Bundesstelle für Seeunfalluntersuchung
Federal Bureau of Maritime Casualty Investigation
Federal Higher Authority subordinated to the Federal Ministry
of Transport and Digital Infrastructure

Investigation Report 211/19

Very Serious Marine Casualty

Collision
between traditional vessel Nº 5 ELBE
and container vessel ASTROSPRINTER on
the River Elbe on 8 June 2019

2 June 2021

This 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). According to said Law, the sole objective of this investigation is to prevent future accidents. This investigation does not serve to ascertain fault, liability or claims (Article 9(2) SUG).

This report should not be used in court proceedings or proceedings of the Maritime Board. Reference is made to Article 34(4) SUG.

The German text shall prevail in the interpretation of this investigation report.

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1 SUMMARY

At 1354[1] on 8 June 2019, a collision occurred on the River Elbe off Stadersand between the container vessel ASTROSPRINTER, flying the flag of Cyprus, and the German traditional vessel № 5 ELBE[2]. The sailing vessel had just turned around to return to Hamburg. After the turn, there was damage to the headsails. The crew was busy gaining control of these sails and failed to move to the correct side of the fairway, i.e. the side appropriate to the direction of travel. As a result of this, the № 5 ELBE just missed the oncoming HANNA and then collided with the ASTROSPRINTER. Eight people on board the former pilot schooner, which was manned by 15 crew members and 28 passengers, suffered mainly minor injuries. In the further course of events, the № 5 ELBE was able to reach the nearby mouth of the River Schwinge under her own steam with the support of the *Deutsche Lebens-Rettungs-Gesellschaft (DLRG)* [German life-saving association] boat KIEK UT, before running aground and foundering there just short of the pier. Thanks to the fortuitous circumstances that emergency responders from the Stade Volunteer Fire Brigade and the DLRG were already in the vicinity due to another mission and that the vessel was in sheltered waters, everybody could be rescued in good time.

[1] Unless stated otherwise, all times shown in this report are local = UTC +2 h (CEST).

[2] According to the certificate of registry, this vessel's name is the ELBE. In the safety certificate she is called the № 5 ELBE, which is also the name used in this report, as it is commonly used in the public domain.

2 FACTUAL INFORMATION

2.1 Photograph of the ASTROSPRINTER

Source: BSU/BSH/J.K.

Figure 1: ASTROSPRINTER

2.2 Ship particulars: ASTROSPRINTER

Name of ship:	ASTROSPRINTER
Type of ship:	Container vessel
Flag:	Cyprus
Port of registry:	Limassol
IMO number:	9349215
Call sign:	C4RJ2
Owner (according to Equasis):	Astromare Bereederungs-GmbH
Shipping company:	Astromare Bereederungs-GmbH
Year built:	2007
Shipyard:	IHDA Marine Service B.V.
Classification society:	Bureau Veritas
Length overall:	132.30 m
Breadth overall:	20.60 m
Draught (max.):	7.30 m
Gross tonnage:	13,978
Deadweight:	9,593
Engine rating:	7,999 kW
Main engine:	MAK 8M43C
(Service) Speed:	17 kts
Hull material:	Steel
Minimum safe manning:	9

2.3 Voyage particulars: ASTROSPRINTER

Port of departure:	Hamburg
Port of call:	Immingham, UK
Type of voyage:	Merchant shipping/ international
Cargo information:	Containers
Manning:	11
Draught at time of accident:	D_f: 6.60 m, D_a: 6.90 m
Pilot on board:	Yes
Number of passengers:	0

2.4 Photograph of the № 5 ELBE

Source: Operator

Figure 2: Pilot schooner № 5 ELBE

2.5 Ship particulars: № 5 ELBE

Name of ship:	ELBE (or № 5 ELBE)
Type of ship:	Pilot schooner/traditional vessel
Flag:	Germany
Port of registry:	Hamburg
IMO number:	-
Call sign:	DANF
Owner:	Stiftung Hamburg Maritim (SHM)
Operator:	SHM
Year built:	1883
Shipyard:	H. C. Stülcken, Hamburg-Steinwerder
Classification society:	-

Length[3]:	24.83 m
Breadth overall:	5.78 m
Draught (max.):	3 m
Gross tonnage:	52
Deadweight:	138 t
Engine rating:	2x 130 HP
Main engine:	2x Volvo common rail diesel
(Service) Speed:	10 kts
Hull material:	Timber
Hull design:	-
Minimum safe manning:	2

2.6 Voyage particulars: № 5 ELBE

Port of departure:	Hamburg
Port of call:	Hamburg
Type of voyage:	Other shipping National
Cargo information:	None
Manning:	15[4]
Draught at time of accident:	3 m
Pilot on board:	No
Number of passengers:	28

[3] According to the London Convention.
[4] According to the minimum safe manning certificate from the Ship Safety Division (BG Verkehr), two people are needed to navigate the vessel. However, SHM regularly assembles the 15 people it believes are needed to navigate the № 5 ELBE safely.

2.7 Marine casualty or incident information

Type of marine casualty:	VSMC, collision[5]
Date, time:	08/06/2019, 1354
Location:	River Elbe off Stadersand
Latitude/Longitude:	φ 053°37.6'N λ 009°32.3'E
Ship operation and voyage segment:	Fairway mode
Place on board:	Bow of each vessel
Consequences:	**ASTROSPRINTER:** Paint abrasions on the starboard side of the bow; nobody injured **№ 5 ELBE:** Heavy damage to the underwater hull and foundered; eight people injured; minor pollution

Extract from Navigational Chart INT 1454,
Federal Maritime and Hydrographic Agency (BSH)

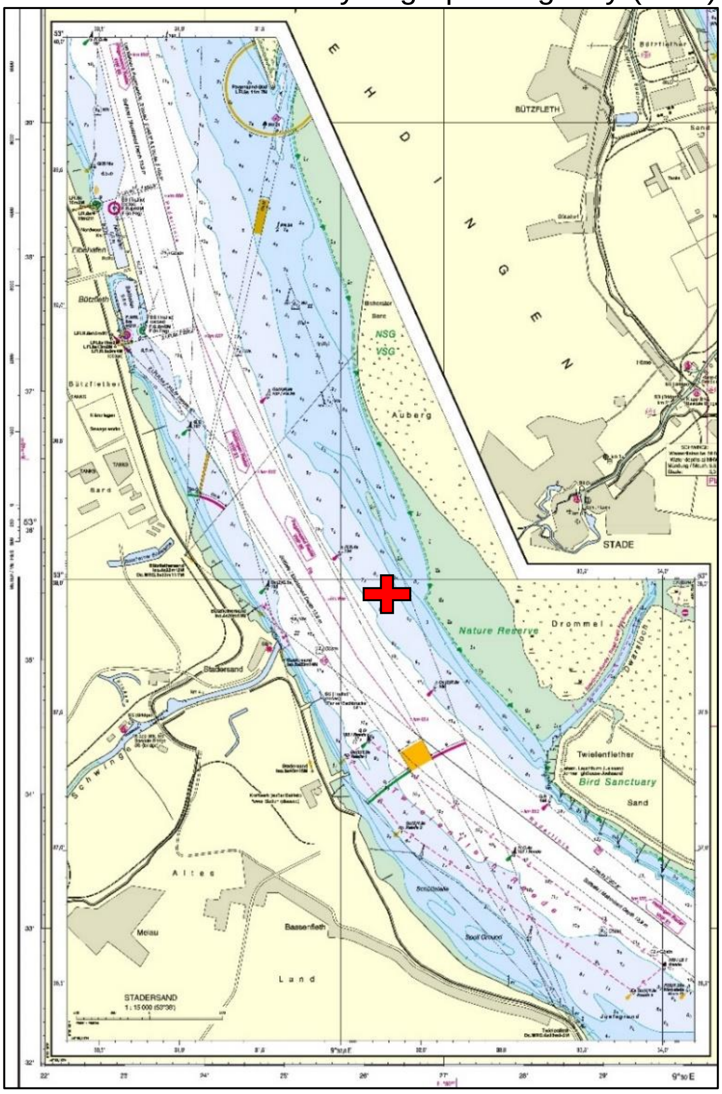

Figure 3: Scene of the accident

[5] The BSU classifies this collision as a VSMC within the meaning of the SUG because the № 5 ELBE foundered subsequently.

2.8 Shore authority involvement and emergency response

Agencies involved:	• Fire and Rescue Control Centre Stade • DLRG Stade • Stade Volunteer Fire Brigade • Waterway Police (WSP) Hamburg • Vessel Traffic Service (VTS) Brunsbüttel
Resources used:	• Motor lifeboats KIEK UT and GOOD WILL from the Stade branch of the DLRG • Fire support boat HENRY KÖPCKE from the Stade Volunteer Fire Brigade
Actions taken:	• First aid administered to the casualties on board the № 5 ELBE • Bilge pumps started and vessel shifted to the mouth of the River Schwinge with the assistance of the KIEK UT • Everybody evacuated and further medical care • The foundering № 5 ELBE secured and oil boom deployed

3 COURSE OF THE ACCIDENT AND INVESTIGATION

3.1 Course of the accident

The subsequent course of the accident is shown in italicised print from the perspective of the № 5 ELBE and in normal print from the perspective of the ASTROSPRINTER.[6]

A № 5 ELBE passenger cruise was planned for 8 June 2019. It was the fourth voyage after being in dock for eight months. As always, the crew assembled on board at around 0900 to prepare the ship, i.e. two hours before departure. The crew was briefed by the nautical officer. The nautical officer assigned the tasks for that day (i.e. which crew member should operate which sails and lines) using a form he had created. Furthermore, the people present were split into the teams required according to the muster list, i.e. to the firefighting team, the damage-control team and the lifeboat team. After the briefing, the team leaders went through the material and tasks with their teams using role cards. Experienced crew members were appointed as team leaders. Coincidentally, the crew included a doctor for the first aid area.

When the passengers arrived on board, they were briefly welcomed by the skipper and the nautical officer gave them a safety briefing. This included demonstrating how to put on the orange lifejackets.

The ship's command had already obtained information on the wind and weather conditions on that day. The skipper knew of south-westerly winds of force 4-5 Bft with gusts of 6-7; the nautical officer estimated 3-5 Bft with gusts of 6-8. Neither believed this was a problem for the vessel. Taking into account the expected current, a speed over ground (SOG) of 6-7 kts was anticipated. A decision to sail with a reduced sail area was taken in the interest of safety. To help with selecting the sail area, the ship has a safety manual which specifies the options at different wind forces.

The Cyprus-flagged container vessel ASTROSPRINTER left the port of Hamburg at 1236 on 8 June 2019 and was sailing to Immingham in the UK. A pilot advised the ship's command during the passage through the River Elbe. The second officer (2nd NO) was on the bridge with the master.

The pilot transfer took place at 1248, i.e. the port pilot left the ship and the River Elbe pilot took charge of giving advice.
The ASTROSPRINTER proceeded as the last of four ships. Ahead of her were the feeder ship HANNA, then the WILLEKE and first the ZAPOLYARNYY. About 2 nm separated each vessel. Wedel was passed at about 1330 and the speed was increased to HALF AHEAD.

[6] Inconsistent statements made by people on board the № 5 ELBE are indicated below.

The VHF units were set to channels 74 and 14 in the Hamburg area and switched to 68 and 9 when they passed the state border (light buoy 125). The pilot took charge of communication (with the VTSs, in particular, as it was conducted in German). The port radar was set to a range of 0.75 nm, off-centred north-up, relative motion. This was later increased to 1.5 nm.

At about 1345, the master handed over the watch to his 2nd NO and gave the pilot permission to operate the rudder and engine independently. He then left the bridge for his quarters.

At 1115, the № 5 ELBE left the Sandtorhafen port and sailed downstream on the River Elbe with 15 crew members and 28 passengers (including three children) on board. Due to the weather forecast, only the boom foresail, the foresail and the inner jib were set at about 1200 off Parkhafen port and the engines were left running.

The listening watch was switched from VHF channel 74 (port of Hamburg) to channel 68 (VTS Brunsbüttel) off Wittenbergen. The engines were stopped off Lühe so as to sail on the northern edge of the fairway in an aft current and south-westerly winds at about 8 kts SOG.

After passing buoy 106 immediately behind the stern of the overtaking WILLEKE at about 1345, they started to turn so as to move onto the southern fairway side and sail back to Hamburg with the tide, which was rising again. The helmsman was to sail for the next green buoy after the turn.

A crew member went to the skipper and informed him that the inner jib had reportedly torn. The skipper went forward to check the situation. He decided to take in the sail. No particular attention was given to the fact that the oncoming HANNA was passed in close proximity on the port side while this was happening.

After about three minutes the skipper went aft to the engine control position to start the engines with the aim of improving the ship's manoeuvrability.

First the starboard jibsheet and then the port jibsheet tore even before it was possible to begin recovering the inner jib. This sail then beat violently in the wind, posing a risk to the people in this area. The skipper ordered the nautical officer to strike the foresail first instead of the inner jib.[7] Meanwhile, the skipper watched the ASTROSPRINTER. Since the fairway bends between buoys 108 and 106, making it necessary to alter course to starboard when sailing downstream on the River Elbe, the skipper (who had been a pilot on the River Elbe for years) expected the ASTROSPRINTER to make a

[7] Contrary to this statement by the skipper, the nautical officer stated in writing that he had made this decision independently.

starboard course alteration and it was with this in mind that he maintained his course toward the southern fairway[8].

After the ASTROSPRINTER had passed the high-voltage lines at Hetlingen, the pilot was able to listen in on a VHF call from the HANNA. The latter called the № 5 ELBE because the pass seemed so close to the HANNA's pilot that he wanted to discuss it[9]. The 2nd NO and the pilot of the ASTROSPRINTER then observed the traditional vessel more closely. The schooner sailed on the northern side of the fairway on the northern edge of the channel. According to the 2nd NO and the pilots, the ASTROSPRINTER and № 5 ELBE each showed the other her starboard side. As they were approaching the next section of the course and in the expectation that the № 5 ELBE would continue on the wrong side of the fairway along the red line of buoys and deviate to port in the prevailing south-westerly wind, the pilot initially altered the ASTROSPRINTER's course by a few degrees to starboard.

The sailing vessel suddenly altered course to starboard. The 2nd NO stated that he thought this manoeuvre seemed "like a person jumping in front of a moving train." Neither the pilot nor the 2nd NO heard an audible warning signal.

As the ASTROSPRINTER came closer and closer, someone started to shout that everyone should move to the stern quickly. Approaching from the bow, the nautical officer ran toward the tiller, looked toward the container ship and then bent down to operate the switch for the horn on the compass: five short blasts, he looked up, then another five short blasts. Someone shouted "HARD TO PORT! Come around here, come around here! HARD TO PORT!" The nautical officer jumped toward the tiller and pushed it away. Other people in the vicinity, including passengers, grabbed hold of and pushed the tiller to port, i.e. with the rudder acting to starboard – and the №5 ELBE thus turned to starboard.[10]

To prevent or at least reduce the damage caused by the looming collision, the pilot turned the ASTROSPRINTER to port. There was too little time for any meaningful intervention, however.

The ASTROSPRINTER's bow struck the port side of the traditional vessel level with the foremast. The mast broke and the ship heeled heavily to starboard. The people on deck tried to hold on as tight as possible. The sailing vessel then righted herself again, scraped along the starboard side of the freighter and finally came free.

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[8] The skipper adhered to this statement.
[9] As he later testified to the BSU.
[10] This paragraph describes the video that a passenger recorded by chance. It is not evident from the video who said what. The master and the nautical officer claimed that a starboard manoeuvre was intended.

Source: Daniel Beneke, Stader Tageblatt

Figure 4: Collision

The 2nd NO ran to the starboard wing to see what happened to the sailing vessel. He saw the ship floating and many people on deck.

The ASTROSPRINTER's master had been in his quarters for only a few minutes when he heard a noise but thought it was a large wave.

Seconds later the 2nd NO called him and informed him of a collision. He hurried to the bridge immediately and asked his officer and the pilot what had happened. He went into the starboard wing and could see from there how the traditional vessel was drifting astern. He saw people sitting and standing on the deck of the sailing vessel. No one seemed to have fallen overboard and he gained the impression that immediate assistance was not needed. He also noticed two lifeboats quickly moving toward the sailing vessel. He asked the pilot to maintain contact with the VTS, which the latter acknowledged.

Source: The ASTROSPRINTER's shipping company

Figure 5: After the collision

Individual members of the traditional vessel's crew immediately began distributing lifejackets from the boxes on deck to everyone present. The three children had been wearing lifejackets permanently since the voyage begun. Lifejackets contained in the forward locker were no longer accessible because the broken foremast was lying on top of it. The nautical officer hurried to the chart table below deck to send a mayday call from the VHF unit installed there. The engineer immediately started all the bilge pumps because a lot of water had quickly accumulated inside the traditional vessel. A few passengers and crew members hurried to get their valuables out of the area, which was slowly filling up with water.

In the meantime, the ASTROSPRINTER's master had called his chief mate and instructed him to sound the forward ballast tanks and forepeak. He then called the engine control room and informed the chief engineer officer about the collision.
The master turned back to his pilot, asking him if he had heard anything about casualties on board the traditional vessel and whether he could offer assistance with his ship. The pilot told him that based on what he had heard on VHF, there were reportedly casualties but that the DLRG and fire service were reportedly already looking after them. According to the VTS, the ASTROSPRINTER should reportedly continue to the Brunsbüttel roadstead, anchor there and await further instructions.
In the meantime, the chief mate and a rating had sounded all relevant tanks and not found any water ingress. The crew started the checks required after a collision and did not find any damage in the cargo holds or engine room.

The master called and informed the owner about the collision and current situation. At 1545 the starboard anchor was dropped in the roadstead off Brunsbüttel.

3.2 Rescue operation

At about 1300, a sailing yacht ran aground outside the fairway level with buoy 108. The Stade Fire and Rescue Control Centre responded to this at 1318 by alerting the Stade branch of the DLRG's motor lifeboats KIEK UT and GOOD WILL and the Stade Voluntary Fire Brigade's fire support boat HENRY KÖPCKE. The motor lifeboat PINNAU from the Wedel branch of the DLRG was also deployed.

Only the motor lifeboat PINNAU operated at the sailing yacht and communicated with her crew, as the latter had merely run aground on silt and did not need any assistance. The other rescue boats were on standby in the immediate vicinity and witnessed the collision between the pilot schooner № 5 ELBE and container ship ASTROSPRINTER at about 1354.

The three rescue boats from the Stade administrative district were at the distressed vessel immediately after the collision. At this point, the pilot schooner had 43 people on board, only a few of whom were wearing lifejackets. The emergency responders saw that the distressed vessel was taking on a lot of water at the forward section, which would inevitably lead to her foundering.

At 1356, the Stade Fire and Rescue Control Centre alerted all available water rescue units of the DLRG and fire service.

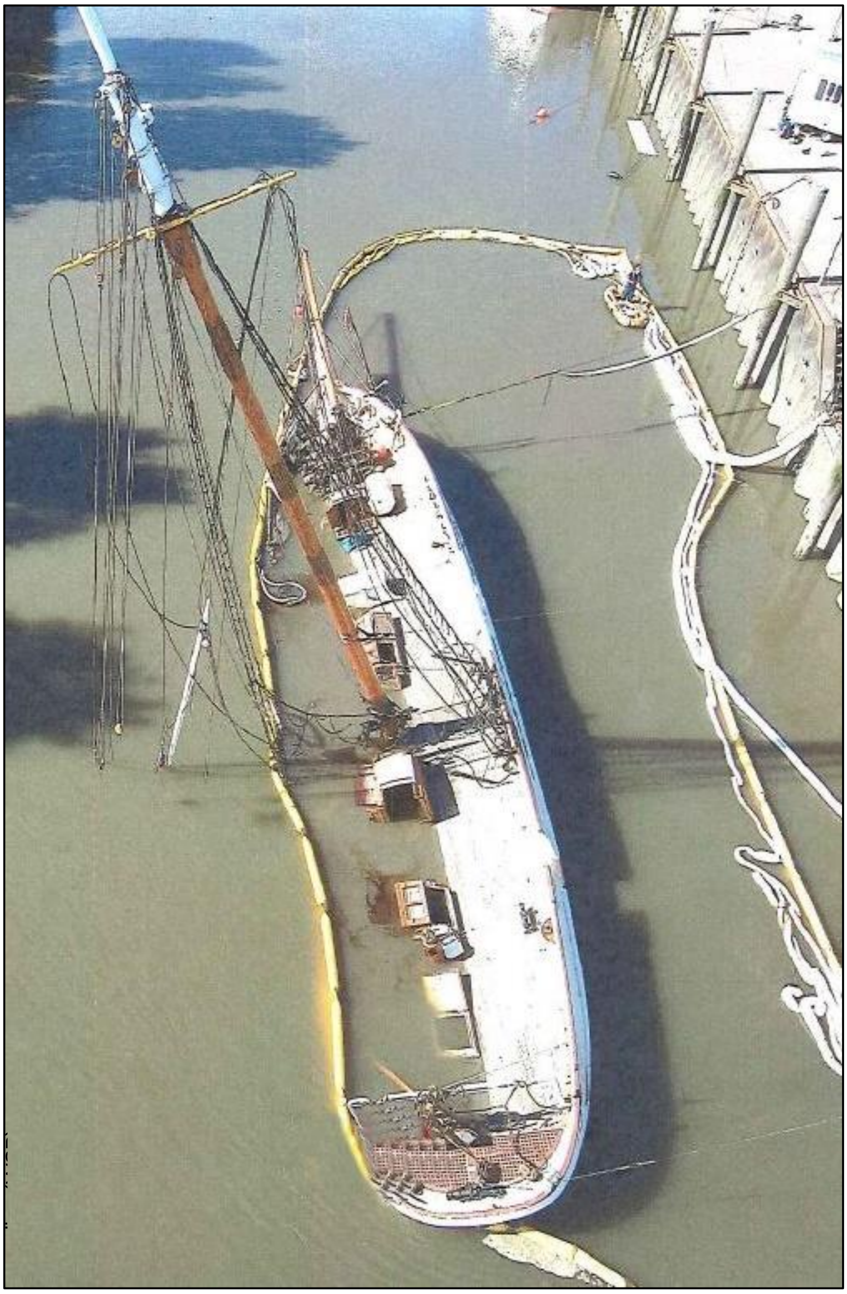
According to the skipper of the DLRG's motor lifeboat KIEK UT, the 43 people could have been evacuated on the three rescue boats but this would have made it impossible to give first aid to the casualties and would have increased the possibility of the distressed vessel foundering in the main fairway of the River Elbe because of the time needed.

To prevent this, the motor lifeboat KIEK UT established a towing connection with the distressed vessel and then helped her move to the mouth of the River Schwinge while the № 5 ELBE proceeded under engine power. At the same time, the crew of the fire support boat HENRY KÖPCKE took charge of casualty triage and first aid and collected the casualties from the distressed vessel. They were assisted by personnel from the Wedel branch of the DLRG with the motor lifeboat PINNAU, which was also at the scene a few minutes after the collision.

The Stade Fire and Rescue Control Centre triggered a mass casualty incident alarm to provide for the casualties and passengers. Following that, emergency responders from almost all the rescue units in the administrative district deployed to Stadersand to assist DLRG and fire brigade units already at the scene.

The motor lifeboat KIEK UT and № 5 ELBE managed to sail into the mouth of the River Schwinge up until the point at which the latter ran aground due to the constant ingress of water. The passengers were then gradually taken off board with the help of additional emergency responders from the DLRG and fire service and transferred in the boats available to the shore-based rescue service for further care.

After everyone had been taken off board, it transpired that it was no longer possible to hold the schooner, despite the pumps being started immediately. Since the leakage following the collision was so great, the schooner foundered in the River Schwinge as the tide was coming in.



Source: Waterway

Figure 6: The № 5 ELBE foundered in the River Schwinge

The WSP took down the particulars of all the peopled rescued ashore. Casualties were taken to the nearest hospital by ambulance. The only access road was closed as a precautionary measure but this also meant that taxis called were unable to reach the people involved in the accident. The fact that the control centre had organised buses for the journey to Stade and thus to other modes of transport had not been communicated sufficiently. Many of the stranded passengers later stated that ultimately, they felt as if they had been left on the pier to fend for themselves.

3.3 Investigation

The WSP had already contacted the BSU's investigator on call to report the marine casualty by 1430. This was the moment at which one of the BSU's more complex investigations began. In addition to standard procedures, such as questioning all the witnesses (where there was an above average number of witnesses, which included almost all the passengers and crew members) and reading out and analysing electronic recordings (VDR and VTS), numerous other questions, such as the structural aspects of the traditional vessel, were investigated.

3.3.1 Qualification of the ship's commands

3.3.1.1 Ship's command of № 5 ELBE

The skipper responsible on the day of the accident has held a certificate of competency as a master mariner for more than 50 years. He worked as a pilot on the River Elbe for 30 years. He still holds the *Sporthochseeschifferschein* [recreational offshore skipper licence] with the qualification to navigate traditional vessels with a hull length of up to 55 m. A doctor confirmed his fitness for service at sea in January 2019. He has sailed on the № 5 ELBE as skipper since 2003. In addition to numerous regattas, he has conducted more than 60 passenger cruises on the River Elbe in the intervening years.

The nautical officer responsible on the day of the accident has been a member of the *Freunde des Lotsenschoners No.5 ELBE e.V.* [friends of the pilot schooner № 5 Elbe] association since 2003 and attended its training programme. He holds the *Sportseeschifferschein* [international certificate for operators of pleasure craft in coastal waters not exceeding 30 nm] with an entry for traditional vessels. He has served as a nautical officer on the № 5 ELBE since 2018. He stated that he has already sailed in the area visited on the day of the accident 5-10 times in this capacity.

All in all, it is reasonable to conclude that SHM goes to great lengths to operate the № 5 ELBE safely. All crew members are deployed in accordance with their level of training and required to complete 'trial runs' so as to become familiar with the ship. Rather than becoming a seaman, helmsman, nautical officer or skipper automatically, for example, crew members must first be familiar with the ship and their duties on board.

3.3.1.2 Ship's command of the ASTROSPRINTER

The ASTROSPRINTER's master has been engaged in seagoing service since 1992. He received the certificate of competency as an officer in charge of the navigational watch in 1998 and worked his way up to chief mate in the years that followed. He received the master's certificate in 2010 and has been engaged as a master in seagoing service since then. He claimed that he has sailed on the River Elbe countless times and was never involved in a marine casualty.

The officer in charge of the navigational watch on the day of the accident has been engaged in seagoing service since 2005. He has served as a nautical officer on various ships since 2015. He claimed that he has sailed on the River Elbe often and has never witnessed a collision.

The advising pilot served as a nautical officer until 2012, most recently as a master. He has been engaged as a sea pilot on the River Elbe since June 2013.

3.3.2 Damage to the ASTROSPRINTER

The collision with the № 5 ELBE merely resulted in paint abrasions on the starboard side of the ASTROSPRINTER's fore section. These were repaired over the days that followed during a scheduled call at a shipyard.

Source: Shipping

Figure 7: Overall view of the damage to the ASTROSPRINTER

Source: Shipping

Figure 8: Close-up view of the damage to the ASTROSPRINTER

3.3.3 № 5 ELBE salvage operation

SHM obtained and analysed a number of salvage proposals and offers from salvage companies in the days after the traditional vessel foundered in the mouth of the River Schwinge. It was finally decided that the wooden hull, which was lying on one side in silt, should be righted and refloated with the aid of lifting bags and strong pumps. The contract was awarded to a Spanish salvage company that specialised in complicated salvage operations using inflatable lifting bags.

The installation of the lifting bags beneath the hull started on Saturday 15 June 2019. This was only possible with the deployment of divers and, moreover, only in high or low tide because the tidal current in the mouth of the River Schwinge ran at up to 4 kts.[11]

The salvage specialists took advantage of the low tide at about 2300 on Sunday 16 June 2019 and righted the № 5 ELBE by pumping air into the lifting bags while at the same time pumping out water that had accumulated inside the ship.

On Monday morning, two investigators from the BSU surveyed the traditional vessel, which was now afloat again. Evidence was secured, photographs were taken and those present were interviewed.

Source: BSU

Figure 9: The № 5 ELBE – upright and floating

[11] Information based on SHM's press release of 13 June 2019.

3.3.4 № 5 ELBE

The two-masted schooner was built by H. C. Stülcken Sohn in Hamburg and launched in 1883. She transferred pilots in the estuary of the River Elbe and the German Bight for 30 years.

The ship went into private hands in 1924 and was renamed WANDER BIRD. She crossed the Atlantic 13 times as a private yacht. The American owner circumnavigated Cape Horn in her in 1937. More Pacific crossings followed.

SHM acquired the ship in Seattle in 2002 and took her back to Hamburg. She was renovated from the ground up with the non-profit association *Jugend in Arbeit Hamburg e.V.* [Hamburg youngsters at work] investing well over 1,000 man hours. The winter of 2005/2006 saw the renewal of the entire propulsion system and large sections of the stern and stem. Following that the ship sailed again under her old name of ELBE. The sail marking 'ELBE' refers to the area of operation and '5' to the serial number five out of originally 11 pilot schooners. Until now the schooner has been available for day trips on the River Elbe and multi-day voyages on the North Sea and Baltic Sea. She belongs to SHM and is operated by the friends' association *Freunde des Lotsenschoners No.5 ELBE e.V.*

After an eight-month stay in the Danish Hvide Sande for restoration, which included the № 5 ELBE being fitted with new outer planking and a new sternpost, the schooner returned to Hamburg on 29 May 2019.[12]

The BSU understands that this call at the shipyard involved an almost complete reconstruction of the underwater hull, in which the keel, the sternpost, most of the frames, as well as the planking (including completely new copper plating) were replaced.

During the consultation phase before the publication of this report, the BSU received, *inter alia*, a statement from the Ship Safety Division (BG Verkehr), which negates a 'new build' and which is presented at Subsection 3.3.11.2.2.

Her length overall and breadth are 37 m and 6 m respectively and she has a sail area of 360 m^2.

The sailing vessel has two masts. The shorter forward mast is referred to herein as the foremast[13]. The aft mast is referred to as the main mast. The gaff sails, the boom foresail and the main sail, are held on both masts. Three more sails could be set at the bow. These are the foresail closest to the foremast and the inner and outer jibs further out. In light winds, more sails can be set on the masts to extend the sail area upwards. Due to the predicted wind forces, only the boom foresail, the foresail and the inner jib were set. Since the mainsail was not set, it was not necessary to reef the boom foresail. The sail area was approximately 124.2 m². According to the safety manual, no more than 204 m² should be set in wind forces up to 6 Bft and no more than 130 m² in wind

[12] Source: Wikipedia (3 April 2020).
[13] The designation foremast is also common.

forces up to 7 Bft. The manual assumes that in the latter case the mainsail and the boom foresail would each have been set in the second reef.

The sail configuration chosen reached or was within an adapted sail area that corresponded to the wind force expected by the skipper. However, the safety manual gives no indication as to whether the recommended maximum sail configuration is based on the average wind or on gusts. According to the nautical officer's statement, gusts of up to 8 Bft were also expected. Consequently, if the maximum sail area was based on the wind force during gusts, then it should not have exceeded 70 m².

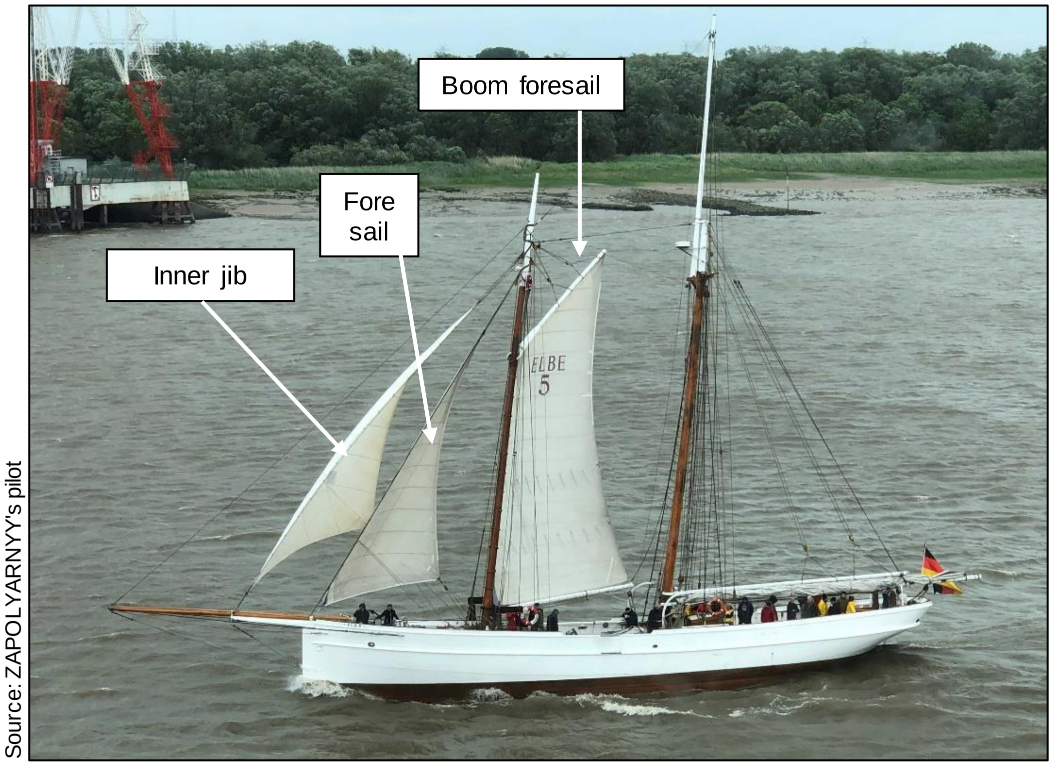


Figure 10: № 5 ELBE's sail configuration on the day of the accident

The sail area chosen on the day of the accident, which was in the forward half of the vessel, suggests that the vessel had a lee helm[14] and responded well to bearing away from the wind with the sheets open. The investigators assume that the sail area was easy and safe to handle with the numerically strong crew. The nautical officer's statement indicated that she responded to course alterations extremely well for a traditional vessel.

Partitions divided the sailing vessel into various sections below deck. The walls did not have a watertight connection to the sides and it was not possible to close the doors watertight, either. Moreover, the bilge was not divided watertight into the individual sections. The space below deck was therefore to be understood as one continuous space.

[14] Refers to the effort of a sailing vessel to turn away from the wind.

The sailing vessel is equipped with two Volvo main engines, each driving a propeller. A total power of 260 HP from both engines produces a ratio of 1.97 HP/t at a displacement of 132 t[15]. This means that sufficient engine power is available as compared to other traditional sailing vessels, too. The investigators are of the opinion that the propulsion of the ship made it possible to proceed safely against the prevailing wind even with the sails set.

The № 5 ELBE was equipped with the usual navigation equipment. This included a Furuno NavNet unit, which at this stage of expansion consisted of a large monitor and an associated control panel. The device was located near the helmsman and mounted so that it could rotate. It could thus be swivelled to port or starboard so as to give the helmsman or the respective skipper standing outside a good view of the daylight display. The investigators assume that this device's general combination of a radar unit with colour chart plotter has been extended by the AIS function[16].

Source: BSU

Figure 11: Combined radar and chart plotter at the steering position

[15] Loading case 2 at Subsection C.2.1 in the expert's report on intact stability and damaged stability (see Annex).
[16] AIS: Automatic identification system.

3.3.5 The ASTROSPRINTER's VDR

The ASTROSPRINTER is equipped with a Kelvin Hughes VDR[17].

The ASTROSPRINTER's master gave a USB stick containing the VDR data to the BSU during a local inspection on the ASTROSPRINTER on 20 June 2019.

An extensive analysis of the data yielded two key findings:

1. a conversation between the people present cannot be heard on the bridge audio recordings in the minutes leading up to the collision (that also applies to VHF);
2. the ASTROSPRINTER was turned slightly to port in the minute before the collision.

The below table contains an extract of the VDR's numerical values.
(Rate of turn[18]: Minus values and positive values mean the ship is turning to port and starboard, respectively.)

The period of the original course is marked yellow. The slight course alteration to starboard, probably to allow a red-red pass with the № 5 ELBE (as with the HANNA) on the northern edge of the fairway, is marked green. The data are marked red from 115343 (the ASTROSPRINTER turns to port).

GPS				Gyrocompass	
Date	Times in UTC	Course over ground in degrees	Speed over ground in kts	Course steered in degrees	Rate of turn in degrees/min.
8 June 2019	115023	307.67	14.34	307.2	0.5
8 June 2019	115042	308.27	14.36	307.2	-1.2
8 June 2019	115052	308.58	14.43	306.8	-1.6
8 June 2019	115102	307.79	14.41	306.4	-2.1
8 June 2019	115112	307.26	14.34	306.3	0
8 June 2019	115122	307.11	14.52	306.5	1.8
8 June 2019	115132	307.72	14.4	306.7	0.8
8 June 2019	115151	307.86	14.44	306.9	0.4
8 June 2019	115201	307.91	14.39	306.8	-3.9
8 June 2019	115211	307.65	14.43	306.5	-1
8 June 2019	115221	307.58	14.47	306.5	1.7
8 June 2019	115231	307.99	14.38	306.9	1.7
8 June 2019	115250	308.72	14.43	306.8	-2.7
8 June 2019	115300	308.16	14.45	306.4	-2.9
8 June 2019	115311	306.48	14.39	306.8	8.1
8 June 2019	115331	311.36	14.27	310.5	4.3
8 June 2019	115341	312.73	14.27	310.9	0

[17] VDR: Voyage data recorder.
[18] Rate of turn: Speed (and direction) of a ship's rotation.

8 June 2019	115342	313.11	14.3	310.9	0
8 June 2019	115343	313.56	14.34	310.9	-1.3
8 June 2019	115344	314.17	14.26	310.8	-1.6
8 June 2019	115345	314.45	14.32	310.7	-6
8 June 2019	115346	314.95	14.31	310.5	-8.8
8 June 2019	115348	314.94	14.34	310.1	-11.6
8 June 2019	115349	315.19	14.26	309.8	-12.7
8 June 2019	115350	315.48	14.36	309.6	-16.5
8 June 2019	115351	315.22	14.36	309.2	-18
8 June 2019	115352	315.34	14.21	308.9	-18.1
8 June 2019	115354	315.07	14.29	308.2	-21.6
8 June 2019	115355	315.12	14.3	307.8	-23.1
8 June 2019	115356	314.72	14.31	307.5	-23
8 June 2019	115357	314.44	14.26	307.1	-23.8
8 June 2019	115358	314.19	14.3	306.6	-23.3
8 June 2019	115359	314.08	14.32	306.3	-23.2
8 June 2019	115400	313.46	14.34	305.9	-23
8 June 2019	115401	312.91	14.31	305.5	-21.3
8 June 2019	115402	312.62	14.32	305.2	-20.9
8 June 2019	115403	312.17	14.23	304.9	-19.3
8 June 2019	115404	311.46	14.2	304.6	-20.7
8 June 2019	115405	310.61	14.27	304.3	-17.9
8 June 2019	115406	310.17	14.21	304.1	-14.9
8 June 2019	115407	309.98	14.18	303.8	-14.6
8 June 2019	115408	309.24	14.14	303.6	-11.8
8 June 2019	115409	309.16	14.14	303.5	-10.6
8 June 2019	115410	308.56	14.18	303.4	-7.8
8 June 2019	115411	308.11	14.22	303.2	-8.6
8 June 2019	115412	307.85	14.14	303.2	-5.2
8 June 2019	115413	307.66	14.26	303.1	-4.9
8 June 2019	115414	307.58	14.17	303.1	-1.8
8 June 2019	115415	306.71	14.14	303	-3.1
8 June 2019	115416	306.84	14.14	303	-0.8
8 June 2019	115417	306.66	14.18	303	0
8 June 2019	115418	306.5	14.13	303	0
8 June 2019	115419	306.69	14.08	303.1	1.6
8 June 2019	115420	306.27	13.95	303.1	0.5
8 June 2019	115421	306.28	13.97	303.1	1.9
8 June 2019	115422	306.18	14.05	303.2	4.3
8 June 2019	115423	306.22	14.05	303.3	3.6
8 June 2019	115424	305.88	13.97	303.4	5.1
8 June 2019	115425	306.5	14.04	303.4	3.3
8 June 2019	115426	306.17	14.06	303.6	6.1

The ASTROSPRINTER's VDR recorded the radar images of one radar unit in accordance with requirements. The VDR did not log which radar unit was recorded. The pilot and officer in charge of the navigational watch both stated that the port radar was used. *Inter alia*, the recorded images clearly show that this radar was continuously operating on a set range of 1.5 nm. The BSU considers that continuous monitoring of the radar image by the ship's command is not absolutely necessary when visibility is excellent during the day. Instead, a visual (physical) lookout should take precedence.

The screenshots shown here start at 1346, at the time when the № 5 ELBE's sails tore. Figure 12 shows buoy 106 in the yellow circle.

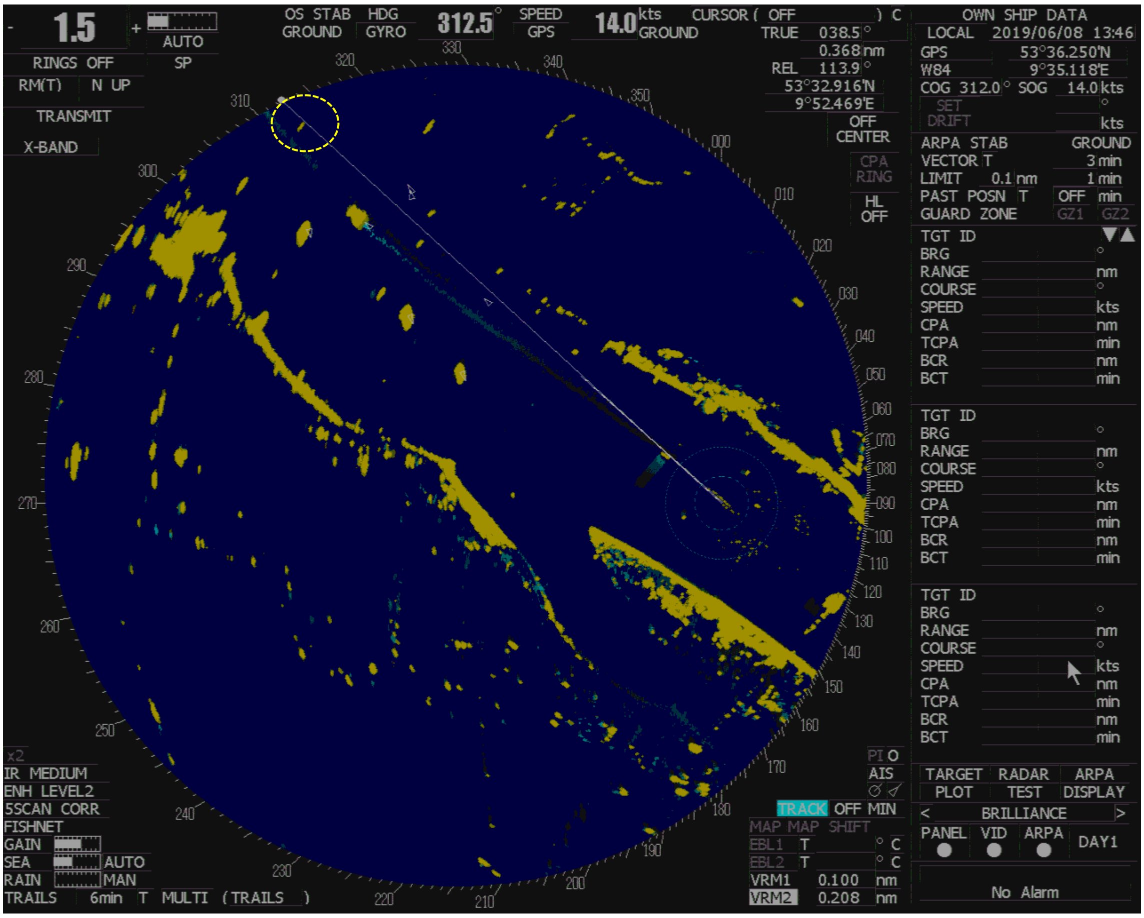


Figure 12: 134631 – sails damaged

The № 5 ELBE, which is approaching the HANNA, is not visible either as a radar or AIS signal. It is possible that the schooner is still just outside the range set on the radar. For comparison and to facilitate a better understanding, a recording of the VTS is shown in Figure 13. Here, the yellow circle also highlights buoy 106 and additionally the № 5 ELBE in the red circle.

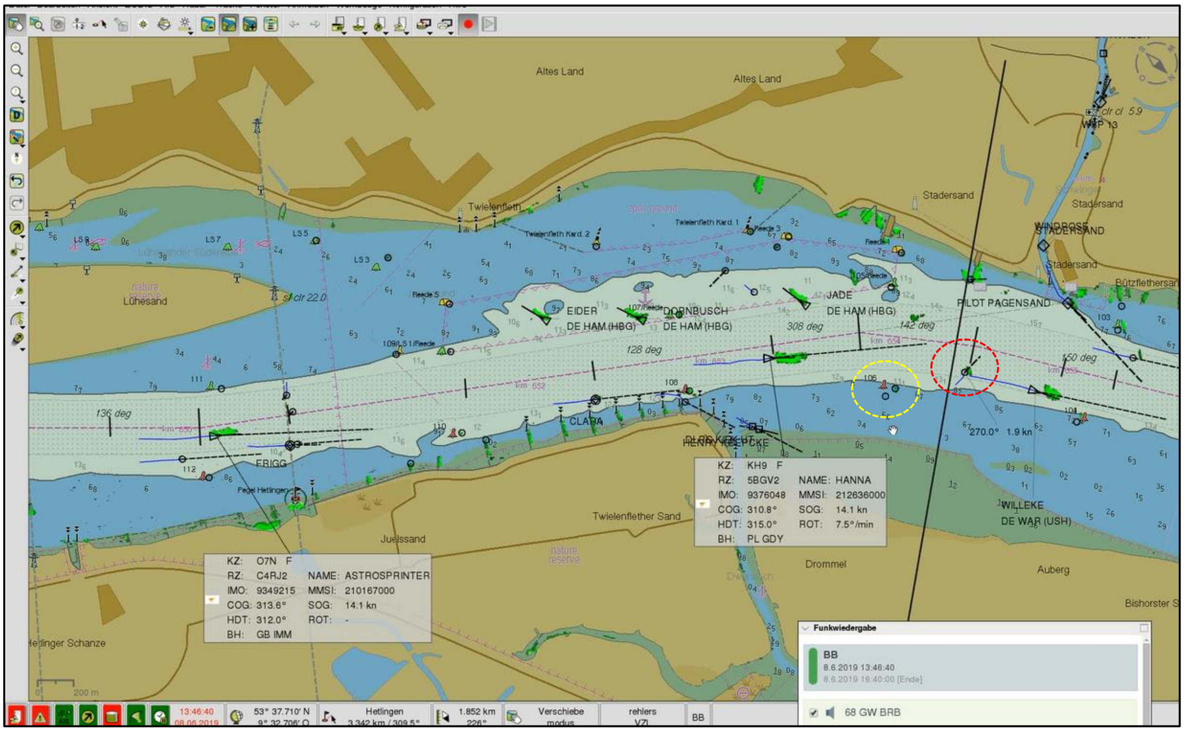


Figure 13: VTS recording at 134640

Figure 14 and Figure 15 show clearly how the HANNA alters course to starboard and sails past buoy 106 (in the yellow circle) in close proximity. The № 5 ELBE is still not visible on these radar images.

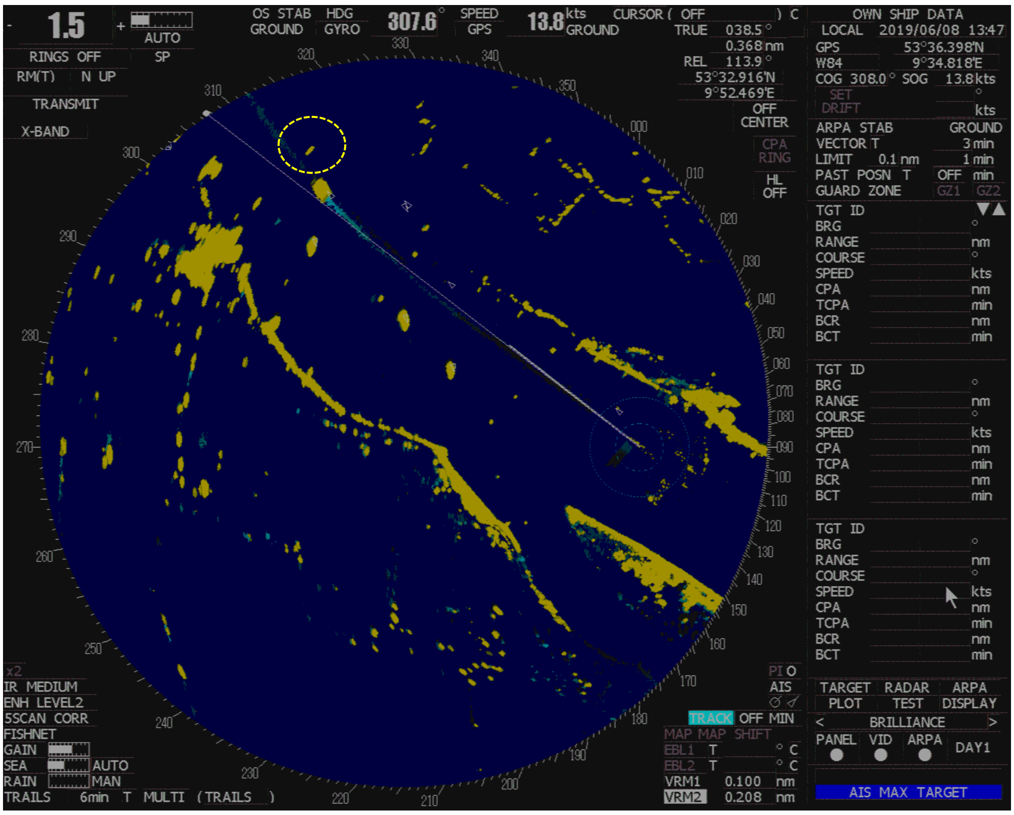


Figure 14: 134731

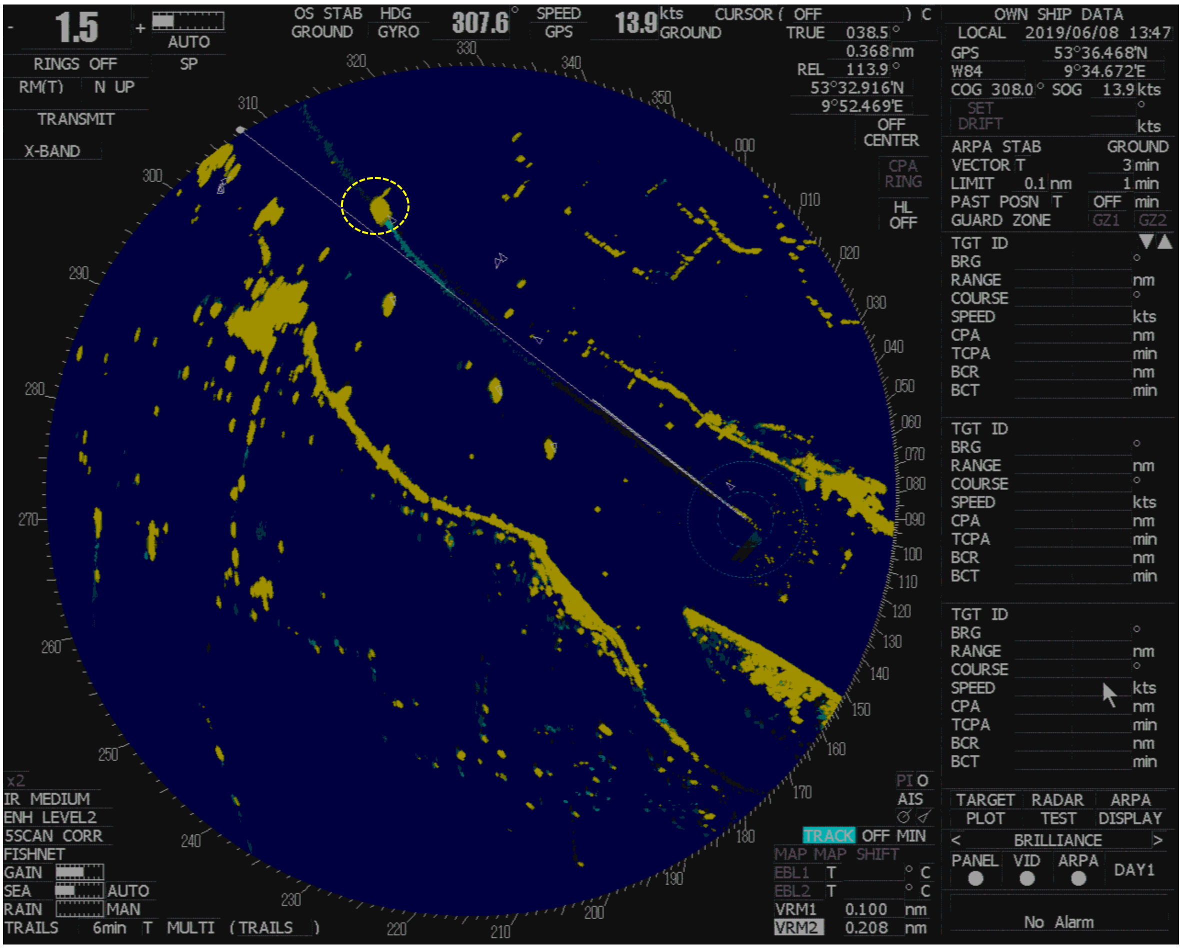


Figure 15: 134801 – HANNA passes buoy 106

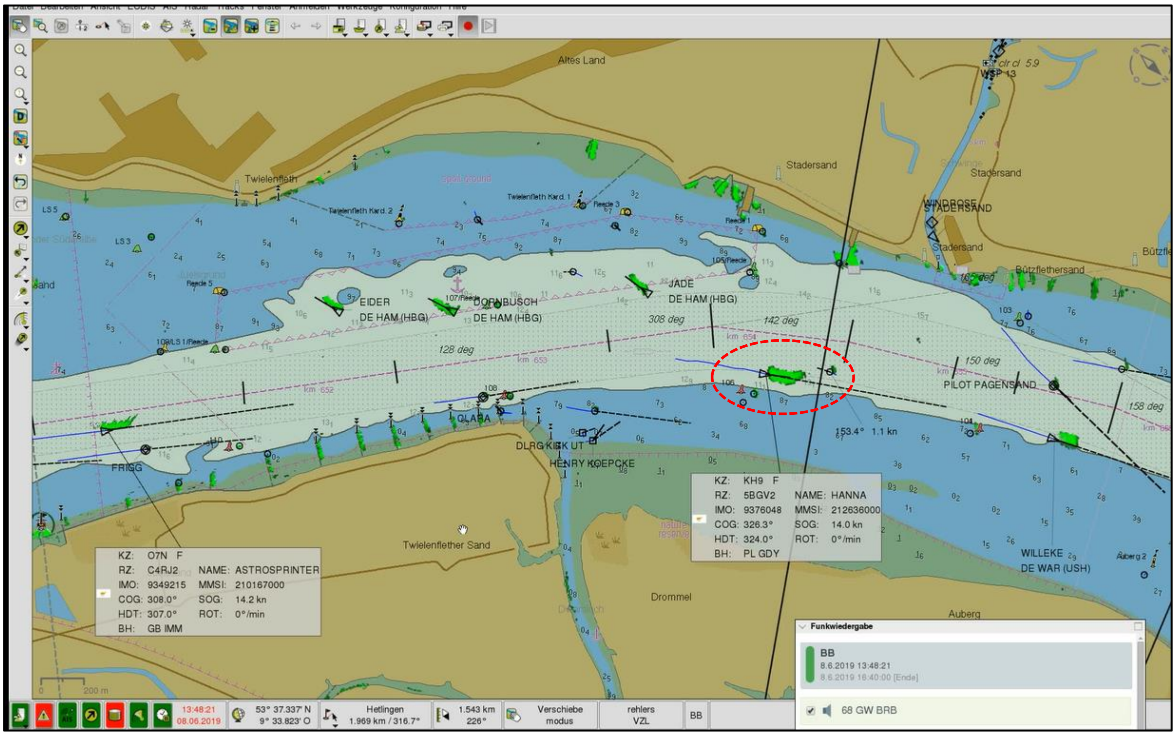


Figure 16: VTS recording at 134821

Figure 16 shows the near collision between the № 5 ELBE and HANNA.

Shortly after, the HANNA's pilot contacted the VTS on VHF and complained about the – in his opinion – irresponsible conduct of the № 5 ELBE. An AIS symbol is still not visible for the schooner.

Figure 17 shows an AIS triangle near the radar echo of buoy 106 only one minute later at 1350.

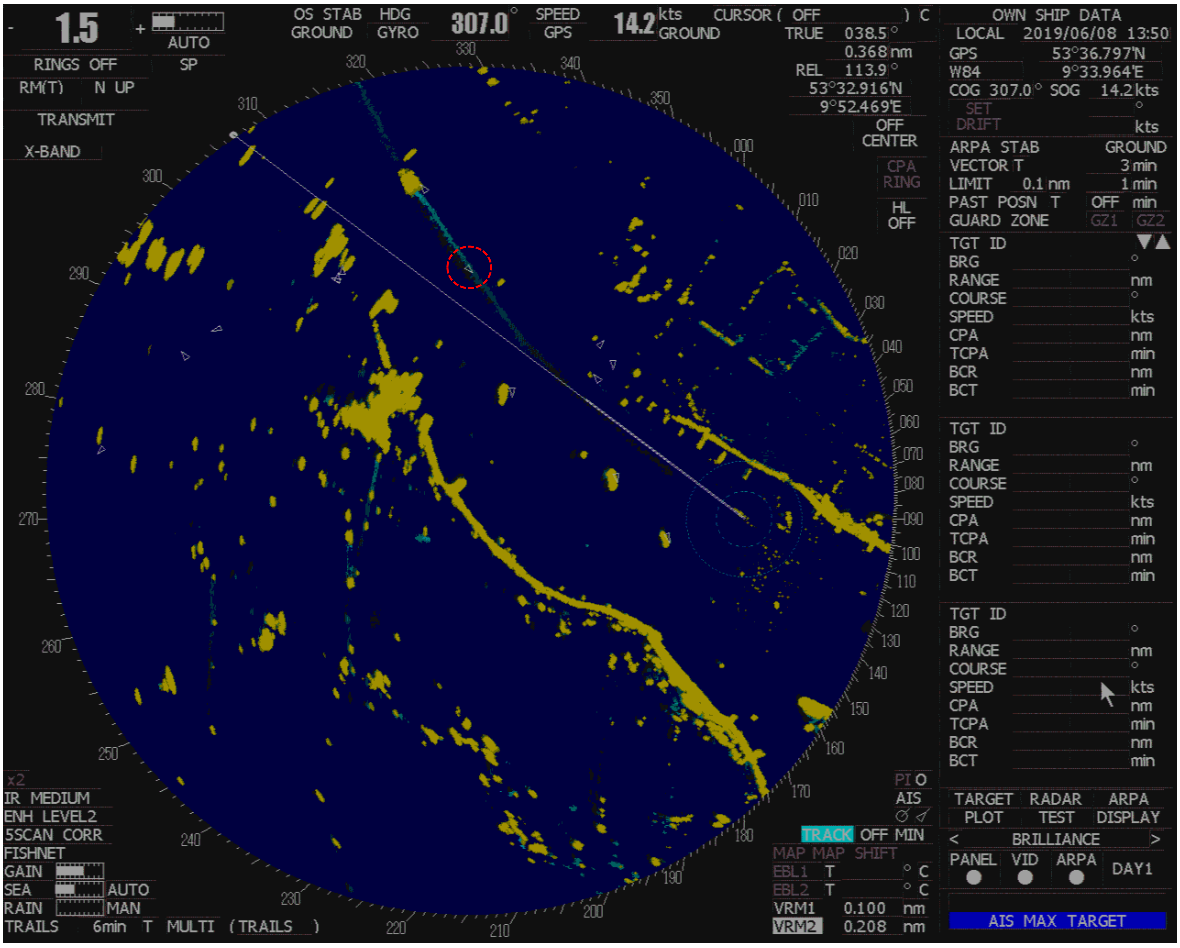


Figure 17: 135016 – an AIS symbol is displayed for the first time

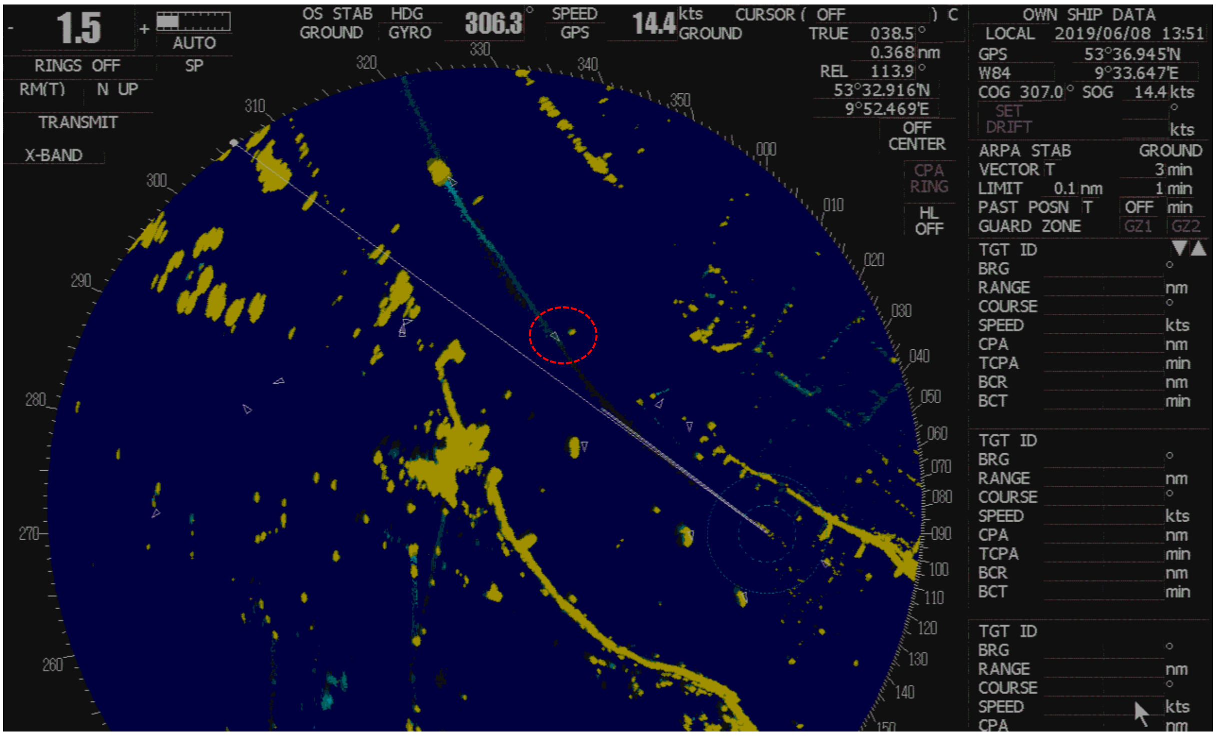


Figure 18: 135116 – constant distance between the AIS symbol and buoy 106's radar echo

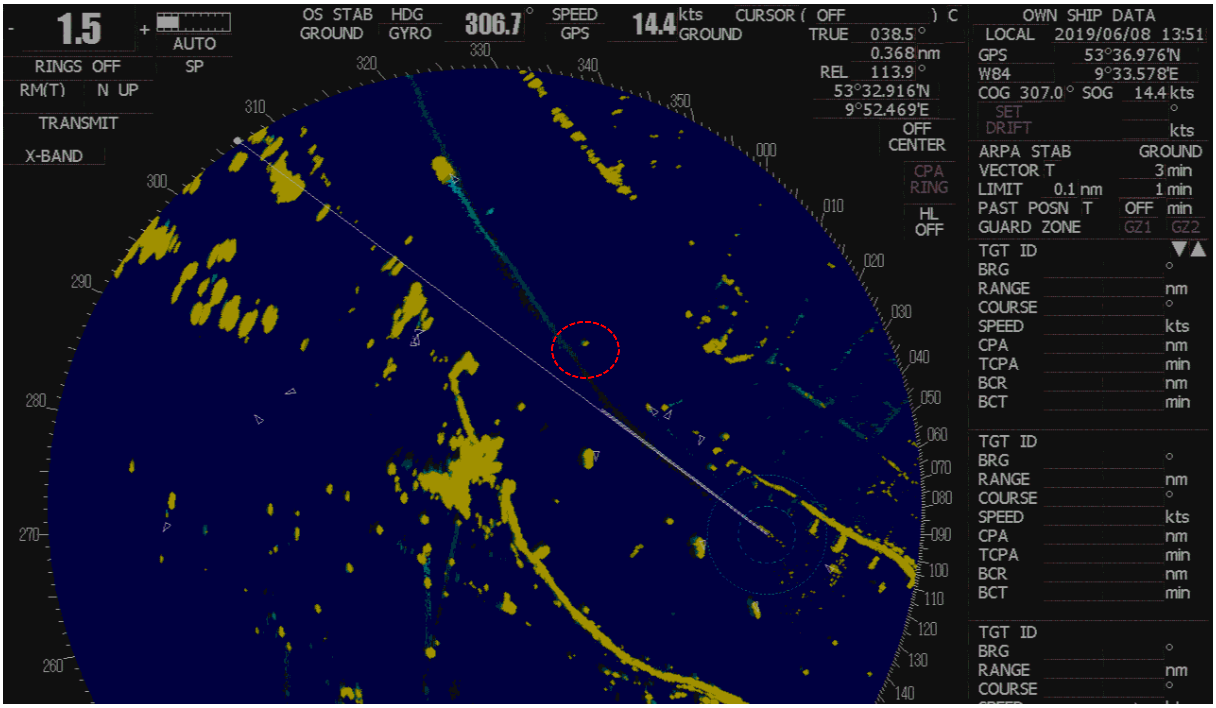


Figure 19: 135131 – buoy 106's radar echo with no further AIS symbol

At times, the AIS symbol disappears completely or two radar echoes are displayed next to each other for a brief period.

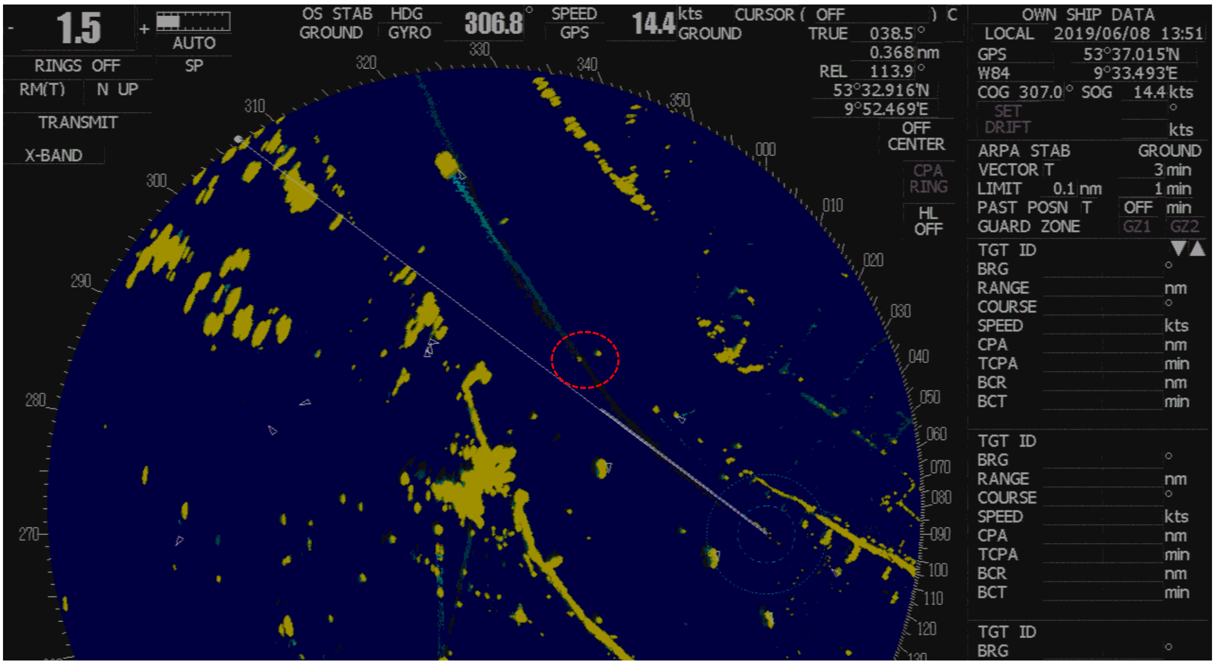


Figure 20: 135146 – two radar echoes without an AIS symbol

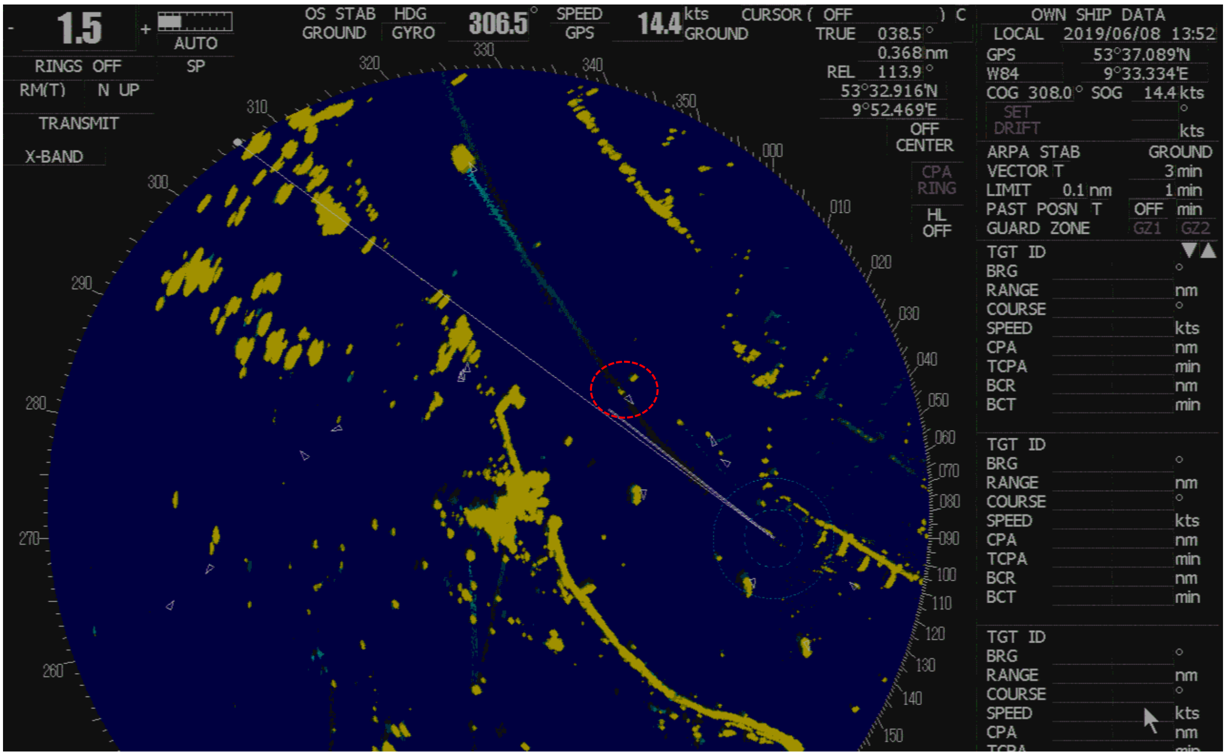


Figure 21: 135216 – two radar echoes with an AIS symbol

Figure 21 shows AIS symbols in the vicinity of the ASTROSPRINTER, too, at 1352. These are the sailing yacht CLARA, which happens to be passing by, as well as the KIEK UT and HENRY KÖPCKE hurrying to provide assistance.

The № 5 ELBE remains on the starboard side of the ASTROSPRINTER (Figure 22).

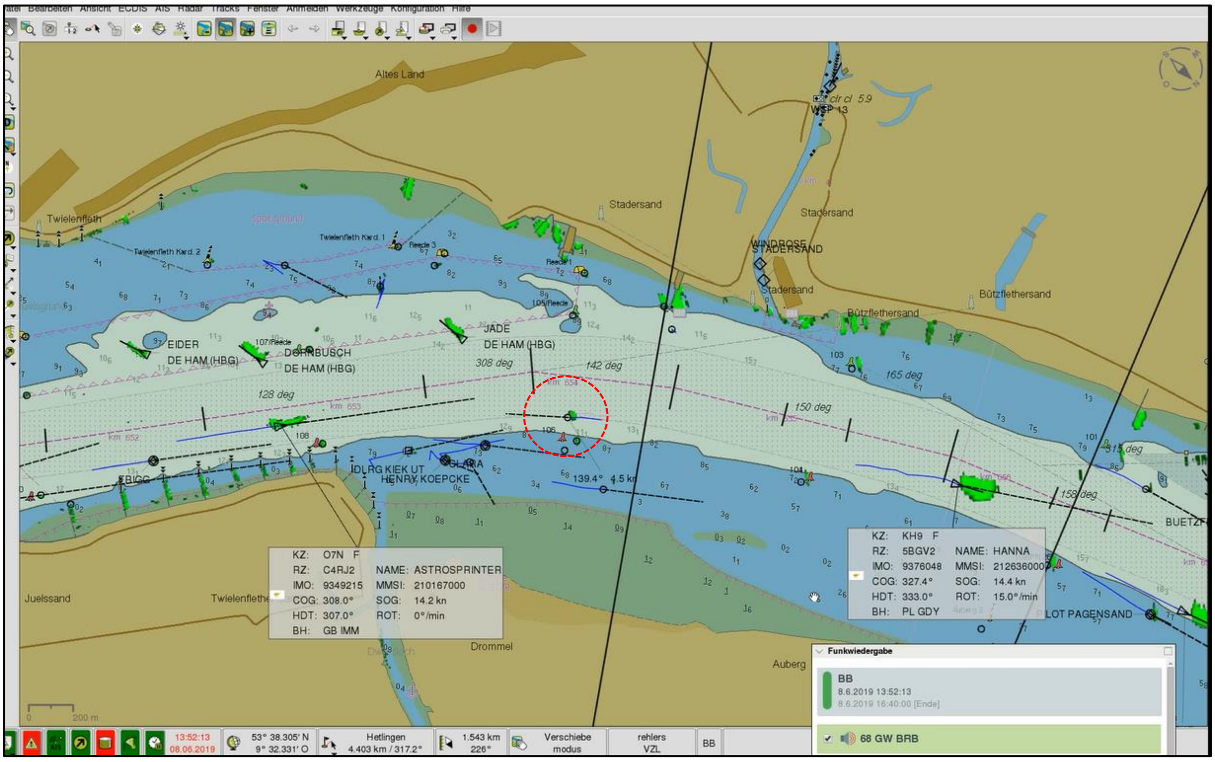


Figure 22: VTS recording at 135213

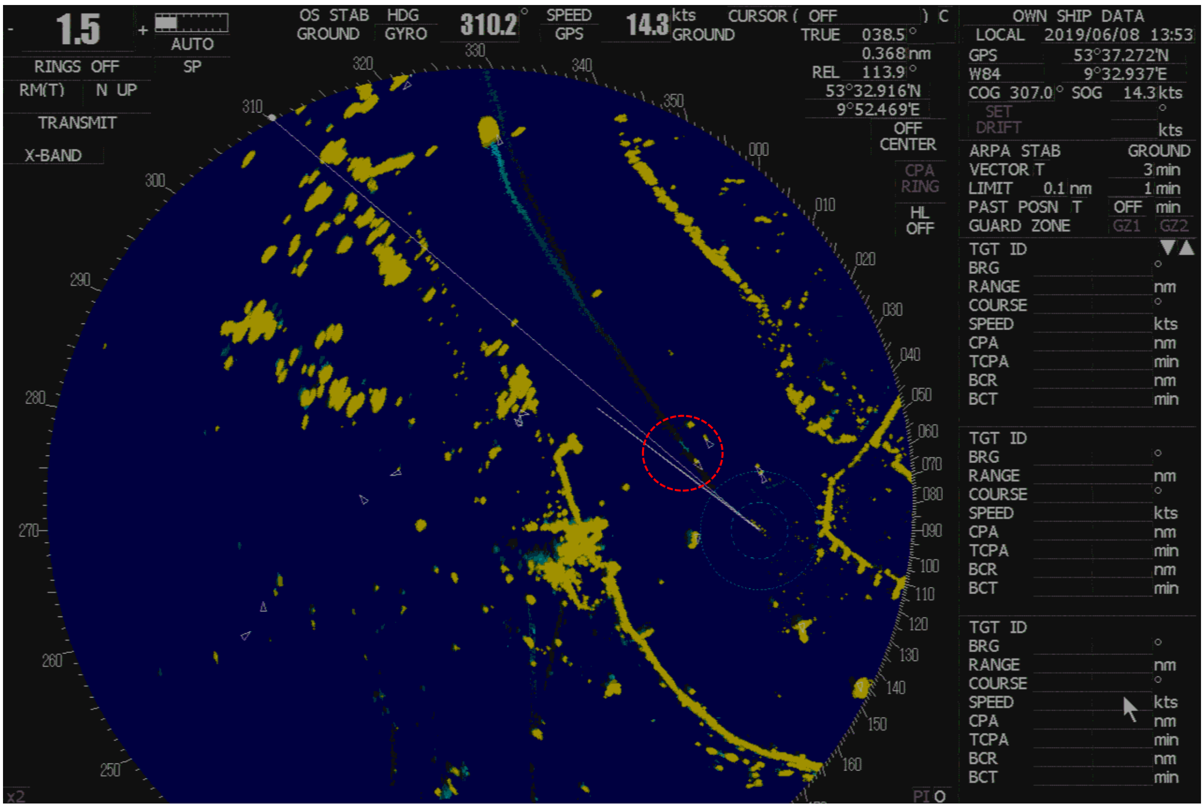


Figure 23: 135331 – risk of collision

The risk of collision comes to a head one minute later. Figure 24 shows the AIS automatic proximity alarm on the radar at 135346.

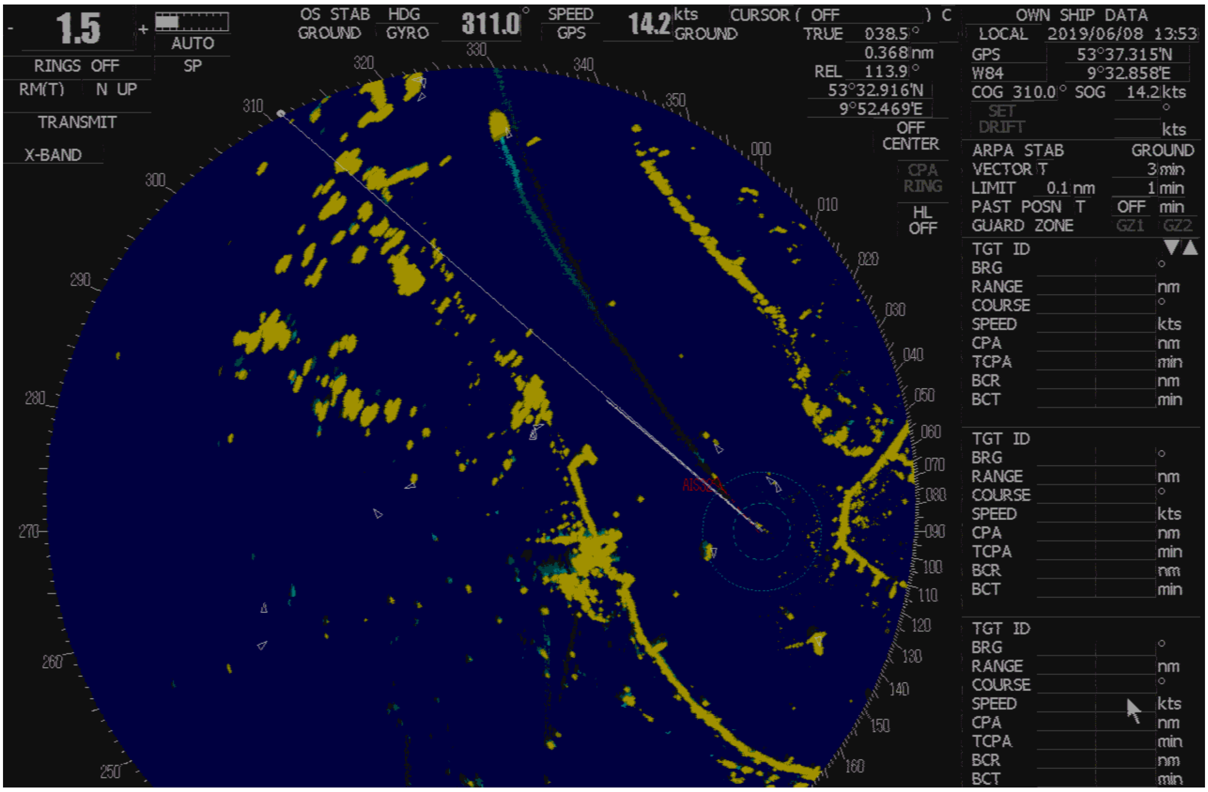


Figure 24: 135346 – seconds before the collision

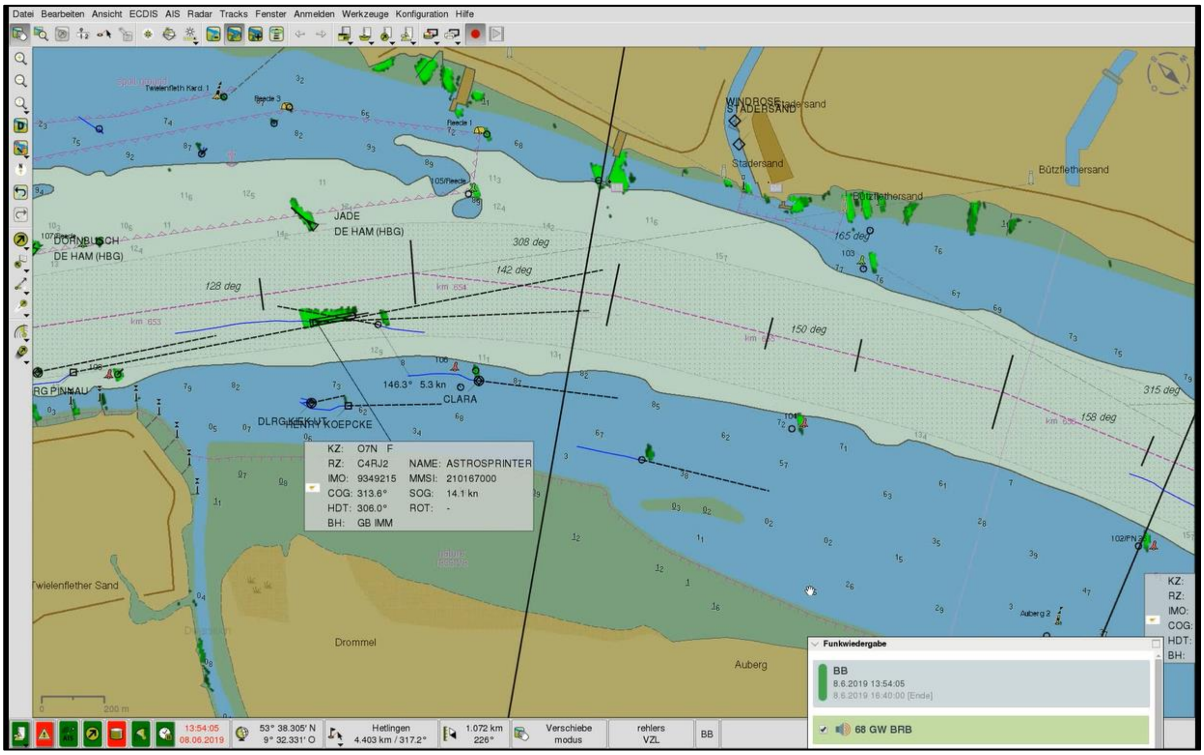


Figure 25: VTS recording at 135405

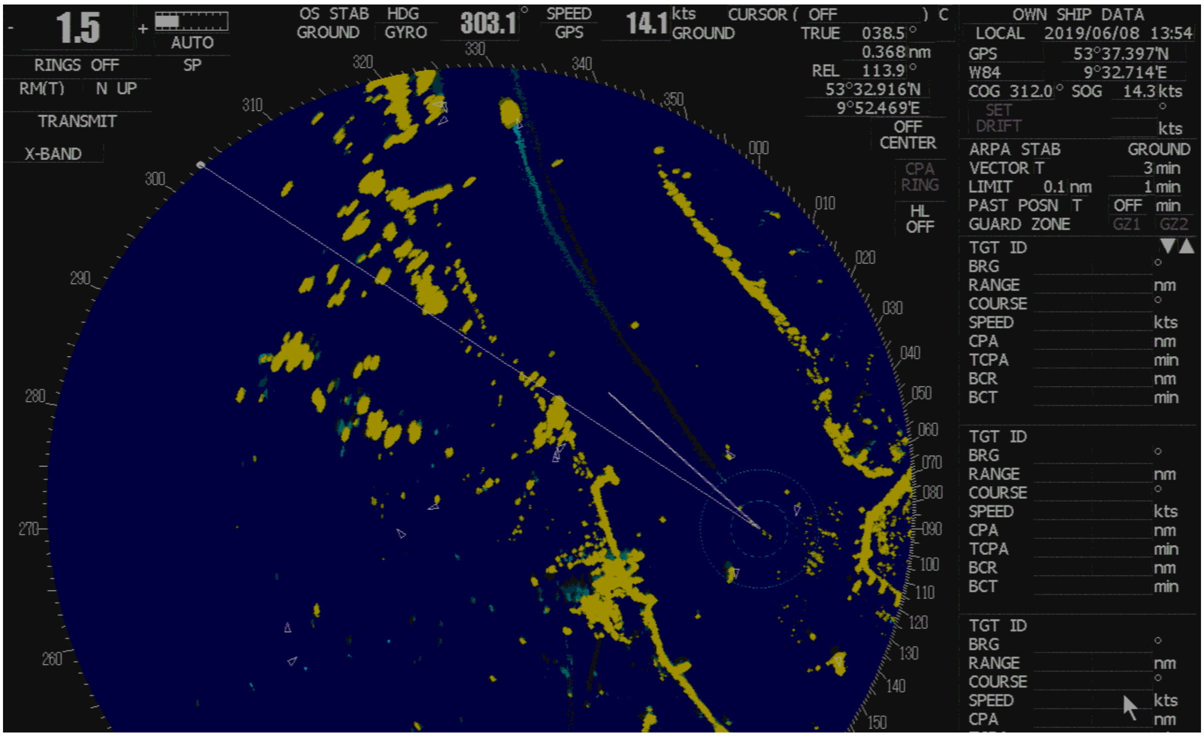


Figure 26: 135416 – collision

When the collision happened at 135416, the № 5 ELBE's radar echo is shown very faintly and no AIS symbol is displayed. To illustrate this, the VTS's recording made at the same time is shown again in Figure 27.

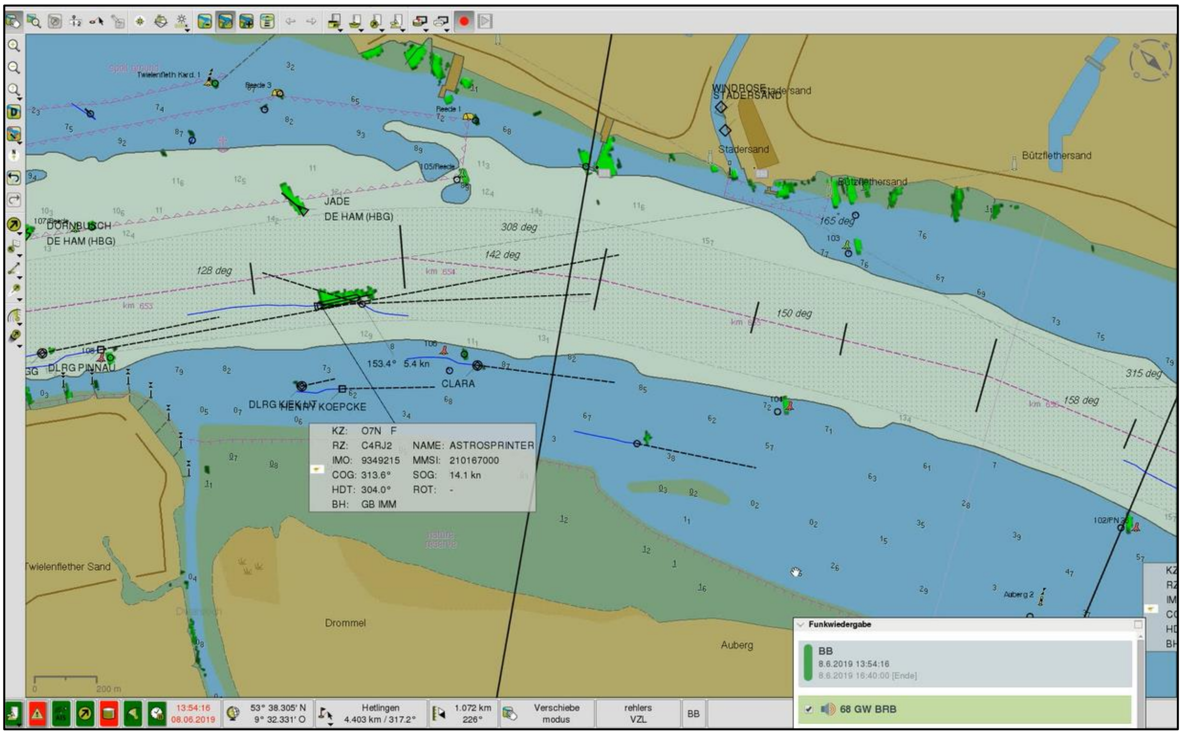


Figure 27: VTS recording at 135416 – collision

Figure 28 shows how the vessels part again at about 1355.

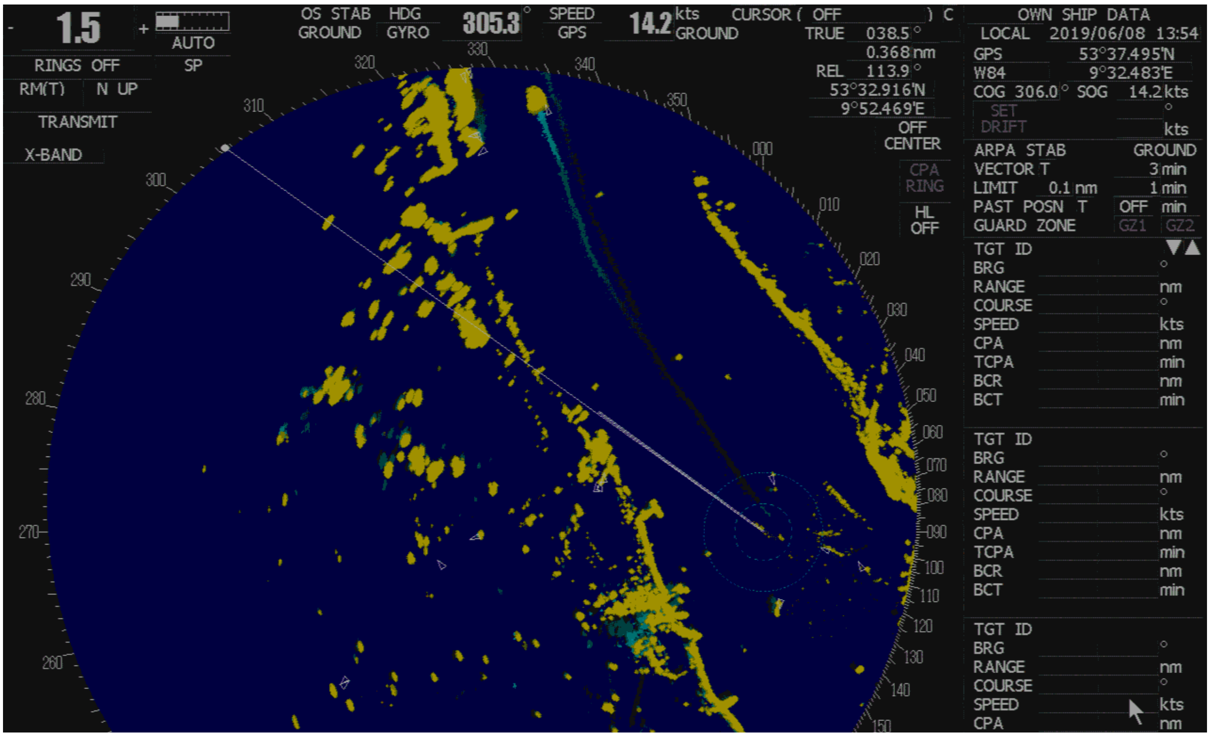


Figure 28: 135501 – the vessels part

3.3.6 The № 5 ELBE's AIS

A Class A AIS was on board the № 5 ELBE.[19] When the BSU tried to track the course of the schooner by means of MarineTraffic on 11 June 2019, it was found that the transmissions stopped when she passed the Hamburg port boundary near Schulau and only started again after the collision.

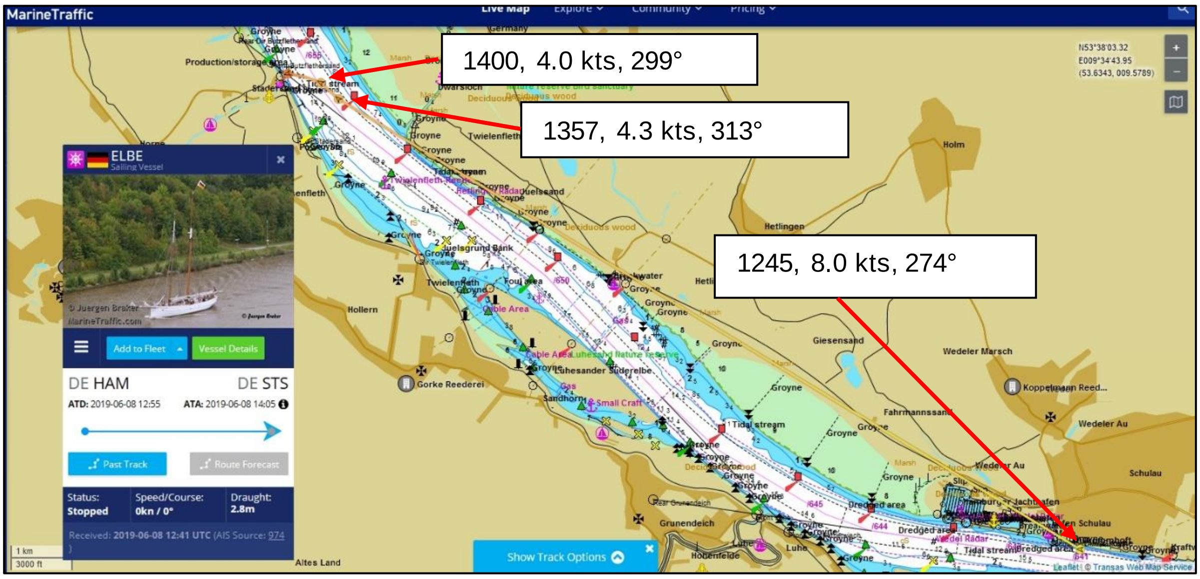


Figure 29: MarineTraffic AIS image showing the course of the № 5 ELBE

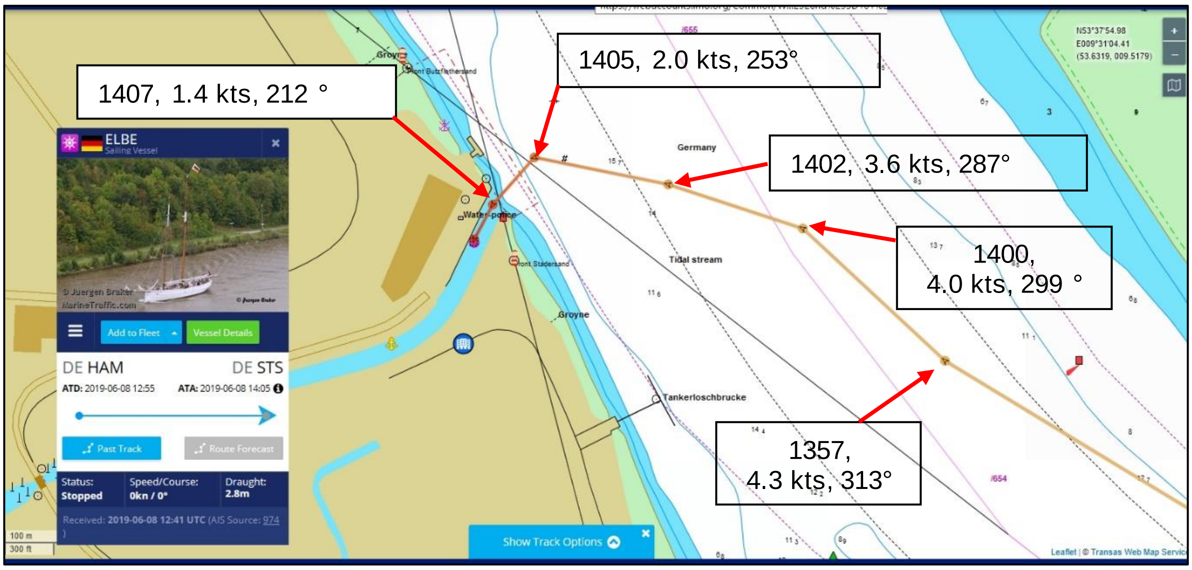


Figure 30: Close-up of MarineTraffic AIS image

A passenger happened to have a GPS tracker with her and provided the data to the BSU (see Figure 31)[20]. Unfortunately, it was not possible to integrate the data into a navigational chart. With all possible inaccuracies, it is the only technical representation

[19] Traditional vessels carrying more than 12 people must be equipped with a Class A AIS (see point 2.2 Chapter 6 Part 3 of Annex 1a to Sections 6 and 6a of the *Schiffssicherheitsverordnung (SchSV)* [German Ordinance for the safety of seagoing ships]).

[20] This image is not based on official navigational chart data.

of the course of the voyage from on board the № 5 ELBE shortly before the collision. Figure 31 has been included here for illustrative purposes only.

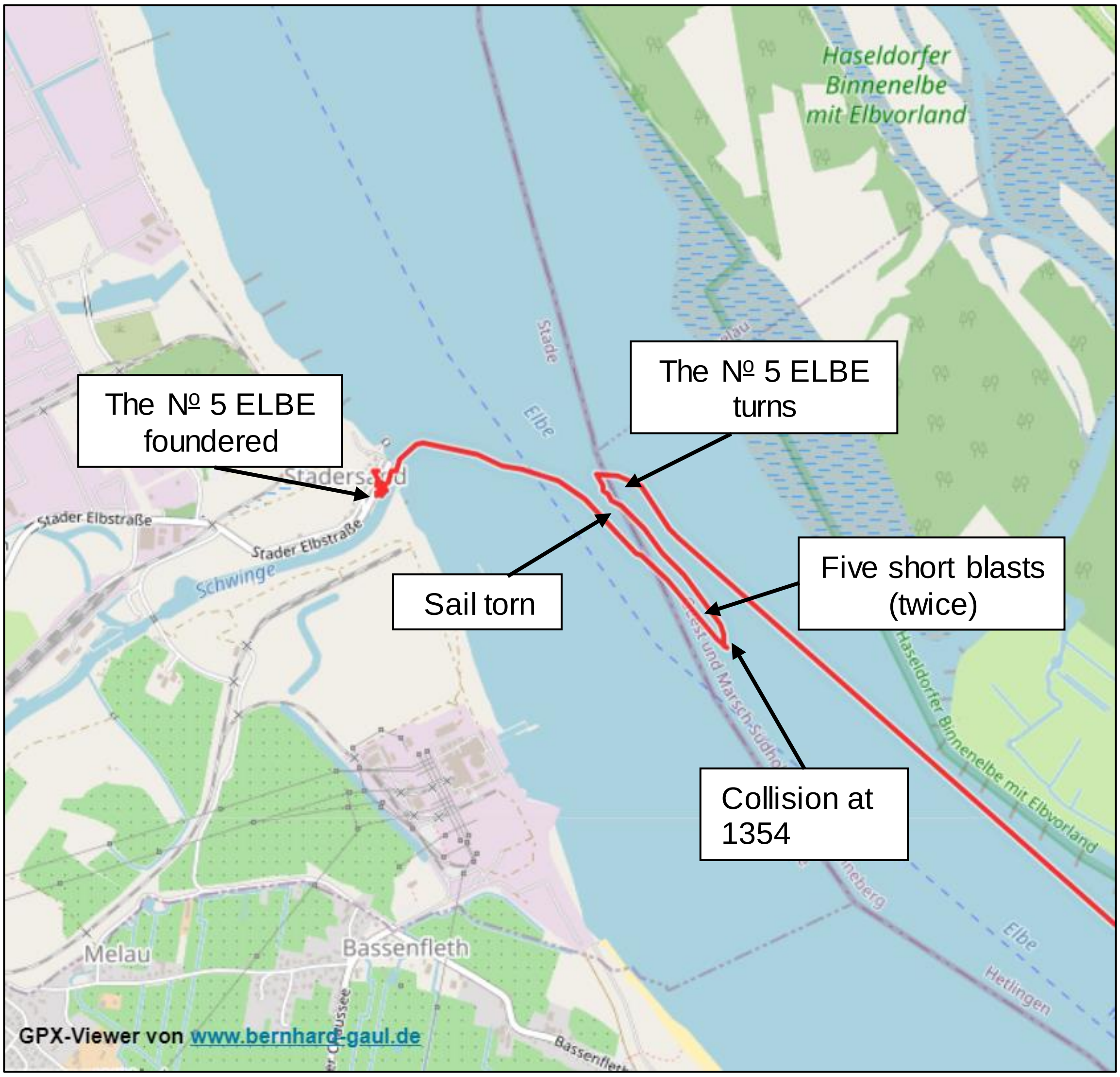


Figure 31: GPS track from a passenger on the № 5 ELBE

Based on submissions made during the consultation phase for this draft report, the company MarineTraffic was requested to provide more data on the № 5 ELBE.
Figure 32 shows the start of the voyage from 092827 to 095440 (red dots connected by a red line). Following that, MarineTraffic does not record any data until 105456. Figure 33 and Figure 34 show that data were then received again until 110417. This is followed by another data gap until 115705, as can be seen in Figure 35 and Figure 36.

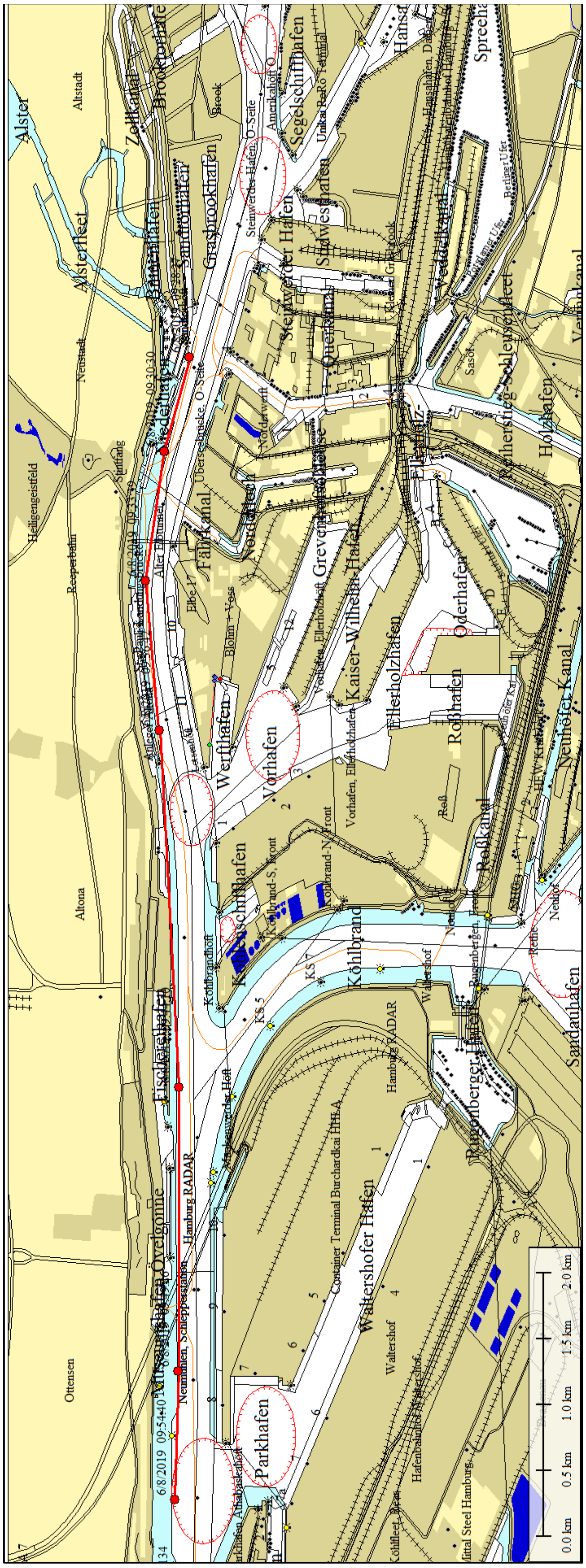


Figure 32: Start at 092827 until 095440

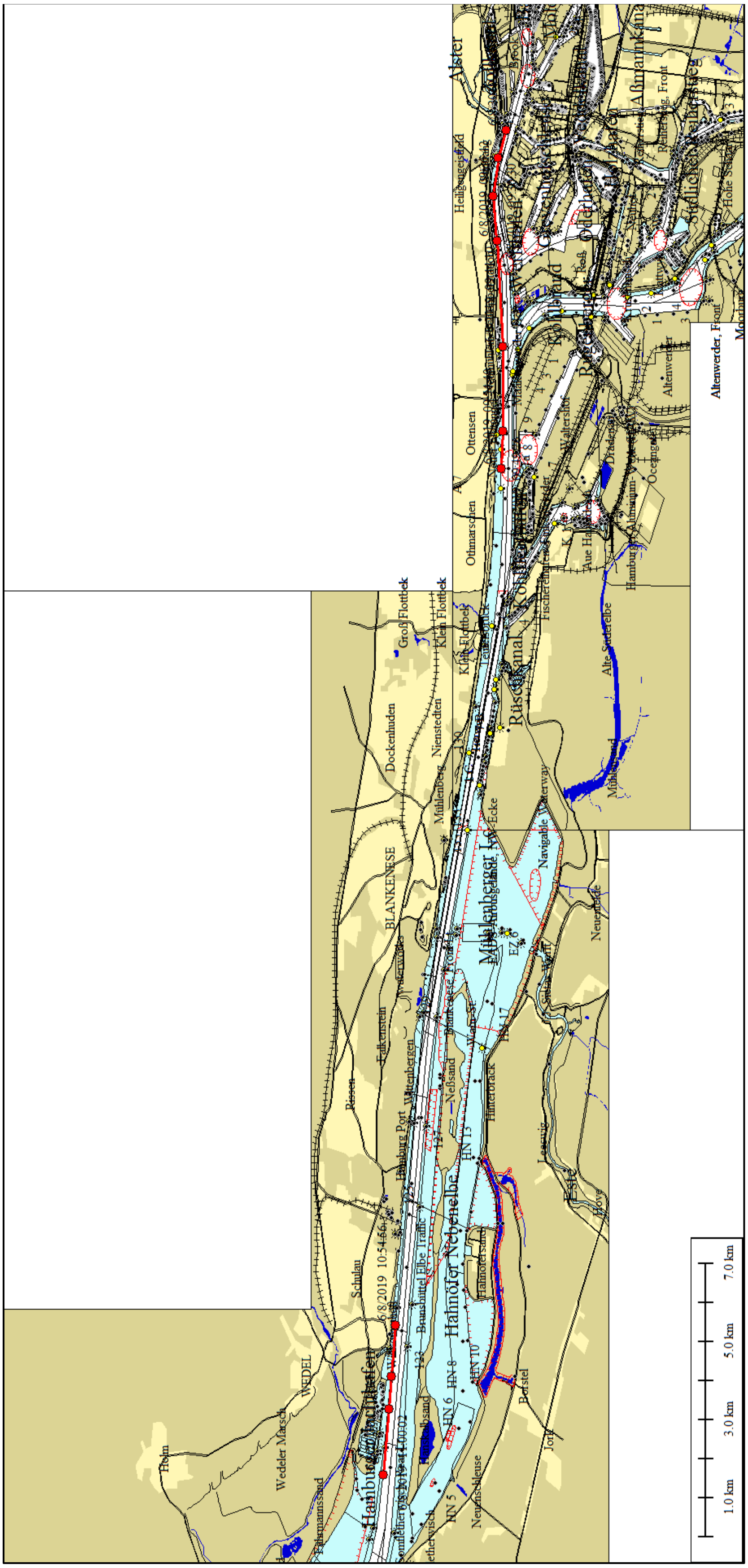


Figure 33: The data for the route from 105456 until 110417 are shown to the left of the image

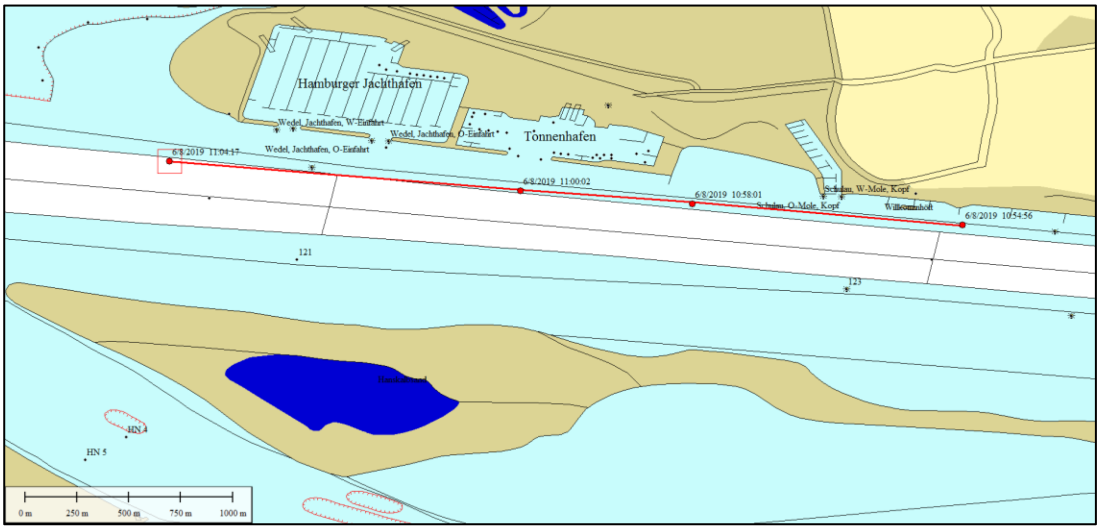


Figure 34: Middle of the route from 105456 until 110417

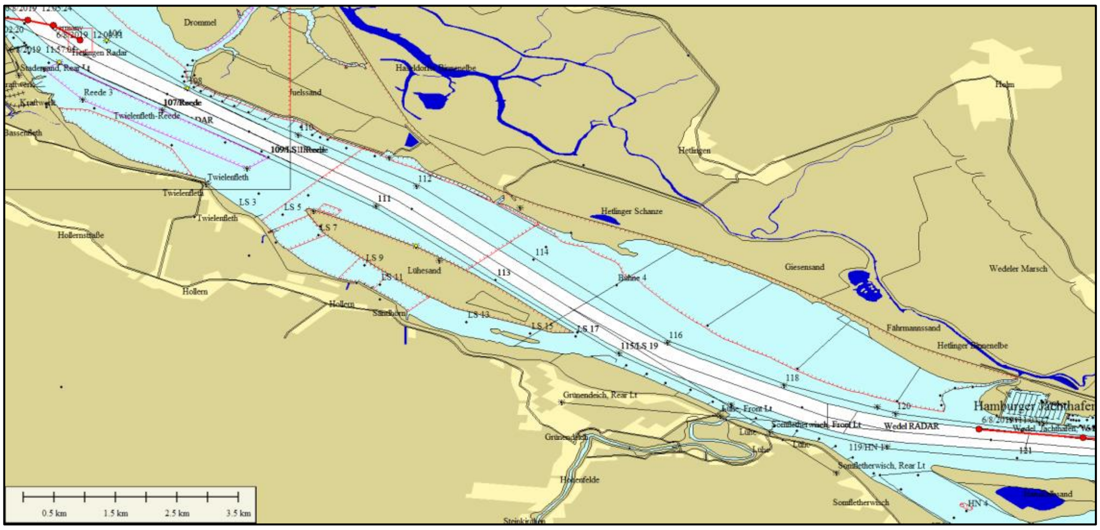


Figure 35: Middle to end of the route from 110417 until 115705

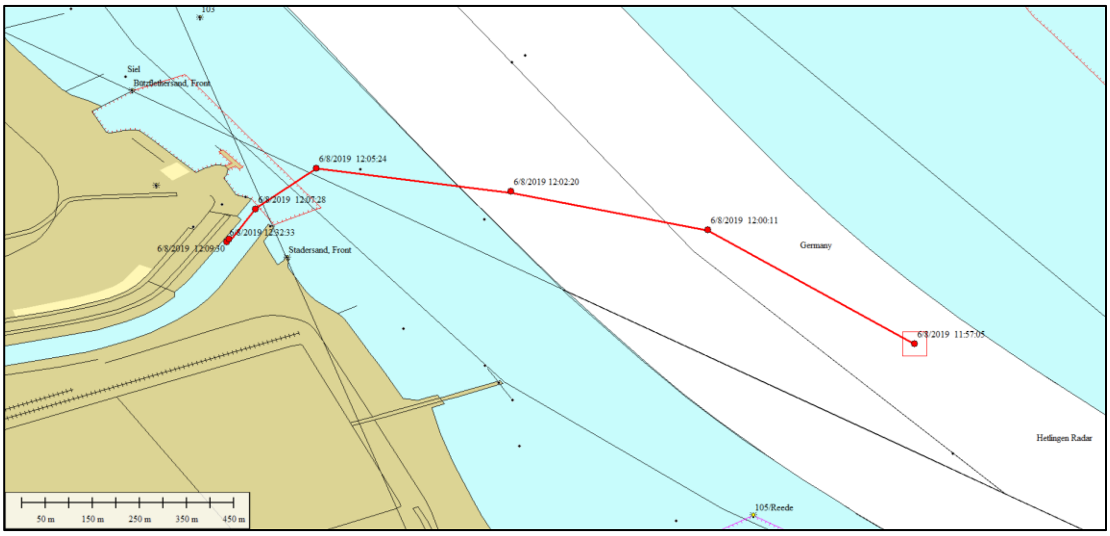


Figure 36: End of the route from 115705 until 123223

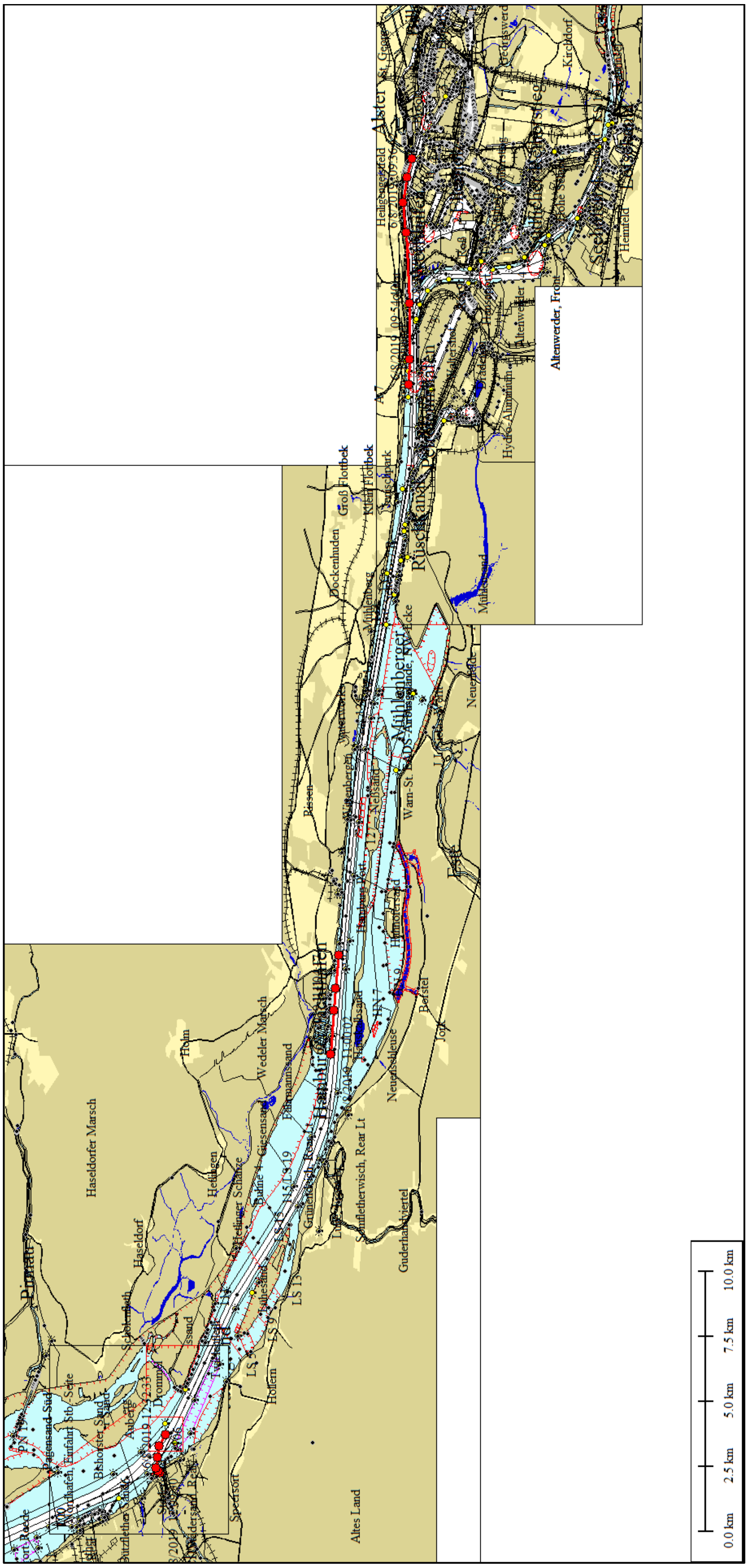


Figure 37: Overall course of the voyage

Showing the overall course of the № 5 ELBE's voyage from the port of Hamburg to the mouth of the River Schwinge, Figure 37 clearly illustrates that it was not possible to receive the traditional vessel's AIS signal continuously.
Data from the same period were obtained from another provider for verification. The Made Smart Group (MSG) from the Netherlands provided data for the period 1100 to 1300 UTC, which also form the basis for an expert report commissioned by SHM to demonstrate that the № 5 ELBE's AIS had been constantly switched on and reportedly transmitting. The BSU has presented these data graphically in Figure 38. It can be seen clearly that the № 5 ELBE did not record any data between 110417 UTC and 115705 UTC.

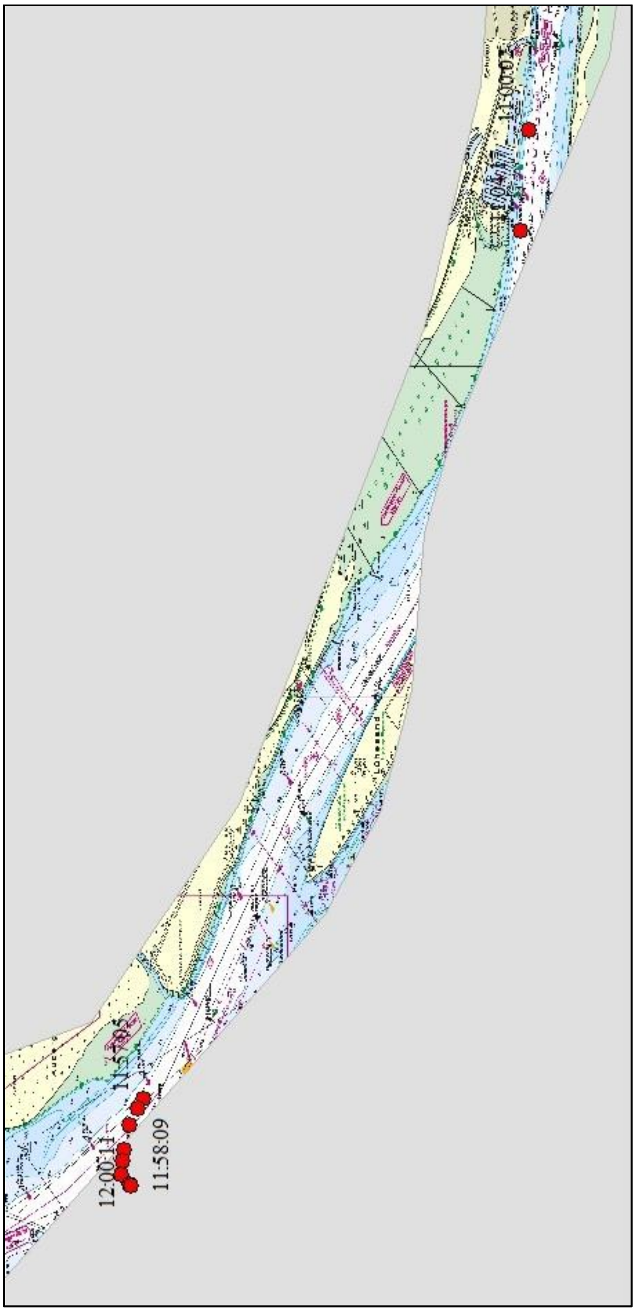


Figure 38: Representation of the AIS data from MSG

The AIS data from Marine Traffic and MSG were superimposed in Figure 39 to illustrate that the gap is virtually identical.

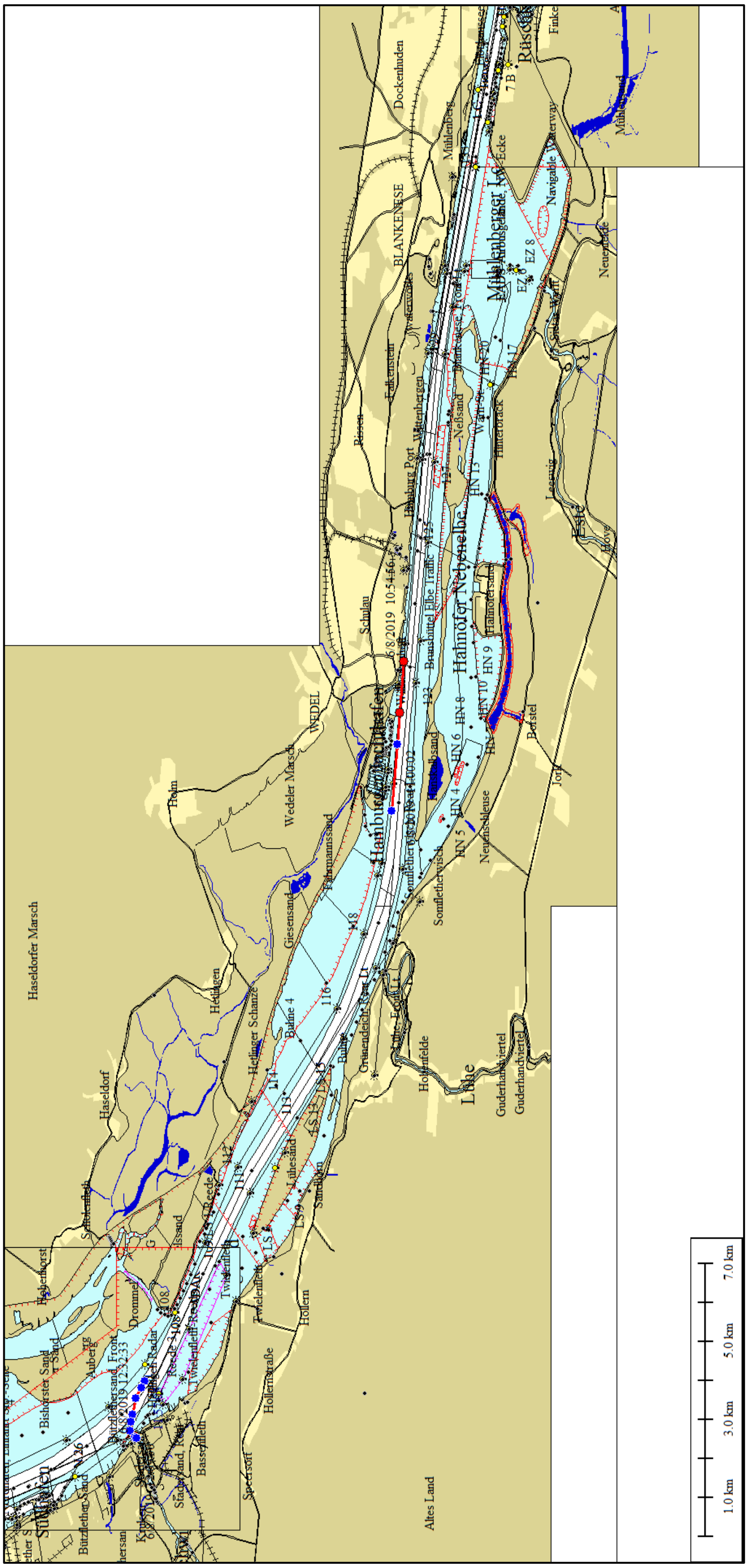


Figure 39: Superimposed AIS data from MarineTraffic and MSG

The following two tables show the numerical values on which the above graphical representations are based. Not only are the actual data identical but also the gaps in the recordings. After the last position was transmitted at about 110417 UTC (130417 LT), no transmission was received until after the collision.

DATEN von MSG				
Date and UTC Time	Lat	Lon	SOG	COG
08.06.2019 11:00:02	53,568670	9,685695	7,8	278,5
08.06.2019 11:04:17	53,569930	9,670505	8,1	281,1
08.06.2019 11:57:05	53,626735	9,539365	4,3	313,2
08.06.2019 11:58:09	53,627590	9,537955	3,7	319,7

DATEN von Marine Traffic					
Datum	Uhrzeit	Latitude	Longtitude	SOG	COG
08.06.2019	11:00:02	53,56867	9,685695	7,8	278
08.06.2019	11:04:17	53,56993	9,670505	8,1	281
08.06.2019	11:57:05	53,62673	9,539365	4,3	313
08.06.2019	12:00:11	53,6289	9,53543	4	299

This is also largely confirmed by the recordings of the VTS. In addition to the identical values at 110002 UTC and 110417 UTC, the recordings continue every minute until 112801 UTC (132801 LT). As opposed to the first two providers, there are no further data after the collision.

DATEN von AIS Deutsche Küste					
Date	Time	Latitude	Longtitude	SOG	COG
08.06.2019	11:00:02	53,56867	9,685695	7,8	278
08.06.2019	11:04:17	53,56993	9,670505	8,1	281
08.06.2019	11:06:17	53,57096	9,66258	9	282
08.06.2019	11:08:27	53,57255	9,65366	9,4	294
08.06.2019	11:09:27	53,57357	9,64966	8,9	294
08.06.2019	11:10:35	53,57479	9,645535	8,9	293
08.06.2019	11:11:35	53,57587	9,64179	8,8	297
08.06.2019	11:12:35	53,57706	9,6383	8,6	299
08.06.2019	11:13:35	53,57831	9,63484	8,7	302
08.06.2019	11:14:36	53,57964	9,631355	8,8	305
08.06.2019	11:15:36	53,58105	9,62797	8,8	305
08.06.2019	11:16:42	53,58256	9,62436	8,4	307
08.06.2019	11:17:42	53,58414	9,621465	8	315
08.06.2019	11:18:43	53,58577	9,61883	8,3	316
08.06.2019	11:19:43	53,58747	9,6158	9	315
08.06.2019	11:22:55	53,59343	9,60655	9	313
08.06.2019	11:23:55	53,59509	9,60382	7,9	312
08.06.2019	11:25:00	53,59672	9,601085	7,4	318
08.06.2019	11:26:00	53,59828	9,598605	8,2	315
08.06.2019	11:27:01	53,60001	9,595625	9	315
08.06.2019	11:28:01	53,60169	9,592935	7,7	316

It can therefore be concluded that the № 5 ELBE's AIS signal was not transmitted continuously and from the perspective of the shore-based stations and the HANNA, ended at 132801 at the latest. Accordingly, the HANNA's pilot was not receiving an AIS signal from the schooner when he called her at 1348 on VHF and complained to the VTS shortly after the pass, stating that the № 5 ELBE was sailing without AIS.

3.3.7 Recordings of the VTS

VTS Brunsbüttel Elbe provided the BSU with recordings of its situation report, which comprised the superimposition of an electronic navigational chart with radar and AIS signals for the course of the accident, as well as recordings of the official VHF channels.

Since the № 5 ELBE did not transmit an AIS signal from 1328 onwards, her small radar echo can only be classified at a late stage. It should be noted that VTS Brunsbüttel did not receive an AIS signal from the № 5 ELBE for the entire period considered below. Therefore, no comparable data are provided for the № 5 ELBE (as for the HANNA or ASTROSPRINTER). The vector for course and speed shown for the № 5 ELBE is derived from the earlier movements of the radar echo and therefore subject to errors. In particular, it does not allow any conclusions to be drawn about this vessel's heading. Rather, the course and the SOG are shown here. Findings on an apparent forthcoming pass by the vessels on their starboard or port sides in the course of the approach are therefore speculative, as the BSU is not aware of their actual position in relation to each other.

The order of the ships involved, constituting the initial situation, can be seen in Figure 40. The ASTROSPRINTER is on the far left of the image (since the image is not facing north, to the east[21]), in front of her the HANNA, in front of her the WILLEKE and lastly the ZAPOLYARNYY as the first ship.

[21] The VTS radar images are not facing north but rather based on the respective location of the radar tower ashore. Accordingly, the direction of view in the following images is toward the south-west. The small compass rose is shown in the upper right corner of the images.

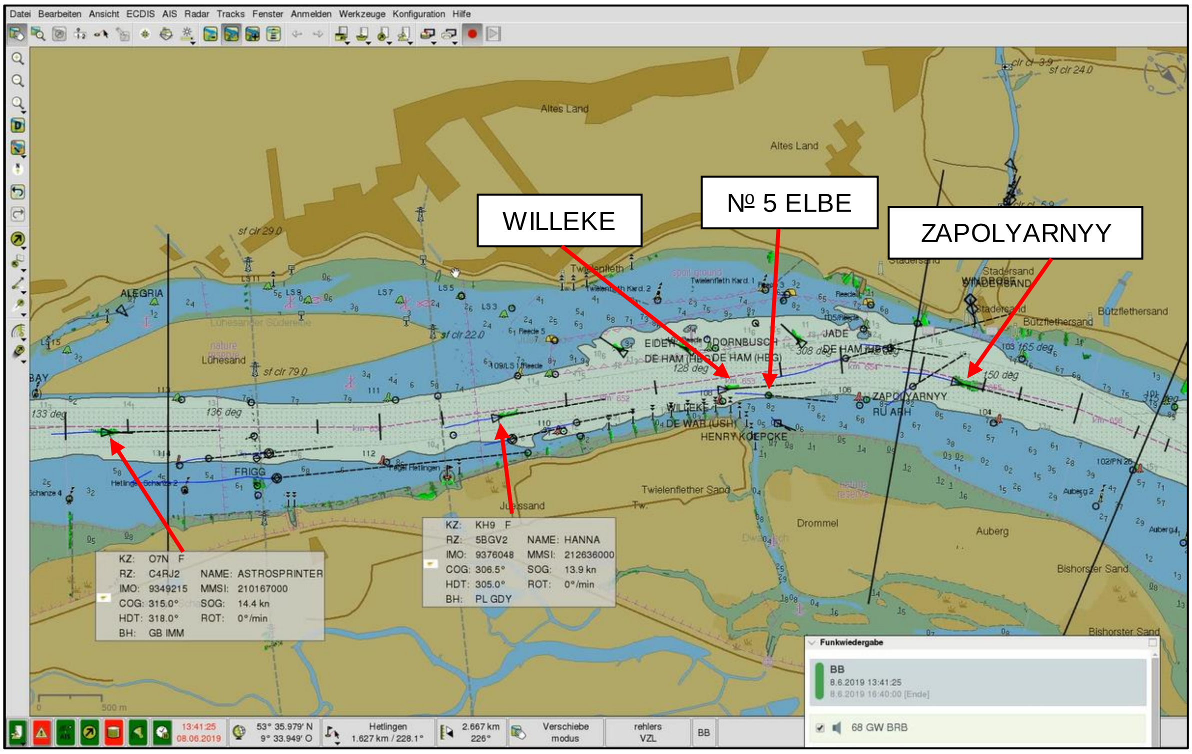


Figure 40: Initial situation at 1341

Figure 41 shows the WILLEKE overtaking the № 5 ELBE. Her radar echo is extremely small and visible below that of the WILLEKE. The № 5 ELBE begins to turn after this pass is completed (Figure 42).

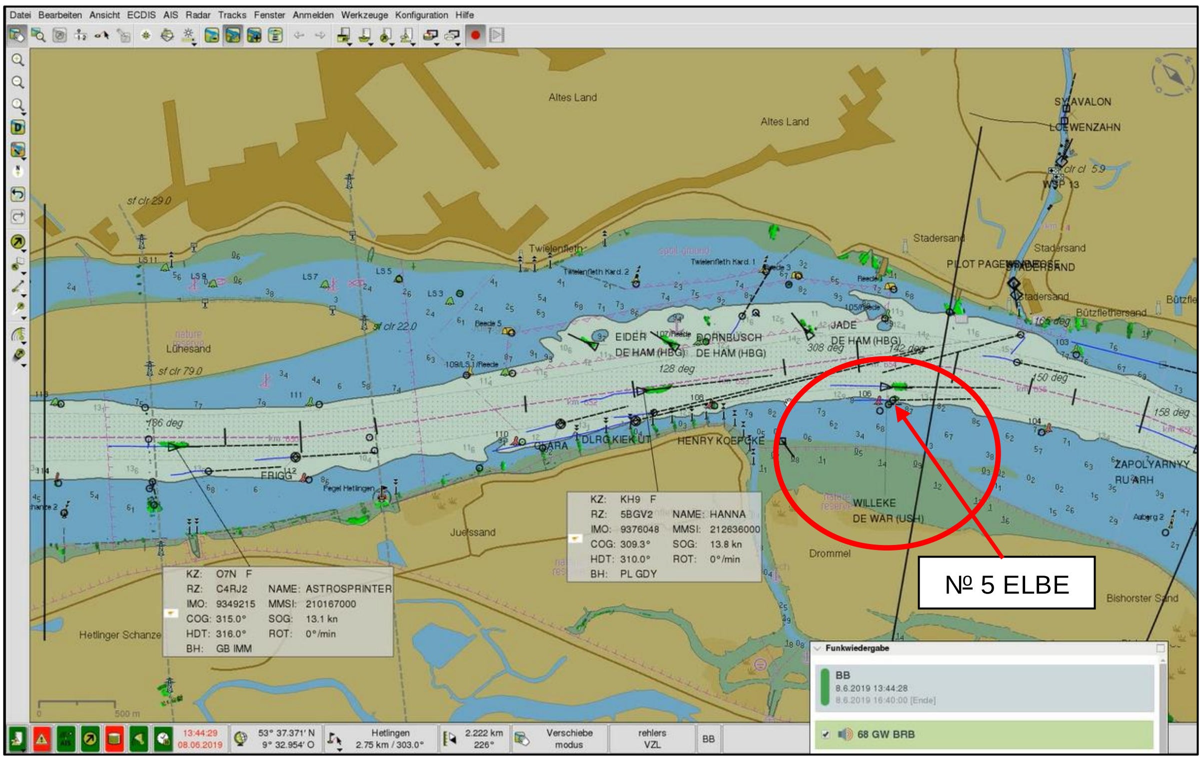


Figure 41: The WILLEKE passes the № 5 ELBE at 1344

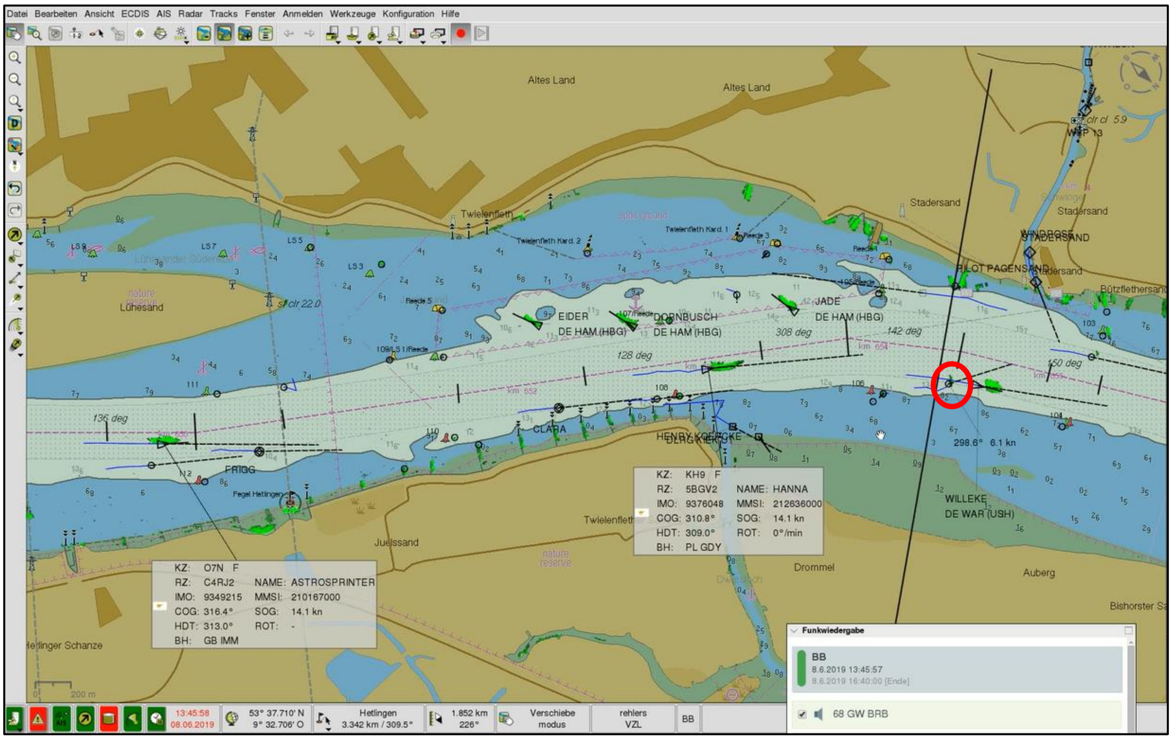


Figure 42: The № 5 ELBE begins to turn at 1346

The distance to the HANNA is about 1,200 m, which means that she still has about three minutes before she reaches the № 5 ELBE.
The schooner's course vector points toward the southern bank of the River Elbe for a few seconds at about 134640, then turns to the east and becomes much smaller, meaning the ship is slowing down. Figure 43 and Figure 44 also show the period in which the damage to the sails occurred.

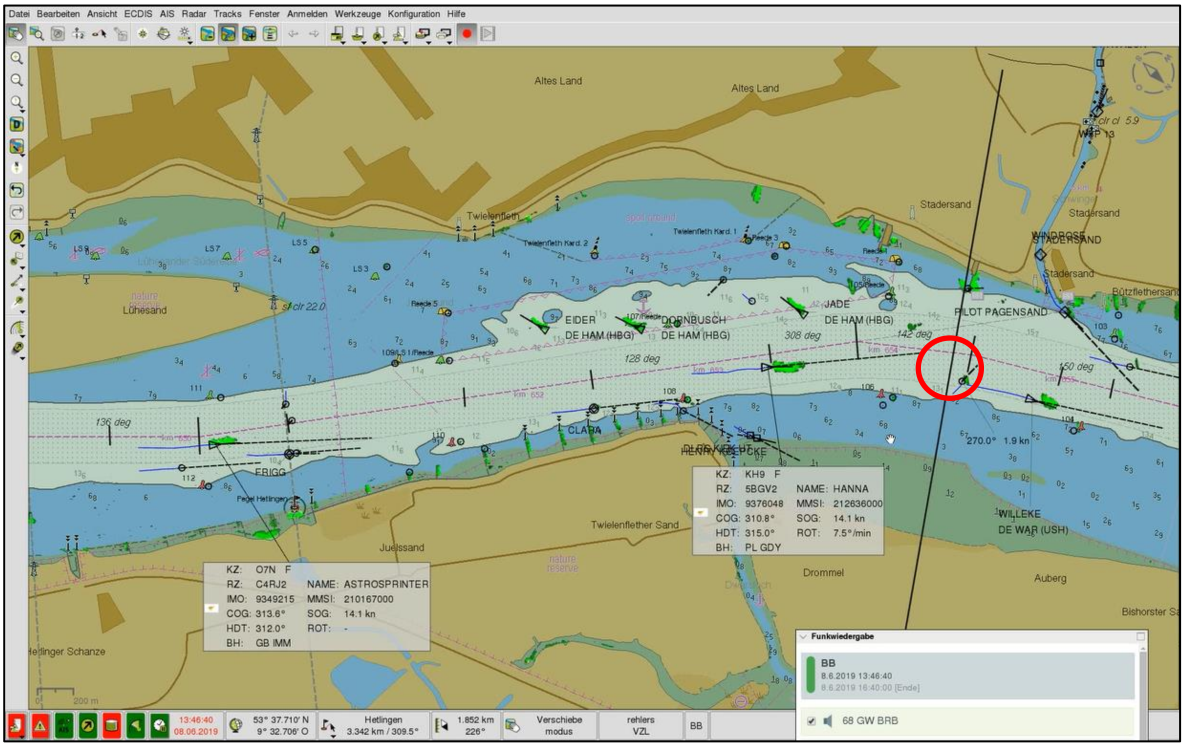


Figure 43: Inner jib of the № 5 ELBE tears

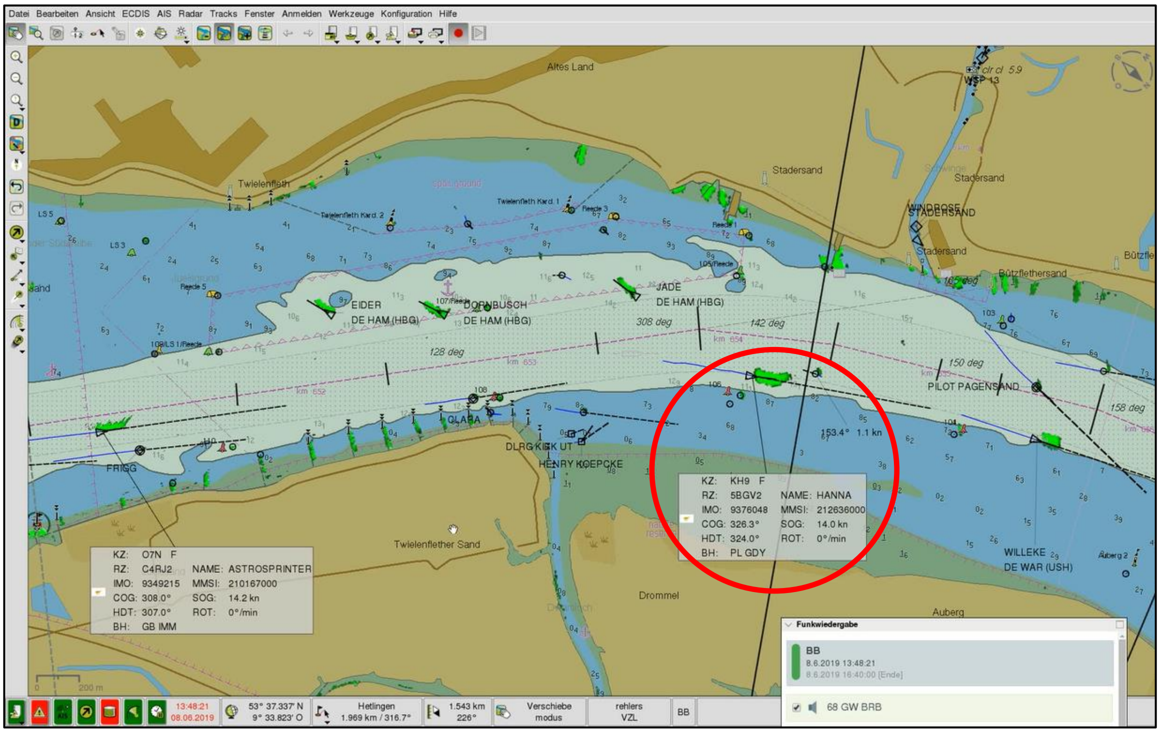


Figure 44: The HANNA calls the № 5 ELBE

The VHF recordings of VTS Brunsbüttel Elbe indicate that the pilot of the HANNA calls the № 5 ELBE twice at about 1348:

"Elbe 5 – HANNA" – "Elbe 5 – HANNA"

There is no response, however. Instead, the two vessels continue to converge and the pilot of the HANNA can only prevent a collision by executing an evasion manoeuvre to starboard, even though this entails his vessel moving close to the fairway boundary (Figure 45). The two vessels thus pass on their port side.

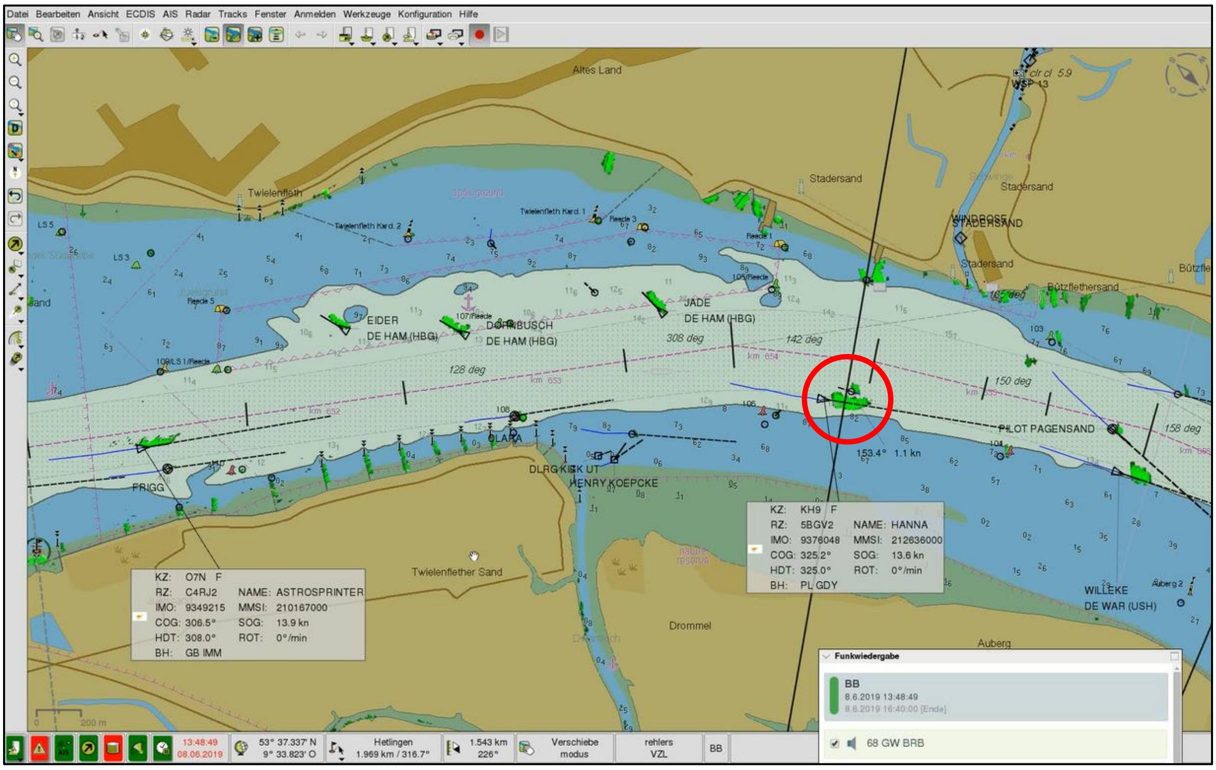


Figure 45: Near collision between the HANNA and № 5 ELBE at 134849

The pilot of the HANNA estimated a distance of 20 m. To substantiate this statement, the BSU instructed the Institute of Photogrammetry and GeoInformation (IPI) at the Leibniz University Hannover to calculate the closest point of approach (CPA) by means of photogrammetry using a photograph that a passenger had taken by chance as the two ships were passing (see Figure 46). The thus calculated CPA between the two vessels stood at 32.1 m.

Source: Passenger

Figure 46: Photograph used for the distance calculation

Just after the two vessels were further apart again (see Figure 47), the HANNA's pilot called VTS Brunsbüttel Elbe at 1349 to complain about the – in his opinion – irresponsible conduct of the traditional vessel.

Pilot: "Brunsbüttel Elbe Traffic – HANNA"
VTS: "This is Brunsbüttel Elbe Traffic – HANNA"
Pilot: "This is Z. Minor complaint with regard to the Elbe 5 but nothing formal. Well, what she did here, with passengers on board, outbound in this fairway, is a disgrace. It was a really close call."
VTS: "Er, okay in the area, it was the 106, yes?"
Pilot: "It is the sailing vessel, which is now returning to Hamburg on the wrong side of the fairway. ***She has no AIS signal."***
VTS: "Okay, thanks, we will make a note of it."[22]

Figure 48 shows that the № 5 ELBE stays on the northern side of the fairway and sails directly for the oncoming ASTROSPRINTER. For that reason, the ship's command of the ASTROSPRINTER had to assume that a green-green encounter was intended, i.e. that the two ships would pass each other on the starboard side.

This was the period in which the ship's command of the sailing vessel was busy gaining control of the damaged sails.

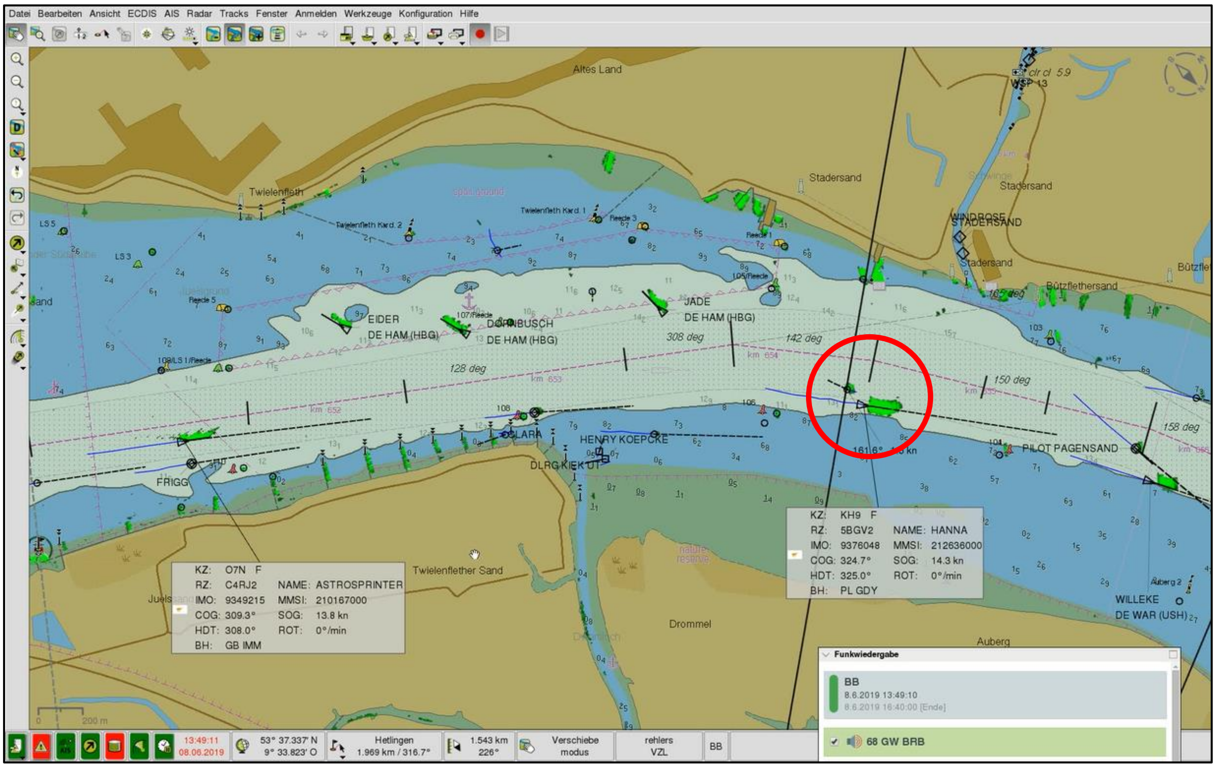


Figure 47: The HANNA and the № 5 ELBE have passed

[22] During the consultation phase, the Federal Waterways and Shipping Agency (GDWS) commented in support of the VTS:
"Not every close-quarters situation between two vessels necessarily leads to the conclusion that the vessel causing the situation will also act contrary to regulations or the principles of good seamanship in future close-quarters situations."

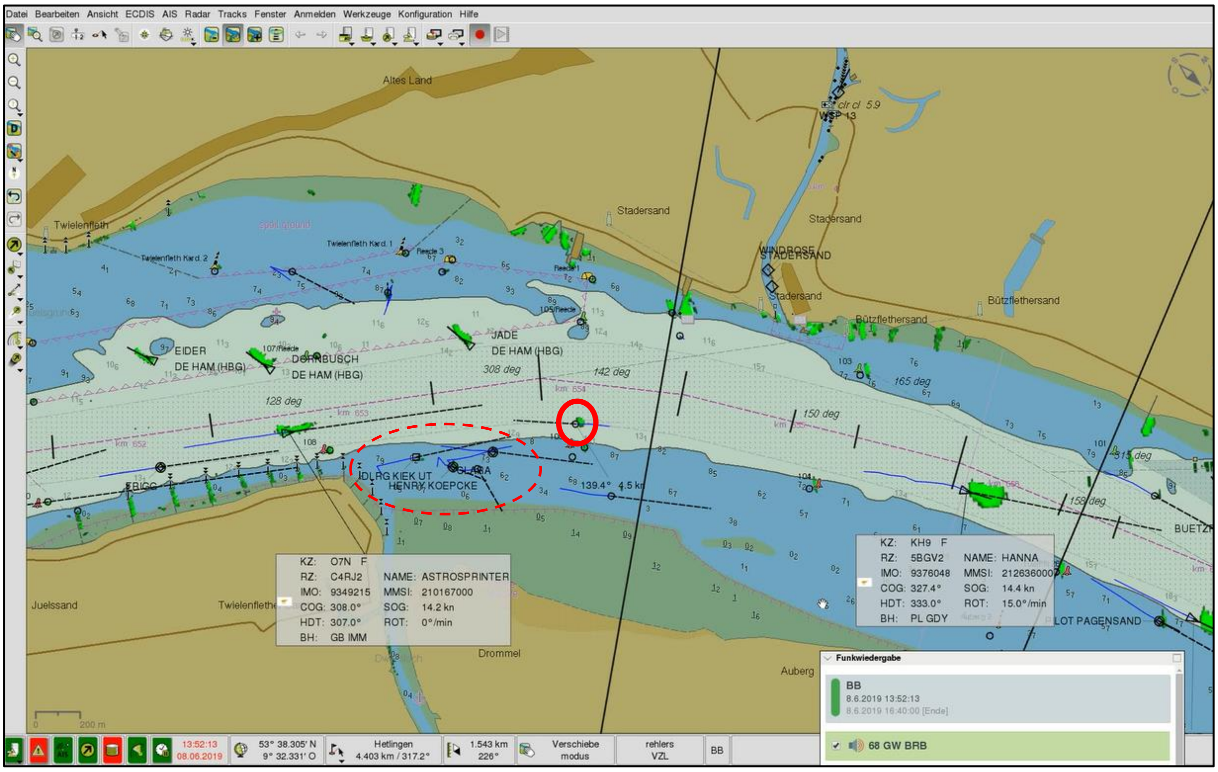


Figure 48: The № 5 ELBE stays on the wrong side of the fairway

The ASTROSPRINTER has finished overtaking the FRIGG (Figure 48). The DLRG and fire brigade vessels are operating to the north of the fairway (dotted circle).

Figure 49 shows how the № 5 ELBE and ASTROSPRINTER move ever closer[23]. A further risk of collision emerges after the near collision with the HANNA. Figure 50[24] and Figure 51[25] show the two vessels collide at 1354.

[23] During the consultation phase, the GDWS commented in support of the VTS:
"The № 5 ELBE is situated on the northern edge of the fairway. From the perspective of the VTS, the vector of the vessels indicate they would pass each other safely on the starboard side, i.e. no danger."

[24] During the consultation phase, the GDWS commented in support of the VTS:
"The vectors continue to indicate a starboard-starboard pass because the ASTROSPRINTER has not yet reached her course alteration position. Only with knowledge of what is about to happen can the observer recognise the starboard tendency of the № 5 ELBE. An imminent danger is not yet evident when both vessels maintain their course."

[25] During the consultation phase, the GDWS commented in support of the VTS:
"A significant course alteration by the № 5 ELBE is evident. The collision is imminent.
In less than two minutes, a seemingly safe situation develops into a collision. The absolute risk of collision is still not even apparent in Figure 49 (23 seconds before Figure 50). The room for manoeuvre in such close-quarters situations is simply too short for the VTS to intervene meaningfully in any form."

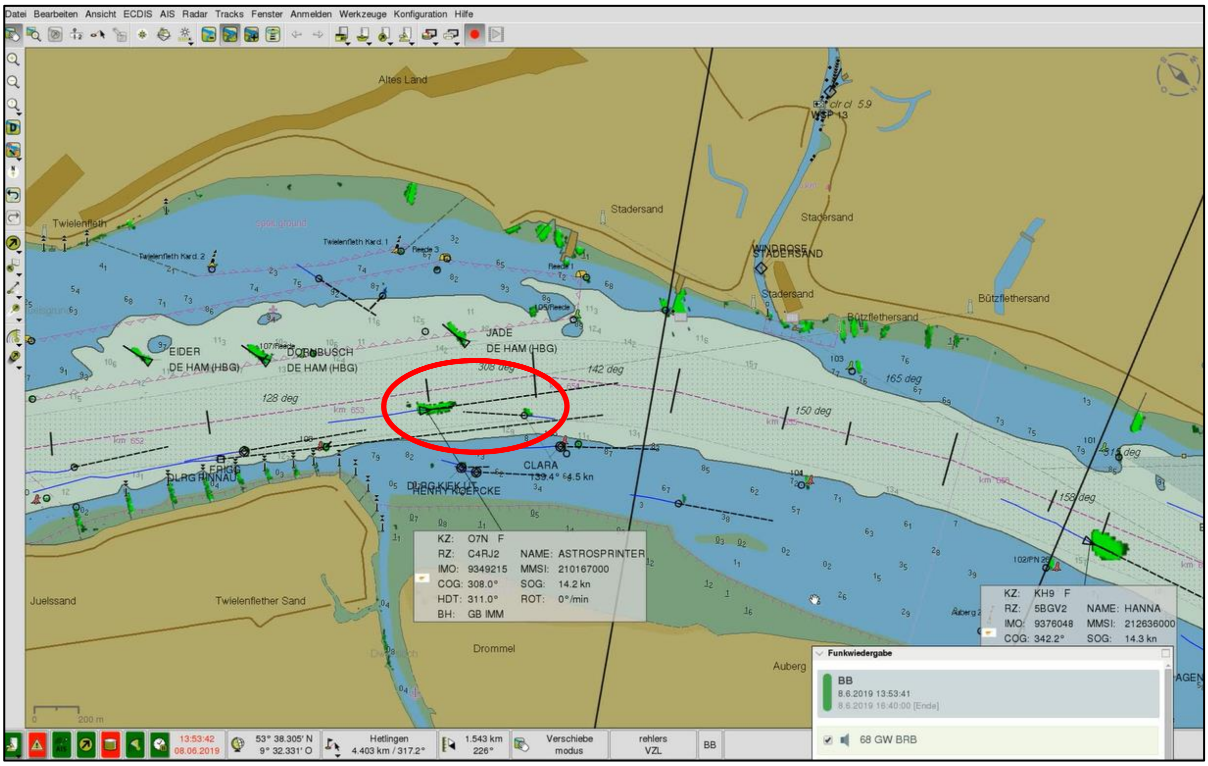


Figure 49: 135342 – risk of collision re-emerges

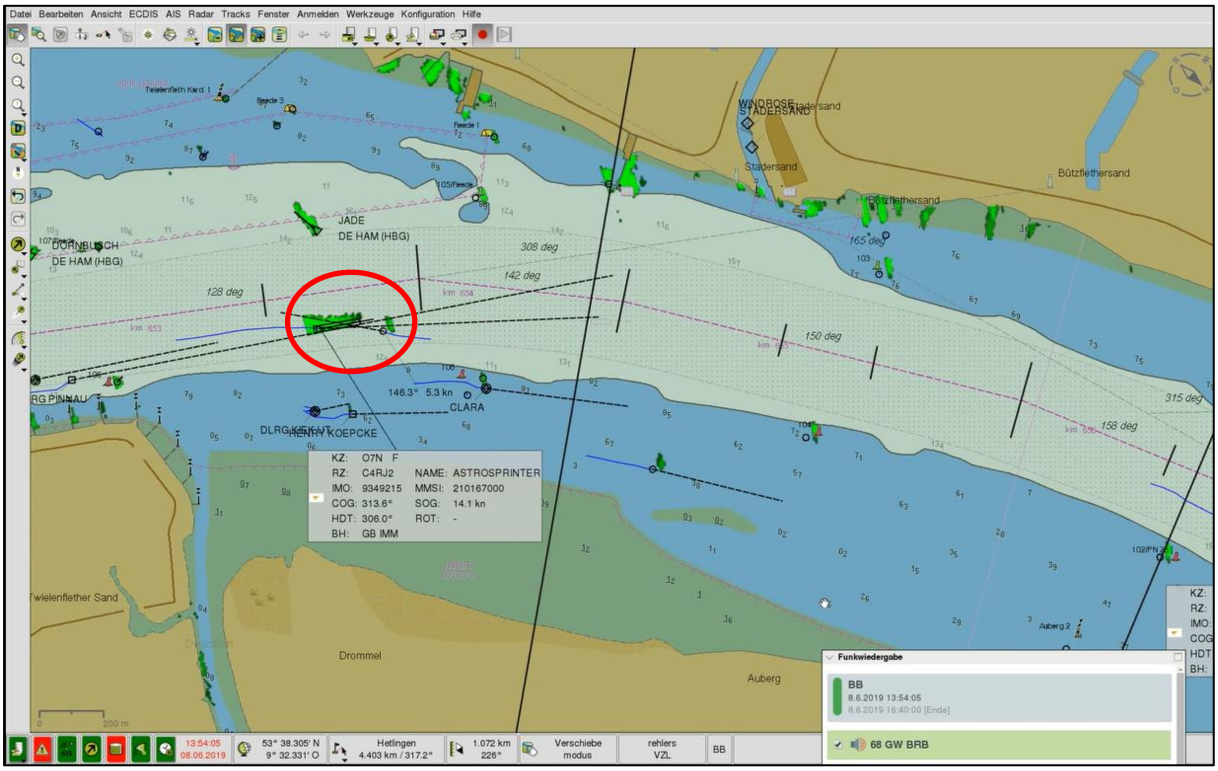


Figure 50: 135405 – seconds before the collision

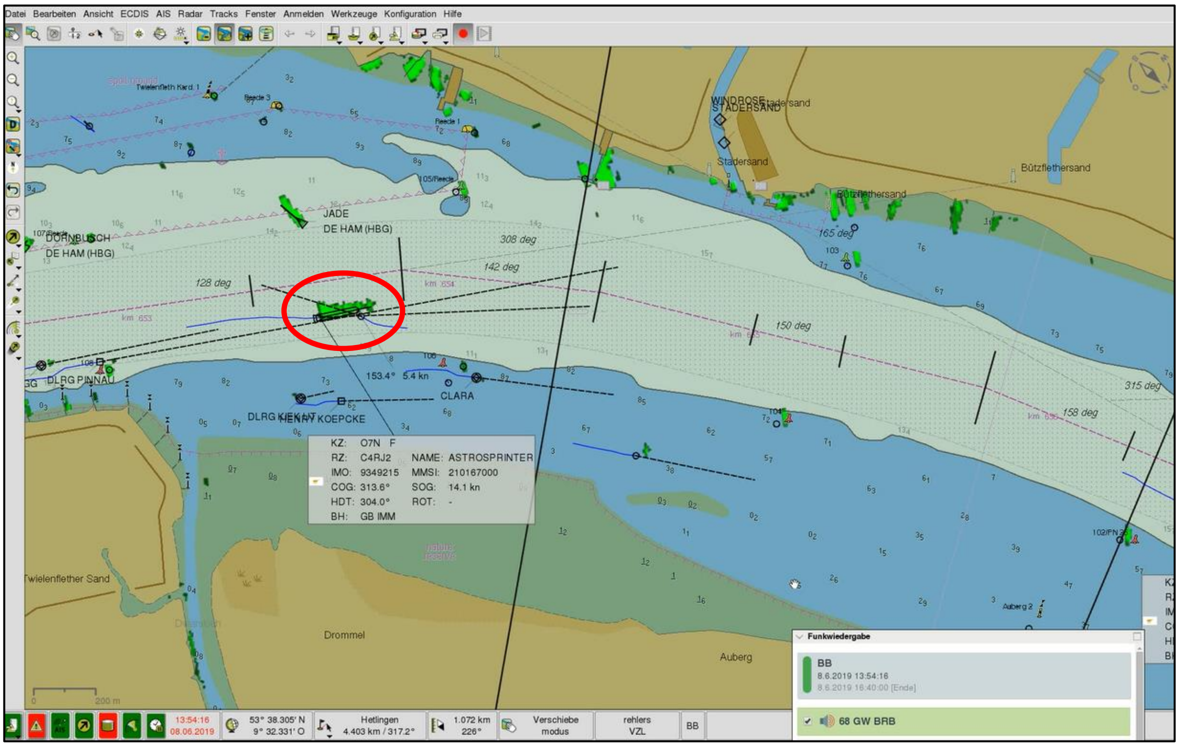


Figure 51: Collision between the ASTROSPRINTER and № 5 ELBE at 1354

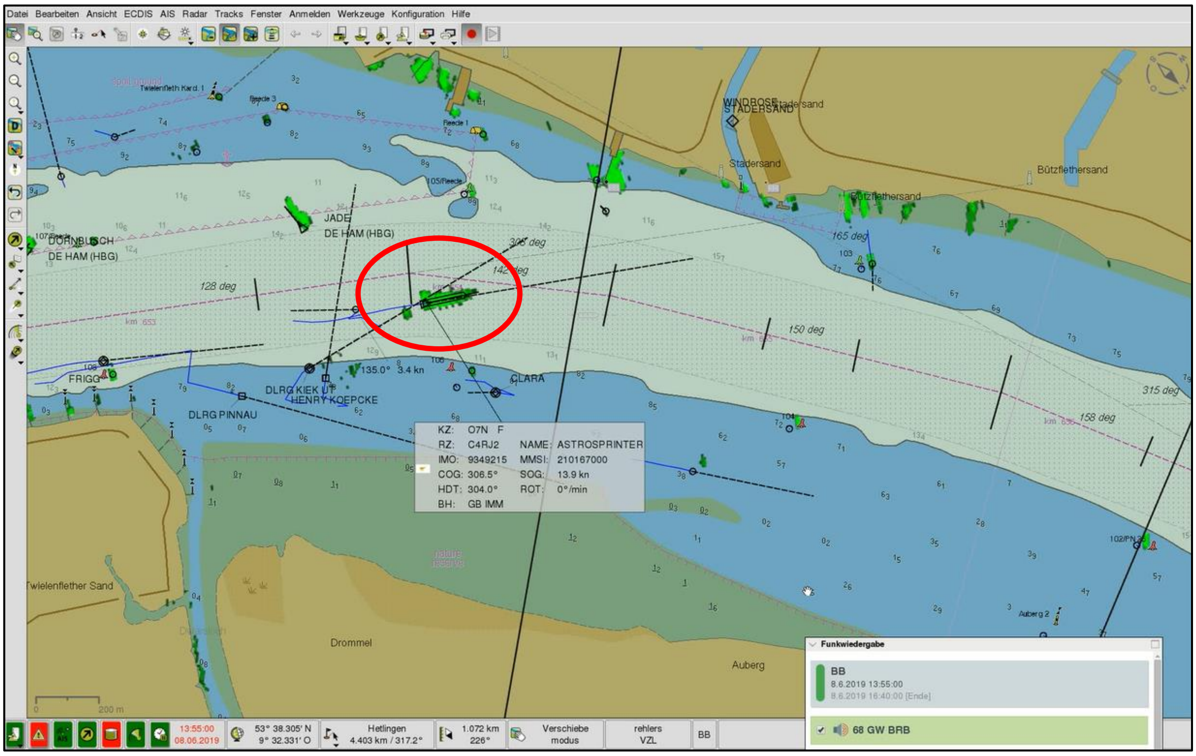


Figure 52: The ships have separated again. The KIEK UT is heading for the distressed vessel

Just one minute later – at 1355 – the two vessels have separated. Figure 52 shows how the DLRG's motor lifeboat KIEK UT is already sailing to the scene of the accident.

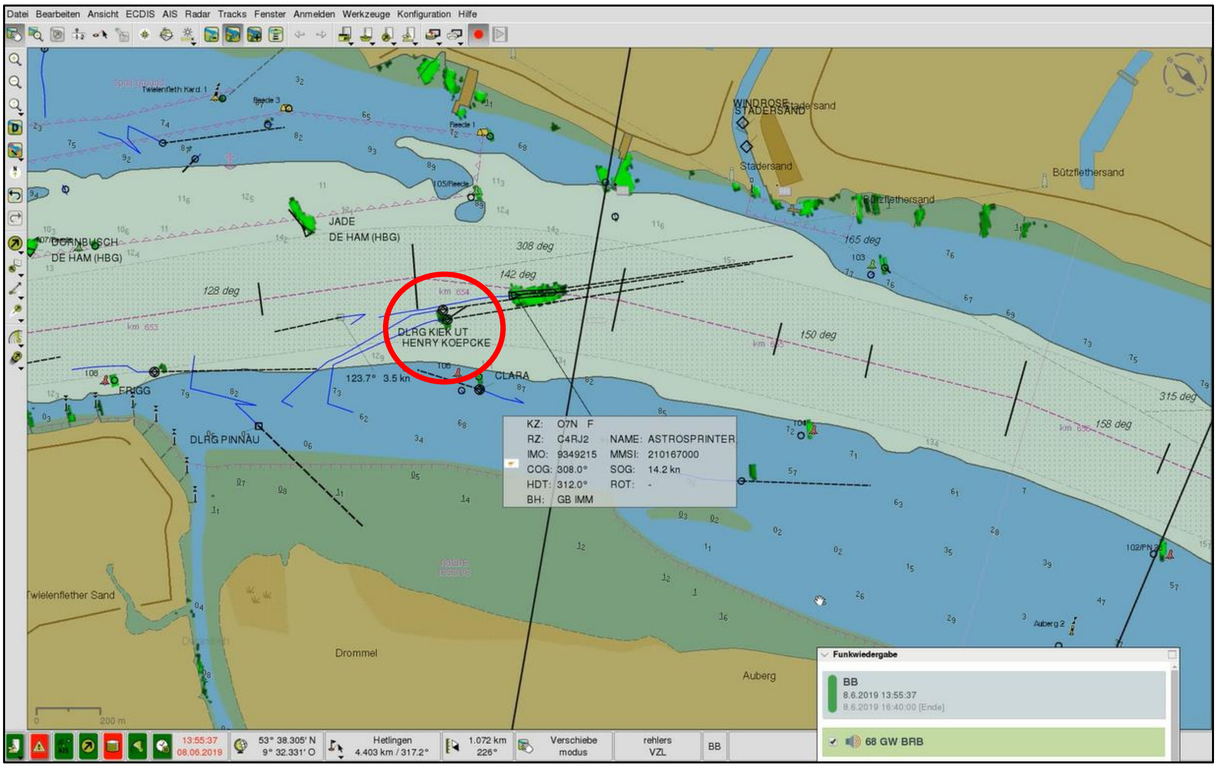


Figure 53: HENRY KÖPCKE is also on scene

VTS Brunsbüttel Elbe records a mayday call from the № 5 ELBE at 1355:
"This is pilot schooner Elbe DANF – collision with vessel – off Stade power plant – I repeat – MAYDAY MAYDAY MAYDAY – pilot schooner Elbe DANF – 211407690 – collision with cargo vessel – position Stade power plant."

However, there is no response when the VTS requests more information:
"Pilot Schooner 5, this is Brunsbüttel Elbe Traffic, hello. Do you have people in the water or are you seriously damaged? – – – Pilot Schooner 5, this is Brunsbüttel Elbe Traffic."

The fire support boat HENRY KÖPCKE has also arrived in the meantime. The ASTROSPRINTER sails for the roadstead at Brunsbüttel and professional rescue personnel begin to administer first aid on board the № 5 ELBE.

3.3.8 VHF traffic and sound signals

The ASTROSPRINTER's VDR recordings indicate that her VHF units were operable. In addition to the direct recordings of the VHF units, the bridge microphones clearly recorded radio traffic. It is also possible to hear the master being briefed on the situation when he enters the bridge after the collision. A conversation between the pilot and 2nd NO in the minutes leading up to the collision cannot be heard, however. Sound signals from the ASTROSPRINTER and the five short blasts issued twice by the № 5 ELBE cannot be heard, either.

All the witnesses from the № 5 ELBE questioned stated that they had not heard anything about a VHF unit, neither on nor below deck. Only the nautical officer states that he heard radio traffic after switching from channel 74 to 68 off Tinsdal but that it did not concern the schooner. The AIS signals recorded by shore-based stations apparently ended at the same time as the switchover of the radio channel at the Hamburg state border (1245) and also began at the same time (about 1347) when the distress call was made off Stadersand.

Due to the long period under water and the salvage operation, it was not possible to check the operability of the radio equipment and AIS unit. No technical problems were reported in the course of the transfer voyage from Denmark after the previous call at the shipyard, during which the masts were pulled and the antennas for radio and AIS were dismantled. The BSU has been provided with the radio survey on small ships certificate (Sea Area A1) dated 24 May 2019. It is conceivable that an untraceable technical or operating error occurred during the duly completed switchover of the VHF channel from 74 to 68 when they crossed the state border, resulting in neither VHF radio traffic being heard nor the transmission of a sufficiently strong AIS signal.[26] The BSU also believes that the listening watch may have been insufficient.
At any event, it is clear that there was no response to the HANNA's call. After the collision, the nautical officer transmitted a mayday call, which was recorded by the VTS. An AIS signal was also recorded again at this point in time.

A passenger's video confirms the sound signal issued twice by the № 5 ELBE (five short blasts). The source of the sound signal was evidently not loud enough because the sound reception system[27] installed on the ASTROSPRINTER did not transmit anything into the bridge according to the VDR audio recording. The shipping company did not submit a technical approval report during the investigation but gave its written assurance that the system had been functional.

[26] During the consultation phase for this report, SHM commented on this point as follows: *"VHF and AIS equipment, including the separate VHF deck station, were switched on at all times. There were no operating errors."*

[27] A sound reception system is mandatory on ships with an enclosed bridge to enable the bridge personnel to receive environmental noises.

3.3.9 Weather

In addition to requesting the usual report from Germany's National Meteorological Service (DWD), which sets out the weather as it was at the time, the BSU also requested the forecast available to the ship's command of the № 5 ELBE prior to departure for the investigation of this marine casualty[28].

COASTAL WEATHER FORECAST
issued by the DWD for the subregions of Germany's North Sea and Baltic Sea coast
at 0630 on 08/06/2019:
Forecast applies up until tonight:

East Frisian coast:
South 6 to 7, temporarily increasing somewhat, veering south-west, scattered heavy thundersqualls.
Elbe estuary:
South 6 to 7, temporarily increasing somewhat, veering south-west, scattered heavy thundersqualls.
Heligoland:
South 6 to 7, temporarily increasing somewhat, veering south-west, scattered heavy thundersqualls, 3 m sea.

Elbe from Hamburg to Cuxhaven:
South 5 to 6, gusts 9, veering south-west, later decreasing somewhat, scattered showers.

Official STORM warning of the Hamburg Maritime Weather Service for the German North Sea coast issued at 0300 LT on Saturday 08/06/2019
East Frisian coast:

South to south-west 7 to 8 with gusts of 10 Bft, scattered thunderstorms.
Elbe estuary:
South to south-west 7 to 8 with gusts of 10 Bft, scattered thunderstorms.
Heligoland sea area:
South to south-west 7 to 8 with gusts of 10 Bft, scattered thunderstorms.
North Frisian coast:
South to south-west 7 to 8 with gusts of 10 Bft, scattered thunderstorms.

Elbe from Hamburg to Cuxhaven:
South to south-west 5 to 6 with gusts of 9 Bft.

Hamburg Maritime Weather Service

The weather forecast available on the day of the accident stops here.

[28] Extract in italics.

The **official report on the weather on the River Elbe between Glückstadt and Wedel from 0900 to 1400 CEST on 8 June 2019** compiled on behalf of the BSU confirms the forecast retrospectively:

The DWD has at its disposal measurements and observations from the surrounding stations for the section of the River Elbe between Wedel and Glückstadt. Some of these stations are not manned permanently or at all. Analyses of the DWD in Offenbach and the UK Met Office in Exeter were referred to for the account of the weather. Forecasts of the ECMWF's (European Centre for Medium-Range Weather Forecasts in Reading, England) global weather forecast model and the DWD's ICON and ICON-EU global and regional weather forecast models were considered in the assessment. Satellite images, radar images and rawinsondes were also analysed. Forecasts of the BSH's circulation model (HBM) were also included in the assessment.

Weather situation on 8 June 2019

As can be seen […] from the analysis charts, the area of the accident was affected by a low pressure system over the North Sea on 8 June 2019. On the south-eastern flank of the low pressure system a relatively strong south to south-westerly air flow carried cloudy air into the forecast area. The figures [...] show the corresponding cloud conditions over the area of the accident as seen from the METEOSAT satellite at selected times within the investigation period.

Weather in the River Elbe area between Wedel and Glückstadt from 0900 to 1400 CEST on 8 June 2019

Mean wind/gusts (at a height of 10 m):

The wind speed measurements at the surrounding stations span a relatively wide range both in terms of time and geographically for the period under investigation. For example, mean wind speeds of less than 10 to 20 kts (3 to 5 Bft) were measured at the beginning of the period under consideration. The wind direction was a south to south-west. ***The mean wind had increased to 20 to 25 kts (5 to 6 Bft) by early afternoon. Widespread gusts of 30 to 35 kts (7 to 8 Bft), at times up to 37 kts (8 Bft), were measured.***

Due to the area of the accident's exposed location on the River Elbe, it must be assumed that the mean wind speeds that prevailed there in the morning were between 17 and 22 kts (5 to 6 Bft). Measurements of between 20 and 25 kts (5 to 6 Bft) are likely from midday onwards.

Taking into account surrounding wind peak measurements at a height of 10 m and vertical temperature and wind profiles, ***gusts of 30 to 36 kts (7 to 8 Bft)*** *must be assumed for the entire investigation period in the area of the accident.*

Weather – precipitation and visibility:
As can be seen from satellite and precipitation radar images, as well as from observations made on the ground, clouds in the area of the accident were initially still scattered during the period in question. However, it soon became very cloudy to overcast and rained lightly at times. Measured hourly rainfall was less than 1 mm. Corresponding precipitation measurements can also be assumed for the area of the accident. Visibility measurements made in the vicinity of the area of the accident indicate visibility was good. Most of them are well over 10 km.

Air temperature (at a height of 2 m) and water temperature:
Air temperatures of between 14 and 17 °C were measured at the surrounding stations, with the lowest values recorded in the vicinity of precipitation. It is reasonable to assume that the temperatures in the area of the accident were within the aforementioned range.

No water temperature measurements are available for the immediate vicinity of the area of the accident.

Measurements in the River Elbe below Hamburg indicate that the water temperature in the area of the accident was between 18 and 20 °C.

Current on the River Elbe:
An ebb tide prevailed in the area of the accident on the River Elbe during the period under consideration. The times predicted for the preceding high tide were before the beginning of the investigation period between Wedel and Glückstadt. The following times were calculated for the onset of low tide: Glückstadt 1410, Stadersand 1453 and Schulau (Wedel) 1519 CEST (source: BSH). Due to the relatively broad isolation of the investigation area in terms of time and geographically, it is only possible to specify the velocity of the current as a range. The calculations of the BSH indicate that at the beginning of the period under investigation it was 2 to 70 cm/s (mostly moving downstream) in the River Elbe's main current, later 10 to 170 cm/s (moving downstream) and in some cases even higher.

A NAVTEX (Mörer Weather Infobox) was on board. The manufacturer's website states that this device combines all required features and can be relied on to supply key weather data anywhere in the world.
It is a parallel receiver for simultaneous reception of freely available weather forecasts and warnings:

- DWD on HF (German/English) and LW (German)
- NAVTEX on 490 kHz (national, national language)
- NAVTEX on 518 kHz (international, English)

Source: BSU

Figure 54: Weather Infobox

On the day of the accident, it was technically possible to receive the following information with this device:

- DWD coastal weather forecast at 0630 on 8 June 2019, which provided the following information: "*River Elbe from Hamburg to Cuxhaven. South 5 to 6, gusts 9, veering south-west, later decreasing somewhat, scattered showers;*[29]
- NAVTEX report LB73: "*080550 NAVTEX-Hamburg (NCC) gale and storm warnings for the German Bight, Warning 83 080050UTC JUN German Bight: Storm south to south-west 7-8 Bft.*"

In other words, this device only receives the weather reports of the DWD. Neither the skipper nor the nautical officer stated that their weather information had been obtained from this device. If they had, then they would have been aware of the above forecast of the DWD.

[29] Only the Elbe sea area section is provided here.

3.3.10 Lifejackets on the № 5 ELBE

Three different types of lifejacket were on board the № 5 ELBE on the day of the accident. One was the older standard type, an orange non-inflatable lifejacket suitable for unconscious people, which was always demonstrated to passengers in accordance with requirements. This type was available on board in the quantity required for the voyage and number of passengers.

Source: Operator

Figure 55: Orange non-inflatable lifejacket

Source: Operator

Figure 56: Neon yellow non-inflatable lifejacket

There was also a second more modern type of lifejacket in neon yellow, which was carried on board in reserve. This was not demonstrated to passengers during the safety briefing, however.

The third type was a work safety vest (automatic lifejacket) for the crew, which also had additional non-inflatable lifejackets suitable for unconscious people at its disposal.

The crew encouraged the three children on board on the day of the accident to wear their specially designed non-inflatable lifejackets on deck at all times. This was left to the discretion of the adults, resulting in nobody wearing one.

Accordingly, only the three children were wearing their lifejackets when the collision happened. Immediately after the collision crew members were keen to distribute lifejackets to everyone and to assist in donning them. Since the broken front mast blocked access to a large number of the orange lifejackets, the neon yellow ones were also distributed. It was not possible to establish whether there were difficulties in putting on this lifejacket because it has to be donned in a different manner and this was not explained during the safety briefing.
What is clear is that ultimately almost every passenger was wearing a lifejacket, while most of the crew members worked without one until the end of the rescue operation.

3.3.11 Structural questions concerning the № 5 ELBE

3.3.11.1 Sails

After compiling and evaluating various statements by crew members of the № 5 ELBE, the BSU believes that the sequence of events surrounding the damage to the headsails is as follows:

To support the turn, the foresail was backed during the turn. Shortly before the turn was completed and the foresail was to be tightened on the port side after the starboard sheet was loosened, the starboard sheet's forerunner parted, causing the pulley and sheet to fall on deck. A crew member reported that the rope running over the pulley was frayed. The foresail was then tightened on the port side.

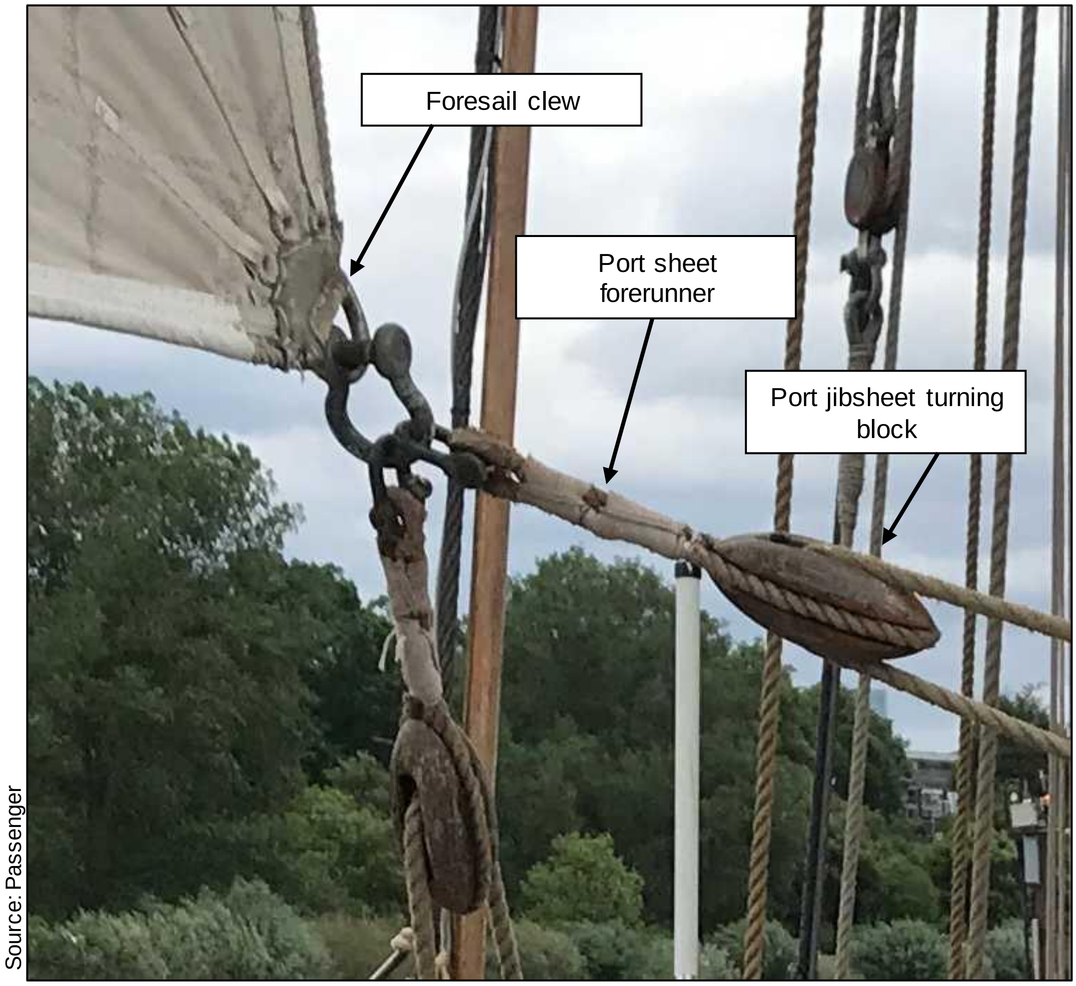


Figure 57: Damage situation at the foresail

Damage to the inner jib clew's reinforcement was detected after completion of the turn. The skipper went to the bow to inspect the damage. He decided that the inner jib should be struck. He then went aft, where he started the engines to improve manoeuvrability while the sail was being struck.

Before it was possible to strike the inner jib, the foresail suffered more damage, probably a tear. The sail then began to beat violently. To prevent the beating sail from harming anyone, the inner jib was left and they started to strike the foresail, which turned out to be more difficult than expected. Consequently, several people were then involved in striking the sail.

Due to the damage caused, the owner (SHM) was asked how old the sails on board are and what maintenance measures had been carried out. The BSU thus discovered that most of the existing sails are still from America. The ship had only been sailed rarely until she was taken over by SHM. In 2007, SHM had a new inner jib made professionally.

Source: Passenger

Figure 58: Tear on the foresail

Furthermore, the foresail and jib were sent for assessment and repair in the autumn of 2018. Sailmakers maintained and repaired all other sails regularly.
The following table can be found in the ship safety manual prepared by the current operator:

A5 Windstärken mit empfohlener maximaler Besegelung									
Beaufort	**<=3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**>=11**
kn	10	16	19	23	29	35	42	50	58
m/s	5	8	11	14	17	21	24	28	33
Winddruck in N/m2	20	39	72	119	183	268	372	504	664
Segelfläche in %	149	122	**100**	71	45	24	15		
Winddruck in daN	854	1.665	2.513	4.153	6.387	9.353	12.983	17.590	
Segelfläche in m2	427	349	**287**	204	130	70	38		
				Reff I	Reff II				
Groß	126	126	126	92	60				
				Reff I	Reff II	Reff II	Reff II		
Schoner	66	66	66	51	38	38	38		
Fock	32	32	32	32	32	32			
Innenklüver	29	29	29	29					
Aussenklüver, klein			34						
Aussenklüver, groß	60	60							
Topsegel	36	36							
Fisherman	78								

Figure 59: Extract from the ship safety manual

First and foremost, this table deals primarily with the effect of wind pressure on the vessel's stability. Nevertheless, the strength of the sails is also considered here.

The foresail and inner jib tore during the turn. The foresail and the inner jib can be used up to 8 Bft and only 6 Bft maximum, respectively.

The BSU inspected the stored sails and masts on 23 July 2019 in the port of Hamburg in the presence of SHM staff. However, it was not possible to make any significant findings because it was difficult to separate damage caused during the collision and damage caused during the subsequent salvage.

According to the stability manual, the masts and sails were measured as follows in 2007.[30]

- Maximum sails comprise the mainsail, topsail, boom foresail, foresail, inner jib, outer jib
- Standard sails comprise the mainsail, boom foresail, foresail, inner jib, outer jib
- Storm sails (reef II) comprise the main with reef II, boom foresail with reef II, foresail
- Before top and rigging-only rigging comprise the mainmast with spars, foremast, fixed and loose bowsprit

[30] See stability manual Yacht concepts and design pilot schooner № 5 ELBE, 1 August 2007.

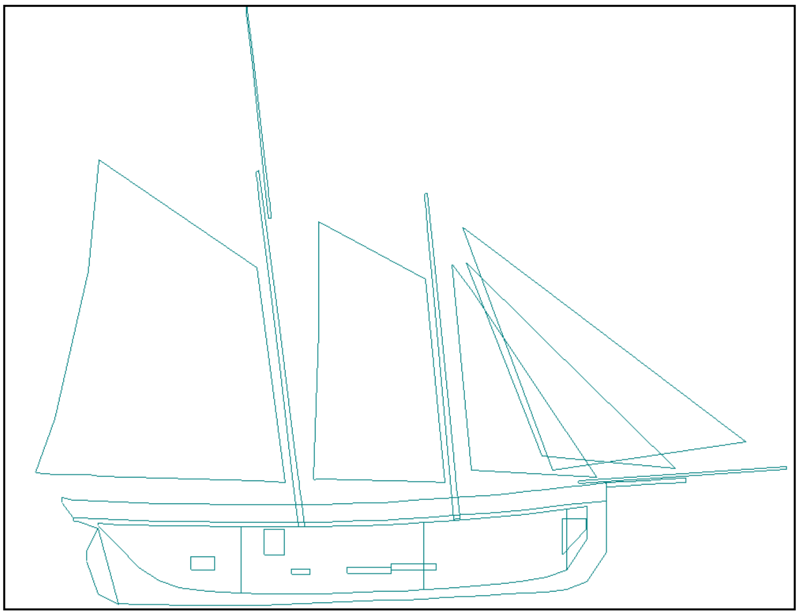


Figure 60: Standard sail configuration

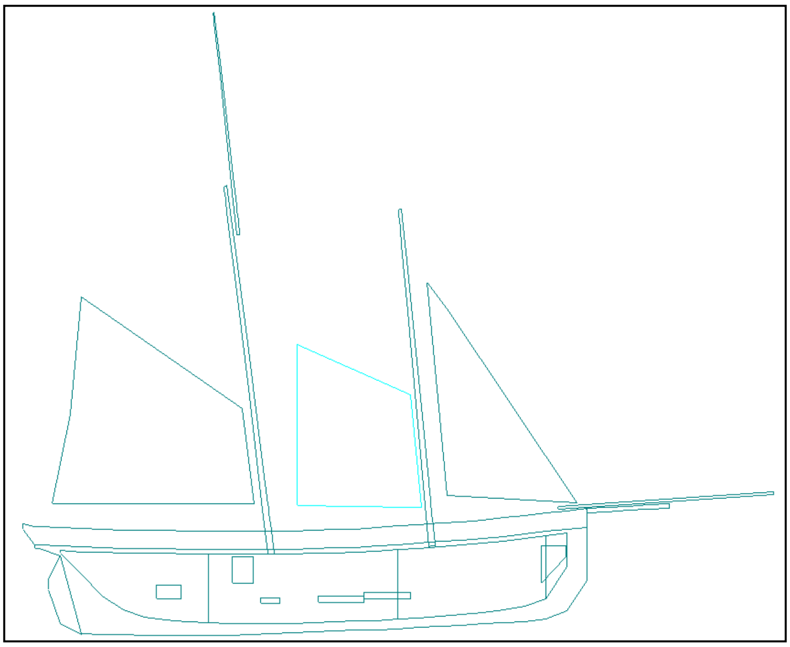


Figure 61: Sail configuration at 7 Bft

3.3.11.2 Ship length

Relevant ship safety regulations are derived from the ship's length.

According to the lines plan G. Junge prepared in 1929 for the conversion on behalf of the American owner, the length is specified as **CWL 23.20 m** and **length overall 26.00 m**.

The length of the schooner's hull was measured at **27.64 m** when SHM purchased her in the summer of 2002. In May 2004, an expert in traditional vessels specified a hull length of **24.80 m** in a safety report for Vessel Category B with up to 50 people on board.

The headnote in the guide for practical application of the old (valid in 2004) *Sicherheitsrichtlinie für Traditionsschiffe* [German Safety Guideline for Traditional Ships] reads as follows:

"The safety requirements in each area are based on the length of the traditional vessel's hull and number of people on board. They are based on the principle that the stringency of the safety requirements should rise concomitantly with the size of the ship and number of people on board."

According to the German Safety Guideline for Traditional Ships, the hull length is the horizontal distance between the outermost points of the stem and sternpost.

SHM requested the BSH to make a re-measurement in January 2005. SHM stated in the request: "*We believe that the measurement of the ship includes an important parameter, the so-called traditional vessel length [...] For the ELBE this measurement is just under 25 metres, a threshold which is of relevance to the manning of the ship. This measurement should be noted in the new tonnage certificate.*"

The BSH then issued a new tonnage certificate on 23 May 2007 with a length of **23.84 m** according to the London Rules[31] (Article 2(8)). In the BSH's measurement report of 22 May 2007, the length over the main deck still stands at **25.79 m**.

The current *Verordnung zur Änderung der schiffssicherheitsrechtlichen Vorschriften über Bau und Ausrüstung von Traditionsschiffen* [German Regulation amending the maritime safety rules for the construction and equipment of traditional vessels] of 7 March 2018 (referred to below as 'the Regulation'[32]) states the following in

2.1.5: **Length:** The registered length according to Article 2(8) of the International Convention on Tonnage Measurement of Ships (London Rules), or for traditional vessels of **less than 24 m** registered length, the hull length LH pursuant to DIN EN ISO 8666, December 2016 edition.

After the last BSH measurement with a length of less than 24 m according to the London Rules, DIN EN ISO 8666 is applied and after that the length (hull length/length above deck) is greater than 25 m. (BSH: 25.79 m.)

The BSU commissioned an external expert to assist with the investigation of the accident involving the № 5 ELBE. According to the above Regulation, the length was

[31] International Convention on Tonnage Measurement of Ships – London 1969.

[32] This replaced the German Safety Guideline for Traditional Ships. This refers to Part 3 of Annex 1a to Sections 6 and 6a of the *Schiffssicherheitsverordnung (SchSV)* [German Ordinance for the safety of seagoing ships] (safety requirements for the construction and equipment of traditional vessels).

calculated at **L= 24.83 m** using the scanned outer shape of the traditional vessel. (See expert report attached under Subsection 9.1.)

3.3.11.2.1 Survey

In the first phase, the damaged traditional vessel was surveyed on a slipway at the Peterswerft shipyard in Wewelsfleth. In addition, the outer contour of the traditional vessel was scanned by officials of the State Office of Criminal Investigation (LKA) in Hamburg (under the guidance of the expert) using a 3D laser scanner and thus formed the basis for subsequent calculations and evaluations of intact and damaged stability.

The following preliminary statements could be made based on the findings of this examination:

- the № 5 ELBE sustained heavy damage in the forward underwater hull (about 2.9 m from the stem) during the collision with the ASTROSPRINTER. Several plank joints on the port side have burst open, resulting in heavy water ingress which could not be stopped with the available bilge pumps;
- the impact of the ASTROSPRINTER's bulbous bow on the underwater hull of the traditional vessel led to extensive deformation of the latter's forward underwater hull section. An asymmetrical deformation of some 170 mm is evident from the analysis of the scanned fore section. In addition, several tears in the forward upper deck and the extensive rippling on the copper plating in the underwater hull on the port and starboard sides point to permanent deformation of the wooden hull;
- the foundering of the TS has seriously damaged or destroyed all technical equipment and the partially historical wooden interior fittings;
- the masts and rigging were either broken or seriously damaged during the collision;
- the tiller with rudder bearings move freely. Since the survey was made outside the water, no statements can be made with regard to the forces when underway and manoeuvring;
- the navigational controls (compass, GPS, etc.) as well as the control elements and levers for the two engines are located in the deck area directly in front of the tiller radius.

3.3.11.2.2 Safety Certificate of the Ship Safety Division (BG Verkehr) for traditional vessel № 5 ELBE, No 05/2018

The Ship Safety Division (BG Verkehr) issued a preliminary safety certificate for the № 5 ELBE on 29 May 2019. However, Chapter 2, Section 1 of the Regulation was already in force at that time, i.e. following renovation and renewal of all the planking and partial renewal of the frames on the traditional vessel. It is unclear how Chapter 1.13.3.b (structural requirements) of the Regulation could apply as a transitional arrangement after this substantial renovation. The following aspects are also relevant:

- Chapter 2, 1.8.1 and 1.8.2 of the Regulation are not complied with. There is no collision bulkhead at 0.05-0.1 x L from FP.
- Chapter 1, 9.2. states that a preliminary certificate may be issued only for a period of six months. This preliminary safety certificate is valid until 16 September 2021, i.e. for more than two years.

Inter alia, the BSU received the following statement from the Ship Safety Division (BG Verkehr) during the consultation phase for this draft report:

"The BSU questions the fact that a preliminary safety certificate with a term of two years was issued for the traditional vessel Nº 5 ELBE. According to the BSU, the maximum period a preliminary certificate may be issued for is six months.

In fact, according to Chapter 1 Rule 9.2 Part 3 of Annex 1a to Sections 6 and 6a SchSV, a preliminary decision may be taken on issuing a safety certificate according to Rule 9.1 under the conditions specified therein, and that the duration of a preliminary certificate issued according to the first sentence of Rule 9.2 is limited to six months. However, Rule 9.2 covers (only) those cases in which a longer period of time is likely to be needed to establish the conditions of entitlement to a safety certificate. Accordingly, these are preliminary decisions that are necessary because time is still needed to prove compliance with already existing requirements. Therefore, for a preliminary decision under this provision, it is also necessary to predict that the conditions exist in all probability.

However, the Nº 5 ELBE's certificate was not limited for this reason, but rather in view of the structural requirements to be met only in the future, i.e. by the intermediate survey. This includes the installation of a collision bulkhead. It was against this background that a term based on the schedule for the intermediate survey was chosen consciously.

The option of issuing a certificate for a period shorter than the standard five years is provided for in Rule 9.1. The designation 'preliminary certificate' is not reserved for certificates under Rule 9.2 in conjunction with Rule 9.1. Rule 9.2 refers only to a preliminary decision on issuing a certificate [...].
[...] Accordingly, the BSU assumes that it is not an existing vessel, but rather a new build in the sense of a 'major conversion' for which the new technical rules of Part 3 of Annex 1a must reportedly be applied directly.

We do not share this view of the (in)applicability of the transitional provision in Chapter 1 Rule 13.3b. According to its wording, the rule applies to any traditional vessel that submits a renewal application for the first time after 14 March 2018, as was the case here. Part 3 of Annex 1a does not contain a 'major conversion' rule in the manner apparently assumed by the BSU. Rather, Chapter 1 Rule 2.1.3 defines as 'new build' only the replica of a historic watercraft whose keel was laid on or after 14 March 2018.

Accordingly, repairs, alterations or major conversions do not preclude application of the transitional rule. Apart from that, the replacement of planks, even on a larger scale, does not constitute a 'major conversion' in our opinion. This also applies to major repairs in the underwater hull section if they do not affect the vessel's hydrostatics.

Consequently, during the periodical survey of the № 5 ELBE on 23 May 2019, the surveyor was right to set a deadline for the installation of the collision bulkhead in accordance with Chapter 1 Rule 13.3b."

3.3.11.3 Bulkheads

According to the applicable Regulation:

Watertight bulkheads

8.1 Traditional ships must be subdivided by bulkheads which should be watertight up to the freeboard deck.

8.2 At least one collision bulkhead must be provided between 0.05 and 0.10 of the traditional vessel's length (Chapter 1 Rule 2.1.5) counting from the forward perpendicular.

8.3 For traditional vessels with a length of 25 m or greater, an after-peak bulkhead is also required at an adequate distance forward of the rudder tube.

8.4 New builds must also be equipped with a forward and aft engine room bulkhead. On traditional vessels with an engine aft, the after-peak bulkhead may replace the aft engine room bulkhead.

8.5 Traditional ships operating outside coastal waters must be subdivided by watertight bulkheads to ensure that the freeboard deck does not sink below the surface when a compartment is flooded.

8.6 Rule 8.3 does not apply to traditional vessels designed without bulkheads if no significant modifications have been made to them.

In the context of the BSU's preliminary findings, the expert has also been instructed to carry out an assessment of intact stability and damaged stability. (See Subsection 9.2.)

The following statements can be made based on the findings of this investigation:

Intact stability according to the Regulation

Taking into account the results and analyses of the inclining test of 21 October 2006 and the assumptions made herein, the results of this calculation confirm that the № 5 ELBE meets the requirements for intact stability in the German traditional vessel guideline.

In all required load cases, the stability criteria and the criteria for moments produced by turning circle, weather and one-sided concentration of people for traditional vessels under engine power and sail are met. The ship may operate with standard sails (without topsail) up to a wind force of 6 Bft and with storm sails (reef II) up to a wind force of 9 Bft. The ship has an excellent range of stability in all load cases with a satisfactory but not excessive initial stability. This implies excellent sea-keeping qualities.
In assessing the results of these calculations, it is assumed that the major restoration work carried out in the winter of 2018/2019 did not change the ship's masses or centres of gravity. It is advisable to carry out a new inclining test after completion of the pending repair phase to calculate masses and centres of gravity. The wash ports in the bulwark should not be lockable and should be fully functional.

Damaged stability

The Ship Safety Division (BG Verkehr) provisionally certified the № 5 ELBE as a traditional vessel without watertight transverse bulkheads in accordance with Germany's latest guideline. In the course of this investigation, the expert was required to assess the extent to which sufficient damaged stability can be achieved for this ship with compliance with one-compartment status[33].

Taking into account the intact stability results and the assumptions made herein, the results of this calculation and assessment show that the № 5 ELBE would meet the damaged stability requirements for one-compartment status under the following conditions:

- the installation of two watertight bulkheads with bulkhead doors in the areas of frame 6 (forward edge of the aft accommodation space) and frame 15 (forward edge of the large accommodation space amidships) enables the achievement of one-compartment status with the criteria for the load cases required here;
- a collision bulkhead positioned in accordance with the requirements of the regulations is not needed for the maintenance of buoyancy in the event of leakage if a watertight bulkhead is installed at frame 15;
- a double bottom from frames 6 to 15 is not needed for the maintenance of buoyancy in the event of damage. Given the design of the strong S frame with keel, the double bottom is only required as protection against ground contact to a limited extent and its inclusion in the design is difficult to achieve in this wooden structure;
- the general requirements regarding stability information for the skipper, damage-control plans, load lines, design of bulkheads and watertight doors would have to be met;

[33] The opinion is available in the Annex.

- the design for the construction of watertight bulkheads on this ship was not part of the investigation. Changes in mass and centre of gravity due to the installation of watertight bulkheads have not been taken into account in these calculations.

The ship would always remain afloat if one main compartment flooded and would meet the required stability criteria in each of the three load cases examined.

3.3.11.4 Tiller

3.3.11.4.1 Fundamentals

The ship is steered with the steering system. The acting components are the rudder blade in conjunction with the ship's wake. The change in the rudder blade's position when it is centred or in a neutral position, where the ship's keel line and rudder blade are in alignment, is indicated in degrees with the word 'port' or 'starboard' indicating to which side the rudder blade is moved. The position to which the rudder blade is moved is referred to as 'rudder position' or 'rudder angle'.

The rudder blade is firmly attached to the rudder stock, which is mounted on the hull such as to allow it to rotate. To move the rudder blade and hold it in position, a force must act on the centre of gravity of the rudder blade. This requires a torque resulting from the force and radius of the rudder stock centre/rudder blade's centre of gravity.

The force producing the torque needed to move the rudder acts on a lever permanently attached to the rudder stock (tiller, rudder yoke or rudder quadrant).

On small vessels the force of a human acting directly on the tiller is sufficient for moving the rudder. Mechanical assistance (or the use of steering gear+) is required on larger ships.[34]

3.3.11.4.2 Steering gear on the № 5 ELBE and its operation

The № 5 ELBE's manoeuvrability is described as generally good. At speeds through water of less than one knot there is often no response to movements of the rudder. At two to three knots the tiller can easily be steered without tackle. At more than three knots it becomes difficult without tackle or it has to be moved in pairs[35]. Hard to starboard or hard to port manoeuvres cannot be made with the tackle – a second person must assist.

[34] Source: K. Bösche 'Vom Handruder zur Rudermaschine' retrieved from www.deutsches-Schiffahrtsmuseum.de.

[35] Tackle was attached to each side of the tiller on board the № 5 ELBE. Tackle comprises at least two blocks (rollers) through which a rope is passed. As with pulley tackle, this extends the path and reduces the force to be applied.

The helmsman receives his orders from the skipper or the nautical officer, depending on who is navigating, i.e. who is responsible at that particular moment.

When using tackle, the helmsman stands on the starboard side of the control position near the VHF unit. This also improves his visibility ahead and to starboard. The helmsman must repeat all commands received. Helm commands are only issued such as to indicate the direction in which the ship should move (one-third to starboard or two degrees to port, for example). The helmsman then has to make a mental conversion, i.e. to turn the ship to starboard he has to move the tiller to port. Commands are also very often given to the helmsman such as to indicate that he should follow the course of the fairway (about one to two ship lengths from the buoy line).

The № 5 ELBE was originally equipped with a tiller of about 3 m in length. During the conversion of 1929/1930 for the then American owner, the tiller was exchanged for a worm-driven steering apparatus with steering wheel. SHM replaced this steering gear 75 years later (2002/2003) with a tiller steering system again.

In 2016, SHM essentially stated the following in an expert opinion for the *Denkmalschutzamt* [heritage protection office]: The reason for changing from tiller to wheel steering during the 1928 conversion was to **reduce the amount of effort and risk**. For the change back to tiller in 2005, they spoke of a **return to the original design**.

The following is stated with regard to the conversion back to tiller:

"In the steering apparatus, a complicated piece of technology that was modern at the time and certainly had its historical value was changed back to the extremely simple original arrangement (tiller steering)*. This bold step has yielded a gain in integrity for the ship. Nowhere else is a ship of this size steered with a wooden tiller – it is after all more than three metres long!"*

However, the BSU is of the opinion that tiller steering in the manner used today represents an increased risk of injury.

1.) Climbing over tackle routing is especially dangerous when the ship is underway and listing. The area aft of the tiller is also used as a seating area for passengers, which is why the area around the tackle routing is often crossed (see Figure 10).

2.) When moving astern there is a risk of the tiller swinging abruptly.

3.) With a worm guide (steering apparatus), the rudder would remain in the required position.

4.) The force that needs to be applied to the steering wheel would be much lower, making the rudder easier to operate.

During the consultation phase for this report, SHM commented as follows:
"Inter alia, the tiller steering cannot be converted due to heritage protection requirements. No conversion solution can ever exceed the rate of response of tiller steering."

3.3.11.5 Aft emergency exit

The № 5 ELBE has several mandatory and designated emergency exits. On 20 September 2019, two investigators went back to Wewelsfleth to survey the aft exit, which up to that point had been defined as an emergency exit. A hatch is located above the engine room, meaning it has a second exit in case of emergency. The cover, which is folded upwards, is so heavy that only two people were able to remove it from the deck. There was no handle inside it. The tiller would be in the way and above the hatch if it were not moved outwards (hard-over rudder angle) beforehand, making it difficult for someone who wanted to open the cover from inside. However, even at a hard-over rudder angle, the tackle (which is usually attached to the tiller) can cause an obstruction. It would certainly be more practicable to install the cover by means of a sliding mechanism. In addition, there would need to be a ladder inside because otherwise it would not be possible to get out of the hatch.

In this context it became apparent that ladders would also be needed at the skylights marked as emergency exits.

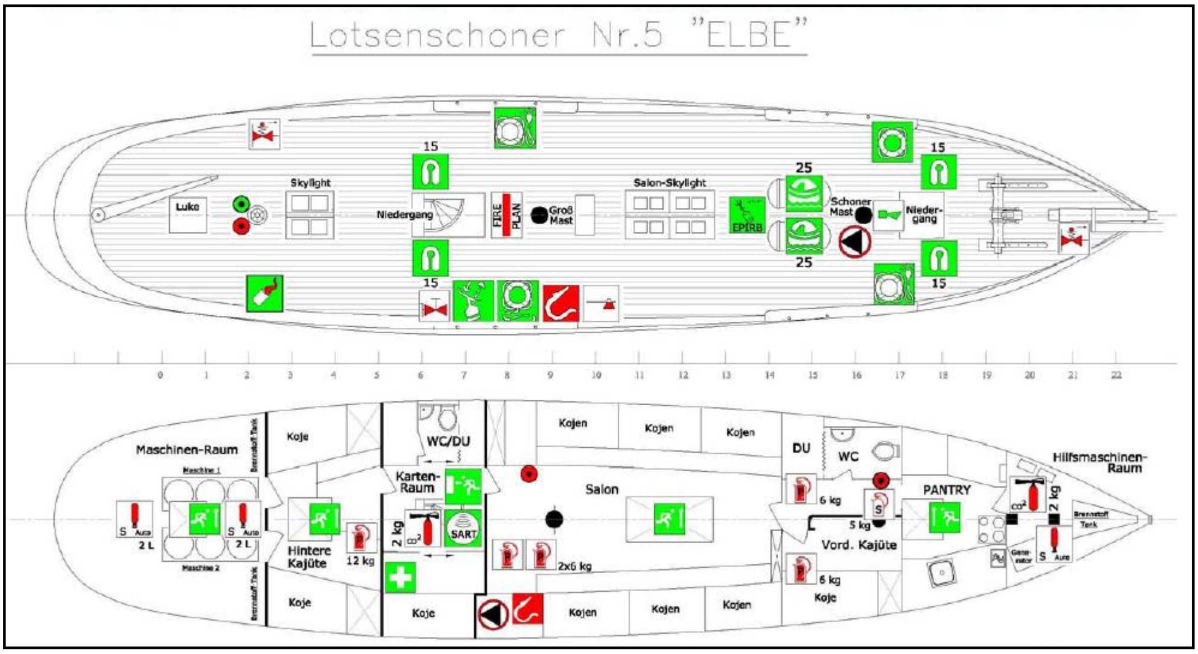


Figure 62: Top view from the fire control and safety plan

Inter alia, the BSU received the following statement on this point from the Ship Safety Division (BG Verkehr) during the consultation phase for this investigation report:

"The requirements for escape routes are laid down in Part 3 Chapter 3 Section 5 of Annex 1a to Sections 6 and 6a SchSV.

The emergency exit referred to [...] is located in the aft section of the vessel at the aft edge of the engine room. It is a small engine room which is accessible via the aft cabins. The engine room does not have to be manned while under way and derogations may be made to Rule 5.5.1 Part 3 Chapter 3, Section 5 due to its size (< 20 m^2 and emergency exit length < 5 m). In accordance with Rule 5.5.3 Part 3 Chapter 3 Section 5, a single emergency exit via the aft cabins is thus sufficient for this engine room. Accordingly, the aft hatch cannot be declared as an emergency exit, meaning that the current structural conditions are not relevant.

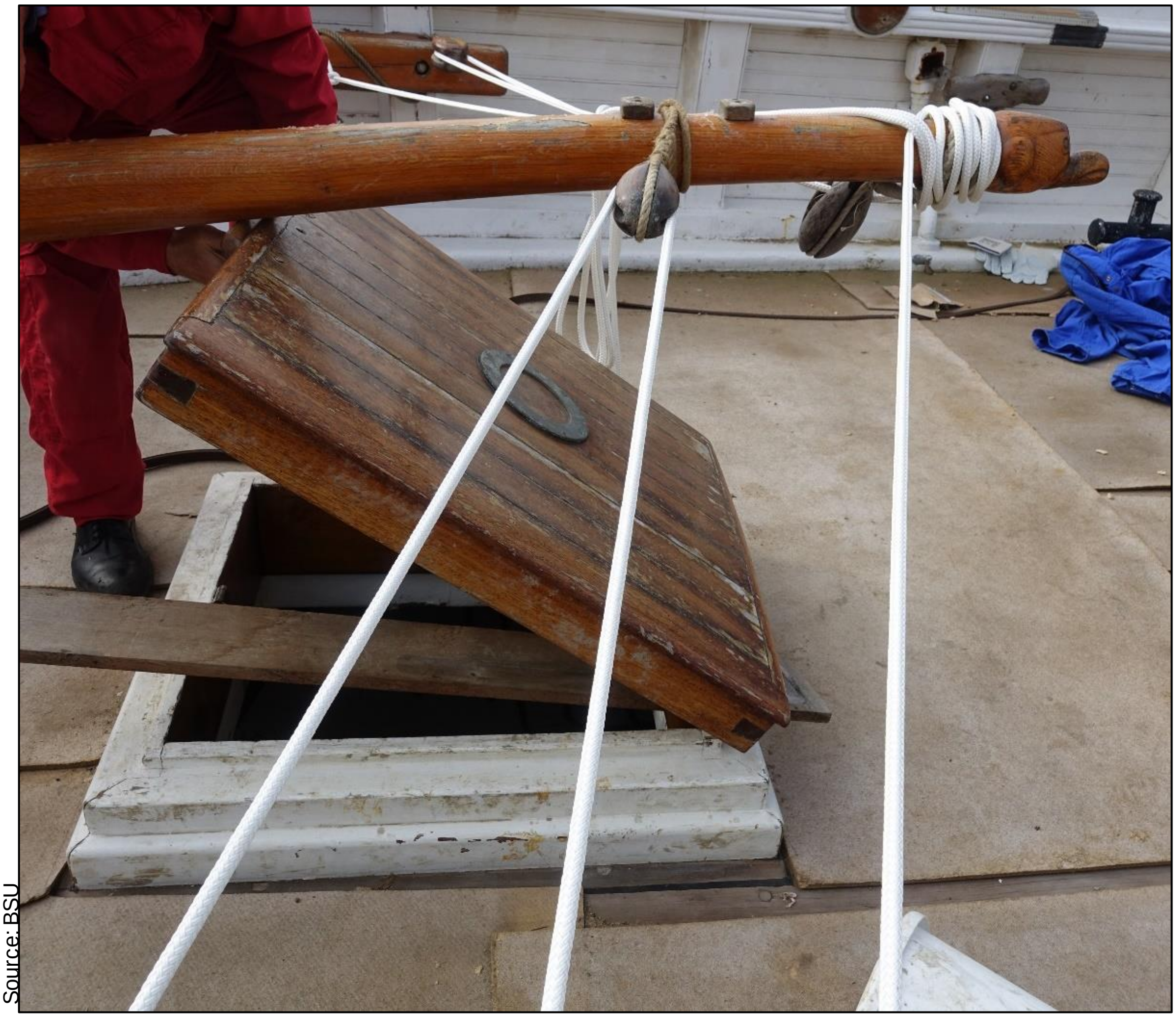
The vessel has four emergency exits across her entire length, which offer sufficient options for evacuation from any part.

The Ship Safety Division (BG Verkehr) will impose a requirement to revise the fire control and safety plan."

Source: BSU

Figure 63: Aft hatch with cover closed

During the consultation phase, SHM commented as follows:
"The propulsion system is designed so that the engines are operated only from the deck control position. People are not situated in the extremely narrow, barely accessible after-peak during the voyage, meaning that an emergency exit is not needed there."



Source: BSU

Figure 64: Aft hatch blocked by the tiller

3.3.12 Navigational considerations

3.3.12.1 Possible sailing courses of the № 5 ELBE

The wind speed and wind direction recordings on the day of the accident offer the following data for the Stade area:

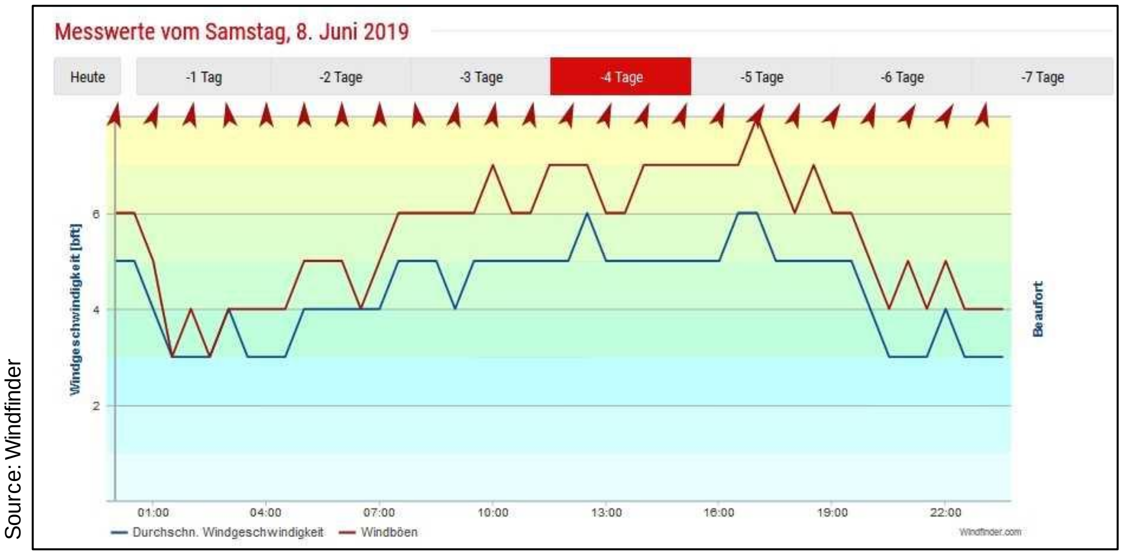


Figure 65: Wind direction and wind force readings at Stadersand on 8 June 2019

The average wind force was therefore 5 Bft. The gusts had a strength of about 6-7 Bft. A south-south-westerly wind prevailed. This is consistent with the findings of the DWD.

The VTS's radar recordings were used to trace the course of the № 5 ELBE. Only a short period of time was available, as only five minutes passed between picking up speed after the turn at 1349 and the collision at 1354. After the turn was completed, the № 5 ELBE initially deviated away from the wind and picked up speed. A relatively constant course was then maintained from about 1351. The analysis revealed a course over ground (COG) of about 142° during these four minutes. This would correspond to what the investigators consider a realistic turning angle[36] for this type of sailing craft of 110-120°. However, it should be noted that in addition to the wind drift, the ebb current, still prevailing until about 1455, may have affected the COG significantly during the further course of the voyage.

The analysis from the experts at brand Marine Consultants[37] gives rise to a similar conclusion with regard to the COG, stating that it was between 139° and 143° in the period leading up to the collision.

[36] Angle between two close-hauled courses of a sailing vessel resulting in an area that cannot be navigated without turning. The angle is affected by the intended optimum ratio between speed and the gain in height to the wind.
[37] SHM instructed brand Marine Consultants to prepare a report, which was provided to the BSU.

Based on the values determined, it becomes clear that after the turn, the № 5 ELBE would have had to sail a considerable distance only under sail to reach the right side of the fairway running upstream on the River Elbe. The investigators believe it is possible that the № 5 ELBE's helmsman was using buoy 107/roadstead (see Figure 66) as a guide.

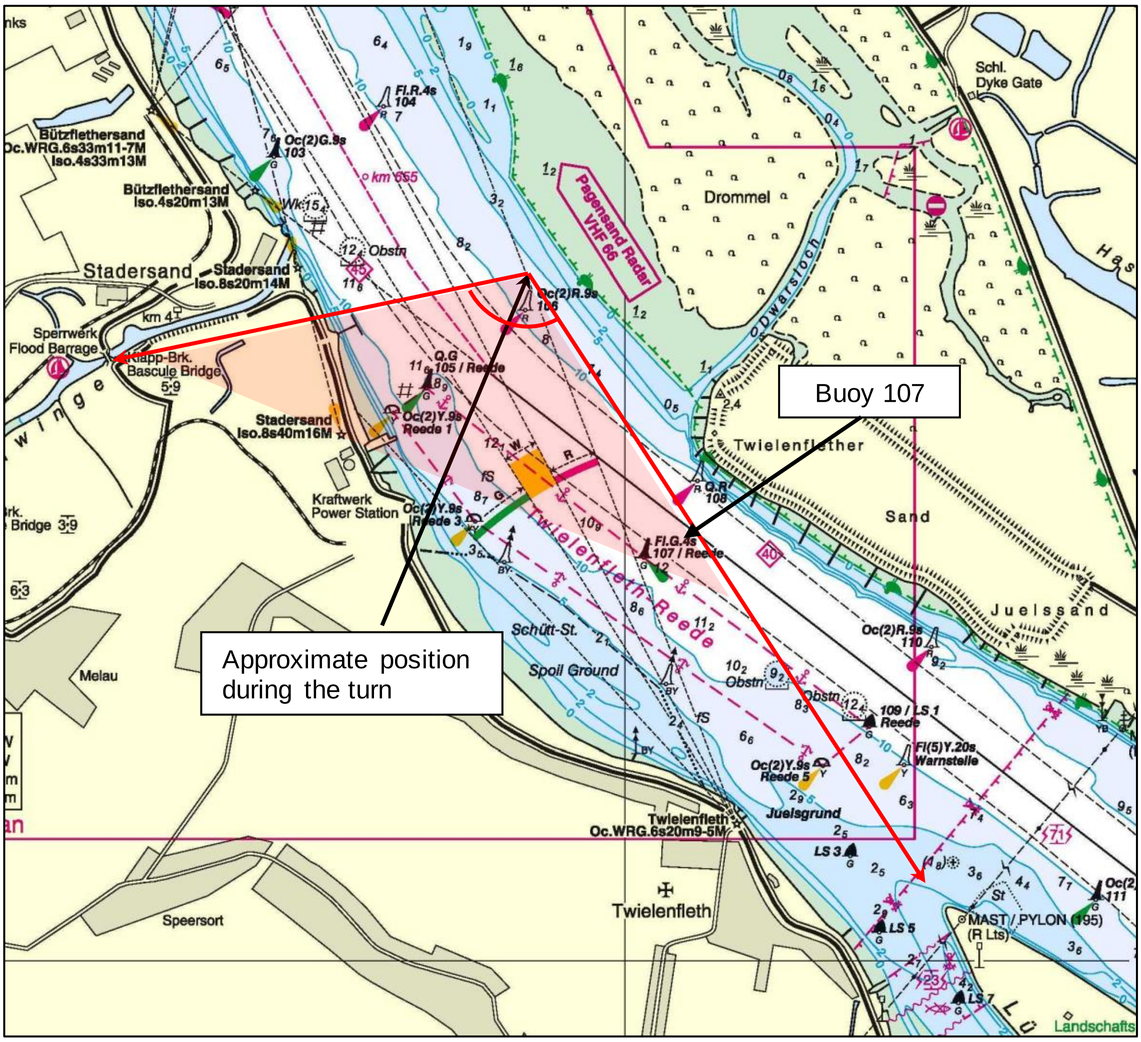


Figure 66: Turning angle of the № 5 ELBE in relation to buoy 106

Area not navigable without turning with wind direction SSW (202.5°) and assumed turning angle of 110°.

On the other hand, the № 5 ELBE's engine power would have been sufficient to set a direct course for the correct side of the fairway with engine support and sails set after the WILLEKE had passed. Buoy 105 would have been a good reference point for this, for example.

The area navigable by the № 5 ELBE under sail is shown in Figure 66. It becomes clear that it would have been possible to reach the correct side of the fairway even without turning, i.e. by luffing or sailing close to the wind.

During the period reviewed in VTS Brunsbüttel's radar recording (134042 to 135730), there was no upstream vessel traffic on the relevant fairway side. To that extent, this fairway side could have been easily reached under engine power or sail.

Figure 67 shows the № 5 ELBE sailing upstream with a relatively hard boom foresail after the turn. Since the photograph was taken with a smartphone, the investigators assume that its time corresponds to the actual time.

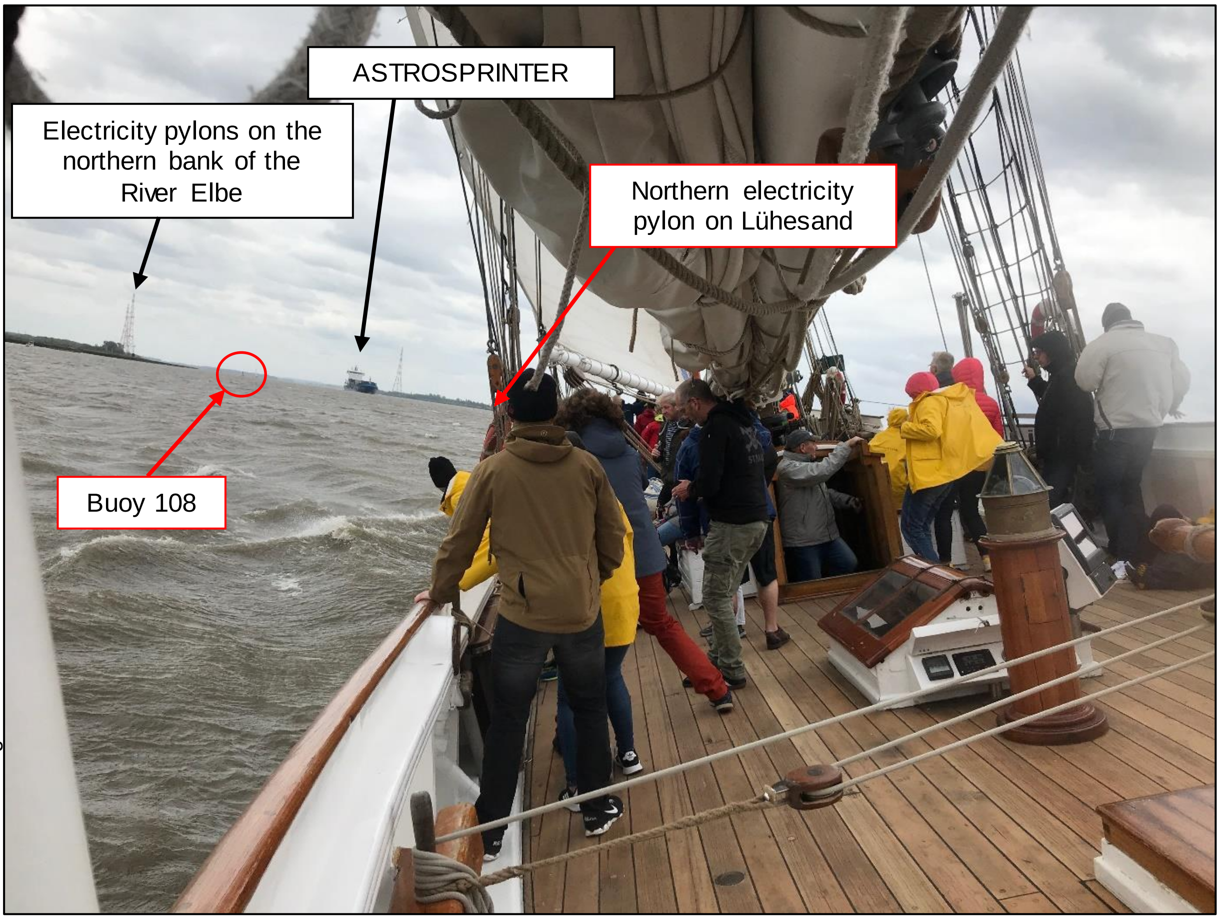


Figure 67: 135228 – image showing the situation

The photograph was taken about two minutes before the collision. The № 5 ELBE is sailing for the northern mast on the island of Lühesand. Buoy number 108 is visible. The № 5 ELBE is situated slightly to the east of the alignment bearing of the two electricity pylons on the northern bank of the River Elbe.

The corresponding radar image (Figure 68) at this point shows the № 5 ELBE on the northern edge of the channel (dotted area of the fairway). Buoy 106 has just been passed on port beam. The ASTROSPRINTER has buoy 108 on starboard beam.

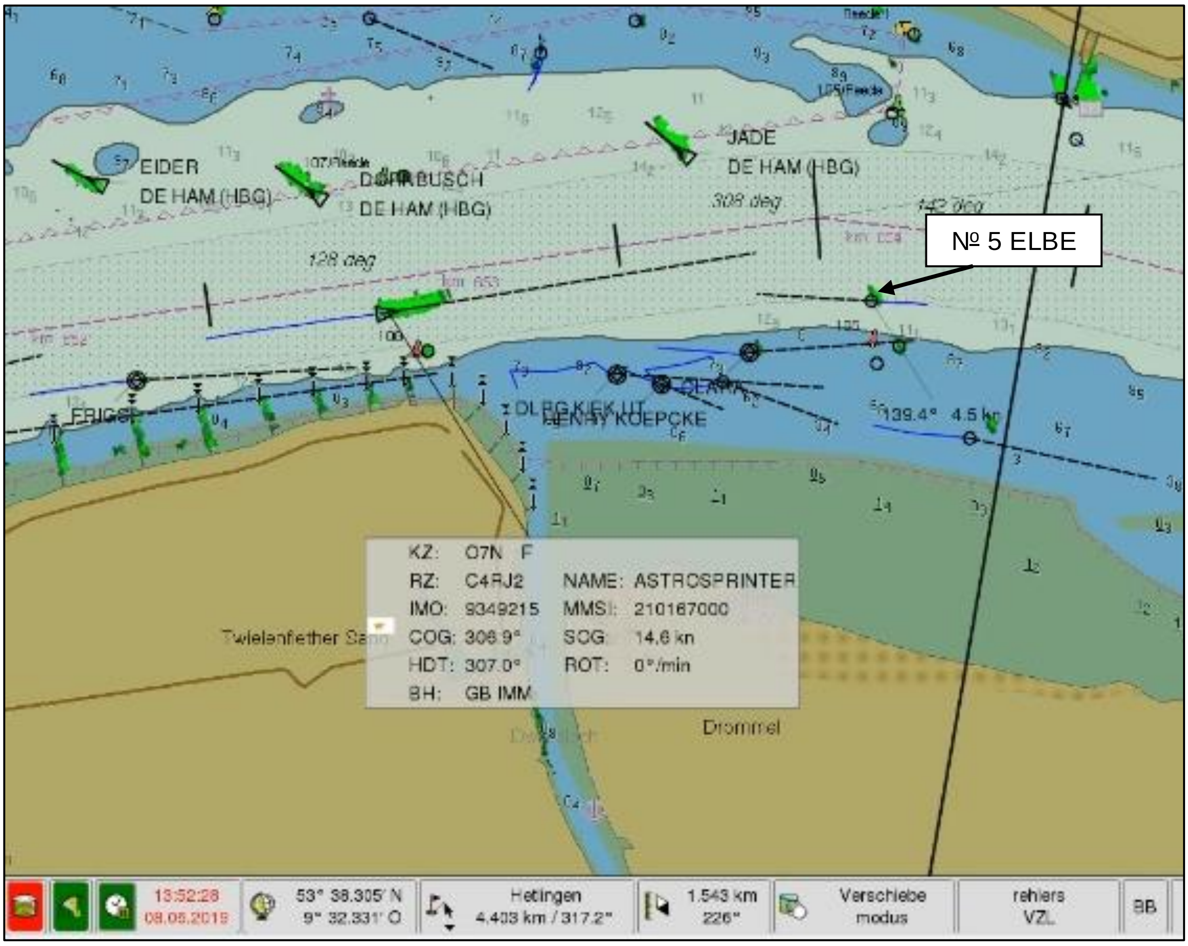


Figure 68: VTS Brunsbüttel radar image at 135228

The respective vector in front of a craft indicates the craft's position two minutes later if speed and COG remain the same. It is evident that the two vessels will be abreast at about 135428.

This makes it possible to determine the № 5 ELBE's position (including in the fairway) quite clearly on the navigational chart (Figure 69). The bearing to the electricity pylon on Lühesand is approximately 143°. Despite the photographer's position in Figure 67, it can be seen that the № 5 ELBE's heading roughly corresponds to this value.

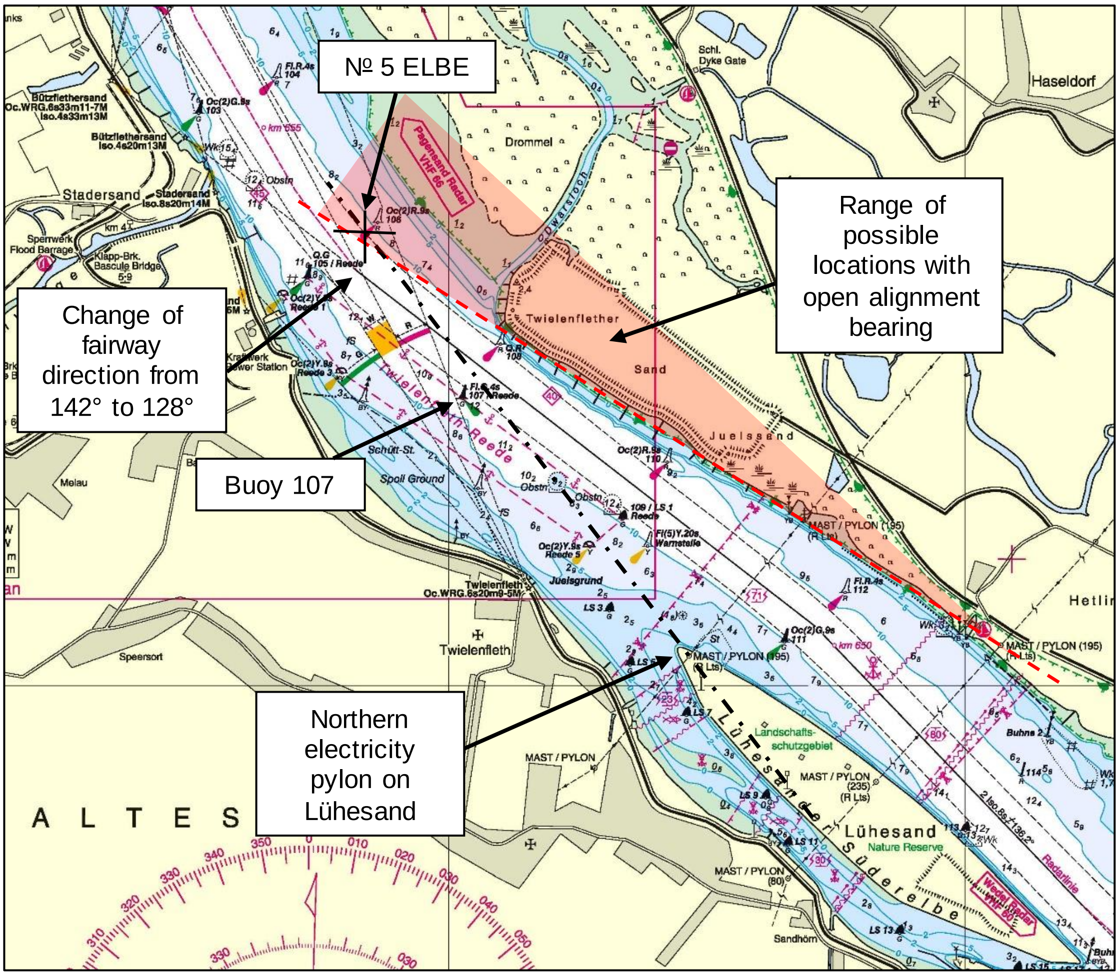


Figure 69: Extract from Navigational Chart 47, BSH

Position of the № 5 ELBE at 135228

The black dotted line indicates the position line to the northern electricity pylon on Lühesand. The red dotted line indicates the alignment bearing on the two electricity pylons on the northern bank of the River Elbe

3.3.12.2 Situational awareness

Situational awareness is understood to be an overall view of the situation, while at the same time becoming aware of what is likely to happen next.

It can be seen from figures 68 and 69 that the № 5 ELBE was still a long way from the middle of the fairway at 135228 and continued to sail parallel with the course of the fairway (chart course of the fairway 142°) in the next minute. It was not until the bend in the fairway at buoy 105 (chart course 128°) that a significant gain in distance covered in the direction of the middle of the fairway (upstream on the River Elbe) was possible.

As the two vessels were converging, the ASTROSPRINTER started to make a course alteration of 4° (from 307° HDG to 311° HDG) toward the № 5 ELBE at about 135327 (Figure 70).

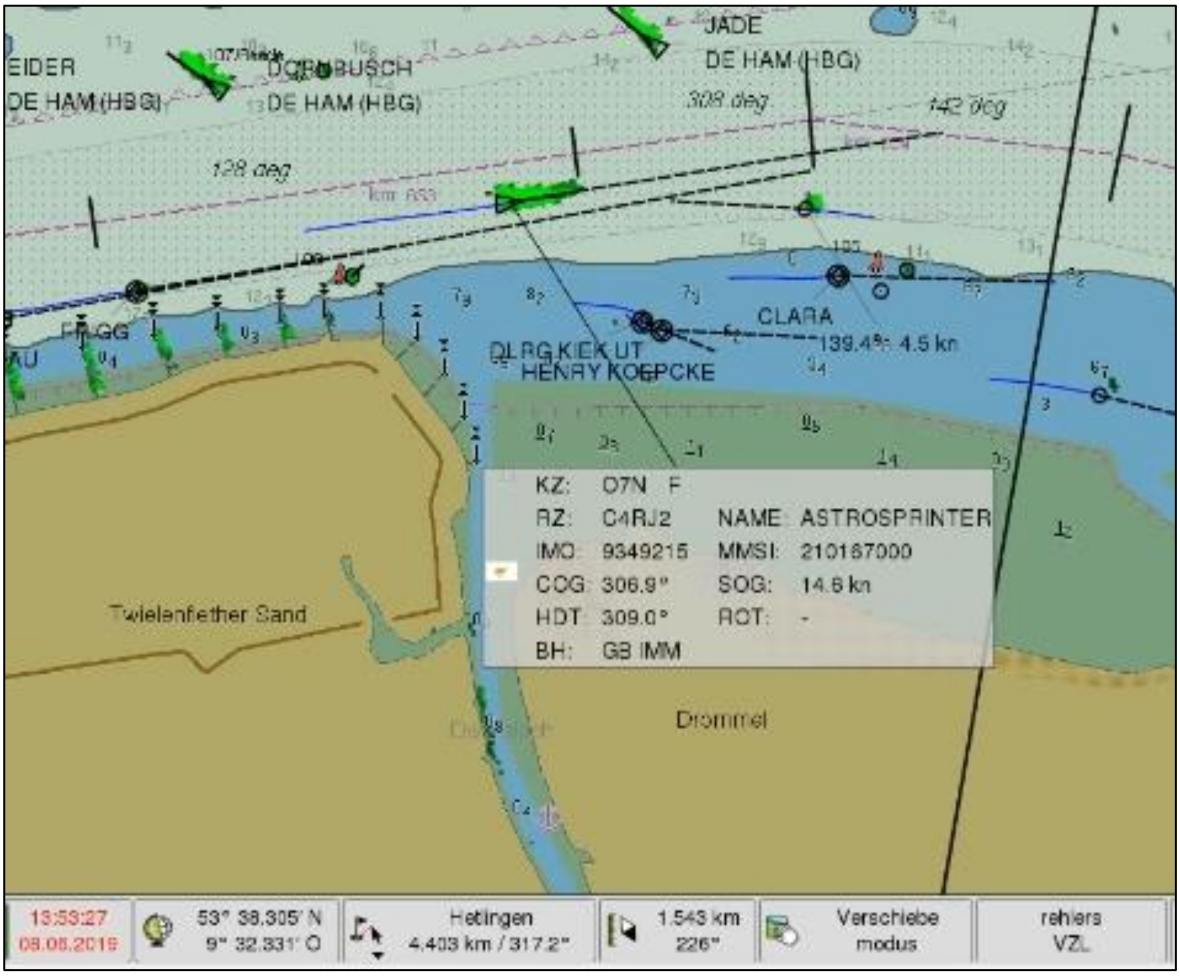


Figure 70: VTS Brunsbüttel radar image at 135327

The ASTROSPRINTER begins to alter course to starboard.

The ASTROSPRINTER's COG had adjusted accordingly (310.8°) at 135346. The № 5 ELBE began her sudden course alteration to starboard at about 135354 at the latest (Figure 71), which led to the turn directly in front of the ASTROSPRINTER's bow (Figure 72). It can be seen that the № 5 ELBE had not significantly reduced the distance to the middle of the fairway by this point in time.

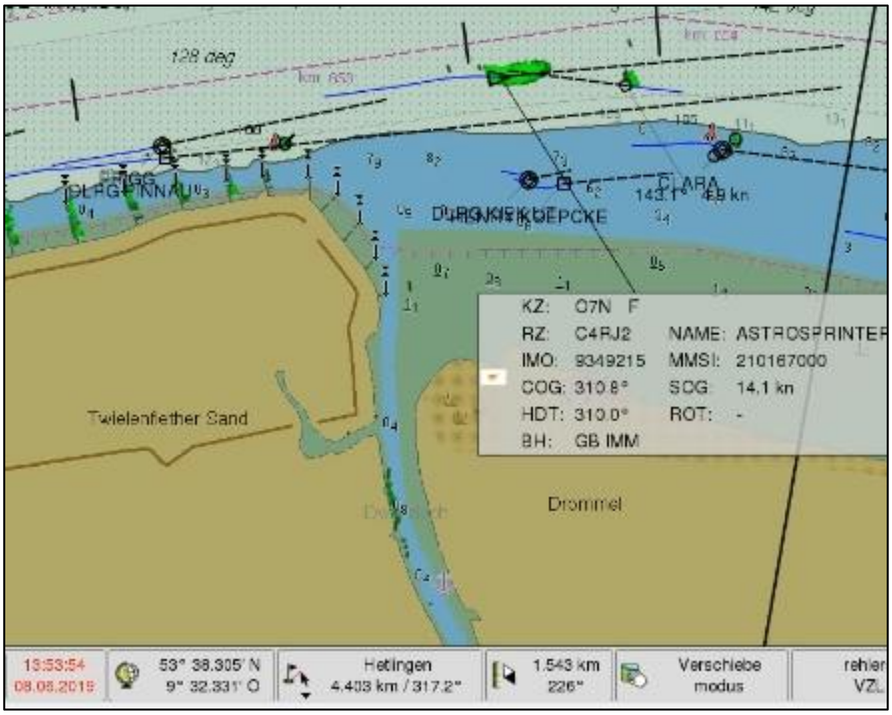


Figure 71: VTS Brunsbüttel radar image at 135354

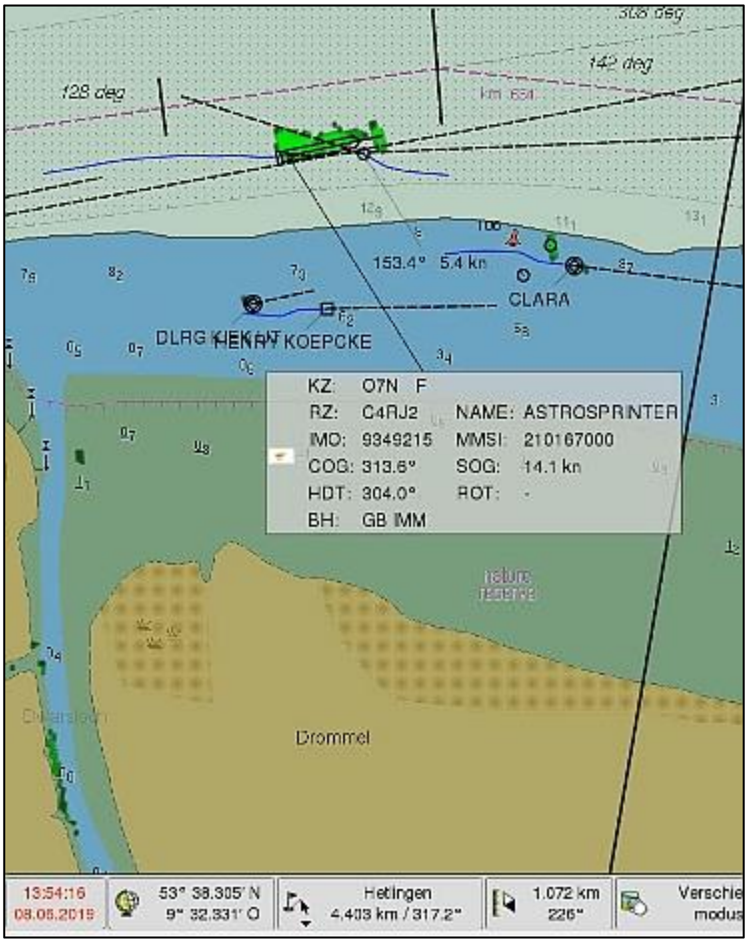


Figure 72: VTS Brunsbüttel radar image at 135416

Figures 66 and 68 show that the below assumptions of the ship's command of the № 5 ELBE were flawed.

1. The constant bearing to the ASTROSPRINTER and her necessary course alteration due to the change of the fairway's course would immediately result in a course alteration by the ASTROSPRINTER to starboard. This would lead to a port-by-port pass.

    - The BSU assumes that such a manoeuvre would only have been theoretically possible up to the time of Figure 68, as the distance between the two vessels would only have made this possible with acceptable safety prior to that. On the other hand, an impartial view would not give rise to the expectation that the ship's command of the ASTROSPRINTER would sail into the tight gap between the № 5 ELBE and buoy 106, especially since this would have necessitated a vigorous manoeuvre toward the northern edge of the fairway beforehand, so as to provide the № 5 ELBE with the space necessary.

    - The ship's command of the № 5 ELBE expected the ASTROSPRINTER to alter course to starboard due to the course of the fairway. It could also be assumed that the ship's command of the ASTROSPRINTER also expected the № 5 ELBE to make this course alteration to port in accordance with the course of the fairway, dissolving the 'constant bearing' in the process.

    - The theoretical course alteration point for the ASTROSPRINTER resulting from the bend in the fairway was much closer to buoy 106 than to buoy 108. At the time of Figure 68, this point was situated quite some distance away at about 4° starboard of the № 5 ELBE. Accordingly, it would have been expected that the ASTROSPRINTER would continue to head for this point and not initiate a course alteration before that.

Therefore, the ship's command of the № 5 ELBE could not reasonably assume that the ship's command of the ASTROSPRINTER would aim for a pass of the two vessels on the respective port side due to the forthcoming course alteration. Rather, it should have initially been assumed that the ASTROSPRINTER would maintain her course up to the course alteration point. This course of the voyage can be observed with the ZAPOLYARNYY, for example (Figure 73).

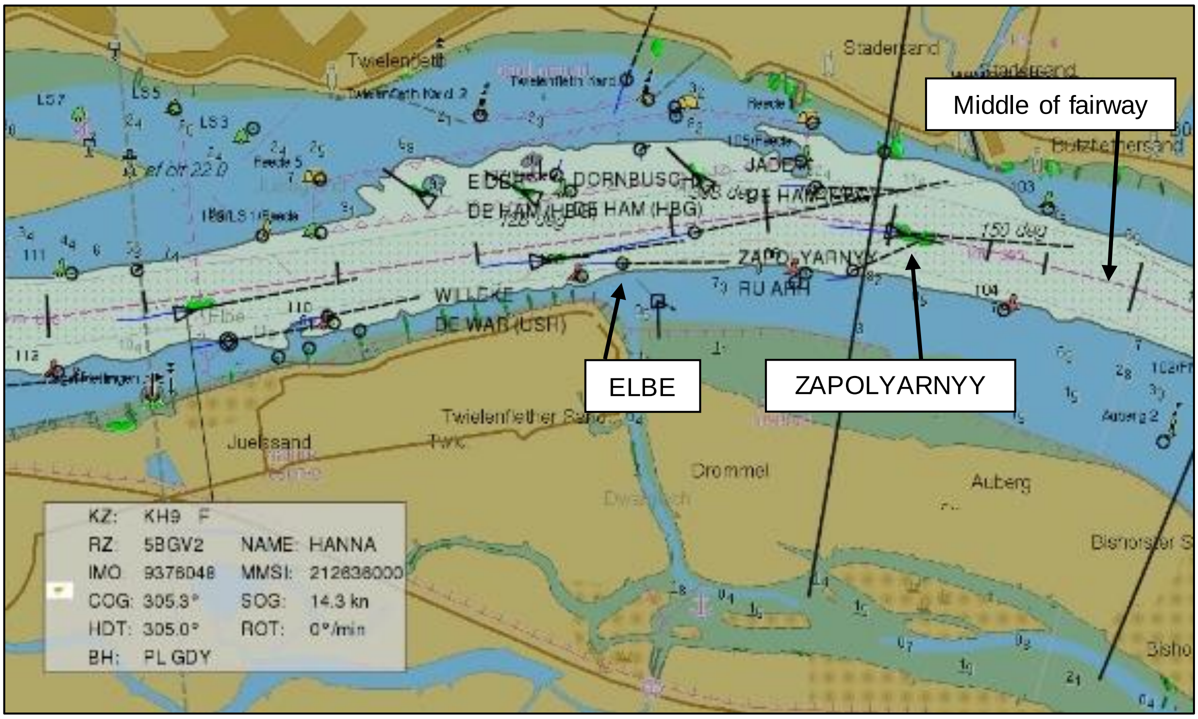


Figure 73: ZAPOLYARNYY follows the course of the fairway

VTS Brunsbüttel radar image at 134050

2. Since the ASTROSPRINTER did not alter course despite the constant bearing and changing course of the fairway, the № 5 ELBE's nautical officer gave the warning signal twice and then turned off to starboard because there was no response.

   – The ASTROSPRINTER was not required give way because she was following the course of the fairway on the correct side and the № 5 ELBE intended to cross the fairway, albeit slowly.

   – The ship's command of the № 5 ELBE initiated a turn in the direction of the ASTROSPRINTER. This manoeuvre took the traditional vessel in front of the ASTROSPRINTER's bow (Figure 72).

   – If the ship's command of the № 5 ELBE had decided to bear away, then the vessel would have remained on the northern edge of the channel. A close pass with the ASTROSPRINTER would have occurred. In the opinion of the investigators, this manoeuvre would have been easy and quick to implement because of the sail pressure point in the forward part of the № 5 ELBE due to the selection of sails.[38] It would not have stopped the № 5 ELBE's momentum and an increase in the distance to the ASTROSPRINTER would also have been possible. The visible buoy 108 would have been a good landmark.

[38] However, this assumption contradicts the nautical officer's statement that the № 5 ELBE had a weather helm due to the sail position.

– The blue lines behind each vessel in Figure 72 show the respective COG. The BSU assumes that without the № 5 ELBE luffing and ultimately altering course ("the bearing away"), there would merely have been a very tight pass between the two vessels.

To sum up:

– the intention to cross the fairway in a long swing so as to then sail on the correct side is permissible, as long as no vessels following the fairway are obstructed. Accordingly, the № 5 ELBE should have given way to the ASTROSPRINTER, which was following the fairway. On the other hand, crossing should take place with a <u>clear</u> deviation from the general direction of travel[39]. That was not the case in this instance, leading to the impression that there was no intention to cross the fairway;

– the assumptions of the № 5 ELBE's skipper regarding the possible course alteration of the ASTROSPRINTER were not confirmed by communicating with the ship's command of the ASTROSPRINTER;

– the skipper, who was in command of the vessel at all times, was not near the helm during the convergence with the ASTROSPRINTER, where apart from the radar and chart plotter, a VHF device would also have been available for contacting the ASTROSPRINTER.

3.3.13 Assessment of events based on traffic legislation

3.3.13.1 Traffic regulations on the River Elbe

3.3.13.1.1 Legal sources

Since the two vessels collided on the section of the River Elbe classed as a German maritime waterway, the provisions of the *Seeschifffahrtsstraßen-Ordnung* (SeeSchStrO) [German Traffic Regulations for Navigable Waterways] are primarily relevant when classifying the accident based on traffic legislation. Moreover, the International Regulations for Preventing Collisions at Sea (COLREGs) also apply on the section of the River Elbe in question, i.e. between the North Sea estuary and port of Hamburg, which is regularly used by seagoing vessels. Section 1(4) SeeSchStrO states explicitly that the COLREGs shall [only] apply if the SeeSchStrO does not expressly provide otherwise.

Accordingly, Sections 21 ff. SeeSchStrO lay down the steering rules to be observed (primarily) on the River Elbe, i.e. in particular, exceptions from the requirement to proceed on the starboard side of a fairway (Section 22), certain rules on overtaking Section 23) and head-on situations (Section 24), and with regard to the right of way of ships in a fairway (Section 25). It also follows from Section 21(1) SeeSchStrO that these rules apply irrespective of the conditions of visibility prevailing. With regard to the applicability of Rules 11 and 19 COLREGs, it is also stipulated that, by way of

[39] See comments by Graf/Steinicke.

derogation, Rules 13(a) and (c) COLREGs (regarding overtaking) and Rules 14(a) and (c) COLREGs (regarding head-on situations) also apply if the vessels have not been sighted but detected by radar.

Since the collision between the two vessels occurred during the day in good visibility, the latter details of the interaction between the aforementioned rules of the SeeSchStrO and of the COLREGs are not of importance when considering events on the day of the accident on the basis of traffic legislation.

On the other hand, the fact that the collision occurred on a stretch of the River Elbe marked by fairway buoys, and thus in a fairway, is of material importance. According to Section 2(1)(1) SeeSchStrO, such fairways are classed as narrow channels for the purposes of the COLREGs, meaning Rule 9 COLREGs, which deals with navigation in narrow fairways, applies insofar as the SeeSchStrO does not contain any different requirements in this regard.

3.3.13.1.2 Steering rules on the River Elbe (extract)

(1) Rules governing right of way

The central rule for governing right of way on the River Elbe maritime waterway is Section 25 SeeSchStrO. According to the Subsection 1, the provisions therein expressly apply <u>in derogation</u> of Rules 9(b) to (d), 15, and 18(a) to (c) COLREGs. *Inter alia*, this means that in the River Elbe fairway the rules of the COLREGs on conduct in a crossing situation (Rule 15) and, in particular, on responsibilities between vessels (Rule 18), which, within the scope of the COLREGs depend largely on belonging to a certain vessel category, are overridden by special rules governing right of way laid down in Sections 25(2) ff. SeeSchStrO.

According to Section 25(2)(2) SeeSchStrO, vessels proceeding along the course of the fairway channel (irrespective of vessel category) thus have right of way over vessels entering, crossing or making turns in that fairway. At the same time it is of no relevance whether 'crossing' refers to the entire width or only part of the fairway. Consequently, a vessel initially following the course of the fairway, which leaves the fairway at right angles, must be regarded as a vessel crossing an oncoming vessel and has an obligation to give way.[40] Subsection 6 states that a vessel having to yield the right of way shall, in good time, demonstrate through her conduct that she has the intention to wait. Passage shall not be resumed until the person in command of her is in a position to verify that he or she can do so without affecting the safety of other vessels in the vicinity.

[40] See Graf/Steinicke, SeeSchStrO, p. 85.

(2) Requirement to proceed on the starboard side of a fairway

As already explained, the two vessels collided in a fairway within the meaning of Section 2(1)(1) SeeSchStrO. Sections 1(4) and 2(1)(1) SeeSchStrO in conjunction with Rule 9(a) COLREGs stipulate a basic requirement to proceed on the starboard side of (narrow) fairways. According to the above, a vessel must keep her starboard side as near to the outer limit of the channel or fairway as is safe and practicable.

The requirement to proceed on the starboard side – as well as the option to evade an oncoming vessel to starboard – is therefore subject to natural limitations in the form of the available water depth in the fairway due to the draught of the respective vessel. Moreover, limitations resulting from other traffic situated at the edge of the fairway are also conceivable.

An exception within the meaning of Section 22(1) SeeSchStrO, which permits derogation from the requirement to proceed on the starboard side of certain sections of the fairway, as officially notified, does not exist for the section in question.

(3) Conduct when on a head-on course (head-on situations)

The regulations applicable on German navigable maritime waterways for vessels encountering correspond with the above requirements concerning the basic obligation to use the right-hand side of the fairway.

To that extent, the basic obligation to take evasive action to the starboard side when encountering on a head-on or almost head-on course is provided for in Section 24(1) SeeSchStrO, which is consistent with Rule 14(a) COLREGs. By way of derogation from Rule 14 COLREGs, Section 24(3) SeeSchStrO permits the evasion of an oncoming vessel to port within certain sections of the fairway, as defined by regulation, in exceptional cases. The rule goes on to state:

"The intention to do so shall be indicated to the approaching vessel. According to this rule, the vessel may indicate to the approaching vessel via VHF radiotelephony in the following circumstances:

1. *all participants in the communication process are unambiguously identified by all other participants;*
2. *an unambiguous understanding and agreement can be achieved through VHF radiotelephony;*
3. *the selection of the VHF channel used ensures that preferably all participants in traffic involved in the process are put in a position to overhear the understanding and agreement being reached through VHF radiotelephony, and*
4. *the traffic situation allows the above action to be taken.*

When the pre-requisites for reaching an agreement on radiotelephony are not met, then the intention shall be indicated to the approaching vessel using the sound signal described in point 5 Annex II.2. […]"

No relevant special rules have been made for the section of the River Elbe fairway on which the collision occurred.

(4) Basic rules for conduct in traffic

Section 3(1) SeeSchStrO requires as a basic rule that the conduct of all traffic be such as to ensure the safety and efficiency of traffic. Accordingly, damage and detriment are prohibited, as is impeding or molestation beyond that inevitable in the circumstances prevailing.

Section 3(1) SeeSchStrO goes on to stipulate any precaution as may be required by the practise of good seamanship or by the special circumstances of the case. Moreover, Subsection 2 of the discussed rule also provides that having due regard to the specific circumstances prevailing, any necessary action shall be taken to avoid imminent peril, even if so doing necessitates derogation from the requirements.

3.3.13.2 Compliance with legal requirements in this particular case

(1) Conduct of the № 5 ELBE

The schooner used the northern edge of the River Elbe fairway on the first part of her passenger cruise downstream under sail and thus consistently observed the requirement to proceed on the starboard side laid down in Rule 9(a) COLREGs.

However, the radar recordings of the VTS and the recording of a passenger's GPS tracker prove beyond doubt that after completing the turn at about 1347 and as the jibsheet's first forerunner parted, the vessel did not move to the southern, i.e. from the perspective of the pilot schooner outermost right-hand, edge of the some 500-metre wide fairway in the section in question by the shortest route. Now sailing with the assistance of engine power due to the jibsheet's parted forerunner and the foresail beating in the wind, the schooner instead continuously steered a course that ran in the immediate vicinity of the northern boundary of the fairway and almost parallel to it in the minutes that ensued. This violation of the requirement to proceed on the starboard side resulted in an extremely dangerous head-on situation with the oncoming HANNA at about 134830. At this point, the HANNA was sailing for the North Sea on the right-hand (northern) fairway in accordance with the regulations. The aforementioned course of the oncoming schooner prompted the HANNA to make two VHF radio calls, which went unanswered. Immediately afterwards (at about 134845) both vessels passed each other extremely closely on their respective port sides. After this extremely dangerous and completely unnecessary convergence, the ship's command of the HANNA felt compelled to report the incident to the VTS, informing the latter about the "vessel [...] on the wrong side of the fairway" and her dangerous conduct, especially "with passengers on board."

The discussed close-quarters situation and imminent encounter with the oncoming ASTROSPRINTER evidently did not prompt the pilot schooner's skipper to manoeuvre his vessel into the edge of the fairway on her starboard side or at least into the southern half of the fairway as quickly as possible. As the VTS's radar recording proves beyond doubt, the schooner instead continued her voyage in the (from her perspective) wrong (i.e. left) half of the fairway, where she continuously followed its northern edge.

Since the River Elbe fairway bends to starboard in the vicinity of the two vessels' CPA from the perspective of the ASTROSPRINTER, the pilot schooner's skipper, who is a retired Elbe pilot and extremely familiar with the area, stated that he assumed the ASTROSPRINTER would soon carry out a starboard course alteration because of the fairway. The schooner's skipper believed that an encounter between the two vessels in accordance with the rules, i.e. port side to port side, should thus be achieved on board the two vessels without any further special action.

However, the analysis of the VTS radar recording shows that the encounter between the pilot schooner and ASTROSPRINTER happened before the fairway turns to starboard from the perspective of the ASTROSPRINTER. Accordingly, if the schooner skipper's calculation actually was that the head-on situation with the ASTROSPRINTER would be defused by the latter altering her course to starboard because of the fairway, then this assumption was based on an erroneous estimation of the position of the forthcoming encounter.

(2) Conduct of the ASTROSPRINTER

The ASTROSPRINTER followed the course of the fairway on her passage downstream on the River Elbe, using the right-hand half of the fairway from her perspective in accordance with the rules. Visual observation of the traffic situation ahead and the aforementioned VHF calls of the HANNA, sailing ahead of the ASTROSPRINTER, to the pilot schooner drew the attention of her pilot and ship's command to the oncoming vessel, which was some 1.7 nm away at this point.

The ASTROSPRINTER continuously approached the oncoming schooner in the minutes that ensued. The ship's command of the ASTROSPRINTER did not see any reason to alter course significantly to begin with but continued to observe the still applicable requirement to proceed on the starboard side approximately in the middle of the right-hand/northern half of the fairway. On the other hand, according to the subjective perception of the ASTROSPRINTER, but also objectively, as evidenced by the radar recording of the VTS, the oncoming pilot schooner initially made no attempt to alter her course to starboard, i.e. to the side of the fairway on her right. The ship's command of the ASTROSPRINTER concluded from the schooner's conduct that the latter would continue to remain on the wrong edge of the fairway thereafter, too.

From the point of view of the ASTROSPRINTER, the logical consequence of this assumption was that their ship's command was expecting a so-called green-green encounter[41].

Shortly after that, the pilot schooner suddenly and unpredictably altered course to starboard in the immediate vicinity of the ASTROSPRINTER, causing her to sail across the latter's course line. An adequate response on her bridge was no longer possible given the short time available. The ASTROSPRINTER's bow therefore inevitably collided with the port side of the schooner at about 135415.

3.3.13.3 Classification of the accident based on traffic legislation

Viewed objectively and in the light of applicable traffic legislation, the following conclusions can be drawn from the aforementioned course of the voyage of each vessel subsequently involved in the collision.

1. After executing the turn, the pilot schooner failed to move toward the southern side of the fairway either immediately or as her voyage continued, even though she would have been obliged to do so according to the requirements of Section 2(1)(1) SeeSchStrO in conjunction with Rule 9(a) COLREGs (requirement to proceed on the starboard side).

That the schooner first proceeded under sail and then had to contend with tearing sails on deck as events unfolded does not qualify this finding. On the River Elbe maritime waterway, a vessel cannot derive any special rights from the fact that she is proceeding under sail according to the steering rules applicable there. Furthermore, the pilot schooner's engine was started upon completion of or immediately after the turn, meaning she was no longer classed as a sailing vessel in the further course of events in any case. Ultimately, it is important to also consider that the findings of the BSU indicate that the engine power of the schooner allows her to manoeuvre properly even if problems arise with her sails.

2. The ASTROSPRINTER did not move to starboard in accordance with the provisions of Section 24(1) SeeSchStrO in order to realise the encounter with the pilot schooner in the fairway. Her plan to pass the schooner on the starboard side (i.e. green-green) instead by altering course to port was therefore not in accordance with the applicable steering rules. On the other hand, the ship's command of the ASTROSPRINTER also had to bear in mind that a starboard manoeuvre would have exposed her to a risk of running aground because of her draught.[42]

[41] Note: In maritime jargon green-green means that vessels are passing one another on their starboard side, which in accordance with the COLREGs is marked by green side lights. In contrast, red-red indicates the rule laid down in the COLREGs and SeeSchStrO that encounters should be made on the port sides, which are marked red.

[42] During the consultation phase, the GDWS commented in support of the VTS:
"As discussed above (in relation to Figure 48 ff.), the situation at 135213 was considered to be safe for the ASTROSPRINTER as well as for the VTS, as the vectors clearly indicated a starboard-to-starboard pass. The prevailing south to south-westerly wind direction reinforced this impression. It is reasonable to assume that the № 5 ELBE will bear away a little if necessary and keep clear of the ASTROSPRINTER's stern."

According to Section 24(3) SeeSchStrO, a green-green pass is permissible in exceptional cases when a vessel has indicated her intention to do so either on VHF or using the stipulated sound signal to the oncoming vessel within a fairway section on the maritime waterway determined by special regulation.

There is no such derogation for the section on which the ASTROSPRINTER and pilot schooner encountered one another.

However, that vessels liaise on VHF with regard to forthcoming convergences outside specially designated sections and – having regard to the specific circumstances (traffic situation and local conditions in the fairway section in question, size of vessel, manoeuvrability, for example) – derogate from the steering rules in the process on a case-by-case basis is in many places consistent with navigational practise, especially in restricted waterways. In particular, the arrangement of green-green encounters is quite common. Such arrangements help to ensure the safety and efficiency of traffic and as such regularly go unsanctioned by the shipping police authorities.

The encounter between the ASTROSPRINTER and schooner did not concern a section of the fairway where green-green passes are allowed in exceptional cases. Moreover, there was no arrangement between the two vessels in this regard. Viewing the convergence in isolation, this means that from a procedural point of view one was not permissible.

That two vessels pass one another on their respective starboard side without making an explicit arrangement on VHF is not consistent with customary practises on the River Elbe maritime waterway, either. Nevertheless, this still occurs again and again in the summer months between pleasure craft/traditional vessels and commercial shipping.

The specific convergence between the ASTROSPRINTER and pilot schooner was characterised by the atypical factor that the latter had continuously moved ahead on the wrong edge of the fairway. Even after the head-on situation with the HANNA and her condemnatory information to the VTS, the schooner failed to move to the opposite side of the fairway even though the traffic situation would have allowed her to do so without any complications.

Given the circumstances, it is understandable that from a seafaring perspective the ship's command of the ASTROSPRINTER was confident that a green-green encounter had been tacitly arranged even without a direct arrangement that one would be executed, as is basically required. However, it is also difficult to understand why the ASTROSPRINTER did not contact the pilot schooner on VHF during the convergence to ensure the latter was actually intending to carry out a green-green encounter.

In addition, that the ship's command of the ASTROSPRINTER did not attempt to warn the № 5 ELBE with sound signals in accordance with Annex II.2 Subsection 2.1 SeeSchStrO or Rule 34(d) COLREGs merits criticism.

3.3.14 Watchkeeping on the № 5 ELBE

The № 5 ELBE's crew was confronted with several simultaneous tasks before the collision. In the event of strong breezes, with gusts possibly reaching gale-force, the foresail and jib were not clear. Meanwhile, the № 5 ELBE was not yet situated on the starboard side of the fairway, meaning vessels sailing downstream and those with right of way restricted the room for manoeuvring. As always, special precautions had to be taken for every manoeuvre because 43 people, including 28 passengers, were on deck together in overwhelming numbers.

Based on these underlying conditions, it was investigated whether the rules of conduct laid down in Section 13 SchSV with regard to sufficient precautions for watchkeeping within the meaning of Regulation VIII/2(2) of the Annex to the STCW Convention[43], in particular with regard to 'navigation' and 'lookout', were observed on the № 5 ELBE.

Many other tasks that have to be carried out in the course of watchkeeping, such as the radio watch or operation of the propulsion machinery, were not examined in greater detail because the aspects of 'navigation' and 'lookout' were considered to be the main cause of the accident and sufficient evidence for improving watchkeeping on the № 5 ELBE and other traditional vessels can already be derived on that basis.

3.3.14.1 Navigation

According to Section 13(3)(4) SchSV, the officer in charge of a navigational watch (OOW deck)[44] is required to check the course, position and speed of the vessel at close intervals appropriate to the prevailing traffic situation using the prescribed and available navigational aids.

The № 5 ELBE's skipper was performing the duties of the OOW deck at the time of the accident.

The skipper left his position at the stern for a few minutes shortly before the collision to assess the condition of the foresail and jib with the nautical officer and make a decision regarding the headsails.

[43] STCW Convention: International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978.

[44] Term from the SchSV, which was adopted in the context of the questions concerning watchkeeping in the investigation report. On the № 5 ELBE, this position corresponds to the role of a watchkeeper.

3.3.14.2 Lookout

According to Section 13(3)(2) SchSV, the OOW deck on a ship flying the flag of the Federal Republic of Germany is responsible for manning the lookout with a suitable person in pilotage waters.

According to the watchkeeping regulations also applicable to traditional vessels[45], a lookout in accordance with the provisions of A-VIII/2(15) and (16) STCW Code[46] "[...] must be able to give full attention to the keeping of a proper lookout and no other duties shall be undertaken or assigned which could interfere with that task. The duties of the lookout and helmsperson are separate and the helmsperson shall not be considered to be the lookout while steering, [...]."

The watchkeeping regulations go on to state that a helmsman on small ships flying a foreign flag may be used as a lookout at the same time, provided in particular that there is an unobstructed all-round view at the helm. This possible exemption is not considered further because the national provisions in the SchSV do not permit any discretion for skippers on board ships flying the flag of the Federal Republic of Germany. Moreover, due to the masts, the sail in conjunction with the heel of the vessel, but especially because of the large number of people on deck, the helmsman did not have all-round visibility.

The safety manual issued by the № 5 ELBE's operator contains only one rule in relation to safe watchkeeping. It states that only an experienced crew member may be employed as a helmsman. Trainees must be supervised by an experienced helmsman. The operator has not included any other rules in the safety manual, e.g. on the assignment of a suitable lookout.

No crew member was explicitly assigned the role of lookout on the № 5 ELBE.

3.3.14.3 Manning and qualifications

Since a lookout had not been assigned on the № 5 ELBE, the investigators were compelled to consider whether suitable crew members would have actually been available to the skipper. To this end, the stipulated manning and qualifications of the crew and the actual manning on the day of the accident were then considered.

On merchant ships, officers on watch may only assign the role of lookout to crew members who have obtained a certificate of competency in navigational watch proficiency in accordance with Regulation II/4 of the Annex to the STCW Convention. This fact is explicitly considered in minimum safe manning certificates, which according

[45] According to Section 2(1)(1) of the *Schiffssicherheitsgesetz (SchSG)* [German Ship Safety Act] in conjunction with Annex A Number VI.1 to Section 1(2) SchSG, these watchkeeping requirements also apply on traditional vessels.

[46] STCW Code, as amended and promulgated on 4 July 2013 (Annex Volume to BGBl. [Federal Law Gazette] II No 18), as last amended by the 11th Ordinance on Amendments to the Annex to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, of 14 November 2018 (BGBl. II No 22).

to the *Schiffsbesetzungsverordnung (SchBesV)* [German Safe Manning Ordinance][47] are issued so as to establish minimum safe manning.

There are no comparable clear rules for traditional vessels. The legal requirements for the manning of traditional vessels are set out in

- Part 3 Chapter 1(12) of Annex 1a to Sections 6 and 6a SchSV[48] in conjunction with
- Section 11 *Sportseeschifferscheinverordnung (SportSeeSchV)* [German Offshore Cruising Licences Ordinance][49].

The minimum qualification requirements are derived from

- the SportSeeSchV, and
- implementation guidelines for traditional shipping[50].

According to Section 11(1) SportSeeSchV, the owner or the operator is responsible for manning a traditional vessel with navigational, technical management and radio personnel, as well as ratings. The manning must make safe operation of the vessel possible. Where certificates of proficiency are not legally required for certain positions, such as in this case for ratings, the crew members must have sufficient practical experience. The operator decides on the sufficient number and suitability of the ratings, taking into account operating organisation and the planned course of the voyage (see Section 11(1)(5) SportSeeSchV).

Without prejudice to the principles of Section 11(1) SportSeeSchV, a regular crew comprising two people would have been sufficient for the № 5 ELBE's voyage on the day of the accident according to Annex 4(4) to Section 11(2) SportSeeSchV. As a minimum requirement, one person should have held a *Sportseeschifferschein (SSS)* [international certificate for operators of pleasure craft in coastal waters not exceeding 30 nm] and the other a *Sportbootführerschein-See (SBF See)* [international certificate for operators of pleasure craft on the waterways navigable by seagoing ships] or a higher or equivalent certificate.

According to the minimum safe manning certificate (traditional vessel) issued for the № 5 ELBE on 18 April 2019, a skipper with an SSS including the additional entry of *Traditionsschiffer* [traditional mariner] and a second person for the deck crew were required for voyages on the River Elbe.

The № 5 ELBE was manned by 15 crew members on the day of the accident. The skipper held the certificates required according to the minimum safe manning certificate. The diverging requirements according to the SportSeeSchV could have also

[47] SchBesV of 18 July 2013 (BGBl. I, p. 2575), as last amended by Article 12 of the Ordinance of 17 July 2017 (BGBl. I, p. 2581).
[48] SchSV of 18 September 1998 (BGBl. I p. 3013, 3023), as last amended by Article 2 of the Ordinance of 3 March 2020 (BGBl. I p. 412).
[49] SportSeeSchV, as amended and promulgated on 3 March 1998 (BGBl. I p 394), as last amended by Article 5 of the Ordinance of 3 March 2020 (BGBl. I p 412).
[50] Guidelines for the implementation of the SportSeeSchiffV of 17 December 1992 (BGBl. I p. 2061; BGBl. I 1993, p. 228), as amended by the Ordinance of 17 December 1997 (BGBl. p. 3197) with regard to the acquisition of the additional entries for traditional shipping and [...] of 19 December 1997 (VkBl. [Gazette of the BMVI] 1998 p. 49), as amended by the Decree of 29 March 2016 (VkBl. 2016, p. 338).

been met with the nautical officer on board on the day of the accident. In addition, the crew list indicated that eight other people were available for the deck department. Moreover, the crew list also indicated that a distinction was made between deck, seaman and deckhand in the deck department. According to the documents provided for the investigation and witness statements, some of these deckhands held a pleasure craft skipper's licence or higher. Some have also demonstrated longer practical experience on pleasure craft and traditional vessels.

3.3.14.4 Participation in the maritime mobile service

The minimum safe manning certificate does not require an authorisation to participate in the maritime mobile service. Section 1(7) SportSeeSchV states that the skipper of a traditional vessel must have the competence to participate in the maritime mobile service according to the traditional vessel's radio equipment. The № 5 ELBE was equipped for sea area A1. Accordingly, the skipper should – as a minimum requirement – have held a short range certificate (SRC) or other equivalent or higher certification according to Section 13(4a) in conjunction with Annex 3 to the SchSV.

The skipper held a general radiotelephone certificate for the maritime radio service, which is not sufficient for this purpose[51]. Moreover, he was not authorised to participate in the maritime mobile service as holder of the master mariner certificate (A6) and the certificate of competency for masters in accordance with Regulation II/2 of the Annex to the STCW Convention (date of expiry passed in each case)[52]. Since the 1 June 2014 (when the *Seeleute-Befähigungsverordnung (See-BV)* [Seafarers' Competencies and Proficiencies Regulations] came into effect), people applying for or renewing certificates of competency for navigation authorising the holder to serve as officer or higher are required to hold an internationally valid GMDSS[53]-radio operator certificate[54].

Accordingly, the skipper had no proof of appropriate competence.

3.3.15 Watchkeeping on the ASTROSPRINTER

The ASTROSPRINTER's bridge was manned by two people at the time of the collision: an OOW deck from the vessel and a pilot. The pilot was permitted to carry out the manoeuvres (course/speed) with the agreement of the master.

The pilot was of the opinion that this transfer of the right to independently issue orders for the navigation of the ship did not mean that he assumed any of the master's

[51] A booklet dated 25 April 2018 from the Federal Waterways and Shipping Administration's [Traffic Technologies] Centre provides an overview of all national radio certificates with corresponding authorisations: https://www.fvt.wsv.de/Webs/WSA/FVT/DE/SharedDocs/Downloads/UBI_Merkblatt-Funkzeugnisse_2018-04-25.html.

[52] See Section 13(4a) SchSV.

[53] Global Maritime Distress and Safety System: An aggregation of technical equipment, services and rules for global assistance in maritime emergencies and for maritime safety.

[54] See Sections 5(2) and 53(4) See-BV of 8 May 2014 (BGBl. I p. 460), as amended by Article 66 of the Regulations of 2 June 2016 (BGBl. I p. 1257).

responsibility for the ship's command or of the OOW deck responsible for the navigational watch (Section 23(2) SeeLG[55]).

This provision of the SeeLG corresponds to the international watchkeeping regulations directed at the ship's command in accordance with A-VIII/2(49) and (50) STCW Code. According to this provision, the presence of a pilot does not relieve the master and the OOW deck of their duties and obligations regarding the safety of the vessel. Both individuals must work closely with the pilot and carefully monitor the position and movements of the vessel. If the officer in charge of the navigational watch, which may also be the master, has any doubts as to the pilot's actions or intentions, he shall seek clarification from the pilot. If doubts persist, then the OOW deck must take any necessary measures until the master takes over the navigational watch.

The master must therefore make adequate arrangements for a safe navigational watch and must not take into account the presence of the pilot and the transfer of rights. According to Sections A-VIII/2(14) ff. STCW Code, the bridge must be manned by a lookout. "The officer in charge of the navigational watch may be the sole lookout in daylight provided that, on each such occasion: [...] it is safe to do so; [...] full account has been taken of all relevant factors [...]." The provision then goes on to mention various considerations, such as state of weather, visibility, traffic density and the possibility to immediately summon assistance to the bridge.

The use of automatic steering gear did not permit the master to completely dispense with a helmsman, as Section 30(2)(3) SeeSchStrO states that a helmsman shall be present in the vicinity of the rudder controls.

[55] *Seelotsgesetz* [German Sea Pilotage Act] as amended and promulgated on 13 September 1984 (BGBl. I p. 1213), as last amended by Article 4(135) of the Act of 18 July 2016 (BGBl. I p. 1666).

4 ANALYSIS

The following sequence of events can be reconstructed based on an analysis of all the information available. As is so often the case, it concerns a chain of causes, decisions and situations, each of which would most probably not have led to the accident on its own.

4.1 Regarding the course of the accident

It was the Whit weekend of 2019 and the day trips of the № 5 ELBE had already been fully booked for a long time. That not only the passengers but also the crew were looking forward to this trip is quite understandable, especially given that the ship had just been out of service for eight months due to an overhaul in a Danish shipyard.

Although the new crew had just been assembled, everyone knew what was expected of them. The ship's command thus obtained information about the expected weather conditions. The DWD's wind forecast (see Subsection 3.3.9) predicted 5-6 Bft with gusts of 9 Bft, which should actually have prompted the ship's command to cancel this day trip. The nautical officer stated that he had already obtained information on the wind and weather conditions on that day from Windfinder and the DWD in preparation for the voyage. According to the information provided by the nautical officer, south-westerly winds of 4-5 Bft (with gusts of 6-8 Bft) were to be expected. On the other hand, the skipper believed he had obtained information from Windfinder indicating gusts of 6-7 Bft. Neither individual mentioned nor apparently used the NAVTEX device available on board for automatically receiving weather reports.

The ship's command was aware that the restriction up to 6 Bft maximum was stipulated in the previous safety certificate, which had been valid for many years. The ship's command was not aware that a new certificate had existed since the call at the shipyard had finished, which allowed day trips in up to 5 Bft, however. However, since the ship's command assumed that they were allowed to sail up to 6 Bft, they reduced the sail area. This was based on the information contained in the sail chart in the ship safety manual for a wind force of 6 Bft. However, due to expecting the schooner to have a weather helm, they refrained from setting the single reefed mainsail, setting the boom foresail unreefed instead. This reduced the sail area from the permitted 204 m^2 to 127 m^2, which is beyond the limit permitted for 7 Bft. This sail chart is based on the stability manual and designed to ensure that excessive wind pressure does not act on the ship, i.e. that the stability of the ship is maintained even in stronger winds. However, the inner jib and the foresail were left in place.

It is established that damage to the headsails occurred during the turn. The ship's command immediately focused on this problem but as a result first barely noticed the near collision with the HANNA and then collided with the ASTROSPRINTER. The skipper was apparently so sure of the position in the fairway that he believed he could attend to the defective sails personally. The BSU believes that if he had confirmed the position regularly, he would have been able to see that the № 5 ELBE was still on the wrong side of the fairway. If the skipper had known the exact position, he would have been able to recognise the risk of collision and carry out appropriate manoeuvres in a timely manner.

Circumstances were more favourable when the collision happened, however. The ASTROSPRINTER's flared bow collided with the № 5 ELBE's boom foresail first, causing this mast to break. However, a lot of kinetic energy was already absorbed and the sailing vessel merely listed but was not sunk. Everyone on board found something to hold on to and nobody fell into the cold water of the River Elbe (18 °C). There were no extremely serious injuries. The underwater hull of the traditional sailing vessel was damaged but due to the new planking the leakage and therefore the amount of water ingress was so minor that the ship remained buoyant for just enough time to reach the mouth of the nearby River Schwinge before running aground.

Another fortunate fact was that lifeboats of the DLRG and volunteer fire brigade were in the immediate vicinity due to another operation and able to help immediately.

4.2 Regarding a lookout on the № 5 ELBE

Based upon the guidance in the safety manual, it is possible that skippers of the № 5 ELBE will not explicitly designate a lookout because the manual does not make any statements on such a requirement.

It is possible that the skipper had considered the helmsman or other crew members to be a lookout. However, the BSU is of the opinion that the helmsman would only have been able to follow the traffic situation marginally, as it was not clearly identifiable from the helmsman's position due to obstructions to vision. Vision was obstructed by the people standing on deck, the masts and sails, as well as the listing of the vessel caused by the pressure of the sails. In addition, the helmsman was to steer "[...] to the next green buoy [...]" in gusty wind conditions. Since only experienced helmsmen are engaged on the № 5 ELBE according to the safety manual, the BSU is of the opinion that the helmsman will have paid attention to the sail position in addition to course instructions issued. All the other crew members were occupied with other tasks, such as striking sails, working in the galley and supervising passengers.

Notwithstanding the finding that nobody had been explicitly assigned the role of lookout, some crew members, such as the nautical officer, reported the ensuing risk of collision to the skipper as soon as possible and despite other assigned duties after recognising that the ASTROSPRINTER was approaching on a constant bearing and that the distance to her was rapidly decreasing. The nautical officer hurried back from the headsails, believing that the collision could only be prevented by sound signals and a starboard manoeuvre, even though at this point he could not have had an overall perspective of the positions of the № 5 ELBE and ASTROSPRINTER due to the other duties assigned. The nautical officer did not think that bearing away was an option at that moment because the mainsheet would have to be struck and there was no time left to do that. The skipper let the nautical officer have his way.

The BSU believes that a suitable lookout would have alerted the OOW deck – in this case the skipper – to the risk of collision at an earlier stage.

4.3 Regarding VHF traffic

A further factor that contributed to the accident was the fact that since the Hamburg port boundary, the VHF unit had evidently been set such as to make it impossible to hear the warning call from the HANNA. On the subject of communication, it was also noted that the two ship's commands, i.e. that of the ASTROSPRINTER and that of the № 5 ELBE, did not call each other to discuss the situation but instead each assumed the other ship was altering course, resulting in neither ship's command taking action.

Despite being a holder of many different certificates, the skipper was not permitted to use the marine radio equipment on board the № 5 ELBE. However, the investigation did not produce any evidence to suggest that the skipper was unable to operate the marine radio equipment.

It was not possible for the operator to infer from the minimum safe manning certificate that an appropriate certificate for the maritime mobile service was required, either, because – in accordance with the SchSV – only an SSS with the traditional mariner entry was noted on it. Unlike certificates of competency for navigational service as a master or officer on merchant ships issued after 1 June 2014 with a maximum validity of five years, operating certificates for GMDSS-radio operators are not a prerequisite for acquisition of the certificate required for navigating a traditional vessel.

4.4 Regarding watchkeeping on the ASTROSPRINTER

The ASTROSPRINTER was flying the flag of Cyprus. Therefore, the OOW deck did not necessarily have to assign a suitable person as lookout, since the relevant standard applies only to vessels flying the flag of the Federal Republic of Germany.

Due to the planned route down the Elbe fairway as a vessel with right of way, the good visibility and in conjunction with the pilotage, the BSU considers that the master's decision to only assign the OOW deck to the navigational watch was appropriate. However, in addition to the duties of an OOW deck, the OOW deck had to perform those of a lookout and, if necessary, also act as helmsman. Having said that, the OOW deck could always have requested the assistance of a rating qualified to form part of the navigational watch or the master.

The BSU assumes that both the OOW deck and the pilot were aware of the № 5 ELBE at an early stage. For reasons that are quite understandable to the BSU, the OOW deck relied on the fact that this close-quarters situation with a sailing vessel approaching on the wrong side of the fairway was not anything out of the ordinary for the pilot. A lookout and/or helmsman would probably have had no effect on the decisions made on board the ASTROSPRINTER. In the opinion of the BSU, a larger bridge team would not have prevented the collision.

4.5 Regarding lifejackets on the № 5 ELBE

There were three different types of lifejacket on the № 5 ELBE. This merits no criticism, as long as all parties know how to handle them. Only the orange non-inflatable lifejacket was explained when the passengers were briefed, however. This had an adverse effect after the collision in that the neon yellow non-inflatable lifejackets were also needed because the broken mast blocked access to some of the orange ones. Prior to the collision only the three children wore a lifejacket – all the other people on board did not. The BSU has already recommended in many reports that a lifejacket should be worn on the deck of recreational craft at all times and is using this investigation as an opportunity to draw attention to this once again. Moreover, such an obligation would mean that it would no longer be necessary to consider whether measures to ensure lifejackets are donned correctly in an emergency – assuming there is enough time for this – are in place.

4.6 Regarding external communication

As regards the conduct of the ship's command of the ASTROSPRINTER, it should be noted that they could have established contact with the № 5 ELBE on VHF in good time. Although her at times non-receivable AIS signal meant that the schooner was not identifiable by name as a labelled signal in the ASTROSPRINTER's navigation equipment, the ASTROSPRINTER knew the name of the schooner from listening to the HANNA's radio messages concerning the schooner and it should also have been recognisable over a longer distance with binoculars. However, since the schooner had already failed to respond to two direct radio calls from the HANNA and an indirect criticism with regard to her conduct, it is highly questionable whether she would actually have taken note of a call from the ASTROSPRINTER.

4.6.1 Sound signals

The risk of collision may have been reduced if the ASTROSPRINTER had issued sound signals. However, it is important to consider that the dangerous convergence was clearly visible on board the № 5 ELBE even without such signals. Accordingly, it is doubtful whether the behaviour on board the № 5 ELBE would actually have been fundamentally different at a time required in this respect due to the ASTROSPRINTER issuing sound signals.

4.6.2 VTS

The GDWS provided a technical paper on request, which has been edited.

According to Annex 1a to Sections 6 and 6a, Part 3, Chapter 6 on navigation equipment, point 2.2 (traditional vessels carrying more than 12 people) of Section 6 *Schiffssicherheitsverordnung (SchSV)* [German Ordinance for the Safety of Seagoing Ships], these vessels must be equipped with a Class A AIS. The VTS assumes retrospectively that the № 5 ELBE's AIS was defective, meaning the schooner was not recognisable as such to the VTS. The ship sailed as a radar echo down the River Elbe in compliance with the rules. In terms of traffic, there was no reason for the VTS to identify this radar echo in more detail.

Since the № 5 ELBE was equipped with VHF, she must also maintain a listening watch according to Section 3(1) SeeSchStrO. The resources of the VTS are very limited if a vessel fails to maintain a listening watch. The staff of the VTS ask a WSP boat for assistance if one is nearby in such cases. If necessary, they may ask other traffic to issue light or sound signals to attract the attention of the vessel (or ship's command) concerned (switch on the VHF unit).

The distance between the HANNA and ASTROSPRINTER was about 1.7 nm. At 14.1 kts SOG, this means a time interval of 7.3 minutes. The nautical supervisor was busy dealing with the minor accident in Dwarsloch. A recreational craft had run aground there. After alerting the rescue control centre, the nautical supervisor monitored the deployment of auxiliary vessels from the fire brigade and the DLRG, which went to the aid of the schooner shortly after.

The situation changed after the № 5 ELBE turned between buoys 106 and 104 at 1347, which went unnoticed by the VTS. The schooner's skipper failed to give notification of this change of direction in the fairway on VHF.

At 1348, the HANNA's pilot called the schooner on VHF and received no answer.

At 1349, the HANNA's pilot contacted the VTS on VHF and reported the dangerous encounter with the schooner.

Since the schooner had no AIS signal, the VTS staff had to search through the many other unmarked radar echoes for the № 5 ELBE. Given that it was the Whit weekend, many recreational craft were on the water. The nautical supervisor wanted to find (or identify) the schooner beforehand so as to be able to warn the skipper if necessary or request specific actions or manoeuvres from him and to warn other traffic in a targeted manner.

The nautical supervisor managed to identify the schooner's radar echo just before she reached the ASTROSPRINTER. It was already too late to make contact because the next close-quarters situation with the ASTROSPRINTER then occurred, which led to a collision at 1354.

A marine casualty occurring in an area monitored by a VTS always gives rise to the question as to whether the VTS had the opportunity to prevent the marine casualty by giving verbal recommendations to the ship's crew(s) and pilot(s) on VHF. It should generally be noted here that ship's commands and pilots on board normally have a better view of the overall traffic situation than the nautical supervisor working remotely at a VTS. Furthermore, when monitoring the various vessels operating in his area of responsibility, the latter is unable to and/or ought not focus his attention on individual traffic movements for an extended period in most cases. What is more, the party responsible at the VTS can normally rely on the fact that the pilots exercise their profession in accordance with the universal legal requirements and the specific instructions issued. These considerations also apply to the traffic on the River Elbe maritime waterway to the fullest extent. They are confirmed by the fact that based on the high number of traffic movements on the River Elbe, dangerous rule violations by ship's commands or pilots occur only rarely.

With regard to the specific accident scenario, the BSU's investigation into the marine casualty revealed that the HANNA had called the schooner twice during the dangerous encounter with her, which the VTS was able to hear. The HANNA's pilot even contacted the VTS directly immediately after the encounter to inform it about the pilot schooner's dangerous actions. The HANNA's pilot also explicitly drew the VTS's attention to the fact that there were passengers on board the schooner and that she was proceeding without an AIS signal. The nautical supervisor at the VTS acknowledged receipt of the message. However, there was no radio contact with the pilot schooner to inquire about her intentions and/or inform her about her conduct in breach of the regulations and absent AIS identification.

As already broadly explained above, the nautical supervisor at the VTS cannot be expected to permanently monitor and analyse every ship movement that he is basically able to observe by technical means and intervene in the traffic environment via radio. However, the information communicated by the HANNA on VHF provided sufficient grounds for taking a closer look at the schooner's conduct by means of her well evaluable radar echo. This would inevitably have brought the impending dangerous head-on situation between the pilot schooner and ASTROSPRINTER to the attention of the nautical supervisor at the VTS. However, as was already the case with regard to the failure of the ASTROSPRINTER to communicate by radio with the schooner, it is doubtful whether such a contact from the VTS to the schooner would actually have been registered there.

4.7 Regarding the structural questions concerning the № 5 ELBE

4.7.1 Preliminary safety certificate

The Ship Safety Division (BG Verkehr) issued the № 5 ELBE a preliminary safety certificate on 29 May 2019. This is valid until 16 September 2021, subject to intermediate surveys. Point 6 lists particular conditions for day trips, which are quoted below as written on the certificate:

"From April until October [sic] trips of max. 14 hours duration are permitted with winds not exceeding windforce [sic] 5 Bft. between sunrise and sunset with up to 50 persons on board in sea areas, where the probability of exceeding ___ m significant wave height is smaller than 10 % over the a.m. restricted period, in the course of which the vessel is at no time more than ___ nautical miles from a safe haven or anchorage not more than 20 nautical miles from the line of the coast at mean high water.

When stronger winds are arising or a warning of stronger winds or a storm is circulated sheltered waters or the nearest haven has to be made for immediately."

The 6 Bft limit in the safety certificate that had applied until then was reduced to 5 Bft. Various statements made by members of the crew revealed that this new limit was not known.

The values omitted in the quotation [___] are not filled out in the original certificate, either.[56] During the consultation phase, it emerged that there were two virtually identical safety certificates for the № 5 ELBE. The only – but significant – difference is that in one copy the values are crossed out and in the other they were left blank. Neither SHM nor the Ship Safety Division (BG Verkehr) was able to explain this.

4.7.2 Ship's length and bulkheads

The № 5 ELBE is built with a continuous hull, which is not divided by bulkheads. There is no collision bulkhead. The hull has not been fitted with watertight bulkheads – not even in the course of extensive and substantial conversions and renovations. Accordingly, it was unavoidable that damage would result in the flooding of the entire hull and inevitable foundering.

According to the latest 'Safety requirements for the construction and equipping of traditional ships' pursuant to point 8 Chapter 2 Part 3 of Annex 1a to the SchSV (the corresponding amendments came into force in March 2018), these ships must be subdivided by bulkheads up to the freeboard deck. There must be at least one collision bulkhead. Vessels of 25 m or more in length that were originally designed without bulkheads must also be fitted with an after-peak bulkhead in the course of substantial alterations. An additional requirement for traditional vessels operating outside coastal waters is that they must be subdivided by watertight bulkheads so as to ensure that the freeboard deck is not submerged when a compartment floods.

[56] See Subsections 9.3 and 9.4.

Depending on the type of measurement used, there are various length measurements for the № 5 ELBE, ranging from nearly 24 m to more than 27 m. However, the present accident shows that the length of the ship is not a suitable criterion for determining whether bulkheads need to be fitted. This corresponds to the Germanischer Lloyd classification rules for wooden ships in commercial shipping of 1964. Point 11.1 of these rules states that watertight bulkheads must separate the engine room, the accommodation space and the cargo or fish hold from one another in all ships. A collision bulkhead is required for ships of 18 m or more in length.

The same applies to the area of navigation. The foundering of a ship with passengers on board is possibly just as dangerous in the middle of a fairway as it may be outside coastal waters. There will not always be other ships in the immediate vicinity that can initiate a rescue operation without delay. Therefore, the area of navigation is not a suitable criterion for differentiation.

The BSU believes that the presence or subsequent fitting of watertight bulkheads should depend on whether passengers are carried on board. In accordance with national or international rules, this should become an obligation if more than 12 passengers are carried.

4.7.3 Tiller

The BSU believes that retaining this original type of rudder operation gives rise to a number of safety aspects, which could certainly be implemented differently. It is barely possible for just one person to operate the long and heavy tiller, which is why tackle, the ropes of which restrict the area around the tiller, is usually installed. In addition, this also blocks the engine room's (former) aft emergency exit.

This means that the routing of the tiller's tackle and the tiller's large swivel range pose a considerable hazard. Accordingly, passengers should not be allowed to assemble in the area of the tiller.

Since modern systems and equipment have long since been installed on the ship inconspicuously as compared to her original condition (such as propulsion engines, bilge pumps, a firefighting system, heating and much more), it should also be possible to operate the rudder hydraulically.

5 CONCLUSIONS

The requirement that a traditional vessel be true to the original cannot be placed on an equal footing with ship safety. The safety of the crew, the passengers and other traffic must be given much higher priority. Otherwise, rather than being permitted to set sail, a traditional vessel must only be visited at the pier.

The BSU has arrived at the conclusion that urgent action be needed to improve the watertight integrity of traditional vessels carrying more than 12 passengers so as to prevent the risk of future marine casualties arising from the same or similar causes.

The BSU believes that the main cause of this marine casualty was the response of the ship's command to the damaged headsails during the turn. This seems to be due to insufficient organisation of the watch and poor situational awareness. The ship's command focused only on the sails and not on leaving the wrong side of the fairway, which they were then on, as quickly as possible to avoid oncoming traffic.

5.1 Watchkeeping

The BSU believes that the Nº 5 ELBE was basically safely manned by the 15 people with their qualifications. All the events that occurred on the Nº 5 ELBE immediately before the collision could have been dealt with by effectively organised watchkeeping in accordance with the regulations.

Due to the large number of crew members regularly required in the deck department of a traditional vessel, their ship's command would probably be more capable of meeting the high standards of safe watchkeeping if it knew the resource management principles according to Table A-II/1 STCW Code[57] and could apply them in practise. In particular, these include knowledge of:

- allocation, assignment, and prioritisation of resources;
- effective communication;
- obtaining and maintaining situational awareness;
- consideration of team experience.

The BSU finds it difficult to understand how according to the minimum safe manning certificate and the SportSeeSchV, a traditional vessel like the Nº 5 ELBE should be considered safely manned on voyages with passengers in pilotage waters and under sail with two people – regardless of the qualifications of these crew members – pursuant to the provisions of Annex 4 to Section 11 SportSeeSchV.

[57] This qualification has been mandatory for OOW decks and masters serving on merchant ships with gross tonnage of 500 and above since 1 January 2017, unless the ship in question is on a near-coastal voyage. The term 'near-coastal' as used here must be defined locally by each Party to the STCW Convention, taking into account established criteria. If the definition affects the territory of a neighbouring state, then a declaration of agreement is required between those states with regard to training standards, *inter alia* (see Annex 9.5).

The legislator should review the legal framework with regard to manning and qualifications and adapt it to allow for actual requirements. The BSU believes that more specific regulations are needed because not every operator of a traditional vessel will necessarily be familiar with the complex issue of ship operation, manning and the qualification of traditional mariners required for this.

5.2 External communication

Communication between the № 5 ELBE, HANNA, ASTROSPRINTER and VTS was inadequate. The main reason for this was that the schooner's VHF unit was switched off or at least not audible. On the other hand, it was the VTS in particular that should have sought contact, even if indirectly via third parties. In addition, the ship's command of the № 5 ELBE and that of the ASTROSPRINTER each assumed that the other would respond in a certain way, without finding it necessary to liaise.

Depending on the equipment, various certificates must be acquired for participation in the maritime mobile service. The skipper of a traditional vessel always requires an appropriate certificate for the maritime mobile service.

To ensure that traditional vessels are actually manned safely in accordance with the various regulations, the BSU believes that all mandatory qualifications should be included in a minimum safe manning certificate. Moreover, a summary of all equivalent or higher certificates for crew members of a traditional vessel should be published in an appropriate section of the German flag administration's website[58].

5.3 Lifejackets

This accident was just as likely to have ended with far more serious consequences. Had the № 5 ELBE capsized or foundered and had people fallen into the water, the value of wearing lifejackets would have been vividly demonstrated. This is especially true if there is not enough time to put on a lifejacket.

It cannot be stressed often enough that lifejackets or work safety vests should be worn on the deck of recreational craft and traditional vessels as a matter of principle.

[58] https://www.deutsche-flagge.de/en: According to the provider's identification published on the website, 'deutsche-flagge.de' "[...] the central web portal of the German flag state administration and is jointly operated by the Bundesministerium für Verkehr und digitale Infrastruktur (federal ministry for [sic] transport and digital infrastructure), the Bundesamt für Seeschifffahrt und Hydrographie (federal maritime hydrographic agency) and the Dienststelle Schiffssicherheit der BG Verkehr (ship safety division of the BG for transport and traffic)."

5.4 Emergency exits

During the consultation phase, the Ship Safety Division (BG Verkehr) advised that the aft hatch, previously specified as an emergency exit from the engine room, was reportedly no longer required as such. During the investigation, it was noted that the aft hatch from the engine room was extremely difficult to open and the ladder needed to get out was missing. Ladders were also missing from the other emergency exits. Accordingly, trapped people would have found it almost impossible to use these emergency exits if so doing had become vitally important.

5.5 Safety certificate

It should also be noted in passing that the Ship Safety Division (BG Verkehr) had issued a preliminary safety certificate for the traditional vessel, which in this case was not only valid for six months but rather for almost 27. Due to the absent collision bulkhead and the defective emergency exits, the certificate should not have been issued. Moreover, in addition to certain values missing from this certificate, the maximum wind force for day trips was reduced from 6 Bft to 5 Bft. There is nothing wrong with the latter, but this crucial detail does not seem to have reached the ship's command.

5.6 Tiller steering

Finally, the particular risks of the tiller steering should be pointed out. In the light of all the other modern equipment already on board, it seems almost self-evident that the steering gear can also be operated hydraulically in a concealed manner.

5.7 Preliminary safety recommendations

The BSU published the following preliminary safety recommendations on 22 July 2019:

5.7.1 Federal Ministry of Transport and Digital Infrastructure (BMVI)

The BSU recommends that the BMVI make every effort to have the aforementioned legal position amended to the effect that all traditional vessels carrying more than 12 passengers be subdivided by watertight bulkheads so that the freeboard deck is not submerged if a compartment is flooded (so-called one-compartment status), regardless of area of operation and length of ship.

5.7.2 Owner and operator of the pilot schooner № 5 ELBE

The BSU recommends that the owner of the № 5 ELBE install watertight bulkheads during the forthcoming repairs so that one-compartment status is ensured.

5.7.3 Owners and operators of a traditional vessel

The BSU recommends that owners of a traditional vessel carrying more than 12 passengers verify that watertight integrity for one-compartment status is met in the event of leakage and install watertight bulkheads if necessary.

6 Actions taken

6.1 Preliminary safety recommendations

Following the consultation phase for the draft report, the № 5 ELBE's operator, SHM, gave its assurance that a watertight collision bulkhead would be installed in the fore section.

6.2 Further action by SHM

SHM notified the following on 17 March 2021:
"Crew training concept
There are extensive ship-specific training concepts for the pilot schooner. The new traditional vessel ordinance provisions are currently being incorporated where still outstanding. This will be completed by the time the pilot schooner is put back into service. All crew members shall be trained on a regular basis in accordance with the distribution of tasks and responsibilities. This is continuously documented and monitored by the Ship Safety Division (BG Verkehr) as part of the safety management system.

Regarding the BSU's safety recommendations
A watertight collision bulkhead will be installed in the fore section. Initial design drawings are available. The works will be duly put out to tender.

Inter alia, the tiller steering cannot be converted due to heritage protection requirements. No conversion solution can ever exceed the rate of response of tiller steering.

The propulsion system is designed so that the engines are operated only from the deck control position. People are not situated in the extremely narrow, barely accessible after-peak during the voyage, meaning that an emergency exit is not needed there.

The ship's command has already been and will continue to be constantly informed about current changes in the approval regulations.

Only one type of lifejacket will be kept on the vessel for passengers in the future. As before, its use will be demonstrated at the beginning of the voyage. Since the pilot schooner's bulwark is high enough to prevent people from falling overboard accidentally, we do not believe it is necessary for lifejackets to be worn at all times. Of course, a lifejacket will be given to a passenger at any time upon request.

VHF and AIS equipment, including the separate VHF deck station, were switched on at all times. There were no operating errors. In future, a member of the ship's command will also be specifically designated as the radio operator.

There will also be adjustments to the bridge standing orders, which are currently being worked on. (Original text in *italics*.)

7 SAFETY RECOMMENDATIONS

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

The BSU published preliminary safety recommendations on 22 July 2019. These are listed again below (see 7.1.1, 7.2.1 and 7.3.1).

7.1 Federal Ministry of Transport and Digital Infrastructure (BMVI)

The BSU recommends that the BMVI

1. make every effort to have the legal position amended to the effect that all traditional vessels carrying more than 12 passengers be subdivided by watertight bulkheads so that the freeboard deck is not submerged if a compartment is flooded (so-called one-compartment status), regardless of area of operation and length of ship;

2. review the legal options for introducing an obligation to wear lifejackets/work safety vests on traditional vessels underway, especially for passengers, depending on the structural conditions;

3. revise the safe manning requirements for traditional vessels in terms of numbers and qualifications, so that crew members should be able to perform safe watchkeeping at all times and adequate ship safety measures in an emergency;

4. further develop the competence of crew members on a traditional vessel, especially with regard to watchkeeping;

5. ensure that all mandatory qualifications are listed in a minimum safe manning certificate and that a summary of all equivalent or higher certificates for crew members of a traditional vessel be published in an appropriate section of the German flag administration's website.

7.2 Owner and operator of the pilot schooner № 5 ELBE

The BSU recommends that the owner of the № 5 ELBE

1. install watertight bulkheads during the forthcoming repairs so that one-compartment status is ensured;

2. make the area around the tiller steering safe or adapt it during the current repairs on the ship so that the tiller is no longer used as the main steering system in its present form;

3. observe and communicate in a comprehensible manner the sailing restrictions on its vessels;

4. install the VHF and AIS equipment in a fail-safe manner and ensure that error-free operation is guaranteed;

5. keep only one type of lifejacket on board one of its ships. If there are different types of lifejacket available, then the passengers must be familiarised with each type.

6. revise the safety manual. In particular, requirements for the performance of safe watchkeeping should be included;

7. continuous training of crew members on the performance of safe watchkeeping, in particular in accordance with the standards set out in Table A-II/1 STCW Code.

7.3 Owners and operators of a traditional vessel

The BSU recommends that owners of a traditional vessel

1. carrying more than 12 passengers verify that watertight integrity for one-compartment status is met in the event of leakage and install watertight bulkheads if necessary;

2. make every effort to ensure that any person on deck wears a lifejacket at all times on its ships;

3. monitor the watchkeeping practised on their vessels and adapt it to the requirements of applicable law (lookout/navigation) if necessary;

4. continuous training of crew members on the performance of safe watchkeeping, in particular in accordance with the resource management principles set out in Table A-II/1 STCW Code.

7.4 Ship Safety Division (BG Verkehr)

The BSU recommends that the Ship Safety Division (BG Verkehr) review its procedures for issuing ship safety certificates for traditional vessels and revise them if necessary so as to ensure that relevant requirements are observed.

7.5 Ship's command of the ASTROSPRINTER

The BSU recommends that the ship's command of the ASTROSPRINTER initiate unambiguous evasion manoeuvres and/or communication in good time if dangerous head-on situations arise.

8 SOURCES

- Enquiries of the WSP
- Written statements of the
  - Ship's commands
  - Shipping company
  - Operator
- Witness testimony
- Opinion of Dipl.-Ing. Jan Hatecke
- Technical paper from the GDWS
- Navigational charts and ship particulars, BSH
- Official weather report, DWD
- VTS recordings
- Documents from the Ship Safety Division (BG Verkehr)
- The № 5 ELBE's safety manual

9 ANNEXES to № 5 ELBE

9.1 Expert opinion for the calculation of the № 5 ELBE's length

G U T A C H T E N

Untersuchung

TS «NO.5 ELBE»

Kollision und Untergang
auf der Elbe am 08.06.2019

Besichtigungen am 24.06.2019 u. 03.07.2019
Ermittlung der Schiffslänge gem. Traditionsschiffs-Richtlinie vom 7. März 2018[59]

Auftrag für: Bundesstelle für Seeunfalluntersuchung (BSU)

Auftrags-Nr.: 211/19

Bericht-Nr.: 2019-07.01

Erstellt von: Dipl.-Ing. Schiffbau Jan Hatecke

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Sachgebiet Rettungsmittel und Rettungseinrichtungen auf Schiffen

[59] Note by the BSU: This and the following refer to Part 3 of Annex 1a to Sections 6 and 6a SchSV ('Safety requirements for the construction and equipping of traditional ships').

Prozess des Dokumentes

Revision	Seiten	Datum	Beschreibung/ Änderungen	Sachverständigenbüro
01	28	23.09.2019	Längen geändert, Seite 5, 8, 22 Y-Koordinatensystem, Seite 20	J.H.
00	28	12.09.2019	Original	J.H.
Dokument:		**2019-07.01**		

Sachverständigenbüro Dipl.-Ing. Jan Hatecke
Öffentlich bestellter und vereidigter Sachverständiger (IHK-Stade für den Elbe-Weser-Raum)

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Inhaltsverzeichnis

1. Auftrag

Von:	Bundesstelle für Seeunfalluntersuchung Bernhard-Nocht-Straße 78 20359 Hamburg
Ansprechpartner:	BSU
Aktenzeichen BSU:	211/19

2. Auftragsumfang

Erstellung eines Gutachtens zum Thema:

Seeunfall TS „NO.5 ELBE" auf der Elbe am 08.06.2019

durch den öffentlich bestellten und vereidigten Sachverständigen Dipl.-Ing. Jan Hatecke.

3. Abkürzungen

Die folgenden Abkürzungen sind in diesem Bericht verwendet worden:

B.B.	Backbord Schiffsseite
S.B.	Steuerbord Schiffsseite
MS	Mitte Schiff
TS	Traditionsschiff
MV	Motorschiff
BSU	Bundesstelle für Seeunfalluntersuchung
BG Verkehr	BERUFSGENOSSENSCHAFT VERKEHRSWIRTSCHAFT POST-LOGISTIK TELEKOMMUNIKATION
t	Tonnen = 1000 kg
ρ	Dichte
kN	Kilo Newton
m	Meter
kn	Knoten = Geschwindigkeit
L	Länge
ü.A.	Über Alles, Gesamte Schiffslänge
Lpp	Länge zwischen den Loten
B	Breite
H	Höhe
kg	Kilogramm
Spt.	Spant
Nr.	Nummer
PS	Leistung in Pferdestärken
Max.	Maximal
MCO	Marine Consultant Office, Sachverständigenbüro Dipl.-Ing. Jan Hatecke
LC	Lastfall
AP	Hinteres Lot
FP	Vorderes Lot

X	Koordinate in Längsrichtung: +=bezogen aufs hintere Lot nach vorne
Y	Koordinate in Querrichtung: +=bezogen auf MS nach S.B.
Z	Koordinate in Höhen: +=bezogen auf Basis nach oben
Tv	Gesamttiefgang vorne gem. Tiefgangsmarke
Th	Gesamttiefgang hinten gem. Tiefgangsmarke
TvL	Tiefgang am vorderen Lot bezogen auf Basis
ThL	Tiefgang am hinteren Lot bezogen auf Basis
LCG	Längenschwerpunkt der Masse (m)
VCG	Höhenschwerpunkt der Masse (m)
TCG	Seitenschwerpunkt der Masse (m)
GZ	Krängender Hebelarm in der Stabilitätsberechnung (m)
GM`	Anfangsstabilität mit Einfluss der freien Oberflächen der Tanks (m)
sm	Seemeile = 1,852 km
Nb.	Neubau
Gem.	Gemäß

4. Referenz- und Quellenverzeichnis

4.1 Normen und Standards

Die Aussagen in diesem Bericht basieren auf folgenden nationalen und internationalen Vorschriften:

I. Richtlinie 2009/45/EG DES EUROPÄISCHEN PARLAMENTS UND DES RATES vom 06. Mai 2009 über Sicherheitsvorschriften und –normen für Fahrgastschiffe

II. Richtlinie (EU) 2017/2108 DES EUROPÄISCHEN PARLAMENTS UND DES RATES vom 15. November 2017 zur Änderung der Richtlinie 2009/45/EG über Sicherheitsvorschriften und –normen für Fahrgastschiffe

III. Verordnung zur Änderung der schiffssicherheitsrechtlichen Vorschriften über Bau und Ausrüstung von Traditionsschiffen und anderen Schiffen, die nicht internationalen Schiffssicherheitsregeln unterliegen, vom 7. März 2018: Teil 3, Sicherheitsanforderungen an den Bau und die Ausrüstung von Traditionsschiffen

IV. Londoner Schiffsvermessungsübereinkommen: Internationales Schiffsvermessungs-Übereinkommen von 1969 vom 23. Juni 1969 (BGBl. 1975 II S. 67);

V. EC-Council Directive 2014/90/EU (former EC-Directive: 96/98)

VI. IMO-RES. A.749(18), Code on Intact Stability

VII. IMO-RESOLUTION MSC.267(85), ADOPTION OF THE INTERNATIONAL CODE ON INTACT STABILITY, 2008 (2008 IS CODE)

VIII. Internationale Konferenz von 1960 zum Schutz des menschlichen Lebens auf See
v. 17. Juni 1960

IX. Life-Saving Appliances, LSA Code 2017 Edition (former: LSA-Code 2010 Edition)

X. IMO-RESOLUTION A.265, REGULATIONS ON SUBDIVISION AND STABILITY OF PASSENGER SHIPS AS AN EQUIVALENT TO PART B OF CHAPTER II OF THE INTERNATIONAL CONVENTION FOR THE SAFTY OF LIFE AT SEA, 1960

XI. Gesetz zu dem Internationalen Freibord-Übereinkommen von 1966 und Internationales Freibord-Übereinkommen von 1966 geändert durch das Protokoll von 1988 (LLC 66/88)

4.2 Referenzen

Dieser Bericht basiert auf Informationen aus den nachfolgenden Referenzen:

Nr.	Dokument Nr.	Titel	Datum
[1]	Jugend in Arbeit Hamburg e.V./MDo	BRANDSCHUTZ- u. SICHERHEITSPLAN	August 2009
[2]	Plan 1	„Objektzeichnung Lotsenschoner „No.5 ELBE"	17.09.2019
[3]	Plan 2	„Objektzeichnung Lotsenschoner „No.5 ELBE"	17.09.2019

4.3 Bildquellen

Fig. 1: Aus: https://segelreporter.com/panorama/unfall-elbe-5-nach-kollision-mit-frachter-gesunken-ignorierte-der-kapitaen-warnungen/, 31.07.2019

Fig. 2: Aus: http://classicsailboats.org/pilot-schooner-elbe-5-struck-by-container-ship/elbe-2/, 31.07.2019

Fig. 3: Aus: https://www.ln-online.de/Nachrichten/Norddeutschland/Nach-Kollision-auf-der-Elbe-Ermittlungen-gegen-Kapitaen-der-No-5-Elbe, 31.07.2019

Fig. 4: Aus: https://www.sy-tongji.de/Segelschiffe/No_5_Elbe/no_5_elbe.html, 31.07.2019

Fig. 5: Aus: 4.2.[1]

Fig. 6-25: Foto-Aufnahmen während des Ortstermins am 24.06.2019 und 03.07.2019 durch den unterzeichnenden Sachverständigen

Fig. 26,28,29,31: Aus: 4.1.III
Fig. 27, 30: Aus: Anlage 1.
Fig. 32-34,39-41: Aus: 4.2.[2]
Fig. 35: Aus: 4.1.IV
Fig. 36, 37, 38: Aus: 4.2.[3]

5. Einleitung

Am Nachmittag des 08.06.2019 ereignete sich im Fahrwasser der Elbe oberhalb der Mündung des Elbenebenflusses Schwinge eine Kollision zwischen dem TS „No.5 ELBE" und dem elbabwärts dem Fahrwasserverlauf folgenden MV „CMS ASTROSPRINTER". Die „NO. 5 ELBE" erlitt im Vorschiffsbereich unterhalb der Wasserlinie an B.B.-Seite mehrere Risse im Bereich der Plankenstöße. Dieses führte zu einem starken Wassereintritt ins Schiffsinnere. Die Schwimmfähigkeit konnte weder mit Bordmitteln noch mit zusätzlichen Hilfspumpen aufrechterhalten werden, so dass das Schiff später im Mündungsbereich des Nebenflusses Schwinge sank. Darüber hinaus wurde die Takelage stark beschädigt. Der vordere Mast mit den Topspieren knickte ein. Mehrere Personen wurden bei diesem Unfall verletzt.

Dieser sehr schwere Seeunfall (SSU) wird von der BSU mit der Untersuchungsnummer 211/19 untersucht. Im Zusammenhang mit ersten Untersuchungsergebnissen der BSU ist der unterzeichnende Sachverständige beauftragt worden, die Untersuchung zur Unfallursache unterstützend zu begleiten und die für die Bewertung der Einhaltung der Traditionsschiffs-Richtlinie (s. 4.1.III/IV) wichtige Länge des „NO. 5 ELBE" zu ermitteln.

Fig. 1: TS „NO. 5 ELBE" kollidiert mit MV „CMS ASTROSPRINTER"

Fig. 2: TS „NO. 5 ELBE“ Unmittelbar nach der Kollision

Fig. 3: TS „NO. 5 ELBE“, vollständig gesunken im Mündungsbereich des Nebenflusses Schwinge

6. Zusammenfassung der Ergebnisse

Der unterzeichnende Sachverständige ist von der BSU beauftragt worden, die Untersuchung zu dem Unfall des TS „NO.5 ELBE“ am 08.06.2019 auf der Unterelbe oberhalb der Schwingemündung gutachterlich zu begleiten.
In einer ersten Phase ist das verunfallte TS auf der Helling der Peterswerft in Wewelsfleth besichtigt worden. Außerdem wurde die Außen-Kontur des TS von Mitarbeitern des LKA-Hamburg unter Anleitung des Sachverständigen eingescannt und somit für sich anschließende Berechnungen und Bewertungen der Intakt- und der Leckstabilität erfasst.
Basierend auf den Ergebnissen dieser Untersuchung können folgende erste Aussagen getroffen werden:

Besichtigung:

- Das TS „NO. 5 ELBE“ ist aufgrund der Kollision mit dem MV „CMS ASTROSPRINTER“ im vorderen Unterwasserschiffsbereich, ca. 2,9 m vom Vorsteven, massiv beschädigt worden. Mehrere Plankenstöße an B.B.-Seite sind aufgesprungen, so dass es zu einem massiven Wassereinbruch kam, der mit Hilfe der vorhandenen Lenzpumpen nicht gestoppt werden konnte.
- Das Auftreffen des Wulstbuges des MV auf den Unterwasserbereich des TS hat zu einer globalen Verformung des vorderen Unterwasserbereiches des TS geführt. In der Auswertung der eingescannten Vorschiffsform lässt sich eine asymmetrische Verformung von ca. 170 mm erkennen. Außerdem deuten mehrere Risse im vorderen oberen Decksbereich sowie das großflächige Aufwellen der Kupferbeplattung im Unterwasserschiffsbereich an B.B. und an S.B.-Seite auf bleibende Verformungen des hölzernen Schiffskörpers hin.
- Das Sinken des TS hat die gesamte technische Ausrüstung sowie den z.T. historischen Holzinnenausbau massiv beschädigt oder zerstört.
- Die Masten und Takelage sind während der Kollision entweder gebrochen oder massiv beschädigt worden.
- Die Pinne mit Ruderlager ist frei beweglich. Über die Kräfte in Fahrt und beim Manövrieren lassen sich aufgrund der Besichtigung außerhalb des Wassers keine Aussagen machen.
- Die navigatorischen Bedienelemente (Kompass, GPS...) sowie die Kontrollelemente und die Fahrhebel der beiden Motoren befinden sich im Decksbereich unmittelbar vor dem Pinnenradius.

Bewertung der Verordnung zur Änderung der schiffssicherheitsrechtlichen Vorschriften über Bau und Ausrüstung von Traditionsschiffen v. 07.03.2018:

- Mit Hilfe der einscannten Außenform des TS ist die Länge gem. der obigen Verordnung mit **L= 24,83 m** ermittelt worden.
- Die Verordnung wird in den Punkten Kapitel 2, 1.8.1 u. 1.8.2 nicht erfüllt. Ein Kollisionsschott auf 0,05-0,1 x L vom VL ist nicht vorhanden.

Sicherheitszeugnis der BERUFSGENOSSENSCHAFT VERKEHRSWIRTSCHAFT POST-LOGISTIK TELEKOMMUNIKATION (BG Verkehr) für Traditionsschiff „NO. 5 ELBE", Nr. 05/2018

- Die BG Verkehr hat am 29.05.2019 ein **vorläufiges** Sicherheitszeugnis für das TS „NO. 5 ELBE" ausgestellt, obwohl das Kap. 2, Abschnitt 1., der Verordnung zu diesem Zeitpunkt nach der Renovierung und Erneuerung der gesamten Beplankung und teilweisen Erneuerung der Spanten des TS bereits in Kraft war. Hier ist zu klären, warum Kap. 1, 13.3.b (bauliche Anforderungen) der Verordnung als Übergangsregelung nach dieser substanziellen Renovierung Anwendung finden konnte.
- Gem. Kap. 1, 9.2. darf ein vorläufiges Zeugnis nur über einen Zeitraum von 6 Monaten ausgestellt werden. Dieses Vorläufige Sicherheitszeugnis hat eine Geltungsdauer bis zum 16.09.2021.

Das Gutachten wurde unparteiisch und nach bestem Wissen und Gewissen angefertigt. Die Haftung des Sachverständigen richtet sich nach § 276 II BGB, wobei leichte Fahrlässigkeit ausgeschlossen ist. Evtl. Schadensersatzansprüche beschränken sich auf die Höhe der bestehenden Berufshaftpflichtversicherung für Personen-, Sach- und Vermögensschäden. Die Haftungsdauer beträgt 2 Jahre ab Gutachtendatum. Gerichtstand und Erfüllungsort ist Stade, sofern dem nicht § 38 ZPO entgegensteht. Eine Übersicht zum Datenschutz ist der Website www.jan-hatecke.de zu entnehmen.

23. September 2019

……………………………………………………………
Jan Hatecke, Dipl.-Ing. Schiffbau

A. Fakten

A.1 Schiffsdaten

Schiffsname: NO. 5 ELBE
Flagge: Deutschland
Heimathafen: Hamburg
Rufzeichen: DANF
Schiffstyp: Traditionsschiff / Segelschiff (ehem. Lotsenschoner)
Bauwerft: H.L. Stülcken
Nb.-Nr.: 769
Baujahr (Kiellegung): 1883
BRZ 52
Länge (nach Richtlinie): 24,84 m
Breite (Rumpf): ca. 5,78 m
Tiefgang hinten : ca. 3,00 m
Leistung: 2 x 130 PS

Fig. 4: TS „NO. 5 ELBE“, Unter Segeln [60]

[60] Note by the BSU: Photograph not from the day of the accident.

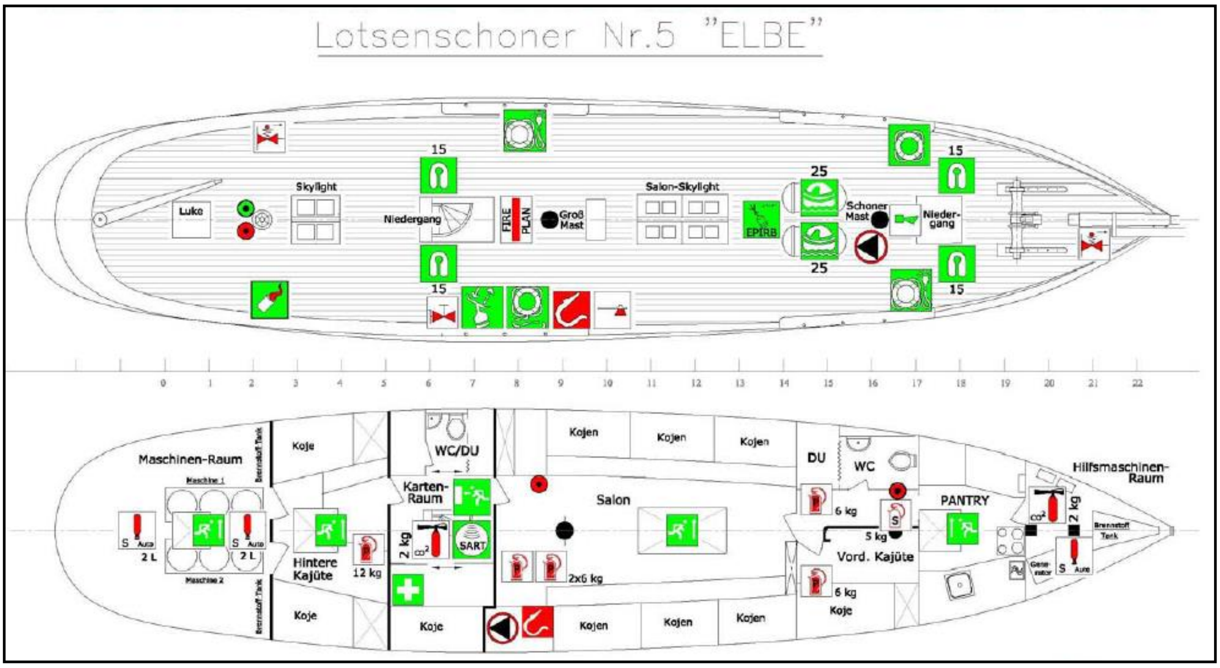


Fig. 5: Draufsicht aus Brandschutz- u. Sicherheitsplan (4.2.[1])

A.2 Besichtigung des verunfallten TS „NO. 5 ELBE" nach der Bergung

Das Schiff NO. 5 ELBE" ist durch den unterzeichnenden Sachverständigen zusammen mit den Mitarbeitern der BSU, … , auf der Helling der Peterswerft in Wewelsfleth besichtigt worden. Die Besichtigung der Gegebenheiten und Räume war ohne Einschränkungen möglich.

Datum: 24.06.2019
Uhrzeit: 1200 Uhr bis 1400 Uhr
Ort: Helling der Peterswerft, Wewelsfleth.
Beteiligte Personen der Stiftung-Hamburg-Maritim:

Weitere Besichtigungen fanden am 03.07.2019 im Rahmen des Einscannens der Außenhaut-Kontur statt.

Fig. 6: TS „NO. 5 ELBE", auf der Helling der Peterswerft

Folgende Ergebnisse können dokumentiert werden:

- Leck im Bereich der Plankenstöße an B.B.-Seite. Mitte des Lecks ca. 3,90 m achterlich vom Vorsteven. Die Kupferbeplattung ist zerstört. Die Auftreffstelle des Wulstbuges der „CMS ASTROSPRINTER" ist gut zu erkennen. Die Holzstruktur der äußeren Beplankung ist weitestgehend intakt. Der Plankenstoß zwischen 1. und 2. Planke ist geweitet und ist als Leck zu erkennen. Die eingebrachten Holzkeile sind im Rahmen der Bergung eingetrieben worden.

Fig. 7

Die noch vorhandene Kupferbeplattung ist z.T. aufgewellt. Das deutet auf eine starke globale Verformung des Schiffskörpers im

Zusammenhang mit den Kräften während der Kollision hin.

Fig. 8

Nach dem weiteren Entfernen der Kupferbeplattung wird ein größerer Schaden der Außenbeplankung sichtbar. Die erste Panke oberhalb des Kiels ist im hinteren Bereich eingerissen. Auch oberhalb der Schleifspuren durch den Wulstburg sind Planken gelöst und sicherlich nicht mehr wasserdicht gewesen.

Fig. 9

Gut zu erkennen ist die Schleifspur des Wulstbuges beim Abrutschen nach S.B. im Rahmen der Kollision.

Fig. 10

An B.B. Seite ist die Kupferbeplattung ebenfalls großflächig gewellt.

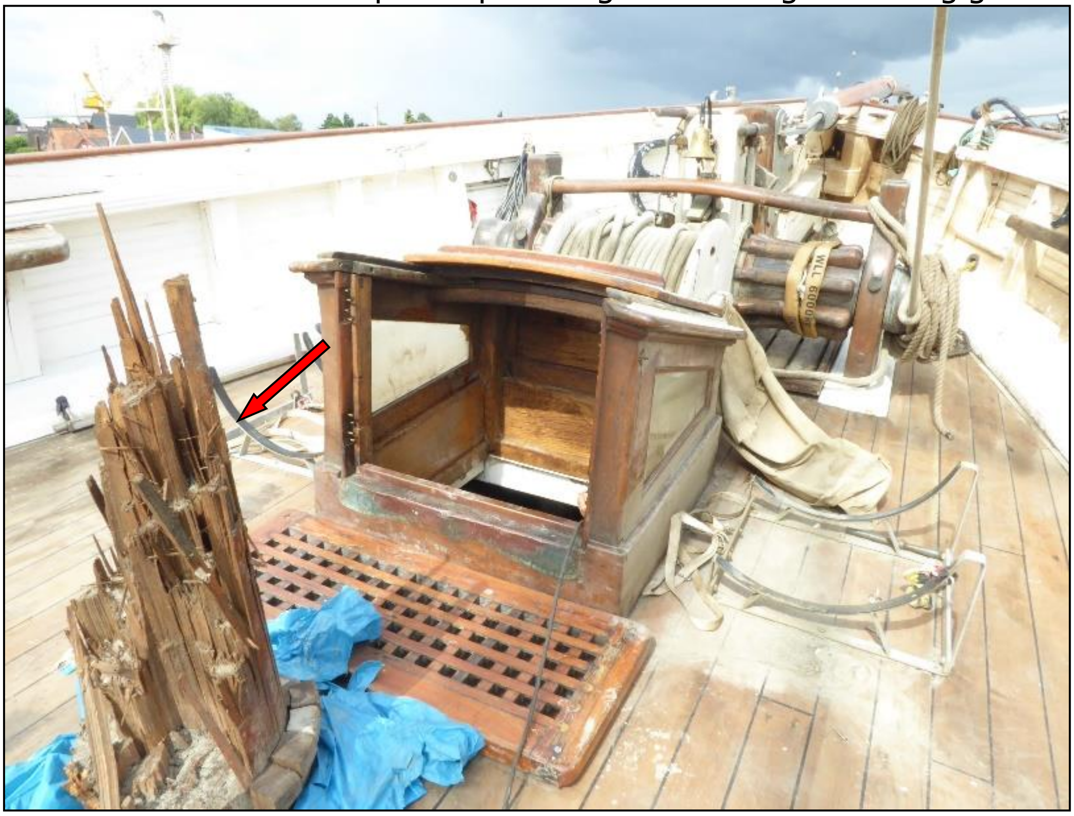


Fig. 11

Der vordere Mast mit Takelage ist oberhalb des Decks stumpf abgebrochen. Auf diesem Foto sind auch die Fundamente der beiden

Rettungsinseln zu erkennen.

Fig. 12

Im Schiffsinneren ist die gesamte Technik sowie der Holzinnenausbau durch das Sinken stark in Mitleidenschaft gezogen worden. Viele Komponenten der Elektrik als auch der Technik sind als Totalschaden anzusehen.

Fig. 13

Fig. 14

Risse im Bereich des Holz-Dollbordes auf beiden Seiten im Vorschiffs- und Mittschiffsbereich

Fig. 15

Die Pinne mit der direkten Ruderanbindung konnte gut bewegt werden.

Fig. 16

Fig. 17

Maschinentelegraph an S.B-Seite des Schanzkleides achterlich von der Schanzpforte

Fig. 18

Motor- und Navigationsinstrumente an Hinterkante Skylight unmittelbar vor dem Kompass

Fig. 19

Sumpf im Kielbereich, mittschiffs mit vertikalen Lenzrohren der

Handlenzpumpe:

Fig. 20

Kombiniert Lenz- und Feuerlöschpumpe an S.B.-Seite im Bereich des Lenzbrunnens. Es liegen keine Leistungsdaten vor.

Fig. 21

Blick in die Bilge im Vorschiffsbereich. Neue Verbolzung des Kiels und neue Bleibaren erkennbar. Außenbeplankung: ca. 80 mm, Spanthöhe ca. 200mm, Wegerung: ca.70mm

Fig. 22

Fig. 23

Hintere Motorraumabtrennung: kein wasserdichtes Schott

Davor unterhalb der Sitzebene: Kühlwasserzufuhr und Kraftstofffilter:

Fig. 24

Tank für Generator im Vorschiffsbereich. Kein Kollisionsschott vorhanden:

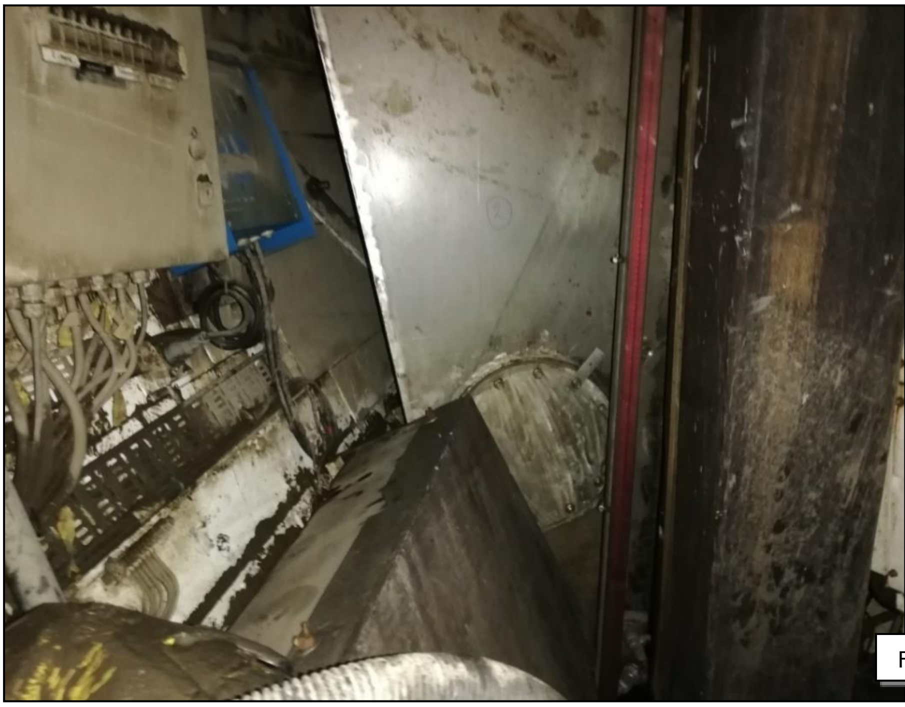


Fig. 25

A.2.2 Zusammenfassung der Ergebnisse:

A.2.2.1: Die für das Sinken ursächlichen Leckagen sind durch die beschädigte unterste Planke an B.B.-Seite, deren Plankenstößen und durch weitere oben liegende gelöste Planken entstanden.
A.2.2.2: Die Lenzpumpensysteme mit der Anordnung der Absaugung im Lenzbrunnen waren nicht in der Lage, die eindringende Wassermenge zu reduzieren.
A.2.2.3: Das Schiff verfügt weder über ein wasserdichtes Kollisionsschott noch über andere bis zum Freiborddeck hochgezogene wasserdichte Schotten.
A.2.2.4: Die zum Teil neue hölzerne Außenhautstruktur hat den Aufprall erstaunlich gut überstanden. Anhand der festgestellten Verformungen der Kupferbeplattung im Unterwasserschiffsbereich wird die globale Verformung des gesamten Schiffskörpers zum Zeitpunkt der Kollision dokumentiert. Bleibende Risse sind ebenfalls im oberen Decksbereich festgestellt worden.
A.2.2.5: Der vordere Mast mit Takelage ist durch den Aufprall der Back des Kollisionsgegners stumpf oberhalb des Decks abgebrochen.

A.2.2.6: Im Schiffsinneren ist die gesamte Technik sowie der Holzinnenausbau durch das Sinken und die über mehrere Tage andauernde Überflutung mit Brackwasser stark in Mitleidenschaft gezogen worden. Viele Komponenten der Elektrik als auch der Technik sind als Totalschaden anzusehen.
A.2.2.7: Die Pinne mit Ruderlager ist frei beweglich. Über die Kräfte in Fahrt und beim Manövrieren lassen sich aufgrund der Besichtigung außerhalb des Wassers keine Aussagen machen.
A.2.2.8: Die navigatorischen Bedienelemente (Kompass, GPS...) sowie die Kontrollelemente und die Fahrhebel der beiden Motoren befinden sich im Decksbereich unmittelbar vor dem Pinnenradius.

A.3. Vorschriften zur Rechtlichen Bewertung

Für das Schiff „NO. 5 ELBE" ist ein vorläufiges Sicherheitszeugnis für Traditionsschiffe (s. Anlage 1), Nr. 05/2018, von der BERUFSGENOSSENSCHAFT VERKEHRSWIRTSCHAFT POST-LOGISTIK TELEKOMMUNIKATION (BG Verkehr) ausgestellt worden. Dieses Zeugnis beschreibt die Erfüllung der Vorschriften des Absatzes 1.1 der Sicherheitsrichtlinie für Traditionsschiffe:

Bundesgesetzblatt Jahrgang 2018 Teil I Nr. 8, ausgegeben zu Bonn am 13. März 2018

Verordnung
zur Änderung der schiffssicherheitsrechtlichen
Vorschriften über Bau und Ausrüstung von Traditionsschiffen
und anderen Schiffen, die nicht internationalen Schiffssicherheitsregeln unterliegen*

Vom 7. März 2018

Fig. 26

A.3.1 Auffälligkeiten:

A.3.1.1: Gemäß Pkt. 2 des Sicherheitszeugnisses wird seitens der BG Verkehr festgestellt, dass das Kap. 2, Abschnitt 1. (Der Bezug zu Abschnitt 1 fehlt im deutschen Text!) der Richtlinie noch nicht erfüllt wird:

Fig. 27

2 das Traditionsschiff nach vorläufiger Prüfung den Anforderungen der Schiffssicherheitsverordnung Anlage 1a Teil 3 entspricht;
based on a preliminary assessment the traditional vessel complies with the requirements of the provisions of the Ordinance for the Safety of Seagoing Ships annex 1a part 3;
Die Bestimmungen des Kap. 2, Abschnitt der SchSV, Anlage 1a, Teil 3 werden noch nicht erfüllt.
The provisions of Ch.2, part 1 pf SchSV, app. 1a, part 3 are not yet met.

Das bedeutet, dass es der BG Verkehr bewusst ist, dass die Vorschriften zur Bauweise des Traditionsschiffes in Bezug auf Bauweise und Unterteilung **noch** nicht erfüllt werden:

Kapitel 2
Bauweise der Traditionsschiffe –
Unterteilung und Stabilität, Maschinen und elektrische Anlagen

Abschnitt 1
Bauweise und Unterteilung

Fig. 28

Da es sich jedoch um eine große Instandsetzung der Außenhaut gehandelt hat, bleibt die Frage zu klären, warum trotzdem ein vorläufiges Sicherheitszeugnis ausgestellt wurde. Denn die Forderungen zu Kap. 2, Abschnitt 1. waren zu diesem Zeitpunkt der Renovierung bereits in Kraft. Dieses hätte im Rahmen der Erneuerungsbesichtigung auffallen müssen. Daher hätte Kap. 1, 13.3.b (bauliche Anforderungen) als Übergangsregelung keine Anwendung finden dürfen.

13. Übergangsregelungen

13.1 Zeugnisse, Bescheinigungen und Prüflisten, die bis zum 14. März 2018 ausgestellt worden sind, bleiben bis zum Ablauf ihrer Gültigkeit wirksam. Bis dahin sind die Anforderungen der Sicherheitsrichtlinie für Traditionsschiffe weiterhin einzuhalten.

13.2 Die Voraussetzungen der Regel 5.1 und der Regel 6.1 Buchstabe a und b gelten für vorhandene Traditionsschiffe als erfüllt. Der Bestandsschutz beschränkt sich auf die bisher zugelassenen Nutzungen. Er erlischt durch eine Nutzungsänderung oder in Fällen, in denen die Abmessungen des Traditionsschiffes wesentlich geändert wurden oder wesentliche Änderungen am äußeren Erscheinungsbild des Traditionsschiffes vorgenommen worden sind.

13.3 Traditionsschiffe, die nach dem 14. März 2018 erstmalig einen Erneuerungsantrag stellen, müssen die Anforderungen der Kapitel 2 bis 11 hinsichtlich

a) der Ausrüstung und des Betriebssicherheitssystems innerhalb eines Jahres und

b) hinsichtlich der baulichen Anforderungen bis zur nächsten Zwischenbesichtigung

erfüllen.

13.4 Die Anforderungen nach Kapitel 3 Regel 13.1 sind spätestens fünf Jahre nach dem 14. März 2018 zu erfüllen, soweit sie die Ausrüstung mit Pressluftatmern betreffen.

13.5 Die Anforderungen nach Regel 12.5 und 12.6 sind spätestens fünf Jahre nach dem 14. März 2018 zu erfüllen.

Fig. 29

A.3.1.2. Gültigkeit des Zeugnisses: 16.09.2021

Fig. 30

Dieses Zeugnis gilt vorbehaltlich der Zwischenbesichtigungen bis 16.09.2021
This certificate is valid until ……………………………… subject to approval by intermediate surveys.

Gem. Kap. 1, 9.2. darf ein vorläufiges Zeugnis nur über einen Zeitraum von 6 Monaten ausgestellt werden.

9. Geltungsdauer und Gültigkeit des Sicherheitszeugnisses

9.1 Das Sicherheitszeugnis für Traditionsschiffe wird für die Dauer von höchstens fünf Jahren erteilt. Die Laufzeit beginnt am letzten Tag der erstmaligen Besichtigung oder der Erneuerungsbesichtigung.

9.2 Über die Erteilung eines Zeugnisses nach Regel 9.1 kann vorläufig entschieden werden, wenn

a) zur Feststellung der Voraussetzungen voraussichtlich längere Zeit erforderlich ist,

b) nach Regel 8 fällige Besichtigungen abgeschlossen sind,

c) nach dem Ergebnis dieser Besichtigung die Voraussetzungen für die Erteilung mit hinreichender Wahrscheinlichkeit vorliegen und

d) der Antragsteller die Umstände, die einer abschließenden Entscheidung entgegenstehen, nicht zu vertreten hat.

Die Gültigkeit eines Sicherheitszeugnisses nach Satz 1 darf sechs Monate nicht überschreiten.

9.3 Das Sicherheitszeugnis wird ungültig, wenn

a) die vorgeschriebenen Besichtigungen nicht innerhalb der in Regel 8.1, 8.4 und 8.6 festgelegten Zeitabschnitte abgeschlossen werden, oder

b) nach einer Besichtigung Veränderungen am Traditionsschiff, der Ausrüstung oder sonstigen Einrichtungen vorgenommen werden, die Gegenstand der Besichtigung waren.

9.4 Das Sicherheitszeugnis ruht, wenn das Traditionsschiff von einem Unfall betroffen ist oder ein Fehler entdeckt wird, der die Sicherheit des Traditionsschiffes oder die Leistungsfähigkeit oder Vollständigkeit seiner Rettungsmittel oder sonstigen Ausrüstungen beeinträchtigt. Die Berufsgenossenschaft entscheidet auf Antrag über das Wiederaufleben des Sicherheitszeugnisses.

Fig. 31

A.3.1.3. Gem. Pkt. 6: max. Windstärken von höchstens 5 Bft. Es herrschte offensichtlich deutlich mehr Wind.

A.4. Einscannen der Außenhaut-Kontur des verunfallten TS „NO. 5 ELBE“

Das gehobene Wrack des TS „NO. 5 ELBE“ wurde am 03.07.2019 durch die Mitarbeiter des LKA-Hamburg auf der Helling der Peterswerft, Wewelsfleth, eingescannt (s. 4.2[2]). Damit sind die äußeren Details des gehobenen TS dokumentiert. Aus dieser Erfassung ist die Außenhaut-Kontur des TS ermittelt worden. Diese Datenpunkte sind vom LKA 38 so aufgearbeitet worden, dass sie als Eingabe für die Hydrostatik-Software genutzt werden können. Damit ist eine genaue Erfassung des der Außenhaut-Kontur als Basis für die unterschiedlichen Stabilitätsberechnungen erfolgt.

In der Auswertung der Außenhaut-Kontur sind die Spant-Koordinaten des TS definiert worden. Dabei wurde die Lage des Ursprungs des Koordinatensystems (Spant 0.) auf dem Schnittpunkt O.K-Kiel mit der Ruderachse definiert. Die Basis (x-Achse) ist eine Parallele zur abzeichnenden Schwimmwasserlinie. Dis Spanten stehen senkrecht auf dieser Wasserlinie. Die Höhe als z-Koordinate hat am Schnittpunkt Kiel-Sponung an diesem Spt.0 die Kennzeichnung=0. Der Spantabstand ist mit 1,00 m definiert und fortlaufend nummeriert, bei 0 beginnend und positiv nach vorne.

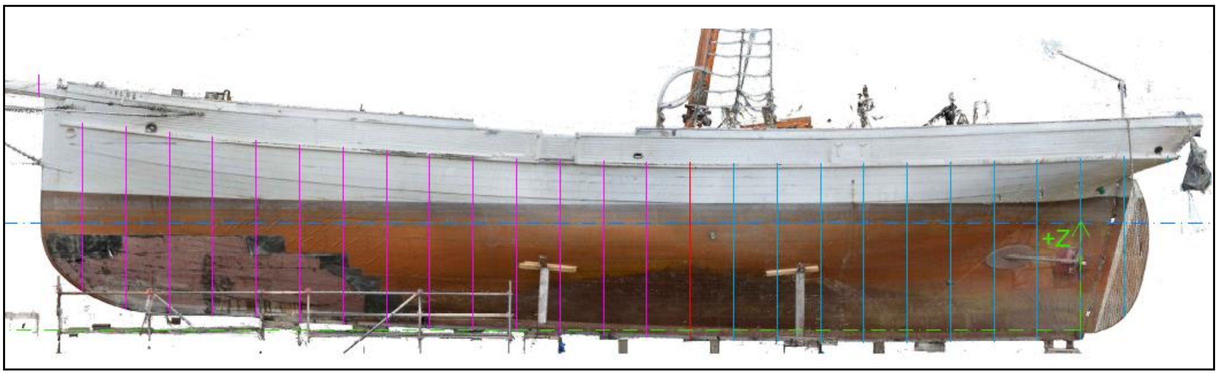


Fig. 32: Ansicht: Auswertung des Scan-Vorganges

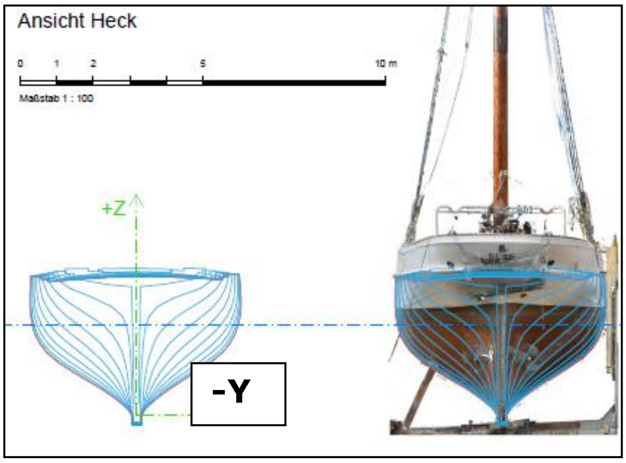


Fig. 33: Querschnitte Ansicht Heck: Spanten

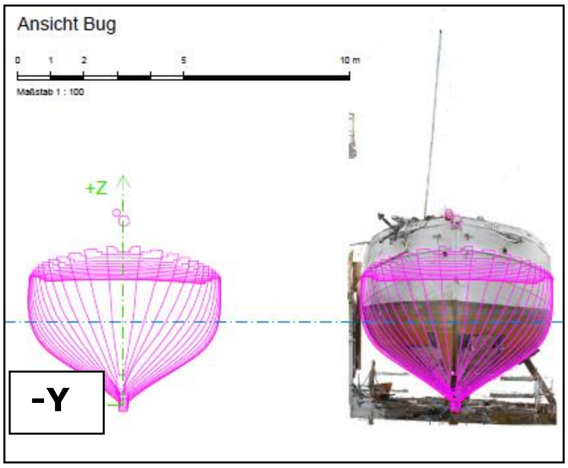


Fig. 34: Querschnitte Ansicht Bug: Spanten

A.5. Bestimmung der Länge des TS „NO. 5 ELBE“

Gem. der Richtlinie (s. 4.1.III), Teil 3, Kapitel 1, Nr. 2.1.2.1, handelt es sich bei dem Fahrzeug „NO. 5 ELBE“ um ein historisches Wasserfahrzeug (Traditionsschiff). Die Kombination von Rumpfform, Antrieb und Aufbauten ist nicht originalgetreu, aber dessen Gesamterscheinung entspricht einem Vorläufertyp, den es in dieser Bauweise nachweislich in der Vergangenheit gegeben hat (Rückbau);

Gem. Kapitel 1, 2.1.5, ermittelt sich die Länge des TS „NO. 5 ELBE“ wie folgt:

1. Nach Maßgabe des Artikels 2 Absatz 8 des Londoner Schiffsvermessungsübereinkommens oder
2. für Traditionsschiffe mit weniger als 24 m Vermessungslänge die Rumpflänge LH nach DIN EN ISO 8666, Ausgabe Dezember 2016;

Ermittlung der Länge gem. des Artikels 2 Absatz 8 des Londoner Schiffsvermessungsüberein- kommens:
(8) "length" means 96 per cent of the total length on a waterline at 85 per cent of the least moulded depth measured from the top of the keel, or the length from the fore side of the stem to the axis of the rudder stock on that waterline, if that be greater. In ships designed with a rake of keel the waterline on which this length is measured shall be parallel to the designed waterline;

Die Länge (L) beträgt:

1. 96 % der Gesamtlänge in einer Wasserlinie in Höhe von 85 % der geringsten Seitenhöhe, von der Oberkante des Kiels gemessen, oder
2. wenn der folgende Wert größer ist, die Länge von der Vorkante des Vorstevens bis zur Drehachse des Ruderschafts in dieser Wasserlinie.

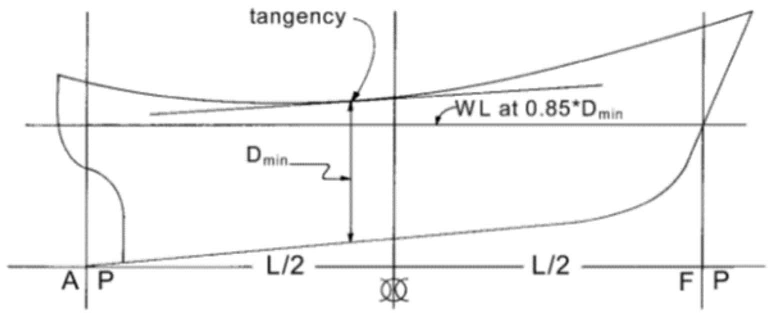
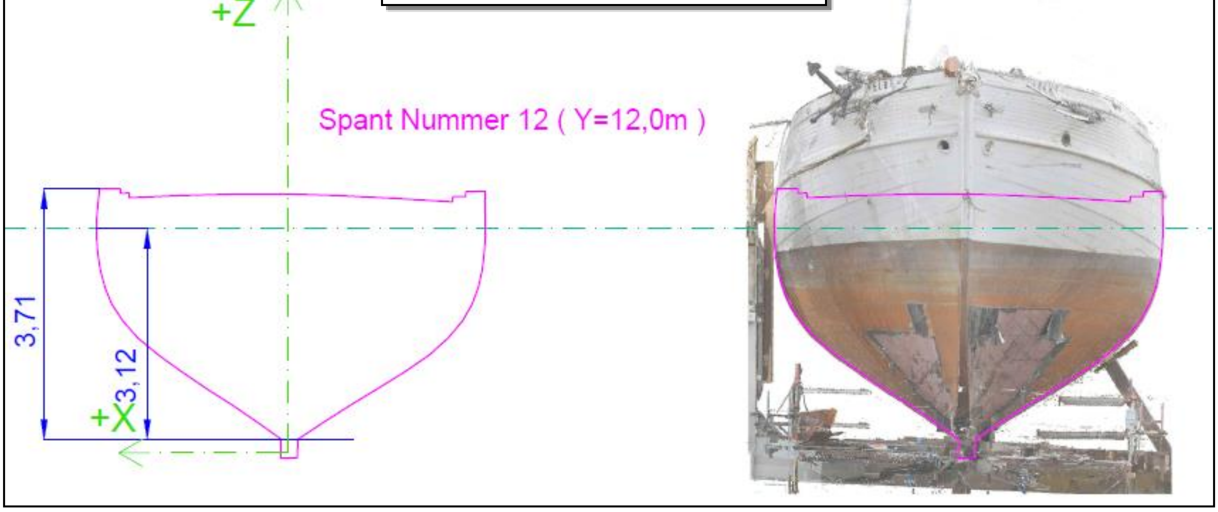


Fig. 35: Skizze aus Vorschrift zur Ermittlung 0,85 x Dmin

Ermittlung der Wasserlinie auf Höhe 0,85 x Dmin bei Spant Nr. 12 (Y=12,00 m).
Dmin: 3,71 m
0,85xDmin: 3,12 m
Die Ebene der Wasserlinie 0,85xDmin ist parallel zur Ebene XY (Z=0) ausgerichtet:

Fig. 36: Dmin/0,85xDmin auf Spt. 12



A.5.1 Berechnung Länge 1.:

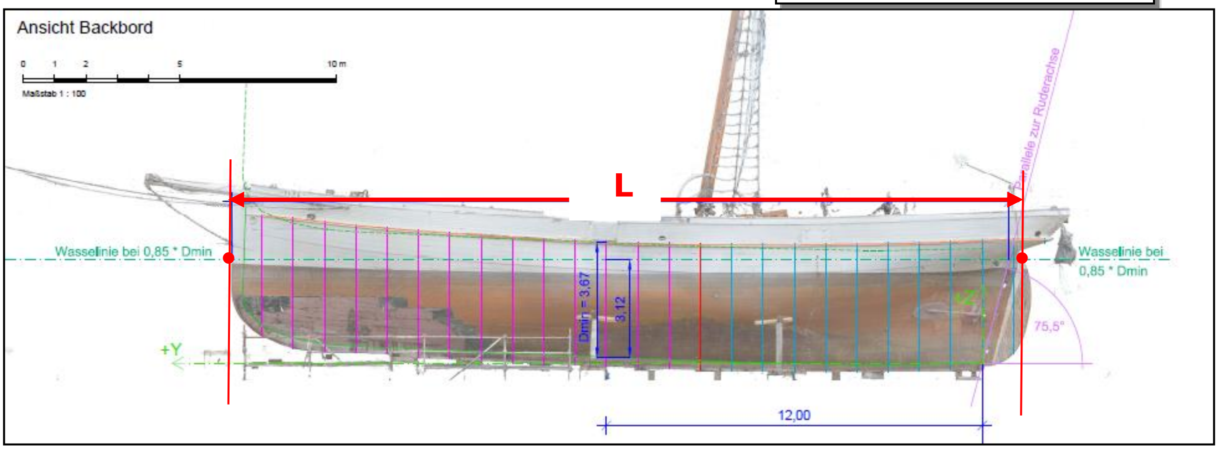
Die Länge L1 berechnet sich aus der 96% der Länge der Wasserlinie auf 0,85xDmin:

L1 = 0,96 x L

L= 25,26 m

L1 = 0,96 x 25,35 = **24,25 m**

Fig. 37: Ermittlung der Länge L

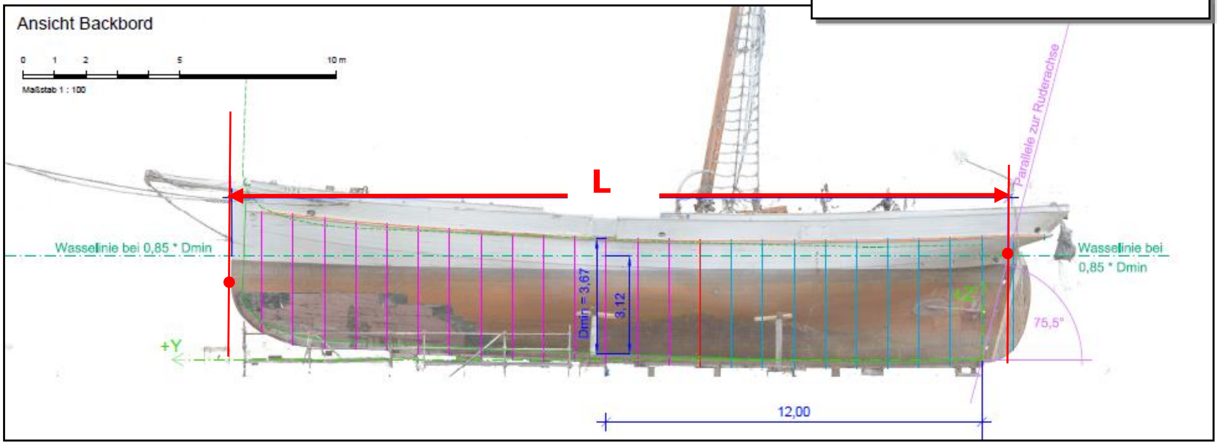


A.5.2 Berechnung Länge 2.:

Die Länge L2 berechnet sich aus der Länge der Wasserlinie auf 0,85xDmin zwischen Schnittpunkt dieser Wasserlinie mit der Ruderachse und dem vordersten Punkt des Stevens:

L2 = **24,83 m**

Fig. 38: Ermittlung der Länge L2



A.5.3 Zusammenfassung der Ergebnisse:

Die Länge **L2 = 24,83 m** ist die größte Länge und größer als 24,00 m. Daher ist diese Länge L2 für die Bewertung der Richtlinie (s. 4.1.III) heranzuziehen

A.6. Forderungen zur wasserdichten Unterteilung aus der Richtlinie (s. 4.1.III) aufgrund der Länge von 24,84 m

Vorschrift	Forderung	Erfüllt?
Kapitel 2, 1.8.1	Schotten bis zum Freiborddeck hochgezogen	Nein
Kapitel 2, 1.8.2	Kollisionsschott auf 0,05-0,1 x L vom VL	Nein

Die Verordnung zur Änderung der schiffssicherheitsrechtlichen Vorschriften über Bau und Ausrüstung von Traditionsschiffen wird in den Punkten Kapitel 2, Abschnitt 1, 8.1 u. 8.2 nicht erfüllt. Ein Kollisionsschott auf 0,05-0,1 x L vom VL ist nicht vorhanden.

A.7. Verformung aufgrund des Zusammenstoßes

Bei der Betrachtung der eingescannten Kontur wird eine deutliche Verformung der Form des Vorschiffes an B.B.-Seite in den Bereichen Spt.18-23 festgestellt. Es wird eine asymmetrische Verformung von bis zu 170 mm im Bereich des Spt. 20 gemessen.

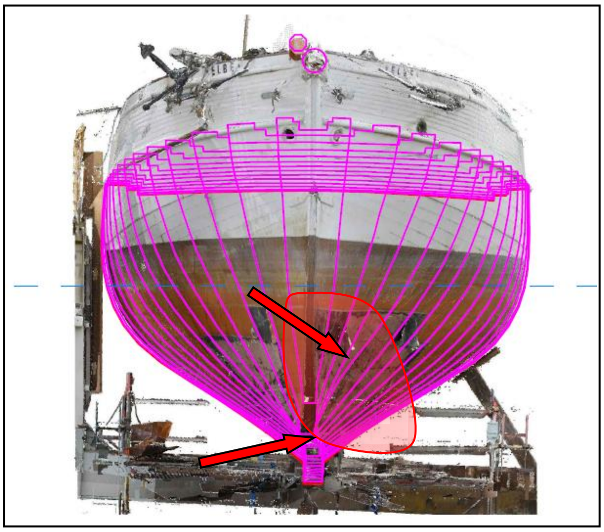


Fig. 39: Bereiche der größten Verformung an B.B

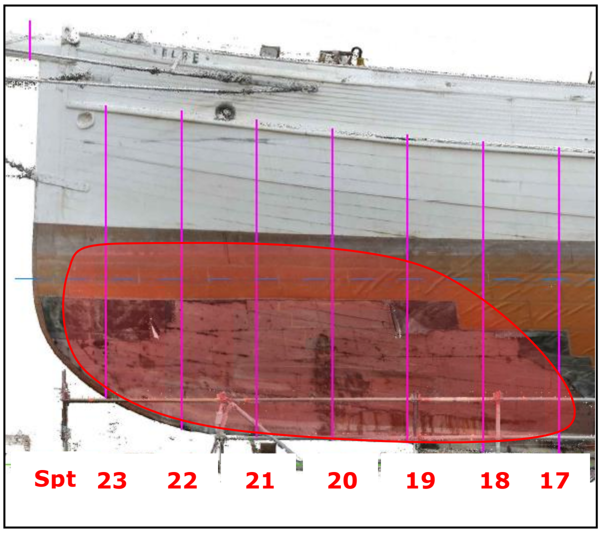


Fig. 40: Ermittlung der Länge L2

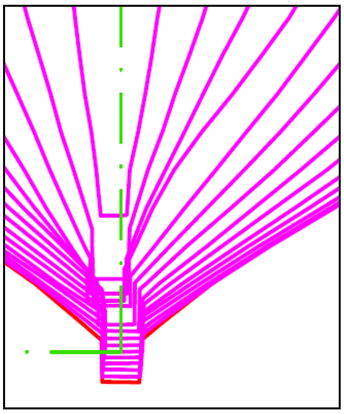


Fig. 41: Detailskizze: Verformungen bis zu 170mm

9.2 Expert opinion for the assessment of intact stability and damaged stability

G U T A C H T E N

BEWERTUNG

TS «NO. 5 ELBE»

INTAKTSTABILITÄT
Verordnung zur Änderung der schiffssicherheitsrechtlichen Vorschriften über Bau und Ausrüstung von Traditionsschiffen vom 7. März 2018[61]

LECKSTABILITÄT
EU-Richtlinie 2009/45/EG
Sicherheitsvorschriften u. Normen für Fahrgastschiffe, Kapitel II-1

Auftrag für: Bundesstelle für Seeunfalluntersuchung (BSU)

Auftrags-Nr.: 211/19

Bericht-Nr.: 2019-08.00

Erstellt von: Dipl.-Ing. Schiffbau Jan Hatecke

Datum: 05.12.2019

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Mobil: 0171-5335934 • Tel.: 04770-808411 • E-Mail: post@jan-hatecke.de • www.jan-hatecke.de
Öffentlich bestellter und vereidigter Sachverständiger (IHK-Stade für den Elbe-Weser-Raum)
Sachgebiet Rettungsmittel und Rettungseinrichtungen auf Schiffen

[61] Note by the BSU: This and the following refer to Part 3 of Annex 1a to Sections 6 and 6a SchSV ('Safety requirements for the construction and equipping of traditional ships').

Prozess des Dokumentes

Revision	Seiten	Datum	Beschreibung/ Änderungen	Sachverständigenbüro
00	71	05.12.2019	Original	J.H.
Dokument:		**2019-08.00**		

Sachverständigenbüro Dipl.-Ing. Jan Hatecke
Öffentlich bestellter und vereidigter Sachverständiger (IHK-Stade für den Elbe-Weser-Raum)

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Internet: **www.jan-hatecke.de**

Inhaltsverzeichnis

1. Auftrag

Von:	Bundesstelle für Seeunfalluntersuchung Bernhard-Nocht-Straße 78 20359 Hamburg
Ansprechpartner:	BSU
Aktenzeichen BSU:	211/19

2. Auftragsumfang

Erstellung eines Gutachtens zum Thema:

Bewertung der Inaktstabilität und Leckstabilität des TS «NO. 5 ELBE»

- **Verordnung zur Änderung der schiffssicherheitsrechtlichen Vorschriften über Bau und Ausrüstung von Traditionsschiffen vom 7. März 2018**
- **EU-Richtlinie 2009/45/EG, Sicherheitsvorschriften u. Normen für Fahrgastschiffe, Kapitel II-1**

3. Abkürzungen

Die folgenden Abkürzungen sind in diesem Bericht verwendet worden:

B.B.	Backbord Schiffsseite
S.B.	Steuerbord Schiffsseite
MS	Mitte Schiff
TS	Traditionsschiff
Bft	Windstärke in Beaufort
BSU	Bundesstelle für Seeunfalluntersuchung
SSU	Sehr Schwerer Seeunfall
BG Verkehr	BERUFSGENOSSENSCHAFT VERKEHRSWIRTSCHAFT POST-LOGISTIK TELEKOMMUNIKATION
t	Tonnen = 1000 kg
ρ	Dichte
kN	Kilo Newton
m	Meter
kn	Knoten = Geschwindigkeit
L	Länge
ü.A.	Über Alles, Gesamte Schiffslänge
B	Breite
H	Höhe
kg	Kilogramm
Spt	Spant
O.K.	Oberkante
Nr.	Nummer
PS	Leistung in Pferdestärken
Max.	Maximal
MCO	Marine Consultant Office Sachverständigenbüro Dipl.-Ing. Jan Hatecke

LC	Lastfall
AP	Hinteres Lot
FP	Vorderes Lot
X	Koordinate in Längsrichtung: +=bezogen aufs hintere Lot nach vorne
Y	Koordinate in Querrichtung: +=bezogen auf MS nach S.B.
Z	Koordinate in Höhen: +=bezogen auf Basis nach oben
Tv	Gesamttiefgang vorne gem. Tiefgangsmarke
Th	Gesamttiefgang hinten gem. Tiefgangsmarke
TvL	Tiefgang am vorderen Lot bezogen auf Basis
ThL	Tiefgang am hinteren Lot bezogen auf Basis
LCG	Längenschwerpunkt der Masse (m)
VCG	Höhenschwerpunkt der Masse (m)
TCG	Seitenschwerpunkt der Masse (m)
GZ	Krängender Hebelarm in der Stabilitätsberechnung (m)
GM`	Anfangsstabilität mit Einfluss der freien Oberflächen der Tanks (m)
sm	Seemeile = 1,852 km
Gem.	Gemäß
LKA 38	Polizei Hamburg, Abteilung 38

4. Referenz- und Quellenverzeichnis

4.1 Normen und Standards

Die Aussagen in diesem Bericht basieren auf folgenden nationalen und internationalen Vorschriften:

XII. Richtlinie 2009/45/EG DES EUROPÄISCHEN PARLAMENTS UND DES RATES vom 06. Mai 2009 über Sicherheitsvorschriften und –normen für Fahrgastschiffe

XIII. Richtlinie (EU) 2017/2108 DES EUROPÄISCHEN PARLAMENTS UND DES RATES vom 15. November 2017 zur Änderung der Richtlinie 2009/45/EG über Sicherheitsvorschriften und –normen für Fahrgastschiffe

XIV. Verordnung zur Änderung der schiffssicherheitsrechtlichen Vorschriften über Bau und Ausrüstung von Traditionsschiffen und anderen Schiffen, die nicht internationalen Schiffssicherheitsregeln unterliegen, vom 7. März 2018: Teil 3, Sicherheitsanforderungen an den Bau und die Ausrüstung von Traditionsschiffen

XV. Londoner Schiffsvermessungsübereinkommen: Internationales Schiffsvermessungs-Übereinkommen von 1969 vom 23. Juni 1969 (BGBl. 1975 II S. 67);

XVI. Life-Saving Appliances, LSA Code 2017 Edition (former: LSA-Code 2010 Edition)

4.2 Referenzen

Dieser Bericht basiert auf Informationen aus den nachfolgenden Referenzen:

Nr.	Dokument Nr.	Titel	Datum
[1]	2019-07.02	MCO Gutachten: Untersuchung nach Kollision am 08.06.2019, TS „NO. 5 ELBE“	26.09.2019
[2]	-	Bericht zum Krängungsversuch, Tecnitas Lotsenschoner No.5 ELBE	21.06.2006
[3]	-	Stabilitätsbuch, Yacht concepts & design Lotsenschoner No.5 ELBE	01.08.2007
[4]	Jugend in Arbeit Hamburg e.V./MDo	BRANDSCHUTZ- u. SICHERHEITSPLAN	August 2009
[5]	Plan 1	„Objektzeichnung Lotsenschoner „No.5 ELBE“	17.09.2019
[6]	Plan 2	„Objektzeichnung Lotsenschoner „No.5 ELBE“	17.09.2019
[7]	-	Drehkreis über Stb 106m (002).PNG, von PANDI SERVICES, J.&K. BRONS	09.08.2019
[8]	-	Testfahrt Maschinenanlage Lotsenschoner No 5 Elbe, von W. Jünke	27.04.2016

4.3 Bildquellen

Fig. 1: Aus: https://segelreporter.com/panorama/unfall-elbe-5-nach-kollision-mit-frachter-gesunken-ignorierte-der-kapitaen-warnungen/, 31.07.2019

Fig. 2: Aus: https://www.ln-online.de/Nachrichten/Norddeutschland/Nach-Kollision-auf-der-Elbe-Ermittlungen-gegen-Kapitaen-der-No-5-Elbe, 31.07.2019

Fig. 3: Aus: https://www.sy-tongji.de/Segelschiffe/No_5_Elbe/no_5_elbe.html, 31.07.2019

Fig. 4, 5, 6: Aus: 4.2.[6]

Fig. 7-11: Ausdruck aus Software MODELMAKER

Fig. 12-13: Aus: 4.2.[5]

Fig. 14-16: Ausdruck aus Software AUTOHYDRO

Fig. 17: Aus: 4.2.[7]

Fig. 18: Aus: 4.2.[8]

5. Einleitung

Am Nachmittag des 08.06.2019 ereignete sich im Fahrwasser der Elbe oberhalb der Mündung des Elbenebenflusses Schwinge eine Kollision zwischen dem TS „NO. 5 ELBE" und dem elbabwärts dem Fahrwasserverlauf folgenden MV „CMS ASTROSPRINTER". Die „NO. 5 ELBE" erlitt im Vorschiffsbereich unterhalb der Wasserlinie an B.B.-Seite mehrere Risse im Bereich der Plankenstöße. Dieses führte zu einem starken Wassereintritt ins Schiffsinnere. Die Schwimmfähigkeit konnte weder mit Bordmitteln noch mit zusätzlichen Hilfspumpen aufrechterhalten werden, so dass das Schiff später im Mündungsbereich des Nebenflusses Schwinge sank. Darüber hinaus wurde die Takelage stark beschädigt. Der vordere Mast mit den Topspieren knickte ein. Mehrere Personen wurden bei diesem Unfall schwer verletzt.
Dieser sehr schwere Seeunfall (SSU) wird von der BSU mit der Untersuchungsnummer 211/19 untersucht. Im Zusammenhang mit ersten Untersuchungsergebnissen der BSU ist der unterzeichnende Sachverständige beauftragt worden, eine Bewertung der Intakt- und Leckstabilität auf Basis der hier aufgeführten Vorschiften (s. 4.1.I, 4.1.II u. 4.1.III) durchzuführen.

Fig. 1: TS „NO. 5 ELBE" kollidiert mit MV „CMS ASTROSPRINTER"

Fig. 2: TS „NO. 5 ELBE", vollständig gesunken im Mündungsbereich des Nebenflusses Schwinge

6. Zusammenfassung der Ergebnisse

Der unterzeichnende Sachverständige ist von der BSU beauftragt worden, die Untersuchung zu dem Unfall des TS „NO.5 ELBE" am 08.06.2019 auf der Unterelbe oberhalb der Schwingemündung gutachterlich zu begleiten.
In diesem Gutachten werden die Intakt- und Leckstabilität des verunfallten TS „NO.5 ELBE" berechnet. Basierend auf den Ergebnissen dieser Untersuchung können folgende Aussagen getroffen werden:

Intaktstabilität gem. Verordnung zur Änderung der schiffssicherheitsrechtlichen Vorschriften über Bau und Ausrüstung von Traditionsschiffen v. 07.03.2018:

Unter Berücksichtigung der Ergebnisse und Auswertungen des Krängungsversuches vom 21.10.2006 (s.4.2[2], 4.2[3]) und den hier getroffenen Annahmen bestätigen die Ergebnisse dieser Berechnung, dass das TS „ELBE NO. 5" die Anforderungen zur Intaktstabilität der Traditionsschiffs-Richtlinie erfüllt. In allen geforderten Ladefällen werden die Stabilitätskriterien sowie die Kriterien für Momente durch Drehkreis, Wetter und einseitiger Personenkonzentrierung für maschinengetriebene und segelnde Traditionsschiffe erfüllt. Unter Standardbeseglung (ohne Toppsegel) kann das Schiff bis zu einer Windstärke Bft 6 eingesetzt werden, unter Sturmbeseglung (Reff II) bis zu einer Windstärke Bft 9. Das Schiff verfügt in allen Ladefällen über einen sehr guten Stabilitätsumfang mit einer befriedigenden, aber nicht zu großen Anfangsstabilität. Dieser Umstand lässt sehr gute Seeeigenschaften erwarten.

Bei der Bewertung der Ergebnisse dieser Berechnungen wird davon ausgegangen, dass die im Winter 2018/19 durchgeführten großen Restaurierungsarbeiten die Massen- und Schwerpunktslagen des Schiffes nicht verändert haben. Er wird empfohlen, nach Abschluss der Reparaturphase einen neuen Krängungsversuch zur Ermittlung der Massen und Schwerpunkte durchzuführen. Die Wasserablaufpforten im Schanzkleid sollten nicht verschließbar und voll funktionsfähig sein.

Leckstabilität gem. EU-Richtlinie 2009/45/EG, Sicherheitsvorschriften u. Normen für Fahrgastschiffe, Kapitel II-1:

Das TS „NO 5 ELBE" ist ohne wasserdichte Querschotten durch die BG-Verkehr als Traditionsschiff gem. der jüngsten Richtlinie vorläufig zertifiziert worden.
Im Rahmen dieser Untersuchung sollte der unterzeichnende Sachverständige bewerten, inwieweit eine ausreichende Leckstabilität mit Erfüllung der entsprechenden Vorschriften bei diesem Schiff realisiert werden kann.
Unter Berücksichtigung der Ergebnisse des Teils B. zur Intaktstabilität und den hier getroffenen Annahmen ergeben die Ergebnisse dieser Berechnung und Bewertung, dass das TS „NO. 5 ELBE" die Anforderungen zur Leckstabilität der Richtlinie 2009/45/EG unter folgenden Bedingungen erfüllen würde:

- Mit dem Einbau von zwei wasserdichten Schotten mit Schotttüren in den Bereichen Spt 6 (vorderkante des hinteren Wohnbereiches) und Spt 15 (Vorderkante des großen Wohnbereiches auf Mittschiffs) kann ein 1-Abteilungstatus mit den Kriterien für die hier geforderten Lastfälle erreicht werden.
- Ein Kollisionsschott, angeordnet gem. den Forderungen der Vorschriften, ist zur Aufrechterhaltung der Schwimmfähigkeit im Leckfall dann nicht notwendig, wenn ein wasserdichtes Schott auf Spt 15 eingebaut wird.
- Ein Doppelboden vom Spt 6 bis Spt 15 ist für zur Aufrechterhaltung der Schwimmfähigkeit im Leckfall nicht notwendig. Aufgrund der Konstruktion des starken S-Spantes mit Kiel ist der Doppelboden als Schutz gegen Grundberührung nur bedingt erforderlich und in dieser Holzbauweise auch konstruktiv kaum realisierbar.
- Die allgemeinen Anforderungen zu Stabilitätsunterlagen an den Kapitän, Lecksicherheitspläne, Ladelinien, Konstruktion der Schotten und wasserdichte Türen müssen erfüllt werden.
- Die konstruktive Umsetzung zur Herstellung von wasserdichten Schotten bei diesem Schiff ist nicht Bestandteil dieser Untersuchung. Massen- und Schwerpunktsveränderungen durch einen Einbau von wasserdichten Schotten sind in diesen Berechnungen nicht berücksichtigt worden.

Das Schiff würde bei dem Volllaufen von jeweils einer Hauptabteilung immer schwimmfähig bleiben und die geforderten Stabilitätskriterien in den drei untersuchten Ladefällen erfüllen.

Das Gutachten wurde unparteiisch und nach bestem Wissen und Gewissen angefertigt. Die Haftung des Sachverständigen richtet sich nach § 276 II BGB, wobei leichte Fahrlässigkeit ausgeschlossen ist. Evtl. Schadensersatzansprüche beschränken sich auf die Höhe der bestehenden Berufshaftpflichtversicherung für Personen-, Sach- und Vermögensschäden. Die Haftungsdauer beträgt 2 Jahre ab Gutachtendatum. Gerichtstand und Erfüllungsort ist Stade, sofern dem nicht § 38 ZPO entgegensteht. Eine Übersicht zum Datenschutz ist der Website www.jan-hatecke.de zu entnehmen.

05. Dezember 2019

....
Jan Hatecke, Dipl.-Ing. Schiffbau

A. Fakten

A.1 Schiffsdaten

Schiffsname:	NO. 5 ELBE
Flagge:	Deutschland
Heimathafen:	Hamburg
Rufzeichen:	DANF
Schiffstyp:	Traditionsschiff / Segelschiff (ehem. Lotsenschoner)
Bauwerft:	H.L. Stülcken
Nb.-Nr.:	769
Baujahr (Kiellegung):	1883
BRZ	52
Länge (nach Richtlinie):	24,83 m
Breite (Rumpf):	ca. 5,78 m
Tiefgang hinten:	ca. 3,00 m
Leistung:	2 x 130 PS

Fig. 3: TS „NO. 5 ELBE“, Unter Segeln

A.2 Einscannen der Außenhaut-Kontur des verunfallten TS „NO. 5 ELBE“

Das gehobene Wrack des TS „NO. 5 ELBE“ wurde am 03.07.2019 durch die Mitarbeiter des LKA-Hamburg auf der Helling der Peterswerft, Wewelsfleth, eingescannt (s. 4.2[6]). Damit sind die äußeren Details des gehobenen TS

dokumentiert. Aus dieser Erfassung ist die Außenhaut-Kontur des TS ermittelt worden. Diese Datenpunkte sind vom LKA 38 so aufgearbeitet worden, dass sie als Eingabe für die Hydrostatik-Software genutzt werden können. Damit ist eine genaue Erfassung der Außenhautkontur als Basis für die unterschiedlichen Stabilitätsberechnungen erfolgt.
In der Auswertung der Außenhautkontur sind die Spant-Koordinaten des TS definiert worden. Dabei wurde die Lage des Ursprungs des Koordinatensystems (Spant 0.) auf dem Schnittpunkt O.K.-Kiel mit der Ruderachse definiert. Die Basis (x-Achse) ist eine Parallele zur abzeichnenden Schwimmwasserlinie. Dis Spanten stehen senkrecht auf dieser Wasserlinie. Die Höhe als z-Koordinate hat am Schnittpunkt Kiel-Sponung an diesem Spt.0 die Kennzeichnung=0. Der Spantabstand ist mit 1,00 m definiert und fortlaufend nummeriert, bei 0 beginnend und positiv nach vorne.

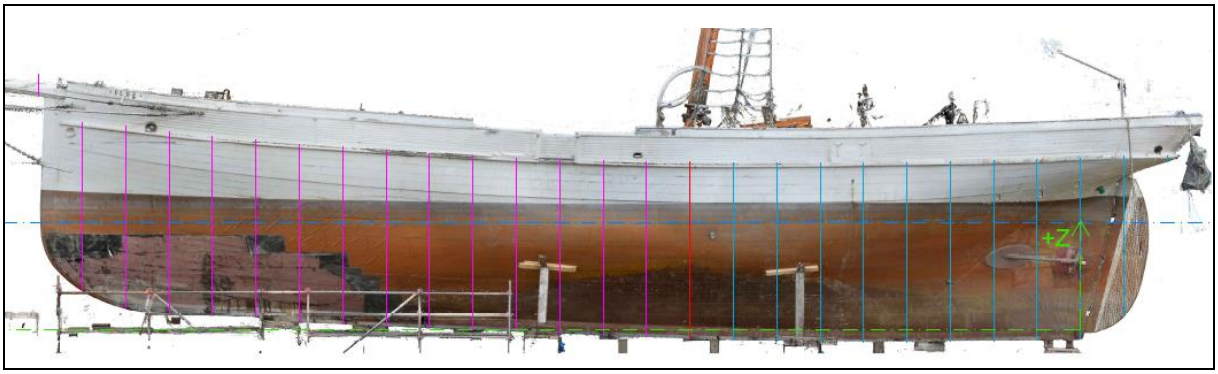


Fig. 4: Ansicht: Auswertung des Scan-Vorganges

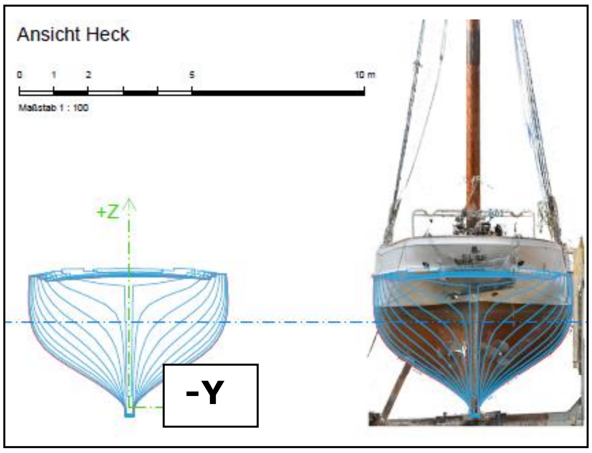


Fig. 5: Querschnitte Ansicht Heck: Spanten

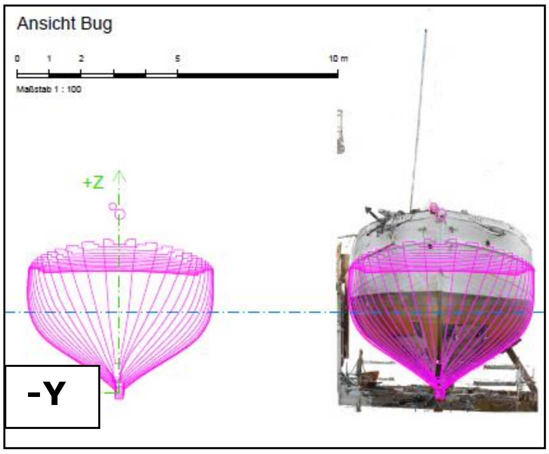
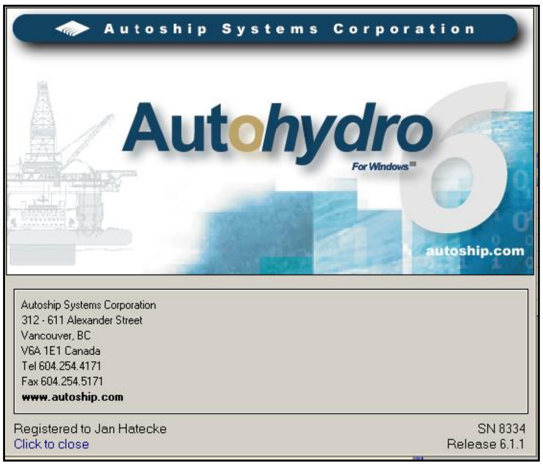
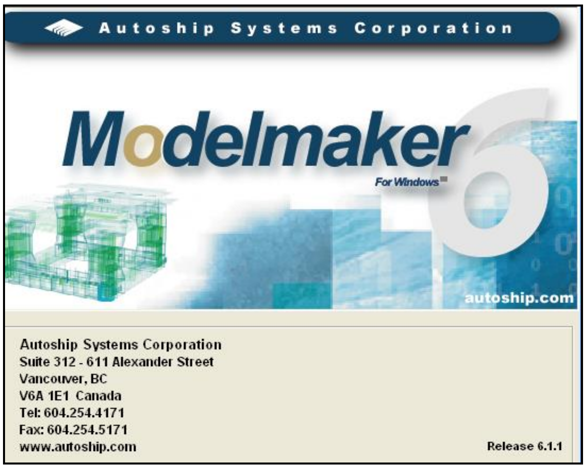


Fig. 6: Querschnitte Ansicht Bug: Spanten

A.3 Hydrostatik-Software

Die nachfolgenden Hydrostatik-Berechnungen sind mit dem Programm AUTOHYDRO, Version 6.6.1., der Firma Autoship System Corporation Canada erstellt worden. Die hierfür notwendige Schiffsgeometrie der Außenkontur des TS „NO.5 ELBE" ist mit dem Programmteil MODELMAKER 6.1.1. mit den in Abs. A.2 ermittelten X/Y/Z-Koordinaten erstellt worden.





Für die nachfolgenden Stabilitätsberechnungen sind in diesem Zusammenhang folgende Geometrien aufgemessen und generiert worden:

Windangriffsflächen: Segel, Masten, Schanzkleid
Tanks: DTK, DTK VORNE, FAEKALIENK BB, FAEKALIENTK MI, TKWTK VORNE BB, TKWTK VORNE SB, TKWTK MITTE BB, TKWTK MITTE SB
Flutungsräume: FLUTUNG VOR KO, FLUTUNG VORNE, FLUTUNG MITTE, FLUTUNG HINTEN

Bei der Dimensionierung der Flutungsräume sind die im Rahmen der Besichtigung aufgemessenen Holzdimensionen für Außenbeplankung, Decksbalken und Innenwegerung berücksichtigt worden.

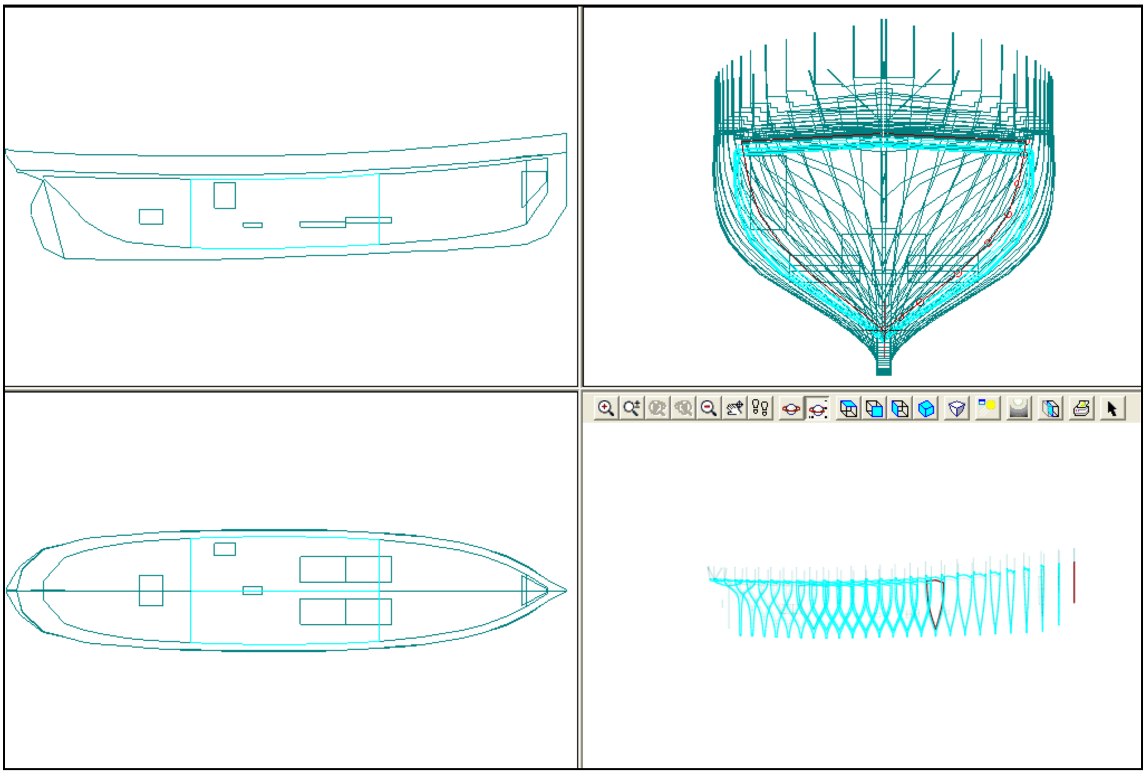


Fig. 7: Output Software MODELMAKER

Die Masten und Segel sind gem. der Angaben aus dem Stabilitätshandbuch (s. 4.2.[3]) aufgemessen worden.

- Max. Besegelung: Großsegel, Toppsegel, Schoner, Fock, Innenklüver, Außenklüver
- Standardbesegelung: Großsegel, Schoner, Fock, Innenklüver, Außenklüver
- Sturmbesegelung-Reff II: Groß mit Reff II, Schoner mit Reff II, Fock
- Vor Topp und Takel-Nur Rigg: Großmast mit Spieren, Schonermast, festes und loses Bugspriet

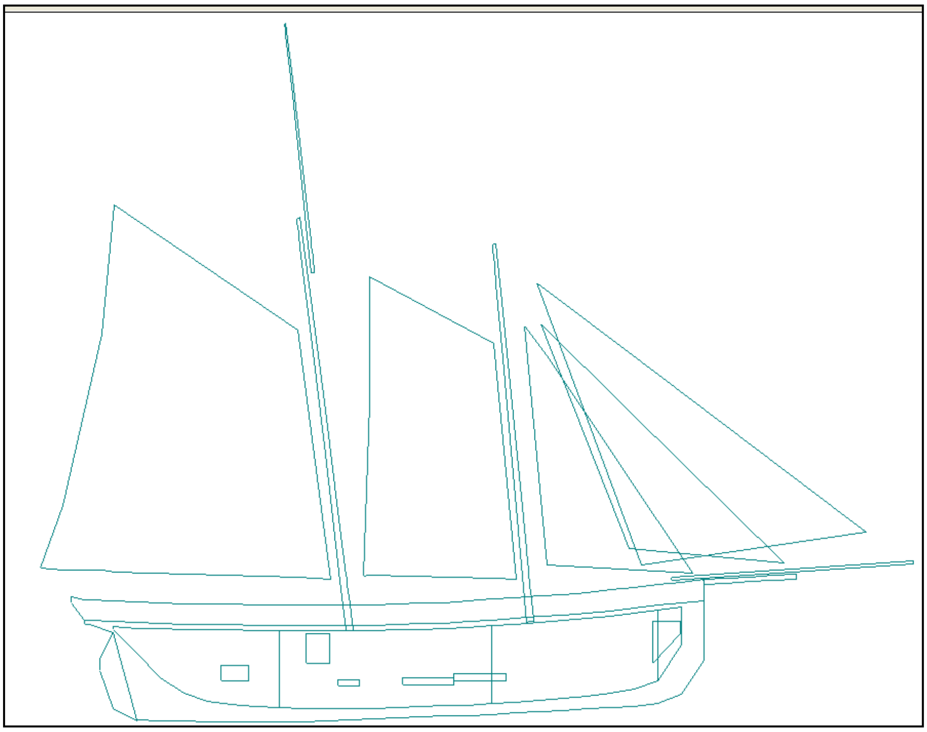


Fig. 8: Standardbeseglung

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Nr.	Bezeichnung	LPA (m2)	Arm (m)
1	Aussen	40.9	2.076
2	Aussen	22.7	3.282
3	MAST HINTEN	3.9	10.173
4	MAST VORNE	3.6	9.891
5	SPIERE MAST HI	1.1	21.918
6	BUGSPRIET FEST	0.8	4.541
7	BUGSPRIET LOSE	1.4	4.893
8	GROSSSEGEL	124.2	10.676
9	SCHONER	63.5	9.99
10	FOCK	31.2	7.875
11	INNENKLÜVER	29.5	8.817
12	AUßENKLÜVER	59.1	9.655
	Außenhaut/Masten/ Segel: Flächen mit Schwerpunkt: Standardsegel Ladefall 1	**381.9**	**8.66**

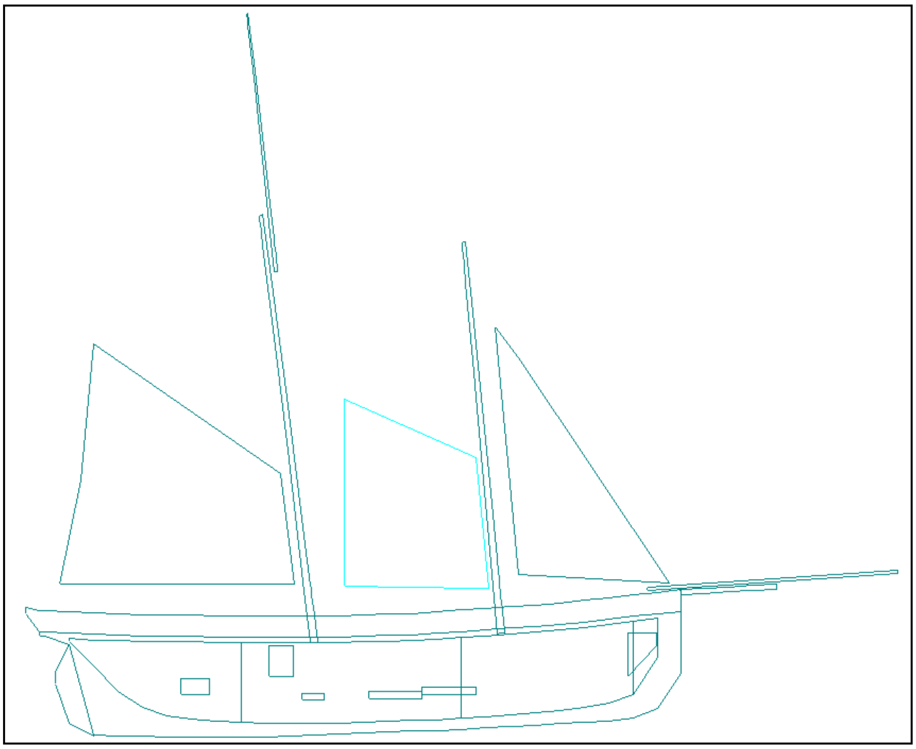

Fig. 9: Sturmbesegelung, Reff II

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Nr.	Bezeichnung	LPA (m2)	Arm (m)
1	Aussen	40.9	2.076
2	Aussen	22.7	3.282
3	MAST HINTEN	3.9	10.173
4	MAST VORNE	3.6	9.891
5	SPIERE MAST HI	1.1	21.918
6	BUGSPRIET FEST	0.8	4.541
7	BUGSPRIET LOSE	1.4	4.893
8	GROSSSEGEL	60.5	8.201
9	SCHONER	35.6	7.798
10	FOCK	31.2	7.75
	Außenhaut/Masten/ Segel: Flächen mit Schwerpunkt: Sturmbeseglung (Reff II), Ladefall 1	**201.7**	**6.37**

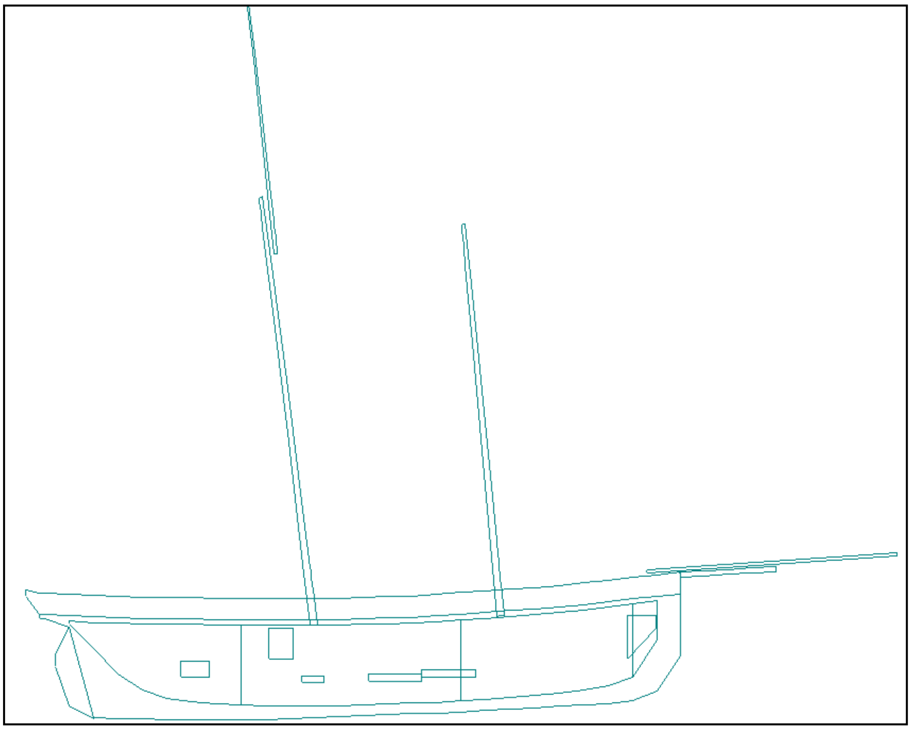

Fig. 10: Vor Topp und Takel, nur Rigg

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Nr.	Bezeichnung	LPA (m2)	Arm (m)
1	Aussen	40.9	2.076
2	Aussen	22.7	3.282
3	MAST HINTEN	3.9	10.173
4	MAST VORNE	3.6	9.891
5	SPIERE MAST HI	1.1	21.918
6	BUGSPRIET FEST	0.8	4.541
7	BUGSPRIET LOSE	1.4	4.893
	Außenhaut/Masten/ Segel: Flächen mit Schwerpunkt: Vor Topp u. Takel (nur Rigg), Ladefall 1	**74.4**	**3.62**

A.4 Ermittlung Massen und Schwerpunkte TS „NO. 5 ELBE"

Nach Rücksprache mit der BSU soll ein Krängungsversuch nicht durchgeführt werden. Die entsprechenden Werte sind der Auswertung eines Krängungsversuchs vom 21.10.2006 durch die Fa. Tecnitas (s. 4.2.[2]) und dem von der Fa. Yacht concepts & design erstellten Stabilitätsbuch–Lotsenschoner N° 5Elbe (s.4.2.[3]) entnommen worden. In diesem Zusammenhang ist auf folgende Punkte hinzuweisen, die die Ergebnisse der nachfolgenden Berechnungen verändern könnten:

- Tanktabellen: die Volumina der Tanks sind im Stabilitätshandbuch (s. 4.2.[3]) angepasst worden. Es gibt Unterschiede zwischen der Auswertung des Krängungsversuches (s. 4.2.[2]) und dem Stabilitätshandbuch, die nicht plausibel sind.
- Schwerpunktslage: Die 0-Punkte des Koordinatensystems aus der Auswertung zu A.2 sind auf Basis der Forderungen zur Ermittlung der Länge des Schiffes angenommen worden. Dieses Koordinatensystem ist Basis dieser nachfolgenden Berechnungen. Die Längen- und Höhenschwerpunkte der Massen aus dem Stabiltätshandbuch (s. 4.2.[3]) beziehen sich auf einen anderen 0-Punkt: Höhe Z: UK Kiel (unvertrimmt), Länge X: Endpunkt Achtersteven-Mitte Schiff. Diese Schwerpunktswerte der Einzelmassen aus dem Stabilitätshandbuch werden daher um folgenden Wert korrigiert: **Höhe: Z= Wert–0,216 m.**
- Das eingescannte Schiff (A.2.) ist aufgrund der Kollision insbesondere im Vorschiff verformt. Diese Verformung ist herausgerechnet worden, so dass die äußere Schiffsform als symmetrisch zur X-Z-Ebene angenommen wird.
- Das Schiff ist im Rahmen der Restaurierungsarbeiten im Winter 2018/19 mit neuer Außenhautbeplankung und zum Teil mit neuen Spanten versehen worden. Auch wurden bei der Besichtigung neue Bleibaren als Ballast im Kiel entdeckt. Etwaige Einflüsse aus diesen Arbeiten sind in den nachfolgenden Berechnungen nicht berücksichtigt, da es keinen Krängungsversuch nach Anschluss dieser Arbeiten gab.

A.4.1 Ermittlung Massen und Schwerpunkte „LEERES SCHIFF“

Sowohl der Schwerpunkt als auch die Masse *LEERES SCHIFF* ist für die nachfolgenden Hydrostatik-Berechnungen zur Ermittlung der Intakt- u. Leckstabilität zwingend erforderlich.

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Nr.	Bezeichnung	Masse (t)	LCG (m)	VCG (m)	TCG (m)
1	Masse Leeres Schiff aus Krängungsversuch / Stabiltätshandbuch (s.4.2.[3]), Seite 2.	122.48	10.780	2.204	0.000
	Masse LEERES SCHIFF TS "NO. 5 ELBE" ohne Tankfüllung	**122.48**	**10.78**	**2.20**	**0.00**

Die Masse LEERES SCHIFF beinhaltet eine Gewichtkonstante für Ausrüstungsgegenstände für das betriebsklare Schiff. Diese Gewichtskonstante umfasst Leinen, Fender, Küchengeräte, Werkzeuge u.s.w., die für den normalen Schiffsbetrieb erforderlich sind.

Die Schwerpunkte basieren auf das globale Koordinatensystem. Der 0-Punkt befindet sich im hinteren Lot. Richtung +y ist nach B.B. gerichtet.

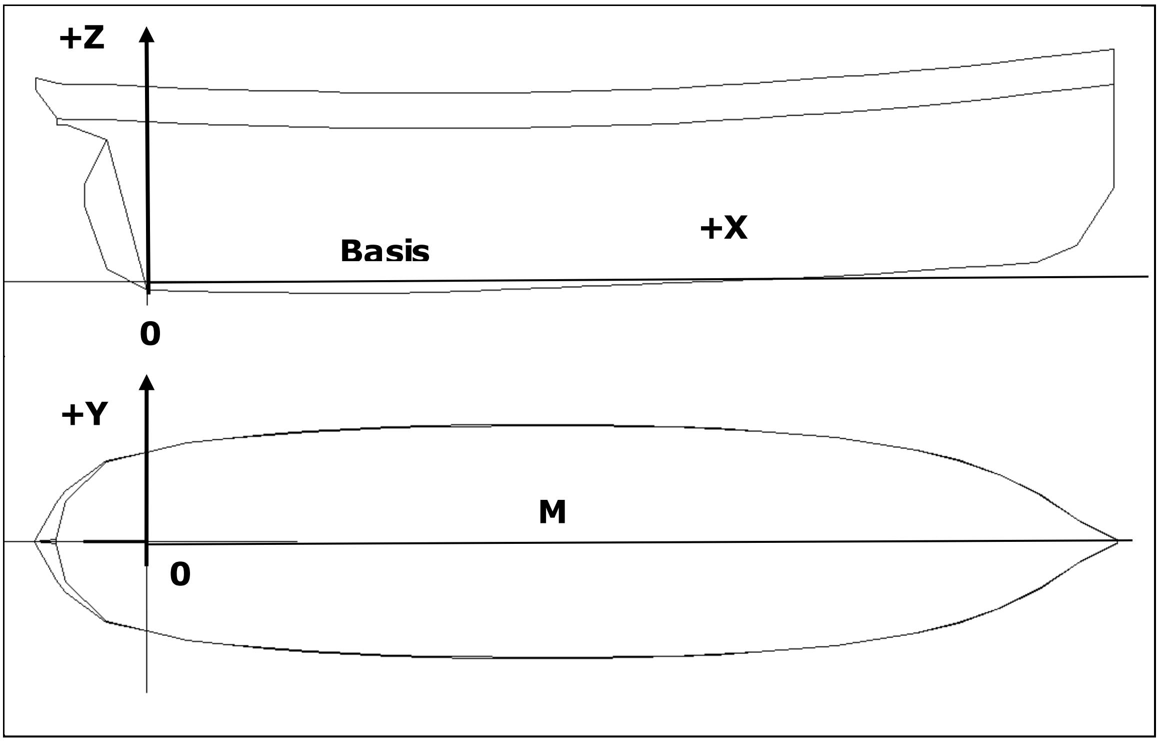

Fig. 11: Koordinatensystem

A.4.2 Ermittlung Masse und Schwerpunkt 50 Personen

Für die Ermittlung der Berechnungs-Ladefälle ist es notwendig, die Besatzung und Passagiere zu definieren. Die max. Personenzahl an Bord von 50 Personen ergibt sich aus dem SICHERHEITSZEIGNIS FÜR TRADITIONSSCHIFFE (Anlage 1.). Die stabilitätsrelevante Ermittlung der Schwerpunkte ergibt sich den Forderungen der Traditionsschiffs-Richtlinie, Kap. 2, Abschnitt 2, 14.1.b) (s.4.1.III):

Personen:	50
Masse/Person:	80 kg
VCG Person:	1 m über Deck
Person / m²:	4 an Deck
m²:	50/4 =12,5²
Einseitiger Ladefall:	50 Personen, stehend, auf B.B.-Seite

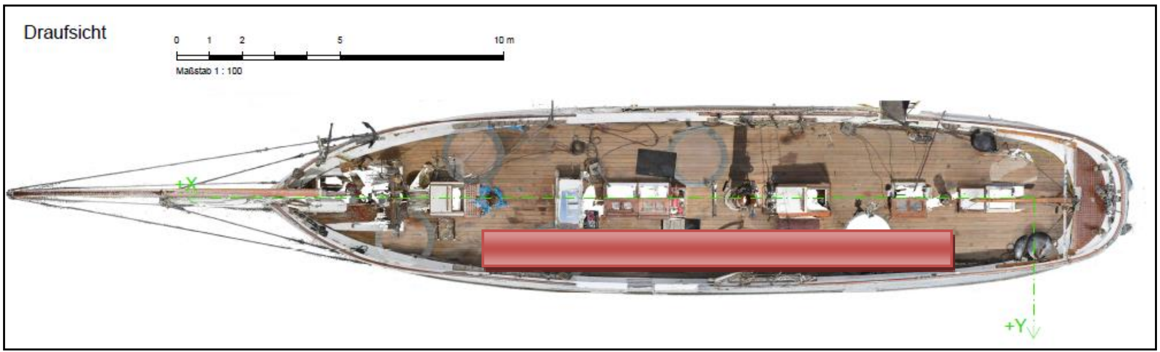

Fig. 12: Einseitige Besetzung an B.B. bei 4 Pers/m² auf dem Hauptdeckauptdeck:Hauptdeck:

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Nr.	Bezeichnung	Masse (t)	LCG (m)	VCG (m)	TCG (m)
1	Masse 50 Personen an B.B-Seite	4.00	9.000	4.690	2.000
	Masse 50 Personen an B.B.-Seite	**4.00**	**9.00**	**4.69**	**2.00**

Symmetrischer Ladefall: 50 Personen homogen über das Deck verteilt:

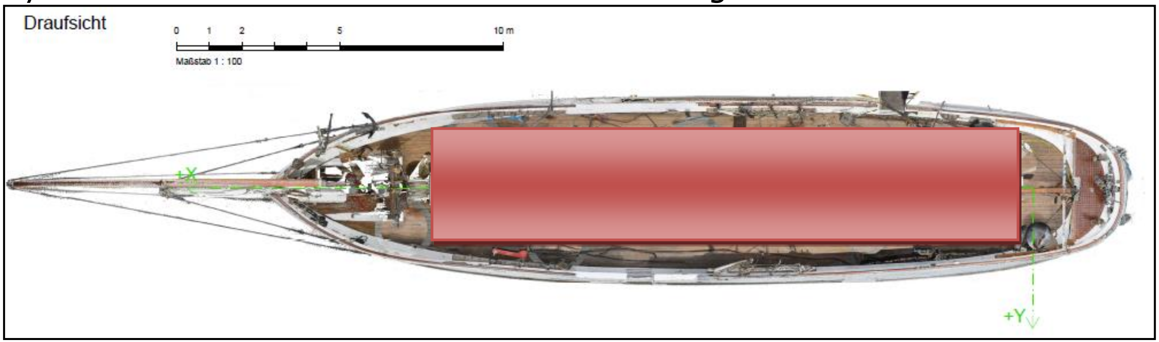

Fig. 13: Symmetrische Besetzung auf der

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Nr.	Bezeichnung	Masse (t)	LCG (m)	VCG (m)	TCG (m)
1	Masse 50 Personen symmetrisch angeordnet	4.00	10.000	4.750	0.000
	Masse 50 Personen symmetrisch angeordnet	**4.00**	**10.00**	**4.75**	**0.00**

Zusätzlich zum Personengewicht wird ein Gewicht von 10kg/Person als Tagesgepäck angesetzt. Zur Ermittlung des Schwerpunktes dieser Masse wird davon ausgegangen, dass sich das Gepäck im unteren Mannschaftsraum befindet.

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Nr.	Bezeichnung	Masse (t)	LCG (m)	VCG (m)	TCG (m)
1	Masse Gepäck 10 kg/Person	0.50	10.500	1.800	0.000
	Masse Gepäck für 50 Personen	**0.50**	**10.50**	**1.80**	**0.00**

A.4.3 Ermittlung Masse und Schwerpunkt Vorräte 100%

Die folgenden Tankinhalte und Schwerpunkte sind mit dem Programm AUTOHYDRO ermittelt worden. Es ist versucht worden, die Volumina und Schwerpunktslagen der unterschiedlichen Tanks aus den Informationen aus dem Stabilitätshandbuch zu generieren.
Es war nicht immer möglich, die genauen Schwerpunktslagen aller Tanks gem. den Angaben aus dem Stabilitätshandbuch in den geometrischen Gegebenheiten der Schiffssituation zu erzeugen. Hierzu folgende Aufstellungen:

Im Höhenschwerpunkt korrigierte Werte aus dem Stabilitätshandbuch:
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Nr.	Bezeichnung	Masse (t)	LCG (m)	VCG (m)	TCG (m)
1	Diesel TK vorne, 100%	0.85	20.350	3.284	0.000
2	Diesel Tk hinten, 100%	0.85	4.150	1.784	0.000
3	Frischwasser TK vorne B.B., 100%	0.72	14.500	1.604	1.000
4	Frischwasser TK vorne S.B., 100%	0.72	14.500	1.604	-1.000
5	Frischwasser TK mitte B.B., 100%	0.72	13.000	1.424	1.000
6	Frischwasser TK mitte S.B., 100%	0.72	13.000	1.424	-1.000
7	Fäkalien TK. B.B, 100%	0.74	7.650	2.984	1.950
8	Fäkalien TK. mitte, 100%	0.09	8.950	1.764	0.000
	Vorräte 100%	**5.42**	**12.37**	**2.04**	**0.26**

Generierte Tanks in der Software:

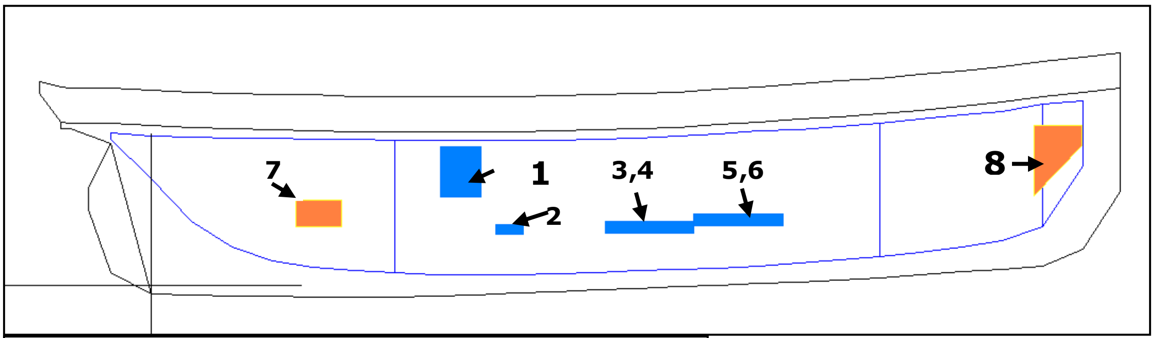

Fig. 14: Anordnung Tanks, 100% Füllung,

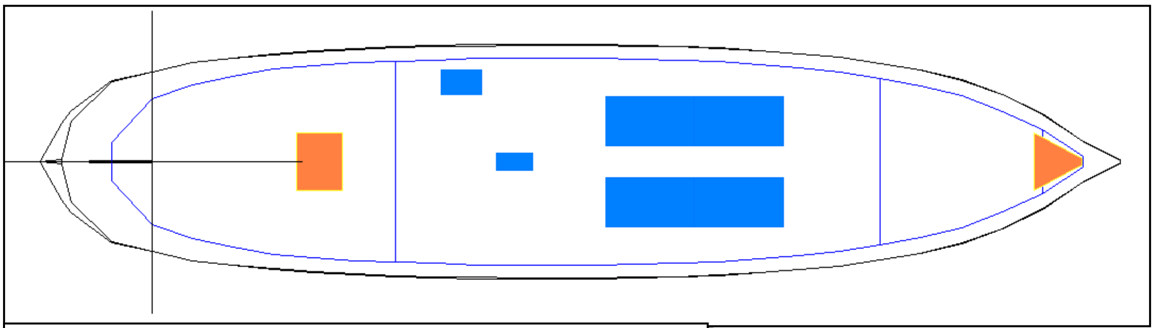

Fig. 15: Anordnung Tanks, 100% Füllung,

Werte aus der Berechnung mit AUTOHYDRO:

FRESH WATER (SpGr 1.000)

Nr.	Tank Name	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)
1.	FAEKALIENTK BB	100.00%	0.74	7.650f	1.950p	2.796
2.	FAEKALIENTK MI	100.00%	0.09	8.950f	0.000	1.375
3.	TKWTK MITTE BB	100.00%	0.72	12.300f	1.000p	1.425
4.	TKWTK MITTE SB	100.00%	0.72	12.300f	1.000s	1.425
5.	TKWTK VORNE BB	100.00%	0.72	14.500f	1.000p	1.605
6.	TKWTK VORNE SB	100.00%	0.72	14.500f	1.000s	1.605
	Subtotals:	**100.00%**	**3.72**	**12.150f**	**0.388p**	**1.767**

DIESEL OIL (SpGr 0.870)

Nr.	Tank Name	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)
7.	DTK	100.00%	0.85	4.152f	0.000	1.780
8.	DTK VORNE	100.00%	0.85	22.204f	0.000	3.473
	Subtotals:	**100.00%**	**1.70**	**13.131f**	**0.000**	**2.622**

Anmerkung: Die freien Oberflächen der Tanks werden in den nachfolgenden Hydrostatikberechnungen berücksichtigt.

<u>A.4.4 Ermittlung Masse und Schwerpunkt Vorräte 98%</u>

Ermittlung gem. Angaben in 4.3:

Werte aus der Berechnung mit AUTOHYDRO:

FRESH WATER (SpGr 1.000)

Nr.	Tank Name	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)
1.	FAEKALIENTK BB	98.00%	0.73	7.650f	1.950p	2.783
2.	FAEKALIENTK MI	98.00%	0.09	8.950f	0.000	1.372
3.	TKWTK MITTE BB	98.00%	0.71	12.300f	1.000p	1.422
4.	TKWTK MITTE SB	98.00%	0.71	12.300f	1.000s	1.422

5.	TKWTK VORNE BB	98.00%	0.71	14.500f	1.000p	1.602
6.	TKWTK VORNE SB	98.00%	0.71	14.500f	1.000s	1.602
	Subtotals:	**98.00%**	**3.65**	**12.150f**	**0.388p**	**1.762**

DIESEL OIL (SpGr 0.870)

Nr.	Tank Name	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)
7.	DTK	98.00%	0.84	4.152f	0.000	1.774
8.	DTK VORNE	98.00%	0.83	22.204f	0.000	3.460
	Subtotals:	**98.00%**	**1.67**	**13.131f**	**0.000**	**2.612**

A.4.5 Ermittlung Masse und Schwerpunkt Vorräte 10%

Ermittlung gem. Angaben in 4.3:

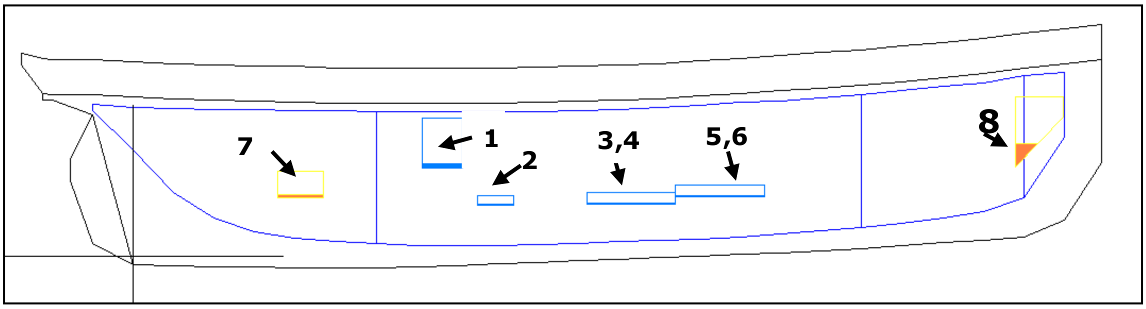

Fig. 16: Anordnung Tanks, 10% Füllung,

Werte aus der Berechnung mit AUTOHYDRO:

FRESH WATER (SpGr 1.000)

Nr.	Tank Name	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)
1.	FAEKALIENTK BB	10.00%	0.07	7.650f	1.950p	2.232
2.	FAEKALIENTK MI	10.00%	0.01	8.950f	0.000	1.262
3.	TKWTK MITTE BB	10.00%	0.07	12.300f	1.000p	1.300
4.	TKWTK MITTE SB	10.00%	0.07	12.300f	1.000s	1.300
5.	TKWTK VORNE BB	10.00%	0.07	14.500f	1.000p	1.480
6.	TKWTK VORNE SB	10.00%	0.07	14.500f	1.000s	1.480
	Subtotals:	**10.00%**	**0.37**	**12.150f**	**0.388p**	**1.555**

DIESEL OIL (SpGr 0.870)

Nr.	Tank Name	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)
7.	DTK	10.00%	0.09	4.182f	0.000	1.480
8.	DTK VORNE	10.00%	0.08	21.983f	0.000	2.649
	Subtotals:	**10.00%**	**0.17**	**13.036f**	**0.000**	**2.061**

B. Bewertung der Intaktstabilität des TS „NO. 5 ELBE"

Die Bewertung der Intaktstabilität wird auf Basis der Forderungen der Traditionsschiffs-Richtlinie, Kap. 2, Abschnitt 2, 13.1 h) und i) (s.4.1.III) für folgende Lastfälle berechnet:

h) Stabilitätsberechnungen für mindestens folgende Betriebszustände:

- aa) Schiff leer, betriebsklar,
- bb) Reiseanfang, Schiff voll ausgerüstet und besetzt, Tankfüllung 98 %,
- cc) Reiseende, Schiff wie oben, Tankfüllung 10 %,
- dd) weitere Ladefälle, sofern diese deutlich von den oben genannten abweichen,

i) bei Segelschiffen zusätzlich:

- aa) Fahren unter Standardbesegelung,
- bb) Fahren unter Sturmbesegelung,
- cc) Fahren vor Topp und Takel,

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Nr.	Bezeichnung	Masse (t)	LCG (m)	VCG (m)	TCG (m)
1	Masse Leeres Schiff aus Krängungsversuch / Stabiltätshandbuch (s.4.2.[3]), Seite 2.	122.48	10.780	2.204	0.000
	LADEFALL 1. Schiff leer, Betriebsklar	**122.48**	**10.78**	**2.204**	**0.00**

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Nr.	Bezeichnung	Masse (t)	LCG (m)	VCG (m)	TCG (m)
1	Masse Leeres Schiff aus Krängungsversuch / Stabiltätshandbuch (s.4.2.[3]), Seite 2.	122.48	10.780	2.204	0.000
2	Masse Gepäck 10 kg/Person	0.50	10.500	1.800	0.000
3	Masse 50 Personen symmetrisch angeordnet	4.00	10.000	4.750	0.000
4	Vorräte 98% aus Berechnung Autohydro	5.33	12.451	1.914	0.381
	Berechnung LADEFALL 2., Reiseanfang , 98% Vorräte	**132.31**	**10.82**	**2.268**	**0.02**

Folgende Stabilitätskriterien sind gem. dieser Richtlinie zu überprüfen:

14.1 Für maschinengetriebene Traditionsschiffe gilt:

a) Die metazentrische Anfangshöhe muss mindestens 0,35 m betragen.

b) Der Neigungswinkel durch das Personenmoment darf 10° nicht überschreiten. Das Personenmoment ist durch zusammengedrängte Personen auf einer Schiffsseite (4 Personen je 80 kg/m²) für die an Bord befindlichen Personen zu berechnen.

c) Der Neigungswinkel im Drehkreis und unter Einwirkung des Personenmomentes darf 12° nicht überschreiten.

d) Der statische Neigungswinkel durch Winddruck darf 12° nicht überschreiten.

14.2 Für Segelschiffe gilt zusätzlich:

a) Die metazentrische Anfangshöhe muss mindestens 0,60 m betragen.

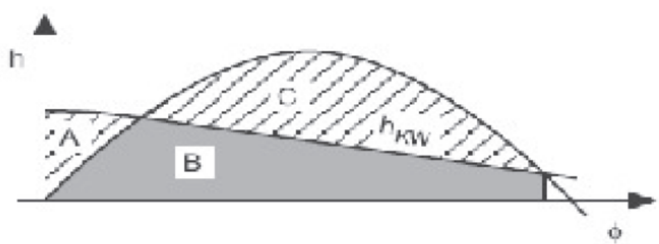
b) Der aufrichtende Hebelarm muss im Maximum der Hebelarmkurve mindestens 0,30 m betragen.

c) Der statische Neigungswinkel unter Segeln darf 20° nicht überschreiten. Falls bei einem geringeren Winkel Seite Deck zu Wasser geht, darf dieser Winkel nicht überschritten werden. Ein Plan der Segelführung ist vorzulegen, der in Abhängigkeit von der Windstärke beschreibt, wie die Einhaltung dieses Kriteriums gesichert werden kann.

d) Bei gestrichenen Segeln muss ein seitlicher Winddruck entsprechend 12 Beaufort ertragen werden können.

e) Verschließbare Öffnungen, durch die der Schiffskörper geflutet werden kann, dürfen nicht bei einem Krängungswinkel zu Wasser gehen, der kleiner ist als 35°.

f) Die Flächen B und C der Hebelarmkurve müssen bei der zu berechnenden Kurve der krängenden Hebelarme infolge seitlichen Winddrucks immer größer oder gleich der 1,4-fachen Fläche von A und B sein:



h_{KW} = Kurve der krängenden Hebelarme infolge seitlichen Winddrucks

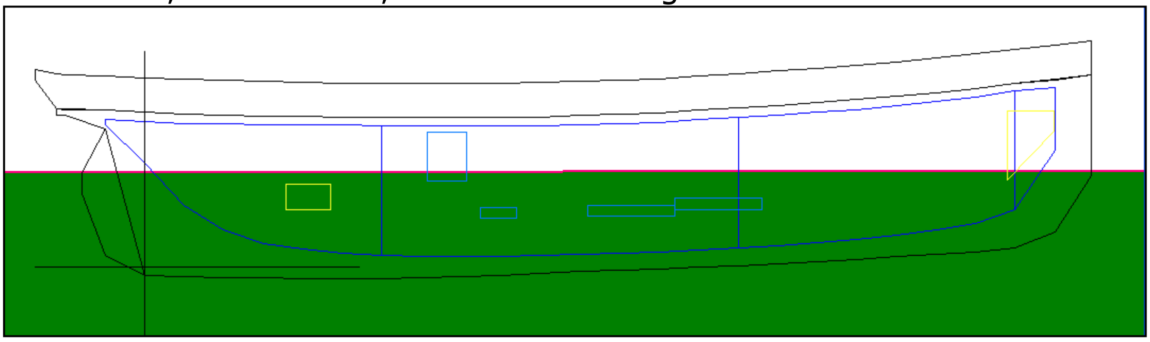
Die Windangriffsfläche der Außenhaut wird in der Software für jeden Ladefall separat entsprechend des jeweiligen Tiefgangs berechnet.

B.1 Stabilitätskriterien für den LADEFALL 1.

Die nachfolgend dargestellten Schaubilder und Ausdrucke sind den Berechnungen der Software AUTOCAD entnommen worden.

B.1.1 Massen/Schwerpunkte für den LADEFALL 1.

Schiff leer, betriebsklar, ohne Tankfüllung.



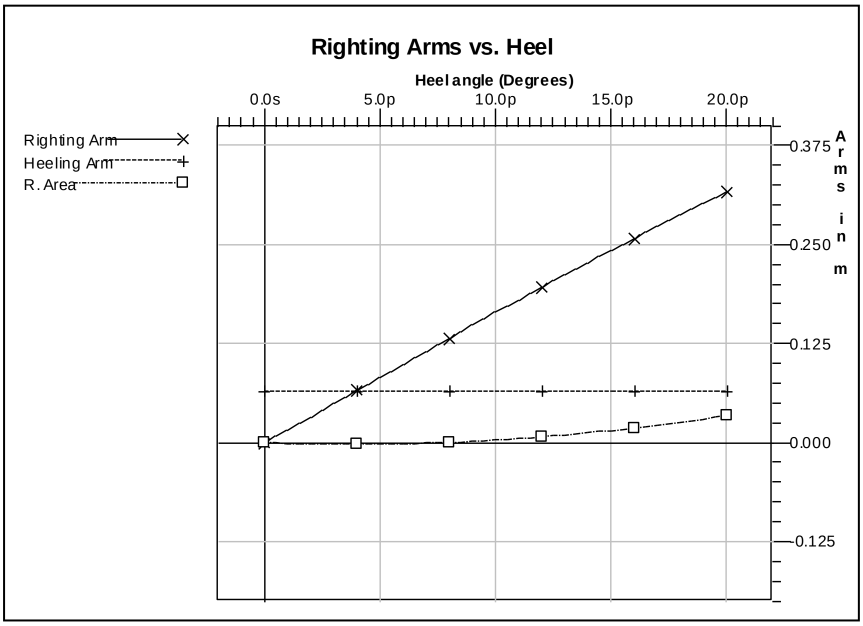
B.1.2 Stabilitätskriterien gem. Abs. 14.1.a) und 14.2.a):

Limit	Min/Max	Actual	Margin	Pass
GM Upright	>0.600 m	0.953	0.353	Yes

B.1.3 Stabilitätskriterien gem. Abs. 14.1.b):

PERSONENMOMENT: HMMT 8 mt

Limit	Min/Max	Actual	Margin	Pass
Absolute Angle at RA zero	<10.00 deg	3.91	6.09	Yes



B.1.4 Stabilitätskriterien gem. Abs. 14.1.c):

PERSONENMOMENT: HMMT 8 mt
DREHKREIS: 106 m bei V(Reise) = 9.2 kn

Für die Drehkreis-Momentenberechnungen wird der kleinste bekannte Drehkreis angenommen (s. 4.2[7]):

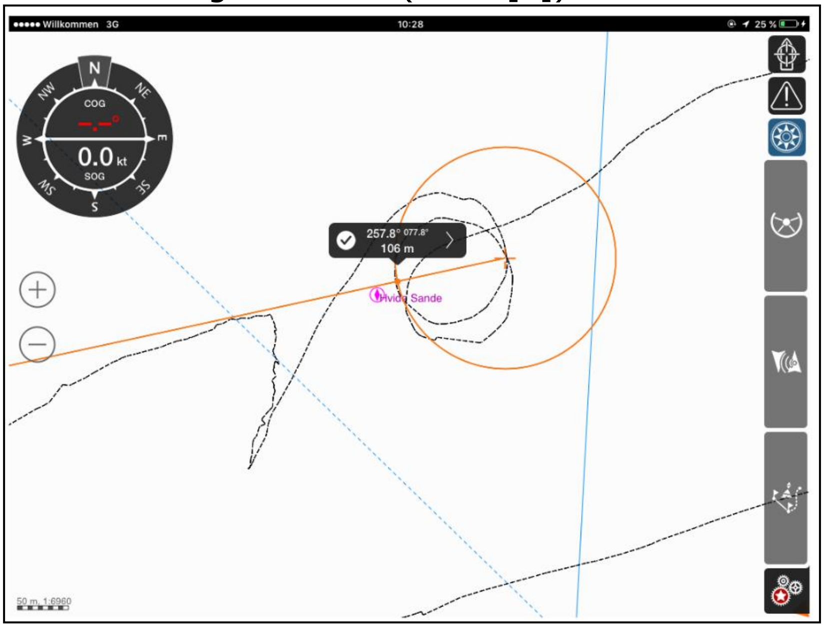
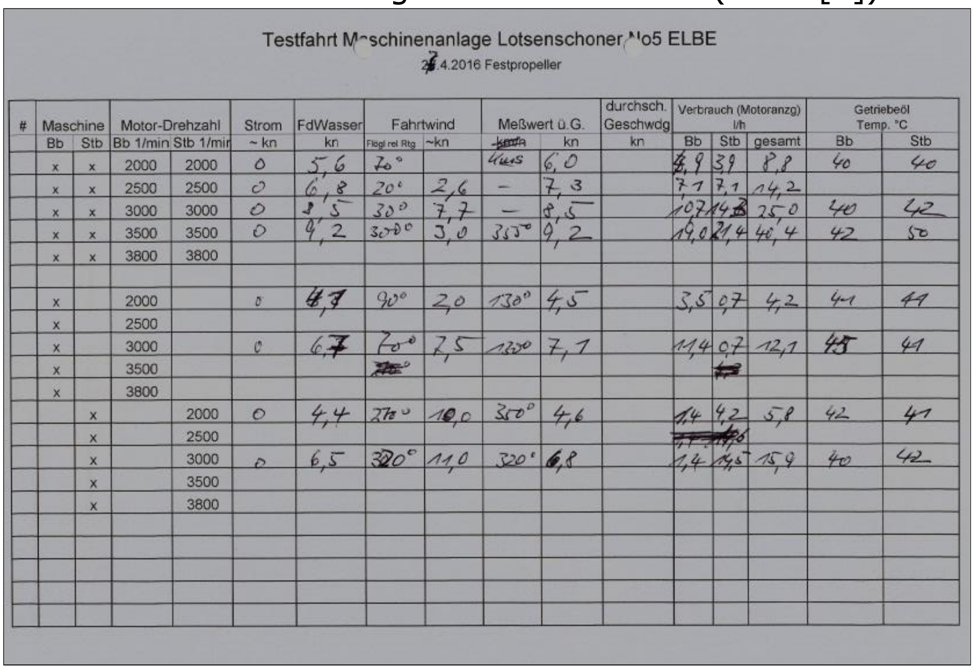


Fig. 17: Drehkreis 106 mauptdeck:Hauptdeck:

Folgende Reisegeschwindigkeit kann bei einer Drehzahl von 3.500 1/min bei beiden Maschinen angenommen werden (s. 4.2[8]):



Testfahrt Maschinenanlage Lotsenschoner No5 ELBE
27.4.2016 Festpropeller

#	Maschine Bb	Maschine Stb	Motor-Drehzahl Bb 1/min	Motor-Drehzahl Stb 1/min	Strom ~ kn	FdWasser kn	Fahrtwind Flögl rel Rtg	Fahrtwind ~kn	Meßwert ü.G. ~~km/h~~	Meßwert ü.G. kn	durchsch. Geschwdg kn	Verbrauch (Motoranzg) l/h Bb	Verbrauch l/h Stb	Verbrauch l/h gesamt	Getriebeöl Temp. °C Bb	Getriebeöl Temp. °C Stb
	x	x	2000	2000	0	5,6	70°		[illegible]	6,0		4,9	3,9	8,8	40	40
	x	x	2500	2500	0	6,8	20°	2,6	–	7,3		7,1	7,1	14,2		
	x	x	3000	3000	0	8,5	30°	7,7	–	8,5		10,7	14,3	25,0	40	42
	x	x	3500	3500	0	9,2	300°	3,0	355°	9,2		19,0	21,4	40,4	42	50
	x	x	3800	3800												
	x		2000		0	4,7	90°	2,0	130°	4,5		3,5	0,7	4,2	41	41
	x		2500													
	x		3000		0	6,7	70°	7,5	130°	7,1		11,4	0,7	12,1	45	41
	x		3500													
	x		3800													
		x		2000	0	4,4	270°	10,0	350°	4,6		1,4	4,2	5,8	42	41
		x		2500												
		x		3000	0	6,5	320°	11,0	320°	6,8		1,4	14,5	15,9	40	42
		x		3500												
		x		3800												

Fig. 18: V = 9,2 knauptdeck:Hau

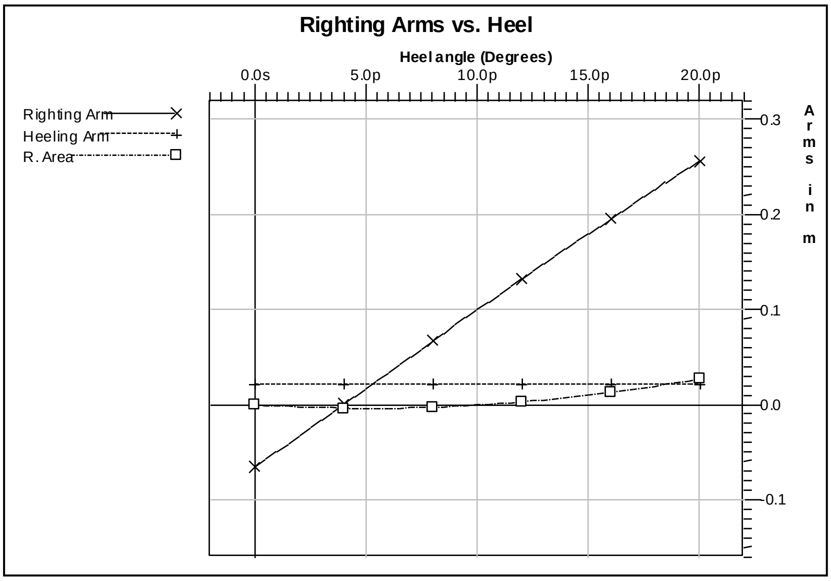
In der Berechnung wird das PERSONENMOMENT als einseitige Masse der Personen berücksichtigt, da in diesem Lastfall keine Personen an Bord sind, wird die Masse LEERES SCHIFF um die Größe des Personengewichtsanteils unter Einhaltung des tatsächlichen Höhen- und Längenschwerpunktes entsprechend reduziert.

TS NO 5 ELBE - Stabilitaetsberechnung LADEFALL 1

Floating Status

Draft FP	2.437 m	Heel	port 5.20 deg.	GM(Solid)	0.950 m
Draft MS	2.424 m	Equil	Yes	F/S Corr.	0.000 m
Draft AP	2.412 m	Wind	Off	GM(Fluid)	0.950 m
Trim	fwd 0.05 deg.	Wave	No	KMt	3.150 m
LCG	10.780f m	VCG	2.204 m	TPcm	0.97
Displacement	122.48 MT	WaterSpgr	1.025		

Limit	Min/Max	Actual	Margin	Pass
Absolute Angle at RA zero	<12.00 deg	5.20	6.80	Yes



B.1.5 Stabilitätskriterien gem. Abs. 14.1.d) und 14.2.d):

Moment aus Winddruck:
Windgeschwindigkeit: 64 kn (Bft. 12)
In der Berechnungssoftware wird von einem CD-Faktor von 1.2 ausgegangen.
Windangriffsfläche ohne Segel:

Heeling Moment Derivation

Wind Velocity at 10 meters = 64.0 knots from port, CD= 1.200

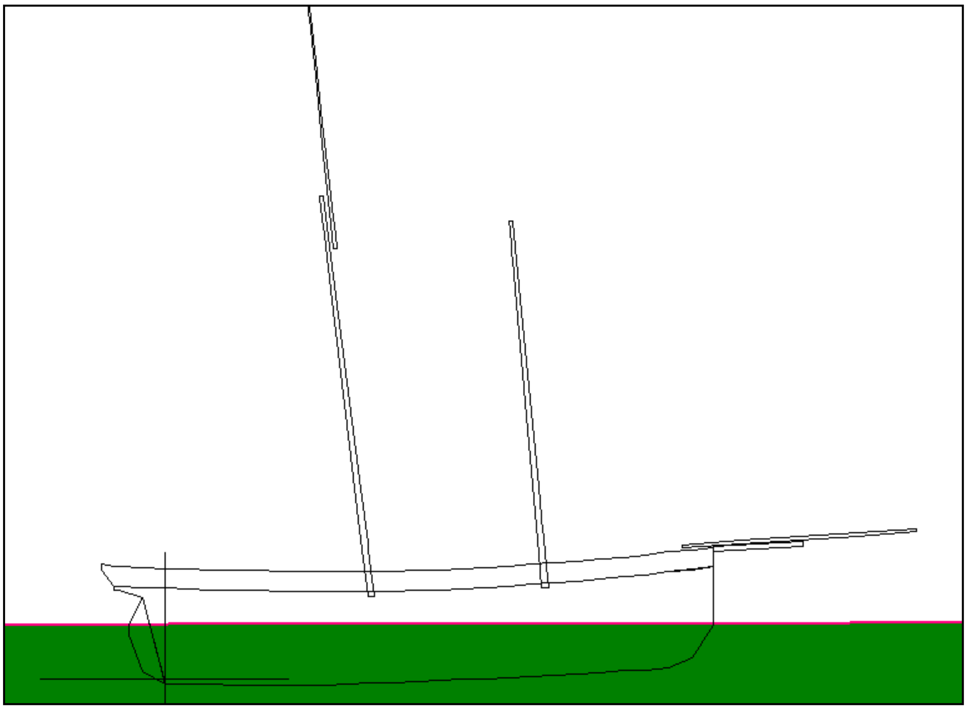
Part	LPA (m2)	HCP (m)	Arm (m)	Pressure (MT/m2)	Moment (m-MT)
Aussen	40.9	0.842	2.076	0.042	3.562
Aussen	22.7	2.048	3.282	0.055	4.116
MAST HINTEN	3.9	8.939	10.173	0.081	3.254
MAST VORNE	3.6	8.656	9.891	0.080	2.864
SPIERE MAST HI	1.1	20.684	21.918	0.098	2.262
BUGSPRIET FEST	0.8	3.307	4.541	0.063	0.223
BUGSPRIET LOSE	1.4	3.659	4.893	0.065	0.438

Total wind heeling moment 16.718 to starboard

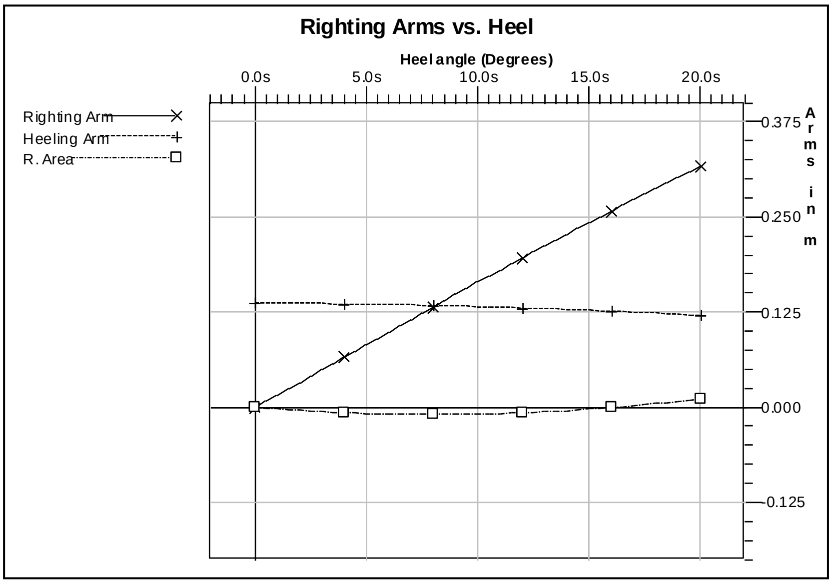
TS NO 5 ELBE - Stabilitaetsberechnung LADEFALL 1

Floating Status

Draft FP	2.443 m	Heel	stbd 8.13 deg.	GM(Solid)	0.944 m
Draft MS	2.423 m	Equil	Yes	F/S Corr.	0.000 m
Draft AP	2.402 m	Wind	64.0 Knots	GM(Fluid)	0.944 m
Trim	fwd 0.07 deg.	Wave	No	KMt	3.138 m
LCG	10.780f m	VCG	2.204 m	TPcm	0.97
Displacement	122.48 MT	WaterSpgr	1.025		

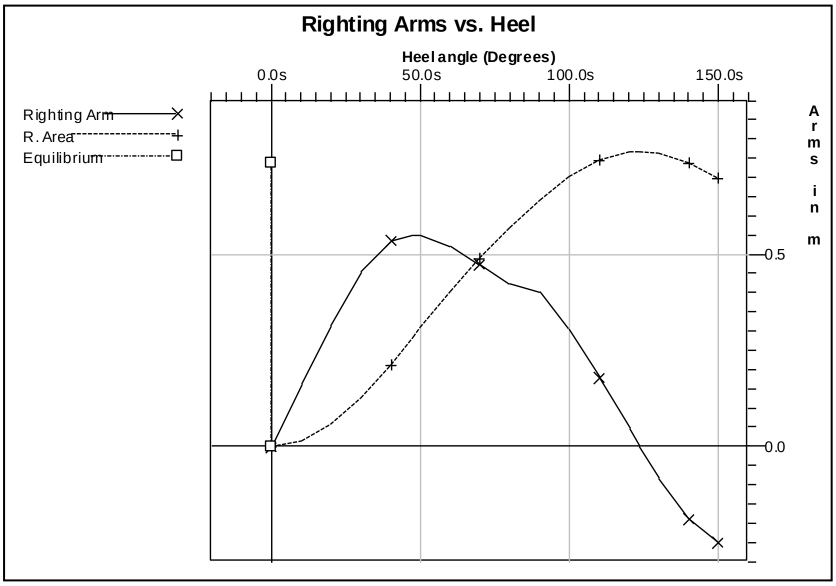


Limit	Min/Max	Actual	Margin	Pass
Absolute Angle at RA zero	<12.00 deg	8.13	3.87	Yes



B.1.6 Stabilitätskriterien gem. Abs. 14.2.b):

Limit	Min/Max	Actual	Margin	Pass
Righting Arm at Max RA	>0.300 m	0.552	0.252	Yes



B.1.7 Stabilitätskriterien gem. Abs. 14.2.c).1:

Krängungswinkel für Punkt an Seite des Decks auf Hauptdecksniveau muss größer als 20° sein:

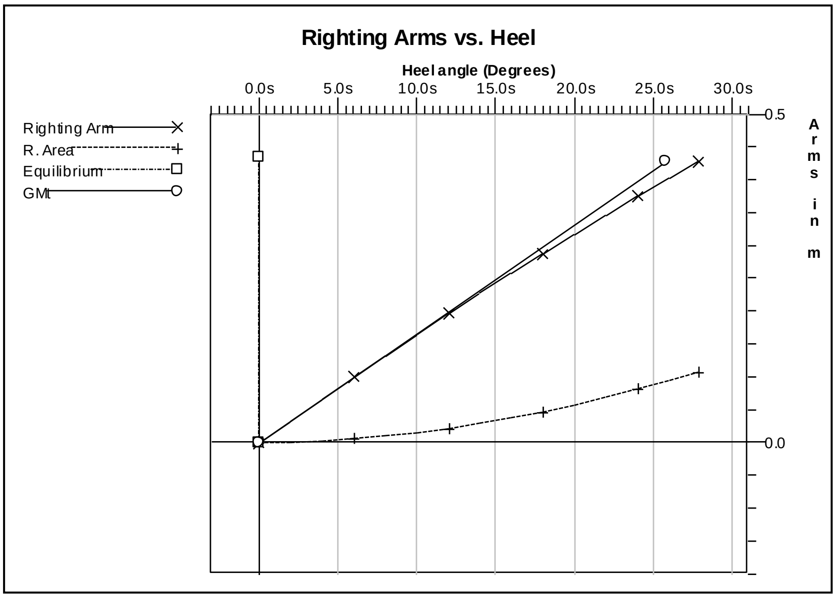
Righting Arms vs Heel Angle

Heel Angle (deg)	Trim Angle (deg)	Origin Depth (m)	Righting Arm (m)	Area (m-Rad)	Flood Pt Height (m)
0.00	0.04f	2.421	0.000	0.000	1.349 (1)
10.00s	0.08f	2.361	0.165	0.014	0.850 (1)
20.00s	0.18f	2.181	0.318	0.057	0.363 (1)
27.88s	0.29f	1.958	0.430	0.108	-0.003 (1)
Flood Point Immersed					

Unprotected Flood Point

Name	L,T,V (m)	Height (m)	Related Tank
(1) Überlauf Seite Deck	9.000f, 2.860s, 3.777	1.349	FLUTUNG HINTEN

Limit	Min/Max	Actual	Margin	Pass
Flutungspunkt Seite Deck Lastfall 1.	>20.00 deg	27.88	7.88	Yes



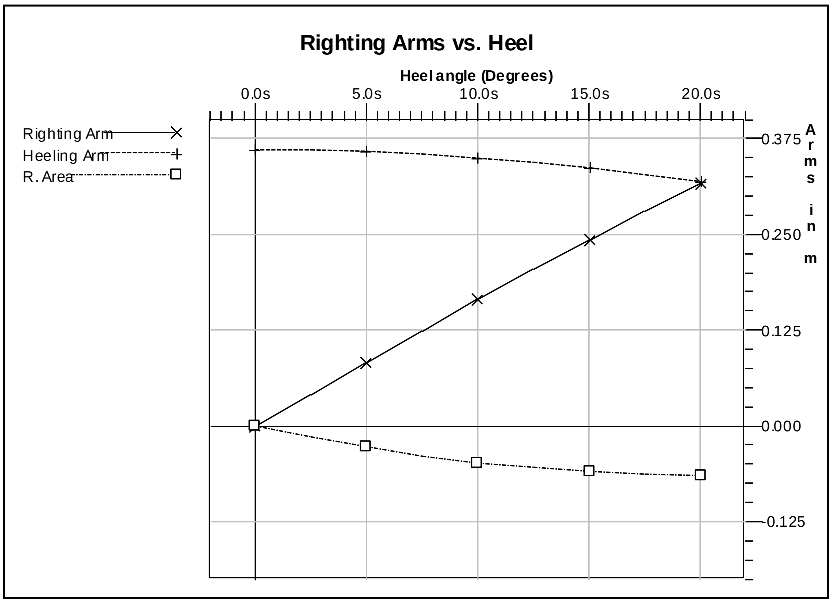
B.1.8 Stabilitätskriterien gem. Abs. 14.2.c).2:

Max. Krängungswinkel von 20° für die Besegelungen unter Bedingungen des Lastfalls 1:

- B.1.8.1: Unter Standardbeseglung
- B.1.8.2: Unter Sturmbeseglung:
- B.1.8.3: Vor Top und Takel:

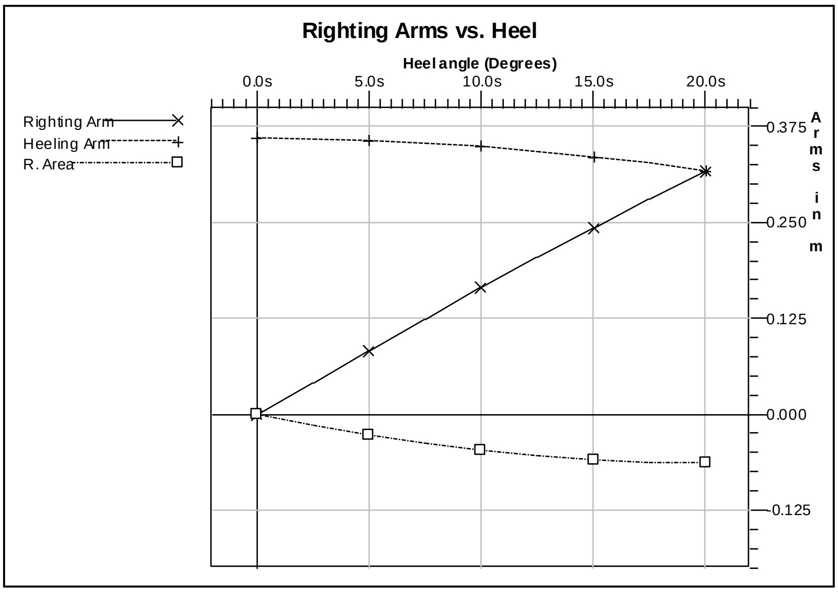
B.1.8.1: Unter Standardbeseglung:

Wind (kn)	Wind (Bft)	Angle to S.B. (deg)	Wind heeling moment *cos² (mt)
26.3	**6**	**20.03 deg**	**44.14**



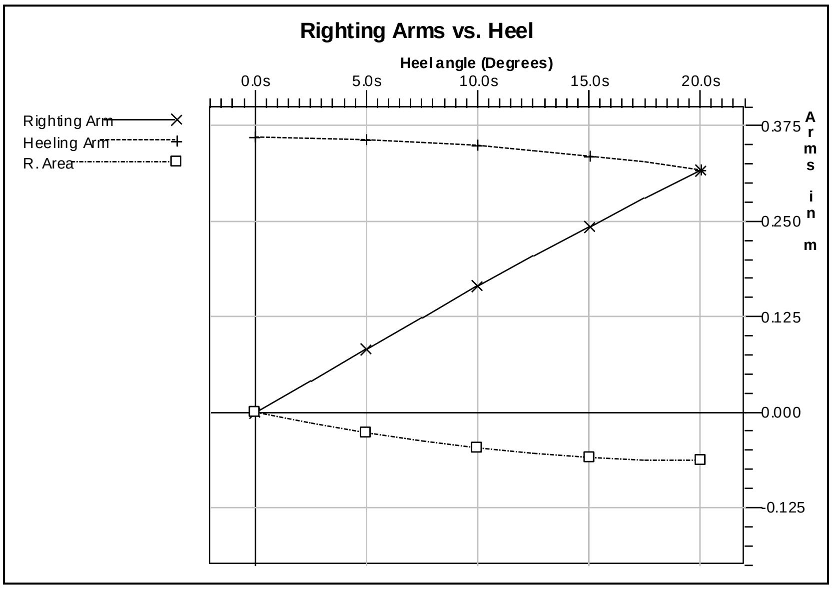
B.1.8.2: Unter Sturmbeseglung:

Wind (kn)	Wind (Bft)	Angle to S.B. (deg)	Wind heeling moment *cos² (mt)
43.8	**9**	**19.99 deg**	**44.04**



B.1.8.3: Vor Top und Takel:

Wind (kn)	Wind (Bft)	Angle to S.B. (deg)	Wind heeling moment *cos² (mt)
65	**12**	**8.38 deg**	**17.24**



B.1.9 Stabilitätskriterien gem. Abs. 14.2.e):

Min. Krängungswinkel von 35° für Flutung einer Öffnung an Deck darf im Lastfall 1. nicht unterschritten werden:
Niedrigste zu flutende Öffnung: Skylight hinten

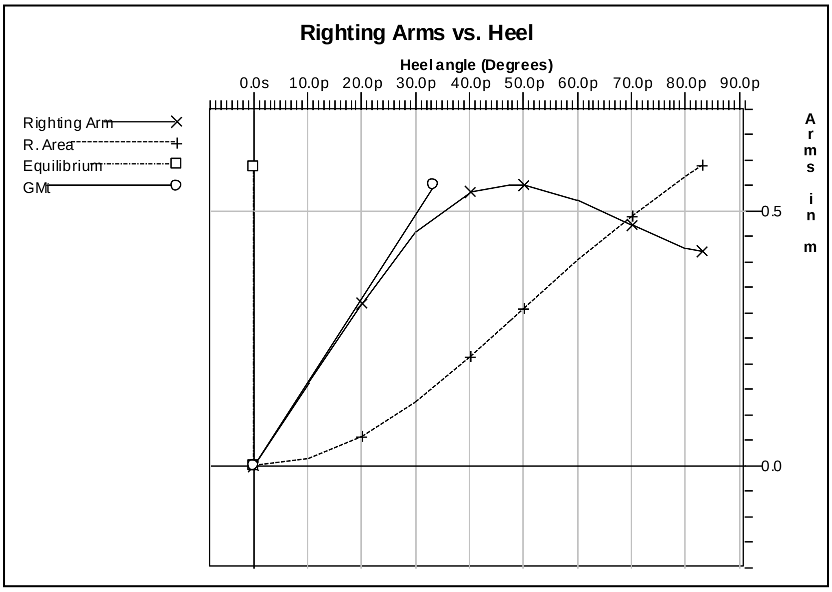
Righting Arms vs Heel Angle

Heel Angle (deg)	Trim Angle (deg)	Origin Depth (m)	Righting Arm (m)	Area (m-Rad)	Flood Pt Height (m)
0.00	0.04f	2.421	0.000	0.000	1.565 (1)
10.00p	0.08f	2.361	0.165	0.014	1.485 (1)
20.00p	0.18f	2.181	0.318	0.057	1.401 (1)
30.00p	0.33f	1.887	0.458	0.125	1.317 (1)
40.00p	0.40f	1.550	0.537	0.212	1.186 (1)
47.49p	0.38f	1.291	0.552	0.284	1.045 (1)
50.00p	0.36f	1.203	0.551	0.308	0.990 (1)
60.00p	0.26f	0.848	0.522	0.402	0.741 (1)
70.00p	0.11f	0.492	0.474	0.490	0.448 (1)
80.00p	0.08a	0.155	0.426	0.568	0.112 (1)
82.98p	0.16a	0.066	0.422	0.590	0.000 (1)
Flood Point Immersed					

Unprotected Flood Point

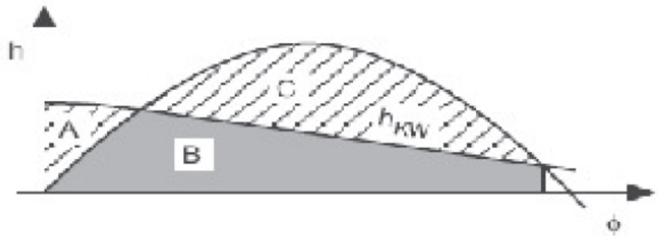
Name	L,T,V (m)	Height (m)	Related Tank
(1) Überlauf Skylight Hinten	5.500f, 0.440p, 3.990	1.565	FLUTUNG HINTEN

Limit	Min/Max	Actual	Margin	Pass
Flutungspunkt "SKYLIGHT HINTEN" Lastfall 1.	>35.00 deg	82.98	47.98	Yes



B.1.10 Stabilitätskriterien gem. Abs. 14.2.f):

Berechnung des Verhältnisses der Hebelarmflächen im Lastfall 1. Bedingung: (B+C) > 1,4 * (A+B)



h_{KW} = Kurve der krängenden Hebelarme infolge seitlichen Winddrucks

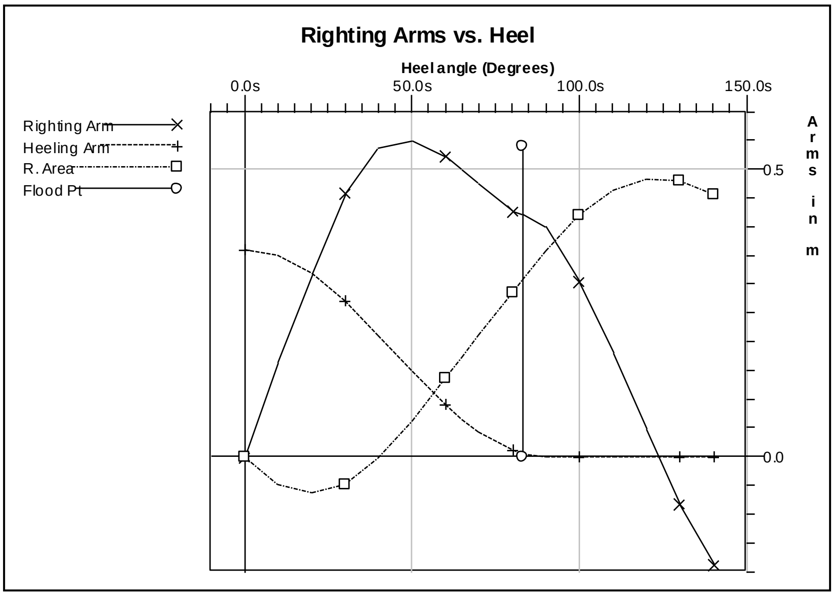
Die Hebelarmkurve ist durch die niedrigste flutbare Öffnung, SKYLIGHT HINTEN, begrenzt:

- B.1.10.1: Unter Standardbeseglung
- B.1.10.2: Unter Sturmbeseglung:
- B.1.10.3: Vor Top und Takel:

B.1.10.1: Unter Standardbeseglung:

Wind (kn)	Wind (Bft)	Wind heeling moment *cos² (mt)	Flutungswinkel (deg)
26.3	**6**	**44.14**	**82.98**

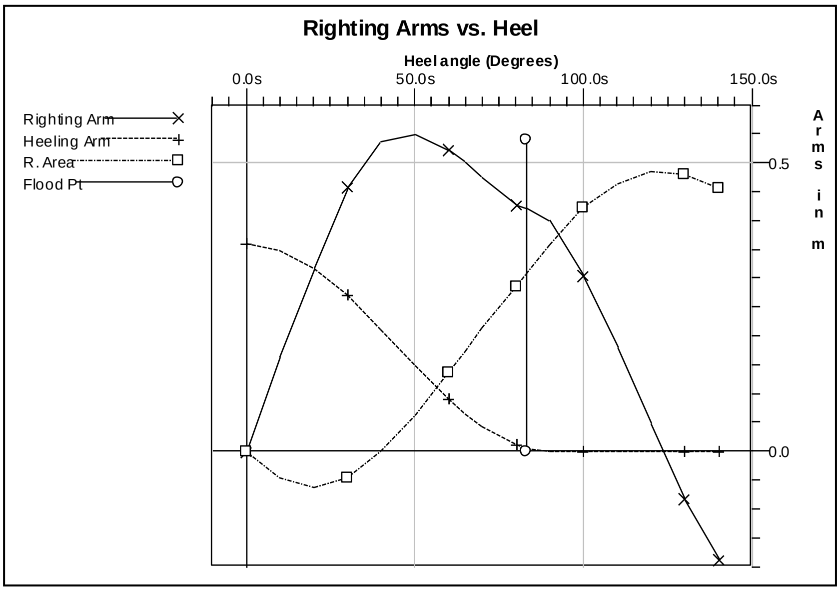
Limit	Min/Max	Actual	Margin	Pass
Absolute Area Ratio from 0.00 deg to RAzero	>1.400	2.087	0.687	Yes



B.1.10.2: Unter Sturmbeseglung:

Wind (kn)	Wind (Bft)	Wind heeling moment *cos² (mt)	Flutungswinkel (deg)
43.8	**9**	**44.04**	**82.98**

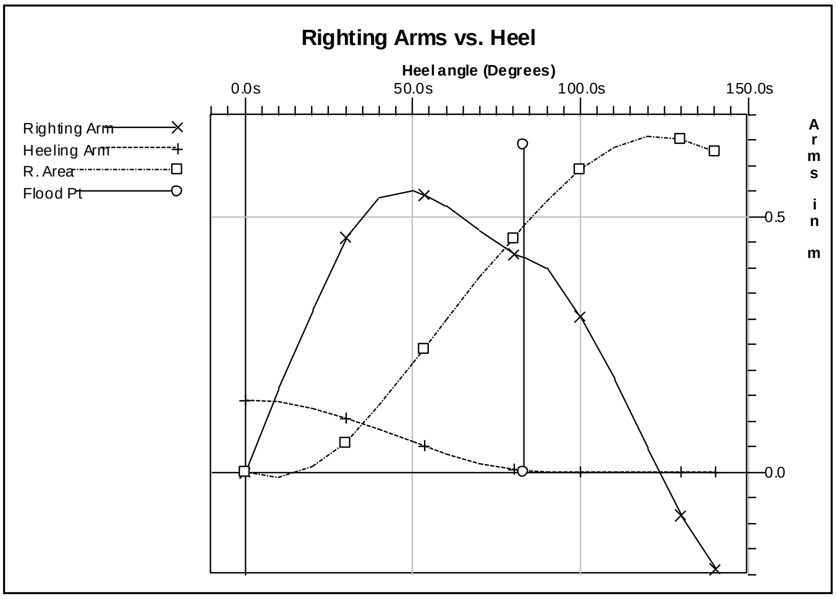
Limit	**Min/Max**	**Actual**	**Margin**	**Pass**
Absolute Area Ratio from 0.00 deg to RAzero	>1.400	**2.092**	0.692	Yes



B.1.10.3: Unter Top und Takel:

Wind (kn)	Wind (Bft)	Wind heeling moment *cos² (mt)	Flutungswinkel (deg)
65	**12**	**17.24**	**82.98**

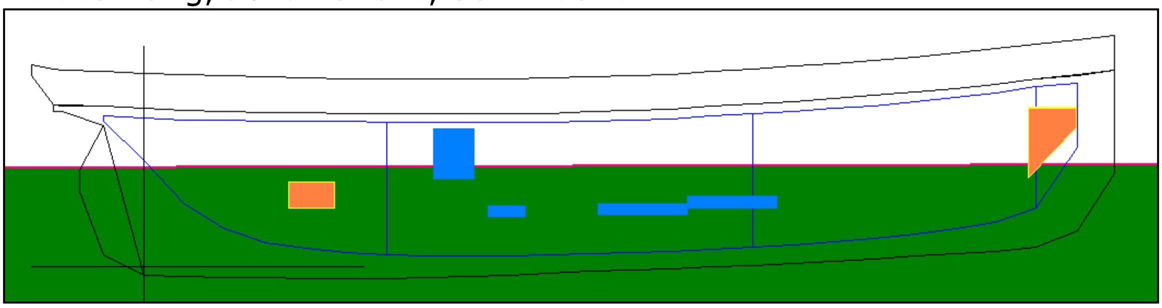
Limit	Min/Max	Actual	Margin	Pass
Absolute Area Ratio from 0.00 deg to RAzero	>1.400	**5.343**	3.943	Yes



B.2 Stabilitätskriterien für den LADEFALL 2.

B.2.1 Massen/Schwerpunkte für den LADEFALL 2.

Reiseanfang, 98% Vorräte, 50 Personen



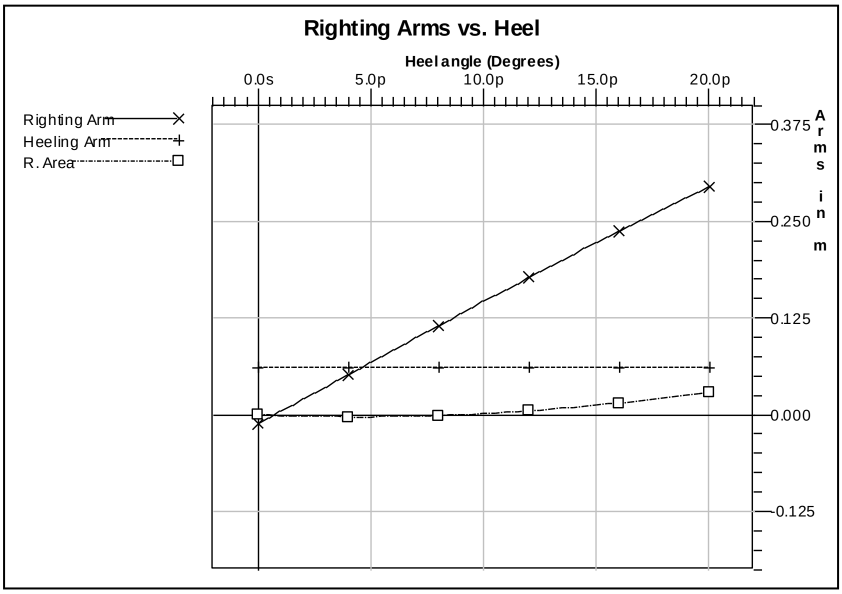
B.2.2 Stabilitätskriterien gem. 14.1.a) und 14.2.a):

Limit	Min/Max	Actual	Margin	Pass
GM Upright	>0.600 m	0.905	0.305	Yes

B.2.3 Stabilitätskriterien gem. Abs. 14.1.b):

PERSONENMOMENT: HMMT 8 mt

Limit	Min/Max	Actual	Margin	Pass
Absolute Angle at RA zero	<10.00 deg	4.51	5.49	Yes



B.2.4 Stabilitätskriterien gem. Abs. 14.1.c):

PERSONENMOMENT: **HMMT 8 mt**
DREHKREIS: **106 m bei V(Reise) = 9.2 kn** (Annahme wie B.1.4)

In der Berechnung wird das PERSONENMOMENT als einseitige Masse der Personen mit dem tatsächlichen Schwerpunkt berücksichtigt.
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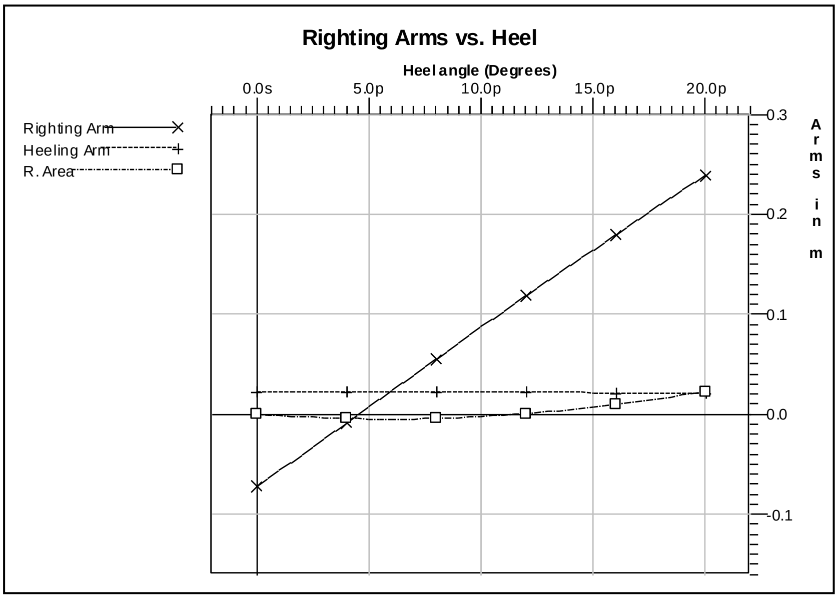
Nr.	Bezeichnung	Masse (t)	LCG (m)	VCG (m)	TCG (m)
1	Masse 50 Personen an B.B-Seite	4.00	9.000	4.690	2.000
	Masse 50 Personen an B.B.-Seite	**4.00**	**9.00**	**4.69**	**2.00**

TS NO 5 ELBE - Stabilitaetsberechnung LADEFALL 2

Floating Status

Draft FP	2.541 m	Heel	port 5.89 deg.	GM(Solid)	0.909 m
Draft MS	2.523 m	Equil	Yes	F/S Corr.	0.001 m
Draft AP	2.505 m	Wind	Off	GM(Fluid)	0.909 m
Trim	fwd 0.08 deg.	Wave	No	KMt	3.175 m
LCG	10.793f m	VCG	2.271 m	TPcm	1.00
Displacement	132.29 MT	WaterSpgr	1.025		

Limit	Min/Max	Actual	Margin	Pass
Absolute Angle at RA zero	<12.00 deg	5.89	6.11	Yes



B.2.5 Stabilitätskriterien gem. Abs. 14.1.d) und 14.2.d):

Moment aus Winddruck:
Windgeschwindigkeit: 64 kn (Bft. 12)

In der Berechnungssoftware wird von einem CD-Faktor von 1.2 ausgegangen. Der Tank FAEKALIENTTK B.B wird in dieser Berechnung an S.B. angenommen, da das Windmoment auch in S.B.-Richtung wirkt.
Windangriffsfläche ohne Segel:

Heeling Moment Derivation

Wind Velocity at 10 meters = 64.0 knots from port, CD= 1.200

Part	LPA (m^2)	HCP (m)	Arm (m)	Pressure (MT/m^2)	Moment (m-MT)
Aussen	38.4	0.793	2.077	0.041	3.280
Aussen	22.7	1.948	3.232	0.054	3.995
MAST HINTEN	3.9	8.840	10.123	0.081	3.229
MAST VORNE	3.6	8.557	9.840	0.080	2.841
SPIERE MAST HI	1.1	20.584	21.868	0.098	2.254
BUGSPRIET FEST	0.8	3.207	4.491	0.063	0.219
BUGSPRIET LOSE	1.4	3.559	4.843	0.064	0.430

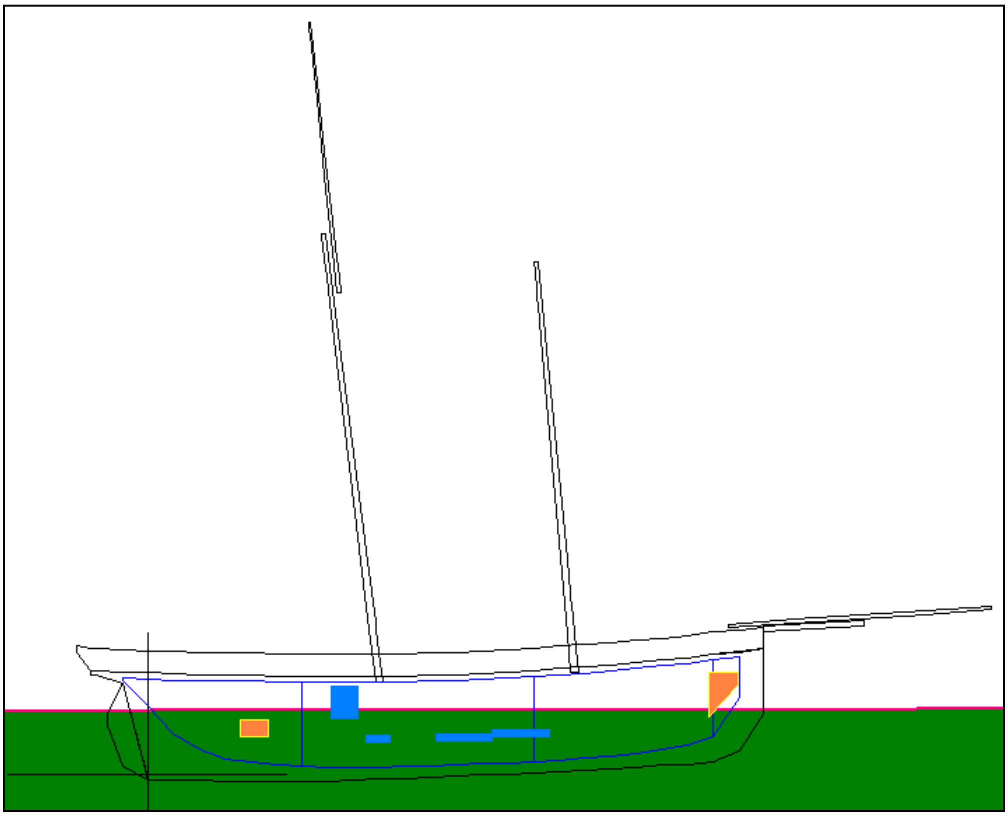
Total wind heeling moment 16.249 to starboard

I

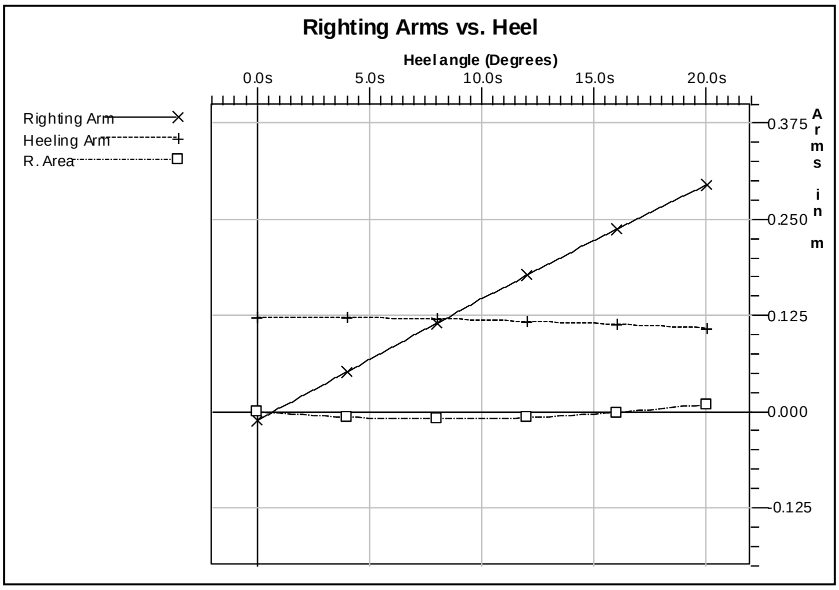
TS NO 5 ELBE - Stabilitaetsberechnung LADEFALL 2

Floating Status

Draft FP	2.581 m	Heel	stbd 8.32 deg.	GM(Solid)	0.908 m
Draft MS	2.530 m	Equil	Yes	F/S Corr.	0.000 m
Draft AP	2.479 m	Wind	64.0 Knots	GM(Fluid)	0.907 m
Trim	fwd 0.16 deg.	Wave	No	KMt	3.171 m
LCG	10.823f m	VCG	2.272 m	TPcm	1.00
Displacement	132.29 MT	WaterSpgr	1.025		

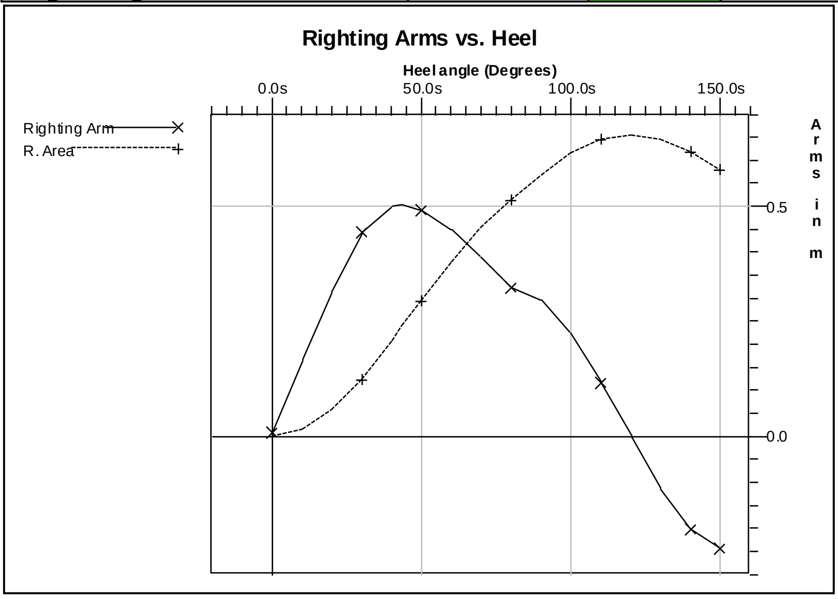


Limit	Min/Max	Actual	Margin	Pass
Absolute Angle at RA zero	<12.00 deg	8.32	3.68	Yes



B.2.6 Stabilitätskriterien gem. Abs. 14.2.b):

Limit	Min/Max	Actual	Margin	Pass
Righting Arm at Max RA	>0.300 m	0.504	0.204	Yes



B.2.7 Stabilitätskriterien gem. Abs. 14.2.c).1:

Krängungswinkel für Punkt an Seite des Decks auf Hauptdecksniveau muss größer als 20° sein. Der Tank FAEKALIENTTK B.B wird in dieser Berechnung an S.B. angenommen, da das Windmoment auch in S.B.-Richtung wirkt.

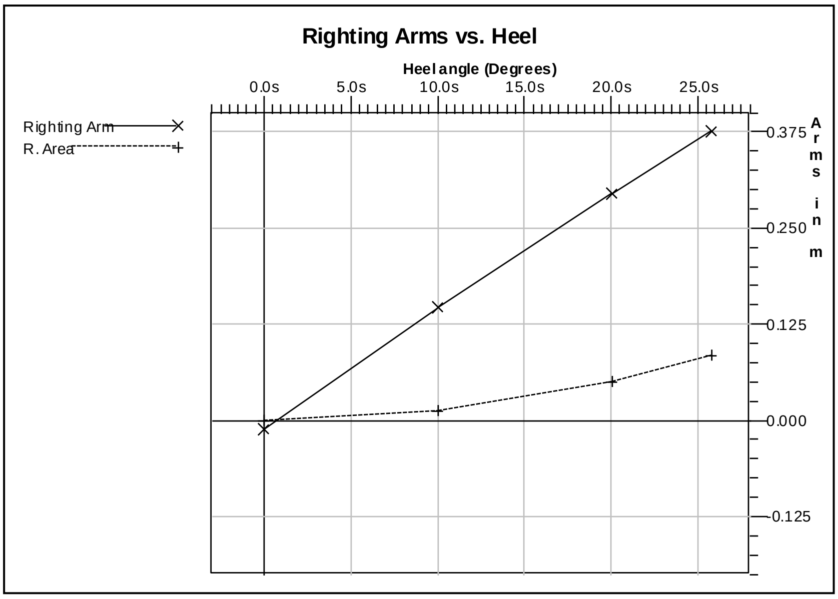
Righting Arms vs Heel Angle

Heel Angle (deg)	Trim Angle (deg)	Origin Depth (m)	Righting Arm (m)	Area (m-Rad)	Flood Pt Height (m)
0.00	0.14f	2.502	-0.011	0.000	1.253 (1)
10.00s	0.17f	2.442	0.147	0.012	0.754 (1)
20.00s	0.27f	2.262	0.296	0.051	0.267 (1)
25.78s	0.35f	2.105	0.376	0.085	-0.002 (1)
Flood Point Immersed					

Unprotected Flood Point

Name	L,T,V (m)	Height (m)	Related Tank
(1) Überlauf Seite Deck	9.000f, 2.860s, 3.777	1.253	FLUTUNG HINTEN

Limit	Min/Max	Actual	Margin	Pass
Flutungspunkt: Seite Deck, Lastfall 2.	>20.00 deg	25.78	5.78	Yes



B.2.8 Stabilitätskriterien gem. Abs. 14.2.c).2:

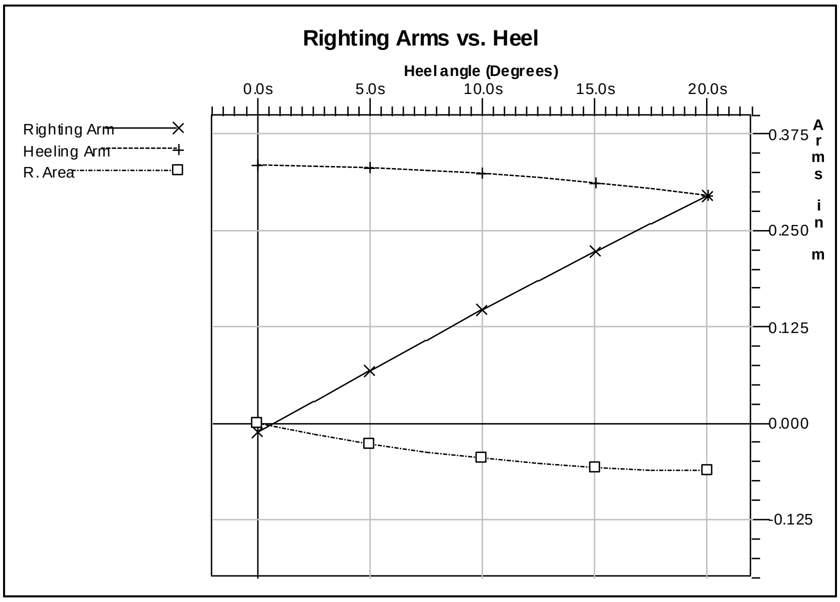
Max. Krängungswinkel von 20° für die Besegelungen unter Bedingungen des Lastfalls 2:

- B.2.8.1: Unter Standardbeseglung
- B.2.8.2: Unter Sturmbeseglung:
- B.2.8.3: Vor Top und Takel:

Der Tank FAEKALIENTTK B.B wird in dieser Berechnung an S.B. angenommen, da das Windmoment auch in S.B.-Richtung wirkt.

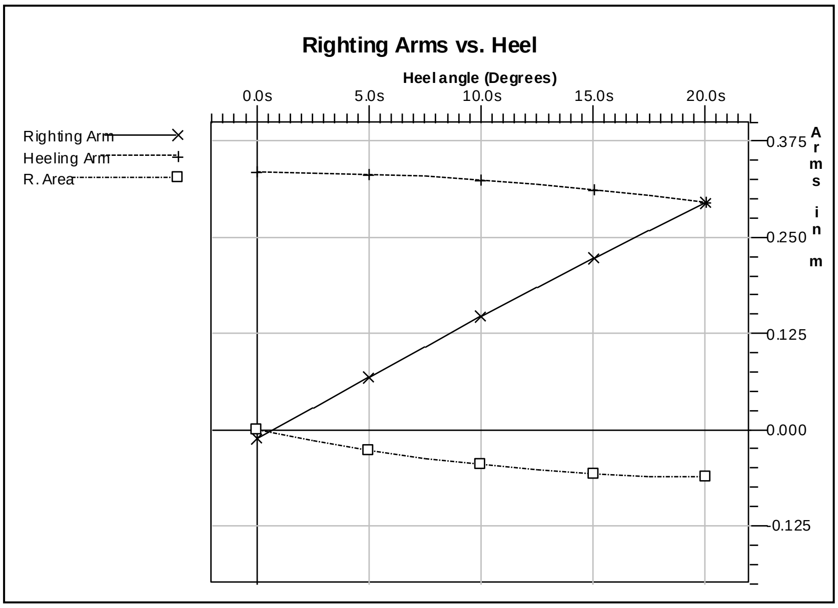
B.2.8.1: Unter Standardbeseglung:

Wind (kn)	Wind (Bft)	Angle to S.B. (deg)	Wind heeling moment *cos² (mt)
26.45	**6**	**20.03 deg**	**44.24**



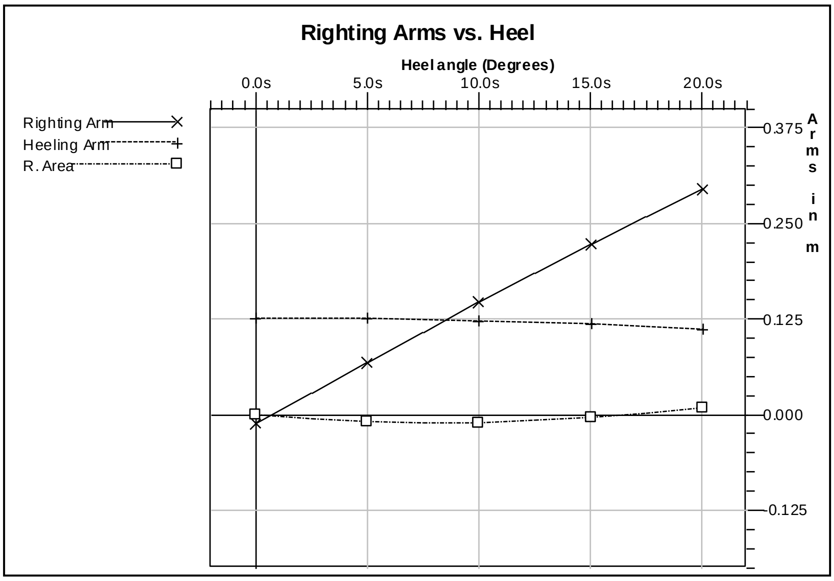
B.2.8.2: Unter Sturmbeseglung:

Wind (kn)	Wind (Bft)	Angle to S.B. (deg)	Wind heeling moment *cos² (mt)
44.2	**9**	**20.03 deg**	**44.26**



B.2.8.3: Vor Top und Takel:

Wind (kn)	Wind (Bft)	Angle to S.B. (deg)	Wind heeling moment *cos² (mt)
65	**12**	**8.55 deg**	**16.76**



B.2.9 Stabilitätskriterien gem. Abs. 14.2.e):

Min. Krängungswinkel von 35° für Flutung einer Öffnung an Deck darf im Lastfall 2. nicht unterschritten werden:
Niedrigste Öffnung: Skylight hinten

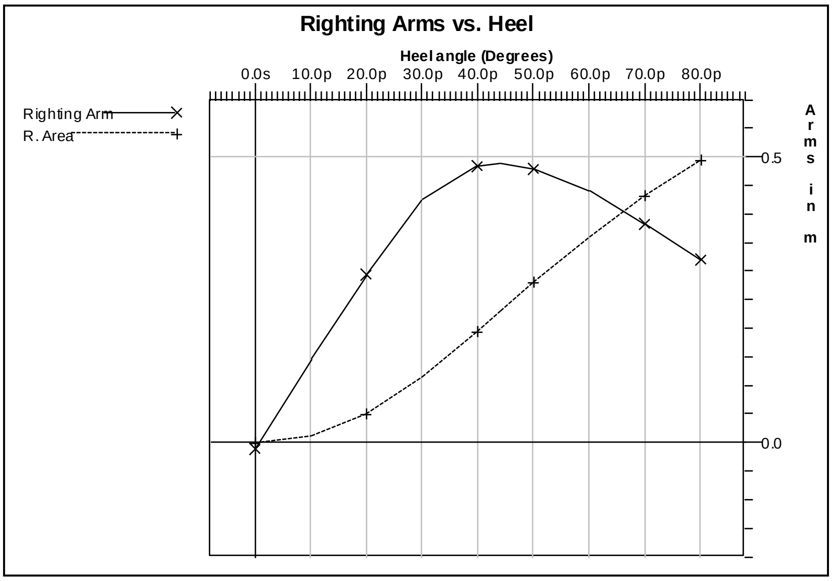
Righting Arms vs Heel Angle

Heel Angle (deg)	Trim Angle (deg)	Origin Depth (m)	Righting Arm (m)	Area (m-Rad)	Flood Pt Height (m)
0.00	0.14f	2.502	-0.011	0.000	1.475 (1)
10.00p	0.17f	2.442	0.147	0.012	1.395 (1)
20.00p	0.27f	2.262	0.296	0.051	1.311 (1)
30.00p	0.40f	1.972	0.427	0.114	1.224 (1)
40.00p	0.42f	1.655	0.484	0.195	1.078 (1)
44.17p	0.40f	1.518	0.488	0.230	0.999 (1)
50.00p	0.35f	1.321	0.480	0.280	0.872 (1)
60.00p	0.24f	0.972	0.441	0.360	0.620 (1)
70.00p	0.09f	0.613	0.383	0.433	0.329 (1)
80.00p	0.08a	0.262	0.322	0.494	0.005 (1)
Flood Point Immersed					

Unprotected Flood Point

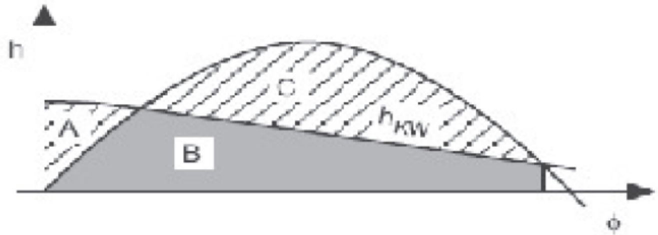
Name	L,T,V (m)	Height (m)	Related Tank
(1) Überlauf Skylight Hinten	5.500f, 0.440p, 3.990	1.475	FLUTUNG HINTEN

Limit	Min/Max	Actual	Margin	Pass
Flutungspunkt "SKYLIGHT HINTEN" Lastfall 1.	>35.00 deg	80.00	45.00	Yes



B.2.10 Stabilitätskriterien gem. Abs. 14.2.f):

Berechnung des Verhältnisses der Hebelarmflächen im Lastfall 2. Bedingung: (B+C) > 1,4 * (A+B)



h_{KW} = Kurve der krängenden Hebelarme infolge seitlichen Winddrucks

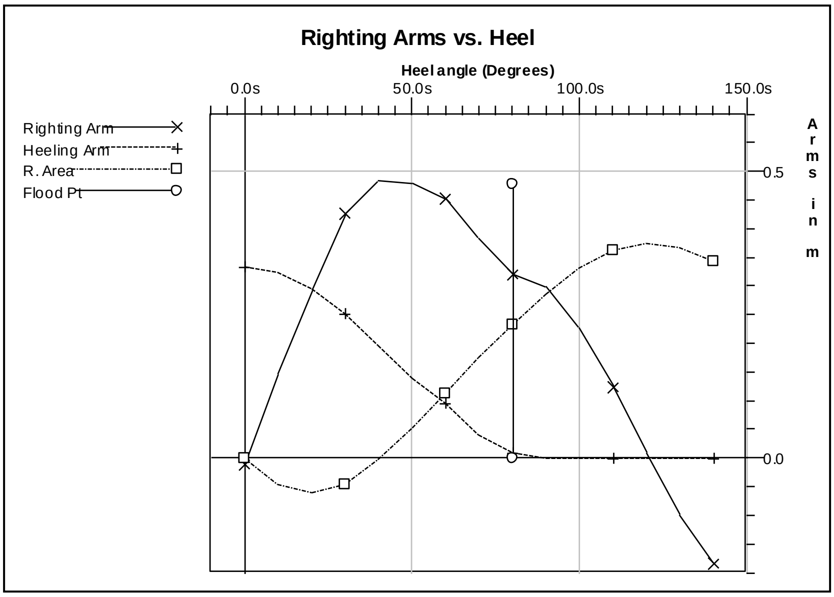
Der Tank FAEKALIENTTK B.B wird in dieser Berechnung an S.B. angenommen, da das Windmoment auch in S.B.-Richtung wirkt. Die Hebelarmkurve ist durch die niedrigste flutbare Öffnung, SKYLIGHT HINTEN, begrenzt:

- B.2.10.1: Unter Standardbeseglung
- B.2.10.2: Unter Sturmbeseglung:
- B.2.10.3: Vor Top und Takel:

B.2.10.1: Unter Standardbeseglung:

Wind (kn)	Wind (Bft)	Wind heeling moment *cos² (mt)	Flutungswinkel (deg)
26.45	**6**	**44.24**	**80.14**

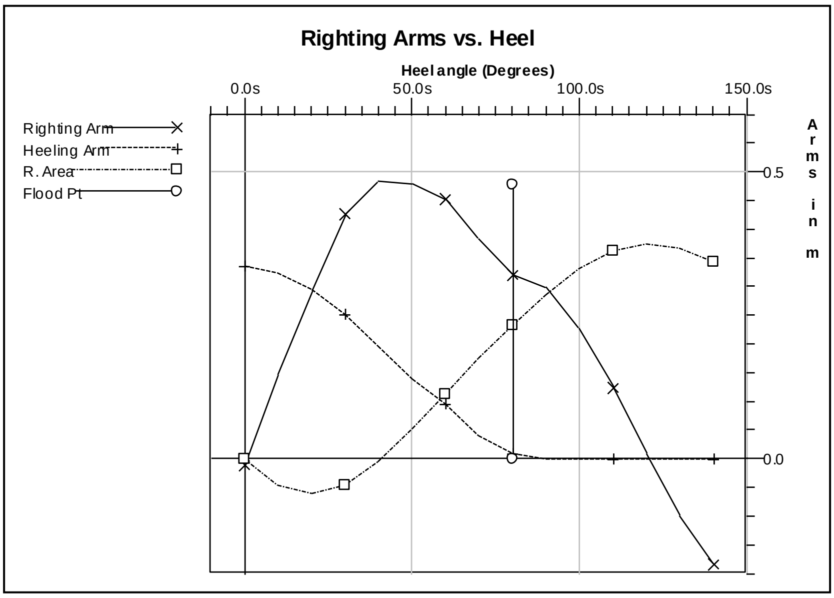
Limit	**Min/Max**	**Actual**	**Margin**	**Pass**
Absolute Area Ratio from 0.00 deg to RAzero	>1.400	**1.882**	0.482	Yes



B.2.10.2: Unter Sturmbeseglung:

Wind (kn)	Wind (Bft)	Wind heeling moment *cos² (mt)	Flutungswinkel (deg)
44.2	**9**	**44.26**	**80.14**

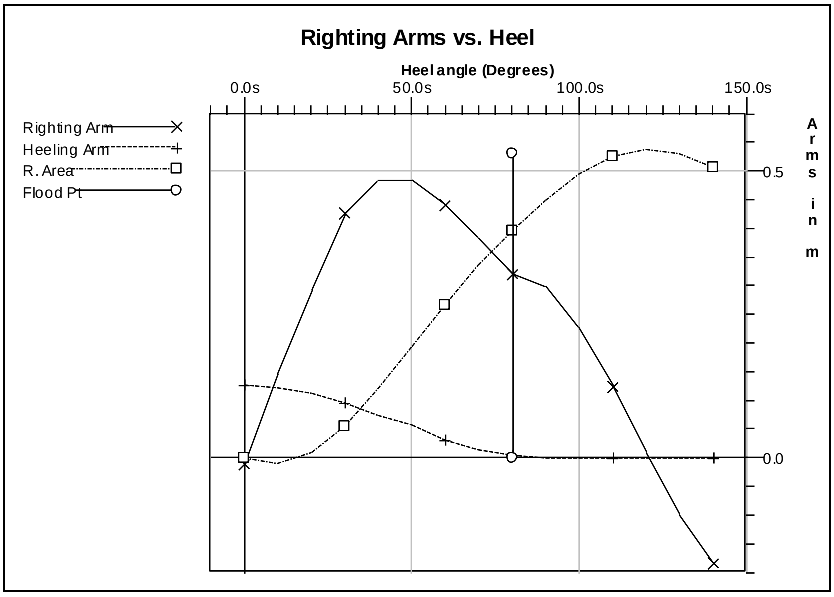
Limit	**Min/Max**	**Actual**	**Margin**	**Pass**
Absolute Area Ratio from 0.00 deg to RAzero	>1.400	**1.881**	0.481	Yes



B.2.10.3: Unter Top und Takel:

Wind (kn)	Wind (Bft)	Wind heeling moment *cos² (mt)	Flutungswinkel (deg)
65	**12**	**16.76**	**80.14**

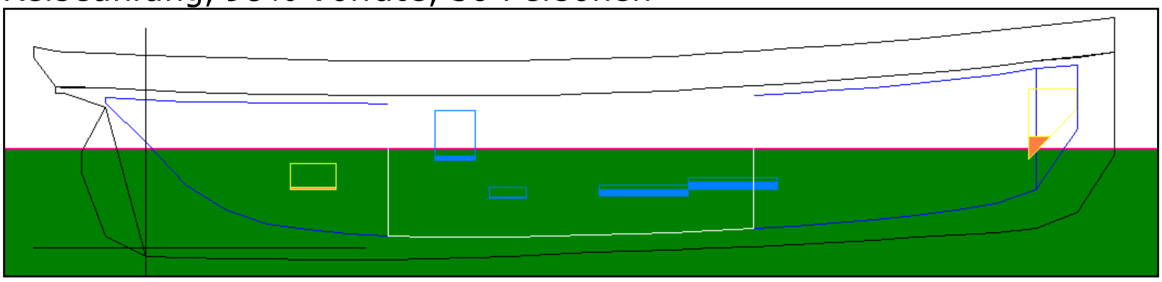
Limit	**Min/Max**	**Actual**	**Margin**	**Pass**
Absolute Area Ratio from 0.00 deg to RAzero	>1.400	**4.948**	3.548	Yes



B.3 Stabilitätskriterien für den LADEFALL 3.

B.3.1 Massen/Schwerpunkte für den LADEFALL 3.

Reiseanfang, 98% Vorräte, 50 Personen



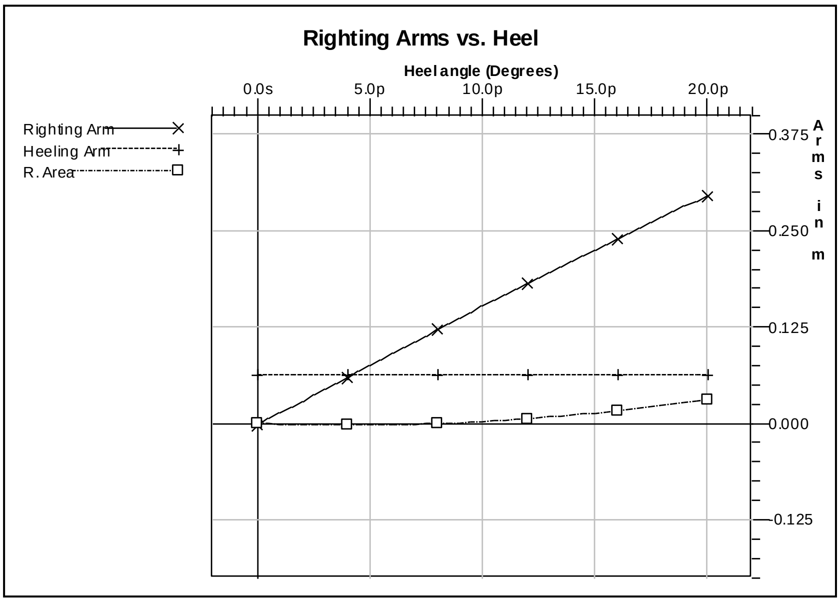
B.3.2 Stabilitätskriterien gem. 14.1.a) und 14.2.a):

Limit	**Min/Max**	**Actual**	**Margin**	**Pass**
GM Upright	>0.600 m	0.881	0.281	Yes

B.3.3 Stabilitätskriterien gem. Abs. 14.1.b):

PERSONENMOMENT: HMMT 8 mt

Limit	Min/Max	Actual	Margin	Pass
Absolute Angle at RA zero	<10.00 deg	4.17	5.83	Yes



B.3.4 Stabilitätskriterien gem. Abs. 14.1.c):

PERSONENMOMENT: HMMT 8 mt
DREHKREIS: 106 m bei V(Reise) = 9.2 kn (Annahme wie B.1.4)
In der Berechnung wird das PERSONENMOMENT als einseitige Masse der Personen mit dem tatsächlichen Schwerpunkt berücksichtigt.
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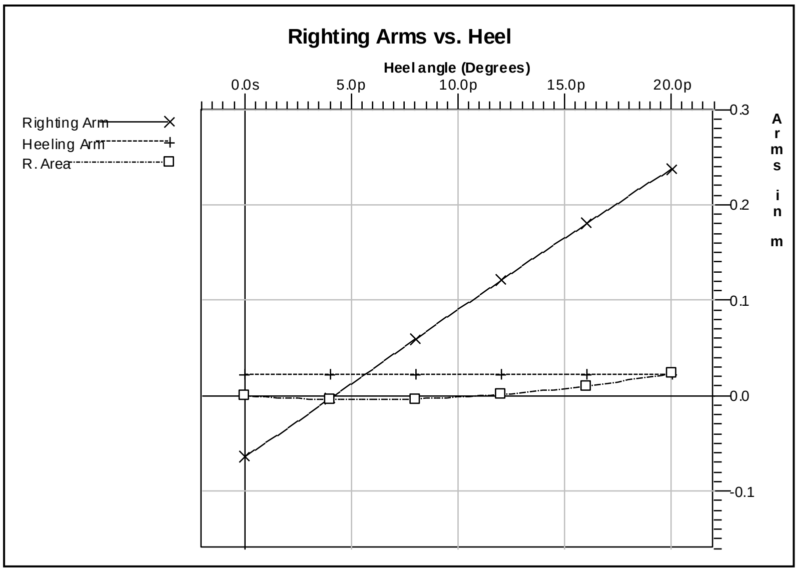
Nr.	Bezeichnung	Masse (t)	LCG (m)	VCG (m)	TCG (m)
1	Masse 50 Personen an B.B-Seite	4.00	9.000	4.690	2.000
	Masse 50 Personen an B.B.-Seite	**4.00**	**9.00**	**4.69**	**2.00**

TS NO 5 ELBE - Stabilitaetsberechnung LADEFALL 3

Floating Status

Draft FP	2.458 m	Heel	port 5.62 deg.	GM(Solid)	0.892 m
Draft MS	2.476 m	Equil	Yes	F/S Corr.	0.005 m
Draft AP	2.493 m	Wind	Off	GM(Fluid)	0.887 m
Trim	aft 0.07 deg.	Wave	No	KMt	3.166 m
LCG	10.730f m	VCG	2.278 m	TPcm	0.99
Displacement	127.52 MT	WaterSpgr	1.025		

Limit	Min/Max	Actual	Margin	Pass
Absolute Angle at RA zero	<12.00 deg	5.62	6.38	Yes



B.3.5 Stabilitätskriterien gem. Abs. 14.1.d) und 14.2.d):

Moment aus Winddruck:
Windgeschwindigkeit: 64 kn (Bft. 12)

In der Berechnungssoftware wird von einem CD-Faktor von 1.2 ausgegangen. Der Tank FAEKALIENTTK B.B wird in dieser Berechnung an S.B. angenommen, da das Windmoment auch in S.B.-Richtung wirkt.

Windangriffsfläche ohne Segel:

Heeling Moment Derivation

Wind Velocity at 10 meters = 64.0 knots from port, CD= 1.200

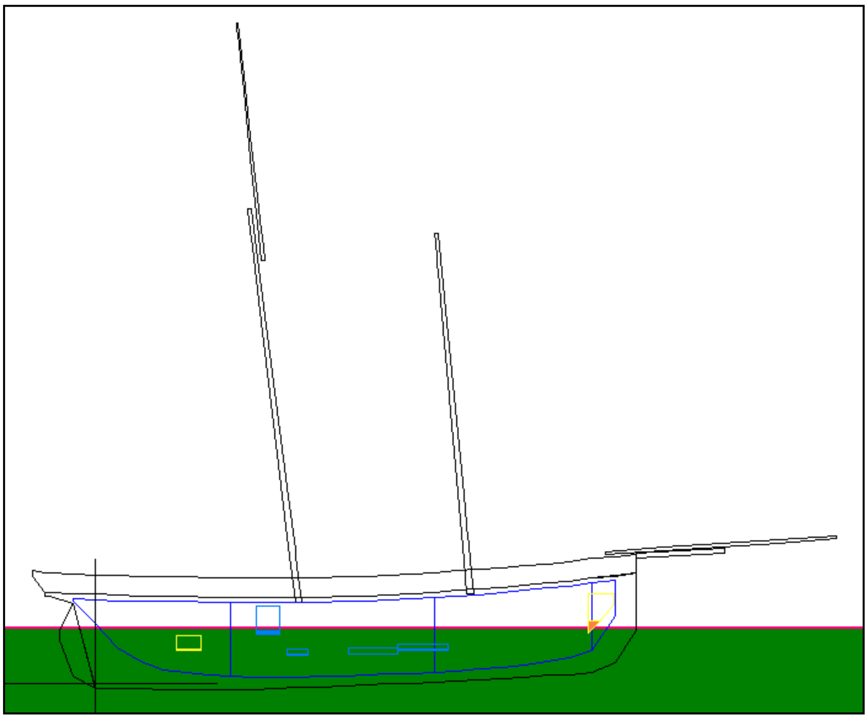
Part	LPA (m^2)	HCP (m)	Arm (m)	Pressure (MT/m^2)	Moment (m-MT)
Aussen	39.6	0.817	2.076	0.042	3.415
Aussen	22.7	1.996	3.256	0.055	4.053
MAST HINTEN	3.9	8.888	10.148	0.081	3.241
MAST VORNE	3.6	8.605	9.865	0.080	2.852
SPIERE MAST HI	1.1	20.632	21.892	0.098	2.258
BUGSPRIET FEST	0.8	3.255	4.515	0.063	0.221
BUGSPRIET LOSE	1.4	3.607	4.867	0.065	0.434

Total wind heeling moment 16.475 to starboard

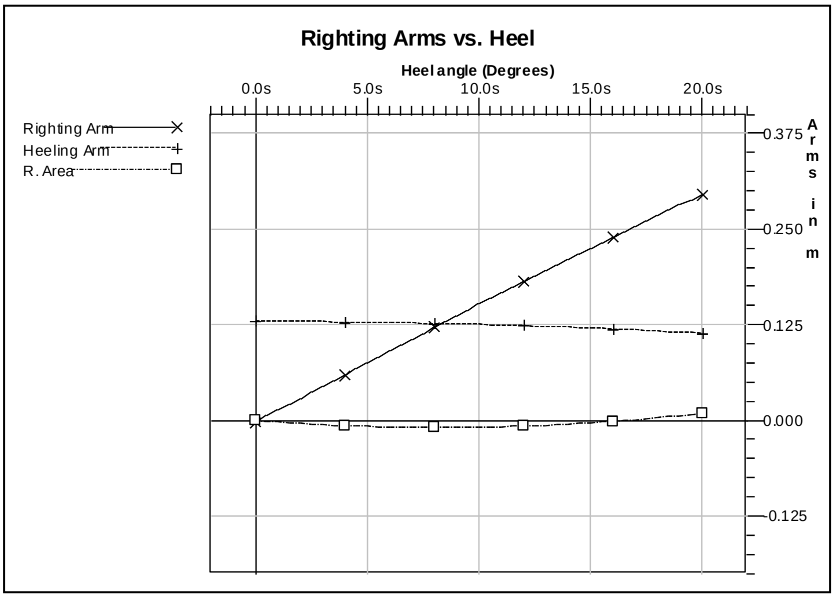
TS NO 5 ELBE - Stabilitaetsberechnung LADEFALL 3

Floating Status

Draft FP	2.475 m	Heel	stbd 8.32 deg.	GM(Solid)	0.885 m
Draft MS	2.470 m	Equil	Yes	F/S Corr.	0.003 m
Draft AP	2.465 m	Wind	64.0 Knots	GM(Fluid)	0.882 m
Trim	0.02 deg.	Wave	No	KMt	3.156 m
LCG	10.761f m	VCG	2.280 m	TPcm	0.99
Displacement	127.52 MT	WaterSpgr	1.025		

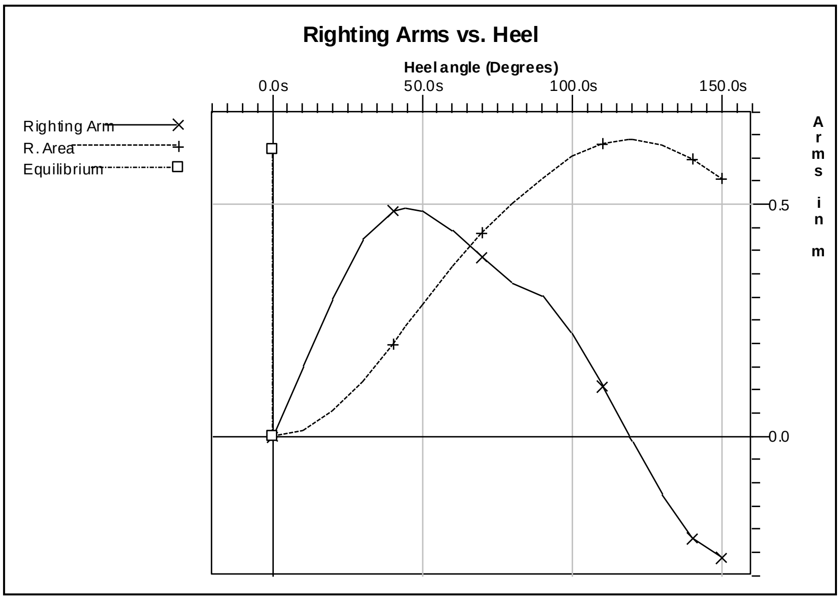


Limit	Min/Max	Actual	Margin	Pass
Absolute Angle at RA zero	<12.00 deg	8.32	3.68	Yes



B.3.6 Stabilitätskriterien gem. Abs. 14.2.b):

Limit	Min/Max	Actual	Margin	Pass
Righting Arm at Max RA	>0.300 m	0.493	0.193	Yes



B.3.7 Stabilitätskriterien gem. Abs. 14.2.c).1:

Krängungswinkel für Punkt an Seite des Decks auf Hauptdecksniveau muss größer als 20° sein. Der Tank FAEKALIENTTK B.B wird in dieser Berechnung an S.B. angenommen, da das Windmoment auch in S.B.-Richtung wirkt.

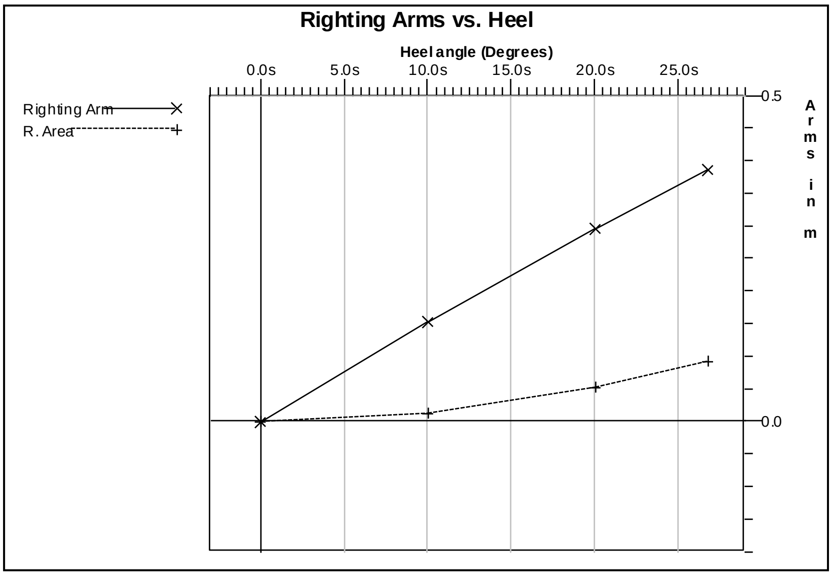
Righting Arms vs Heel Angle

Heel Angle (deg)	Trim Angle (deg)	Origin Depth (m)	Righting Arm (m)	Area (m-Rad)	Flood Pt Height (m)
0.00	0.01a	2.482	-0.001	0.000	1.296 (1)
10.00s	0.03f	2.422	0.152	0.013	0.797 (1)
20.00s	0.13f	2.241	0.296	0.052	0.310 (1)
26.74s	0.23f	2.054	0.386	0.093	-0.003 (1)
Flood Point Immersed					

Unprotected Flood Point

Name	L,T,V (m)	Height (m)	Related Tank
(1) Überlauf Seite Deck	9.000f, 2.860s, 3.777	1.296	FLUTUNG HINTEN

Limit	Min/Max	Actual	Margin	Pass
Flutungspunkt: Seite Deck, Lastfall 2.	>20.00 deg	26.74	6.74	Yes



B.3.8 Stabilitätskriterien gem. Abs. 14.2.c).2:

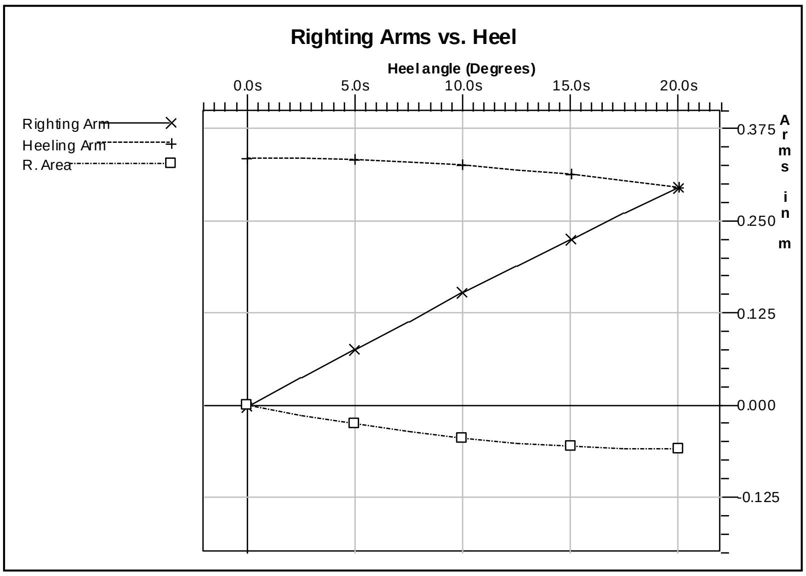
Max. Krängungswinkel von 20° für die Besegelungen unter Bedingungen des Lastfalls 3:

- B.3.8.1: Unter Standardbeseglung
- B.3.8.2: Unter Sturmbeseglung:
- B.3.8.3: Vor Top und Takel:

Der Tank FAEKALIENTTK B.B wird in dieser Berechnung an S.B. angenommen, da das Windmoment auch in S.B.-Richtung wirkt.

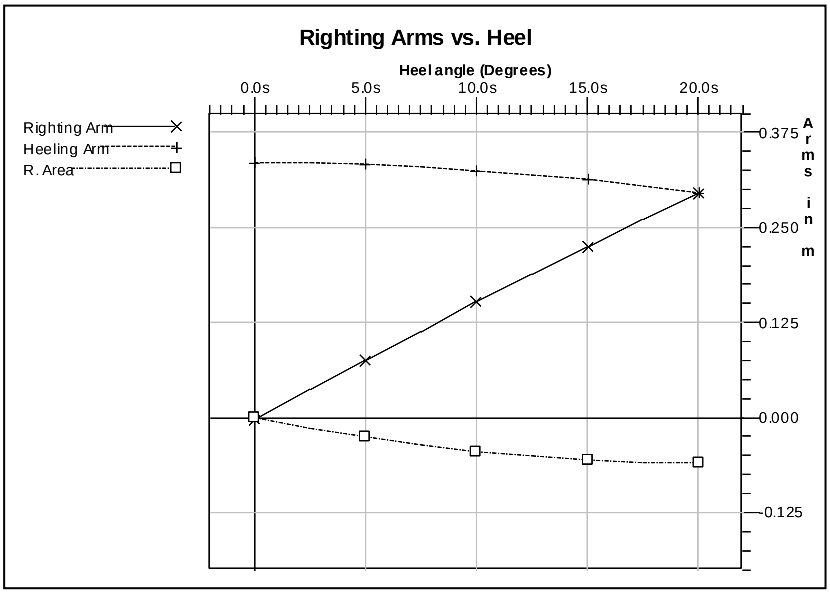
B.3.8.1: Unter Standardbeseglung:

Wind (kn)	Wind (Bft)	Angle to S.B. (deg)	Wind heeling moment *cos² (mt)
25.95	**6**	**20.01 deg**	**42.77**



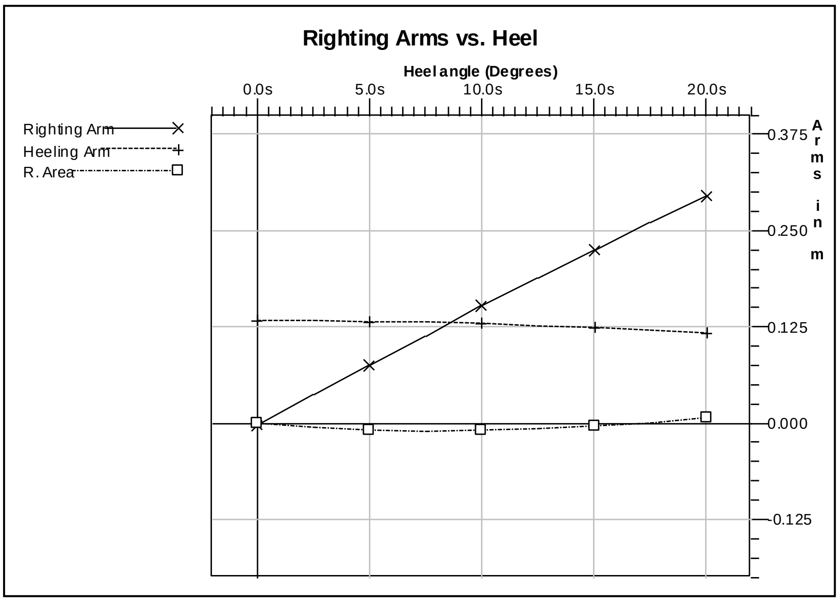
B.3.8.2: Unter Sturmbeseglung:

Wind (kn)	Wind (Bft)	Angle to S.B. (deg)	Wind heeling moment *cos² (mt)
43.3	**9**	**20.00 deg**	**42.75**



B.3.8.3: Vor Top und Takel:

Wind (kn)	Wind (Bft)	Angle to S.B. (deg)	Wind heeling moment *cos² (mt)
65	**12**	**8.57 deg**	**16.99**



B.3.9 Stabilitätskriterien gem. Abs. 14.2.e):

Min. Krängungswinkel von 35° für Flutung einer Öffnung an Deck darf im Lastfall 3. nicht unterschritten werden:
Niedrigste Öffnung: Skylight hinten

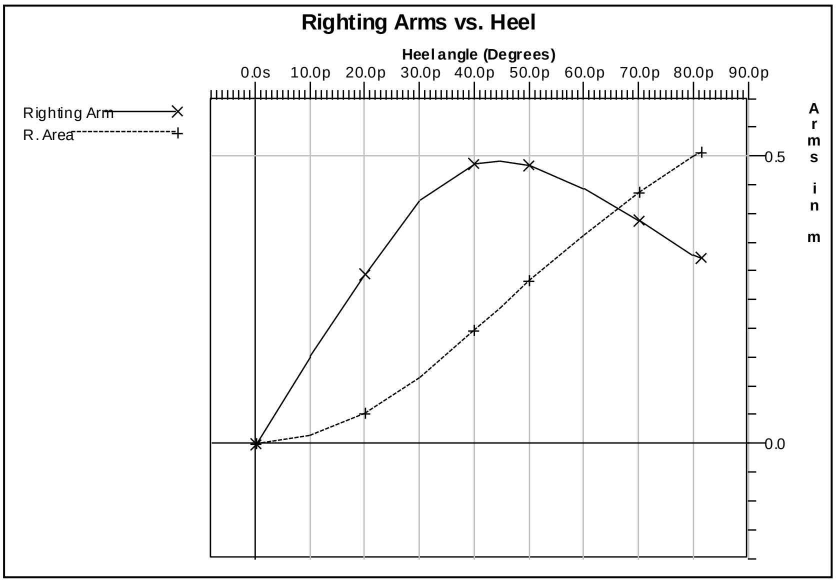
Righting Arms vs Heel Angle

Heel Angle (deg)	Trim Angle (deg)	Origin Depth (m)	Righting Arm (m)	Area (m-Rad)	Flood Pt Height (m)
0.00	0.01a	2.482	-0.001	0.000	1.509 (1)
10.00p	0.03f	2.422	0.152	0.013	1.429 (1)
20.00p	0.13f	2.241	0.296	0.052	1.346 (1)
30.00p	0.28f	1.948	0.426	0.116	1.261 (1)
40.00p	0.32f	1.621	0.486	0.196	1.122 (1)
44.57p	0.30f	1.468	0.492	0.235	1.037 (1)
50.00p	0.26f	1.282	0.484	0.282	0.920 (1)
60.00p	0.16f	0.929	0.445	0.363	0.670 (1)
70.00p	0.02f	0.571	0.387	0.436	0.378 (1)
80.00p	0.15a	0.224	0.329	0.499	0.050 (1)
81.50p	0.18a	0.174	0.323	0.507	-0.003 (1)
Flood Point Immersed					

Unprotected Flood Point

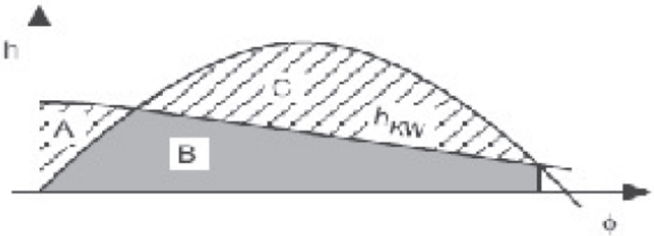
Name	L,T,V (m)	Height (m)	Related Tank
(1) Überlauf Skylight Hinten	5.500f, 0.440p, 3.990	1.509	FLUTUNG HINTEN

Limit	Min/Max	Actual	Margin	Pass
Flutungspunkt "SKYLIGHT HINTEN" Lastfall 1.	>35.00 deg	81.50	46.50	Yes



B.3.10 Stabilitätskriterien gem. Abs. 14.2.f):

Berechnung des Verhältnisses der Hebelarmflächen im Lastfall 3. Bedingung: (B+C) > 1,4 * (A+B)



h_{KW} = Kurve der krängenden Hebelarme infolge seitlichen Winddrucks

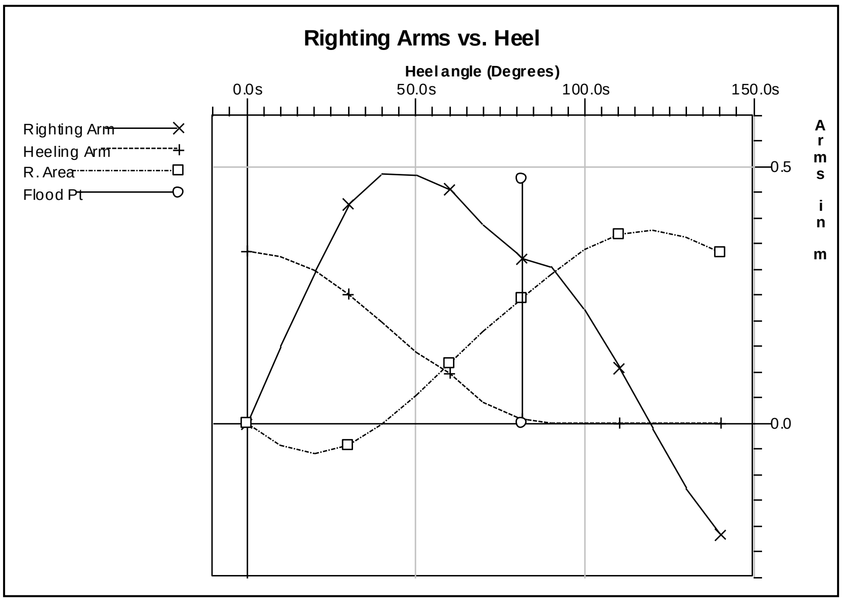
Der Tank FAEKALIENTTK B.B wird in dieser Berechnung an S.B. angenommen, da das Windmoment auch in S.B.-Richtung wirkt. Die Hebelarmkurve ist durch die niedrigste flutbare Öffnung, SKYLIGHT HINTEN, begrenzt:

- B.3.10.1: Unter Standardbeseglung
- B.3.10.2: Unter Sturmbeseglung:
- B.3.10.3: Vor Top und Takel:

B.3.10.1: Unter Standardbeseglung:

Wind (kn)	Wind (Bft)	Wind heeling moment *cos² (mt)	Flutungswinkel (deg)
25.95	**6**	**42.77**	**81.50**

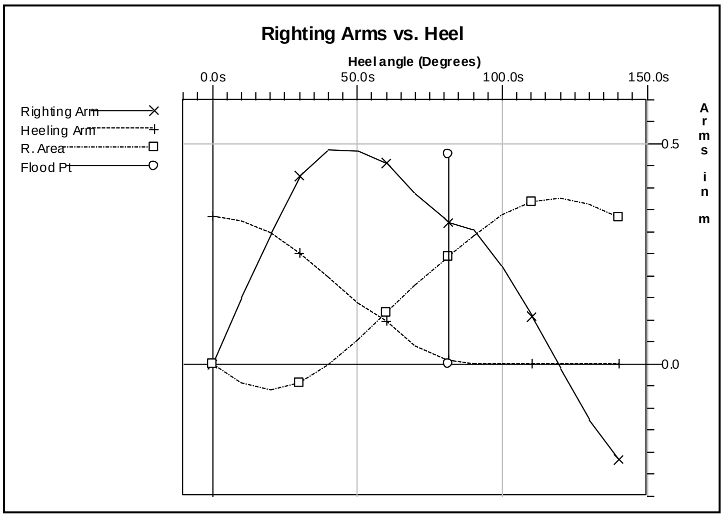
Limit	Min/Max	Actual	Margin	Pass
Absolute Area Ratio from 0.00 deg to RAzero	>1.400	**1.921**	0.521	Yes



B.3.10.2: Unter Sturmbeseglung:

Wind (kn)	Wind (Bft)	Wind heeling moment *cos² (mt)	Flutungswinkel (deg)
43.3	**9**	**42.75**	**81.50**

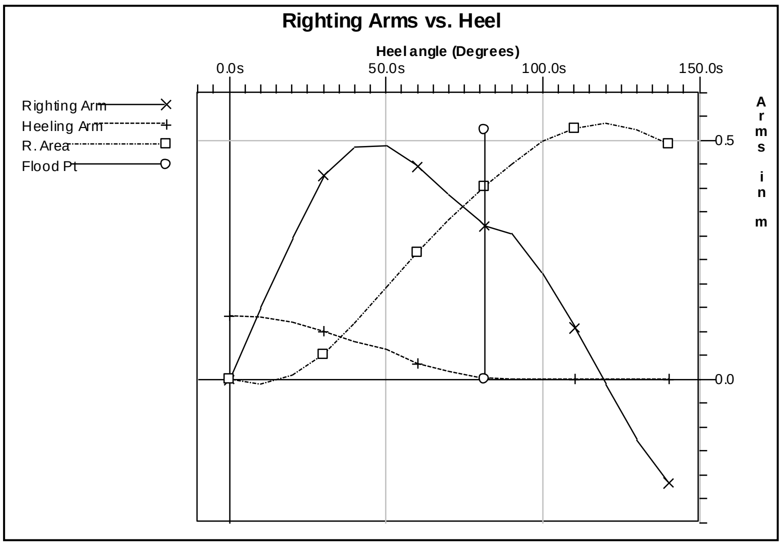
Limit	**Min/Max**	**Actual**	**Margin**	**Pass**
Absolute Area Ratio from 0.00 deg to RAzero	>1.400	**1.922**	0.522	Yes



B.3.10.3: Unter Top und Takel:

Wind (kn)	Wind (Bft)	Wind heeling moment *cos² (mt)	Flutungswinkel (deg)
65	**12**	**16.99**	**81.5**

Limit	**Min/Max**	**Actual**	**Margin**	**Pass**
Absolute Area Ratio from 0.00 deg to RAzero	>1.400	**4.818**	3.418	Yes



B.4 Zusammenfassung der Ergebnisse zur Intaktstabilität

Nr.	Vorschrift	Gefordert	Ladefall 1	Ladefall 2	Ladefall 3	Pass?
B.1.2 B.2.2 B.3.2	s. 4.1.III, Kap.2, Abschn.2, 14.1.a u. 14.2.a	GM > 0.60 m	0.953 m	0.905 m	0.881 m	Ja Ja Ja
B.1.3 B.2.3 B.3.3	s. 4.1.III, Kap.2, Abschn.2, 14.1.b	<10.00 deg Einseitige Personen	3.91°	4.51°	4.17°	Ja Ja Ja
B.1.4 B.2.4 B.3.4	s. 4.1.III, Kap.2, Abschn.2, 14.1.c	<12.00 deg Einseitige Personen + Drehkreis	5.20°	5.89°	5.62°	Ja Ja Ja
B.1.5 B.2.5 B.3.5	s. 4.1.III, Kap.2, Abschn.2, 14.1.d u. 14.2.d	<12.00 deg / Bft=12 (64 kn) Seitlicher Winddruck	8.13°	8.32°	8.32°	Ja Ja Ja
B.1.6 B.2.6 B.3.6	s. 4.1.III, Kap.2, Abschn.2, 14.2.b	GZ max >0.30m	0.552 m	0.504 m	0.493 m	Ja Ja Ja
B.1.7 B.2.7 B.3.7	s. 4.1.III, Kap.2, Abschn.2, 14.2.c).1	>20 deg Seite Deck zu Wasser	27.88°	25.78°	26.74°	Ja Ja Ja
B.1.8.1 B.2.8.1 B.3.8.1	s. 4.1.III, Kap.2, Abschn.2, 14.2.c).2 13.i) aa)	<20 deg/Bft=? Standardbes eglung	20°/Bft 6	20°/Bft 6	20°/Bft 6	Ja Ja Ja
B.1.8.2 B.2.8.2 B.3.8.2	s. 4.1.III, Kap.2, Abschn.2, 14.2.c).2 13.i) bb)	<20 deg/Bft=? Sturmbesegl ung	20°/Bft 9	20°/Bft 9	20°/Bft 9	Ja Ja Ja
B.1.8.3 B.2.8.3 B.3.8.3	s. 4.1.III, Kap.2, Abschn.2, 14.2.c).2 13.i) cc)	<20 deg/Bft=12 Vor Topp und Takel	8.57°/Bft 12	8.57°/Bft 12	8.57°/Bf t 12	Ja Ja Ja

B.1.9 B.2.9 B.3.9	s. 4.1.III, Kap.2, Abschn.2, 14.2.e	>35 deg Flutungspunkt an Deck	82.98°	80.00°	81.50°	Ja Ja Ja
B.1.10.1 B.2.10.1 B.3.10.1	s. 4.1.III, Kap.2, Abschn.2, 14.2.f 13.i) aa)	Ratio area >1.4 Wind heeling moment Standardbeseglung	2.087/Bft 6	1.882/Bft 6	1.921/Bft 6	Ja Ja Ja
B.1.10.2 B.2.10.2 B.3.10.2	s. 4.1.III, Kap.2, Abschn.2, 14.2.f 13.i) bb)	Ratio area >1.4 Wind heeling moment Sturmbeseglung	2.092/Bft 9	1.881/Bft 9	1.922/Bft 9	Ja Ja Ja
B.1.10.3 B.2.10.3 B.3.10.3	s. 4.1.III, Kap.2, Abschn.2, 14.2.f 13.i) cc)	Ratio area >1.4 Wind heeling moment Vor Topp und Takel	5.343/Bft 12	4.948/Bft 12	4.818/Bft 12	Ja Ja Ja

Die Bewertung der Intaktstabilität ist gem. Forderung der BSU auf Basis der *1. Verordnung zur Änderung der schiffssicherheitsrechtlichen Vorschriften über Bau und Ausrüstung von Traditionsschiffen und anderen Schiffen, die nicht internationalen Schiffssicherheitsregeln unterliegen, vom 7. März 2018: Teil 3, Sicherheitsanforderungen an den Bau und die Ausrüstung von Traditionsschiffen* (Traditionsschiffs-Richtlinie, s.4.1.III), Kapitel 2, Abschnitt 2, durchgeführt worden.
Unter Berücksichtigung der Ergebnisse und Auswertungen des Krängungsversuches vom 21.10.2006 (s.4.2[2], 4.2[3]) und den hier getroffenen Annahmen bestätigen die Ergebnisse dieser Berechnung, dass das TS „ELBE NO. 5“ die Anforderungen zur Intaktstabilität der Traditionsschiffs-Richtlinie erfüllt.
Für diese Berechnungen sind die Abmessungen der Segel, Takelage und Tanks dem Stabilitätshandbuch (s.4.2.[3] entnommen worden. Die Außengeometrie des Schiffes ist durch das LKA 38 aufgemessen und für die Eingabe in die Berechnungssoftware aufgearbeitet worden.
In allen geforderten Ladefällen werden die Stabilitätskriterien sowie die Kriterien für Momente durch Drehkreis, Wetter und einseitiger Personenkonzentrierung für maschinegetriebene und segelnde Traditionsschiffe erfüllt. Bei der Standardbeseglung wird das zusätzliche Toppsegel nicht berücksichtigt, denn es wird als Leichtwettersegel eingestuft. Als Sturmbeseglung wird die Situation REFF II angesetzt. Unter Standardbeseglung kann das Schiff bis zu einer Windstärke Bft 6 eingesetzt

werden, unter Sturmbeseglung bis zu einer Windstärke Bft 9. Das Schiff verfügt in allen Ladefällen über einen sehr guten Stabilitätsumfang mit einer befriedigenden, aber nicht zu großen Anfangsstabilität. Dieser Umstand lässt sehr gute See-Eigenschaften erwarten.
Bei der Bewertung der Ergebnisse dieser Berechnungen wird davon ausgegangen, dass die im Winter 2018/19 durchgeführten großen Restaurierungsarbeiten die Massen und Schwerpunktslagen des Schiffes nicht verändert haben. Er wird empfohlen, nach Abschluss der Reparaturphase einen neuen Krängungsversuch zur Ermittlung der Massen und Schwerpunkte durchzuführen. Die Wasserablaufpforten im Schanzkleid sollten nicht verschließbar und voll funktionsfähig sein.

C. Bewertung der Leckstabilität des TS „NO. 5 ELBE"

Das TS „NO 5 ELBE" ist ohne wasserdichte Querschotten durch die BG-Verkehr als Traditionsschiff gem. der jüngsten Richtlinie vorläufig zertifiziert worden.
Im Rahmen dieser Untersuchung soll der unterzeichnende Sachverständige bewerten, ob mit dem Einbau von wasserdichten Schotten bis zum Hauptdeck (Schottendeck) ein 1-Abteilungsstatus zur Erfüllung der Leckstabilitätsvorschriften der entsprechenden Vorschriften bei diesem Schiff realisiert werden kann.
Die „NO. 5 ELBE" ist von der BSU als vorhandenes Fahrgastschiff der KLASSE B eingestuft worden. Dieses Schiff hat eine größere länge als 24,00 m.
Somit werden die nachfolgenden Kriterien bei den geforderten Ladungsfällen untersucht. Da es bei diesem Schiff keine Ballastwasser-Tanks gibt werden die Ladefälle aus der Berechnung der Intaktstabilität auf Basis der Traditionsschiffs-Richtlinie angewandt:
Ladefall 1: Schiff leer, Betriebsklar
Ladefall 2: Reiseanfang, 98% Vorräte
Ladefall 3: Reiseende, 10 % Vorräte

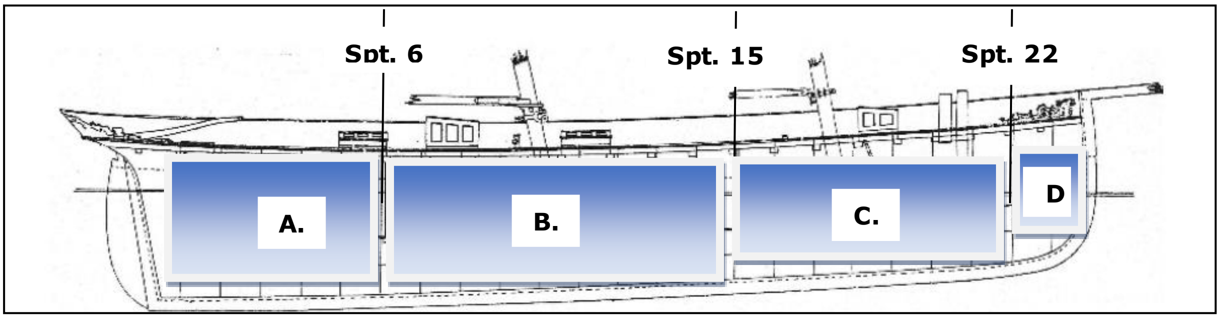
Diese unterscheiden sich zu den Forderungen der Richtlinie 2009/45/EG (s. 4.1.I) nur im Füllgrad der Tanks im Ladefall 2. Hier wird in den nachfolgenden Betrachtungen weiterhin mit 98% anstatt 100% gerechnet. Das entspricht einer Reduzierung von 90 kg, die in diesem Zusammenhang zu vernachlässigen ist!
Die flutbaren Hauptabteilungen sind gem. A.3 in der Hydrostatik-Software aufgemessen worden.

C.1 Rahmenmbedingungen

C.1.1 Wasserdichte Unterteilung, Teil B.2:

Folgende wasserdichte Unterteilungen sind als KLASSE B-Schiff vorstellbar:
Spt 6: Wasserdichtes Schott als Abtrennung des hinteren Maschinenbereiches und hinteren Wohnbereich

Spt 15: Wasserdichtes Schott als vordere Abtrennung des großen Wohnbereiches auf Mittschiffs
Spt 22: Kollisionsschott in Verbindung mit vorderem Diesel Tank



Die Wasserdichtigkeit gem. B.12 wird für die diese Berechnungen als Voraussetzung angenommen. Somit ergeben sich folgende flutbare Hauptabteilungen/Räume:

A. FLUTUNG HINTEN
B. FLUTUNG MITTE
C. FLUTUNG VORNE
D. FLUTUNG VOR KOLLISIONSSCHOTT

C.1.2 Flutbare Länge, Teil B.3:

Beim TS „NO. 5 ELBE"" mit weniger als 400 Personen ist der Abteilungsfaktor = 1,0. Somit ist die Flutbare Länge = Abteilungslänge. Folgende Flutbarkeitswerte bis zur Tauchgrenze sind anzunehmen:

Räume	Flutbarkeit (%)
Bestimmt für Ladung oder Vorräte	60
Belegt durch Unterkunftsräume	95
Belegt durch Maschinenanlagen	85

Folgende Flutbarkeitswerte werden für die Räume aufgrund Ihrer Ausrüstungsstruktur angenommen
FLUTUNG HINTEN: 85%
FLUTUNG MITTE: 95%
FLUTUNG VORNE: 85%

C.1.3 Stabilität des beschädigten Schiffes, Teil B, 8.:

.1.1 Die Stabilität des unbeschädigten Schiffes muss in allen Betriebszuständen so bemessen sein, dass das Schiff der Flutung jeder Hauptabteilung standhalten kann, für welche die flutbare Länge einzuhalten ist.

Als Betriebszustände werden die drei Ladefälle nach B. in den nachfolgenden Berechnungen untersucht. Somit wird auch hier von einem

Gewicht pro Person von 80 kg und ein Tankinhalt für Ladefall 2. von 98% ausgegangen.

C.2. Stabilitätskriterium des beschädigten Schiffes, Teil B, 8.2.3.1 – 8.2.3.3

Die Bewertung der Stabilitätskriterien wird für die drei größten Hauptabteilungen durchgeführt

.2.3.1 Die Kurve der aufrichtenden Resthebelarme muss mindestens 15° gegenüber der Gleichgewichtsschwimmlage betragen. Wenn jedoch die Fläche unter der Kurve der aufrichtenden Hebelarme der in Absatz .2.3.2 bezeichneten und um 15/Bereich multiplizierten Fläche entspricht, wobei der Bereich in Grad ausgedrückt ist, kann dieser Bereich höchstens bis auf 10° verkleinert werden.

.2.3.2 Die Fläche unter der Kurve der aufrichtenden Hebelarme muss mindestens 0,015 m rad. betragen, gemessen von der Gleichgewichtsschwimmlage bis zum kleineren der folgenden Werte:

.1 dem Winkel, bei dem die fortschreitende Überflutung eintritt;

.2 22° (von der Senkrechten gemessen) im Fall der Überflutung nur einer Abteilung oder 27° (von der Senkrechten gemessen) im Fall der gleichzeitigen Überflutung von zwei oder mehr benachbarten Abteilungen.

.2.3.3 Es ist ein aufrichtender Resthebelarm innerhalb eines positiven Stabilitätsbereichs unter Berücksichtigung des größten der folgenden Krängungsmomente zu ermitteln:

.1 Versammeln aller Fahrgäste auf einer Seite;

.2 Aussetzen aller voll besetzten mit Davits auszusetzenden Überlebensfahrzeuge auf einer Seite;

.3 Winddruck;

nach folgender Formel:

$$GZ(\text{Meter}) = \frac{\text{Krängungsmoment}}{\text{Verdrängung}} + 0{,}04$$

Der aufrichtende Hebelarm darf jedoch keinesfalls weniger als 0,10 Meter betragen.

C.2.1 Stabilitätskriterium des beschädigten Schiffes, Teil B, 8.2.3.3 Berechnung des max. größten Krängungsmomentes:

Alle Fahrgäste auf einer Seite:

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Nr.	Bezeichnung	Personen (80 kg)	Masse (t)	LCG (m)	VCG (m)	TCG (m)	KM (mt)
1	Masse 50 Personen an B.B.-Seite im Bereich der Schanz	50	4.00	9.000	4.690	2.000	8.000

Annahmen:

- Die Annahmen der Massen und Schwerpunke für die Personen ergeben die ungünstigste Situation und somit das größte Moment

Aussetzen des Überlebensfahrzeuges (nur Boot) auf einer Seite:
Dieser Lastfall ist bei diesem Schiff nicht vorhanden, da es keine unter Davits ausschwenkbaren Überlebensfahrzeuge gibt.

Krängung durch Winddruck:
Berechnung des Windmomentes (Druck von 120N/m²) mit dem Programm (gem. IMO Res A749 Wind) in unbeschädigtem Zustand für die Ladefälle 1:

Ladefall 1 mit Standardbeseglung: (größte Außenfläche)

- Wind Heeling Moment Derivation aus AUTOHYDRO: **39,697 mt**

Das größte Krängungsmoment ergibt sich somit für alle Ladefälle aus dem Wind Heeling Moment:

KM= 39,697 mt

Der minimale Hebelarm in den Flutungssituationen der Ladefälle darf folgenden Wert nicht unterschreiten:

$$GZ(\text{Meter}) = \frac{\text{Krängungsmoment}}{\text{Verdrängung}} + 0{,}04$$

Der aufrichtende Hebelarm darf jedoch keinesfalls weniger als 0,10 Meter betragen.

Part	Krängungsmoment (mt)	Verdrängung (t)	GZ min (m)
Ladefall 1	**39,697**	122,48	**0,364**
Ladefall 2	**39,697**	132,31	**0,340**
Ladefall 3	**39,697**	127,51	**0,351**

C.3 Hauptabteilung FLUTUNG VORNE
Diese Hauptabteilung kann in allen Ladefällen 1.-3. allein geflutet werden. Die Flutbarkeit der Abteilung wird mit 85% gem. Vorgabe angenommen. Dieser Wert ist aufgrund der Anordnung der Einbauten mit Wirtschafts- und Maschinenteile als belastbar anzusehen.
In dieser Berechnung wird der Raum vor dem Kollisionsschott mit als Flutungsraum angenommen, da er nur ein sehr kleines Volumen hat. gem. Traditionsschiffs-Richtlinie ist das Kollisionsschott vorgeschrieben, bei diesem Schiff ca. auf Spt 22. Allerdings ist es dort schlecht realisierbar, da sich dort der Dieseltank befindet.

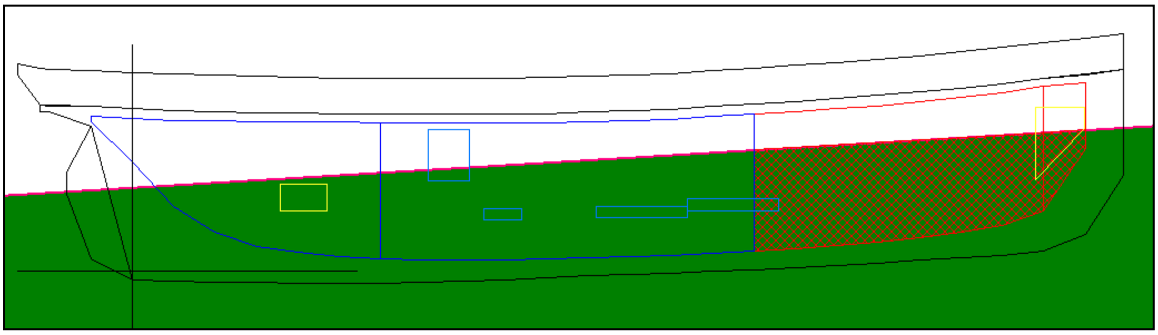
Es ist ein zusätzlicher Flutungspunkt für die Flutung des nächsten FLUTUNGSRAUMES MITTE eingegeben worden. Beim Erreichen dieses Punktes wird die Abteilung FLUTUNGSRAUM MITTE geflutet. Beim Erreichen dieses Flutungspunktes durch Krängung ist der Stabilitätsumfang erreicht, denn der aufrichtende Hebelarm reduziert sich ab diesem Krängungswinkel dramatisch.

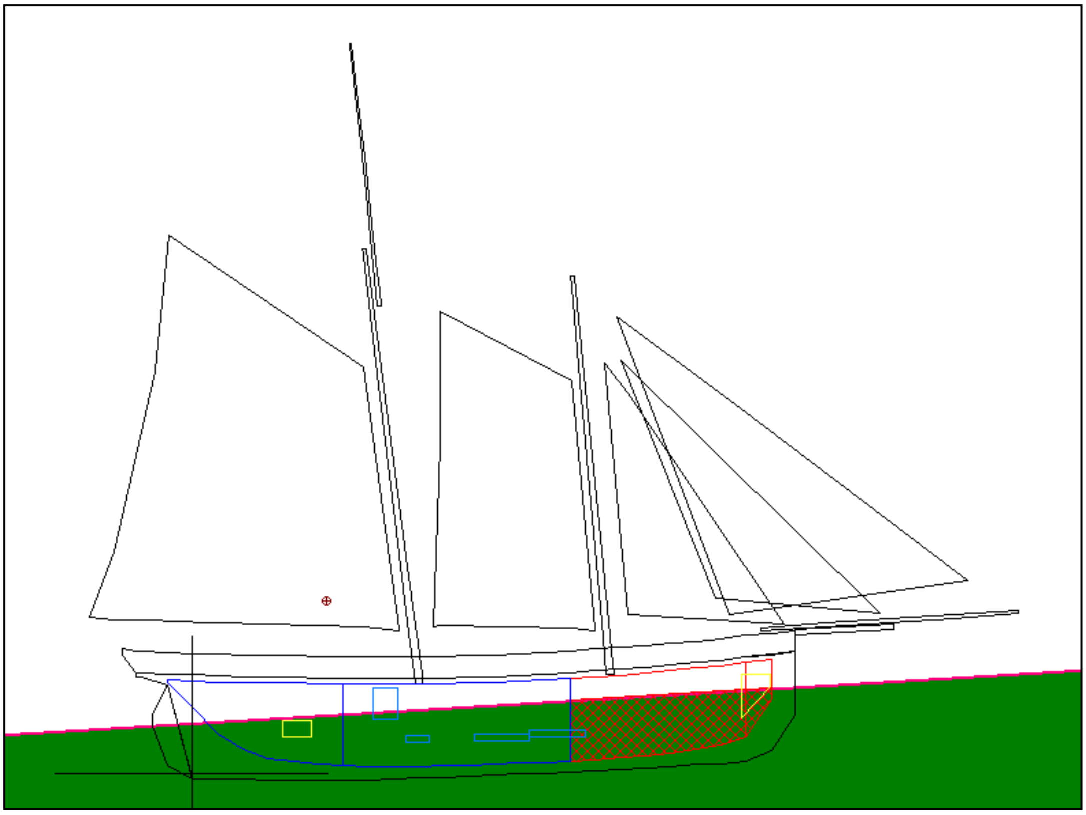
C.3.1 Ladefall 1: Schiff leer, Betriebsklar

TS NO 5 ELBE - Stabilitaetsberechnung Leckstabilitaet LADEFALL 1 /8.2.3.1/.2/.3

Floating Status

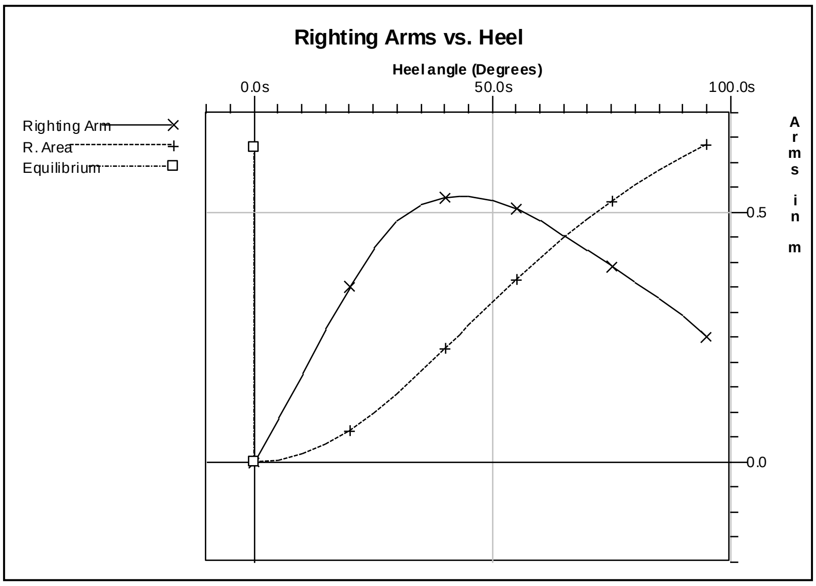
Draft FP	3.480 m	Heel	zero	GM(Solid)	1.034 m
Draft MS	2.666 m	Equil	Yes	F/S Corr.	0.000 m
Draft AP	1.853 m	Wind	Off	GM(Fluid)	1.034 m
Trim	fwd 3.49 deg.	Wave	No	KMt	3.236 m
LCG	10.780f m	VCG	2.204 m	TPcm	0.81
Displacement	122.48 MT	WaterSpgr	1.025		





VORSCHRIFTEN 2009 /45/EG LASTFALL 1, Teil B. 8.2.3.1. u. 8.2.3.2

Limit	Min/Max	Actual	Margin	Pass
8.2.3.1 Area at RAzero up to 22°	>0.015m-R	0.075	0.060	Yes
8.2.3.2 Absolute Angle at RAzero	>15.00 deg	95.00	80.00	Yes
8.2.3.3 Righting Arm at MaxRA	>0.364 m	0.533	0.169	Yes

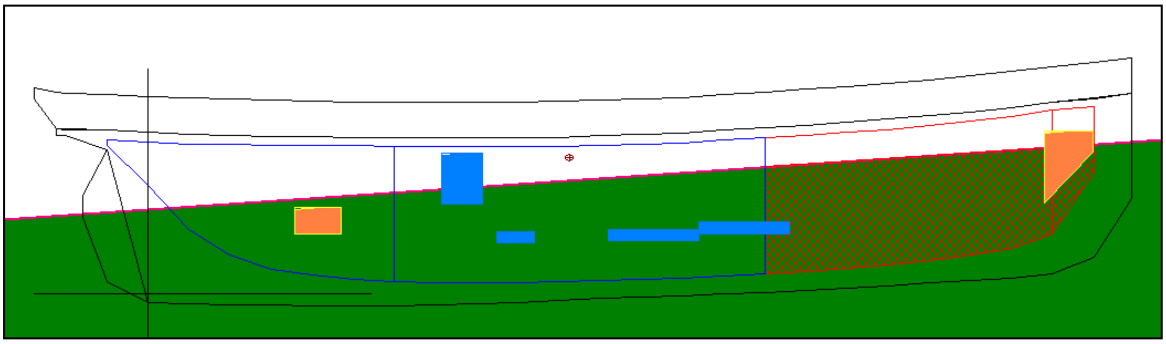


C.3.2 Ladefall 2: Reiseanfang, 98% Vorräte

TS NO 5 ELBE - Stabilitaetsberechnung Leckstabilitaet LADEFALL 2 /8.2.3.1/.2/.3

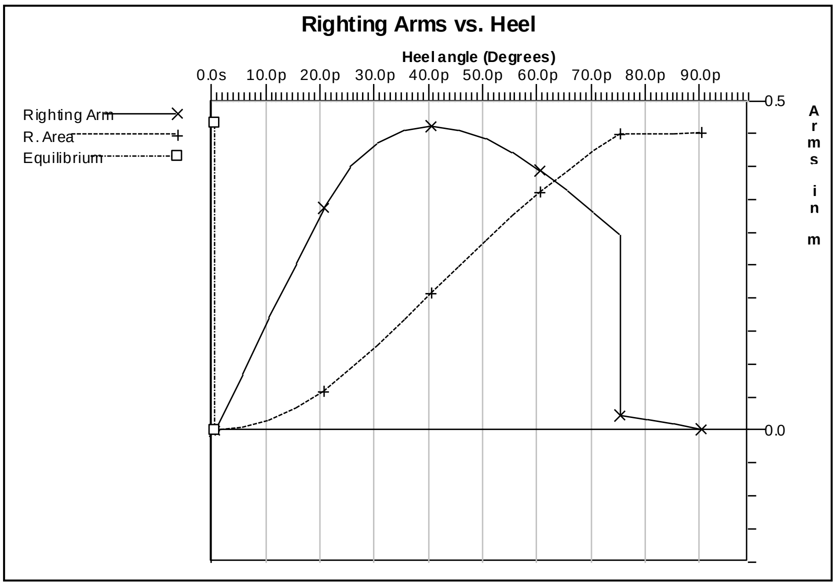
Floating Status

Draft FP	3.711 m	Heel	port 0.61 deg.	GM(Solid)	0.987 m
Draft MS	2.792 m	Equil	Yes	F/S Corr.	0.002 m
Draft AP	1.873 m	Wind	Off	GM(Fluid)	0.986 m
Trim	fwd 3.94 deg.	Wave	No	KMt	3.257 m
LCG	10.823f m	VCG	2.272 m	TPcm	0.82
Displacement	132.29 MT	WaterSpgr	1.025		



VORSCHRIFTEN 2009 /45/EG LASTFALL 2, Teil B. 8.2.3.1. u. 8.2.3.2

Limit		Min/Max	Actual	Margin	Pass
8.2.3.1	Area at RAzero up to 22°	>0.015m-R	0.068	0.053	Yes
8.2.3.2	Absolute Angle at RAzero	>15.00 deg	75,31	60.31	Yes
8.2.3.3	Righting Arm at MaxRA	>0.340 m	0.462	0.122	Yes

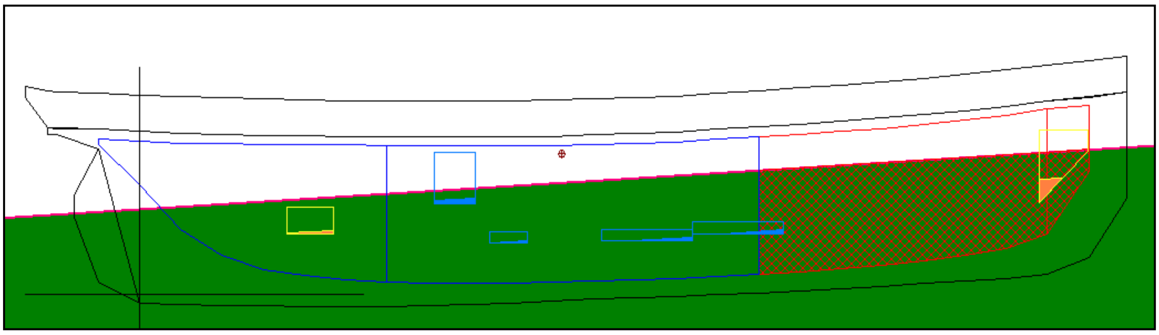


C.3.3 Ladefall 3: Reiseende, 10 % Vorräte

TS NO 5 ELBE - Stabilitaetsberechnung Leckstabilitaet LADEFALL 3 /8.2.3.1/2/3

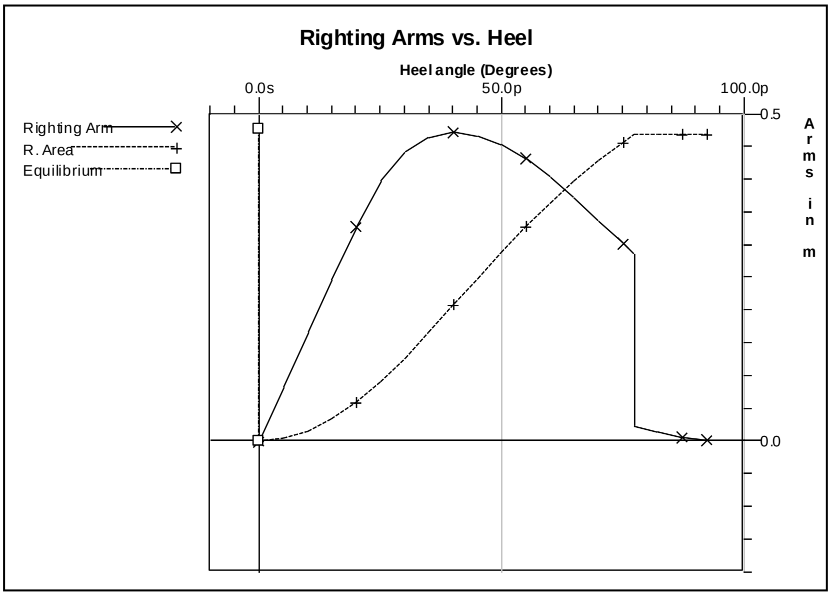
Floating Status

Draft FP	3.564 m	Heel	port 0.07 deg.	GM(Solid)	0.968 m
Draft MS	2.729 m	Equil	Yes	F/S Corr.	0.003 m
Draft AP	1.894 m	Wind	Off	GM(Fluid)	0.965 m
Trim	fwd 3.58 deg.	Wave	No	KMt	3.247 m
LCG	10.763f m	VCG	2.280 m	TPcm	0.82
Displacement	127.52 MT	WaterSpgr	1.025		



VORSCHRIFTEN 2009 /45/EG LASTFALL 3, Teil B. 8.2.3.1. u. 8.2.3.2

Limit		Min/Max	Actual	Margin	Pass
8.2.3.1	Area at RAzero up to 22°	>0.015m-R	0.070	0.055	Yes
8.2.3.2	Absolute Angle at RAzero	>15.00 deg	77.24	62.24	Yes
8.2.3.3	Righting Arm at MaxRA	>0.351 m	0.472	0.121	Yes



C.4 Hauptabteilung FLUTUNG MITTE

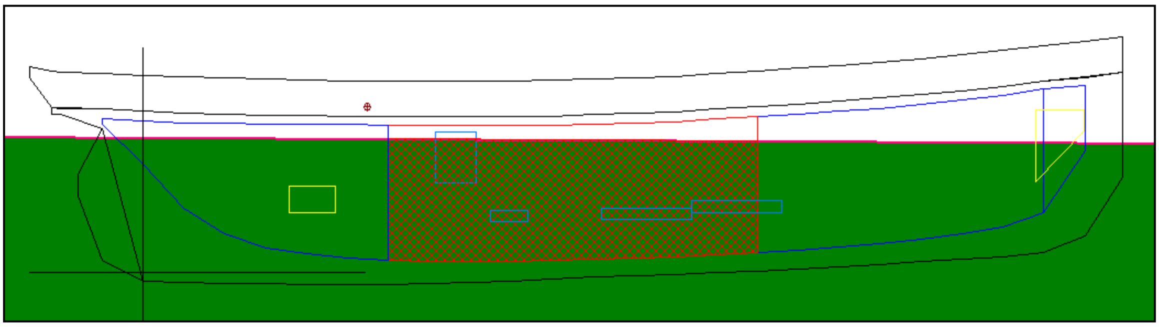
Diese Hauptabteilung kann in allen Ladefällen 1.-3. allein geflutet werden. Die Flutbarkeit wird mit 95% gem. Vorgabe als Wohnraum angenommen. Dieser Wert ist aufgrund der Anordnung der Einbauten als belastbar anzusehen.
Es ist ein zusätzlicher Flutungspunkt für die Flutung des nächsten FLUTUNGSRAUMES HINTEN eingegeben worden. Beim Erreichen dieses Punktes wird die Abteilung FLUTUNGSRAUM HINTEN geflutet. Beim Erreichen dieses Flutungspunktes durch Krängung ist der Stabilitätsumfang erreicht, denn der aufrichtende Hebelarm reduziert sich ab diesem Krängungswinkel dramatisch.

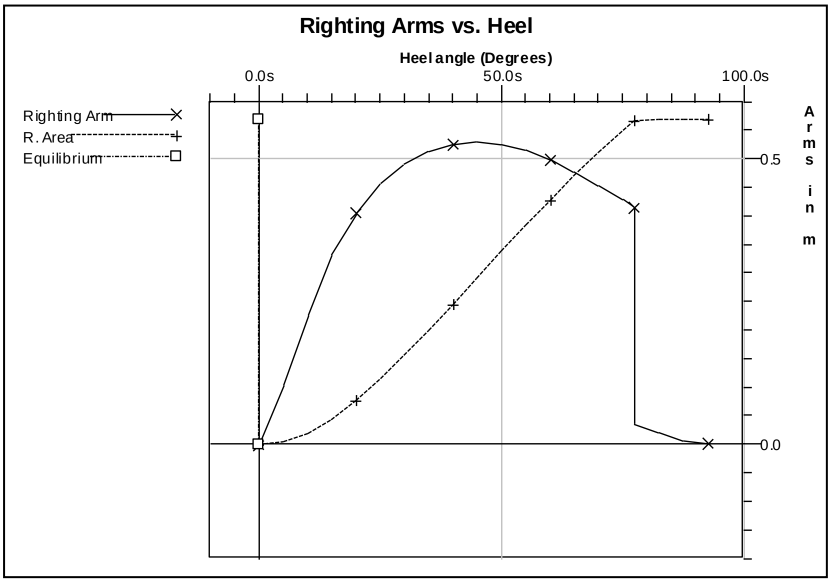
C.4.1 Ladefall 1: Schiff leer, Betriebsklar

TS NO 5 ELBE - Stabilitaetsberechnung Leckstabilitaet LADEFALL 1 /8.2.3.1/2/3

Floating Status

Draft FP	3.154 m	Heel	zero	GM(Solid)	1.210 m
Draft MS	3.232 m	Equil	Yes	F/S Corr.	0.000 m
Draft AP	3.311 m	Wind	Off	GM(Fluid)	1.210 m
Trim	aft 0.34 deg.	Wave	No	KMt	3.414 m
LCG	10.780f m	VCG	2.204 m	TPcm	0.71
Displacement	122.48 MT	WaterSpgr	1.025		





VORSCHRIFTEN 2009 /45/EG LASTFALL 1, Teil B. 8.2.3.1. u. 8.2.3.2

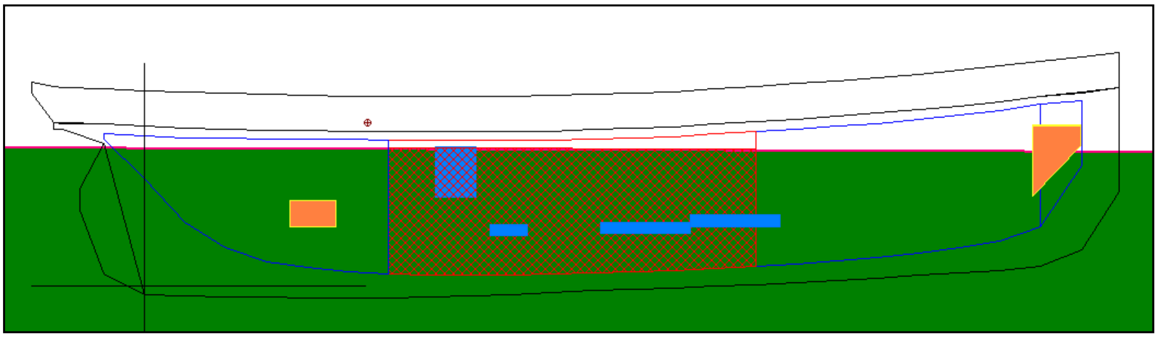
Limit		Min/Max	Actual	Margin	Pass
8.2.3.1	Area at RAzero up to 22°	>0.015m-R	0.091	0.076	Yes
8.2.3.2	Absolute Angle at RAzero	>15.00 deg	77.49	62.49	Yes
8.2.3.3	Righting Arm at MaxRA	>0.364 m	0.567	0.203	Yes

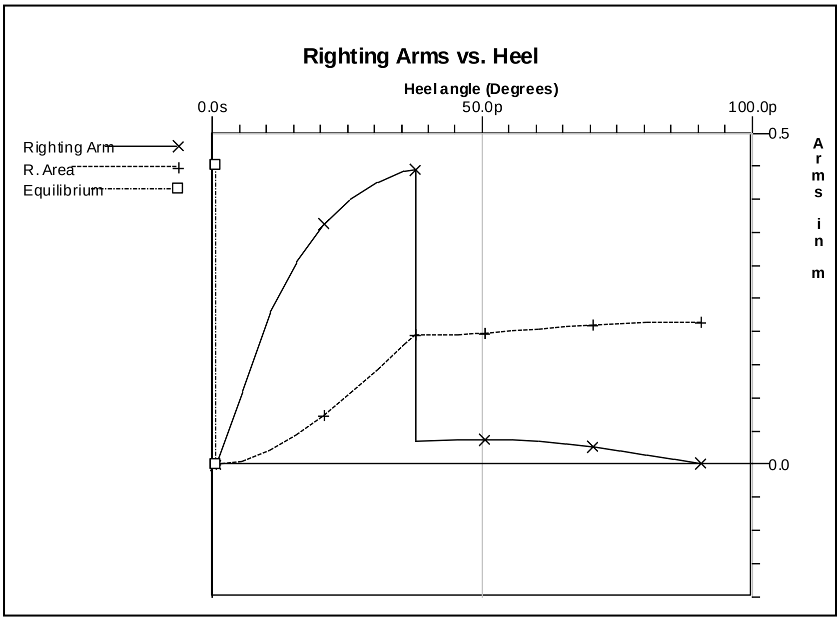
C.4.2 Ladefall 2: Reiseanfang, 98% Vorräte

TS NO 5 ELBE - Stabilitaetsberechnung Leckstabilitaet LADEFALL 2 /8.2.3.1/2/3

Floating Status

Draft FP	3.324 m	Heel	port 0.53 deg.	GM(Solid)	1.182 m
Draft MS	3.371 m	Equil	Yes	F/S Corr.	0.008 m
Draft AP	3.417 m	Wind	Off	GM(Fluid)	1.174 m
Trim	aft 0.20 deg.	Wave	No	KMt	3.454 m
LCG	10.823f m	VCG	2.272 m	TPcm	0.73
Displacement	132.29 MT	WaterSpgr	1.025		





VORSCHRIFTEN 2009 /45/EG LASTFALL 2, Teil B. 8.2.3.1. u. 8.2.3.2

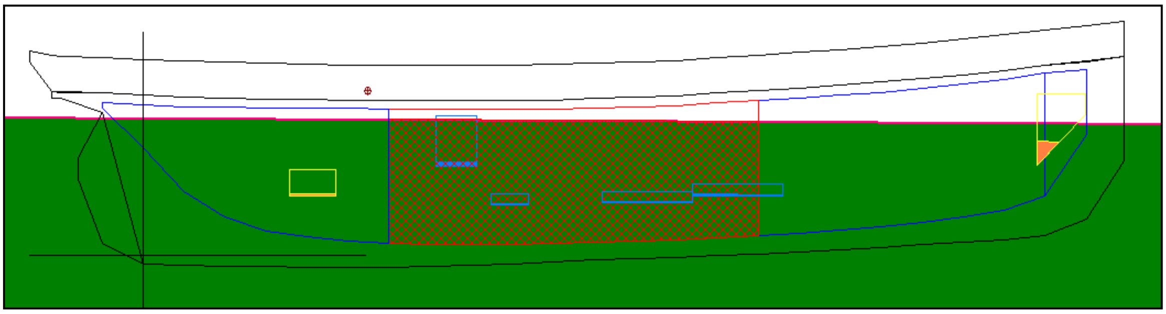
Limit		Min/Max	Actual	Margin	Pass
8.2.3.1	Area at RAzero up to 22°	>0.015m-R	0.082	0.067	Yes
8.2.3.2	Absolute Angle at RAzero	>15.00 deg	37.45	22.45	Yes
8.2.3.3	Righting Arm at MaxRA	>0.340 m	0.446	0.122	Yes

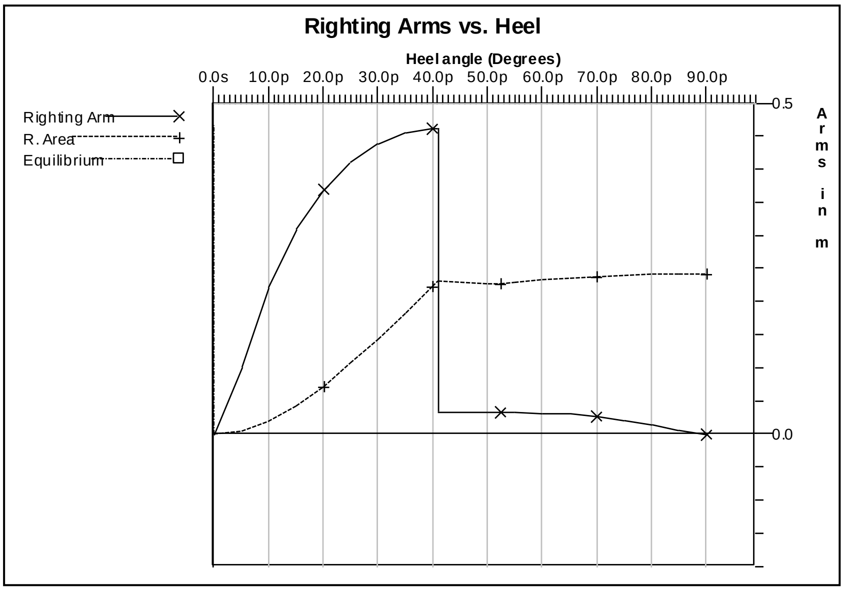
C.4.3 Ladefall 3: Reiseende, 10 % Vorräte

TS NO 5 ELBE - Stabilitaetsberechnung Leckstabilitaet LADEFALL 3 /8.2.3.1/2/3

Floating Status

Draft FP	3.223 m	Heel	port 0.06 deg.	GM(Solid)	1.154 m
Draft MS	3.304 m	Equil	Yes	F/S Corr.	0.011 m
Draft AP	3.384 m	Wind	Off	GM(Fluid)	1.143 m
Trim	aft 0.34 deg.	Wave	No	KMt	3.434 m
LCG	10.761f m	VCG	2.280 m	TPcm	0.72
Displacement	127.52 MT	WaterSpgr	1.025		





VORSCHRIFTEN 2009 /45/EG LASTFALL 3, Teil B. 8.2.3.1. u. 8.2.3.2

Limit		Min/Max	Actual	Margin	Pass
8.2.3.1	Area at RAzero up to 22°	>0.015m-R	0.085	0.070	Yes
8.2.3.2	Absolute Angle at RAzero	>15.00 deg	41,09	26.09	Yes
8.2.3.3	Righting Arm at MaxRA	>0.351 m	0.462	0.111	Yes

C.5 Hauptabteilung FLUTUNG HINTEN

Diese Hauptabteilung kann in allen Ladefällen 1.-3. allein geflutet werden. Die Flutbarkeit wird mit 85% gem. Vorgabe als Maschinenraum angenommen. Dieser Wert ist aufgrund der Anordnung der Einbauten als belastbar anzusehen.

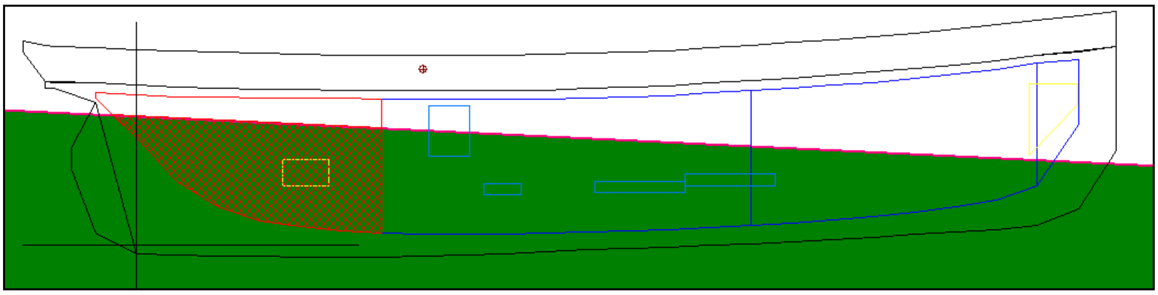
Es ist ein zusätzlicher Flutungspunkt für die Flutung des nächsten FLUTUNGSRAUMES MITTE eingegeben worden. Beim Erreichen dieses Punktes wird die Abteilung FLUTUNGSRAUM MITTE geflutet. Beim Erreichen dieses Flutungspunktes durch Krängung ist der Stabilitätsumfang erreicht, denn der aufrichtende Hebelarm reduziert sich ab diesem Krängungswinkel dramatisch.

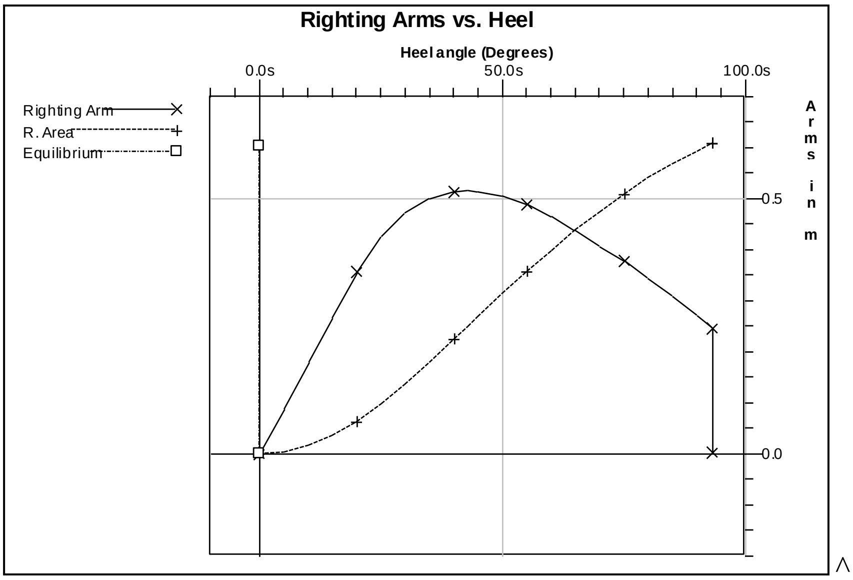
C.5.1 Ladefall 1: Schiff leer, Betriebsklar

TS NO 5 ELBE - Stabilitaetsberechnung Leckstabilitaet LADEFALL 1 /8.2.3.1/2/3

Floating Status

Draft FP	2.009 m	Heel	zero	GM(Solid)	1.020 m
Draft MS	2.652 m	Equil	Yes	F/S Corr.	0.000 m
Draft AP	3.296 m	Wind	Off	GM(Fluid)	1.020 m
Trim	aft 2.76 deg.	Wave	No	KMt	3.223 m
LCG	10.780f m	VCG	2.204 m	TPcm	0.84
Displacement	122.48 MT	WaterSpgr	1.025		





VORSCHRIFTEN 2009 /45/EG LASTFALL 1, Teil B. 8.2.3.1. u. 8.2.3.2

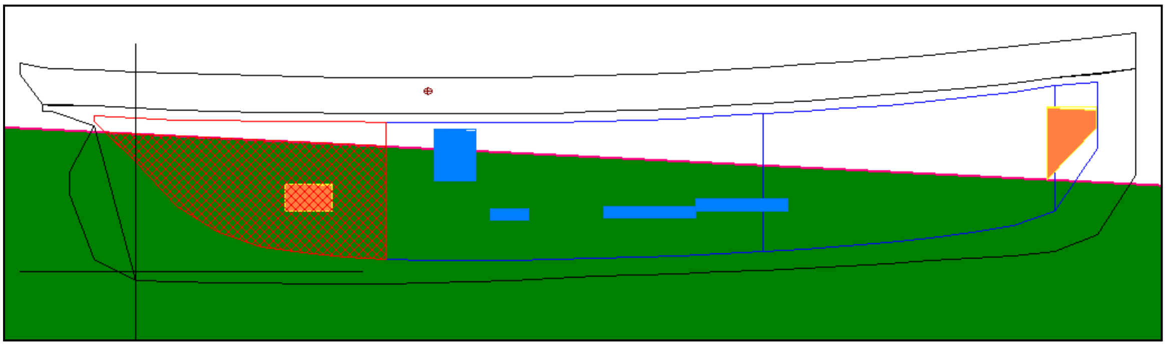
Limit		Min/Max	Actual	Margin	Pass
8.2.3.1	Area at RAzero up to 22°	>0.015m-R	0.076	0.061	Yes
8.2.3.2	Absolute Angle at RAzero	>15.00 deg	93,14	78.14	Yes
8.2.3.3	Righting Arm at MaxRA	>0.364 m	0.515	0.151	Yes

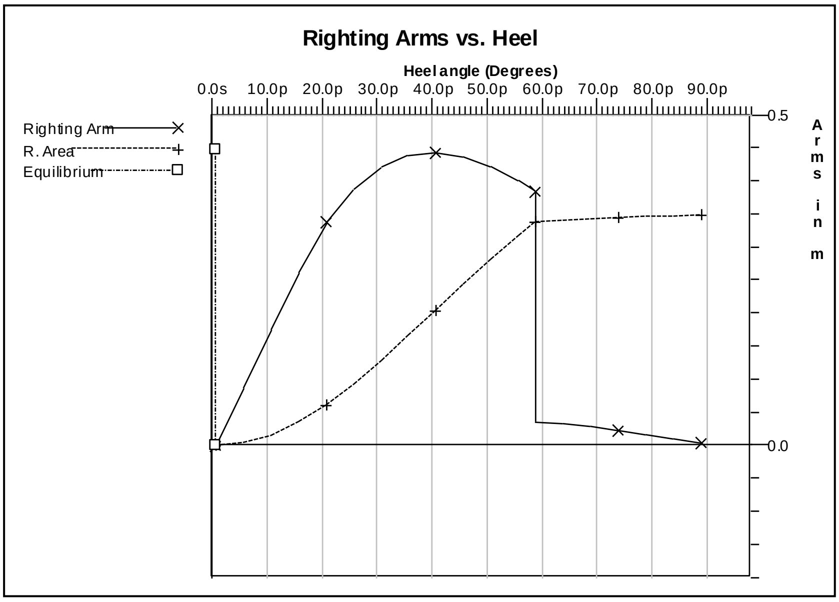
C.5.2 Ladefall 2: Reiseanfang, 98% Vorräte

TS NO 5 ELBE - Stabilitaetsberechnung Leckstabilitaet LADEFALL 2 /8.2.3.1/2/3

Floating Status

Draft FP	2.099 m	Heel	port 0.66 deg.	GM(Solid)	0.975 m
Draft MS	2.771 m	Equil	Yes	F/S Corr.	0.002 m
Draft AP	3.444 m	Wind	Off	GM(Fluid)	0.973 m
Trim	aft 2.88 deg.	Wave	No	KMt	3.246 m
LCG	10.822f m	VCG	2.272 m	TPcm	0.85
Displacement	132.29 MT	WaterSpgr	1.025		





VORSCHRIFTEN 2009 /45/EG LASTFALL 2, Teil B. 8.2.3.1. u. 8.2.3.2

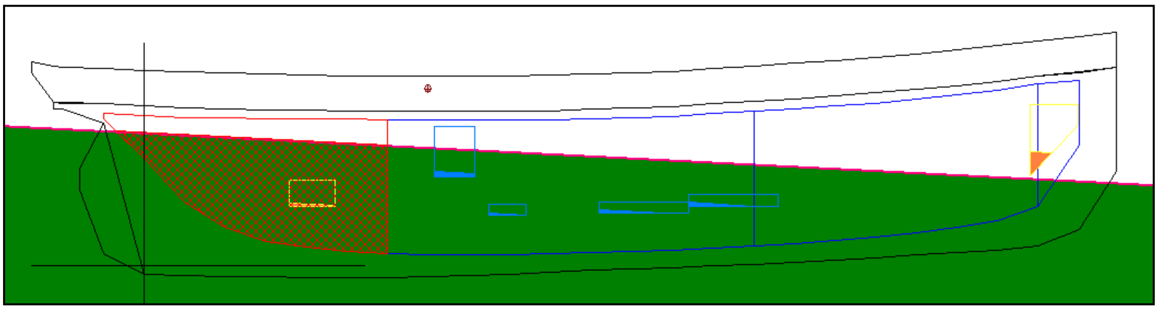
Limit	Min/Max	Actual	Margin	Pass
8.2.3.1 Area at RAzero up to 22°	>0.015m-R	0.069	0.054	Yes
8.2.3.2 Absolute Angle at RAzero	>15.00 deg	58.80	43.80	Yes
8.2.3.3 Righting Arm at MaxRA	>0.340 m	0.443	0.103	Yes

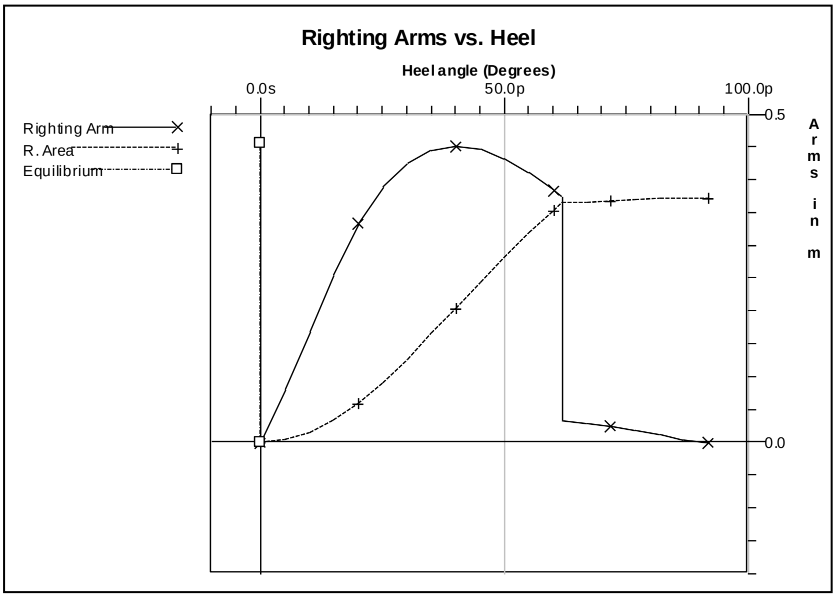
C.5.3 Ladefall 3: Reiseende, 10 % Vorräte

TS NO 5 ELBE - Stabilitaetsberechnung Leckstabilitaet LADEFALL 3 /8.2.3.1/2/3

Floating Status

Draft FP	2.023 m	Heel	port 0.07 deg.	GM(Solid)	0.959 m
Draft MS	2.717 m	Equil	Yes	F/S Corr.	0.003 m
Draft AP	3.411 m	Wind	Off	GM(Fluid)	0.956 m
Trim	aft 2.97 deg.	Wave	No	KMt	3.238 m
LCG	10.760f m	VCG	2.280 m	TPcm	0.84
Displacement	127.52 MT	WaterSpgr	1.025		





VORSCHRIFTEN 2009 /45/EG LASTFALL 3, Teil B. 8.2.3.1. u. 8.2.3.2

Limit		Min/Max	Actual	Margin	Pass
8.2.3.1	Area at RAzero up to 22°	>0.015m-R	0.071	0.056	Yes
8.2.3.2	Absolute Angle at RAzero	>15.00 deg	61.79	46.79	Yes
8.2.3.3	Righting Arm at MaxRA	>0.351 m	0.452	0.101	Yes

C.6 Zusammenfassende Bewertung der stabiltätsrelevanten Kriterien und Anforderungen an die Leckstabilität des TS „ELBE NO. 5“ gem. Richtlinie 2009/45/EG, Kapitel II-1, Teil B

Bei der Bewertung wird davon ausgegangen, dass es entsprechend der vorliegenden Berechnungen mindestens drei wasserdichte Schotten bis zum Hauptdeck gibt:

Vorschrift	Forderung	Situation “No.5 ELBE”	Pass ?
2. Wasserdichte Unterteilung	Schotten bis zum Schottendeck	Hauptdeck = Schottendeck	Ja
3.1 Flutbare Länge	Definition Tauchgrenze	3.2, 3.3=NA	Ja
4. Zulässige Länge der Abteilungen	ZL=FL*AF	ZL=FL	Ja
5. Flutbarkeit unterhalb Tauchgrenze	Faktoren für Flutbarkeit	s. 8.3	Ja
6. Abteilungsfaktor	AF= 1,0 bei < 400 Pers.	1,0, 50 Pers	Ja
7.6 Kriterien für Unterteilung	Hauptschott mit Stufe: Beide betreffenden Abteilungen		NA
8.1.1 Kriterium für Stabilität bei Flutung	Die Stabilität in den drei Ladefällen im Intaktzustand muss bei Flutung einer Hauptabteilung mit der Flutbaren Länge ausreichend sein.	AF= 1 für Hauptabteilungen FLUTUNG VORNE FLUTUNG MITTE FLUTUNG HINTEN	Ja
8.1.2 Kriterium für Stabilität bei Flutung mit Stufe im Hauptschott	Die Stabilität in den drei Ladefällen im Intaktzustand muss bei Flutung zweier benachbarter Hauptabteilungen mit der Flutbaren Länge ausreichend sein.	Hauptabteilung: FLUTUNG VORNE FLUTUNG MITTE FLUTUNG HINTEN	NA
8.1.3 Abteilungsfaktor	AF=0,5	NA	NA
8.2.1 Allgem. Berechnungen	Gem. 3,4,6	Durchgeführt	Ja
8.2.2 Trennwände in den Hauptabteilungen	Berücksichtigung in den Berechnungen	NA	NA
8.2.3 Kriterien für Stabilitätsumfang	Berechnung für jeden Lastfall und jede Flutung	FLUTUNG VORNE FLUTUNG MITTE FLUTUNG HINTEN	Ja Ja Ja

8.2.3.1 Stabilitätsumfang 8.2.3.2 Fläche unter Hebelarmkurve 8.2.3.3 GZ min	der entsprechenden Hauptabteilung		
	> 15°	Berechnung	Ja
	> 0,015 m-rad	Berechnung	Ja
	>GZ min	Berechnung	Ja
8.2.4.-6. Kriterien für weitergeh. Flutung	Grad der Reduzierung von GZ	Berechnung	NA
8.3 Flutbarkeitswerte	Gem. Tabelle	In Berechnungen berücksichtigt	Ja
8.4 Ausdehnung des Schadens 8.4.1 Längenausdehnung			
	Kleinerer Wert: 3m+3%L oder 10m+10%L	Berechnung	Ja
8.4.2 Querausdehnung 8.4.3 Vertikal 8.4.4 Ungünstige Ausdehnung	S=B/5	Berechnung	Ja
	Senkrecht von der Basis unbegrenzt aufwärts	Berechnung	Ja
	Zu rechnen mit schlechteren Ergebnissen bei Ungünstiger Ausdehnung	Berechnung	Ja
8.5.-6. Unsymmetrische Flutung	Sonderkriterien	NA	NA
8.7.-8. Stabilitätsunterlagen für Kapitän	Bewertung der Stabilität zur Bestimmung der max. Eintauchung	Nicht an Bord vorhanden	Nein
8.9. Tiefgangsmarken an Bug und Heck	Zur Bewertung der Stabilität und der max., Eintauchung	Nicht vorhanden	Nein
8.10 Anforderung an Kapitän	Berechnung von Trimm und Stabilität mit Stabilitäsrechner oder anderen Hilfsmitteln.	Nicht an Bord vorhanden	Nein
8.11.-12. Anforderung an die Verwaltung	Lockerung der Vorschriften in Bezug auf Wert GZ und anderer verhältnismäßiger Kriterien	NA	NA
9.1 Position Vorpiek- oder	Wasserdicht bis zum Schottendeck	Nicht vorhanden	Nein

Kollisionsschott	Abstand v. VL: Mind: 5%: 1,2m Höchstens: 3m +5%= 4,2m		
9.8 Stevenrohr u. Wellenstopfbuchse	Seperater wasserdichter Raum	Wellenstopfbuchse liegt im Maschinenraum	Nein
10.1.1 Doppelboden	Schiffe < 61m: DB von Maschinenraum bis Vorpiekschott	Kein Doppelboden vorhanden	Nein
10.1.5 Anforderung an die Verwaltung wg. Doppelboden	Lockerung der Vorschriften in Bezug Doppelboden bei auf Wert Unterteilungsfaktor 0,5.	Unterteilungsfactor = 1,0	NA
11.1 Markierung Mittschiffs	Kennzeichnung der Ladelinie für max. Schottentiefgang	Nicht vorhanden	Nein
12.1 Dimensionierung der Längs- u. Querschotten	Gegen max. Druck bei Erreichen der Tauchgrenze	Nicht vorhanden	Nein
13. Wasserdichte Öffnungen in Schotten	Schiebtür in Maschinenraumfrontschott Muss dieser Vorschrift 13. und insbesondere 13.5 und 13.5.3 entsprechen	Nicht vorhanden	Nein
15. Öffnungen in der Außenhaut	Unterhalb der Tauchgrenze	Nicht bekannt!	?
16. Wasserdichtigkeit	Außenhaut u. Schottendeck Oberhalb der Tauchgrenze	Nicht bekannt!	?
18. Aktuelle Stabilitätsunterlagen	Unterlagen auf Basis eines überwachten Krängungsversuches	Vorhanden	Ja
19. Lecksicherheitspläne	Unterlagen zur Instruktion der Schiffsleitung	Nicht vorhanden	Nein
21. Kennzeichnung wasserdichte Türen	Nachweis der regelmäßigen Prüfung der Türen	Nicht vorhanden	Nein

Unter Berücksichtigung der Ergebnisse des Teils B. zur Intaktstabilität und den hier getroffenen Annahmen ergeben die Ergebnisse dieser Berechnung und Bewertung, dass das TS „NO. 5 ELBE““ die Anforderungen zur Leckstabilität der Richtlinie 2009/45/EG unter folgenden Bedingungen erfüllen würde:

- Mit dem Einbau von zwei wasserdichten Schotten mit Schotttüren in den Bereichen Spt. 6 und Spt 15 kann ein 1-Abteilungstatus mit den Kriterien für die hier geforderten Lastfälle erreicht werden.
- Ein Kollisionsschott, angeordnet gem. den Forderungen der Vorschriften, ist zur Aufrechterhaltung der Schwimmfähigkeit im Leckfall dann nicht notwendig, wenn ein wasserdichtes Schott auf Spt. 15 eingebaut wird.
- Ein Doppelboden vom Spt. 6 bis Spt. 15 ist für zur Aufrechterhaltung der Schwimmfähigkeit im Leckfall nicht notwendig. Aufgrund der Konstruktion des starken S-Spantes mit Kiel ist der Doppelboden als Schutz gegen Grundberührung nur bedingt erforderlich und in dieser Holzbauweise auch konstruktiv kaum realisierbar.
- Die allgemeinen Anforderungen zu Stabilitätsunterlagen an den Kapitän, Lecksicherheitspläne, Ladelinien, Konstruktion der Schotten und wasserdichte Türen müssen erfüllt werde
- Die konstruktive Umsetzung zur Herstellung von wasserdichten Schotten bei diesem Schiff ist nicht Bestandteil dieser Untersuchung. Massen- und Schwerpunktsveränderungen durch einen Einbau von wasserdichten Schotten sind in diesen Berechnungen nicht berücksichtigt worden.

Das Schiff würde bei dem Volllaufen von jeweils einer Hauptabteilung immer schwimmfähig bleiben 1und die geforderten Stabilitätskriterien in den drei untersuchten Ladefällen erfüllen.

9.3 Preliminary safety certificates with deletions and without seal

Gebührenbescheid gefertigt
am: 6.6.19 VC

Akte

Bundesrepublik Deutschland
Federal Republic of Germany

VORLÄUFIGES
SICHERHEITSZEUGNIS FÜR TRADITIONSSCHIFFE
Preliminary
Safety Certificate for Traditional Vessels

Ausgestellt im Namen der Regierung der
BUNDESREPUPLIK DEUTSCHLAND durch die
BERUFSGENOSSENSCHAFT VERKEHRSWIRTSCHAFT POST-LOGISTIK
TELEKOMMUNIKATION
nach den Vorschriften der Anlage 1a Teil 3
SCHIFFSSICHERHEITSVERORDNUNG (SchSV - 1998)

Issued under the authority of the Government of the
FEDERAL REPUBLIC of GERMANY by
BERUFSGENOSSENSCHAFT VERKEHRSWIRTSCHAFT POST-LOGISTIK
TELEKOMMUNIKATION
under the provisions of the annex 1a part 3
ORDINANCE FOR THE SAFETY OF SEAGOING SHIPS - 1998

Name des Traditionsschiffes .... **NO. 5 ELBE**
Name of traditional vessel

Unterscheidungssignal .... **DANF**
Distinctive number or letters

Heimathafen .... **Hamburg**
Port of registry

Länge in Metern[1] **23,84**
Length in metres[1]

Baujahr **1881**
Year of construction

Zugelassene Personenzahl .... **17** **Mehrtagesfahrten** *Overnight-trips* **50** **Tagesfahrten**[2] *Daytrips*[2]
Number of persons the vessel is certified to carry

Fahrzeugart .... **Segelschiff**
Type of vessel *Sailing Vessel*

Fahrtgebiet[3] .... **Fahrt in küstennahen Seegewässern**
Range of trade[3] *Trade in near coastal waters*

Dieses Zeugnis ist durch ein Ausrüstungsverzeichnis ergänzt.
This certificate is supplemented by a record of equipment.

---

[1] **Vermessungslänge gem. Freibordübereinkommen. Für Traditionsschiffe mit weniger als 24 m Vermessungslänge gilt die Rumpflänge L_H nach DIN EN ISO 8666**
Waterline length as calculated by load line regulations. For Traditional vessels of less than 24m lwl the length of hull L_H according to DIN EN ISO 8666 applies

[2] **Besondere Bedingungen gemäß Nr.6**
Special conditions according no.6

[3] **Kein international gültiges Zeugnis. Auslandfahrt nur mit Zustimmung des Hafenstaates**
Certificate valid only for domestic voyages. International voyages only with approval of Port State

Vorläufiges Sicherheitszeugnis für Traditionsschiffe 05/2018

Hiermit wird bescheinigt, dass
This is to certify, that:

1 **das Traditionsschiff in Übereinstimmung mit den anzuwendenden Vorschriften der Schiffssicherheitsverordnung Anlage 1a Teil 3 besichtigt worden ist;**
the traditional vessel has been surveyed in accordance with the provisions of the Ordinance for the Safety of Seagoing Ships annex 1a part 3;

2 **das Traditionsschiff nach vorläufiger Prüfung den Anforderungen der Schiffssicherheitsverordnung Anlage 1a Teil 3 entspricht;**
based on a preliminary assessment the traditional vessel complies with the requirements of the provisions of the Ordinance for the Safety of Seagoing Ships annex 1a part 3;
Die Bestimmungen des Kap. 2, Abschnitt der SchSV, Anlage 1a, Teil 3 werden noch nicht erfüllt.
The provisions of Ch.2, part 1 pf SchSV, app. 1a, part 3 are not yet met.

3 **das Traditionsschiff mit Lichtern, Signalkörpern, Vorrichtungen zur Abgabe von Schall- und Notsignalen in Übereinstimmung mit den Anforderungen der Internationalen Regeln zur Verhütung von Zusammenstößen auf See in der jeweils gültigen Fassung ausgerüstet ist;**
the traditional vessel is provided with lights, shapes, means of making sound signals and distress signals in accordance with the requirements of the International Regulations for Preventing Collisions at Sea in force;.

4 **Ausnahmen:** --
Exemptions:

5 **Nebenbestimmungen:** --
Incidental Provisions:

6 **Besondere Bedingungen für Tagesfahrten:** **zutreffend**
Particular conditions for daytrips[4]: *applicable*

In den Monaten April bis Oktober dürfen bei Windstärken von höchstens 5 Bft. zwischen Sonnenaufgang und Sonnenuntergang Tagesfahrten von höchstens 14 Stunden Dauer mit bis zu 50 Personen an Bord bis zu einer Distanz von höchstens 20 Seemeilen von der Küstenlinie bei mittlerem Hochwasser ~~und Seemeilen von einem sicheren Hafen oder Ankerplatz in Seegebieten durchgeführt werden, in denen während des o.g. Zeitraumes die Wahrscheinlichkeit, eine m überschreitende kennzeichnende Wellenhöhe anzutreffen, unter 10 v.H. liegt.~~
Bei aufkommendem Starkwind oder bei Sturm- oder Starkwindwarnung müssen unverzüglich geschützte Gewässer aufgesucht oder der nächste Hafen angelaufen werden.
From April until Oktober trips of max. 14 hours duration are permitted with winds not exceeding windforce 5 Bft. between sunrise and sunset with up to 50 persons on board in sea areas, ~~where the probability of exceeding m significant wave height is smaller than 10 % over the a.m. restricted period, in the course of which the vessel is at no time more than nautical miles from a safe haven~~ or anchorage not more than 20 nautical miles from the line of the coast at mean high water. When stronger winds are arising or a warning of stronger winds is circulated sheltered waters or the nearest haven has to be made for immediately.

Bedingungen:
Conditions:

- Es findet sich unter Deck für jede Person ein geschützter Aufenthalt,
  Sheltered space under deck is available for each person on board,
- für jede Person an Bord wird eine Rettungsweste plus 10 v.H. Reserve mitgeführt,
  a life jacket is provided for each person on board and, in addition, a number of life jackets for not less than 10% of the total number of persons on board,
- für jede Person an Bord ist ein Platz in einem Rettungsfloß vorgesehen
  the liferafts carried on board have the capacity to accommodate the total number of persons on board.

Vorläufiges Sicherheitszeugnis für Traditionsschiffe 05/2018

Abschlussdatum der Besichtigung, auf der dieses Zeugnis beruht 23.05.2019
Completion date of the survey on which this certificate is based

Dieses Zeugnis gilt vorbehaltlich der Zwischenbesichtigungen bis 16.09.2021
This certificate is valid until …………………………… subject to approval by intermediate surveys.

Ausgestellt in *Issued at* **Hamburg** **(Ort der Ausstellung)** *(Place of issue of certificate)* **am** *the* **29.05.2019** **(Datum der Ausstellung)** *(Date of issue)*

(Siegel)
(Seal)

BERUFSGENOSSENSCHAFT VERKEHRSWIRTSCHAFT
POST-LOGISTIK TELEKOMMUNIKATION
- [redacted]

(Signature)

Vorläufiges Sicherheitszeugnis für Traditionsschiffe 05/2018

9.4 Preliminary safety certificate without deletions and with seal

Bundesrepublik Deutschland
Federal Republic of Germany

VORLÄUFIGES
SICHERHEITSZEUGNIS FÜR TRADITIONSSCHIFFE
Preliminary
Safety Certificate for Traditional Vessels

Ausgestellt im Namen der Regierung der
BUNDESREPUPLIK DEUTSCHLAND durch die
BERUFSGENOSSENSCHAFT VERKEHRSWIRTSCHAFT POST-LOGISTIK TELEKOMMUNIKATION
nach den Vorschriften der Anlage 1a Teil 3
SCHIFFSSICHERHEITSVERORDNUNG (SchSV - 1998)

Issued under the authority of the Government of the
FEDERAL REPUBLIC of GERMANY by
BERUFSGENOSSENSCHAFT VERKEHRSWIRTSCHAFT POST-LOGISTIK TELEKOMMUNIKATION
under the provisions of the annex 1a part 3
ORDINANCE FOR THE SAFETY OF SEAGOING SHIPS - 1998

Name des Traditionsschiffes .... **NO. 5 ELBE**
Name of traditional vessel

Unterscheidungssignal .... **DANF**
Distinctive number or letters

Heimathafen .... **Hamburg**
Port of registry

Länge in Metern[1] **23,84**
Length in metres[1]

Baujahr **1881**
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Zugelassene Personenzahl... **17** **Mehrtagesfahrten** *Overnight-trips* **50** **Tagesfahrten[2]** *Daytrips[2]*
Number of persons the vessel is certified to carry

Fahrzeugart.. **Segelschiff**
Type of vessel *Sailing Vessel*

Fahrtgebiet[3] .... **Fahrt in küstennahen Seegewässern**
Range of trade[3] *Trade in near coastal waters*

Dieses Zeugnis ist durch ein Ausrüstungsverzeichnis ergänzt.
This certificate is supplemented by a record of equipment.

1 **Vermessungslänge gem. Freibordübereinkommen. Für Traditionsschiffe mit weniger als 24 m Vermessungslänge gilt die Rumpflänge L_H nach DIN EN ISO 8666**
Waterline length as calculated by load line regulations. For Traditional vessels of less than 24m lwl the length of hull L_H according to DIN EN ISO 8666 applies

2 **Besondere Bedingungen gemäß Nr.6**
Special conditions according no.6

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Certificate valid only for domestic voyages. International voyages only with approval of Port State

Vorläufiges Sicherheitszeugnis für Traditionsschiffe 05/2018

Hiermit wird bescheinigt, dass
This is to certify, that:

1 **das Traditionsschiff in Übereinstimmung mit den anzuwendenden Vorschriften der Schiffssicherheitsverordnung Anlage 1a Teil 3 besichtigt worden ist;**
the traditional vessel has been surveyed in accordance with the provisions of the Ordinance for the Safety of Seagoing Ships annex 1a part 3;

2 **das Traditionsschiff nach vorläufiger Prüfung den Anforderungen der Schiffssicherheitsverordnung Anlage 1a Teil 3 entspricht;**
based on a preliminary assessment the traditional vessel complies with the requirements of the provisions of the Ordinance for the Safety of Seagoing Ships annex 1a part 3;
Die Bestimmungen des Kap. 2, Abschnitt der SchSV, Anlage 1a, Teil 3 werden noch nicht erfüllt.
the provisions of Ch.2, part 1 pf SchSV, app. 1a, part 3 are not yet met.

3 **das Traditionsschiff mit Lichtern, Signalkörpern, Vorrichtungen zur Abgabe von Schall- und Notsignalen in Übereinstimmung mit den Anforderungen der Internationalen Regeln zur Verhütung von Zusammenstößen auf See in der jeweils gültigen Fassung ausgerüstet ist;**
the traditional vessel is provided with lights, shapes, means of making sound signals and distress signals in accordance with the requirements of the International Regulations for Preventing Collisions at Sea in force;.

4 **Ausnahmen:**
Exemptions:

5 **Nebenbestimmungen:**
Incidental Provisions:

6 **Besondere Bedingungen für Tagesfahrten:** **zutreffend**
Particular conditions for daytrips[4]: *applicable*

In den Monaten April bis Oktober dürfen bei Windstärken von höchstens 5 Bft. zwischen Sonnenaufgang und Sonnenuntergang Tagesfahrten von höchstens 14 Stunden Dauer mit bis zu 50 Personen an Bord bis zu einer Distanz von höchstens 20 Seemeilen von der Küstenlinie bei mittlerem Hochwasser und Seemeilen von einem sicheren Hafen oder Ankerplatz in Seegebieten durchgeführt werden, in denen während des o.g. Zeitraumes die Wahrscheinlichkeit, eine m überschreitende kennzeichnende Wellenhöhe anzutreffen, unter 10 v.H. liegt.
Bei aufkommendem Starkwind oder bei Sturm- oder Starkwindwarnung müssen unverzüglich geschützte Gewässer aufgesucht oder der nächste Hafen angelaufen werden.
From April until Oktober trips of max. 14 hours duration are permitted with winds not exceeding windforce 5 Bft. between sunrise and sunset with up to 50 persons on board in sea areas, where the probability of exceeding m significant wave height is smaller than 10 % over the a.m. restricted period, in the course of which the vessel is at no time more than nautical miles from a safe haven or anchorage nor more than 20 nautical miles from the line of the coast at mean high water. When stronger winds are arising or a warning of stronger winds is circulated sheltered waters or the nearest haven has to be made for immediately.

Bedingungen:
Conditions:

- Es findet sich unter Deck für jede Person ein geschützter Aufenthalt,
  Sheltered space under deck is available for each person on board,
- für jede Person an Bord wird eine Rettungsweste plus 10 v.H. Reserve mitgeführt,
  a life jacket is provided for each person on board and, in addition, a number of life jackets for not less than 10% of the total number of persons on board,
- für jede Person an Bord ist ein Platz in einem Rettungsfloß vorgesehen
  the liferafts carried on board have the capacity to accommodate the total number of persons on board.

Abschlussdatum der Besichtigung, auf der dieses Zeugnis beruht **23.05.2019**
Completion date of the survey on which this certificate is based

Dieses Zeugnis gilt vorbehaltlich der Zwischenbesichtigungen bis **16.09.2021**
This certificate is valid until ………………………… subject to approval by intermediate surveys.

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(Seal)

BERUFSGENOSSENSCHAFT VERKEHRSWIRTSCHAFT
POST-LOGISTIK TELEKOMMUNIKATION
- Dienststelle Schiffssicherheit -

Vorläufiges Sicherheitszeugnis für Traditionsschiffe 05/2018

9.5 STCW Code for BRM

Spalte 1	Spalte 2	Spalte 3	Spalte 4
Befähigung	**Kenntnisse, Verständnis und Fachkunde**	**Verfahren für den Nachweis der Befähigung**	**Kriterien für die Beurteilung der Befähigung**
	den meteorologischen Daten auszuwerten		werden richtig ausgewertet und sachgerecht angewandt.
Gehen einer sicheren Brückenwache	*Wachdienst* Gründliche Kenntnisse über Inhalt, Anwendung und Zweck der Kollisionsverhütungsregeln von 1972 in ihrer jeweils geltenden Fassung Gründliche Kenntnis der Grundsätze für die Brückenwache Praktische Kenntnisse über die Routenplanung entsprechend den Allgemeinen Bestimmungen über die Routenplanung Fähigkeit zur Verwendung der durch Navigationsgeräte gewonnenen Daten für das Gehen einer sicheren Brückenwache Kenntnisse über Verfahren für das Führen eines Schiffes unter ausschließlicher Zuhilfenahme der technischen Ausrüstung ohne optische Sicht Fähigkeit zur Abgabe von Meldungen entsprechend den Allgemeinen Grundsätzen für Schiffsmeldesysteme sowie den einschlägigen VTS-Verfahren	Prüfung und Beurteilung von nachweisbaren Leistungen, die auf eine oder mehrere der nachstehenden Arten erbracht wurden: .1 anerkannte im regulären Dienstbetrieb gewonnene Erfahrung .2 anerkannte auf einem Ausbildungsschiff gewonnene Erfahrung .3 gegebenenfalls eine zugelassene Ausbildung am Simulator .4 eine zugelassene Ausbildung an Laborgeräten	Durchführung, Übergabe und Übernahme der Wache entsprechen allgemein anerkannten Grundsätzen und Verfahrensweisen. Es wird jederzeit und entsprechend allgemein anerkannten Grundsätzen und Verfahrensweisen ein gehöriger Ausguck gehalten. Lichter, Signalkörper und Schallsignale entsprechen den Vorschriften der Kollisionsverhütungsregeln von 1972 in ihrer jeweils geltenden Fassung und werden richtig erkannt. Häufigkeit und Umfang der Überwachung von Verkehr, Schiff und Umwelt entsprechen allgemein anerkannten Grundsätzen und Verfahrensweisen. Über alle Schiffsbewegungen und alle Tätigkeiten im Zusammenhang mit der Führung des Schiffes werden ordnungsmäßige Aufzeichnungen geführt. Die Zuständigkeit für die

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			jederzeit eindeutig festgelegt, auch für Zeiten der Anwesenheit des Kapitäns auf der Brücke und während das Schiff unter Lotsenberatung fährt.
	Effektiver Umgang mit den Ressourcen auf der Brücke Kenntnis der Grundsätze über den richtigen Umgang mit Ressourcen auf der Brücke, insbesondere .1 Einteilung und Aufgabenzuweisung sowie Priorisierung der zur Verfügung stehenden Mittel entsprechend ihrer Wichtigkeit .2 wirksame Verständigung .3 Durchsetzungsvermögen und Führungskompetenz .4 Bewusstsein für die momentane Lage und Aufrechterhaltung dieses Bewusstseins .5 Berücksichtigung der Erfahrungen der Mitarbeiter	Beurteilung von nachweisbaren Leistungen, die auf eine oder mehrere der nachstehenden Arten erbracht wurden: .1 eine zugelassene Ausbildung .2 anerkannte im regulären Dienstbetrieb gewonnene Erfahrung .3 eine zugelassene Ausbildung am Simulator	Der Ressourceneinsatz wird dem Erfordernis gerecht, notwendige Aufgaben in der ihrer Wichtigkeit entsprechenden richtigen Reihenfolge wahrzunehmen. Die Verständigung erfolgt in beiden Richtungen deutlich und eindeutig. Werden durch Reden oder Handeln Zweifel ausgelöst, so führt dies zu einem der Sache angemessenen kritischen Meinungsaustausch. Echtes Führungsverhalten wird als solches erkannt und anerkannt. Alle Besatzungsmitglieder im Decksbereich sind auf einem zutreffenden Wissensstand bezüglich des momentanen und des zu erwartenden Zustands des Schiffes, des zu steuernden Kurses sowie des äußeren Umfelds.

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