entrance door on the starboard side on the main deck to the superstructure/accommodation area was open. The rubber seal and all locking bolts were present and operable. Through the door opening it was possible to look into the galley. However, access was blocked by sundry items of equipment and wall cladding panels, as well as sand, and the galley door no longer hanging in its hinges. The master's cabin adjoining the galley was filled with sand up to the top edge of the lower bunk and access was not possible initially because of the wall panels wedged diagonally in the passage on which a part of the ceiling panels lay.

Later the two signal night lights of the ring lifebuoys, hand-torches and parachute signals, two automatic jackets and a solid lifejacket were found in the master's cabin. The passage to the washroom and toilet on the starboard side next to the master's

cabin was blocked by sand. The sand was so high that only approx. one quarter of the access door was visible.
The access to the accommodation below the main deck and to the engine room was blocked by water and a sand-mud mixture.
The access to the bridge was only possible through the internal stairway, as only one aluminium stringboard of the external companionway stairs to the poop deck was still present. On the starboard side of the bridge two side window panes and one window midships were completely free of glass. The section between the two side windows had net yarn wrapped round several times and this pulled on downwards through the entire superstructure up to the engine room door.
A fourth defective window was the half-broken hinged window on the starboard side that was only firmly closed by the toggle bolts at the bottom.

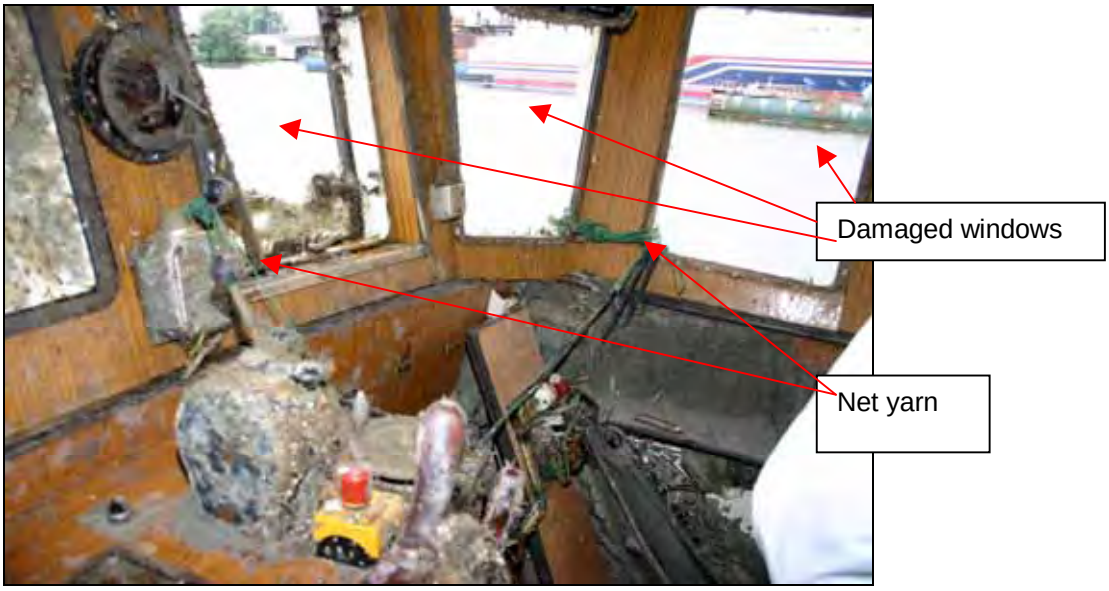


Figure 17: Bridge starboard side

The bridge was relatively well passable. The wooden wheelhouse door was lying on the chart table, all the drawers of the chart table were pushed in. Personal objects such as papers and the purse and keys of the master were later found in the top drawer.
The electronic device on board could no longer be evaluated because of the long time lying below water.
The bridge clock was no longer in its place midships between the windows and the on-board computer was not found.
The control lever was coupled at the position between “idling” and “slow ahead”. It was secured/knotted with green netting yarn at the switch panel of the hydraulic device for the self-steering system.

Two GMDSS[23] distress handheld radio sets were hanging unused on the starboard side above the companionway without the operable batteries having been activated. On the compaß bridge the bearings/holder for the inflatable boat and the holder for the automatically triggered EPIRB were found. The radar mast wth radar devices and antenna was undamaged. Net yarn and a signal light not belonging to the vessel were hanging on the mast.

Figure 18: Bridge port side

Figure 19: Companion-way and distress radio equipment

[23] Global Maritime Distress and Safety System

5.7.2 Main deck

The bulwark was ripped off at deck height over the whole length on the starboard side as a consequence of the salvage and was only still fast at the superstructure and the end of the forecastle.

The weather guard above main deck including the railing and liferaft holder that could still be seen during the diving operations was no longer present after the recovery.
The fish-processing machines had been ripped out of their holders and were partly lying on the fish hold hatches 2 and 3. The lid of hatch 1 (net hold) was lying in open position on the cage nuts of the lock bolt turned open up to the end of the thread.

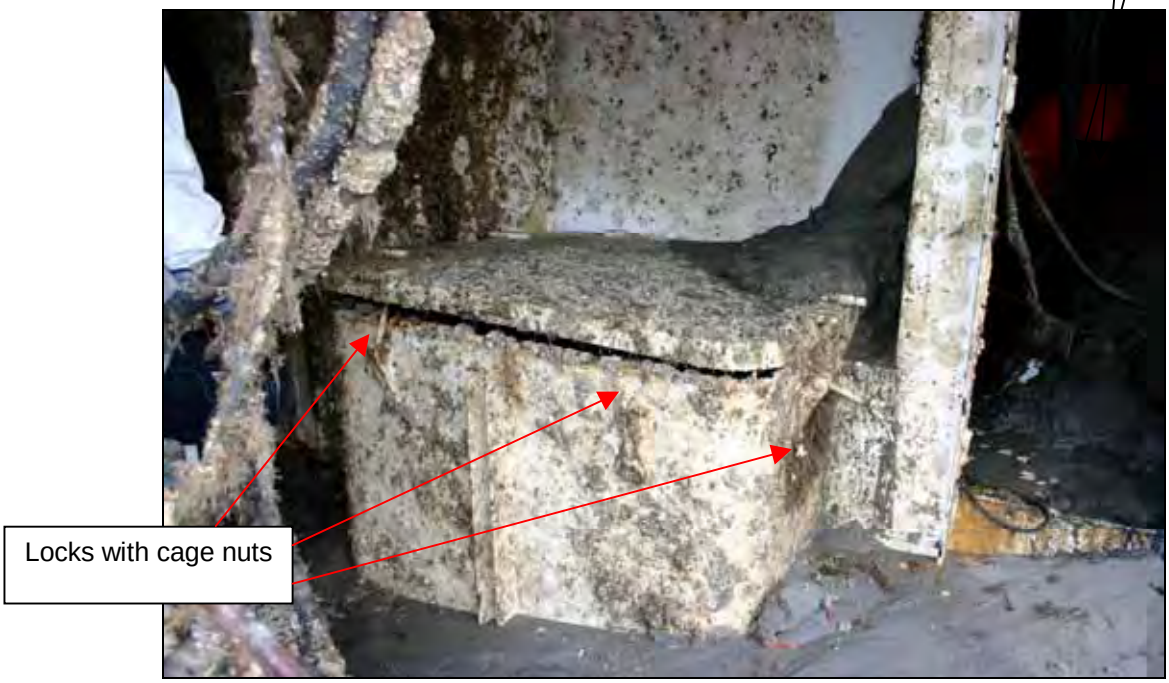


Figure 20: Hatch 1, net hold

The aluminium cover of fish hold hatch 2 was ripped off and lying sanded in on the starboard side by the bulwark. The cage nuts still present were turned open to the end position. The lid of fish hold hatch 3 was not found. Cage nuts still present were also turned open up to the end of the thread. A non-lockable hold with a diameter of 0.38 m was found between hatches 2 and 3 on the port side on the main deck. A metal funnel with a minimal freeboard height of 0.13 m was lying loose over this so-called fish hole.
The derrick winch with wire rope coiled up was found on the main deck beneath the mast.

In front of the superstructures was the three-drum trawl warp winch with wire ropes spooled up. On the middle drum the wires of the individual parts were lying tidily next to one another. On the outer drums the wire ends that were led aft via guide pulleys to the trawl boards had been drawn under the parts that had not been coiled uniformly. The way the outer wire ropes were found indicates that only the middle

wire rope was coiled under load under constant tension. According to witnesses, the port and starboard trawl warp wires were renewed at the beginning of November

2006 and recoiled prior to leaving port. The port side drum was the only one that was shifted out[24] and as the belt brake was not tightened, it could easily be turned. The wire on the port side winch was uncoiled and measured. The length of the 18 mm thick wire rope found was in line with the new trawl warp coiled up on board at the beginning of November.

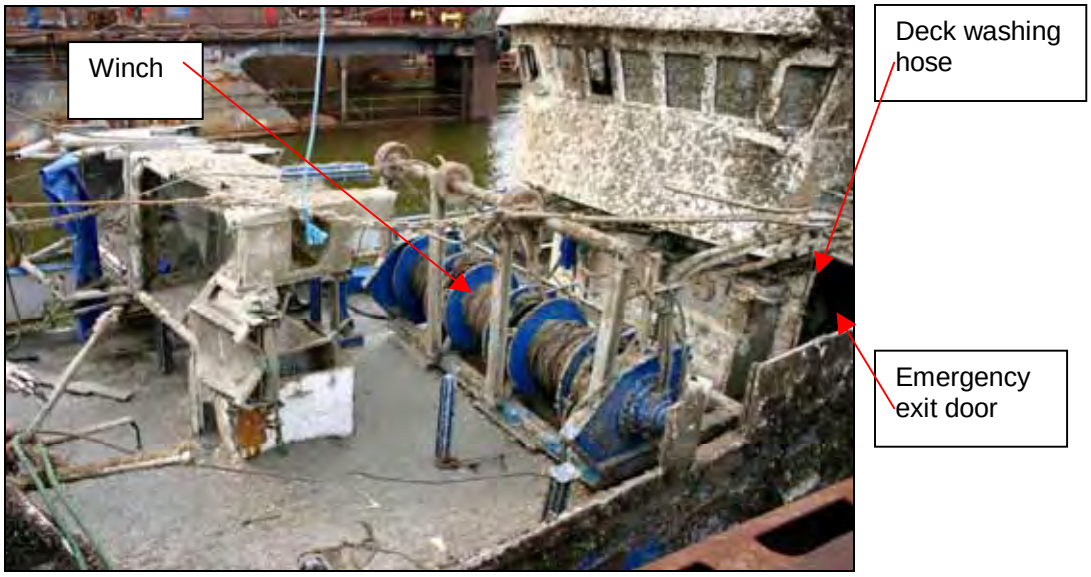


Figure 21: Winch forward edge bridge

At the forward edge of the superstructure there was a distribution station for the deck washing hoses. All the valves stood open. One deck washing hose was hanging loose outboard on the starboard side of the main deck over the bulwark when the vessel was salvaged. The second hose led up to the poop deck on the port side and from there tightly to the Kort nozzle. This hose was ruptured in the way of the round parts of the bridge superstructure and was jammed at the stern between the propeller blade and Kort nozzle. One end of the approx. 1 m long hose was still hanging loose behind the jammed location and contained residues of an aluminium pipe that showed signs of crushing and deformation. The propeller was blocked by the hose and could not be turned. It was not possible to coil the hoses on the hose holding device welded onto the superstructure because of the hydraulic pipe for operating the net winch on the poop deck newly installed in this area.
The emergency exit door from the engine room on the port side was no longer present.

[24] not connected with the winch drive

5.7.3 Forecastle with store, rope store and chain locker

The access door was open and blocked by sand. There were only three sliding bolts on the door and the upper sliding bolt had been missing for a long time as could be seen from the partition points painted over. The door handles were also missing, the lock box was still there. A ventilation flap was lying open on the door, another ventilation flap on the port side was tied fast in open position.
The store room was also filled with sand but could still be entered. Sundry items of equipment, tickler chains, nets and oilskins were lying round loose.
The lid of the chain locker was open and locked permanently in open position by a chain jammed crossways. The anchor chain was still in the chain locker. Part of the chain was hanging in the chain locker down pipe to the forecastle and was shackled in the chain locker with a firmly attached tightening-up screw. The chain hawse pipe with the chain had been sealed against water ingress with construction foam. There was no longer any anchor chain above the chain hawse pipe and the chain hawse pipe was closed with a rubber glove tied tightly round the pipe.
On the forecastle was the ”idler anchor windlass” with opened band brake and opened chain stopper. Traces of use indicating that there was an anchor could not be found clearly in the hawse pipe. An additional guide pulley had been mounted in front of the anchor windlass and T-beams with three large guide pulleys for the trawl warps were installed at the aft edge of the forecastle. The anchor with chain outboard shot was not discovered and had not been found at the time of the first diving investigations either.

Figure 22: Door to forecastle

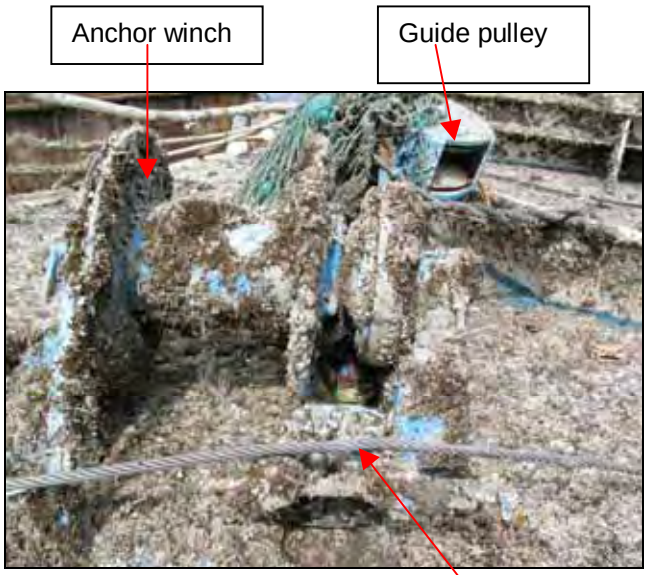


Figure 23: Anchor winch

Under the first owner of the vessel, the second anchor – the 178 kg heavy reserve anchor specified by the See-BG – had been carried at the bulkhead to the forecastle standing on a welded steel bracket and secured with a stirrup. The anchor was not found on board and at the place on the bulkhead only a stay bolt of the fastening facility was found.
The possibility of stowing an anchor securely there had evidently no longer existed at the time of the accident.

5.7.4 Poop deck, winch and trawl boards

The net winch with the nets coiled up almost completely was standing on the poop deck.
The trawl boards and the aft blocks for the trawl warps were no longer on board. The port side trawl board, unlike the starboard trawl board, had not been discovered already at the time of the first diving operations. The vessel had been lying on the starboard trawl board all the time under water and had moved in the waves. This trawl board and a net weight (chain weight) could be seen clearly on the diver's films. However, only the starboard trawl warp to the trawl board remained in the guide pulleys on the forecastle and the forward gallows.

5.8 Anchor chain and anchor facility

Of the anchor chain found, a part of the chain secured in the chain hawse pipe with construction foam against water ingress into the chain locker was handed over to the Institut für Werkstoffkunde und Schweisstechnik (Institute for Material Science and Welding Technology) - HAW Hamburg for inspection.

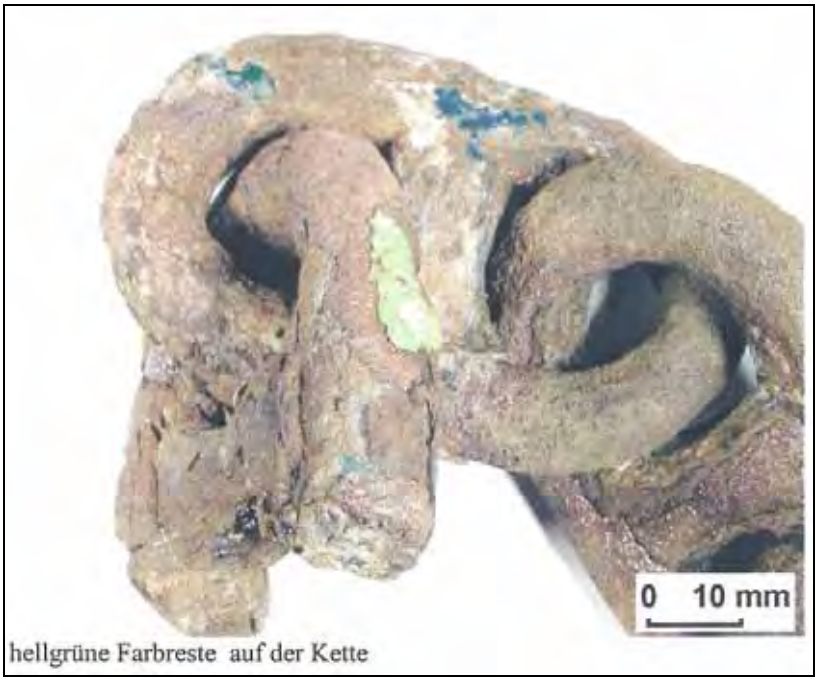


Figure 24: Anchor chain

The chain had altogether started to rust strongly and the diameter of the chain links was between 11.5 mm and 14.5 mm. The reduction of the original chain thickness of 16 mm to these dimensions cannot be explained by material removal due to corrosion attributable to the long time lying under water. Instead it must be assumed that the chain had rusted in the chain locker of FV HOHEWEG for many years. In view of the thickness still present, this chain should have been replaced a long time before solely due to the corrosion. The broken chain link hanging out of the hawse pipe up on deck was investigated in more detail. Because of the corrosion, no fracture structures were found any more on the broken chain link that could have led to conclusions concerning the type of fracture. Paint residues were found on a fractured surface indicating that the chain had sustained preliminary damage already a long time before.

Within the framework of the BSU investigation it was determined that the anchor facility was converted in the years 2003/2004. The anchor windlass without any drive of its own provided up to that time, known as an idler windlass, could evidently no longer be used as a result of the conversion and the new position of the trawl warp winch. The anchor was thereupon guided with a short outboard shot over the existing chain stopper, the chain wildcat from the idler windlass and an additionally installed pulley on the forecastle with an approx. 4 m long wire rope foregoer. This wire rope foregoer should have been secured at the mast with a slip shackle. In order to anchor it was necessary to secure the port side trawl warp to the chain foregoer and this first had to be released from the trawl board aft.

With this method the anchor is only clear for dropping after several work stages.

There is no note of this change to the anchor facility in the files of the See-BG. The responsible surveyor merely noted in the survey report of 21 June 2005 under point 9 “Repair and present anchor windlass”. At a subsequent survey on 20 July 2005 he ticked off this point as completed and extended the voyage permit certificate with a validity up to 19 July 2007.
In response to enquiries by the BSU, the surveyor declared that it was not possible to conduct a drop test with the anchor gear as at that time the vessel had been lying in the dock.

The BSU investigations revealed that on guiding the trawl warp over the chain wildcat there is a risk that the trawl warp used for this as an anchor warp and the connecting links between the chain foregoer and the trawl warp become jammed in the chain wildcat. In the same way it is not possible to fix the trawl warp/anchor warp with the chain stopper arranged in front of the idler windlass when the anchor is dropped, as this stopper only catches the anchor chain as chain stopper when a 14 mm to 16 mm thick anchor chain is used.
The functionality and practicability of the converted anchor facility must be doubted.

5.9 Investigation of the engine, transmission, coupling, propeller and Kort nozzle

When the wreck was salvaged it was ascertained that a deck washing hose was jammed between the propeller and the Kort nozzle. In order to ascertain whether this jammed hose could have been the cause of the failure of the propelling unit and whether the engine was still in operation at the time of the casualty, the investigation representative of the BSU, Prof. Dipl.-Ing Diederichs, was commissioned as expert. After the engine room had been largely freed of sand and sludge, a survey was conducted on 31 July and 8 August.

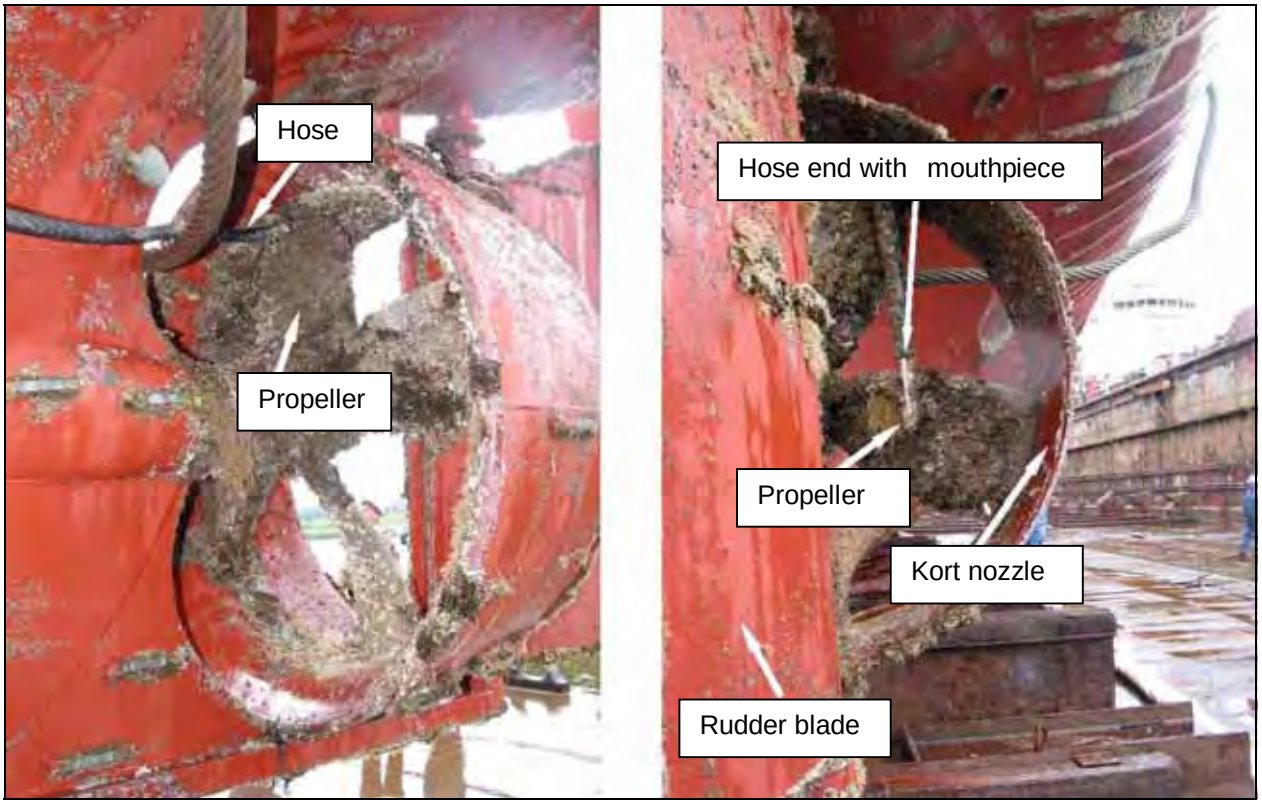


Figure 25: Jammed hose

5.9.1 Description of the propelling unit

5.9.1.1 Diesel engine

The engine is an irreversible, right-hand 8 cylinder four-stroke left engine with exhaust supercharging and the following technical data:

Manufacturer:	Klöckner - Humboldt Deutz AG
Engine type:	SBA 8 M 528
Bore:	220 mm
Stroke:	280 mm
Ignition sequence:	1 - 3 - 2 - 5 - 8 - 6 - 7 - 4
Rated output:	560 hp (412.2 kW)
Rated speed:	750 min^{-1} (12.5 s^{-1})

The engine can only be started from the engine room. Figure 26 shows the series-mounted conning position on the engine with operating lever serving to start and start-up the engine.
In the wheelhouse there is a control lever for shifting the reversing gear and adjusting the engine speed. The transfer from the control lever to the pilot valve at the reversing gear and the engine speed controller is via rope pulls.

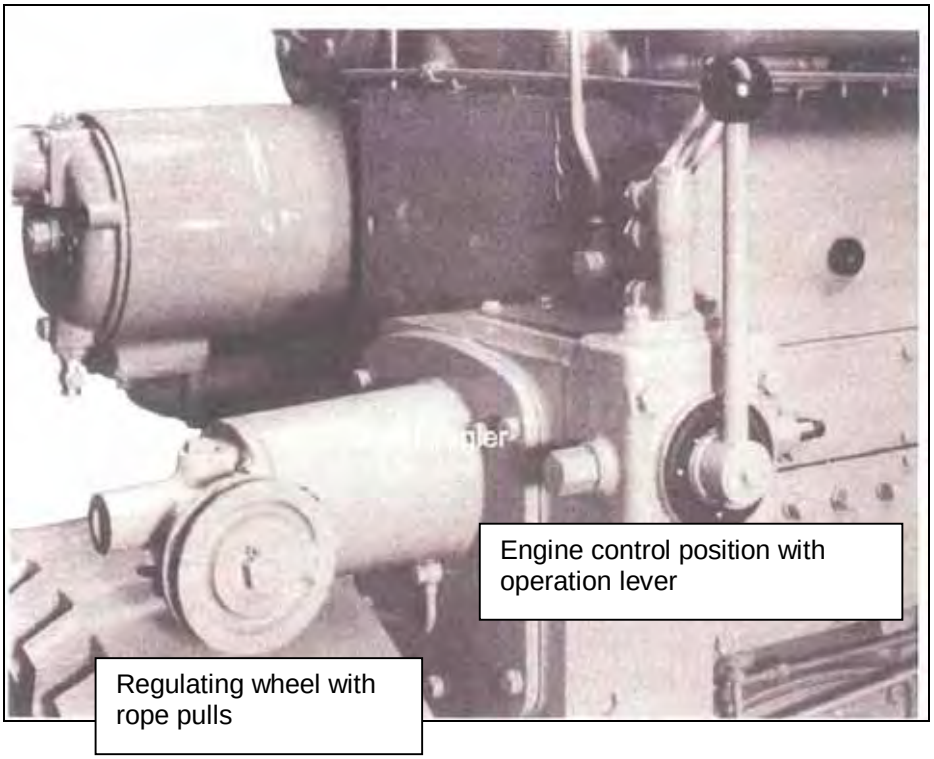


Figure 26: Engine control position

On the bridge next to the control lever a threaded spindle and adjusting nut are also arranged that are connected with the rope pull to the speed regulator. This setting arrangement is not standard and was retrofitted later in order to be able to change the engine speed in idling position too, i.e. with the propeller shaft uncoupled, for example if the engine is only to be used to drive the oilpump for the deck winches coupled to the transmission.

To start the engine

- the control lever is set to the “zero” position (vertical position) on the bridge,

- the adjusting nut on the threaded spindle is turned to the idling position (top end position) by turning the hand wheel,

- the lubricating oil is pumped ahead until the pressure gauge behind the filter shows sufficient oil pressure (above the alarm limit) for ½ to 1 minute,

- the shut-off valves at the compressed air containers are opened,

- the operating lever at the engine control position is moved from the “stop position (vertical position) to “start” (approx. 30° in a clock-wise direction),

- after the idling speed of approx. 250 rpm is reached, the operating lever is shifted to the operating position (horizontal position),

- the valves on the compressed air containers are closed again.

After starting up of the engine either

- the propeller shaft is coupled for “ahead” or “astern” by shifting the control lever in a 30° position forward or aft and the engine speed is increased by shifting the control lever beyond the switch position, or

- the engine speed only is increased without the propeller shaft being coupled by turning the threaded spindle using the hand wheel.

When the engine is running the volume of fuel injected from the injection pump depends on the turning angle of the pump piston in the injection pumps. This turning angle is set by a regulating rod that is moved axially by the regulator. The path of the regulating rod in “mm” can be read off on the regulating rod and is described as “filling”.

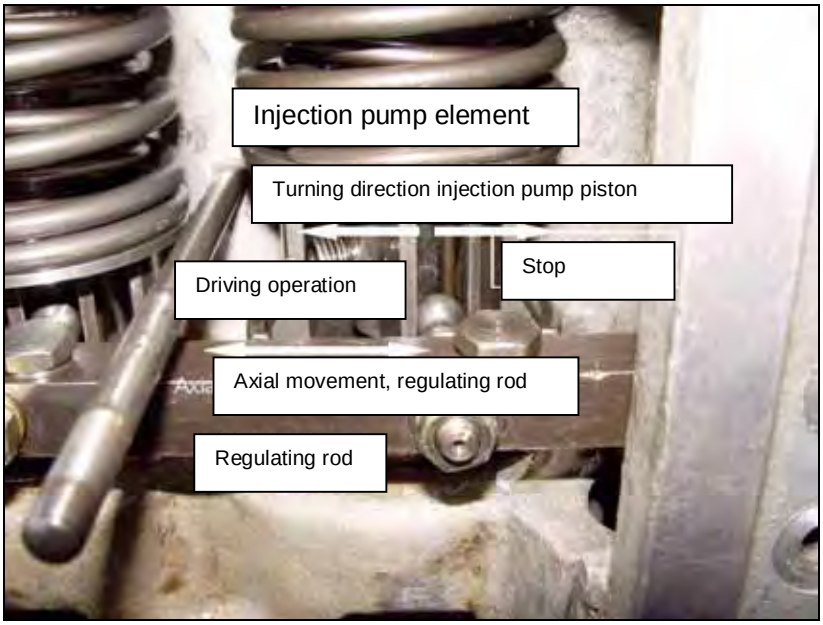


Figure 27: Regulating rod in a-new injection pump

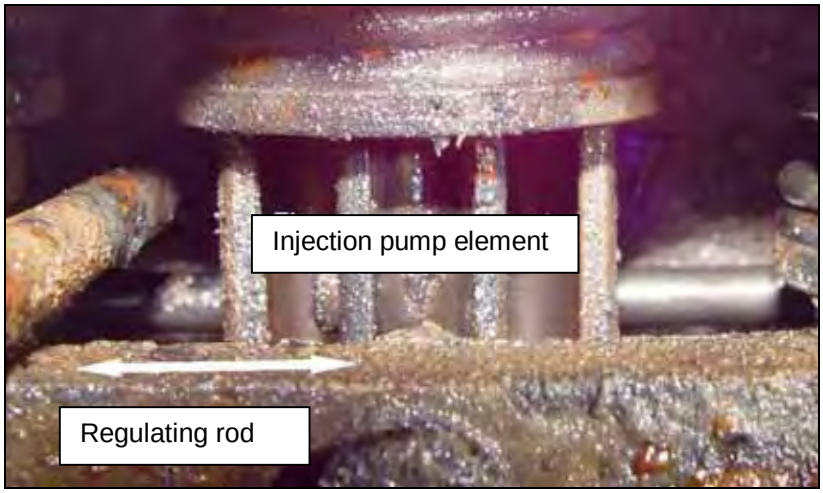


Figure 28: Regulating rod in injection pump found

The respective position of the regulating rod is determined by the balance between

- a spring tension that is proportionate to the position of the control lever or the adjusting nut on the threaded spindle and
- a centrifugal force that is dependent on the engine speed.

The balance can only be changed by

- manual change of the spring tension by actuating the control lever on the bridge control position or at the hand wheel with the threaded spindle,
- an operational change of the loading moment at the propeller.

In the event of a change in the balance condition the speed regulator tries to restore the balance by shifting the regulating rod.

The engine is switched off by shifting the operating lever at the engine control position to the “stop” position. This presses the regulating rod in the injection pump into the right end position through a “switch-off cam” and stops it in this position.

Switching off the engine via the switch-off cam is carried out when a limit value of the safety facility – oil pressure, cooling water pressure, cooling water temperature – is undercut or exceeded.

5.9.1.2 Coupling

An elastic coupling of type “Vulkan EZ“ is arranged between the engine and the transmission to transmit the engine power. The coupling consists of two rubber membranes with woven inserts that are clamped in by rings on the flywheel of the engine and on the coupling disk on the transmission shaft.

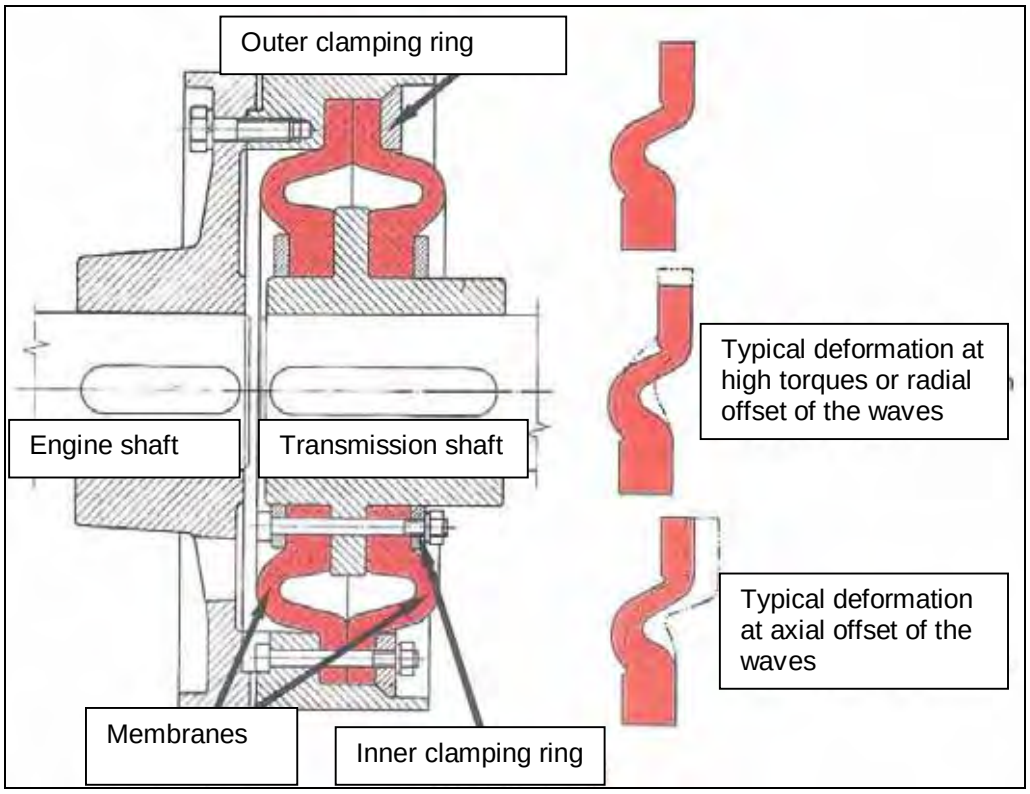


Figure 29: VULKAN EZ coupling

The power is transmitted by tensile forces inside the membranes which is why after a relatively long operating time typical permanent deformations can occur in the membranes. Conversely, jerky overloads can lead to the formation of cracks in the membranes that are visible on the surface.

5.9.1.3 Transmission

The transmission is a ships reversing reduction gear with the following technical data:

Manufacturer:	Eisenwerke Reintjes GmbH
Type:	WGV 330
Transmissible power:	560 hp at 750 rpm
Reduction gear ratio:	2.98 : 1

The power is transmitted from the drive shaft to the propeller shaft via a “switchable” multiple disk clutch.

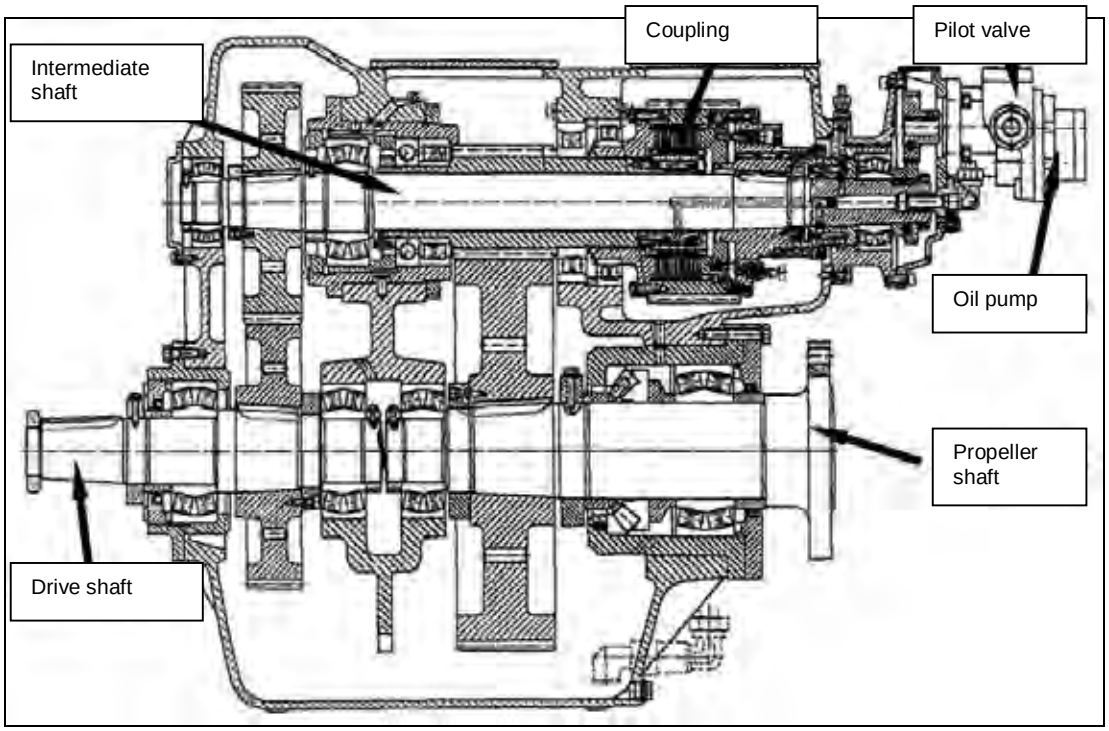


Figure 30: Reintjes WGV transmission

The pressure oil for switching the multiple disk clutch is pumped by the oil pump driven by the intermediate shaft. The pilot valve is operated by shifting the control lever on the bridge control position to a “30° position” and passing pressure oil to the shifting piston of the multiple disk clutch. This displaces the switching piston axially against spring tensions and presses the disks of the multiple disk clutch together. This establishes the power operations between the engine and the propeller shaft by the friction force between the multiple disk. The respective position of the pilot valve (ahead = left, reverse = right) is displayed externally on the gearbox.

If the oil pressure at the switching piston drops due to

- insufficient speed of the intermediate shaft (engine speed) or
- insufficient oil level in the transmission or
- a very strong side position of the vessel (heeling),

the switching piston is pressed into its initial position by spring tensions and the power operation is interrupted.

5.9.2 Survey on board

5.9.2.1 Diesel engine

The operating lever at the engine control position was in the horizontal position “operation” and the adjusting nut on the threaded spindle was in the upper end position.

According to the instructions the engine is started with an idling speed of 250 rpm and at the time of the casualty was operated via the control lever on the bridge. The control lever was set at approx. 35° in the ahead position.

A device to limit the filling to approx. 17 mm was fitted on the injection pump. This device had been installed subsequently to observe Regulation EC 850/98 (Limiting of engine power for “beam trawl vessels in fisheries” to 221 kW). The customary seal to secure the limitation was no longer present.

The regulating rod was not stopped in the “stop” position. The filling was about 10 mm, corresponding to an engine torque of approx. 1.91 kNm, the distance up to the filling level was still approx. 6 – 7 mm corresponding to an engine torque of 3.22 kNm.

The power units were inspected at cylinders 2 and 7 to check whether a “hydraulic shock” had occurred with very high pressure forces due to sea water ingress. No side bucklings as a consequence of high bearing forces were ascertained at the connecting rod bearings; the connecting rods did not show any bending.

The combustion chamber at cylinder 8 was inspected to check whether lubricating oil had infiltrated into the combustion chamber with running engine and extreme heeling position. The turning angle up to complete loosening of the screws was within the range of the data in the general operating manual at 130°. The fuel pressure line to the injection valve and the leak oil line were still filled.

The combustion chamber trough of the piston was only filled with sea water, covered by a thin layer of oil.

No deformation was ascertained at the inlet and outlet valve.

The inner face of the exhaust pipe was covered with a layer of oil. After removal of this layer of oil customary deposits were evident that are generally soluble in water.

Deposits that had formed during operation by contamination in the aspirated combustion air were ascertained at the rotor blades of the compressor at the exhaust gas supercharger. These deposits are also soluble in water and are normally removed during engine operation by adding slight quantities of water to the aspiration air.

5.9.2.2 Coupling

The membrane of the elastic coupling on the transmission side shows a slightly wavy surface represented in the following figure. No cracks were ascertained on the surface of the membrane.

Figure 31: Surface of the membrane on the transmission side

5.9.2.3 Transmission

The display of the pilot valve at the transmission showed the switch position for “ahead” – see figure – and could easily be turned by hand after removal of the rope pull.

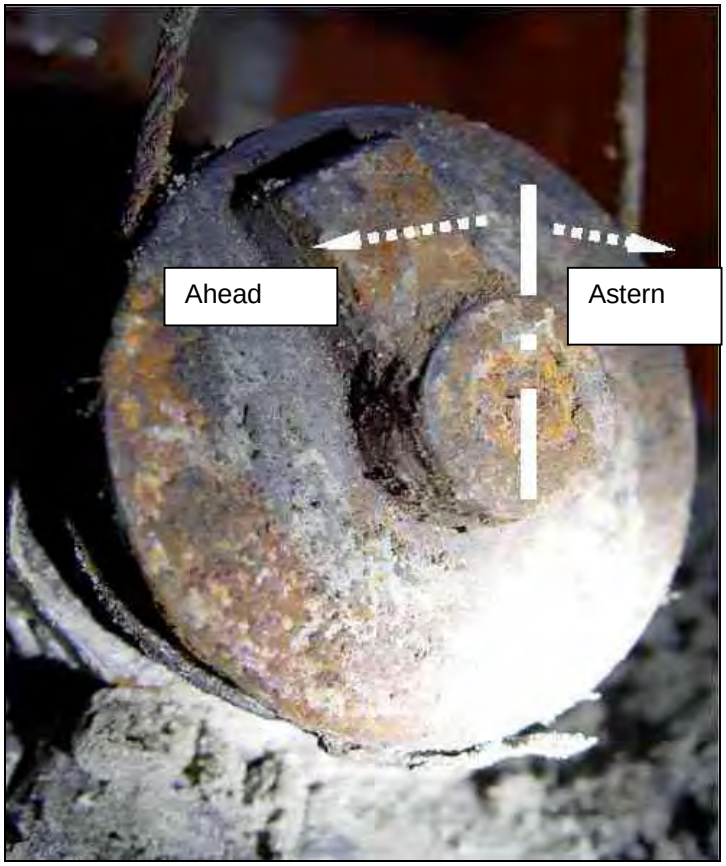


Figure 32: Display position of the transmission shift valve

The transmission was still almost completely filled with sea water so that an oil level could no longer be measured.

5.9.2.4 Propeller and Kort nozzle

In the way of the tip clearance of the propeller, the inner face of the Kort nozzle was heavily covered with mussels.

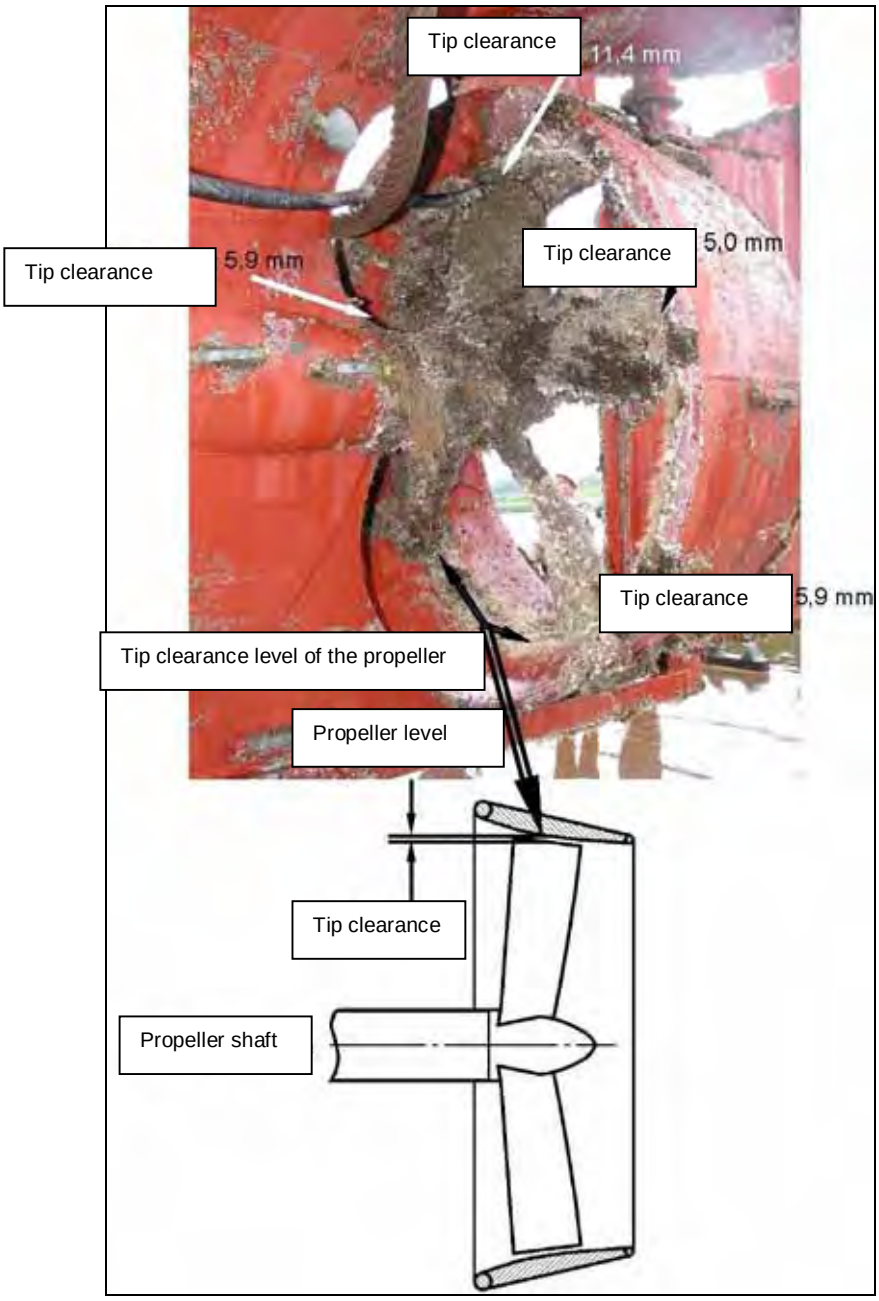


Figure 33: Kort nozzle with hose and propeller tip clearances

After removal of the mussels a surface that differed from the rest of the area in colouring (light red) and smoothness (roughened) became visible.

Prior to dismantling of the Kort nozzle the tip clearances at the blade tips were measured and entered in the above figure.

After dismantling, the diameter of the Kort nozzle was subsequently measured with a steel measuring tape. A deviation in the diameter in the vertical axis of approx. +2 mm by comparison with the horizontal axis was ascertained. The mean value of the diameters in the vertical and horizontal axis was 1838 mm.

The following data were hammered into the propeller hub:

Diameter:	1820 mm
Pitch:	1855 mm
Weight:	390 kg
Mass inertia moment :	78 kgm^2
Material:	G 6 Ni Al Bz 78

No mechanical damage was ascertained at the propeller blades, not even there where the hose was jammed. The rubber abrasion at the jamming position was easy to remove.

The lengths of the propeller blades were not measured. It is to be assumed that the lengths are the same due to the mechanical machining of the propeller to match the diameter of the Kort nozzle.

5.9.2.5 Hose

The end piece was made of aluminium and still firmly pressed into the hose. Deformations not caused by mechanical influence (effect of blows) but instead only subsequently by rubbing on the Kort nozzle were ascertained.

A sample approx. 570 mm long of the hose was removed for examinations in the laboratory.

5.9.3 Measurement on hose

The jammed hose was a wound hose in accordance with DIN 7715 with a rubber core, double fabric inlay and a hose jacket of rubber. The hose had an outer diameter of 50 mm, a wall thickness of 6.3 mm, and was designed for an operating pressure of 15 bar.

Figure 34: Cross section of hose

Wound hoses of this type only display satisfactory buckling and bending strength and longitudinal extension, but are frequently used in marine shipping because of their low price. Provided with a weather-resistant and UV-resistant hose jacket and a connection screw fitting pressed in, as well as a mouthpiece pressed in, they are marketed specially as deck-washing hoses.

Measurements were carried out on the sample of the jammed hose to determine the following data:

- the pressure force necessary to press/crush the hose together at the same level as the tip clearance measured at the jamming position,

- the shear strain that leads to the hose jacket being detached from the fabric,

- the coefficient of adhesion friction μ_0, the coefficient of mixed friction μ_{Tr} and the coefficient of sliding friction μ_F.

5.9.3.1 Compressive force

The examination was carried out on a hydraulic testing machine. In order to determine the upset force F that is necessary to crush the hose on the measured clearances, a hose section was placed on a level surface and pressed together with a wedge.

The measurements were carried out at various places on the hose section with two different wedge faces. The radius of curvature of the round wedge face was 5 mm, the width of the level wedge face 12 mm.

The upset force F and upset path s were measured continuously.

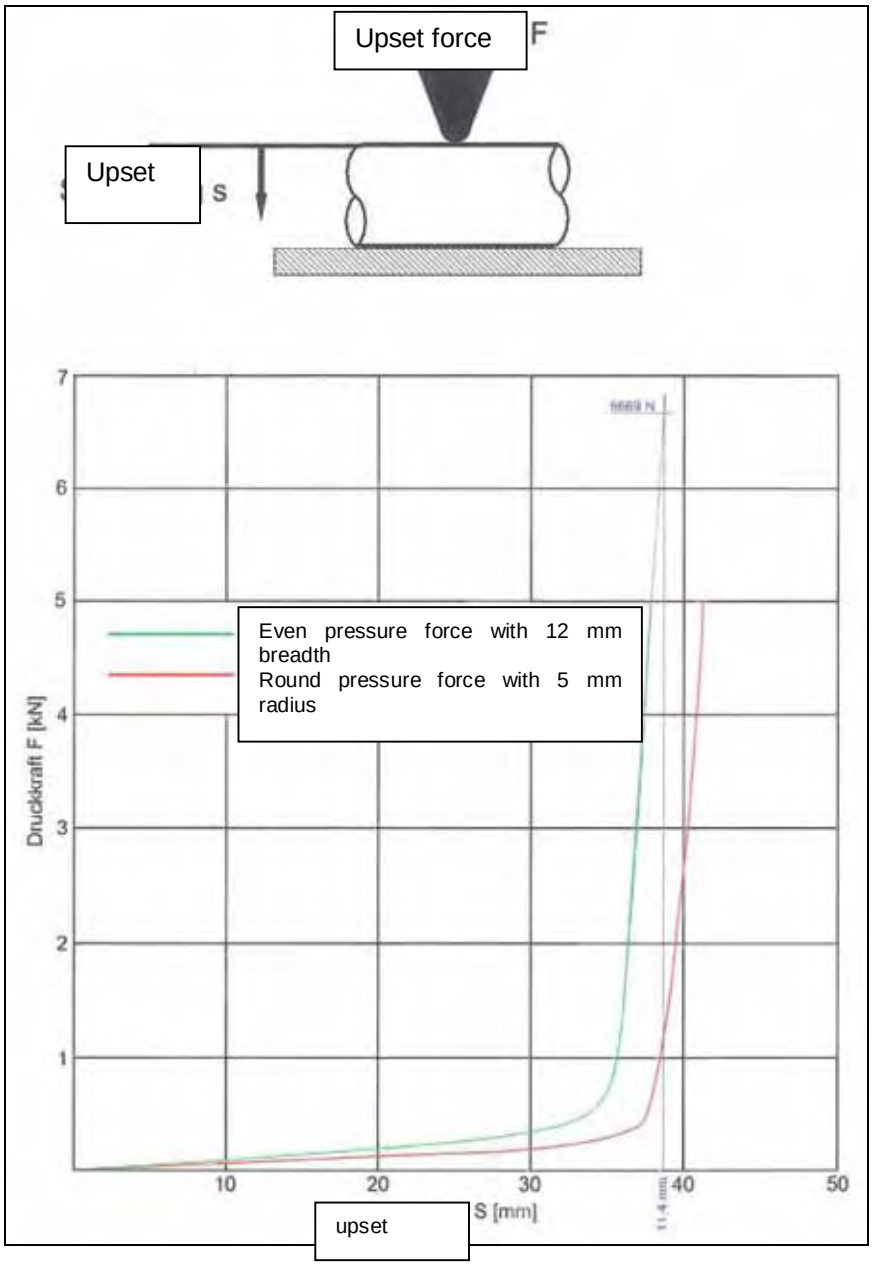


Figure 35: Upset force and upset path diagram

5.9.3.2 Shear strain

The examination was carried out on the same hydraulic test machine. To determine the tensile force F that is possible until the hose jacket becomes detached from the fabric inlay, a round steel with an outer diameter of 37.5 mm was first pressed into the ends of the hose sample, after this the ends were clamped in a concentric device and stretched in the test machine. The clamping or friction face As at the concentric clamping devices was 2600 mm^2 in each case.

The tensile force F and the extension length ΔL were measured continuously.

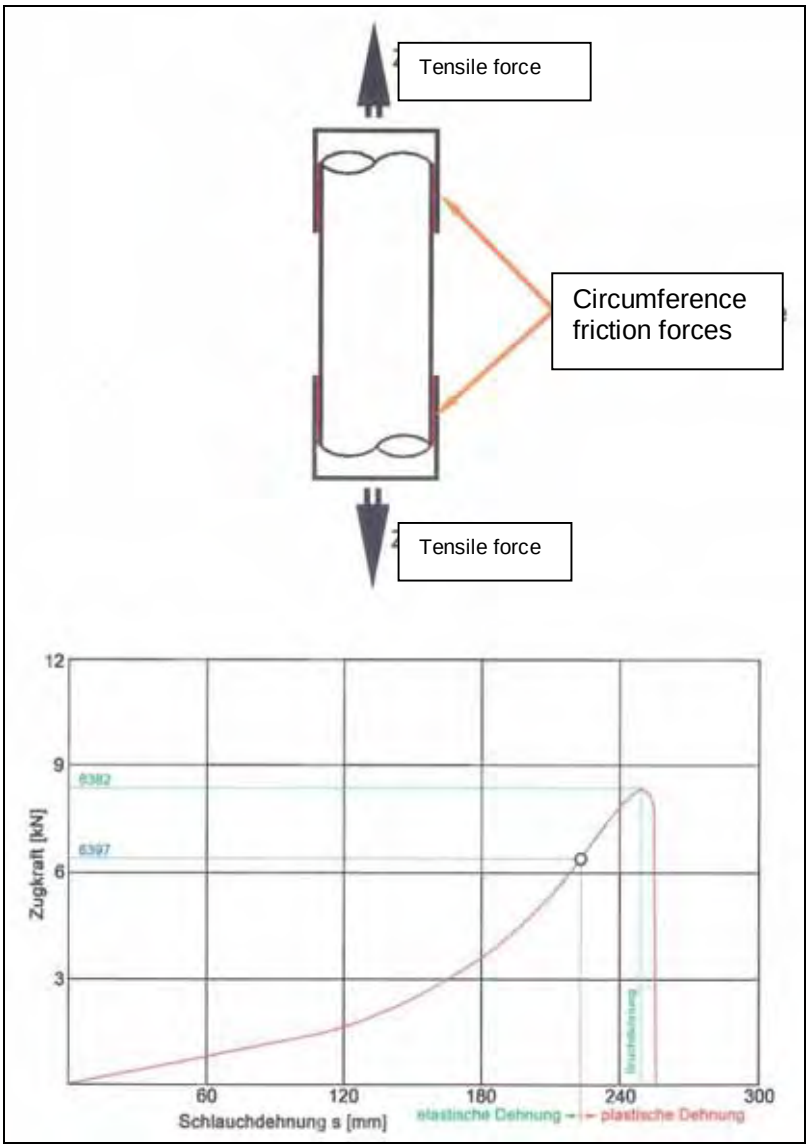


Figure 36: Tensile force and tensile length diagram

Strong crack formation starts in the hose jacket from a tensile force of approx. 6500 N onwards. At a tensile force of 8382 N the hose jacket became completely detached from the fabric in the way of the clamping device; it was not possible to increase the tensile force any further.

The maximum possible surface shear strain τ results as a quotient from the measured tensile force F and the clamping area As. The results are shown in the following table.

Tensile force F	6583	8382
Shear strain τ [N/mm$_2$]	2.53	3.22
Extension ε [$\Delta L/L_0$]	0.693	0.766

5.9.3.3 Coefficient of friction

The hose was placed over a rotatable steel disk with a diameter of 350 mm and loaded at one end with a constant weight force of F_1 = 500 N. The wrapping angle in the arch dimension was 30°.
To determine the coefficient of adhesion friction μ_0 the disk was stopped and the force F_2 measured. To determine the coefficient of mixed friction μ_{Tr} and the coefficient of sliding friction μ_F the disk was driven by an electric motor and the power P_M and force F_2 transmitted by the electric motor were measured.

The following coefficients of friction were determined:

	Arrested disk	Rotating disk	Rotating disk
Coefficient	μ_0 = 0.47	μ_{Tr} = 0.32	μ_F = 0.17

The values μ_0 and μ_{Tr} determined with the material pairing rubber/steel were compared with the data in technical literature for the material pairing rubber/bronze. These are on average approx. 10% lower than the levels determined.

5.9.4 Simulation of the investigation results

To simulate the effects of an additional load moment on the propeller of a fixed propeller system, examinations were conducted on the machine simulator. The initial parameters necessary for this were determined from characteristics for the engine series M528 and are marked with the letters “A” - cruising speed - and “D” - reduced speed.

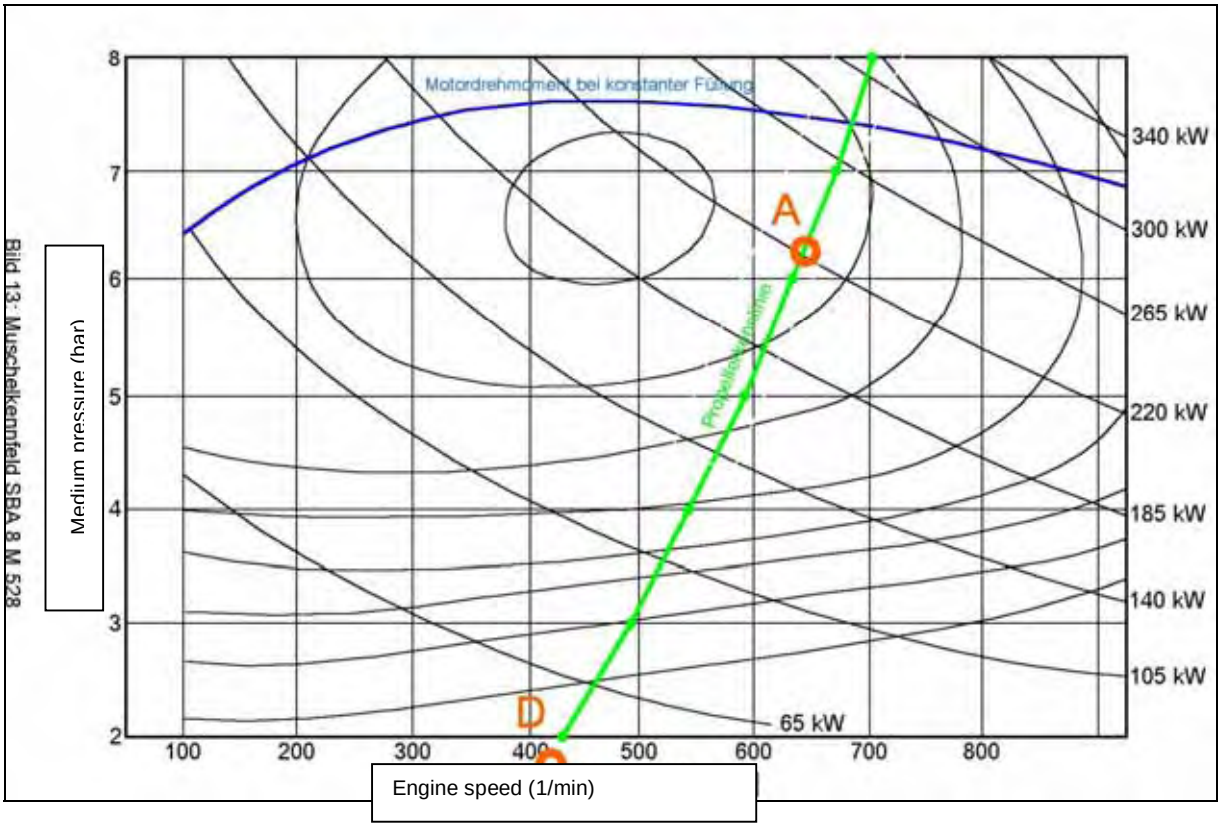


Figure 37: Mussel characteristics engine SBA 8 M 528

	Operating point “A”	Operating point “D”
Position of the control lever on the bridge	60°	35°
Filling at the injection pump	16.7 mm	8 mm
Engine rating P_M	221 kW	67 kW
Engine speed n_M	655 min-1	414 min-1
Engine torque M_M	3.222 kNm	1.543 kNm
Propeller torque M_P	9.602 kNm	4.598 kNm

The additional load moments were calculated from the measurements on the hose sample and are compiled in the following table.

Coefficient of friction μ	Coefficient force F_R [kN]	$M_{P,Z}$ [kNm]	Relative additional torque $M_{P,Z}/M_P$	
			Operating point “A”	Operating point “D”
0.17	1.134	1.032	0.107	0.224
0.32	2.134	1.942	0.202	0.422

On the basis of the stationary operating points “A” and “D” the load moment on the propeller was increased on the simulator using a ramp function in accordance with the respective relative additional torques. The simulator then calculated the time progress of the data, of which the engine speed, the filling, the engine rating, the engine torque and the combustion air ratio were needed for the assessment.

As expected, the speed declined immediately when an additional load moment was switched on at the propeller. The drop in speed depends on the stored energy from the rotating components available at the time of superimpostion, the speed with which the speed regulator increases the filling at the injection pump, and the quality of the ignition and combustion through which the energy of the injected fuel supplied is translated.

Accordingly the engine rating and the torque increase with a time lag in the case of interference of the regulator, as first of all the “used” rotation energy has to be “replaced” by the qualitative release (ignition and combustion) of the higher volume of fuel injected. Without any regulator intervention the speed, engine rating and engine torque drop with a time lag. The time lag depends on the rotation energy stored. The dynamic operating behaviour of a system is determined critically by

- the stored rotation energy available
  (centrifugal mass and engine speed)

- the combustion air ratio λ_V that is defined as the relative agnitude of the fuel mass flow m_B and the air mass flow m_L (fuel quantity, turbocharger speed, engine speed). Customary values for safe ignition and combustion are at 1.8 ÷ 1.9; at $\lambda_V \leq 1.4$ disturbances in the ignition and incomplete combustion cannot be ruled out.

Starting from operating point “A”, the possible operating characteristics of the system when the additional torques $M_{P,Z/0.17}$ and $M_{P,Z/0.32}$ were superimposed as ramp function was examined. As the engine was already being run at the limit of blocking at this operating point, the speed regulator could no longer intervene and balance the loss in speed.

Initial point “A”		
Relative additional torque $M_{P,Z}/M_P$	Speed change Δn_M	Combustion air ratio λ_V
0.107	34	1.75
0.202	70	1.66

After superimposition of a relative additional torque of 0.107, the speed collapsed by approx. 34 min^{-1}. As soon as the additional torque was switched off, the speed rose again to the initial value within a time lag period of approx. 18 seconds. The combustion air ratio dropped accordingly for a short period from 1.95 to 1.75.

At a higher relative additional torque, the torque dropped correspondingly more strongly with approx. 70 min^{-1}. The time lag period after switching off the additional torque increased to approx. 42 seconds and the combustion air ratio was reduced briefly to 1.66 – see table.

At an even higher additional torque with a speed drop of approx. 110 min^{-1} the combustion air ratio dropped to below 1.35 and the time lag period increased to approx. 105 seconds.

Then starting from operating point “D” the possible operating characteristics of the system at superimposition of the same absolute, but higher relative additional torques was examined. As the engine was run below the blocking level at this operating point, it was possible for the regulator to intervene.

Initial point “D”		
Relative additional torque $M_{P,Z}/M_P$	Speed change Δn_M	Combustion air ratio λ_V
0.224	97	1.54
0.422	----	----

At a relative additional torque of 0.224 the speed first dropped due to the lower rotation energy stored by approx. 97 min^{-1}, but within a time lag period of about 156 seconds was balanced by regulator intervention. The combustion air ratio dropped during the compensation phase briefly from 1.86 to approx. 1.54.

When the relative additional torque of 0.422 was superimposed, the speed dropped by 173 min^{-1} and the regulator became unsteady. This was attributable to exceeding the “stability limit” of the mathematical calculation model in the simulator. These levels can therefore no longer be considered as representative.
Despite this exceeding of the mathematical stability, on the basis of the examinations conducted the progress of the failure of the engine system can be reconstructed as follows with great certainty:
The system is operated at operating point “A”. The hose is briefly caught by the propeller and crushed. At a circumferential speed of 21 m/s at the propeller tip, the friction force F_R caused by crushing is critically determined by the coefficient of sliding friction (μ_F = 0.17). The hose is crushed and stretched but does not tear off.
The briefly acting friction force F_R

- causes a speed reduction that is balanced without regulator intervention with a brief time lag, as the combustion air ratio is still sufficiently high, and
- causes distinctly perceptible jerky pump noises at the supercharger.

Even a larger brief reduction in speed due to a higher additional torque can still be balanced without regulator intervention.

By reducing the filling to approx. 8 mm (operating point “D”) the following are reduced by comparison with operating point “A”

- the initial torque made available by the engine by 52 %,
- the rotation energy stored by 60%, and
- the circumferential speed at the propeller tip by 38 %.

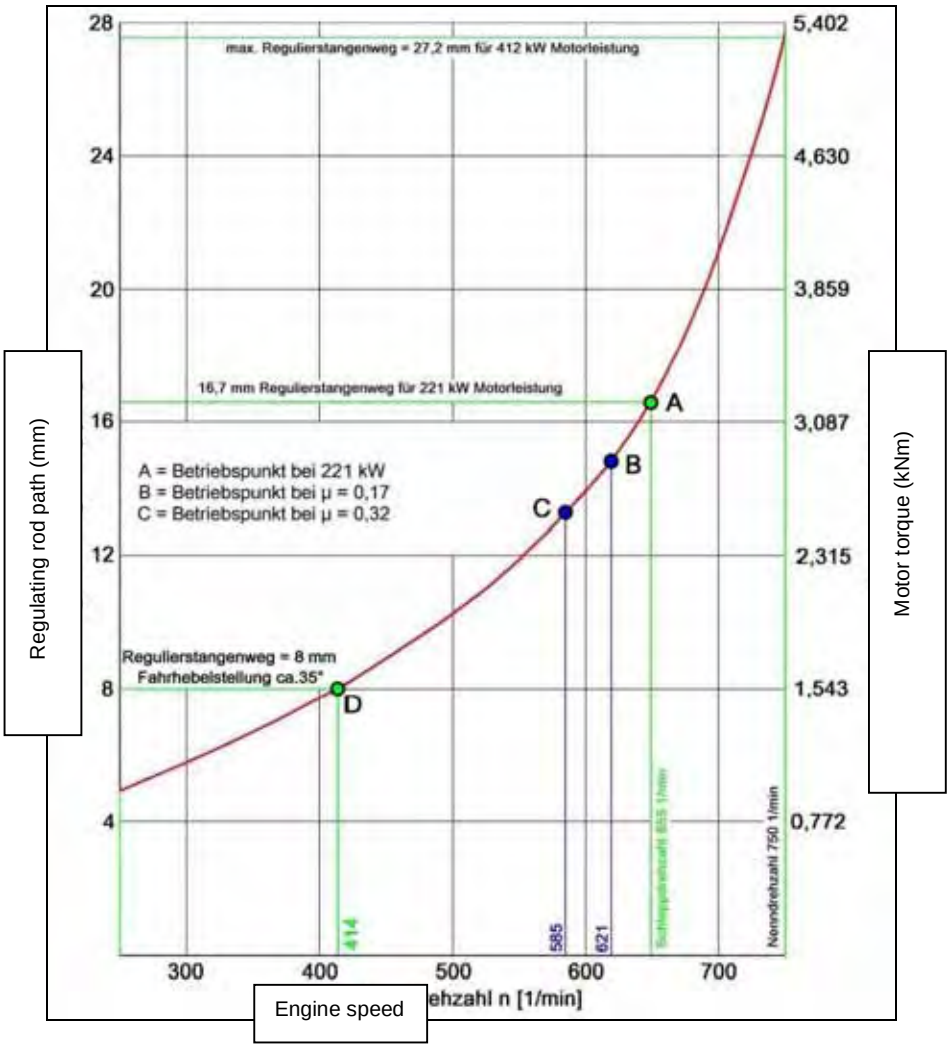


Figure 38: Operating points of the facility

The hose is in turn caught by the propeller, but the friction force at the propeller is now determined more strongly by the mixed friction than by the sliding friction. A higher relative additional torque is now confronted by a lower stored rotation energy. Accordingly the short-term reduction in speed becomes larger. The speed regulator promptly increases the filling up to the stop level of 16.7 mm in order to balance the speed loss, at the same time the combustion air ratio drops strongly. As a result of the speed reduction and the regulator intervention the filling remains above the initial level even after the additional torque is no longer applied and returns to the starting position with a time lag with rising engine speed. However, the air ratio is still

sufficient to raise the engine speed back to the initial value within a relatively long time lag period after the additional torque is no longer applied.

During this time lag phase the hose is caught by the propeller again and the speed drops again. Because of the lower initial speed for this renewed speed drop, the effective coefficient of friction is higher and the rotation energy still available is lower. The speed reduction is correspondingly greater with the consequence that the entire time lag extends further and with an increasing number of speed reductions the respective “initial speeds” drop increasingly further away from the initial speed. With regulator intervention the engine is practically operated with the regulating rod blocked at 16.7 mm until it fails due to lack of air. During the examinations on the simulator attempts were made to determine the number of speed reductions by varying the time intervals. At an interval of approx. 120 seconds between the speed reductions the regulator became unstable already after three reductions, i.e. the mathematical stability limit described above was exceeded.

It is to be assumed that the number of speed reductions before the engine stopped was of a similar order of magnitude.

At an engine speed of approx. 80 min^{-1} the oil pressure available at the coupling has dropped to such an extent that the coupling begins to slip. Although the engine is relieved, the combustion air ratio has already dropped so far that the fuel injected no longer ignites safe due to insufficient compression pressure and only burns incompletely. In this operating condition the hose is caught by the propeller again. Now the engine speed has already dropped so far that is is practically jerked to a stop by the risen friction force and the low rotation energy.

The engine had not been stopped either manually or by a safety device or due to lack of fuel, but instead by external forces and prior to the ingress of sea water into the engine room.

In conclusion,

- the regulating rod at the injection pump was not stopped in the right end position and

- the water-soluble deposits in the exhaust duct and in the supercharger were still present and coated with a layer of oil.

The forces acting on the propeller for “stalling” of the engine were low, because

- no cracks occurred on the membrane surface of the elastic coupling between the engine and the transmission,

- the crack formation on the hose jacket prior to the tensile experiment was much lower than after the tensile experiment,

- the shear strains and extensions calculated from the friction forces correlate with the measured values from the tensile experiment,

- at a total rotation mass of approx. 1000 kgm^2, an additional torque of only approx. 2 kNm at the propeller is sufficient to brake the engine, including the propeller shaft, suddenly down to a stop at a speed of 80 min^{-1}, and

- the paint surface of the Kort nozzle was only polished, but not mechanically abraded.

5.9.5 Summary

The causes of the failure of the machine system could be clearly ascertained and the progress of the failure of the engine system could be reconstructed. The control lever on the bridge was moved from full load to the “30° position”, just coupled. After this the reduction of the filling at the fuel pumps led to such a strong reduction of the torque still available at the engine shaft that short additional torques due to jamming of the hose braked the engine step by step to stoppage.

It could further be ascertained clearly that at the time of the sinking of the fishing vessel the engine had already stopped. The period between failure of the system and sinking could not be determined precisely, however. According to the results of the examinations it could have been between 4 and 6 minutes.

The blocking of the regulating rod on the reduced engine output of 221 kW had no influence on the course of events. Even if the complete engine output had been available, the stoppage of the engine could no longer have been prevented after reducing of the filling.

5.10 Examination of the stability of FV HOHEWEG

In the course of the operating period only one yard heeling test to determine the vessel weight and the centres of gravity was carried out with the Fishing Vessel HOHEWEG, on 18 January 1974. In this heeling test the fixed ballast of altogether 13.8 t between the floor plates of fish hold 1 and fish hold 2 was already present. (Note: This ballast was still found in the same way when the vessel was broken up and evidently no additional ballast was installed subsequently.) During the heeling test it was noted in writing that *„fishing gear such as nets etc. not yet on board"*. These missing weights comprised the reserve trawl boards, nets, fish boxes and the complete fish-processing system on deck. The following values emerged as a result of this heeling test:

Empty vessel weight	:	**157.33 t**
Centre of gravity in height	:	**3.08 m**
Centre of gravity in length:		**10.24 m**

With these values a firm of engineers calculated altogether five stability cases in 1974. The weights lacking in the heeling test were included in the calculations with altogether 5 t for *"equipment in net load"*. The Ship Safety Divisionof the See-BG sent these tested stability calculations to the owner with the remark that for three stability cases the minimum values were only sufficient in accordance with the recommendations for fishing vessels if the buoyancy of the poop was included in the calculations. In addition the following supplement was included: "*In operation of the vessel care should therefore be taken to ensure that in the case of unfavourable weather openings in the poop are closed weather-tight. The weight of the deck load (catch on deck) is to be restricted to an unavoidable minimum."*

Several conversions were conducted by comparison with the original construction and outfitting, so that already prior to salvage of the vessel it was suspected on the basis of photos and statements by witnesses that the overall vessel mass and centres of gravity, especially the height centre of gravity, could have been changed. These negative changes would have in so far also have had an influence on the hydrostatic and hydrodynamic properties, and particularly the stability-relevant figures would then have deteriorated.
Originally it had been planned to restore the vessel to a floating condition after recovering the wreck and to carry out a heeling test. However, after the first survey it was decided not to do this due to the heavy damage sustained as a result of the long period spent under water, the strong filling with sand and sludge, and the fact that the insulation and facilities were completely soaking with water, because no informative results could then be expected. Instead the heeling test of 1974 examined by GL and the See-BG was analysed again and on the basis of this heeling test the weight increases and reductions and the centre of gravity above base line and longitudinal centres of gravity that were subsequently changed were determined.

After salvage of the vessel, the weights determined here were ascertained by weighing the individual components, in as far as they were still present, by

calculations on the basis of the material thicknesses and by estimations. The weighing was carried out with two tested crane weighing installations.
The centres of gravity of the individual masses were in most cases measured on the vessel with the assistance of the drawing documents.

These measurements and examinations were conducted on 26 July, 30 July and 31 July 2007 on the recovered wreck of FV HOHEWEG in the dock of Messrs. BREDO, Bremerhaven. The firm of experts Dipl.-Ing. Jan Hatecke was commissioned as expert by the BSU to conduct the measurements and calculate the stability.

The following changed masses were determined:

5.10.1 Installation of a Kort nozzle

A Kort nozzle was installed in the year 1980. The Kort nozzle was weighed and the weight was established as 1.13 t.

Figure 39: Kort nozzle

5.10.2 Installation weather guard and alteration of the liferaft position

During the operating period of the vessel a weather guard made of aluminium with a railing on both sides was installed over the main deck in approx. 1980. The liferaft holder was mounted on this weather guard during the conversion work 2003/2004; it had previously been positioned aft of the wheelhouse.
The weather guard was no longer present after the vessel was salvaged. It can be assumed that it was torn off during the long period in which the vessel lay under water (it was still present on films taken by the divers).
As no design drawings of this guard were available anymore or possibly were never prepared, the masses and centres of gravity were reconstructed on the basis of an analysis of photos and the structural connections found on the wreck.

Bezeichnung		L (m)	B (m)	Fläche (m²)	Dicke (m)	Dichte (t/m³)	Masse (kg)	Vcg (m)	Lcg (m)
Beplattung oben		63.78	23.00	1466.94	0.05	2.70	198.04	5.80	12.38
	0.5	25.86	31.25	404.06	0.05	2.70	54.55	5.80	16.24
		25.86	7.25	187.49	0.05	2.70	25.31	5.80	16.67
		33.78	15.50	523.59	0.05	2.70	70.68	5.80	13.69
	0.5	26.58	31.25	415.31	0.05	2.70	56.07	5.80	21.50
Beplattung Seite		34.00	7.00	238.00	0.05	2.70	32.13	5.00	13.70
			Anzahl	lfm.		kg/m			
Profil 80 x 8			1	6.38		1.73	11.01	5.80	12.19
			1	6.99		1.73	12.08	5.80	12.50
			1	7.71		1.73	13.32	5.80	12.86
			1	8.31		1.73	14.35	5.80	13.16
			1	5.93		1.73	10.25	5.80	14.97
			1	6.66		1.73	11.50	5.80	15.55
			1	1.29		1.73	2.22	5.80	18.61
			1	1.93		1.73	3.34	5.80	18.93
			1	2.62		1.73	4.52	5.80	19.27
			1	1.55		1.73	2.68	5.80	12.00
			1	2.38		1.73	4.10	5.80	17.96
			1	3.40		1.73	5.87	5.00	13.70
Geländerrohr 32 x 2			1	6.4		0.51	3.26	6.90	12.20
			1	6.5		0.51	3.32	6.90	15.25
			1	1.5		0.51	0.77	6.90	12.00
Geländerdurchz. 16 mm			2	6.4		0.55	6.98	6.40	12.20
			2	6.5		0.55	7.09	6.40	15.25
			2	1.5		0.55	1.64	6.40	12.00
Geländerstütze 60 x 12			17	10		1.94	330.48	6.40	12.70
Gesamte Masse							**885.53**	**6.01**	**13.82**

Draufsicht Wetterschutzdeck:

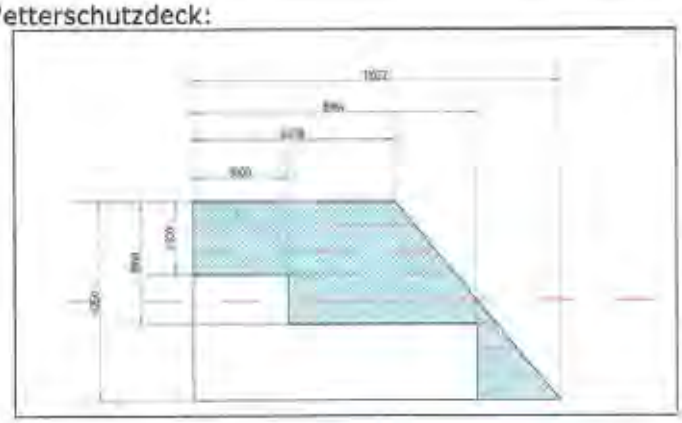


Figure 40: HOHEWEG in the port of Brake on 9 June 2006

5.10.3 Arrangement of the trawl warp winch

At the time of the conversion work in 2003/2004 the combined net and trawl warp winch standing in the fore-to-aft line on the main deck was removed from on board the vessel. Instead a pure trawl warp winch was newly positioned and fitted. As no details were available on the original condition of the combined winch, it was assumed that the conversion of this winch with the wire warps coiled on it did not have any influence on the weight and centre of gravity.
However, in connection with this conversion this winch was mounted raised on a new foundation with light grating. These masses of the foundations and the centre of gravity could be determined. Furthermore, a guide pulley with bracket was mounted above the stack for the net warp. Additional total weight: 0.66 t.

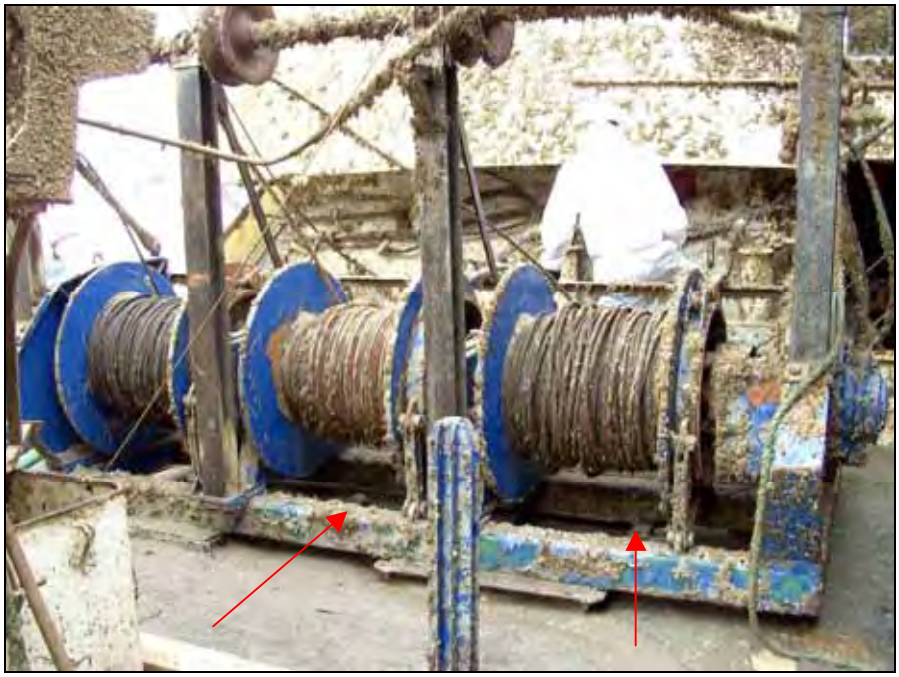


Figure 41: Trawl warp winch with foundation

Figure 42: Guiding pulley at the stack

5.10.4 New net winch with guide at the transom

The largest conversion was carried out on the poop deck in 2003/2004 by mounting a new net winch with two drums, complete with foundations and side brackets for the trawl warp blocks. In addition a hauling-up facility and a transom guard were installed at the transom. The masses and centre of gravity of the winch with coiled net and the side blocks and trawl warp guides as well as the foundations were measured. The total weight was 9.40 t.

Figure 43: Net winch on the poop deck

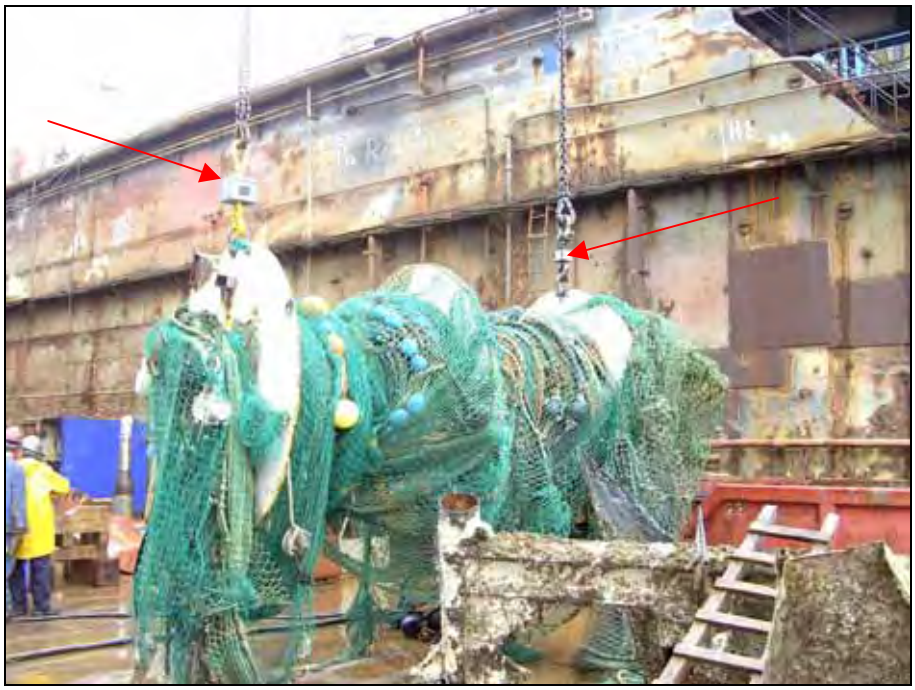


Figure 44: Net winch being weighed

Figure 45: Hauling-up facility for net

Figure 46: Hauling-up facility and transom guard

5.10.5 Additional hydraulic set on the main deck

An additional hydraulic set with tank and lines weighing 1.19 t was installed on the poop deck to actuate the net winch.

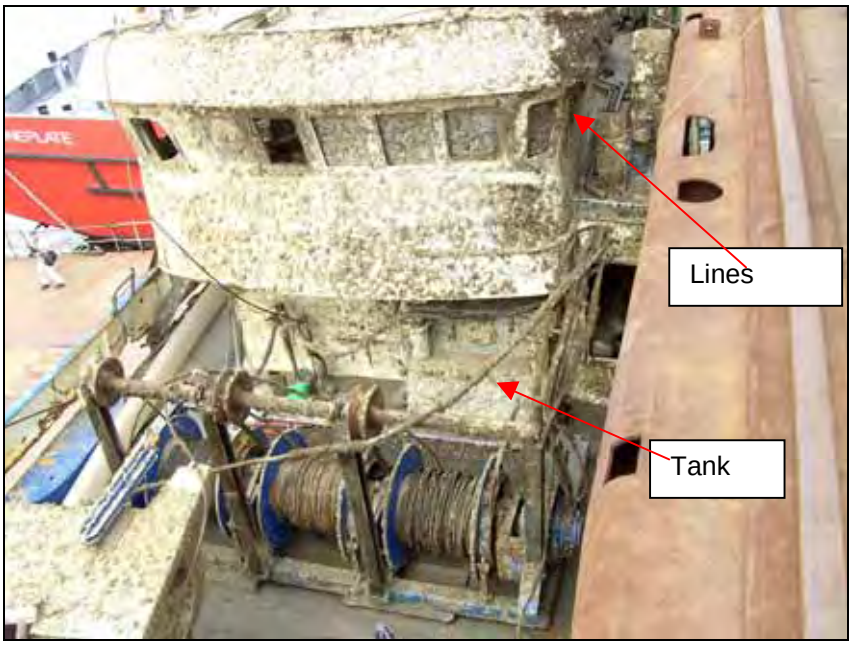


Figure 47: Hydraulic system

5.10.6 Support on the forecastle with guide pulleys

At the time of conversion in 2003/2004 a support with guide pulleys was mounted on the forecastle for the trawl warp guidance, weight 1.31 t.

Figure 48: Supports with guide rollers

5.10.7 Extension of the side poop deck

In order to accommodate the net winch on the poop and as a holder for the starboard trawl board, the poop deck and side plating were extended in 2003/2004. Additional weight: 0.26 t.

Figure 49: Extension of poop deck, close at side

Figure 50: Side plating with profiles

5.10.8 Trawl boards and chain weight

The reserve trawl boards used to be stowed beneath the forecastle in corresponding holders that were still on board.

Figure 51: Bracket for reserve trawl boards

As a result of the change in catching method, the trawl boards were no longer run on the gallows on the main deck, but instead at the time of the casualty were hanging on their brackets aft on the poop deck. The trawl boards with a total weight of 1 t were accordingly arranged with a centre of gravity approx. 2.5 m upwards.

In order to draw the net down an additional chain weight of 400 kg was run on the middle trawl warp.
The chain weight and also the starboard trawl board were not salvaged. The weights were taken from the following sketch of Messrs. CUXTRAWL from Cuxhaven. This sketch also shows the altered catching method and the two renewed port and starboard trawl warps each 350 m long and 18 mm thick.

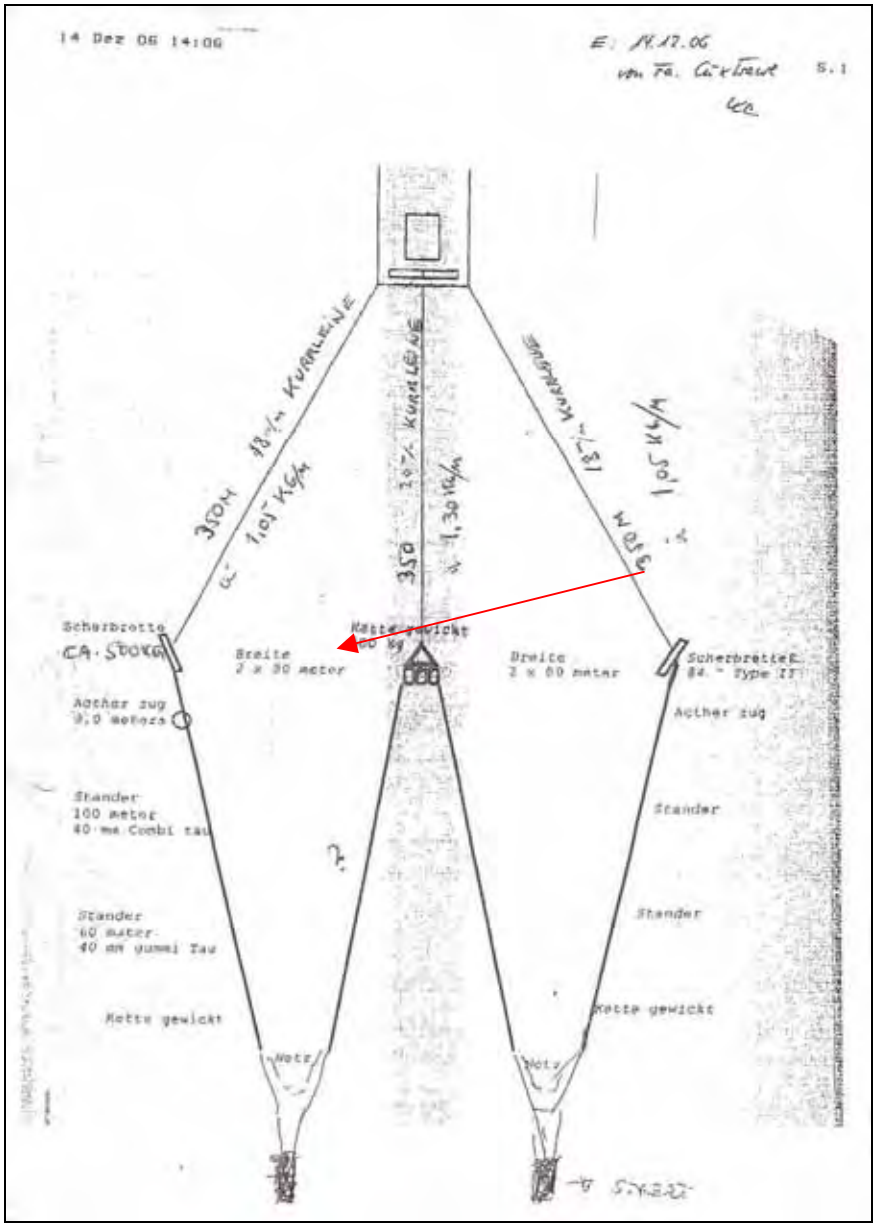


Figure 52: Net arrangement with weights and trawl board

5.10.9 Anchor equipment and aft mast

It must be assumed that there was only one anchor on board. This was run in a hawse with an approx. 4 m wire warp foregoer. The main part of the anchor chain was still in the chain locker, but was separated from the anchor.
The reserve anchor with 178 kg had been removed from the vessel and in addition a new guide pulley weighing approx. 50 kg had been installed, resulting in a weight reduction of 130 kg.

The aft steel mast with struts, boom, gaffle and steadying sail was dismounted in 2003/2004 and a new aluminium mast was installed. This aluminium mast was not recovered.
The weight reductions here amount to approx. 190 kg.

5.10.10 Aft trawl board gallows

The original aft trawl board gallows were dismounted when the catching method was changed. The new trawl board holders were mounted aft on the poop deck at the side of the net winch. The extra weights of this holder arrangement were weighed and documented when the net winch weight was recorded. The removal of the trawl board holder results in a weight reduction of 290 kg.

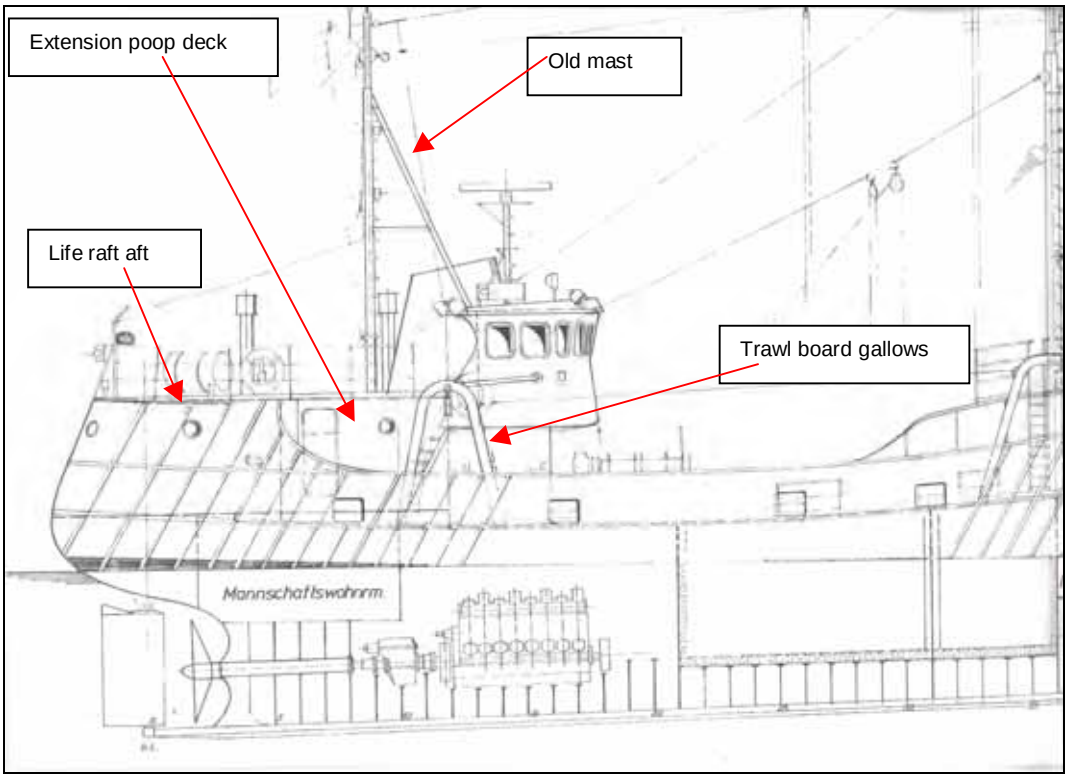


Figure 53: Old general arrangement drawing

5.10.11 Fore mast with winch

A boom was mounted on the fore mast as tail gallows and derrick. An additional winch was installed on the main deck below the mast to operate the running rigging on the fore mast. The total weight of the additional blocks, bearings, running rigging and winch was determined as 630 kg.

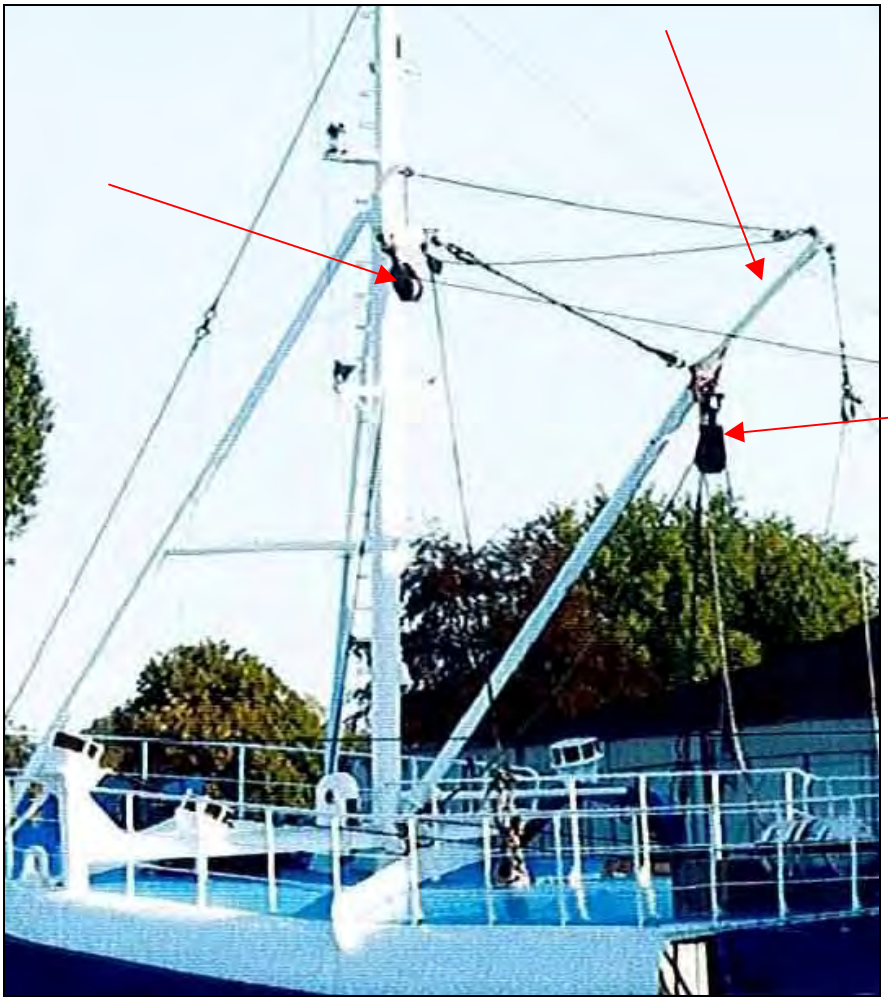


Figure 54: Mast with various pulleys

Figure 55: Winch at the mast

5.10.12 Cooling unit and fish-processing facility

In the course of the operating period a cooling unit was installed in the forward forecastle. In addition the associated cooling coils were mounted on the insulation in the fish hold. The total additional weight amounted to 300 kg.

Figure 56: Cooling set

The fish-processing facility with an additional weight of 2.24 t was mounted on the main deck in the way of the fish hatches. The individual weights were weighed and measured after the recovery.

Figure 57: Fish-processing facility

5.10.13 Summary of the weights and centres of gravity

Section	Designation	Date	Weight	Vcg (m)	Lcg (m)
	Weight of empty ship according to heeling test	18.01.1974	**157,33**	**3,08**	**10,24**
	Structural changes				
5.10.1	Installation of kort nozzle	1980	1,13	0,90	0,78
5.10.2	Installation of weatherguard over main deck with railing	1980	0,89	6,01	13,82
	Old position of lieferaft with bearing	2004	-0,12	6,65	0,95
	New position of liferat with bearing	2004	0,12	6,64	10,00
5.10.3	Foundation of trawl warp winch und guide pulley	2004	0,66	4,39	9,68
5.10.4	Net winch on poop deck complete with net	2004	9,40	7,50	4,00
	Transom guide for nets and trawl warp	2004	1,06	7,40	-0,30
5.10.5	Additional hydraulic set on main deck	2004	1,19	4,62	8,39
5.10.6	Forward support with guide pulleys	2004	1,31	6,60	18,30
5.10.7	Extension of side poop deck on stb.		0,26	5,35	3,95
5.10.8	Old position trawl boards	2004	-1,00	4,85	18,00
	New position trawl boards	2004	1,00	7,00	2,30
	Chain net connection	2004	0,40	7,60	0,00
5.10.9	Anchor/anchor chain		-0,13	4,55	18,26
	Reduced weight of aft mast	2004	-0,19	9,25	3,22
5.10.10	Dismantling of aft trawl board holder		-0,29	5,32	6,00
5.10.11	Boom on fore mast as tail gallows with winch		0,63	7,76	17,54
5.10.12	Cooling unit in the forecastle with cooling coils		0,30	3,27	15,27
	Fish processing installations on the main deck		2,24	4,89	15,28
	Weight of empty vessel at the time of the accident on 8.11.2006		**176,19**	**3,44**	**9,84**

In the course of the operating period, according to the above compilation the weight of the vessel increased by 18.86 tonnes, corresponding to an increase of approx. 12%. The centre of gravity moved upwards as a result of the conversion by 0.36 m (approx. 11.6%).
The shift in the longitudinal centre of gravity by 0.40 m aft only affected the increase of the aft trim and magnification of the aft draft.

	Old :	New:
Weight of empty vessel :	**157.33 t**	**176.19 t**
Centre of gravity above baseline :	**3.08 m**	**3.44 m**
Longitudinal centre of gravity:	**10.24 m**	**9.84 m**

5.11 Determination of the weights and centres of gravity at the time of the casualty

The weights of the crew, provisions and effects, additional navigation equipment and the deck area, the machine equipment and reserve fisheries equipment were recorded with a total weight of 5.0 t and a centre of gravity height of 3.74 m in the "mass constant at the time of the accident". This calculation includes the reserve equipment parts and nets found in the forecastle.
The consumable supplies in the tanks, fresh water and propulsion oil tanks, were checked on the basis of the old stability documents and calculated as 31.77 t with a centre of gravity height of 2.34 m in the "mass tank fillings (95 %)".
FV HOHEWEG had taken on 3 t ice as cargo in Bremerhaven on 8 November 2006. It is to be assumed that this quantity of "ice cargo at the time of the casualty" was distributed uniformly in fish hold No. 2 with a centre of gravity height of 1.2 m.
To summarise, the following vessel weight and centres of gravity on the day of the casualty considered in the further stability calculations were as set out below:

	Designation	Weight (t)	VCG (m)	LCG (m)
	Weight of empfy vessel at time of accident	**176,19**	**3,44**	**9,84**
	Mass constant at time of the accident	**5,00**	**3,74**	**13,67**
	Mass tank filling (95%)	**31,77**	**2,34**	**11,39**
	Ice cargo at the time of the accident	**3,00**	**1,20**	**13,00**
	Vessel at the day of the accident	**215,96**	**3,25**	**10,200**

5.12 Stability calculation according to regulations

5.12.1 Calculation of the hydrostatic values

The BSU expert Hatecke used the AUTOHYDRO program from the firm Autoship System Corporation for the tank and stability calculations. The shipyard line drawing was digitised, the attachments such as rudder and Kort nozzle were also recorded in the measurements. The poop and the forecastle were also measured, as if these are properly closed they count as an additional buoyancy and improve stability. The superstructures with areas relevant for the consideration of the heeling wind moments such as bridge, stack and weather deck have been idealised in the calculation model and these ship parts do not improve or deteriorate the stability.
The hydrostatic values calculated with this program were compared with the values calculated in 1974.

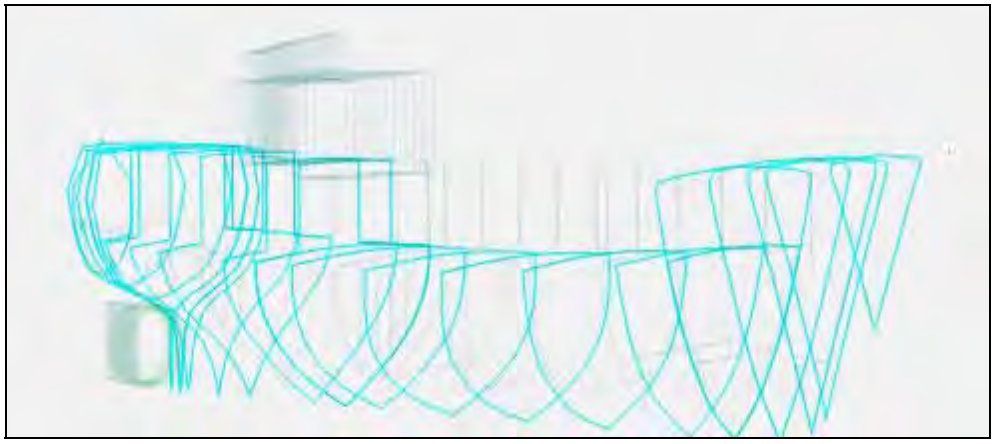


Figure 58: Frames and superstructures

5.12.2 Vessel particulars before the time of the casualty

In the course of the operating period no further heeling test was carried out and no draft checks were documented either in order, for instance, to ascertain the changes in weight.
Within the framework of other police investigations, photos were taken of the vessel in the port of Brake on 9 June 2006. These photos were analysed by the BSU and the loading case was reconstructed in accordance with the vessel condition.

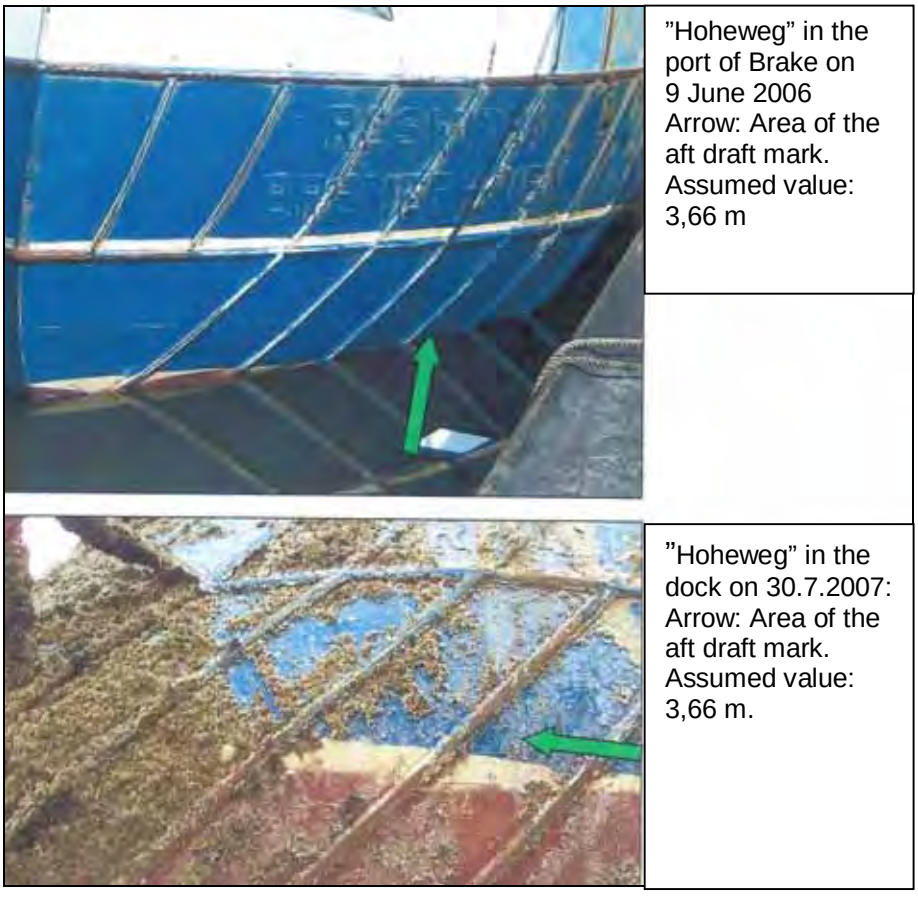


Figure 59: Draft mark aft

The aft draft was determined on the basis of the photos and the draft marks in the dock after salvage as 3.66 m. It was not possible to determine the forward draft precisely in the dock, so that the Institute for Photogrammetry and Geoinformation was commissioned with calculating the forward draft on the basis of the photos taken by the waterway police. The Institute determined the forward draft of 2.37 m by measuring via comparative calculation and evaluating the reflected draft marks on the surface of the water using two different paths.

Figure 60: View of bow in the port of Brake on 9 June 2006

When drawing up the data for this load case of 9 June 2006 it was taken into account that the vessel probably only bunkered the following day. On the basis of the forward and aft drafts determined, a stability calculation with a vessel weight of 217.04 t was carried out. The masses calculated for the cargo in the fish holds and the reserve equipment are documented with the centres of gravity of the approved stability calculation of 1974 – *Case 3 – Vessel fully equipped, outward voyage.*

On the basis of the following results (actual) it can be seen that at the time the photos were taken on 9 June 2006 none of the stability criteria (limit) and minimum values (min/max) required by the See-BG (Accident Prevention Regulations Sea § 245) are satisfied.

Righting Arms vs Heel Angle

Heel Angle (deg)	Trim Angle (deg)	Origin Depth (m)	Righting Arm (m)	Area (m-Rad)
0.00	1.51a	3.175	0.000	0.000
5.00s	1.49a	3.157	0.030	0.001
10.00s	1.44a	3.105	0.059	0.005
15.00s	1.39a	3.029	0.081	0.011
17.00s	1.39a	2.997	0.083	0.014
20.00s	1.39a	2.947	0.079	0.019
25.00s	1.37a	2.852	0.058	0.025
30.00s	1.31a	2.730	0.027	0.028
33.52s	1.24a	2.626	0.000	0.029
35.00s	1.20a	2.578	-0.011	0.029
40.00s	1.05a	2.399	-0.050	0.026

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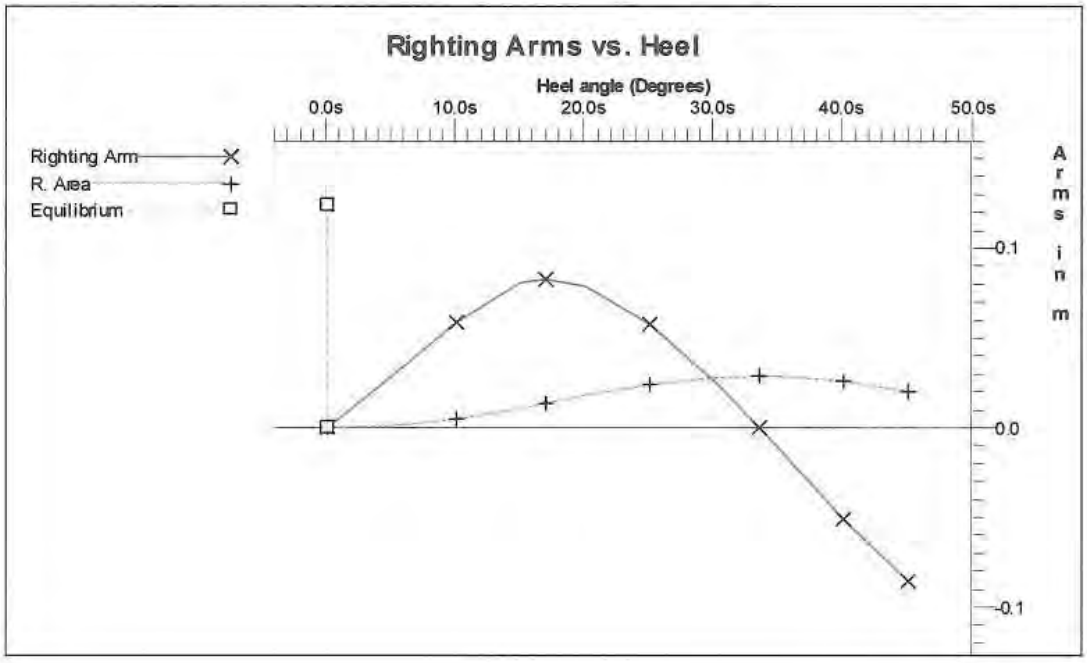
Limit	Min/Max	Actual	Margin	Pass
(1) Area from 0.00 deg to 30.00	>0.0550 m-R	0.028	0.027	No
(2) Area from 0.00 deg to 40.00	>0.0900 m-R	0.026	0.064	No
(3) Area from 30.00 deg to 40.00	>0.0300 m-R	-0.002	0.032	No
(4) Righting Arm at 30.00 deg or MaxRA	>0.200 m	0.027	0.173	No
(5) Angle from 0.00 deg to RAzero	>60.00 deg	33.52	26.48	No
(6) GM Upright	>0.350 m	0.329	0.021	No

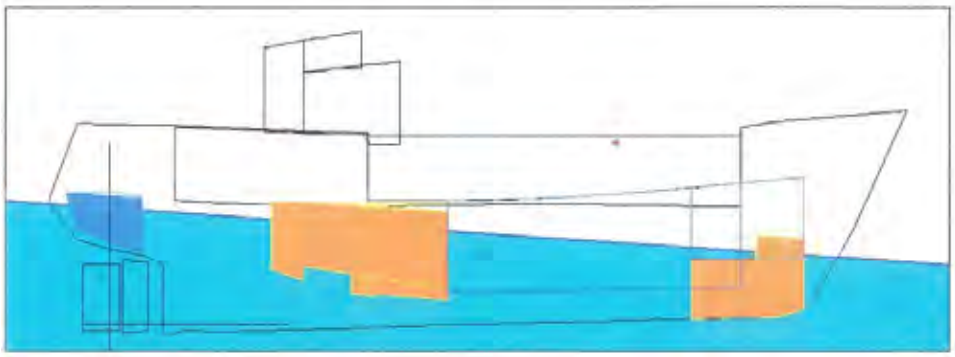


5.12.3 Vessel particulars at the time of the casualty

The following input data and stability calculations were carried out with the masses and centre of gravity intervals assumed at the time of the casualty:

Floating Status

Draft FP	2.046 m	Heel	zero	GM(Solid)	0.377 m
Draft MS	2.812 m	Equil	Yes	F/S Corr.	0.056 m
Draft AP	3.578 m	Wind	Off	GM(Fluid)	0.321 m
Trim	aft 1.532/23.000	Wave	No	KMt	3.630 m
LCG	-10.195 m	VCG	3.254 m	TPcm	1.30
Displacement	215.96 MT	WaterSpgr	1.025		



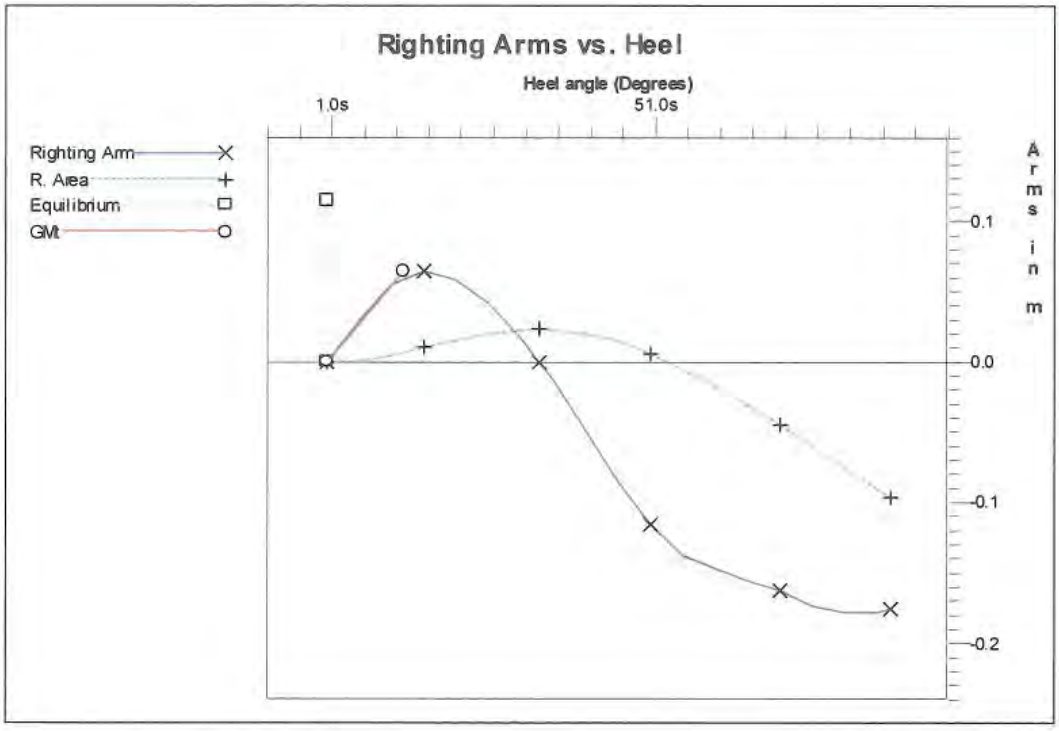
Fluid Name	Legend	Weight (MT)	Load%
DIESEL OIL		26.85	95.00%
FRESH WATER		4.92	95.00%

5.12.4 Stability criteria of the See-BG (Accident Prevention Regulations See)

The stability calculation was carried out taking into account the volumes and influences of the closed poop and forecastle. The least favourable calculation case is heeling to starboard caused by the asymmetrical poop (entrance area on starboard side).

Calculated stability values at the time of the casualty by comparison with national regulations:

Limit	Min/Max	Actual	Margin	Pass
(1) Area from 0.00 deg to 30.00	>0.0550 m-R	0.025	0.030	No
(2) Area from 0.00 deg to 40.00	>0.0900 m-R	0.023	0.067	No
(3) Area from 30.00 deg to 40.00	>0.0300 m-R	-0.002	0.032	No
(4) Righting Arm at 30.00 deg or MaxRA	>0.200 m	0.021	0.179	No
(5) Angle from 0.00 deg to RAzero	>60.00 deg	33.38	26.62	No
(6) GM Upright	>0.350 m	0.321	0.029	No

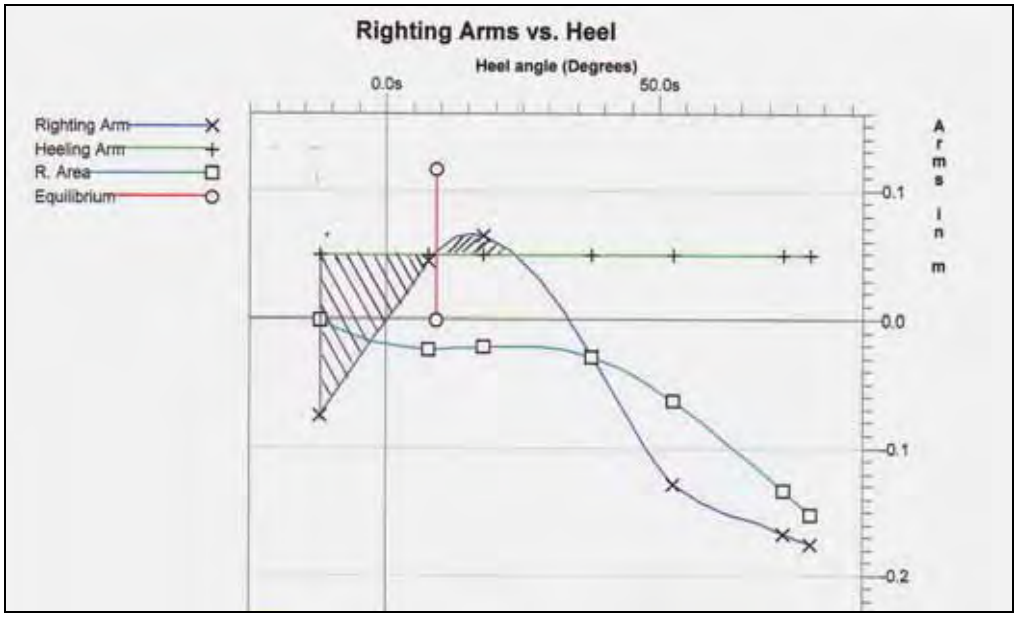


This loading case is required in particular in the Accident Prevention Regulations See of the See-BG in § 245 Chapter XIII – Fishing Vessel as the case: *Departing for tthe fishing grounds with complete load of fuel, supplies, ice, fishing gear etc.; taking into account the free surfaces for liquids.*

None of the stability criteria and minimum values required above are satisfied by FV HOHEWEG at the time of the casualty. The very low range of stability of only **33,4°** (the regulation states a range of 60°) is particularly noticeable.

5.12.5 Stability criteria according to the code on intact stability

In addition, the stability in accordance with the weather criterion for strong wind and rolling of IMO A.749(18), code on intact stability of all vessel types treated in the IMO Rules, was calculated. The ability of a vessel to withstand the joint influence of side wind and rolling through seaway is demonstrated with this. The vessel is subjected to a constant wind pressure standing at right angles to the fore-and-aft line of the vessel and additionally to the wind pressure of a gust. It is then assumed that on the basis of the waves the vessel swings up to a roll angle. Under this dynamic mode of consideration the area “B” should be equal to or larger than the area “A”.



The weather criterion for resisting the joint influence of side wind and rolling is **not** satisfied. The area “B” is considerably smaller than the area “A”, as can be seen easily on the above righting arm.

5.12.6 Influence of the cargo on the stability

The approved stability documents of 1974 assume a loading case *“vessel fully equipped – outward voyage – “* with an ice load in the fish holds of 25.0 t. In the course of the operating time a cooling unit was installed that did not require this volume of ice anymore. The stability calculations of the BSU expert were checked additionally with an ice load of 25.0 t instead of with a load of 3.0 t. The range of stability increased only insignificantly from 33.4° to 34.0°. The required range of stability of 60° is not achieved. The GM was magnified in this calculation from 0.321 m to 0.375 m and the required stability criterion, GM larger than 0.35 m, is thus satisfied in this one criterion.

As it is not known whether the 3 t ice cargo in the fish hold was stowed such that it could not slip, the shifting of the ice cargo was calculated too. With an assumed shift path of 2.5 m to starboard without changing the centre of gravity above baseline and the longitudinal centre of gravity, this results in a list (inclination) of 5.6°.

In all probability the fish-processing facilities only slipped when the vessel sank and landed on the Nordergründe. As these facilities were evidently not connected sufficiently sea-fast with the deck of the vessel, however, a possible shifting of the fish-processing facility prior to capsizing was calculated. The weight of the fish-processing facility is assumed as 2.24 t an the shift path as 1.5 m. Without altering the centre of gravity above baseline and the longitudinal centre of gravity, this results in an angle of inclination of 2.6° to the starboard side.

5.12.7 Determination of the angle of flooding

The angle of heel for the time of the casualty was determined for a case in which openings in the vessel hull, the superstructures or deck houses that could not be closed weather-tight or were not close were immersed.
As it is to be assumed that the FV HOHEWEG capsized over the starboard side and the only opening on the port side, the emergency exit from the engine room, was closed at sea in accordance with regulations, this calculation is based only on the openings on the starboard side.

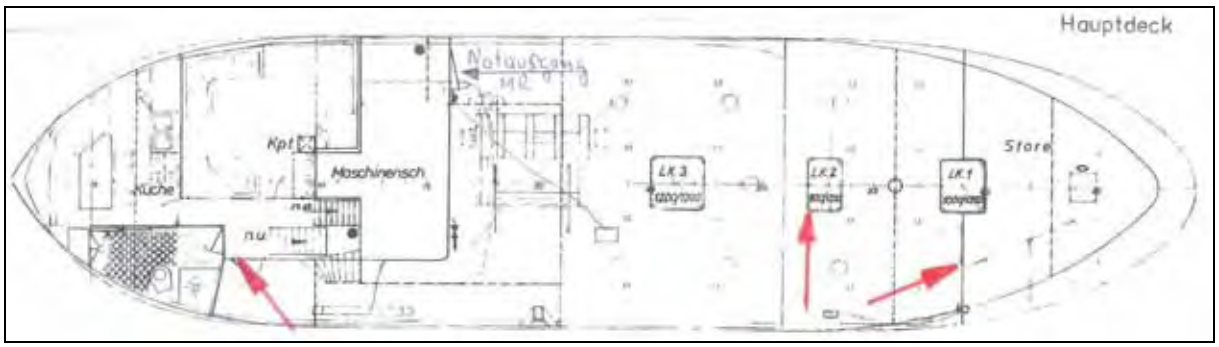


Figure 61: Flooding points

When determining the floating positions the following flooding points resulted:

1.) Upper edge coaming of the fish hatches:	79.2°
2.) Upper edge coaming of the forecastle door:	54.7°
3.) Upper edge coaming of the superstructure door:	27.8°

When the flooding points of the fish hatches (1) and the net hold hatch not closed sea-tight and an open door to the forecastle (2) are reached, the vessel has already exceeded its positive range of stability of 33.4°. The holds are flooded at a later stage of capsizing due to the lack of watertight integrity at a point where uprighting of the vessel again is no longer probable.

Prior to reaching the maximum range of stability of 33.4°, only the flooding point of the aft superstructure door (3) comes to water at a value of 27.8°. This door in the poop on the starboard side was found on salvage in a non-barred condition. It can therefore be assumed that watertight integrity was thus not established and that additional water made its way into the aft hull of the vessel at this point. This water will have led to accelerated sinking via the starboard side.

5.12.8 Loss of stability on the day of the casualty

In this investigation the stability situation during the time of the casualty is reconstructed by calculating hydrostatic cases, and the possible causes of capsizing are pointed out. The calculation considers the following situations described inter alia in the"Research Project 557" of the University of Newcastle for small fishing vessels:

1. The vessel hull "balances" on a wave (without water on deck), leaves the water line area necessary for stability and capsizes.

2. A wave runs over the bulwark, floods the deck, produces a rolling moment and the vessel capsizes.

3. The vessel is hit at the side by a high, steep wave so that a rolling motion develops leading to strong lurching and subsequent capsizing.

5.12.8.1 Wind and sea conditions in the sea area

On the basis of the official weather expertise by the DWD, the measurement data from ALTE WESER Lighthouse and the statement by the witness, the following values result for the calculation:

Wind direction	:	**243 °**
Wind force	:	**35 knots (Bft 8)**
Wave height	:	**3 m**
Wave period:		**5 sec**
Wave length	:	**32 m**

On the basis of the situation in which the wreck of FV HOHEWEG was found, for the purpose of the investigation the cause of sinking of the vessel is assumed to be capsizing to the starboard side. External loads made up of wind and sea were examined for three static scenarios:

1. The vessel at reduced speed ahead of 180° to the prevailing wind and wave direction (exactly from aft).

2. The vessel at reduced speed ahead of 135° to the prevailing wind and wave direction (at an angle from aft).

3. The vessel at reduced speed ahead of 90° to the prevailing wind and wave direction (at right angles from the side).

5.12.8.2 Influence of the wind on the stability

The calculation revealed that the influence of the wind coming exactly from aft, from an angle of 180° to headway,can be neglected.
The considerations therefore assumed lateral wind loads of 135° and 90° on the centre of area of the above-water wind pressure area lying above the surface of the water.

At a constant wind load of 8 Bft (35 kn) from the port side, an inclination of 1.15° to the starboard side results from the influence of the wind alone at an angle of below 45° to the crossways ship direction, in other words at an angle of 135° from aft.
At a load coming exactly at right angles from the side, 90° to the cross axle of the vessel, a constant inclination of 2.3° to starboard results. The range of stability is reduced to approx. 31°.

The vessel operator handed over documents to the BSU according to which FV HOHEWEG had spent altogether 548 sea days in the North Sea and the Baltic Sea in the years 2004 to 2006. It is evident from these lists that the vessel cannot have experienced any wind forces greater than 7 Bft at sea after the conversion in 2003/2004. The operator states that from the reports of the master on days and sea areas that can no longer be reconstructed, wind forces of over 9 Bft were occasionally measured on board. Although this statement could not be verified, the influence of a higher wind force than that which occurred on the day of the casualty was additionally calculated.
The least favourable stability case, wind of force 10 Bft (50 kn*)*, wind coming exactly at right angles from the side (90°), results in an inclination of 4.7° and the range of stability is reduced at this heeling moment to approx. 28.5°.

To summarise, it was determined that even under a higher wind force than prevailing on the day of the accident, the vessel would not have capsized solely due to the influence of the wind.

5.12.8.3 Wind and slipping of ice and facilities

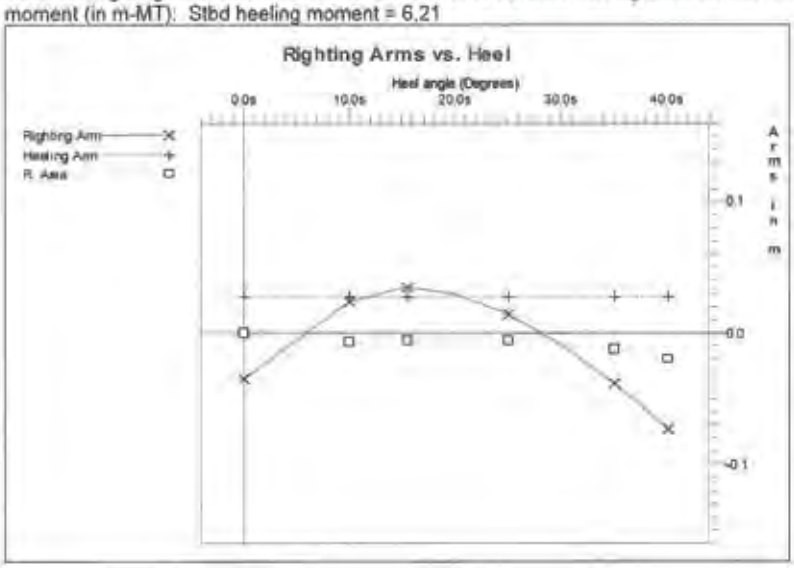
In addition, the sideways slipping of the 3 t ice cargo was considered under the influence of a higher wind force than that prevailing on the day of the casualty, and in a further calculation additionally the slipping of the fish-processing facility.

At a heeling wind moment caused by the mean wind load of 10 Bft (50kn) from the port side, exactly abeam below 90°, and at the same time slipping of the 3 t ice cargo with a slipping path of 2.5 m to starboard, the vessel heels 11.2° to starboard. The range of stability then is approx. 21.0°.

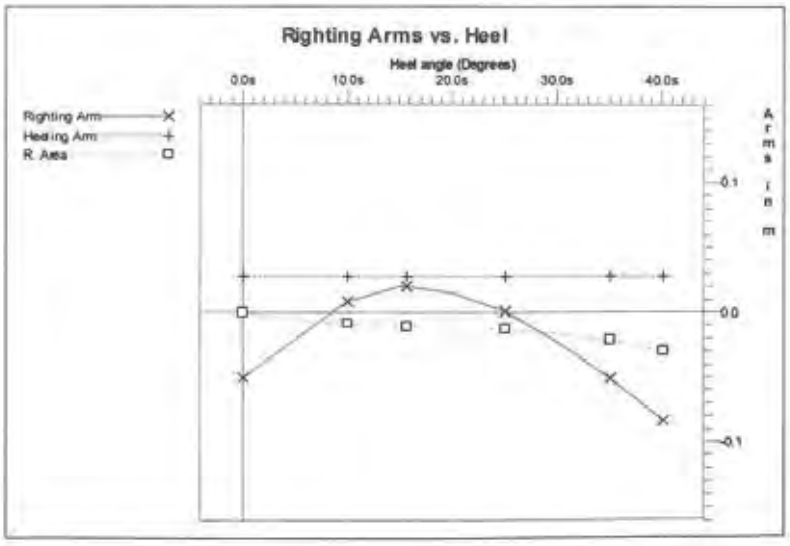
Residual Righting Arms vs Heel Angle

Heel Angle (deg)	Trim Angle (deg)	Origin Depth (m)	Residual Arm (m)	Area (m-Rad)
0.00	3.81a	3.569	-0.063	0.000
5.00s	3.79a	3.552	-0.033	-0.004
10.00s	3.75a	3.505	-0.005	-0.006
15.00s	3.76a	3.450	0.006	-0.005
15.52s	3.77a	3.443	0.006	-0.006
20.00s	3.78a	3.379	0.001	-0.005
25.00s	3.76a	3.281	-0.014	-0.006
30.00s	3.68a	3.153	-0.038	-0.008
35.00s	3.54a	2.994	-0.067	-0.012
40.00s	3.34a	2.805	-0.101	-0.020

Note:
Residual Righting Arms shown above are in excess of the wind heeling arms derived from this moment (in m-MT): Stbd heeling moment = 6.21



If in addition to the load of wind at 10 Bft and the slipping of the 3 t ice cargo a further moment resulting from the slipping of the 2.24 t heavy fish-processing facility with a side slipping path of 1.5 m to starboard is added, the vessel no longer has any positive righting arms and capsizes to starboard.

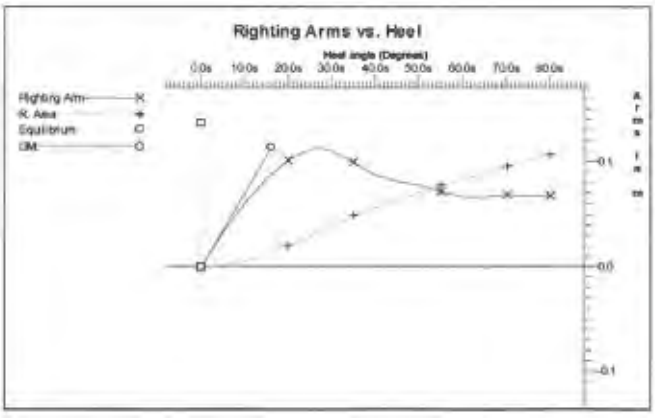


5.12.8.4 Influence of the sea on the stability

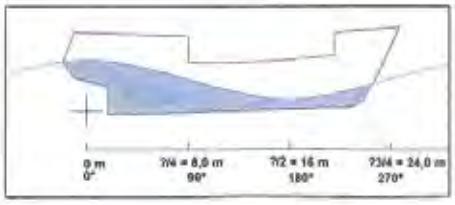
In this static examination only the sea is considered without the influence of wind or other moments (e.g. moment from turning or shift of the load).
The stability limits are determined by exclusion processes with the input data wave period = 5 sec, wave height = 3 m and wave length = 32 m. For the wave height, the measured value of 3 m was assumed as input value for the calculations. If higher wave heights occur in this wave characteristic, the instability and subsequent capsizing occur in any case.

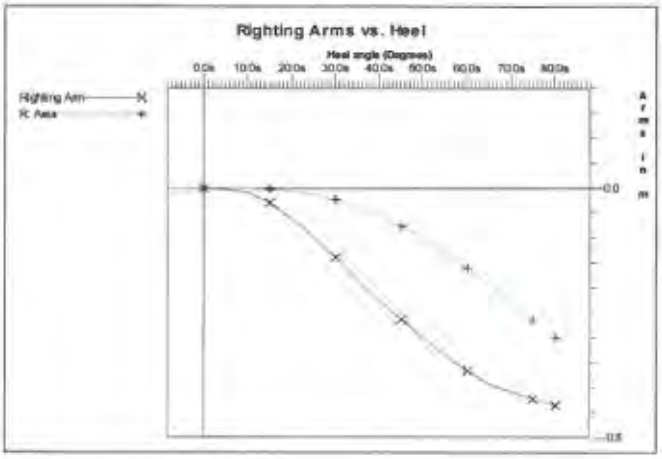
Wave direction from 180°

This first possibility examines wheather the vessel capsizes over the starboard side with a speed ahead of 180° to the prevailing wave direction. In other words, the waves come exactly from aft and the vessel hull balances on a wave, thus looses the necessary water line area and capsizes. To this end calculations of the static balance situation for waves rolling on from aft were carried out. The position of the wave comb related to the aft perpendicular from which the vessel no longer has any righting arm is determined.

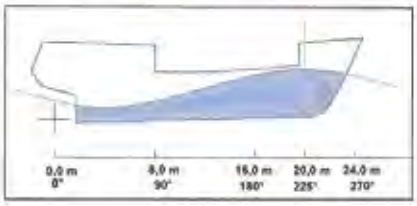


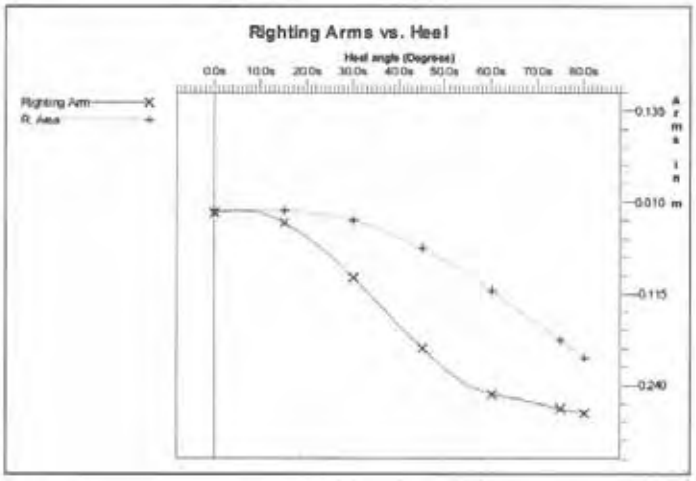
Phase of crest relative to origin:
0.0 degrees **(0.00 m)**
Wave length: 32.0 m
Crest-to-trough height: 3.0 m
Angle of encounter:
0 degrees (following sea)



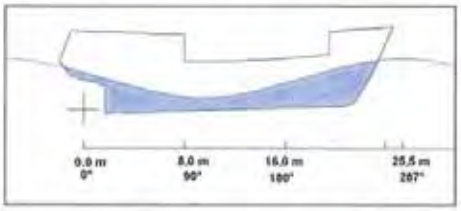


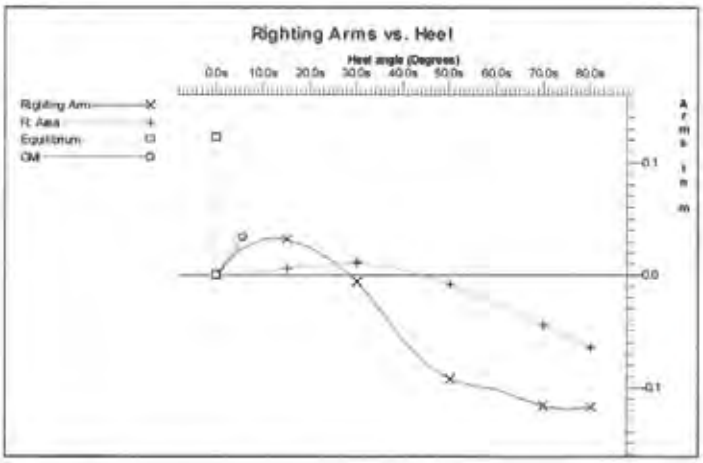
Phase of crest relative to origin:
225.0 degrees **(20.0 m)**
Wave length: 32.0 m
Crest-to-trough height: 3.0 m
Angle of encounter:
0 degrees (following sea)



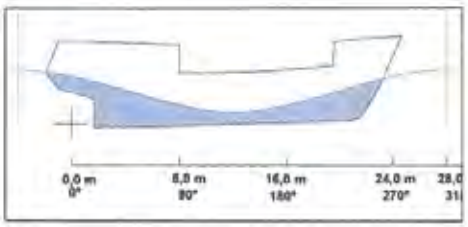


Phase of crest relative to origin:
287.0 degrees **(25.5 m)**
Wave length: 32.0 m
Crest-to-trough height: 3.0 m
Angle of encounter:
0 degrees (following sea)





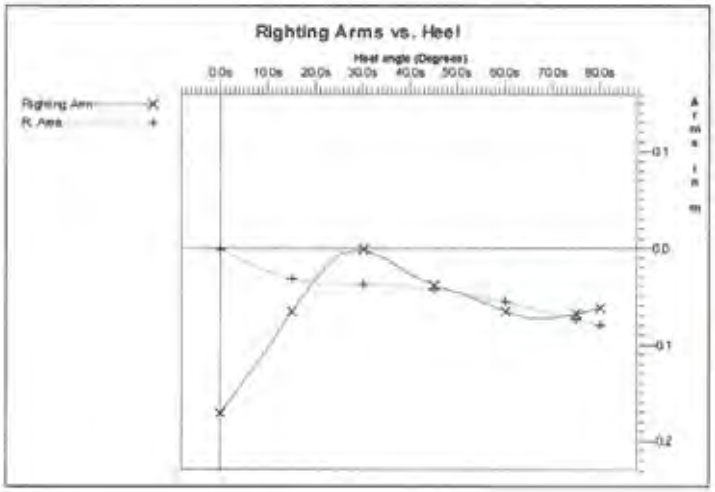
Phase of crest relative to origin:
315.0 degrees **(28.0 m)**
Wave length: 32.0 m
Crest-to-trough height: 3.0 m
Angle of encounter:
0 degrees (following sea)



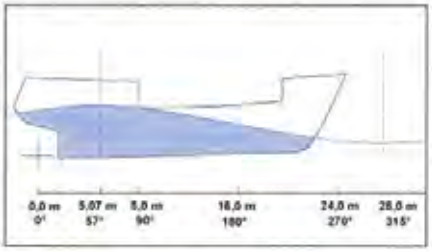
It can be seen on the above figures that the vessel is unstable without any positive righting arm if the wave crestof a 32 m long and 3 m high wave in the vessel's area is between **20.0 m** and **25.5 m** from the aft perpendicular.
A calculation for the purpose of comparison was then carried out with unchanged load case and unchanged longitudinal centre of gravity,solely with a variation of the centre of gravity above base line. With a centre of gravity above baseline of the empty vessel of **3.15 m** instead of 3.44 m, the vessel has positive righting arms over the entire wave area of a wave running up from aft. With the old empty vessel centre of gravity of 3.08 m, prior to the conversion in 2003/2004, the vessel would not have capsized in this aft wave.

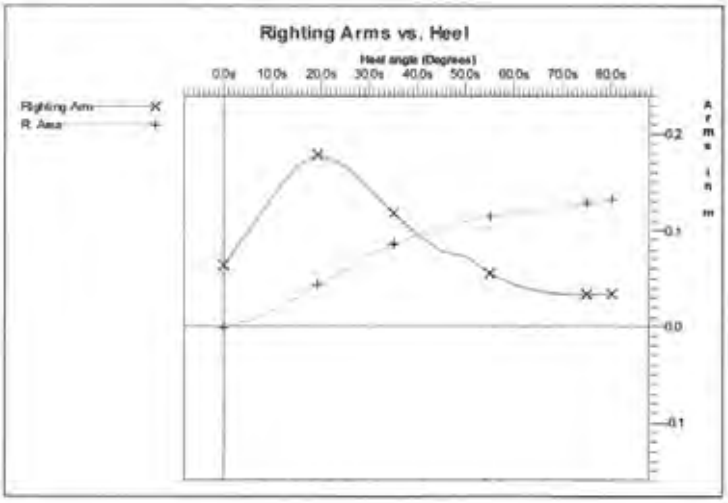
Wave direction from 135°

In the second possibility the waves come at an angle from aft of 45° to the fore-and-aft line of the vessel with the vessel proceeding ahead. The calculating method used is analogous to the calculation of the wave direction from 180°.

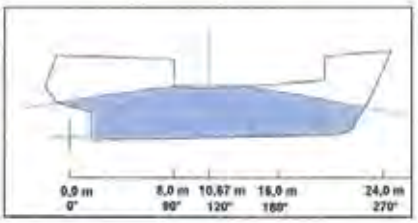


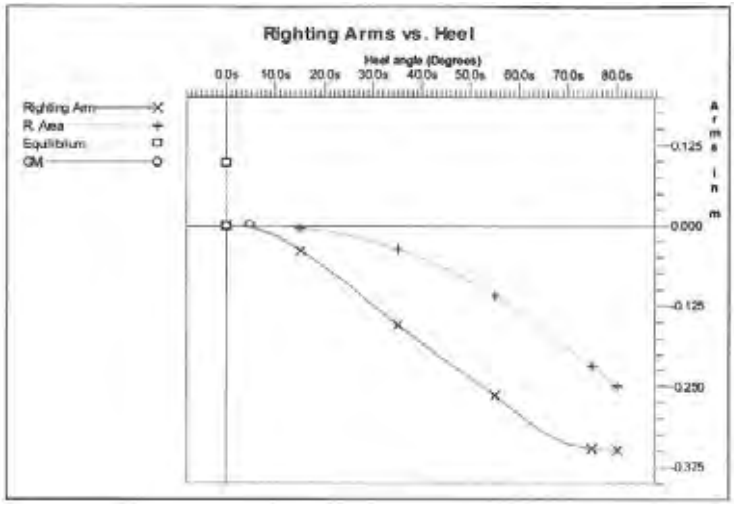
Phase of crest relative to origin:
57 degrees **(5.07 m)**
Wave length: 32.0 m
Crest-to-trough height: 3.0 m
Angle of encounter:
-45 degrees (port quartering sea)



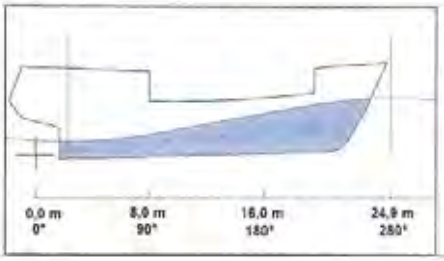


Phase of crest relative to origin:
120.0 degrees **(10.67 m)**
Wave length: 32.0 m
Crest-to-trough height: 3.0 m
Angle of encounter:
-45 degrees (port quartering sea)





Phase of crest relative to origin:
280.0 degrees **(24.9 m)**
Wave length: 32.0 m
Crest-to-trough height: 3.0 m
Angle of encounter:
-45 degrees (port quartering sea)

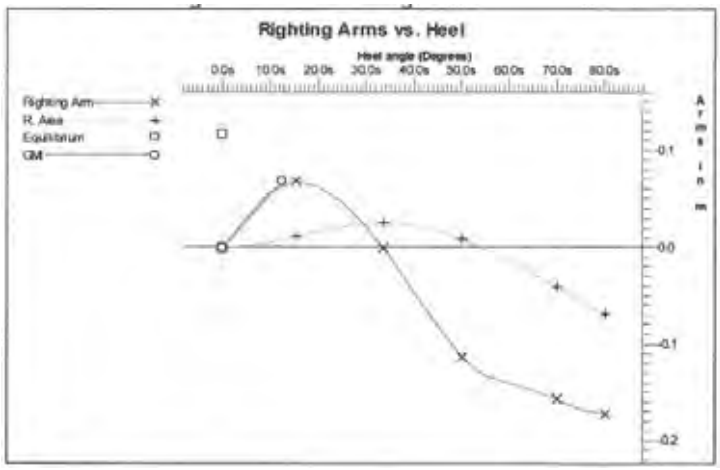


The vessel is stable with righting arms if the wave crest of a wave coming up at an angle of 45° from aft on the port side is between **5.07 m** and **24.9 m** from the aft perpendicular in the area of the vessel.

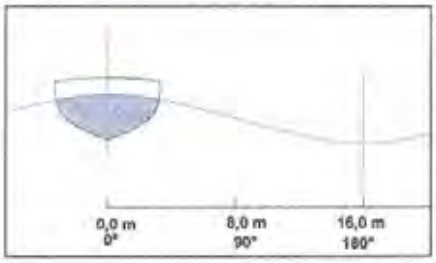
A calculation carried out for the purpose of comparison with unchanged load case and the centre of gravity above baseline being varied revealed that with an empty vessel weight of **3.05 m** instead of 3.44 m over the entire wave area of a wave coming up at 45° from aft, there are positive righting arms.

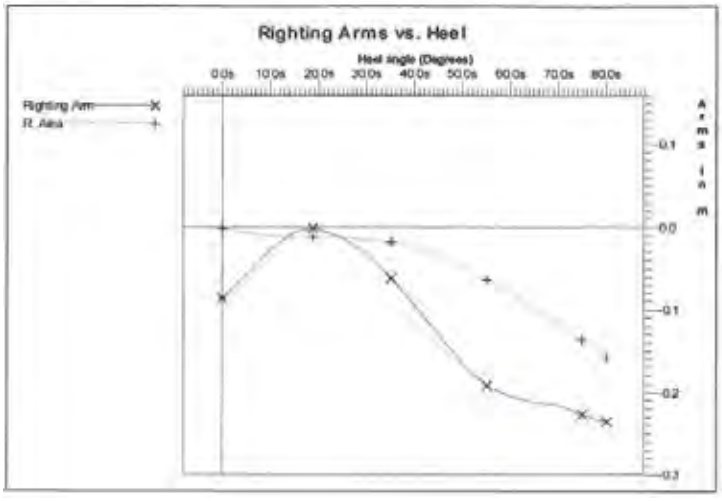
Wave direction from 90°

In the third possibility the vessel capsizes over the starboard bow when proceeding ahead at 90° to the prevailing wave direction. Within the framework of the calculation the stability at a wave coming exactly abeam from the side was examined. The vessel is hit by a high wave from the side so that a rolling motion develops that leads to strong lurching and subsequent capsizing.

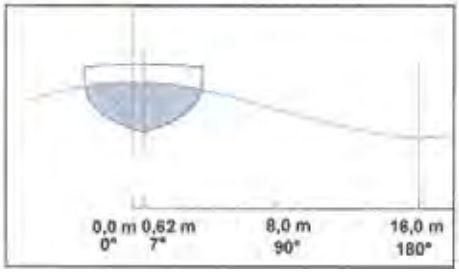


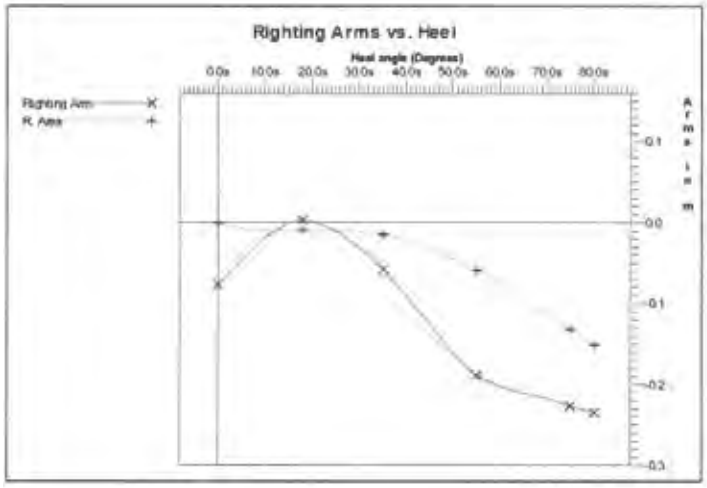
Phase of crest relative to origin:
0 degrees **(0.0 m)**
Wave length: 32.0 m
Crest-to-trough height: 3.0 m
Angle of encounter:
-90 degrees (port beam sea)

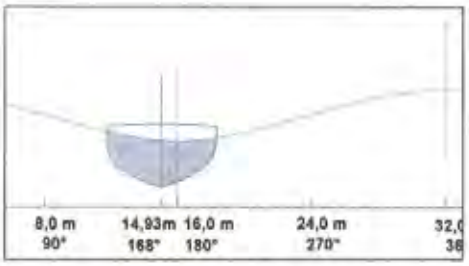




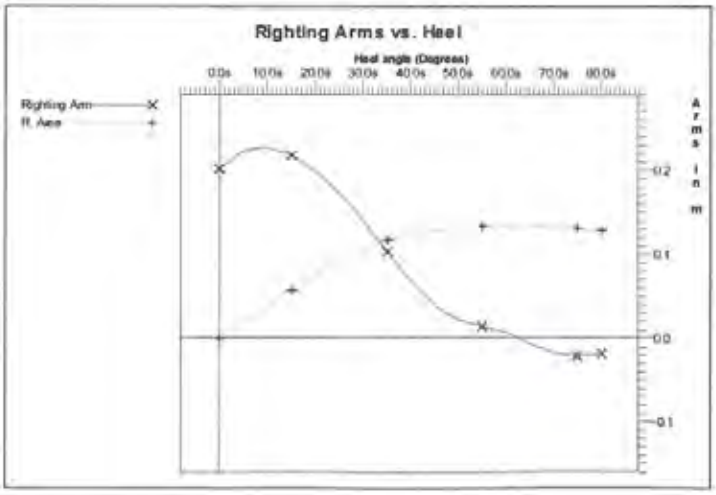
Phase of crest relative to origin:
7.0 degrees **(0.62 m)**
Wave length: 32.0 m
Crest-to-trough height: 3.0 m
Angle of encounter:
-90 degrees (port beam sea)

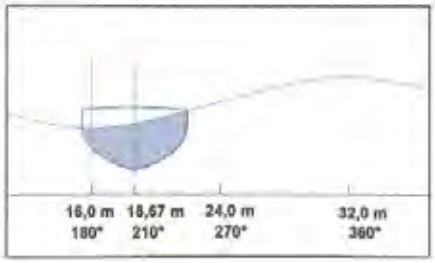






Phase of crest relative to origin:
168.0 degrees **(14.93 m)**
Wave length: 32.0 m
Crest-to-trough height: 3.0 m
Angle of encounter:
-90 degrees (port beam sea)





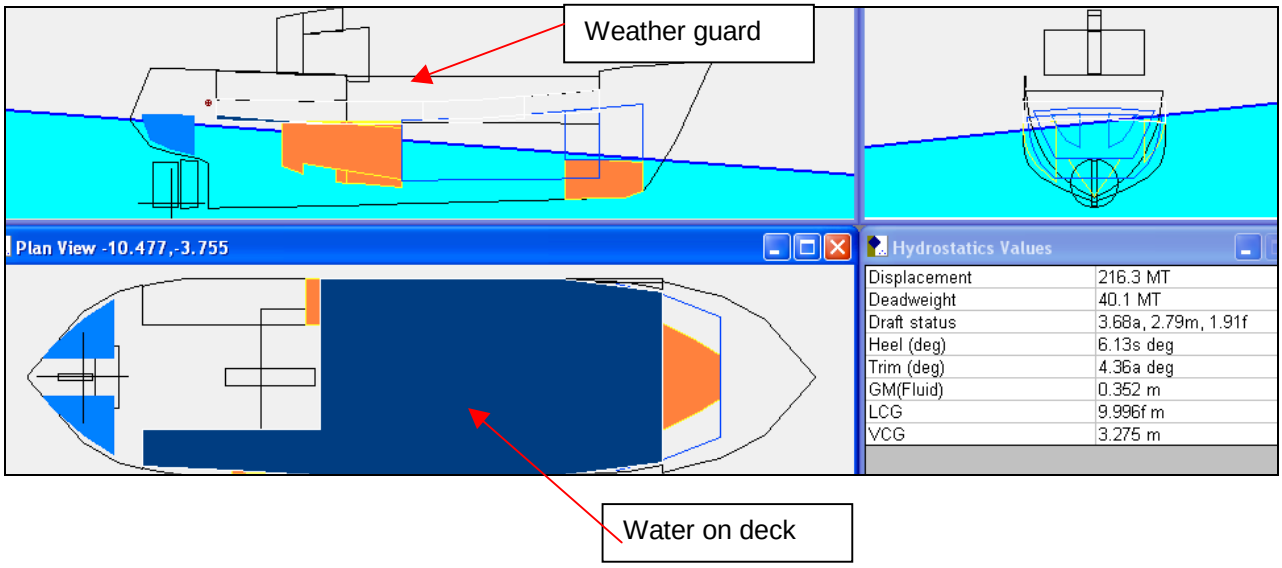
Phase of crest relative to origin:
210.0 degrees **(18.67 m)**
Wave length: 32.0 m
Crest-to-trough height: 3.0 m
Angle of encounter:
-90 degrees (port beam sea)

The vessel is then unstable with out a righting arm if the wave crest of a 32 m long and 3 m high wave running up at an angle of 90° is located at a distance between **0.62 m** and **14.93 m** from the fore-and-aft line of the vessel on the port side. The result is plausible, as the vessel tends to tilt over to the starboard side and there is not enough buoyancy there due to the asymmetry of the poop. If the vessel is located in the rising wave area, the asymmetrical superstructure on the port side has a stabilising effect.

In a calculation conducted for the purpose of comparison it was determined that from an empty vessel centre of gravity above baseline of **2.80 m** with unchanged load case and longitudinal centre of gravity, there are righting arms over the entire wave area of a wave approaching from abeam.

5.12.8.5 Heeling moment on the basis of the main deck being awash

As a possible cause of capsizing the BSU also examined whether for example flooding of the main deck between the forecastle, poop and the two bulwarks due a wave entering from the starboard side led to the HOHEWEG capsizing. Both the side wind load and the wave situations that had been examined before were left out of account here.



This situation corresponds to the stability case in which a wave washes over the bulwark, floods the deck and produces a rolling moment and the vessel thereupon capsizes. It is presumed here that the water-freeing ports that were admittedly sufficiently largely dimensioned on board still did not manage to allow the water to flow off fast enough. Although it was technically possible to stop the water-freeing ports, it could not be ascertained that these were blocked in closed position.

The cases 2 cm (1.52 t), 16.5 cm (12.57 t) and 23.5 cm (17.91 t) water on deck were examined.
At a flooding level of 2 cm the heeling moment due to the flooded main deck is so large that the vessel heels 3.06° to starboard.
At 16.5 cm water on deck the heeling moment is so large that the vessel heels to starboard up to an angle of inclination of 27.15°. With further heeling the water would flow off outboards over the top edge of the bulwark from this inclination onwards. The range of stability would be approx. 34°.
With 23.5 cm water on deck the heeling moment due to the flooded main deck is so large that the vessel would capsize to starboard without any positive righting arm.

With an additional side load with a wind of 35 kn coming from the side there would not be any positive righting arms available any more already as of a water height of 21.9 cm on deck.

SEA WATER (SpGr 1.025)

Tank Name	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)
TANK-SCHANZKLE	16.50%	12.57	-7.72	2.591	4.068

Righting Arms vs Heel Angle

Heel Angle (deg)	Trim Angle (deg)	Origin Depth (m)	Righting Arm (m)	Flood Pt Height (m)
22.15s	3.84a	3.391	0.000	0.000 (1)
22.15s	3.84a	3.391	0.000	0.000 (1)
27.15s	3.69a	3.226	0.029	-0.255 (1)
27.15s	3.67a	3.212	0.048	
32.15s	3.56a	3.071	0.018	
34.58s	3.48a	2.991	0.000	
37.15s	3.39a	2.899	-0.018	
42.15s	3.20a	2.700	-0.051	
47.15s	2.96a	2.474	-0.084	

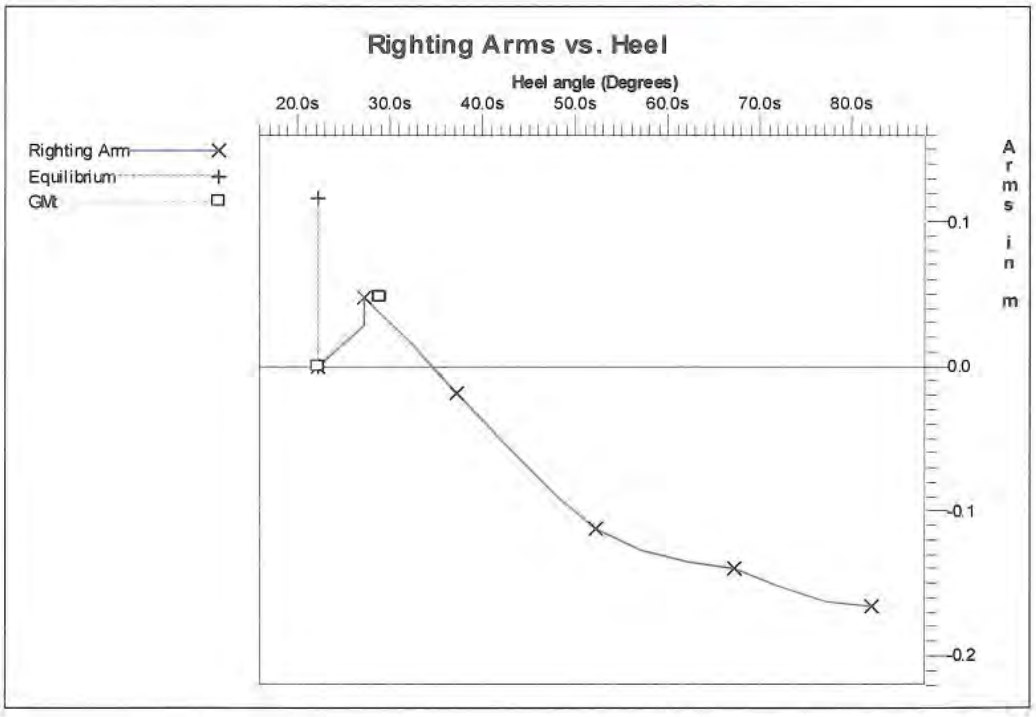


Figure 62: Lever arm curve with 16.5 cm water on deck

5.13 Examination of the watertight integrity

With the situation found on board it must be assumed that at the time of the casualty not all the openings were closed properly in sea-worthy condition. It was technically possible to secure all doors and hatches on board with sliding bolts and cage nuts and rubber seals accordingly. Only the “fish hole” on the port side between fish hatches I and II could technically not be closed in seaworthy condition.

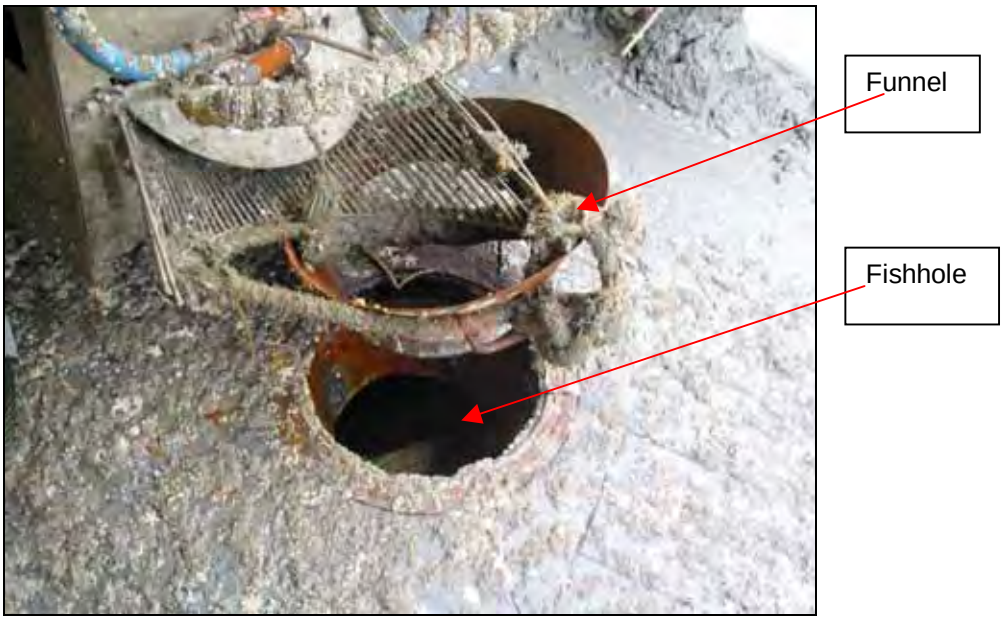


Figure 63: Fish hole port side

An angled funnel with a diameter of 0.38 m was located lying loosely over the “fish hole” and only sealed with sealing compound. The lowest height above deck was 0.13 m and the highest 0.44 m. It is possible that water could have entered the hold unnoticed already through this non-lockable opening on the River Weser, leading to a negative influence on the stability (free surfaces). This case was not calculated separately when investigating the stability.
The surveyor of the See-BG gave credible assurances in response to questioning by the BSU that this opening had either been closed during the survey or covered by items of equipment lying around and could not be seen.
The further 6 fish holes/openings installed on deck were closed sea-tight with rotary fasteners in accordance with regulations.

The crew is responsible for establishing the watertight integrity prior to leaving the port. Judging by the way the forward hatch to the net hold was found on salvage and also judging by the position of the fasteners of the two fish holes, it must be assumed that they were not closed sea-tight. The fact that the hatches were not closed would not by itself lead to sinking of the vessel, but would have accelerated foundering after capsizing.

With the doors to the forecastle and the superstructure found open it can possibly be assumed that these were only opened by the crew at the time of the casualty in order to carry out emergency measures on deck.

The emergency exit door from the engine room on the port side that was not found also makes it possible to conclude that the door was opened by someone, possibly to fetch tools from the engine room, or that during the actual capsizing stage, for example, someone tried to save himself from the superstructure/engine room via the emergency exit door. As the door was not found it is suspected that this door was lying in open condition for the whole time that the wreck was on the sea bottom, swung to and fro as a result of the current, and that ultimately the hinge bolts sheared off and the door sank completely to the bottom.

5.14 Radio equipment, life-saving appliances and signalling gear

5.14.1 Radio equipment

FV HOHEWEG was equipped with a firmly installed VHF radiotelephone installation and a GW-radiotelephone installation from Messrs. SAILOR. In addition there were two GMDSS emergency hand radio sets from Messrs. NAVICO, type AXIS 30, mounted at the companionway.

The radio system was inspected by the BSH (Federal Maritime and Hydrographic Agency) in Bremerhaven on 01 June 2005 and found to be in order.

The radio safety certificate was issued with a validity up to 31 July 2010.

5.14.2 Liferaft

The liferaft from Messrs. AUTOFLUG, last inspected on 08/2006, was triggered automatically by the water-pressure trigger after foundering. Altogether 22.93 m of the 8 mm thick rip-line for triggering the liferaft were still hanging on the completely inflated and intact liferaft. This line, not cut through but instead torn off, had evidently been properly connected with the vessel and had only ruptured after the liferaft moved upwards to the water surface. It was not possible to determine whether any persons had reached the liferaft after it rose. The packaged distress signals found drifting near the liferaft were probably only flushed out of the liferaft later.

5.14.3 Ring life-buoys and life-buoy lights, life jackets

The ring life-buoys found were partly not lettered and partly only with the wording "*BRAKE"* . In accordance with § 286 of the Accident Prevention Regulations Sea of the See-BG ring life-buoys must be lettered with the name of the vessel and port of registry. The non-lettering of the ring life-buoys was often a complaint during See-BG surveys, and this was also reiterated at the penultimate survey on 21 June 2005. On 20 July 2005 the surveyor of the See-BG also ticked off this point as settled. According to this at the time of the survey the ring life buoys were evidently in accordance with the regulations.
According to the Accident Prevention Regulations Sea, two ring life-buoys are to be equipped with night lights and the other two ring life-buoys still necessary with a 28 m long floating line. Neither lines nor lights were found secured to the ring life-buoys. The two lights, equipped with batteries and fastening cords, were evidently not secured on the ring life-buoys on deck as they were found in the master's cabin.
No possibility of stowing the ring life-buoys on deck or near the wheelhouse in brackets ready to handle, was found.

The two automatic life jackets and all solid life jackets found on board were operable. The jackets were not lettered.

5.14.4 Survival suits

According to the documents, FV HOHEWEG was equipped with four survival suits from Messrs. Helly Hansen. At the survey by the See-BG on 21 June 2005 it was directed that the lights in the survival suits should be renewed, and in the report of 20 July 2005 this point was checked and declared settled.
These survival suits, not lettered by name, should have been stowed in the master's cabin.
The survival suits were not found on board or with the corpses and as far as could be learnt have not been washed ashore elsewhere either.

5.14.5 Distress signalling appliances and radar transponder

The distress signalling gear on board in accordance with regulations with still valid stability was found complete and packed water-tight in a case in the desk in the master's cabin. Altogether there were 11 red parachute signal rockets and three red hand torches sealed in plastic sheeting.
In accordance with regulations the vessel was equipped with a radar transponder (SART)[25], type SA50, from Messrs. SIMRAD. It was not possible to find out anything about where this was kept or any lettering with a vessel name. The water-tight and floatable radar transponder with a battery failure date 09/2010 has not been found yet.

[25] SART= Search And Rescue Transponder

6 Analysis

6.1 Course of the voyage

After passing the Weser buoy “A6” at about 20.38 h, the vessel made the necessary course change towards the main ELBE navigation channel. At 20.41 h the vessel proceeded with a new heading of 038° and an angle of 155° to the prevailing wind and wave direction (at an angle from the port side aft).
After or during the course change the water hose lying on the aft poop went over board on the port side. This hose subsequently became caught in the area of the propeller and the Kort nozzle, so that it ultimately blocked the propeller. With reducing speed the vessel turned back in the direction of wind and wave.

It remains unknown what exactly happened on board the Fishing Vessel HOHEWEG between 20.38 h and 20.44 h and what actions were still taken to rescue vessel and crew, as there are no witnesses for the course of the accident.

6.2 Capsizing after loss of stability and sinking

Judging by the position in which FV HOHEWEG was found, it is to be assumed that on the day of the casualty the vessel sank over its starboard side in intact condition at the scene of the accident. There are no indications of third party influence such as collision or leakage of the hull. It can therefore be assumed that the vessel lost stability.

The Federal Bureau of Maritime Casualty Investigation examined various scenarios of possible capsizing. Four possibilities are set out below by way of example:

1. *Capsizing of the vessel over starboard due to an exceptionally high wave coming crossways from the side*

   There are no findings documenting the occurrence of such a high wave.

2. *Grounding of the vessel in the wave trough of an exceptionally high ground swell and subsequent overrolling by the wave.*

   No damage to the keel or masts was discovered and the prevailing wave height rules this possibility out.

3. *Loss of a trawl board with trawl warp due to wash or blow of the sea, followed by the trawl board becoming fast on the bottom (“net hooking”) and capsizing of the vessel to the starboard side due to the sudden braking action.*

   This case would certainly be conceiveable if the starboard trawl board had not been found. However, as only the port side trawl board was not seen from the

start and the trawl warps were still present on board in their full length, such a case can be ruled out.

4. *The stability values of the vessel have deteriorated considerably due to conversion so that as a consequence of external influences such as wind and waves the vessel capsized over its starboard side.*

   This latter case was investigated thoroughly by the BSU and is considered to be the most probable with calculations carried out in Chapter 5, summarised below:

   The massive deteriorations of the stability values due to conversion on the vessel in the years 2003/2004 are the cause of capsizing. The capsizing was triggered by the external loads of sea, wind influence and water on the main deck. It is possible that a strong list of the vessel and accelerated foundering of the vessel were promoted by shifting of items of equipment and ice cargo or ingress of water through open doors and hatches.
   Due to blocking of the propeller, the master had no chance of stabilising the vessel by increasing speed in conjunction with changes of course.

After the last conversion measures the vessel no longer had the prescribed range of stability of at least 60°, but instead only 33.4°. The calculations set out under Chapter 5 demonstrate that with the course set at the time of the casualty with aft waves the vessel must have capsized solely due to the influence of the prevailing wave direction, wave length and wave height. The wave height was not unusual, and under the old stability condition prior to the conversion would have been tolerable for the vessel.

The BSU further demonstrated that the vessel could have capsized as a result of a combination of wind influence and shifting of the ice cargo and fish-processing machines. In these calculated stability cases too, FV HOHEWEG would probably not have capsized under the old stability values valid up to the year 2003.

In the case of intact, non-blocked propulsion system capsizing would also have been possible with a following wave running at an angle from aft and a low speed. The blocked propeller did not have any influence on the stability, but greatly restricted the manoeuvrability.

The reduction of the output from 412.2 kW to 221 kW did not have any influence on the blockage of the propeller by the hose. Even at a higher output the engine would have been “stalled” with the position in which the filling lever was found.

The vessel operator and the master are responsible for observing the stability regulations. It cannot be reconstructed why these regulations were disregarded during the last conversions, which were not carried out by a shipyard, and why no expertise from a ship-building engineer was introduced.

The See-BG is responsible for checking whether regulations have been observed. The responsible technical surveillance officer was on board for the first time prior to

the last conversion work in the year 2003 and after this twice more in the year 2005. Despite the visible considerable conversion works, he did not notice these. During an inspection of the general arrangement drawing and study of the stability documents the major conversion works should have been immediately apparent.

The Federal Bureau of Maritime Casualty Investigation issued safety recommendations to the See-BG and its surveyors as well as to vessel operators and masters of vessels on the occasion of another stability accident, the *"foundering of FV NEPTUN on 30 July 2003, Investigation Report No. 226/03 of 5 March 2004".* These recommendations targeted observance, inspection and surveillance of the stability regulations. This present very serious marine casualty has shown that these recommendations are not yet being observed.

6.3 Watertight integrity and sea-worthy condition

The vessel was not in watertight condition in the midships area, because of the fish hole opening. It was technically impossible to close this aperture with simple on-board materials.
It was not possible to clarify why this was not noticed by the See-BG on previous surveys after the conversion work, especially when the fish-processing facility on deck and the aperture for the fish hatch with the hopper were set up.

It was technically possible to close all other apertures against water ingress.
The crew are responsible for establishing watertight integrity in accordance with regulations. The open doors to the superstructure and the emergency exit from the engine room can be explained, as these represented the only escape routes out of the superstructure and the engine room and it is possible that these were only opened in the course of capsizing.

It is part of the sea-fast and sea-worthy condition of a vessel that the possibility of items of equipment being washed over board is prevented. Safe fastening of the deck washing hoses, lines, mooring warps and the like are part of good seamanship.

It was not possible to clarify how the deck washing hoses were coiled and secured on board and why the deck washing hose drawn into the propeller jet was laid up to the poop deck.

6.4 Anchor facilities and trawl boards

The BSU assumes that there was only one anchor left on board. This anchor was carried secured in the hawse pipe and with a chain outboard shot and wire rope at the mast. The anchor was not clear for dropping; it was first necessary to shackle a trawl warp on it.

Whether the anchor facility was used after the conversion work in 2003/2004 and the crew were sufficiently familiar with the new anchor method could not be clarified.

As neither the anchor nor the port trawl board were found, it is suspected that after the failure of the propulsion system attempts were made to clear the anchor gear. This is backed up by the fact that the door to the forecastle and the emergency exit door to the engine room were opened, possibly in order to take out the tools for this work. It is to be suspected that during this work the anchor and the trawl board may have been lost. However, the time frame of approx. 3 to 4 minutes between slowing down and capsizing does not indicate that any promising measures could have been taken in order to anchor off Nordergründe.
It was not investigated whether after noticing the failure of the propulsion system a fast emergency anchoring operation with the anchor facility in accordance with regulations would have turned the vessel with the stem against the wind and the waves and thus possibly prevented capsizing.

Prior to leaving the port on the last voyage the port and starboard trawl warps were renewed. During this work the old wire ropes were detached from the trawl boards and uncoiled from the winch. It was not possible to ascertain whether the new trawl warps were properly connected with the trawl boards again after being spooled up.

When the trawl boards are not used they are kept in brackets at the aft side on the poop deck and according to statements made normally simply secured against each other with a lashing. These lashings and other securing and bracket facilities were not found on board. According to § 257 of the Accident Prevention Regulations of the See-BG, trawl boards hieved up mast have sufficiently dimensioned holding facilities for safe stowage. These devices were not present on the poop deck.

6.5 Life-saving appliances and emergency alarm

Radio equipment and sufficient life-saving appliances were on board.

The fact that no distress call was transmitted and why the emergency radiotelephone sets and radar transponder were not activated can only be explained by the fact that the foundering must have happened very quickly. It is also possible that the master had left the bridge in order to seek the cause of the failure of the propulsion system in the engine room so that on capsizing no one was able to reach the emergency radiotelephone equipment.

The ring life-buoys were found without the required life-buoy night lights and lines. The life jackets and survival suits were not used and the liferaft was probably not entered by anyone either.

It is to be assumed that the EPIRB was not triggered by hand, but automatically floated up after the water-pressure trigger was activated.
The distress alert by this EPIRB and the search for the distressed vessel were not optimal. The existing EPIRB could only transmit the 406 MHz signal and the bearing signal on 121.5 MHz, but – due to the design – not the current GPS position.

6.6 Summary

The very serious marine casualty could have been avoided if the stability criteria of the See-BG had been maintained after the last conversions. If these regulations had been observed, the vessel would not have capsized.

The fast foundering was promoted by the lack of watertight integrity that was not technically feasible in one point, but otherwise lay in the sphere of responsibility of the crew.

The blocking of the propeller by the deck washing hose did not lead to the loss of stability. This failure of the propulsion system could have been avoided if the crew had stowed all items of equipment sea-worthy.

As a result of the conversions of the anchor facility the anchor was not immediately clear for dropping.

7 Safety recommendations

The following safety recommendations shall not create a presumption of blame or liability, neither by form, number nor order

7.1 Owners, operators and vessels commands

The Federal Bureau of Maritime Casualty Investigation recommends the following to owners, operators and masters of fishing vessels:

1. When changing the fishing gear and performing other conversion works on the vessels, the consequences for the stability must be considered and in the event of uncertainties experts should be called in to calculate the stability documents. Conversion works and changes are to be reported to the See-BG.

2. It must be possible to establish watertight integrity and seaworthy condition, observing the valid freeboard regulations and accident prevention regulations. Crews must check the sea-worthy watertight condition prior to leaving port and during the voyage too.

3. In the case of conversion of anchor facilities and other technical facilities, the common regulations should be observed.

4. Ring life-buoys are to be equipped with life-buoy night lights and lines in accordance with the accident prevention regulations and be stored ready to grab. The ring life-buoys must be lettered with the name of the vessel and port of registry in accordance with the Accident Prevention Regulations Sea.
   The survival suits, life jackets and radar transponders should also be lettered in order to facilitate the search when items of equipment are found.
   Distress and life-saving appliances should be stored ready for use and at hand.

5. Vessels that must be equipped with a distress radio beacon (EPIRB) should be equipped beyond the regulations with an EPIRB that in addition to the emergency frequency and homing signal additionally transmits the current GPS position.

7.2 See-Berufsgenossenschaft (Marine Insurance and Safety Association)

The Federal Bureau of Maritime Casualty Investigation recommends the following to the See-Berufsgenossenschaft:

1. It should train and instruct its surveyors even more thoroughly in checking and observing the above safety recommendations.

2. It should instruct its surveyors to pay even more intensive consideration to structural and technical changes on board. In the case of uncertainties, in particular the general arrangement drawings and stability documentations present on board should be consulted and the condition of the vessel should be documented by photos if appropriate in order to notice changes more easily.

7.3 Federal Ministry of Transport, Building and Urban Affairs

The Federal Bureau of Maritime Casualty Investigation recommends to the Federal Ministry of Transport, Building and Urban Affairs that it should arrange to have reviewed in appropriate international committees whether EPIRBs should not basically be additionally equipped with a GPS receiver to mark the distress position in order to improve the search and rescue operations and hence safety in shipping traffic in case of distress.

8 Sources

- Investigation by the Waterway Police (WSP) Bremerhaven
- Records of the VTS (Vessel Traffic Services) Bremerhaven and Cuxhaven
- Records of the sea and wind conditions at Alte Weser Lighthouse - WSA (Local Ofice for Waterways and Shipping) Bremerhaven
- Official weather expertise by Deutscher Wetterdienst (DWD) – Germany's National Meteorological Service
- Sea charts of the Federal Office for Seeschifffahrt and Hydrographie (BSH (Federal Maritime and Hydrographic Agency))
- Statements by witnesses
- Recording of AIS data from on board FV CHRISTINE, Fedderwardersiel
- Reports and films by divers of the BSH (Federal Maritime and Hydrographic Agency)
- Expertise by the firm of experts Dipl.-Ing. Jan Hatecke,
  Authorised investigation officer of the BSU
- Expertise by Prof. Dipl.-Ing Hark Ocke Diederichs,
  Authorised investigation officer of the BSU
- Test report by the Institute for Material Science and Welding Engineering, HAW Hamburg
- Calculations by the Institute for Photogrammetry and Geoinformation, Leibnitz University Hanover
- Research Projekt 557- University of Newcastle
  Suitability of Stability Criteria Applied to Small Fishing Vessels and Associated Survivability, Report No. MCA 557, January 2006
- Photos: Hasenpusch Schenefeld, Klaus Krukau Bremerhaven, WSP, BSU
- Investigation Report No. 226/03 of 5 March 2004, Very serious marine casualty, "Foundering of FV NEPTUN on 30 July 2003 in the port entrance of Norddeich", BSU Hamburg

9 Comments

In accordance with § 15 Para. 1 SUG in conjunction with § 17 Para. 2 FIUGG, well-founded essential comments are taken into account in the investigation report. Accordingly individual statements are reproduced in the following. In as far as comments deviating from the draft of the investigation report were confirmed by additional investigations by the BSU and documents respectively, these have been incorporated into the investigation report at the relevant places without being highlighted specifically.

9.1 Comment of the See- Berufsgenossenschaft

On **Section 5.8, Anchor chain and anchor facility**, the See-BG writes in its comments of 6 February 2008 on the draft of the investigation report:

.....
The anchor facility was evidently converted and retrofitted several times before and also after the last survey by the See-BG. At the time of the last survey an anchor was run on the forecastle, with the anchor warp leading to one of the trawl warp winches at the forward edge of the bridge, and a reserve anchor lashed on deck. The concept appeared conclusive, an anchor drop test as initially requested could not be carried out as at this time the vessel was lying in the dock. The surveyor of the See-BG had the impression that the operator had only "fitted" the anchor for the survey in any case.

The mounting of the anchor at the time of the accident was thus presumably not identical with the mounting of the anchor at the time of the survey in July 2005. This is also documented by a photo of the vessel at the pier in Brake (see Fig. 59) that was evidently taken after the last survey by the See-BG and that shows the anchor in the meantime in the hawse pipe on the port side. No traces of the anchor were found on the wreck so that it appears questionable whether the anchor was in fact on board at all.

The See-BG establishes the following regarding the nature of anchoring on fishing vessels:
Anchoring with fisheries winches has been common practice for a long time now. The anchor or anchors are run in the hawse pipe or on the forecastle with chain foregoer and wire warp with a fast connection (claw, shackle etc.), e.g. to the trawl warp. This connection is naturally only produced when needed.
Even on smaller fishing vessels it is practice to anchor using a fisheries winch. A further common method of anchoring is with the assistance of tow weights or trawl boards.

With regard to Section 6.2, Capsizing after loss of stability and foundering, the See-BG writes in its comment of 6 February 2008 on the draft of the investigation report:

.....
We cannot agree with the formulation in this paragraph. It suggests indirectly that the surveyor of the See-BG bears a contributory fault on the foundering of the vessel. This must be clearly rejected.
There are two years between the two said surveys. Within this period a surveyor surveys some 600 to 800 vessels. Therefore it cannot be presupposed that one can remember all the structural features of the survey two years before. Furthermore, the subsequently mounted winch was already a used net winch at the time of installation (more than one year before the surveys in June/July 2005). During the said surveys in 2005 it was therefore by no means visible that "new" equipment had come on board within the two years.

For the rest we must point out that on fishing vessels of this size it is regularly the case that no detailed general arrangement plans are available for study.

9.2 Operator and owner

The lawyer representative writes in his comment of 19 February 2008 on the draft of the investigation report:

.....
To summarise the former operator draws attention to the fact that not even indications of stability impairment were ascertained in any movement situation of the vessel, whether during heavy weather voyages in ballast, while catching as side or stern catcher, during towing operations (FV "Hoheweg" towed FV "Rote-Sand" through heavy weather) or in any other voyage or catching assignment. As described by the witness ….., FV "Hoheweg" showed itself to be extremely seaworthy, stable to a high extent even in heavy side seas, without any conspicuous rolling motions, not even when used as a side trawler, for example in extreme situations with drawing in the fishing net filled with large caught quantities over the side under side sea conditions.

A shift in the weight of the centre of gravity upwards is substantially doubted in view of the complete removal of the material and gear stowed there on the aft deck, removal of the coverings and fish boxes and of the wooden bulkheads, substitute trawl boards etc., as also the additional mounting of extra weights to the extent assumed in the report.

This having been said, and taking into account that the assumed wave heights are based on measurements that presumably were not (could not be) identical with those at the scene of the foundering and thus ground swells were certainly possible, by contrast with what is taken as a basis in the report, the reasons for the foundering of FV "Hoheweg" are more likely to lie in a conglomeration of poor weather and wind conditions, an incorrect navigational decision and the loss of propulsion on the basis of the hose that went over board in the sea conditions and became caught between the propeller and the Kort nozzle, rather than in stability changes according to the calculations presented.

In all other considerations one would have to take into account the realistic knowledge status of the subsequent operator and father of the master of FV "Hoheweg", declared dead in the meantime, who knew the vessel and thus its sea characteristics only in the equipment condition present at the time it was taken over. After the conversions set out, nothing changed in this condition and the associated behaviour in heavy sea too that gave rise to either qualified fears or any concerns. Neither the masters deployed on this vessel nor the seamen working on it nor the vessel operator affected by the subsequent foundering had any indications that the stability of FV "Hoheweg" could be impaired. The exclusively hypothetical considerations – as set out above – that were drawn up in favour of genuine heeling test after salvage of the wreck are subject to considerable concerns and do not realistically reproduce the actual stability condition and hence the sea behaviour of the vessel. Overall they are not suitable for determining the exclusive reasons for the marine casualty.

9.2.1 Affidavit

In addition the lawyer enclosed an affidavit of 19 February 2008 from the master who had sailed for several voyages as responsible master on board FV HOHEWEG during the period 1993 to 1997. Excerpts from this letter:

.....
Prior to the purchase by Messrs. Hullmann the vessel was equipped with a weather guard and a fish slaughtering machine, fish rinsing drum and elevators.

During my period and also with the fisher ..... (previous owner) the aft deck was used as storage area for reserve nets and other fish materials. The cover over the working deck was used as in the past to store reserve fish crates. Quantity between 400 and 600 pieces.

During the catch voyages it occurred that with good fishing up to 20 t fish was stored on deck for processing. Throughout my time on the Fishing Vessel "Hoheweg" no stability problems occurred, regardless of the weather situation and loading.

10 Attachment

Art	distress_unspec	Anrufer	COSPAS
Ort	N53° 56,23'	Telefon	
	E7° 48,65'	Station	
H: Havarist hoheweg		Sb	
R: Rufz. DEOY			
M: MMSI			
P: POB 4			

Info Hullmann Handy: 0171[redacted]

08.11.2006	21:02:40	Einsatz eröffnet von wcubasch auf MRCC_N1
08.11.2006	21:02:51	hoheweg
08.11.2006	21:03:00	Einsatzart : *distress_unspec.*
08.11.2006	21:23:30	*Bernhard Gruben* wurde in den Einsatz aufgenommen
08.11.2006	21:23:36	eigner hullmann: 04401[redacted]
08.11.2006	21:24:00	kutter: 0171[redacted]
08.11.2006	21:24:18	Hohe Weg DEOY
08.11.2006	21:24:35	20.37 pos Alte Weser
08.11.2006	21:25:02	18.00 auslaufen aus brhvn
08.11.2006	21:25:09	4
08.11.2006	21:25:41	26m lang; Tfg 2,80m Farbe blau
08.11.2006	21:26:03	auf dem weg nach brunsbüttel
08.11.2006	21:26:37	helms, steffens & gruben fahren
08.11.2006	21:26:54	*Hermann Helms* wurde in den Einsatz aufgenommen
08.11.2006	21:27:06	*Vormann Steffens* wurde in den Einsatz aufgenommen
08.11.2006	21:28:01	N53° 58,00' / E8° 10,36'
08.11.2006	21:30:16	mlz gebrieft
08.11.2006	21:32:21	53-58N 008-10,6E
08.11.2006	21:36:09	rcc h7c angefordert
08.11.2006	21:38:46	um 21.04 revierzentr. cx , weser , deutsche bucht haben kein ais kontakt
08.11.2006	21:40:23	*Hermann Marwede* wurde in den Einsatz aufgenommen
08.11.2006	21:40:51	21.38 marwede & neuwerk (Neuwerk-Reede Anker hieven)
08.11.2006	21:41:23	*Hannes Glogner* wurde in den Einsatz aufgenommen
08.11.2006	21:43:38	BRR strahlt mayday relay um 21.43
08.11.2006	21:44:29	53-58N 008-10,6E
08.11.2006	21:45:15	N53° 56,23' / E7° 48,65'
08.11.2006	21:48:05	Von Steffens FK Christine hat die Hoheweg um 19:30 in der alten Weser mit nördlichen Kurs gesehen
08.11.2006	21:50:48	Glücksburg bietet an Öl-Doi aus der Ostsee zu verlegen

08.11.2006	21:53:44	PB Bremen2 beim Robbennordsteert, fährt zur pos. ETA 2h
08.11.2006	21:57:26	Von Meerkatze 20:34 53°54,5n 8°1,7e
08.11.2006	22:06:49	eta öl-do 22.55 v on rcc
08.11.2006	22:08:56	Von Meerkatze 20:34 Kurs 344° 9kn
08.11.2006	22:21:56	Fischereikennzeichen NB1
08.11.2006	22:22:13	ETA Meerkatze 23.20
08.11.2006	22:24:47	Presse informiert
08.11.2006	22:36:28	Suchgebiet an Glücksburg durchgegeben: A: 54°N8°e B: 54°N 8°15E C: 53°53´N 08°15É D: 54° 53´N 8°E
08.11.2006	22:36:39	wx marwede: wind aus 265° 7 bft, Wellenhöhe 5m
08.11.2006	22:38:32	Suchgebiet korrektur A: 54°N8°e B: 54°N 8°15E C: 53°53´N 08°15É D: 53° 53´N 8°E
08.11.2006	22:48:46	22.41 gasölgeruch auf 53-55,8N & 008-07,8E
08.11.2006	22:50:31	22.41marwede pos. 53-56,6N &008-07,3E peilt 121,5 in 152°
08.11.2006	22:52:37	2248 meerkatze meldet keinen peilempfang der HOHE WEG, peilautomatismus 15min überfällig
08.11.2006	23:00:36	Epirb 22.45 53°54,5N 008°08,9E
08.11.2006	23:06:17	23.04 christoph darf nachts nicht winschen (von rcc)
08.11.2006	23:07:28	23.05 helms fischt epirb auf 53-53,6N & 008-09.7
08.11.2006	23:15:14	WSP Bremen2 gibt beim Bremer Kreuz auf
08.11.2006	23:20:30	23.17 A 53-57N 008-05E; B 53-57N 008-20E; C 53-50N 008-20E; 53-50N 008-05E an marwede für öl-do
08.11.2006	23:24:12	23:23 küwaz nord um pirol gebeten
08.11.2006	23:26:50	rescue 5701 ist die öl-do
08.11.2006	23:32:28	23-29 puma braucht 2h bis airborne sagt küwaz
08.11.2006	23:33:04	mrcc fordert puma
08.11.2006	23:46:18	23.44 bürgermeister brauer fährt ins Suchgebiet
08.11.2006	23:51:30	23.43 Steffens meldet Fischkisten auf 53-53,4N & 008-07E
08.11.2006	23:58:01	23:48 von Küwaz: Puma wird klargemacht
09.11.2006	00:06:43	von rcc: sar h/c Kiel wird gelauncht
09.11.2006	00:07:32	& rcc 23.17 suchgebiet übermittelt
09.11.2006	00:10:19	gruben findet 1,5nm östlich Tn alte weser reichlich fischkisten; marwede hat westertill abgesucht & macht sich auf den weg zur Tegeler Rinn
09.11.2006	00:13:28	auf pos 53-51,8 & 008-10,2E
09.11.2006	00:20:13	00.19 bürgermeister brauer gibt auf
09.11.2006	00:23:05	00.21 von rcc sar h/c airborn

09.11.2006	00:26:06	00.25 bg 24 fährt von hlg
09.11.2006	00:32:19	eta H/C 30 min
09.11.2006	00:48:12	von marw: leuchturm checken
09.11.2006	00:48:49	vz brhvn bekommt alarm, wenn tür geöffnet wird
09.11.2006	00:57:56	00:56 h/c 10nm vor dem suchgebiet
09.11.2006	01:06:38	*01:03 von küwaz: PIROL 802 in Itzehoe gestartet* wurde in den Einsatz aufgenommen
09.11.2006	01:07:15	info an rcc & marwede
09.11.2006	01:14:24	01:10 Öldo entlassen
09.11.2006	01:16:02	01:08 rescue 8951on scene ,öldo entlässen
09.11.2006	01:40:36	01:35 marwede: gruben findet in der Robinsbalje Sack mit Notfallmunition ; Steffens einen blauen Kanister
09.11.2006	01:42:45	53-50N & 008-16E
09.11.2006	01:53:29	Rettungsring beschriftung Brake bei Tonne R3 aufgepickt
09.11.2006	02:02:17	von Gruben
09.11.2006	02:27:29	mrcc an marw: s'l Neuwerk, Weser-Elbe Wattfahrwasser &Norder- &Ostertill absuchen lassen durch h/cs
09.11.2006	02:28:28	marw. an h/cs Suche ab 53-53N &008-27E
09.11.2006	02:30:49	02.30 steff&gru pass R7
09.11.2006	02:42:18	02:35 mrcc an küwaz: wo ist die bp24? sie ist nicht losgefahren wg 5,20m Tfg
09.11.2006	02:56:07	02.50 von marw: meerk.& neuwerk sind bei Tn 25/26 Hohe Weg Rinne & suchen Richtung Leuchtturm,
09.11.2006	02:56:38	steff&grub wurster arm
09.11.2006	02:58:07	glogner n'l Tegeler Rinne, Pirol schließt sich dem SAR-H/C an , suchen s'l Neuwerk
09.11.2006	02:58:39	02:52 Wind 290°, 6 Bft
09.11.2006	03:04:28	DEOY
09.11.2006	03:04:53	Anrufer : *COSPAS.*
09.11.2006	03:10:28	Glogner meldet Fischkisten NE T6a
09.11.2006	03:30:18	03:25 Hubschrauber meldet leeres Boot in posn: 53°49,76 N 008° 19,65 E
09.11.2006	03:31:05	03:28 Hubschrauber meldet Mastspitze in posn: 52°49,83N 008°19,5 E
09.11.2006	03:33:14	03:28 Korrektur: Hubschrauber meldet Mastspitze in posn: 53°49,83N 008°19,5 E
09.11.2006	03:33:27	Info an MLZ
09.11.2006	03:47:56	Taucher bei MLZ für nächstes Stauwasser angefordert
09.11.2006	03:52:09	Mastspitze ist nur Pricke

09.11.2006	03:59:05	03:52 marw: neuwerk & meerkatze bei altre weser, sie werden um 03:58 entlassen
09.11.2006	04:10:55	03:55 mrcc bestellt taucher ab
09.11.2006	04:19:49	04:15 Knechtsand & 3sm umzu hat Pirol abgesucht, muß tanken & wird entlassen
09.11.2006	04:20:04	baw.
09.11.2006	04:23:38	mrcc-marw.: um 04.20 ziehen sich die kreuzer in den Wurster Arm zurück & warten auf tageslicht; SAR H/C fliegt noch ca. 3h
09.11.2006	04:27:17	Pirol wird entlassen
09.11.2006	04:52:51	04:50 von Gruben: Schlauchboot hat die SBG Nr.: 17371 & Personen XXX, ziehen sich mit steffens in die Robinsbalje zurück
09.11.2006	05:13:15	05:11 von mrcc an marw: H/C verläßt Gebiet um 05.30 Richtung Kiel, kommt bei Tageslicht mit frischer Crew
09.11.2006	05:16:09	marw vor anker
09.11.2006	05:35:12	Von Marwede: H/C hat um Fundstelle Schlauchboot expending Square 5 sm abgesucht. Danach eine Linie von 53°54N008°13E bis Schlauchbootposition 2sm recht und links abgesucht. Hubschrauber wird entlassen. Rettungseinheiten ankern.
09.11.2006	05:51:52	Quickinfo: Hullmann Handy: 0171[redacted]
09.11.2006	07:07:51	07:02 Übermittlung des neuen Suchgebietes an RCC Glücksburg: Bake A 53-59N & 008-19E; Alte Mellum 53-43,5N & 008-10,5E; Cx 53-55N & 008-40E , Wremen 53-40N & 008-29E
09.11.2006	07:23:32	07:12 RCC-MRCC: breguet atlantique aktivieren; dauert bis ca. 10.00 MEZ
09.11.2006	07:24:15	H/C um ca. 08.00 Start
09.11.2006	07:51:10	07.45 Kreuzer beginnen Suche
09.11.2006	07:51:46	H/C um 08.00 bei Bake A
09.11.2006	07:53:03	wasser 10,5 °C
09.11.2006	07:53:49	Von Glücksburg: Sar H/C ab 08.25 im Area, Lynx ca 09:00 Wangerooge DRLI in Cux
09.11.2006	07:57:50	07:56 an marw: Marineschlepper Wangerooge aus CX? wird eruiert
09.11.2006	07:58:46	Pirol ca 09:30, Briguet ca.???
09.11.2006	08:01:38	Auftrag an Hubschrauber: Suchgebiet mit 0,5sm Trackspacing. Primäres Target Rettungsinsel
09.11.2006	08:05:11	Auftrag an MLZ Küste zwischen Wremen und Cuxhaven abzusuchen
09.11.2006	08:09:52	08:06 Bremen 3 dient sich beim mrcc an; ok; gibt eta
09.11.2006	08:25:59	*Hans Hackmack* wurde in den Einsatz aufgenommen
09.11.2006	08:26:29	08:23Helms sucht in Wester-&Nordertill; Gruben&Steffens in der Robinsbalje, Marw. Tegeler Rinne , Glogner dto
		Von Glücksburg: Vor ort Seaking Rescue 8960. Do228 Rescue 5701.

09.11.2006	08:44:44	zum Absuchen benötigt 4 Stunden, Zu erwarten: Lynx, Breguet Pirol, evtl. 2. Seaking
09.11.2006	08:53:30	08.49 von marwede Wind 300° 7Bft, See 8m
09.11.2006	08:54:58	von german bight: von 20.00 bis 22.00 (8.11.06) wird ein onlineplot erstellt & zugefaxt
09.11.2006	09:00:05	08:50 Bremen2 DBAZ Auslaufen Geeste durch Wurster Arm; Zollboot Bremerhaven dto.
09.11.2006	09:08:21	09:7 Niedersachsen 5 ETA 2h
09.11.2006	09:09:19	WSP Niedersachsen 5 aus Whaven läuft,eta 11.00
09.11.2006	09:38:18	Lynx 8322 09.30 o/c
09.11.2006	09:39:48	09.09 o/s Breguez 6112
09.11.2006	09:45:03	NT : 0930-0940LT : erbitten von RLsT psych. für Angehörige (mit Ads. von [redacted] = ok =
09.11.2006	09:54:12	Anfrage bei MLZ wegen Taucher
09.11.2006	10:08:18	NT : de MARWEDE : Lage: 1 x "Brege Atlanic" mit 8 h endurance = SK GLOGNER psn Tegler Plate mit hdg: süd = STEFFENS / GRUBEN psn n-lich Leuchtturm 'Alte Wese' hdg: NW = MARWEDE psn Westertill = Helms psn Nordertill =
09.11.2006	10:13:57	RCC GBG will Taucher organisieren
09.11.2006	10:16:11	Info de MARWEDE : H/C hat in PSN 53-47,49 N 008-31,96 E Rettungsfloss gesichtet =
09.11.2006	10:16:35	RCC G'burg informiert : Sichtung H/C ist Strandkorb
09.11.2006	10:18:13	Hr. [redacted] fragt nach : Lage ? - gebe Tel [redacted]
09.11.2006	10:24:03	NT : 0941LT: info von MARWEDE : on sceene: 3 x H/C = 1 x Pol H/C = Zollboot: "HB" = WSP-Boot: "HB" = WSP-Boot: "NIEDERSACHSEN 5" hdg: Roter Sand = div DGzRS-S/Ks =
09.11.2006	10:25:13	von RCC GBG Strandkorb war doch Rinsel,wird von Heli weiter untersucht
09.11.2006	10:25:47	NT : BLE Hbg informiert : um 2034LT war der F/K in PSN : 53-54,5 N 008-01,7 E mit V = 8 kts und hdg = 344°
09.11.2006	10:30:48	NT : 0955LT : Hr [redacted] informiert : hat nur kommerzielle Taucher was ist zu tun? - wir benoetigen info ob in der psn (Oelgeruch) Wrack liegt und wenn ja ob und wieviele 'Personen' o/b? - dazu bitte geeignete Maßnahmen ergreifen (de MRCC) =
09.11.2006	10:32:06	RCC G'burg erfragt Position für Taucher : 53-56 N 008-08 E
09.11.2006	10:32:51	marwede meldet,daß Strandkorb doch rinsel und daß in der Position auch Fischkisten gefunden wurden
09.11.2006	10:34:41	NT : 1000LT : Anruf von A. [redacted] regt an : 1) Handypeilung und 2) Realplot bei German Bight =
09.11.2006	10:35:36	Hr [redacted] : erbittet Infos zum Fall (ist Versicherer) = gebe TelNr [redacted]
		NT : ????LT : Anfrage von 'Miko Leipzig' : erbittet Info = erteile TelNr

09.11.2006	10:38:30	[redacted]
09.11.2006	10:38:34	RCC GBG Tauchereinsatz wegen Wetterbedingungen nicht möglich.Wassertiefe,Tiefgang "Wangerooge"
09.11.2006	10:52:50	10.48 von Marwede Rinsel eindeutig ident.,Fischkugel auf 53:33,8N 8:17.3E, diverse Fischkisten auf 53:55,7N 8: 15,3E
09.11.2006	11:00:14	von WSP Bhaven eindeutig Rinsel von Hohe Weg ,letzte Inspektion in BX am 14.8.06 6 Personen-insel Ser No: 20191
09.11.2006	11:11:50	11.05 von Marwede a/C haben 60-65% des Gebietes abgesucht,Seeeinheiten haben größten Teil des Gebietes abgesucht
09.11.2006	11:13:18	RCC GBG kärt wann A/C mit der Suche der Gebiete fertig
09.11.2006	11:16:16	NT : 1105LT : S/K "HELMS" informiert : Ankern bei Tn WE14 Elbe/Weserfahrwasser - sind fertig mit Suche - keine Wrackortung - Vermutung: bei EPIRB in psn 53-53,46 N 008-05,84 E - Unfallzeitpunkt bei Niedrigwasser - wx: 3-4 m See Boen =
09.11.2006	11:17:50	von Marwede:Hackmack meldet verstärkt Fischkisten und Trümmer in der Westertill
09.11.2006	11:18:58	von GBG: restzeit für A/C-Suche bis ca 14:00 Lokal
09.11.2006	11:22:12	GBG schickt Lynx Heli zur Position mit "Ölmerkmalen",hat ein Sonar a/B
09.11.2006	11:46:40	WSP Bhaven erkundigt sich nach Verlauf der Suche,ob weiterhin Suche an Land erforderlich.Antwort,wenn Landseitig abgesucht,nicht mehr unbedingt
09.11.2006	11:50:13	Info MARWEDE informiert Fleiger hat PIW mit grünem Pollover gesichtet in PSN 53-47,3N 008-26,6E (Robbensbalje) =
09.11.2006	11:56:27	Anfrage an MARWEDE : Wassertemp? TWasser=10,5 °C =
09.11.2006	12:15:45	von GBG: Heli mit Sonar ohne Erfolg in der vermuteten Untergangsstelle wegen Wassertiefe zu gering usw.,Helis fliegen zum refuelen
09.11.2006	12:26:55	Anfrage von WSP Cx Suche wie lange noch
09.11.2006	12:27:19	Antwort bis 14.00-14.30
09.11.2006	12:27:51	Info MARWEDE : jetzt konzentration auf PIW, die z.Z. nicht mehr sichtbar = STEFFENS / GRUBEN vor Ort - ohne neue Infos = GLOGNER / BHV / HB2 unterwegs = Frage von MARWEDE : Verlegen Suche weiter ins Watt? Entscheidung vor Ort/OSC hat bessere Kenntnis des Situation vor Ort =
09.11.2006	12:42:55	Anfrage RCC G'burg : OelDO geht zum Betanken dann wieder zurueck on sceene? - ok geht dann wieder on sceene! wie alle anderen nach dem Betanken - OK =
09.11.2006	12:50:27	Anruf eines Verwandten mit Frage nach Situation: gebe kleine Darstellung des Verlaufes - ok ds =
09.11.2006	12:54:41	RCC GBG : Öl Do wird refuelt,geht dann wieder ins Gebiet. Atlantik könnte bis sunset.Sind so verblieben,daß Suche bis 14.00 bzw 14.30
09.11.2006	13:04:17	Info / Frage RCC G'burg : in ca. 20 Minuten haben alle L-Fzg Area abgesucht = die Breguet Atlantic will dann L-Fzg dann entlassen = OK = folglich Sucheende um 1330 LT =

09.11.2006	13:17:13	HMarwede : Hackmack meldet Fund einer R'weste Aufschrift Kontiki 98 Pos Nordergründe. Breguet hat Seaking um 12.02 entlassen aus dem Gebiet
09.11.2006	13:18:05	Info an RLst (betroffene) zur weiterleitung an die Seelsorge / Verwandtenbetreuung : um 1330LT wird Suche ergebnislos eingestellt - Gebiet ist durch 6 Luftfzg. und mind. 6 Seefzg. sehr gründlich abgesucht worden jedoch ohne Ergebnis der Personenfindung - Teile von Bord eines Fischereifzg. wurden gefunden =
09.11.2006	13:26:19	MARWEDE informiert : Rescue 6112 hat Suche komplett durchgefuehrt - keine Erkenntnisse - und beendet Suche - OK dann gesamte Suche einstellen bis weitere 'Erkenntnisse' zum Termin 1330LT =
09.11.2006	13:35:28	Absage an RCC G'burg / RCC Münster / MLZ / (MLZ informiert WSP BHV ueber Sucheende) =
09.11.2006	13:51:25	Bitte an RCC: 1530 ist HW Cuxhaven. Strandbereich mit einem H/C (Personensuche) nocheinmal abfliegen. RCC kümmert sich
09.11.2006	13:59:25	Info von RCC G'burg : H/C aus HLG wird ab 1530LT sstg. Strandbereich im Area nachsuchen und dann melden
09.11.2006	16:14:53	H.Helms 14.40 P3
09.11.2006	16:15:21	H.Glogner 15.00 P3
09.11.2006	16:15:41	H.Marwede 15.30 P3
09.11.2006	16:33:04	H. Hackmack 16:30 P3
09.11.2006	16:35:49	NT : 1530LT H/C Type "LYNX" sucht mit Sonargeraet nach Wrack von 'Oelgeruch-Position' nach SO mit Sonarreichweitenabstand =
09.11.2006	16:58:19	Anfrage an RCC G'burg : Sonar-H/C schon Ergebnisse? - nil ist noch on sceene - und Rescue 8968 hat Kuestenlinie abgesucht und geht in Kuerze retour on base =
09.11.2006	17:36:43	von MLZ ; Öl Do hat Gebiet nochmal überflogen.Wird morgen früh Gebiet ab 09.30 erneut überfliegen
09.11.2006	17:37:11	keine neuen Erkenntnisse von der Do
09.11.2006	17:38:06	Anruf H[redacted](Verwandter) mit Frage Neuigkeiten ?: NIL = Suche seit Nachmittag eingestellt ohne Erkenntnisse - eine Rettungsinsel (ohne Personen) durch H/C gesichtet = Ein Sonar-H/C sucht noch unter Wasser nach Objekten = bis jetzt noch keine Rückmeldung = OK ds =
09.11.2006	17:44:51	Info von RCC G'burg : Sonar-H/C hat zwei Kontakte aber keine Erkenntnis - muß jetzt abbrechen wg. Dunkelheit = Oel-Do hat keine 'Kontakte' und soll mgn vormittags noch einmal abfliegen = RCC fragt: Was wird mit dem Rettungsfloß vom Strand (z.Z. in Nordholz in der Halle) - empfehle Rueckgabe an Eigner / Reeder - OK werde noch 'mal dort anrufen =