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

Investigation Report 226/03

5 March 2004

Very serious marine casualty

Foundering of FC NEPTUN
on 30 July 2003
in the harbour entrance of Norddeich

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1 Summary of the marine casualty

On 30 July 2003 at about 7:40 h CEST the FC NEPTUN coming in from sea capsized in the port entry of Norddeich, approx. 400 m off the mole head, after passing the Ferry FRISIA IV.
Low water, reference point Norderney, was at 07:19 h. The wind was blowing from SE with a strength of 2 Bft and visibility was good.

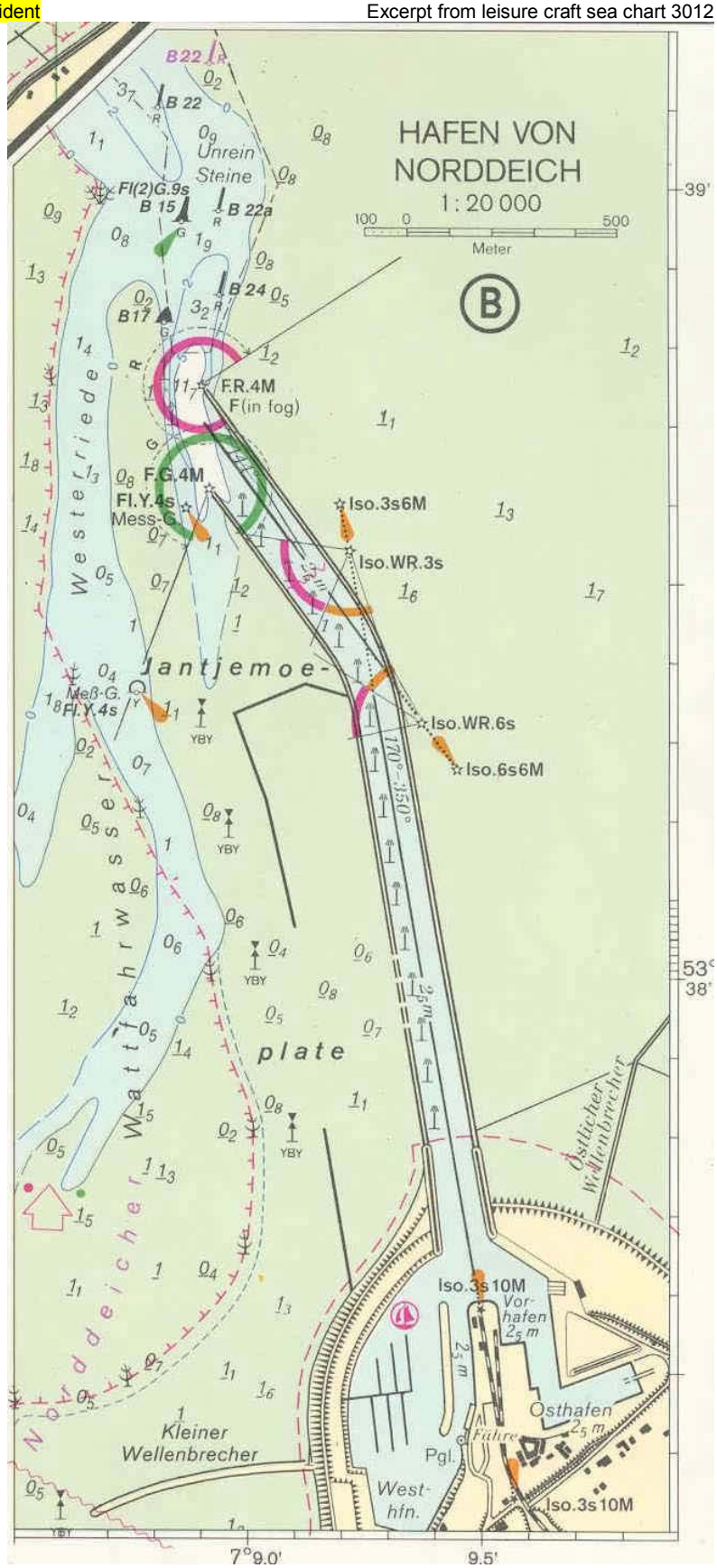
On passing abeam of the ferry the Cutter NEPTUN sustained ground contact, capsized first to the starboard side, after passing the ferry over the port bow, and remained lying on its side. The two crewmembers were able to rescue themselves.

The vessel sustained a total loss.

2 Scene of the accident

Scene of the accident

Excerpt from leisure craft sea chart 3012 (BSH)



3 Vessel particulars and photos

3.1 Vessel particulars FC NEPTUN

Name of vessel:	NEPTUN
Operator:	(known)
Port of registry:	Norddeich
Nationality/flag:	Federal Republic of Germany
IMO number:	none
Ship's call sign:	DCKS
Fisheries code:	NOR 206
Type of vessel:	Fish Cutter
Crew:	2
Classification	Built in accordance with the regulations of GL and UVV-See (accident prevent regulations) of the See-BG
Class:	none
Year built:	1971
Building yard:	Lübbe Voß, Westerende
Length over all:	16.11 m
Width over all:	5.20 m
Draft max.:	2.20 m
GRT:	29.78
Drive:	Fixed-pitch 4-blade propeller, right-hand, in Kort nozzle
Main engine:	Diesel, Deutz MWM
Engine rating:	280 kW, throttled to 221 kW

3.2 Vessel particulars MV FRISIA IV

Name of vessel:	FRISIA IV
Operator:	AG Reederei Norden-Frisia
Port of registry::	Norderney
Nationality/flag:	Federal Republic of Germany
IMO number:	9246839
Ship's call sign:	DCHS
Type of vessel:	Passenger vessel
Crew:	6 + 5 for catering
Classification:	Germanischer Lloyd, GL-Reg. 110125
Class:	100 A5 Passenger Ship-Ferry
Year built:	2002
Building yard:	Cassens Werft Emden
Length over all:	70.70 m
Width over all:	13.70 m
Draft max.:	1.75 m
GRT:	1,574
Deadweight:	300 t
Main engine:	4 x electric motor Schorch on 4 x Voith Schneider drive
Engine rating:	1880 kW
Speed:	12 kn

4 Course of voyage / course of accident

4.1 Voyage of FC NEPTUN

FC NEPTUN left the port of Norddeich at 19:00 h on 29 July 2003 to fish for sole. At this time the vessel draft was 1.60 m forward and 2.20 m aft. The vessel was carrying sufficient bunker and was manned with the 56-year old skipper and owner, holder of a BKü coastal licence, and a deckhand. At 21:00 h the nets were placed for the first catch and were then heaved in every 2 hours for emptying. The last heaving in of the nets ended at 05:00 h on 30 July 2003. The crew had caught approx. 100 kg sole and the gear was heaved up for the home voyage. At about 06:20 h the vessel called at the port of Norderney where about half of the catch was sold. At about 07:00 h it left the port to continue its voyage and at 07:25 h FC NEPTUN ran into the approx. 1 sm long port channel of Norddeich.

4.2 Statements by the Skipper of FC NEPTUN

The Skipper of FC NEPTUN stated that the speed in the port channel had been reduced to 3 to 4 kn because of the low water level. He had noticed that the cutter had frequently run through the ground, which among other factors had led to a constant "nodding" of the cutter. He had therefore changed over to manual steering. When he passed the end of the interrupted part of the W-Mole (inland), he had seen the car and passenger ferry FRISIA IV approaching him roughly on a level with the "Frisia" office. He had assumed that the ferry would either remain in the port basin and not run into the channel because of the low water, as was customary between ferries, or would at least pass the cutter at low engine power. He had further observed that the ferry had continued to pick up speed and ran into the port channel with a high stern sea.

FC NEPTUN had been running in the middle of the navigation channel and because of its draft had only been able to take a little evasive action to starboard. He had expected an unpleasant passage and was therefore at the wheel with full concentration. At about 07:40 h FC NEPTUN had passed the ferry FRISIA IV approx. 300 m in front of the Mole. On passing the bow of the ferry the cutter had heeled to starboard and he, the skipper, had turned the rudder to port. As he approached the middle of FRISIA IV he had first laid the rudder midships and then steered against this to starboard. On passing the stern of the ferry, however, the stern had turned abruptly and strongly to port, despite the starboard rudder. At the same time all the water had been sucked away, whereupon the cutter had turned across the channel. Shortly after that NEPTUN had capsized over port and did not upright itself again.

It had cost considerable effort for him to climb out of the wheelhouse and onto the roof of the wheelhouse. The deckhand, who had been clearing the aft deck, had also been able to escape safe and sound onto the roof.

4.3 Voyage of the Ferry FRISIA IV

The ferries leave Norddeich every hour in the morning at 06:30 h, 07:30 h and 08:30 h.

The bridge of the Ferry FRISIA IV was manned by the 42-year old Captain, holder of an AG (Foreign Trade Master) licence. In addition the vessel was manned with the Chief Mate, who also held an AG licence, a Chief Engineer with a CT licence, and four seamen, one of whom was allocated as look-out.

The ferry departed from Pier I on the west side of the mole in accordance with schedule at 07:31 h on 30 July 2003.

4.4 Statements by the Captain of the Ferry FRISIA IV

He, the Captain of the ferry FRISIA IV, had passed the mole head and kept on the east side of the port channel, since three fishing cutters were approaching him from the sea. The first fishing cutter had been the NEPTUN. He had kept to the eastern side of the port entrance as far as possible considering the 1.50 m draft of the ferry, FRISIA IV, in order to allow FC NEPTUN safe passage. The ferry had run slowly, approx. 5 to 6 kn, and he had made certain by looking into the stern camera that the ferry was not drawing any visible swell behind it. When the first cutter had approached him he had reduced speed to approx. 4 to 5 kn and had only been running with the two forward Voith Schneider drives.

He had known the estuary area for 14 years and of course the area of the Norddeich channel. Close to the port it had been partly very shallow and there had also been isolated stones in the water.

The vessels had encountered each other at the start of the Norddeich channel, approx. 500 m in front of the mole head, with a side distance of approx. 7 to 10 m. During passing he had switched on the ahead-side camera on the port side in order to check the passing distance. From the bridge, which was arranged in the middle of FRISIA IV, he had seen the masts optically and the full length of the passing cutter on the camera. When the cutter was roughly on a level with the middle of his vessel it had stopped completely and developed a list to the starboard side, in other words the side facing away from the passing ferry. According to his observations it had often happened that with corresponding water conditions passing cutters had stopped due to ground contact and developed a certain list due to their underwater form, just like some passing sail boats.

FRISIA IV had not touched ground at all, but was able to continue the passage with a speed of 4 kn. When the stern part of the ferry was roughly on a level with the cutter he had been able to see via the port-stern camera how FC NEPTUN had come out of its starboard list into a port list. He had thereupon switched to the stern camera and seen how FC NEPTUN had turned into the navigation channel and capsized over port roughly in the middle of the channel. At this time the cutter had been lying crossways in the navigation channel. He had thereupon stopped the ferry and informed the crew via loudspeaker and walkie-talkie that there had been an emergency and they should all go to their positions. He had called the rescue cruiser from Norderney via channel 16 and informed them that FC NEPTUN had capsized in front of the Norddeich harbour. At this time the stern of the ferry had been approx. 50 m away from the capsized fishing cutter. Even before he had been able to launch his own boat he had seen how the two crew members were sitting on the cutter roof and the vessel of the public authority SEEHUND had been approaching the cutter for assistance. He had asked the SEEHUND to rescue the crew of the cutter via channel 16. At this time low water conditions had been prevailing and the cutter was evidently lying immovable on the ground. He had notified Head Office via radio as well as the fire brigade and the river police.

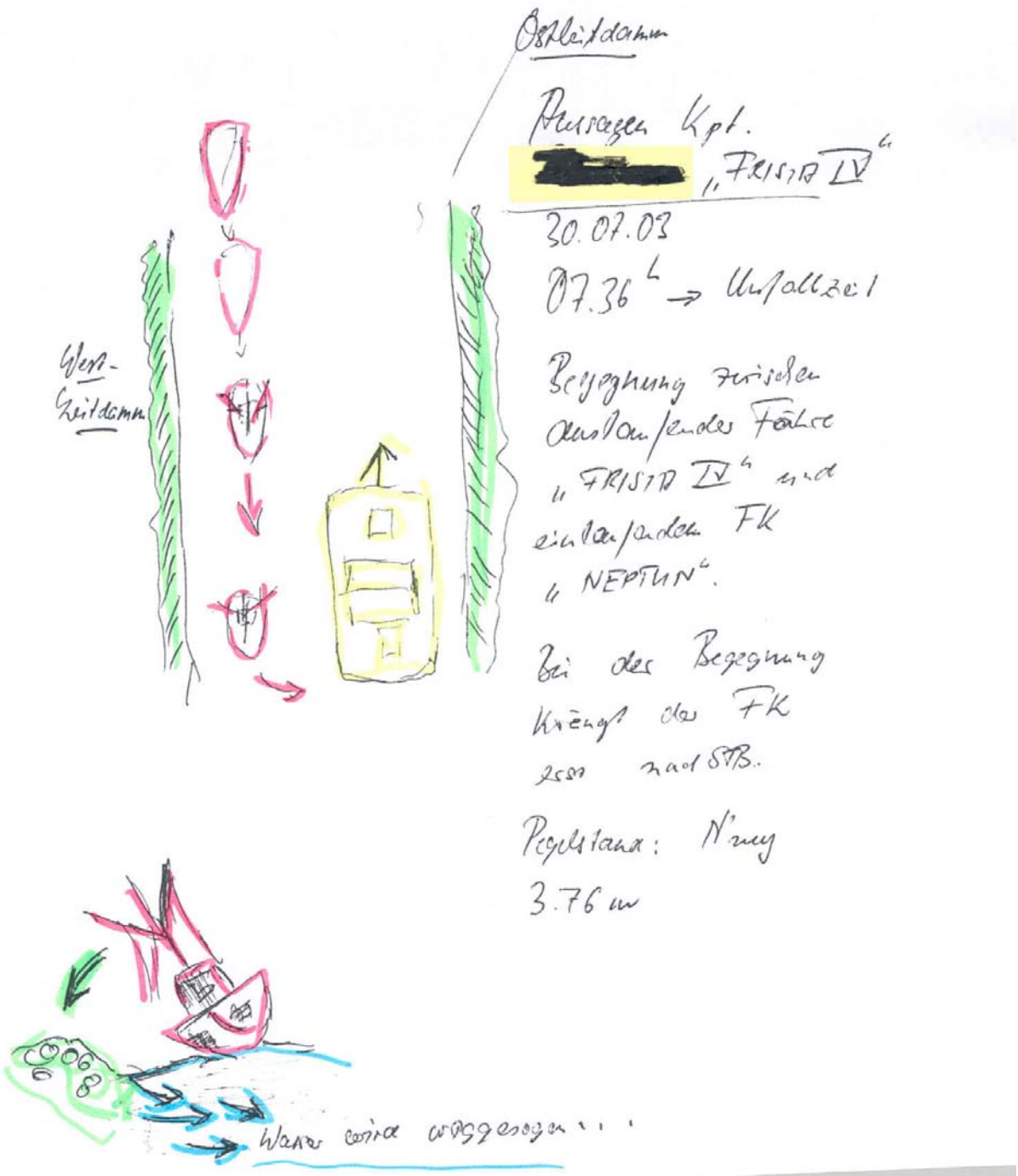
In consultation with the Water Police via channel 10 he had continued the voyage towards Norderney at 07:53 h in order to clear the way for necessary assistance and salvage measures, and in particular to allow the rescue cruiser BERNHARD GRUBEN from Norderney to approach FC NEPTUN better. The two other cutters had stopped their passage since they had been notified of the incident via radio and had seen it optically too. The ferry passed these cutters, like NEPTUN. They had also stopped during the passage and developed a starboard list, but after this had been able to continue their voyage without problems.

The ferry had passed the rescue cruiser BERNHARD GRUBEN at the east tower of the pier without any irregularities.

The statements by the captain of FRISIA IV were confirmed by the onboard records of the electronic sea chart, type Transas Marine, as regards speed, location and course.

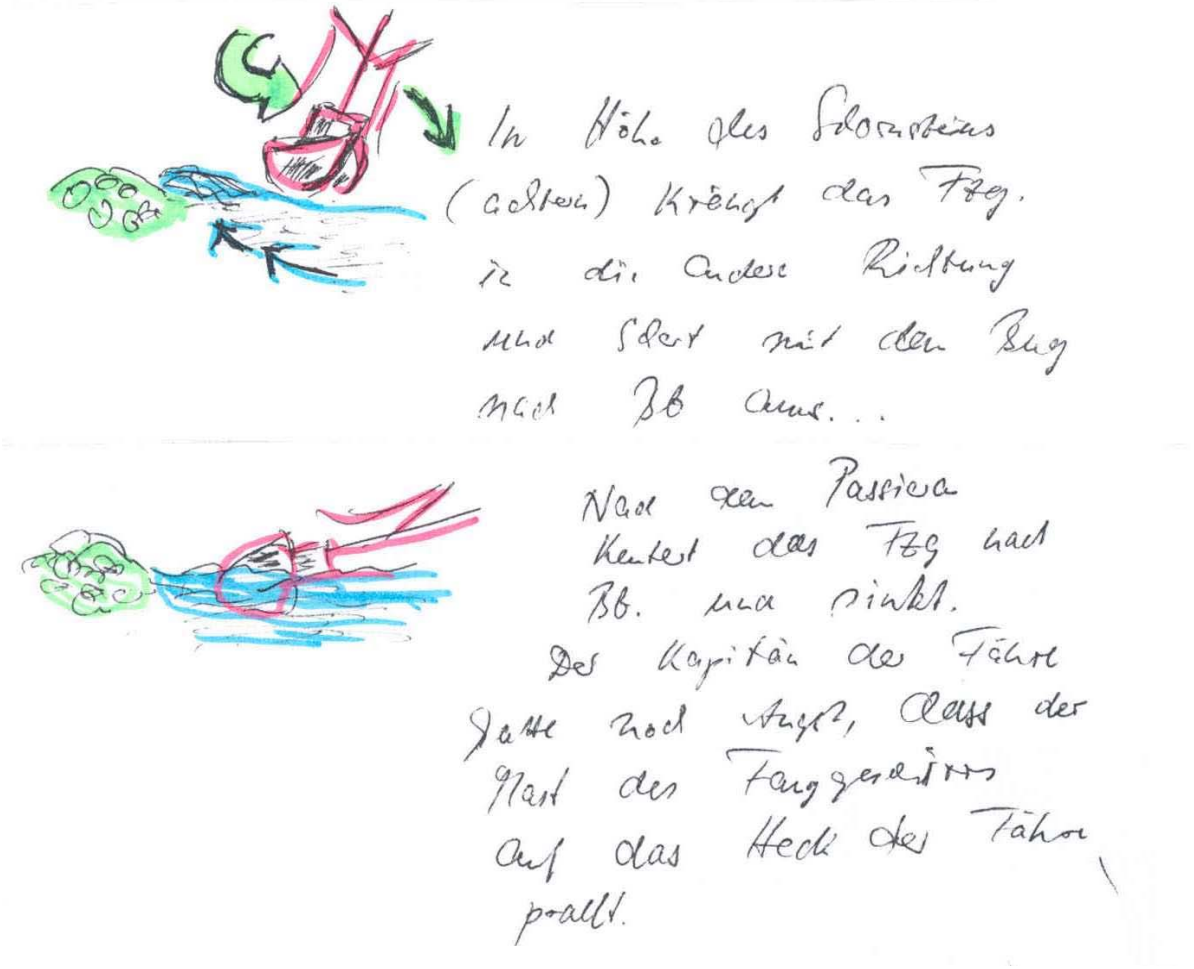
It is assumed that FC NEPTUN foundered at 07:39:45 h. The battery-operated ship's clock stopped at this time.

The following sketches were made by the Water Police (WSP) on the basis of the Captain's statement:



Statement by Captain of FRISIA IV
30.07.03
07:36 (l) -> time of accident

Encounter between departing ferry FRISIA IV and incoming FC NEPTUN
On encounter FC lists to starboard
Water level Norderney 3.76 m
Water is sucked away …



On a level with the stack (aft) the vessel lists in the other direction and the bow veers to port.
After the passage the vessel capsizes to port and sinks. The Captain of the ferry was afraid that the mast of the fishing vessel would collide with the stern of the ferry.

4.5 Salvage proceedings

The first salvage attempt was carried out with Barge S28. A working crane on board this barge had grasped the starboard cargo boom with the grab and tried to upright the foundered vessel from its side position. This was unsuccessful, and as the tide came in more water ran into the vessel, which then remained lying completely under water in the middle of the navigation channel.

In the second salvage attempt the rescue cruiser BERNHARD GRUBEN and the Buoy Layer NORDEN pulled the foundered cutter approx. 250 m through the mud to the Muschel Pier. After this the cutter was lifted so far out of the water by a shore-based crane that the open apertures through which water flowed were above the water level. The cutter was then freed from mud and water using drain pumps.

4.6 Vessel history FC NEPTUN

The fishing cutter NEPTUN (GRE 10) was built in 1971 at the Lübbe Voss yard in Westerende-Kirchloog as a fishing vessel in steel with a cruiser stern. The combined yard heeling test and rolling period test on 27 May 1971 revealed the following values for the empty vessel:

Displacement	: 47.0 t
GM	: 0.90 m
KG/H	: 0.85 m
KG	: 1.78 m
Rolling period value "f"	: 1.00 m

The last owner bought the vessel on 4 August 1982.

The main engine installed in 1971 was a KHD type F8M716 with 200 HP. In 1977 this engine was replaced by a KHD type SBF8M716 with altogether 268 HP. On the second engine replacement in 1995 a Deutz MWM type KHD BA 8M816 with a design rating of 380 HP (280 kW) was installed. This engine was throttled to 300 HP (221 kW).

During this conversion in 1995 the plate rudder was removed and replaced by a Kort rudder nozzle and a new shaft system was installed. In addition the cruiser stern / sharp stern was replaced by a flat stern. The water line area in the aft part of the vessel was broadened and the length extended by 0.8 m. According to the information supplied by the owner approx. 5 t concrete were cast into the fish hold to improve stability.

Following these conversion works a combined heeling and rolling time test was carried out on 11 May 1995 and the following values were determined:

Displacement	: 65.3 t
GM	: 0.78 m
KG	: 1.82 m
Rolling time value "f"	: 0.95 m

On 30 June 1999 a heeling test was carried out by a firm of engineers from Leer. The following values were determined:

Displacement	: 66.21 t
GM	: 0.61 m
KG	: 1.99 m
LCG	: 6.31 m

On 21 September 2001 the vessel was involved in an accident as a consequence of failure of the main engine after an object had been caught in the screw. The vessel made contact with an underwater obstacle off Norderney and was towed free by a rescue cruiser with water intake in the engine room.

From October to December 2001 approx. 21 m² outer plating on the port side and approx. 23 m² outer plating on the starboard side, including defective frames, were renewed at a Dutch yard in Lauwersoog. The forward mast had been converted and provided with 20 mm thick brackets to carry the blocks.

A heeling test carried out on 29 November 2001 in Lauwersoog revealed the following values:

Displacement	: 54.76 t
GM	: 0.64 m
KG	: 2.29 m
LCG	: 7.102 m

Provisional stability calculations revealed a stability lever arm of 0.22 m at a gradient of 20° and 0.216 m at a gradient of 30°. Final, verifiable stability documents were not drawn up since the owner did not supply all information to the yard.

The evaluations of the heeling test were carried out by a Dutch firm of engineers that came to the following conclusion in a letter of 13.9.2003: "*The result is minimal. But it is enough for this vessel."*

5 Summary of damage/photos of damage

6 Analysis

6.1 Salvage of the vessel

As a result of the unusual pulling of the vessel under water over the mud, it was ultimately possible to salvage the cutter from shore. The BSU was unable to determine whether the damage on board was caused by this kind of salvage operation, or whether it had been sustained already prior to sinking. To secure the evidence it would have been better to salvage the vessel at the point where it sank. The cutter had not blocked the entire navigation channel, so that general shipping would have been able to pass the scene of the accident.

6.2 Command of FC NEPTUN

Following the conversion of FC NEPTUN in the year 1995 the safety organisation See-BG and GL had pointed out the problems regarding stability frequently in sundry correspondence with the owner and skipper. It cannot be reconstructed why the weight of the catching gear was increased despite this knowledge, and why not everything was done during the repair in November 2001 to observe the stability criteria. The command of FC NEPTUN knew the times of departures of the ferries and after noticing ground contact the skipper was prepared for an "unpleasant passage". At this time it would have been possible to stop the vessel and let it fall dry in controlled manner, or to have asked the ferry to wait in the port basin.

6.3 Minimum freeboard, displacement and existing freeboard

FC NEPTUN is not subject to regulations governing the freeboard. The See-Berufsgenossenschaft (safety organisation) specifies the minimum freeboard in accordance with § 47 (3) UVV-See (Accident Prevention Regulations) and this is noted in the carpenter certificate. The minimum freeboard specified was 0.53 m, valid up to October 1999, according to the provisions of § 47 (4) of UVV-See. Fishing with double catching gear was not admitted.

Following the installation of an automatic facility for rapid release of the fishing gear in 1999, the freeboard was reduced to 0.34 m. However, this automatic facility could be switched off from the bridge. According to § 245 (2) (3) UVV-See if an automatic brake was installed then a righting arm of only 0.20 m at an angle of list of 30° needed to be observed.
According to § 251 (1) UVV-See the minimum freeboard could have been reduced to a minimum of five per cent of the ship's width of 5.0 m, = 0.25 m freeboard if sufficient stability was proven for this draft.

According to the statements supplied by the owner, FC NEPTUN had a draft of 2.20 m aft on the day of the accident and of 1.60 m forward. This results in a mean draft of 1.90 m. At a side height of 2.10 m this still leaves a freeboard of 0.20 m.

The calculations reveal a displacement of 73.5 t with these drafts.

A draft check was carried out during the survey by the BSU on 19.8.2003. The vessel had been largely emptied, the tanks and stores emptied, the fishing gear completely removed on shore, and there were only slight remaining quantities of water and mud in the fish hold. At this time the vessel was in an almost empty condition. The following freeboards were measured:

Aft at the stern, middle: 0.60 m = D HL = 2.19 m
Midships approx. on a level with forward edge of wheelhouse door:
Port: 0.46 m
Starboard: 0.30 m
This results in midships: (0.46 m + 0.30 m): 2 = 0.38 m

The forward draft was determined at the existing welding beads of the draft marks on the port side that had been painted over as exactly 1.30 m.

The following weights were removed after salvage:

Fuel approx.	2.000 t
Fresh water	0.500 t
Chains and shackles aft	1.000 t
Fishing gear in fishing hold	1.000 t
Fishing gear beam trawl beams	2.400 t
Total :	6.900 t

According to the hydrostatic values of GL and the engineering firm Ing. Büro KBN, the increase in weight due to cargo and parallel deeper immersion was 0.6 t/cm. The additional weight of 6.9 t : 0.6 t/cm corresponds to a parallel greater immersion of 11.5 cm, and hence to a residual freeboard of 0.38 m – 0.115 m = 0.265 m.

The displacement and draft on the date of the accident were confirmed by the draft check and the calculations.

On the basis of the calculation and the draft details provided by the owner and according to the determination of the freeboard existing after the accident, the vessel fell below the admissible freeboard of 0.34 m specified by the carpenter certificate of the See-BG dated 28.10.1999.

6.4 Ballast on Board

In his letter of January 1999 to the See-BG the owner stated that approx. 5 t concrete had been poured into the fish hold. In the iron longitudinal section from the ship's files of the BSH presented to the BSU, the word "cement" is entered from MR-frame 12 to fish hold frame 19, approx. 100 mm above the inner keel and over a width of approx. 4 m. According to the calculations of the BSU, this ballast probably had a weight of approx. 5 t.

According to the inspection report No. 38 of the See-BG, additional ballast in the form of steel plates, approx. 11000 mm x 200 mm x 173 mm (approx. 3.0 t) was welded into the outer keel area in May 1999. The arrangement of the steel plates with the exact centre of gravity heights and centre of gravity lengths was not stated.

During the survey of the vessel by the BSU in August 2003 only three frame fields from frame 16 to frame 19 were filled with concrete over approx. 2.20 m overall width and 5 cm below the keelson. At a rough estimate these frame fields result in a weight of 1.5 t.

In a written statement from his lawyer dated 1.10.2003, the owner states that approx. 3 t concrete had been placed in the forward fish hold, accommodation and fore peak.

The Technical Supervisory Service of See-BG determined on board on 24.10.2003 that there should have been approx. 4.0 t solid ballast on board with a longitudinal centre of gravity of 10.9 m and a centre of gravity above base of 0.12 m above the painted edge of the outer plating. This ballast of exactly 3976.5 kg was calculated from 2123.2 kg in the accommodation area, 853.8 kg in the forward ship, and 683.1 kg concrete and 316.4 kg steel in the fish hold. The 2123 kg ballast in the accommodation area were calculated on the basis of the information supplied by the owner, since it was not possible to see into the space beneath the floor plates.

In a further letter from the lawyer dated 24.11.2003 the owner states that prior to the repair of the bottom in 2001 there had not been any 5 t concrete in the vessel, since at the time the concrete had been placed on an approx. 10 cm thick layer of polystyrene insulation. After the repair initially 1.5 cbm concrete had first been poured. (Concrete with a density of 2.3 results in approx. 3.45 t.)

The owner of FC NEPTUN and the Dutch repair yard did not supply any documentation on the quantity of ballast placed. In the record of the heeling test on 29.11.2001 it was noted "*visruim beton verwijder*" (concrete removed from fish hold). According to this there was no concrete in the fish hold in the heeling test on 29.11.2001. After consulting a lawyer on this the insurance that processed the claim at the time was not willing to provide information on the quantities of concrete ballast settled.

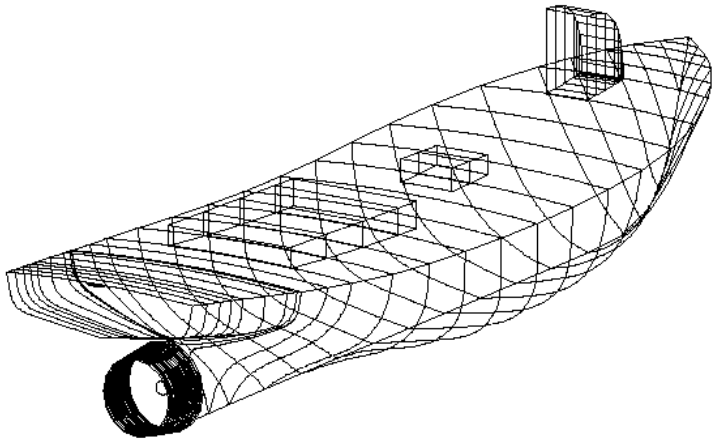
To summarise it is to be ascertained that during all heeling tests following conversions or repairs, the quantity and arrangement of the fixed ballast was not sufficiently documented by the surveyors and the engineers responsible for the heeling tests.
On the basis of the change in the ship's weight and the longitudinal and centre of gravity above base at the last repair in 2001, it can be assumed that the ballast on board during the heeling test in 1999 was not replaced.

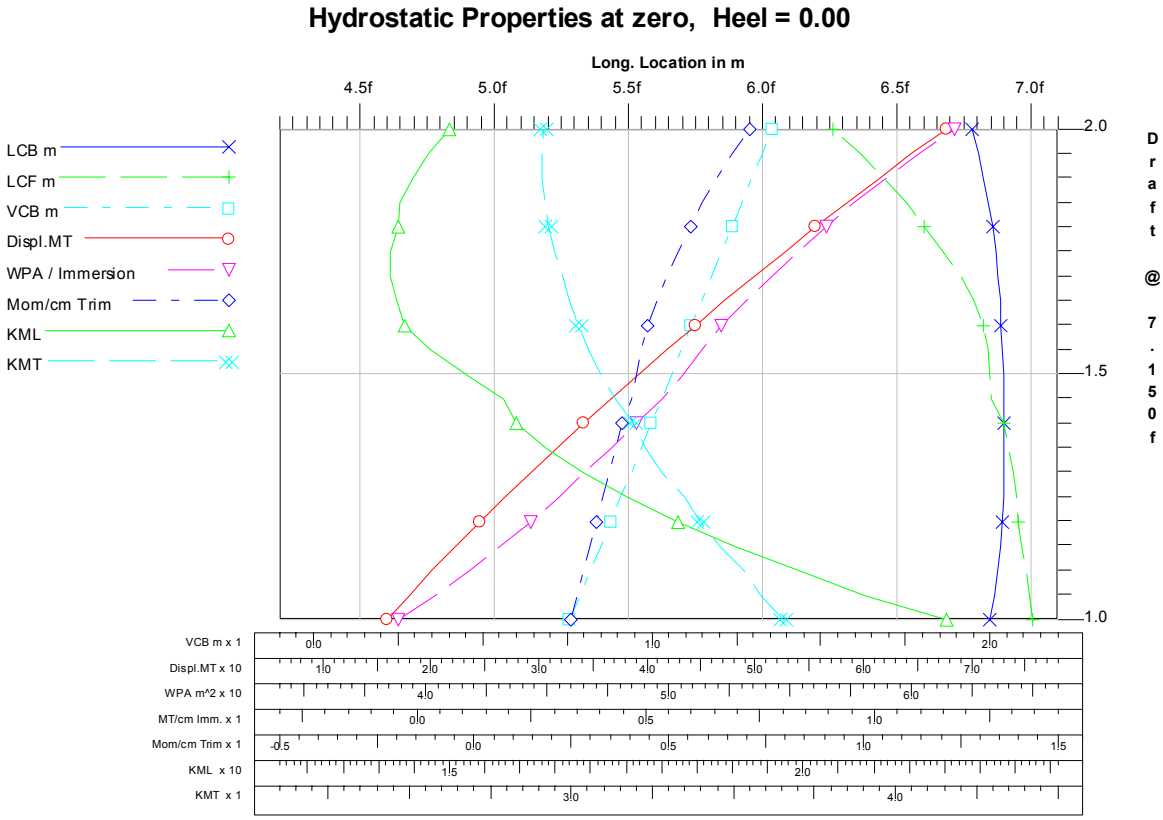
6.5 Stability calculations

Stability up to 1995
Up to the conversion of the vessel in 1995 no stability problems were known. The heeling test carried out on 11.5.1995 after the conversion resulted in an evaluation that the stability values were not sufficient. Germanischer Lloyd (GL) thereupon measured the vessel on the basis of the conversion drawings and the water line measuring table in May 1998 and calculated a graph sheet and the cross-curves of stability.

Stability 1999
A heeling test was carried out in the harbour of Norddeich by the engineering firm Ing.-Büro **A** from Leer on 30.6.1999. The form curve values of the trimmed water line and the entire curve sheet values and cross-curves of stability were provided to the firm of engineers by GL. On the basis of these values this firm of engineers calculated altogether 5 loading cases, all of which were checked and approved by GL. The evidence of this sufficient intact stability is certified by GL's own curve sheet calculations drawn up with the program NAPPA®.

Calculation of stability by BSU
A firm of design engineers commissioned by BSU measured the ship anew with the program AUTOHYDRO® and calculated the curve sheet and cross-curves of stability anew.



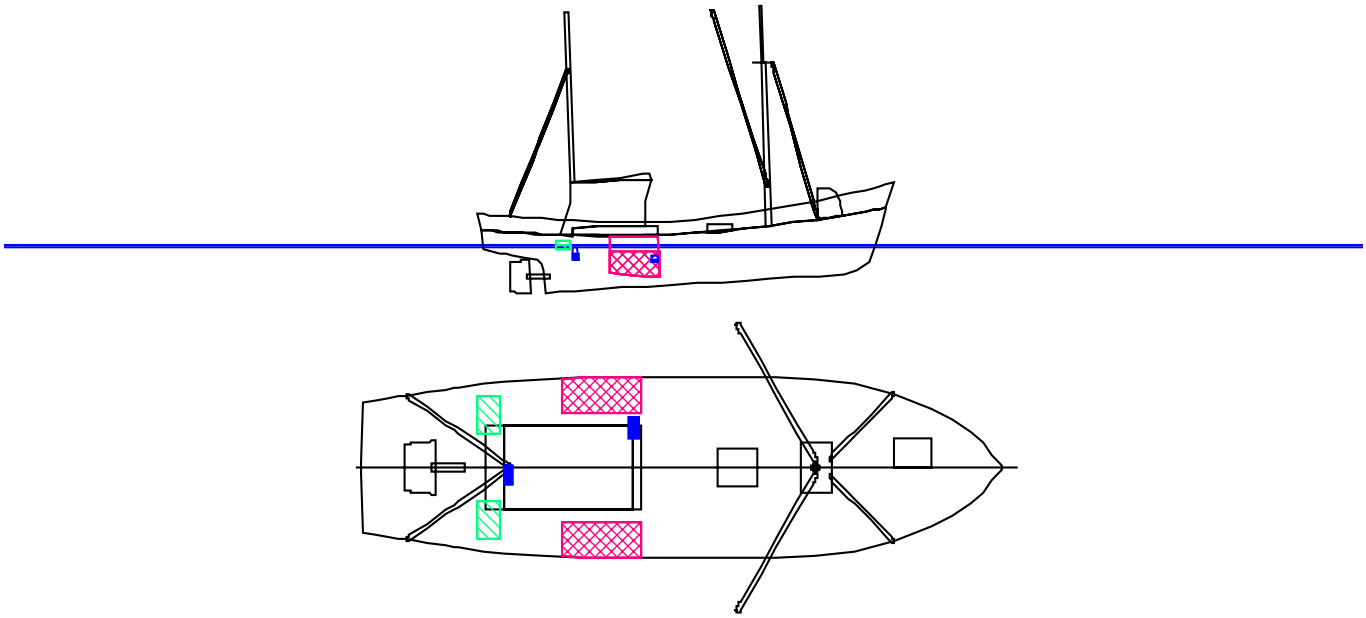


The deviations of the values from the vessel measurements of GL are not significant. The heeling test in 1999 was carried out and evaluated correctly in accordance with the IMO Code via intact stability A.749 (18).

It was determined that the 5 loading cases drawn up by Ing.-Büro **A** were defective. The fishing gear was stated with a weight of altogether 1.0 t and a centre of gravity height of 3.0 m over the bottom edge of the keel (BEK). The weight appears to have been assumed too low already at that time and the centre of gravity height is absolutely wrong. A height of 3.0 m over BEK corresponds to the situation when the fishing gear is laid down. The least favourable stability case occurs when the booms are up and the beam trawl beams are raised up to the blocks.
In the calculation of this particular stability case by the engineering firm commissioned by the BSU, with 100% stocks at the start of the voyage, 2.40 t gear, and a centre of gravity height of 11.90 m above BEK (9.45 m above deck at frame 20), the stability criteria of the See-BG are not maintained.

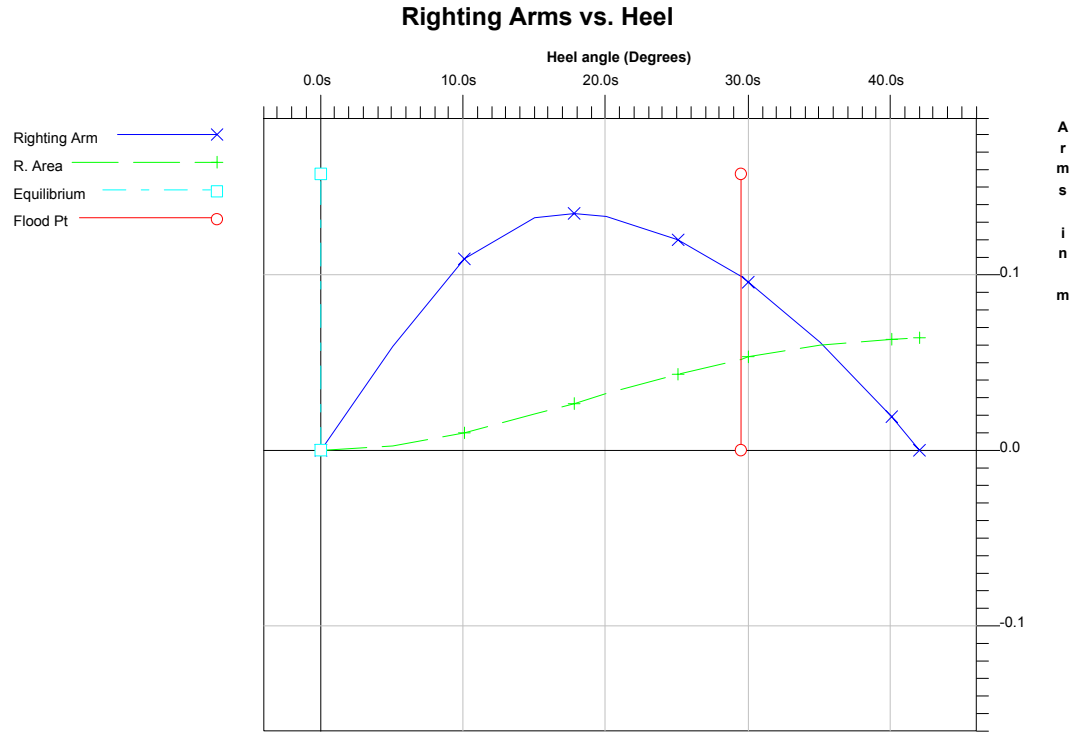
The owner stated within the period for hearing in accordance with § 15 SUG that a part of the fishing gear had been lying on deck and according to his calculations the centre of gravity height had been 7.20 m above the base. This stability case was subsequently checked, but even with this assumed centre of gravity height the stability criteria of the See-BG are not observed.

Stability with heavy trawl beams



Fluid Legend

Fluid Name	Legend	Weight (MT)	Load%
FUEL OIL		4.29	98.01%
HYDR. OIL		.05	98.00%
ENGINE OIL		.05	98.00%
FRESH WATER		.48	95.00%

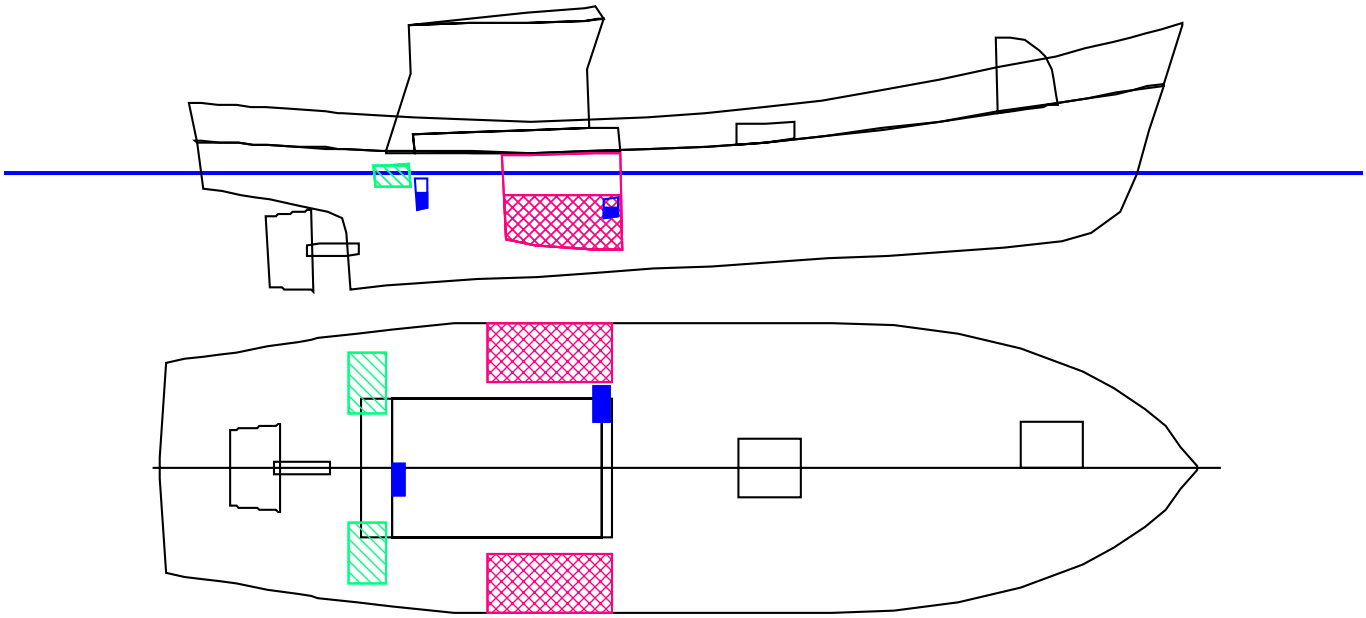


In particular in this calculated stability case the range of stability is only 43.41° (60° required), the righting arm at 30° is only 0.108 m (0.20 m required), and the areas below the righting arm curve from 0° to 40° and from 30° to 40° are not sufficient either.

Stability following repair in Holland 2001

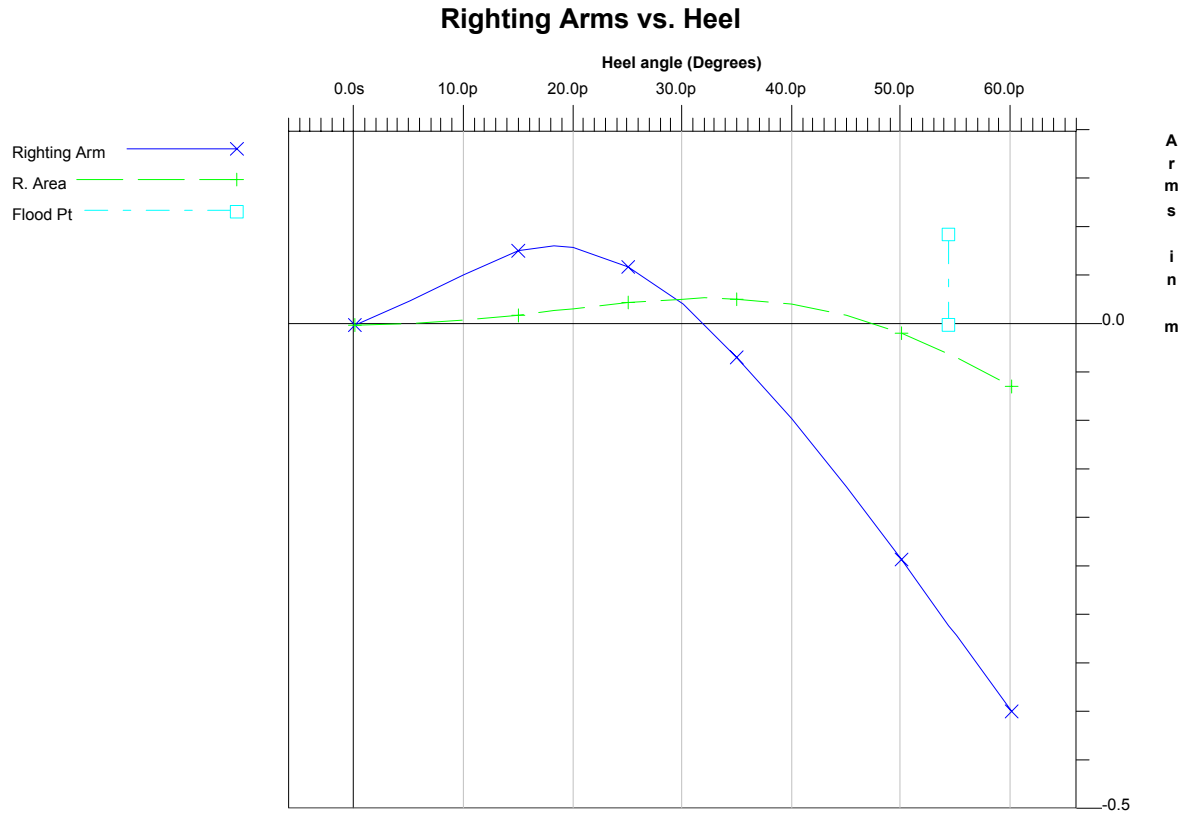
The heeling test in Holland following the repair of 29.11.2001 was not approved by the See-BG. The checking of this test revealed a few irregularities. The determination of the over and under-weight says nothing about the equipment condition of the vessel. In particular it cannot be seen whether the fishing gear was on board. Nor can it be seen how many measurements of heeling were carried out. The displacement path (L) is stated in the summary as 3.50 m and calculated with 3.95 m. A stability case "Departure Port" was calculated with the height moment of the fuel oil calculated wrongly. A comparison of the evaluation with the heeling test of 30.6.1999 results in the following discrepancies.

The empty weight of the vessel determined is 11.45 t (approx. 18%) lower, the longitudinal centre of gravity is displaced 0.79 m (11%) further forward, and the centre of gravity above base is 0.30 m (15%) higher than the values shown in 1999. A stability check with these values results in considerably poorer stability values.



Fluid Legend

Fluid Name	Legend	Weight (MT)	Load%
FUEL OIL		2.00	45.66%
HYDR. OIL		.03	50.00%
MOTOR OIL		.03	50.00%
FRESH WATER		.50	99.20%

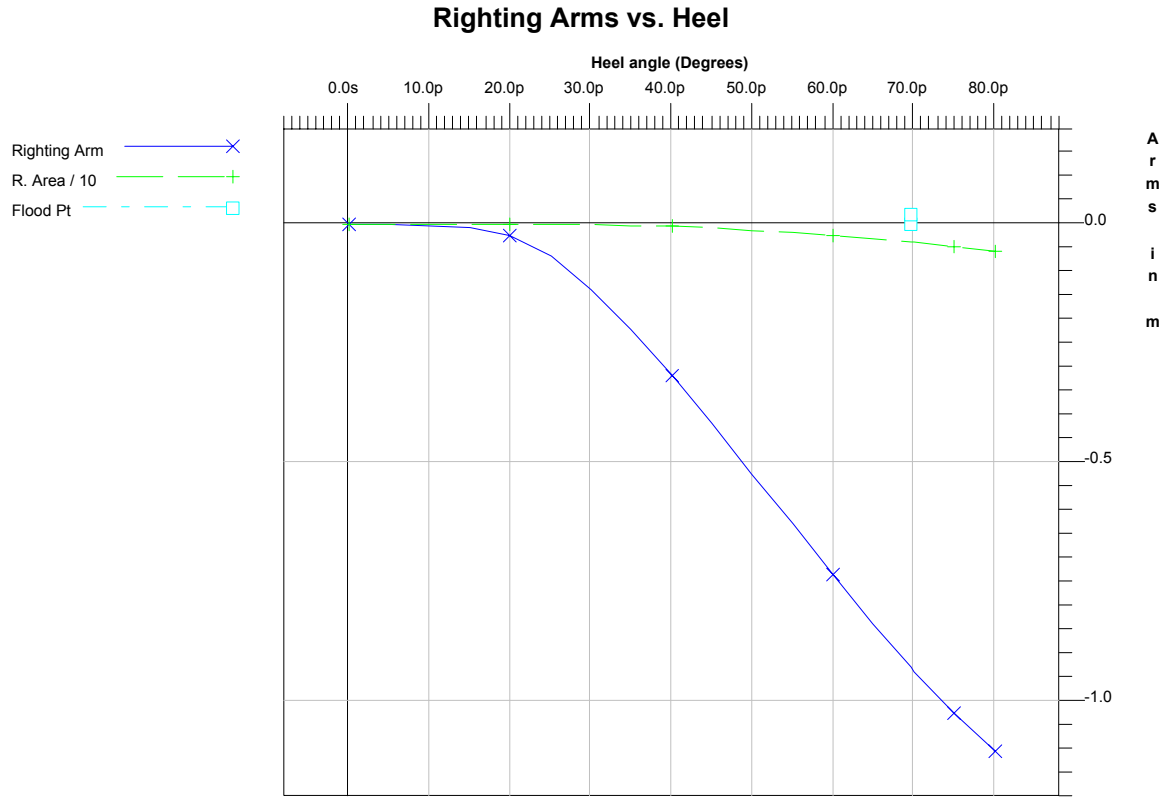


The GM is 0.269 m (required 0.35 m), the range of stability in this case is only 32°, the righting arm at 30° is 0.02 m, and the areas beneath the righting arm curve are absolutely insufficient.

Stability on grounding of the cutter

The following stability case has been calculated for grounding of the stern frame. For this the draft was reduced at constant displacement and a water line 15 cm lower than the floating water line in deep water before the time of the accident was assumed.
The range of stability is only 31° here and the righting arm at a heel of 20° is 0.012 m.

The stability case is even worse when even more water runs out and the water line area is reduced even further. At a water line 29 cm lower than the water line existing in deep water there is a negative initial stability and no righting moment any more.



Stability when passengers are carried

On studying the stability calculations for FC NEPTUN, BSU noticed that since 1974 this and other fishing cutters have been allowed by the See-BG to carry passengers for procession trips and cutter regattas.

The maximum admissible number of passengers is fixed in accordance with the following calculation:

Cutter length x cutter width x 0.5 = number of passengers

According to the calculation using this formula, FC NEPTUN would have been allowed to take altogether 36 passengers on board. No conditions regarding life rafts and safety jackets were set. Only the shrimp catching gear was to be placed on shore.
The above formula was checked in accordance with the Code on Intact Stability of all the vessel types dealt with in the IMO Rules, IMO Code A.749 (18).

Operating condition		Stability criteria according to publication of stability regulations for freighters, passenger vessels and special crafts of 24.10.1984			
		Angle of heel			Remaining freeboard taking into account heel >0.20m
		by passenger mom. <10°	by passenger and turning circle mom. <12°	by wind pressure mum. <12°	
No	Designation	degrees	degrees	degrees	m
6	Cutter in procession with 36 passengers on board	5,00	6,23	2,70	At 5,00°=0,089 At 6,23°=0,001 At 2,70°=0,179

The maximum admissible angles of heel stated in the Code are not exceeded by cross shifting of all passengers to one side of the vessel, turning circle passage and cross shift of passengers, and side wind pressure.

The remaining freeboard required by the See-BG of at least 0.20 m up to the exposed deck under the influence of the above moments is by no means achieved.

6.6 Steering system

After the capsizing the Kort rudder nozzle pointed to port and the electrical steering system display stopped at approx. 30° rudder to port. The skipper confirmed in writing that his last conscious rudder manoeuvre was "hard to starboard" and that he did not consciously place the rudder to port. The rudder tiller might have been unintentionally actuated when he climbed out of the wheel house, or the rudder nozzle may have turned to the port side as the oil pressure dropped.

It was not possible to clarify finally whether the increase in heel with a hard rudder position led to a dangerous heel due to centrifugal force, since especially vessels with low stability values should avoid hard rudder positions at high vessel speeds (Directive H1 (7) of the See-BG for behaviour under influences jeopardising stability on fishing vessels).

6.7 Fishing gear

In the last stability calculation of 1999 checked by Germanischer Lloyd, the calculations were carried out with a fishing gear of 500 kg per ship side at a centre of gravity height of 3.00 m above the bottom edge of the Kiel (BEK). This centre of gravity height relates to the derrick-pin bearing of the loading/fishing booms or to the beam trawl beams placed in their bearings on deck. It would have been correct here to calculate the actual load point with the booms up on top at a height of altogether 9.45 m above deck.

At the time of the capsizing two beam trawl beams were being carried at the top booms on board. The wind force was 2 Bft. from SE and the swell was zero.

During the survey by the See-BG on 31.7/1.8.2003 the owner stated that the weight per beam was 800 kg. The WSP Norddeich had the beams weighed, including the shoes (straps) and tickler chains with a calibrated draw balance and determined a total weight of 1200 kg each.
The existing beam trawl beams were 4.5 m long. The distance between bearing points for lowering the beam trawl beams on deck is too large at 6.90 m to be able to place the beam trawl beams on these bearings. The bearing points are in any case made for tubular beam trawl beams. The beam trawl beams carried on board at the time of the accident were made of flat iron 450 x 20 x 4 mm. The beam trawl beams can only be set down with difficult lashings and it is very difficult to observe § 261a (3) of the accident prevention regulations UVV-See.

§ 261a (3) UVV-See

"During travel to the fishing grounds and back the fishing gear may only be heaved up and carried on the booms up to a wind strength of 4 Bft."

6.8 Closed condition

The entrance to the forward accommodation and to the forward and aft peak (store aft) was closed with a catch and bolts at the time of the salvage. The upper sliding bolt and the door seal to the companionway to the accommodation were missing.

There was no hatch cover for the fish hold. According to the information supplied by the owner to the See-BG, the hold had been covered but not secured. The fish hold hatch cover has dimensions of 1000 x 900 mm with a coaming height of 300 mm. The coaming edge is formed by round iron. There are no sliding bolts or supports and facilities for securing the hatch cover and the cover was not produced in accordance with § 201 UVV-See.

6.9 Carpenter certificate

The carpenter certificate for coastal fishing with simple gear was issued in 1971 with a minimum freeboard of 0.53 m. The carpenter certificate was issued on 28 October 1999 with the condition: "Fishing with double fishing gear is only allowed after installation of an automatic facility for fast release of the fishing gear in accordance with § 245(3) of the UVV (accident prevention regulations). Minimum freeboard 0.35 m."
The carpenter certificate on board was issued by the See-BG on 28 October 1999 and was valid up to 29 June 2001. A first extension up to 28 June 2003 had been entered on 21 June 2001 following the ship's survey in Holland.
The carpenter certificate had been extended up to 31 August 2003 by stamp without a date and without a survey of the vessel.

6.10 Command of the Ferry FRISIA IV

The evaluation of the voyage of FRISIA IV does not show any technical failure or misconduct on the part of the crew. Speed was reduced prior to passing FC NEPTUN and stopped immediately after the accident, and the appropriate rescue measures were initiated. The ship's crew of FRISIA IV could not foresee a danger situation for the cutter.
On the day of the accident the ferry had a draft of 1.50 m on level keel and was able to pass the low water condition without any problems. It cast off in accordance with schedule. In accordance with § 39 Para 2 SeeSchStrO "*the voyages are to be carried out in accordance with the times stated in the timetable*". These fixed timetables are binding for the vessel operator so that the shipping police authorities have an overview of traffic at the berthing points in good time and so that they are able, if necessary, to avoid any impairment of the safety and ease of traffic at the berthing stations and in the navigation channel.

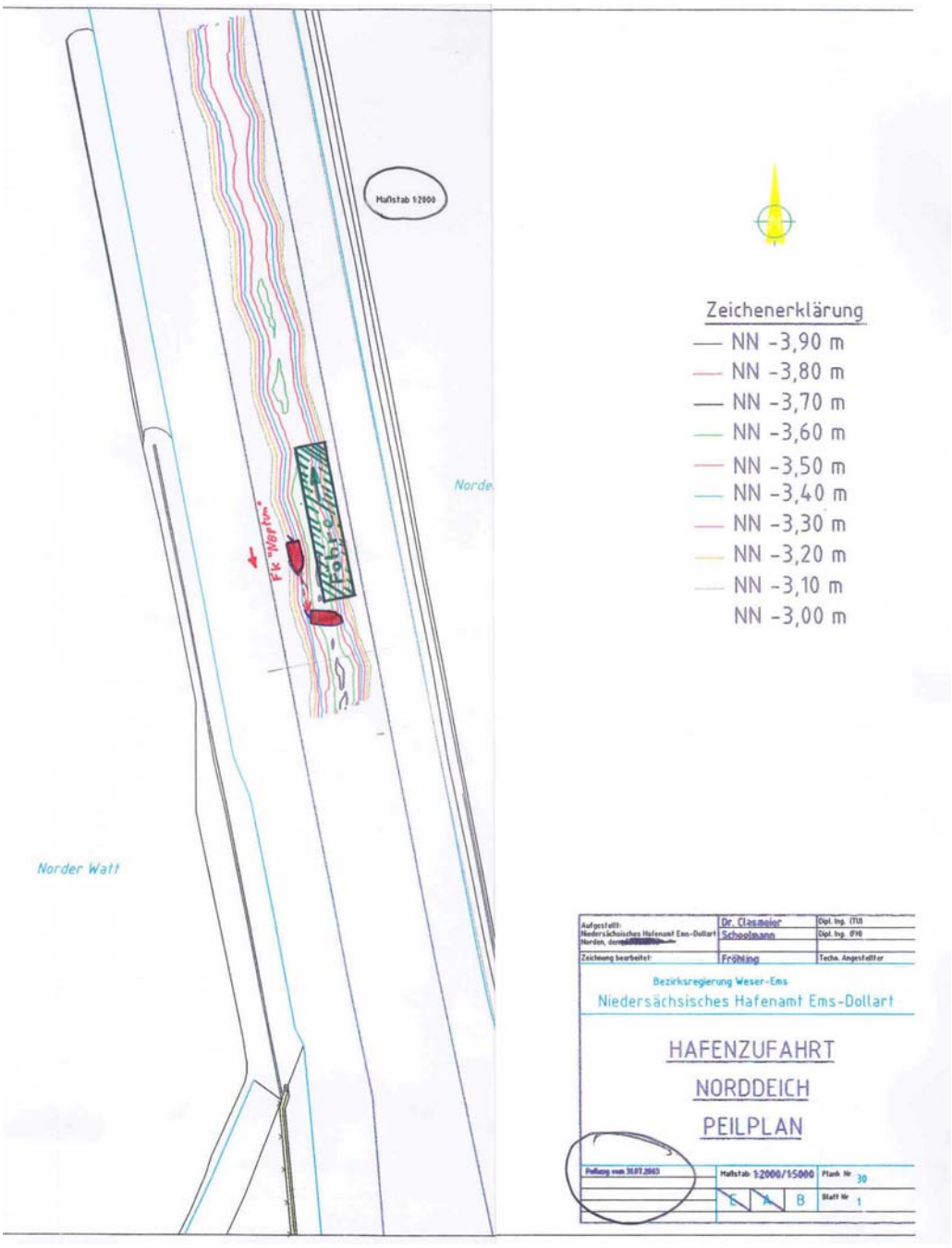
6.11 Traffic regulation

In the special Port Regulations for East Frisia (BesHOOstfr.), that were valid up to 2000, nothing is regulated regarding right of way for the Norddeich harbour. It is only stated, for instance for the port in Norderney: *"Vessels other than small leisure craft may not be overtaken in the port entrance. Vessels running out of port have right of way over vessels running in." "*
This ruling is currently still contained in the BSH North Sea Manual, Eastern Part.

All that applies in the Norddeich harbour is the "Regulation for ports in the state of Lower Saxony - General Port Regulations (AHO)". Right of way and encounters are regulated by application of § 2 Para 1 Letter b of AHO only by the German Collision Regulations (acronym SeeSchStrO). § 25 Para 2 of the SeeSchStrO, according to which vessels entering a navigation channel have right of way over vessels leaving their anchorage or berths is not applied here, since the accident took place after the passage in the course of the navigation channel.

6.12 Summary of the course of the accident

At the time of the accident there was a spring tide. The lowest water level was at 07:30 h according to the water level curve of the Norddeich harbour. The evaluation of the water level curve and the sounding drawings revealed that there was a water depth of 2.26 m in the middle of the navigation channel and 9 m to the western side of the navigation channel a depth of 1.56 m.



The cause of the marine casualty was the deficient stability and insufficient closed condition of FC NEPTUN. The stability was changed negatively by changing the ballast and taking heavy fishing gear on board. Due to the fact that the fishing hatch could not be closed sea-tight, it was not possible to produce the necessary closed conditions.

FC NEPTUN ran aground on passing the ferry FRISIA IV and as a result of the high beam trawl beams heeled over to starboard. The 60 cm lower stern post of FC NEPTUN remained caught in the shallower part of the navigation channel. The suction following the Ferry FRISIA IV drew the floating forward part of the vessel into the navigation channel and FC NEPTUN swung to port and remained lying at an angle of heel of 90°. In this condition the fish hold ran full via the fish hatch that was not closed sea-tight.

7 Recommendations

7.1 Classification Society Germanischer Lloyd (GL)

GL provided its calculations of the curve sheet, the cross-curves of stability and the trimmed water line of the heeling test to Ing.-Büro **A** and approved these as engineering input documents drawn up by GL itself, as it were.
Independent and objective checking of stability and trim calculations submitted is only expedient if these are drawn up completely outside GL.

7.2 See-Berufsgenossenschaft (See-BG - Safety Organisation)

On issuing and extending carpenter certificates the ships' safety department should check carefully whether the stability of the vessel has deteriorated as a result of any conversion or repair work, especially if it is known that there were stability problems in advance. The chain of information from surveyor to ships' safety department should be checked in order to prevent carpenter certificates from being extended without all documents being submitted.

The load case with freely suspended loads is not listed in the first four standard load cases / operating conditions of the implementation instruction D of (1) in § 245 of the UVV-See. Only the last operating condition states that "unfavourable operating conditions if these occur" should be calculated as well "including the factors "consideration of the weight of wet fishing nets, tackle etc." The UVV-See § 261a Para 3 allows fishing gear to be hoisted up to wind speeds of 4 Bft. during travel and consequently this stability case must also be checked, especially for this small vessel where it is known that there were stability problems.

The calculation formula and the approvals of passenger travel for cutter regattas / procession trips must be checked for admissibility in accordance with the existing stability regulations.
The BSU recommends that these calculations be carried out in accordance with the regulations for passenger vessels and it must be ensured that sufficient safety gear is available on board.

7.3 Surveyors

The surveyors of the classification societies and the See-BG must ensure that the guidelines for carrying out heeling tests are observed. In particular reference is made here to the code on intact stability A.749(18) Chapter 7 and Annex 1. All overweight and underweight and existing fixed ballast are to be documented.

In the regularly recurring repeat tests attention should be paid to observation of the closed condition and whether fishing gear and/or items of equipment have been changed.

7.4 Port Regulations on passing of vessels

The BSU recommendation is to be issued to persons responsible for safety and ease of shipping traffic, if appropriate with a special regulation for the period of lowest water level, in order to avoid future accidents, since this danger point is not covered by the German Collision Rules (SeeSchStrO). In particular §§ 23 and 25 SeeSchStrO did not have any sufficient effect on traffic regulation covering this maritime casualty. The port channel in Norddeich is not shown as a narrow place with, for instance, visual signals A.2 of Annex I SeeSchStrO, and even the navigable width remaining at normal water levels does not make this a narrow place.
An additional improvement would be, for instance, to specify sufficient communication via VHF between passing vessels in order to minimise such and similar danger situations.

7.5 Fishing gear and fish hatch cover

When fishing gear is changed the responsible command should observe the consequences for stability, and if appropriate the fishing gear should be weighed in cases of uncertainty.

It must be possible to lower the fishing gear quickly and lash it sea-tight on board. §§ 261 and 261a of UVV must be observed.

Fish hatch covers are to be secured watertight in accordance with § 249 UVV.

7.6 Responsibility of Captain and owner

The § 3 of SeeSchStrO "Basic rules for behaviour in traffic" should be observed. According to these each traffic participant must behave in such a way that safety and ease of traffic is ensured and no other is harmed, jeopardised, impeded or bothered more than unavoidable according to the circumstances.

The owner and operator must observe his obligation under the law governing shipping safety and report repairs that cause changes in the structural condition to the supervisory institution, and maintain his vessel at all times in an operationally safe condition.

8 Sources

The survey report refers to the investigations, calculations and ship survey of the BSU and to

- determinations by the Water Police Norddeich
- survey and calculations as well as files of the See-BG and Germanischer Lloyd
- stability expertise by KBN Konstruktionsbüro GmbH, Bremen
- photos by the shipping expert Fechner, Hamburg
- sea charts of BSH
- water level data from the measuring station Pegel Norddeich and measurement plan port access Norddeich.

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