



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

Investigation Report 459/15

Serious Marine Casualty

**Collision on the Lower Elbe
between MV EENDRACHT and
MV TRANSCAPRICORN
on 26 November 2015**

14 July 2017

The investigation was conducted in conformity with the Law to improve safety of shipping by investigating marine casualties and other incidents (Maritime Safety Investigation Law – SUG) of 16 June 2002, amended most recently by Article 1 of 22 November 2011, BGBl. (Federal Law Gazette) I p. 2279.

According to said Law, the sole objective of this investigation is to prevent future accidents and malfunctions. 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.

Issued by:
Bundesstelle für Seeunfalluntersuchung – BSU
(Federal Bureau of Maritime Casualty Investigation)
Bernhard-Nocht-Str. 78
20359 Hamburg
Germany



Phone: +49 40 31908311
posteingang-bsu@bsh.de

Fax: +49 40 31908340
www.bsu-bund.de

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1 Summary

At 0528 on 26 November 2015¹, the Dutch-flagged EENDRACHT, sailing downstream on the Elbe, collided at high speed with the Gibraltar-flagged TRANSCAPRICORN, sailing upstream on the Elbe, at buoy 51 off the Oste estuary. Due to an abrupt course alteration to port by the EENDRACHT, she crossed the middle of the fairway and sailed across the TRANSCAPRICORN's bow, rendering a collision unavoidable. Rudder and engine manoeuvres implemented by each vessel made it possible to avoid an obtuse collision angle and prevent more severe damage. The two vessels scraped past each other. The TRANSCAPRICORN ran aground in mud in the process and had to be hauled clear with tug assistance. The EENDRACHT remained afloat. There were no casualties and no pollutants escaped.

¹ Unless stated otherwise, all times shown in this report are Central European Time (CET) = UTC + 1 hour.

2 FACTUAL INFORMATION

2.1 Photo



Figure 1: Photo of the EENDRACHT

2.2 Ship particulars

Name of ship:	EENDRACHT
Type of ship:	General cargo vessel
Nationality/Flag:	Netherlands
Port of registry:	Urk
IMO number:	9512783
Call sign:	PBMS
Owner:	Global Seatrade CV
Year built:	2009
Shipyard/Yard number:	Partner shipyard, Szczecin
Classification society:	Bureau Veritas
Length overall:	105.0 m
Breadth overall:	15.6 m
Gross tonnage:	2,981
Deadweight:	3,394 t
Draught (max.):	5.8 m
Engine rating:	3,680 kW
Main engine:	Wärtsilä 8L32
(Service) Speed:	18.0 kts
Hull material:	Steel
Hull design:	Double bottom

2.3 Voyage particulars

Port of departure:	Hamburg
Port of call:	Harlingen
Type of voyage:	Merchant shipping, international
Cargo information:	Unknown
Manning:	9
Draught at time of accident:	5.2 m
Pilot on board:	Yes

2.4 Photo



Figure 2: Photo of the TRANSCAPRICORN

2.5 Ship particulars

Name of ship:	TRANSCAPRICORN
Type of ship:	General cargo vessel
Nationality/Flag:	Gibraltar
Port of registry:	Gibraltar
IMO number:	9187928
Call sign:	ZDNJ4
Owner:	Transatlantic Rederi AB
Year built:	2000
Shipyard/Yard number:	Bodewes Shipyards, Hoogezand/588
Classification society:	Bureau Veritas
Length overall:	118.5 m
Breadth overall:	6.3 m
Gross tonnage:	4,871
Deadweight:	6,663 t
Draught (max.):	6.3 m
Engine rating:	3,840 kW
Main engine:	MaK 8M32
(Service) Speed:	14.0 kts
Hull material:	Steel
Hull design:	Double bottom

2.6 Voyage particulars

Port of departure:	From the sea
Port of call:	Tornio via the Kiel Canal
Type of voyage:	Merchant shipping, international
Cargo information:	Unknown
Manning:	9
Draught at time of accident:	6.2 m
Pilot on board:	Yes

2.7 Marine casualty or incident information

Type of marine casualty:	Serious marine casualty, collision
Date, time:	26/11/2015, 0528
Location:	Lower Elbe, Oste estuary
Latitude/Longitude:	ϕ 53°51.1'N λ 008°59.8'E
Ship operation and voyage segment:	Harbour mode
Place on board:	Fore sections
Human factors:	Yes, human error
Consequences (for people, ship, cargo, environment, other):	TRANSCAPRICORN grounded, no physical injuries, superficial damage, no pollutant discharge

Extract from Navigational Chart 46,
Federal Maritime and Hydrographic Agency (BSH)

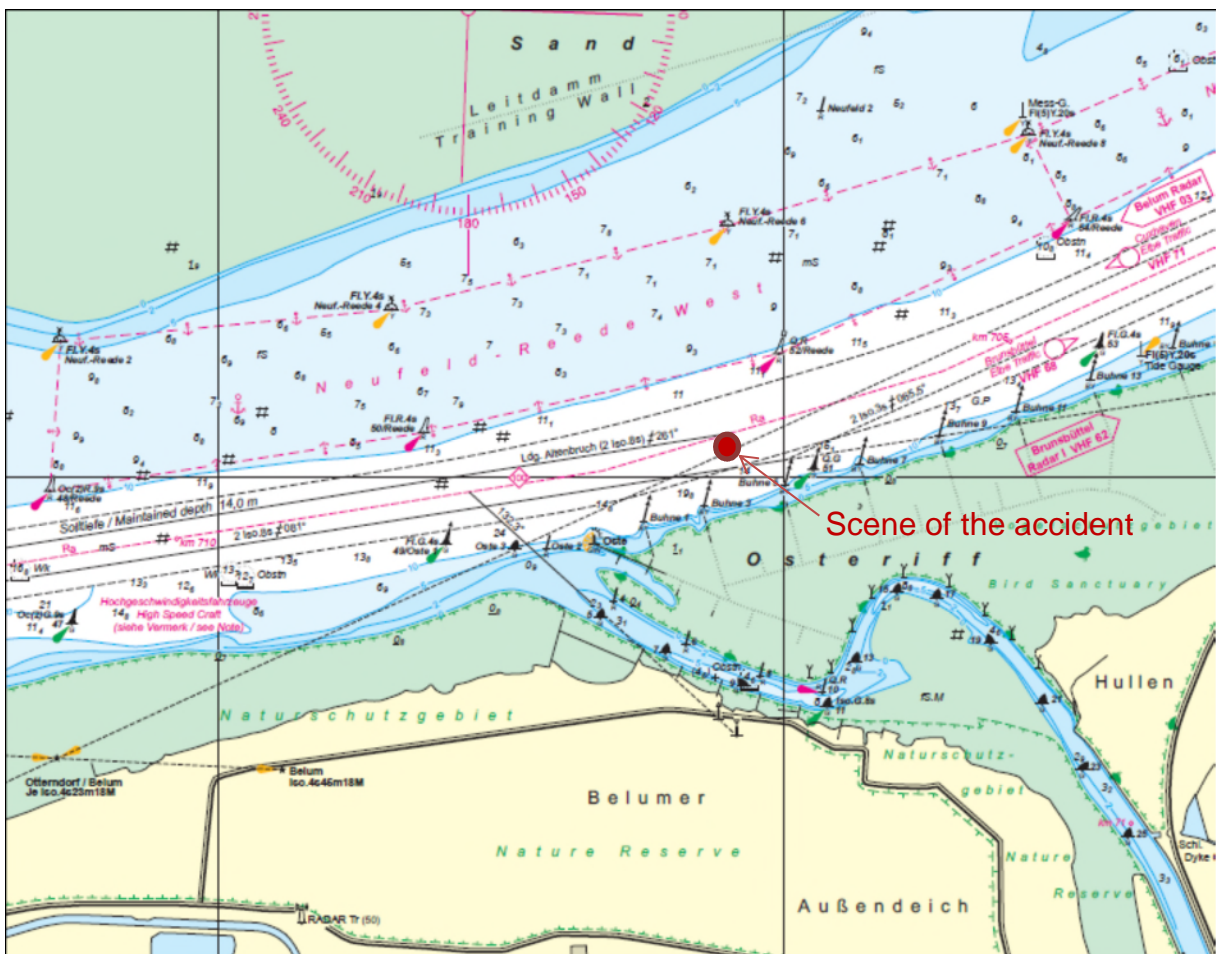


Figure 3: Navigational chart

2.8 Shore authority involvement and emergency response

Agencies involved:	Waterway Police (WSP) Cuxhaven, German Maritime Search and Rescue Association (DGzRS), Central Command for Maritime Emergencies (CCME), Taucher Otto Wulf (TOW)
Resources used:	BUERGERMEISTER BRAUER, NEUWERK HERMANN HELMS, TOW 3, TOW 5
Actions taken:	Traffic control, tug assistance
Results achieved:	TRANSCAPRICORN refloated

3 COURSE OF THE ACCIDENT AND INVESTIGATION

At 0850 on 26 November 2015, the WSP boat BUERGERMEISTER BRAUER advised the BSU's on-call service of a heavy collision on the Lower Elbe off the Oste estuary. The EENDRACHT, sailing downstream on the Elbe, collided at high speed with the TRANSCAPRICORN, sailing upstream on the Elbe, off buoy 51 at 0528. The scene of the accident was secured by the NEUWERK at the request of the CCME and by the DGzRS's rescue cruiser HERMANN HELMS. As a result of the collision, the TRANSCAPRICORN ran aground at groyne 3 and was unable to refloat again unassisted. The EENDRACHT remained afloat and anchored in the Neufeld-Reede roadstead at 0544. The TRANSCAPRICORN was refloated with tug (TOW 3 and TOW 7) assistance at 1002 and then also shifted to the Neufeld-Reede roadstead. There were no casualties and no pollutants escaped due to the collision. Owing to the superficial damage, the Ship Safety Division (BG Verkehr) issued a detention order and the two vessels sailed on to Cuxhaven at about midday.

The following account of the course of the accident is based on testimony given by the EENDRACHT's pilot on 30 November 2015. According to his certificate, the pilot had been appointed for about 5 months at the time of the accident.

The TRANSCAPRICORN and the EENDRACHT were sailing under pilotage in good visibility and weather conditions. A 2 Bft NW wind prevailed and the sea was calm. The sky was bright with 50 per cent cloud cover. An ebb current prevailed. The EENDRACHT was proceeding to sea from Hamburg. A pilot transfer took place in the Brunsbüttel Elbehafen port at 0506. Her heading (HDG) and speed through water (STW) were 268° and 6-7 kts respectively. The pilot, the master and a crew member were on the bridge. The heading on the gyrocompass corresponded with the true course. The pilot was operating the X-band radar system on the port side. The lubber line was adjusted properly. The system was set to a range of 1.5 nm, off-centred north-up, relative, and the VHF units were receiving on channels 68 and 71.

Once the Elbe pilot was released, the master enquired as to whether they could proceed at full ahead again. The sea pilot agreed, advising they would have to slow down again at buoy 54 for the passage of the dredger NJÖRD, which was operating off the Oste. The ship was steered on autopilot. At this point, only the master and the pilot were on the bridge. The autopilot executed the first significant course alteration at buoy 58a from 266° to 246° precisely and promptly without overriding. Proceeding at 16 kts STW and 19 kts speed over ground (SOG) in the spring ebb tide, the EENDRACHT was well north of the radar reference line near the dredged channel on the new course. The swell was weak.

The ECDIS indicated the NJÖRD below buoy 50/roadstead roughly on the radar reference line. Further downstream on the Elbe, the TRANSCAPRICORN was approaching well to the south of the radar reference line. The BBC FUJI was located between the buoys close to the Neufeld-Reede roadstead boundary. She indicated red with no significant movement and opened masthead lights.

According to the AIS, her status was laid-up. She was in the process of hoisting anchor and returning to the Neufeld-Reede roadstead upon request of the VTS centre. The EENDRACHT was on the northern perimeter of the channel at this point.

According to the pilot, the master was recommended to sail slightly closer to the radar reference line initially, and then back to starboard after the passage of the BBC FUJI, so as to pass the NJÖRD well to the north. Her speed was then reduced to 10 kts STW. In the meantime, the TRANSCAPRICORN had passed the NJÖRD. She was still located well into the middle of the southern half of the fairway. In the pilot's view a smooth passage of all vessels involved was thus ensured. At buoy 52, the master stated that he intended to switch to manual helm and control the ship himself, even though the pilot saw no need for this. At this point, 242° was set. The course was to be maintained a moment longer and then altered to starboard.

The master then switched the steering selector to manual. Immediately afterwards, the EENDRACHT made a hard turn to port. Hard to port was displayed on the rudder angle indicator. The ship heeled markedly to starboard and there was a risk of colliding with the TRANSCAPRICORN. The distance to her stood at 3 cables. It was no longer possible to stop in time. Consequently, the turn to port with hard-over rudder angle was maintained to avoid an obtuse angle in the imminent collision and move parallel to the TRANSCAPRICORN. The manoeuvre was effective for the most part because the TRANSCAPRICORN had altered her course to starboard. The collision then followed.

To begin with, the fore section of each vessel touched (starboard shoulder of the EENDRACHT and port shoulder of the TRANSCAPRICORN). The collision angle was about 40° and roughly SE was set on the EENDRACHT. The fore sections then parted and the two vessels touched each other again at their aft sections. The EENDRACHT's transom (starboard edge) touched the port aft section of the TRANSCAPRICORN (forward edge of the bridge). After the two vessels parted, the EENDRACHT moved full astern with her bow thruster set full power to port. This manoeuvre made it possible to stop and avoid running aground on the EENDRACHT. The collision was then reported to the VTS centre and arrangements made for her to shift to the Neufeld-Reede roadstead. At about 0600, the port anchor was let go in the Neufeld-Reede roadstead between buoys 6 and 52 with three shackles immersed.

The following brief statement of the owner is based on a letter from its legal counsel dated 21 April 2017.

Prior to the collision, the EENDRACHT's pilot altered her course by a few degrees to port with the autopilot due to the vessels on her starboard side. When the TRANSCAPRICORN came into sight, the master took charge of the helm and the pilot suggested making an attempt to pass the TRANSCAPRICORN's bow on the port side. At that point, the EENDRACHT was already on the other side of the radar reference line and the pilot reportedly told the master that the TRANSCAPRICORN

was proceeding improperly. The master set the controls to full astern immediately before the collision to prevent its consequences from being more severe.

The BSU is not in possession of statements concerning the course of the accident on the TRANSCAPRICORN from her crew. Inasmuch, it is not possible to give an account of this perspective here. According to the recordings of VTS Cuxhaven, the buoy at groyne 3 was at the stern of the grounded TRANSCAPRICORN. No pollutant discharge was found. The NEUWERK hauled in the buoy at groyne 3 as a precaution. At 1002, the TRANSCAPRICORN was hauled free by tugs (TOW 3 and TOW 7). She then anchored in the Neufeld-Reede roadstead west at 1047. In the early afternoon, the Ship Safety Division (BG Verkehr) allowed the EENDRACHT and the TRANSCAPRICORN to sail to Cuxhaven for further surveys. A port State control and a classification society survey were carried out on the two vessels on 27 November 2015.

The EENDRACHT was permitted to sail on to Harlingen for repairs, with due regard to the weather conditions. No conditions were imposed on the TRANSCAPRICORN. Apart from the collision damage, no deficiencies were found on either vessel in terms of manning or equipment. The EENDRACHT sustained dents with cracks in the bow section on the starboard bulwark and on the starboard side of the transom.



Figure 4: Damage to the EENDRACHT's fore section, Ship Safety Division (BG Verkehr)



Figure 5: Damage to the EENDRACHT's aft section, Ship Safety Division (BG Verkehr)

4 ANALYSIS

The BSU was provided with recordings from the TRANSCAPRICORN's voyage data recorder (VDR). The EENDRACHT did not have a carriage requirement and there was no statement from the two ship's commands or the TRANSCAPRICORN's pilot. Inasmuch, the BSU only had the investigations of WSP Hamburg with the outstation at Cuxhaven and the recorded data of VTS Cuxhaven to refer to. This included the radiotelephony recorded on VHF channel 71 (local radio channel), the superimposed AIS and radar data from the VTS, and the analysed AIS data from the WSP. The BSU commissioned the Federal Waterways Engineering and Research Institute (BAW) in Hamburg with preparing the data to form an overall picture with ship and shore-based recordings and a more in-depth analysis. The BAW also calculated the currents for the course of the accident using its PROPTTEL predictive model – an operational tidal modelling system – and showed them in its animation. The Ship Safety Division (BG Verkehr) conducted a port State control of each vessel in Cuxhaven and provided the reports to the BSU.

4.1 Analysis of the TRANSCAPRICORN's VDR

The radar sequence at a range of 1.5 nm off-centred shows the five-minutes leading up to the collision from the perspective of the TRANSCAPRICORN. The groyne echoes of Osteriff are visible in the southern part of the fairway (see above navigational chart). The northern part shows the red fairway buoys, which also form the southern boundary of the Neufeld-Reede West roadstead. The thick blue pilot trail shows the echo of the EENDRACHT on a permanently constant bearing to the TRANSCAPRICORN. The thin blue echo on the radar images is the track of the BBC FUJI and slightly closer to the lubber line of the TRANSCAPRICORN the NJÖRD. The variable range marker (or VRM) is set to 1,229 nm. According to the audio recordings, the hard to starboard command was issued at 052724, the first contact with the EENDRACHT was at 052757, and the second contact at 052810. The full astern command was issued at 052820.

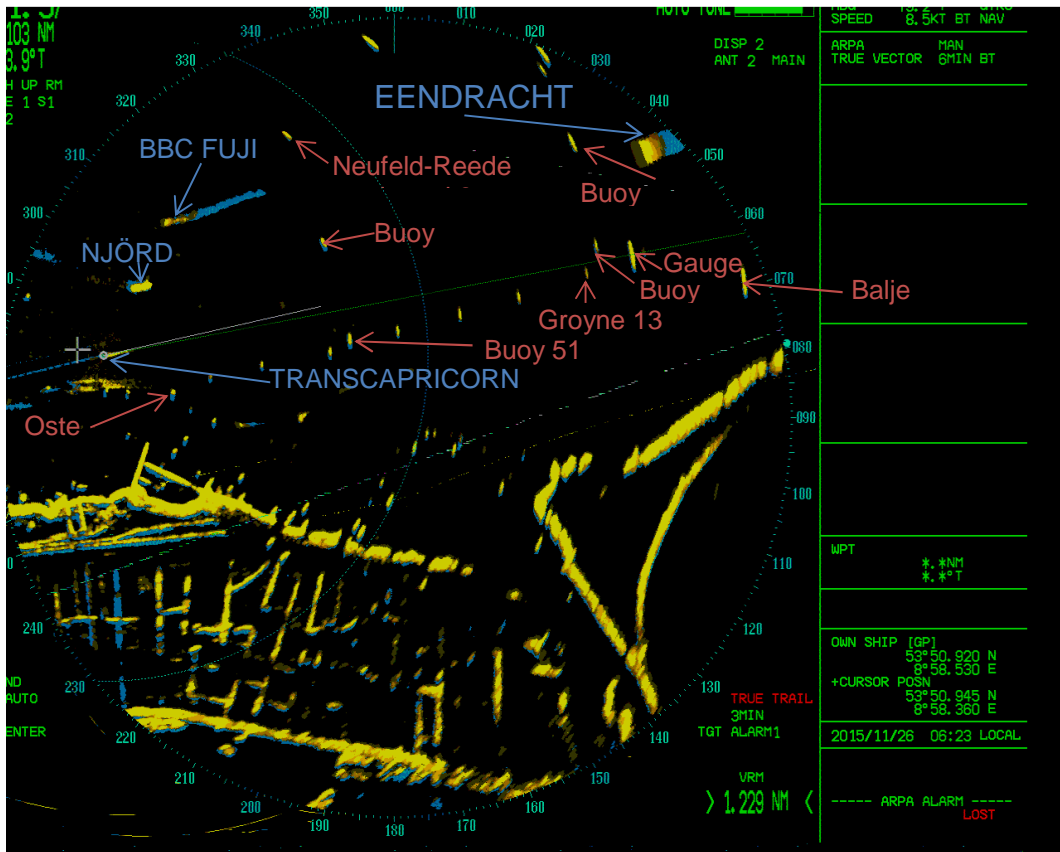


Figure 6: Radar at 052319

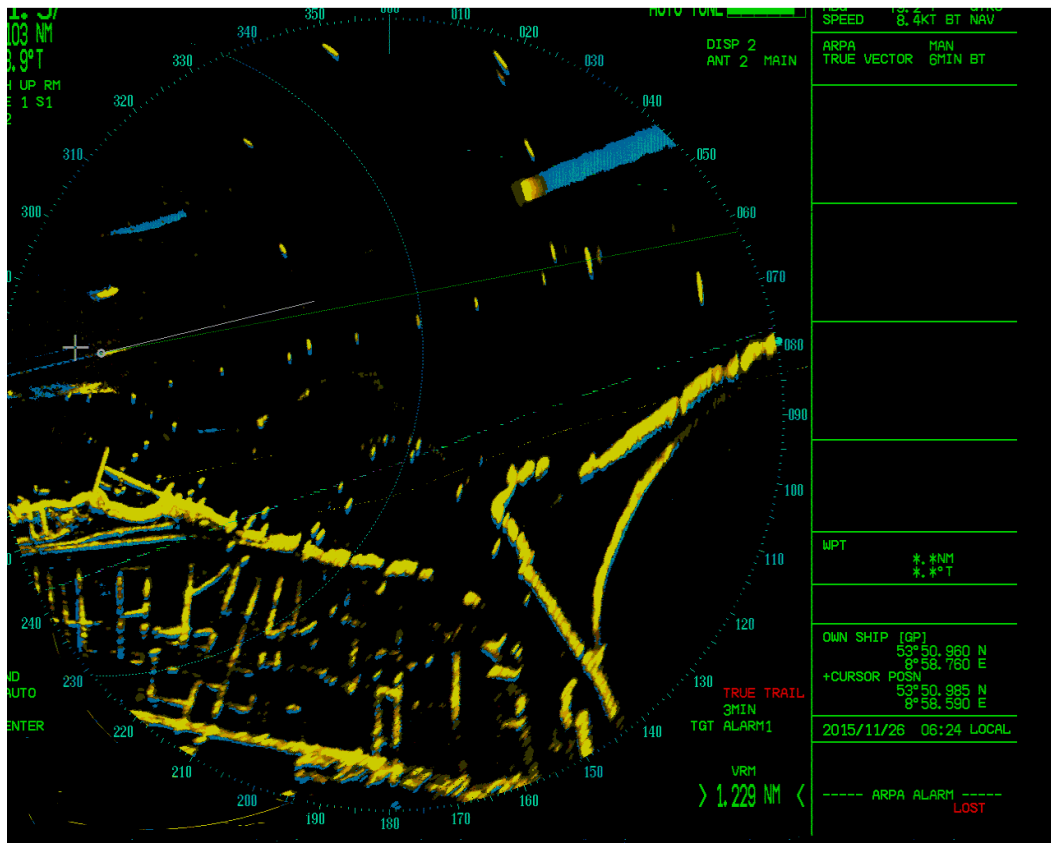


Figure 7: Radar at 052419

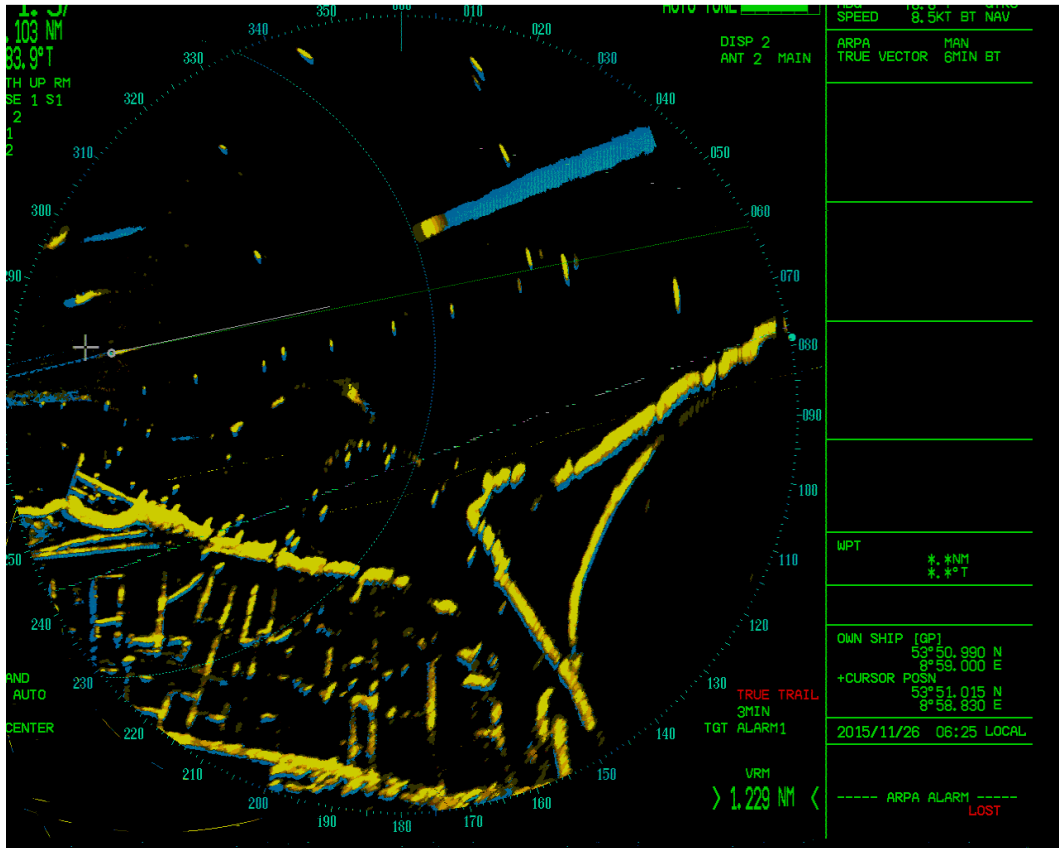


Figure 8: Radar at 052519

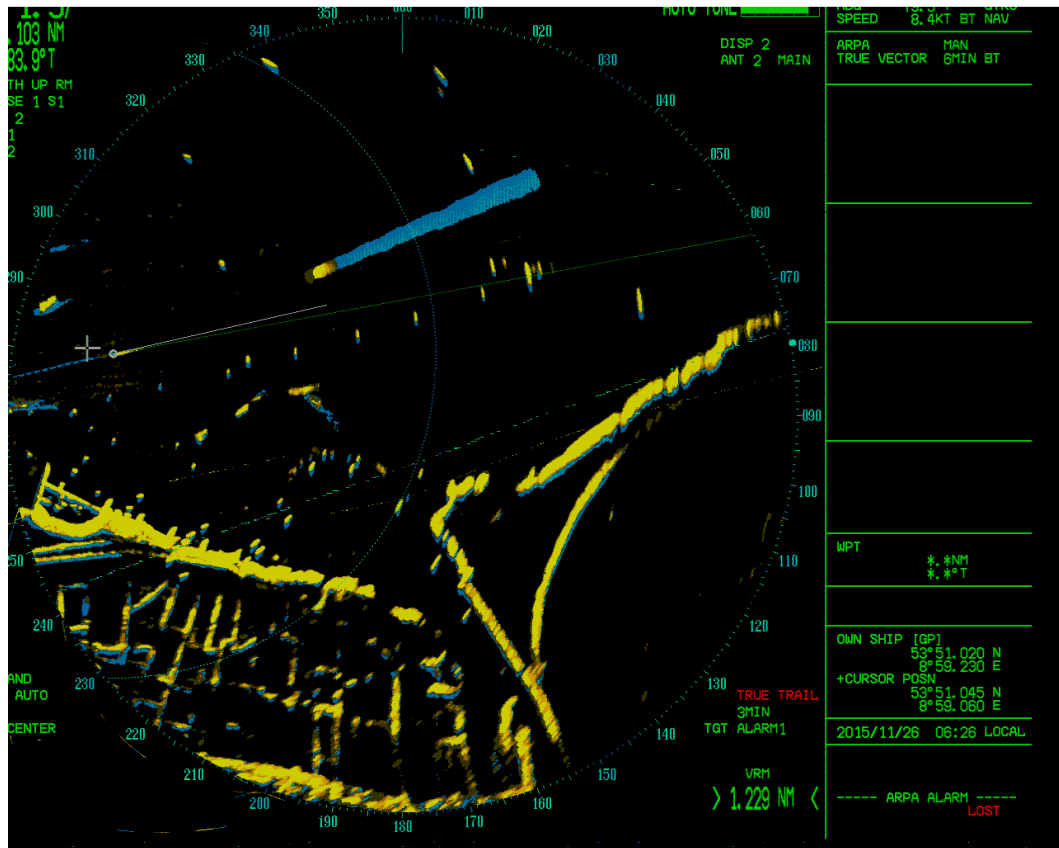


Figure 9: Radar at 052619

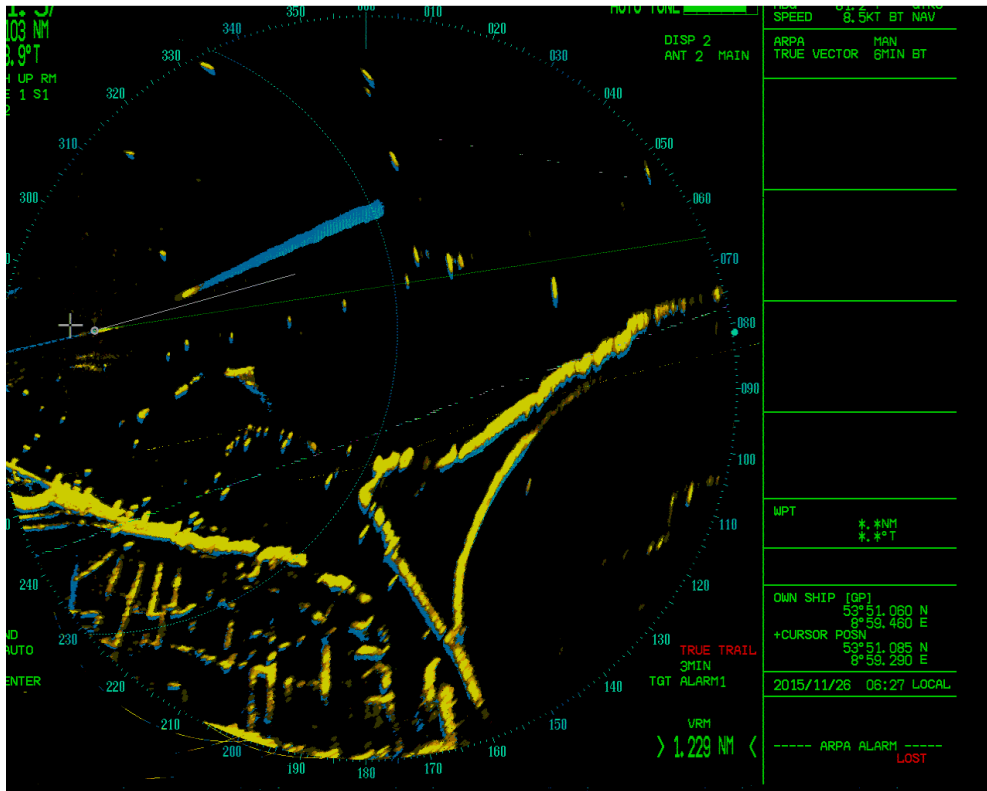


Figure 10: Radar at 052719

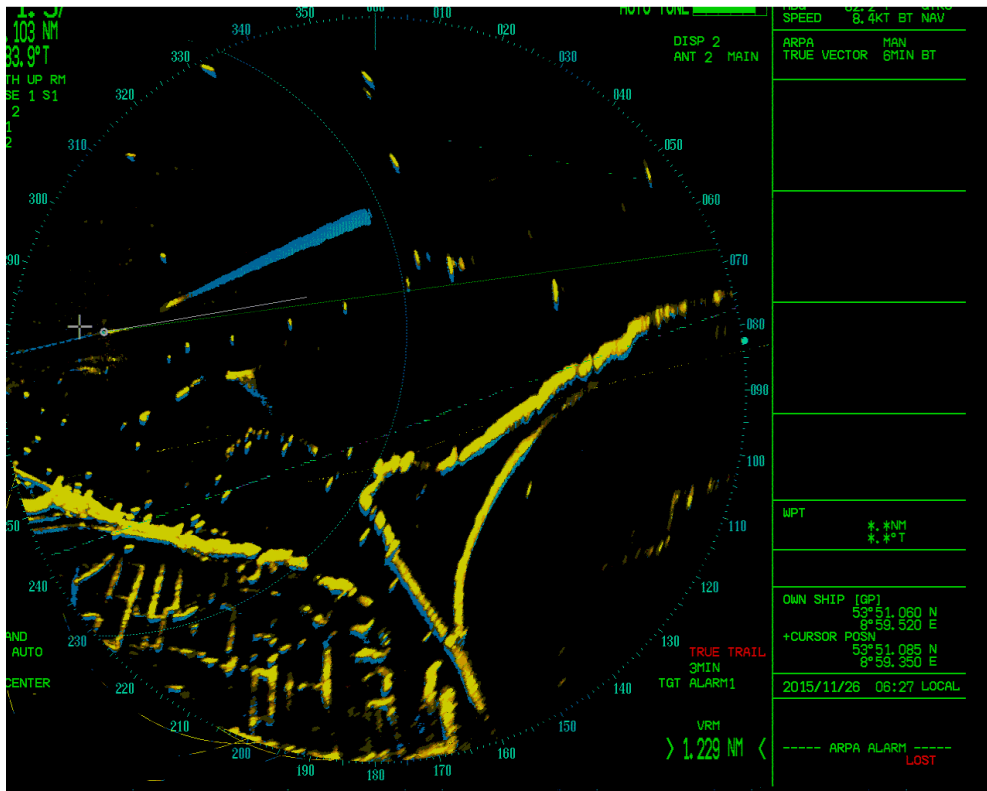


Figure 11: Radar at 052734, hard to starboard

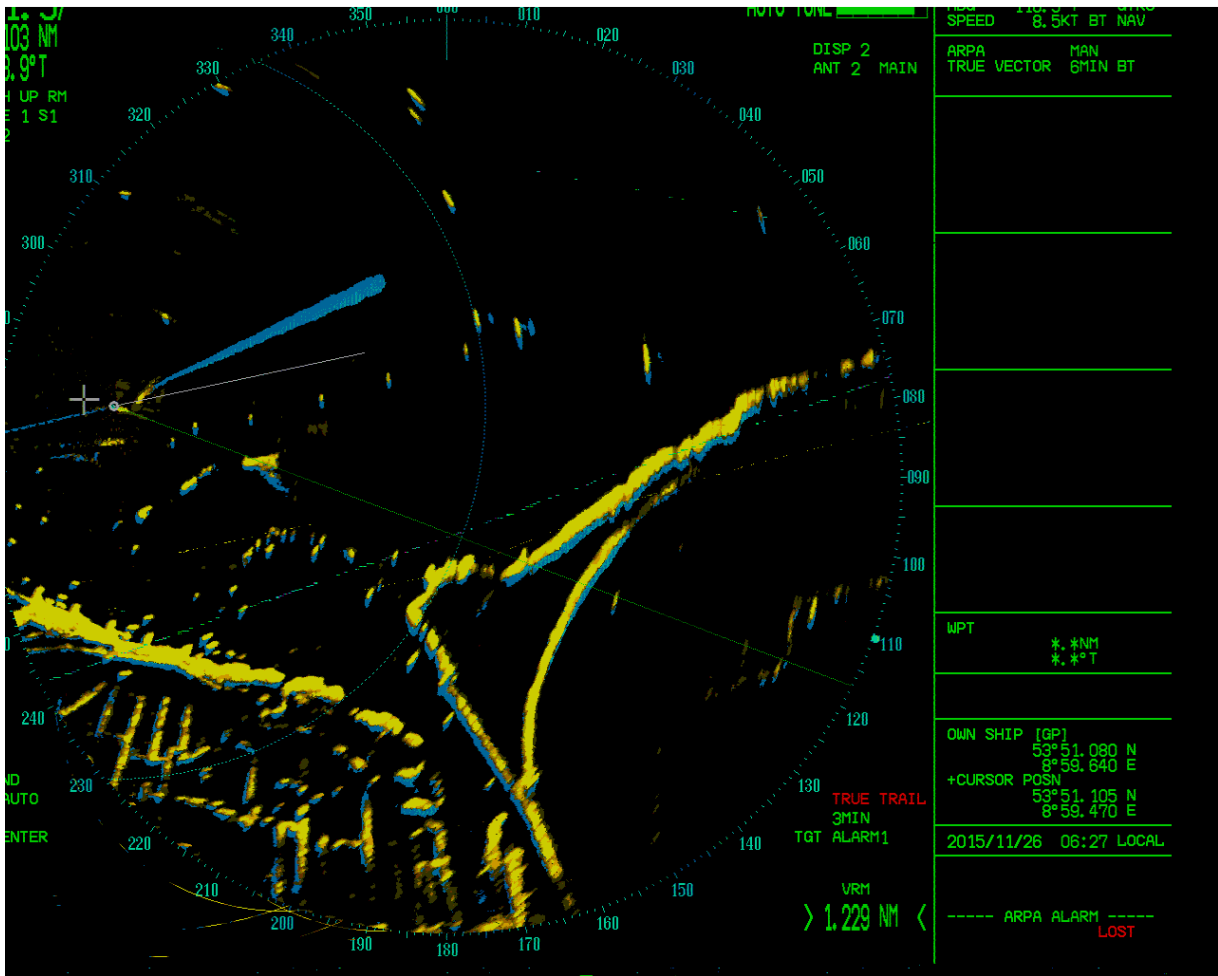


Figure 12: Radar at 052804, collision

4.2 VTS image analysis

To make it easier to compare with the radar data, almost the same time frames were used. Compared to the WSP recordings, the radar targets are also overlaid and displayed as orange echoes. The navigational chart extracts indicate the dashed dredged channel left and right of the radar reference line plotted in magenta in the fairway. The blue area marks the 0-10 m depth zone with the mud shown in green. The Neufeld-Reede West roadstead is located to the north and the Oste estuary to the south. The echo of the BBC FUJI is visible at the buoyed perimeter of the roadstead. The targets indicated using AIS vectors are the TRANSCAPRICORN sailing upstream and the EENDRACHT sailing downstream on the Elbe.

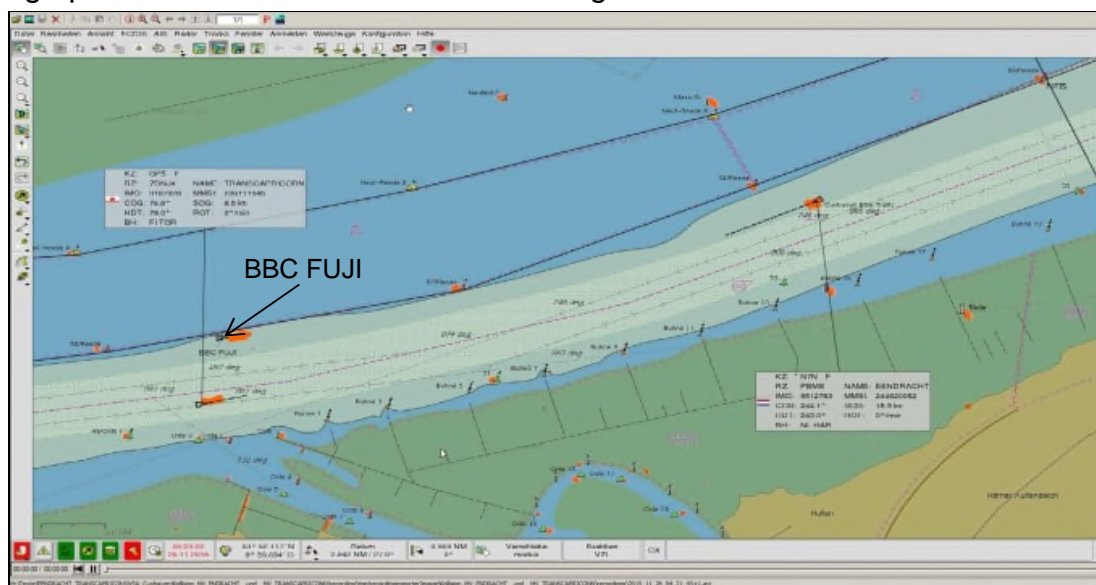


Figure 13: VTS at 052322

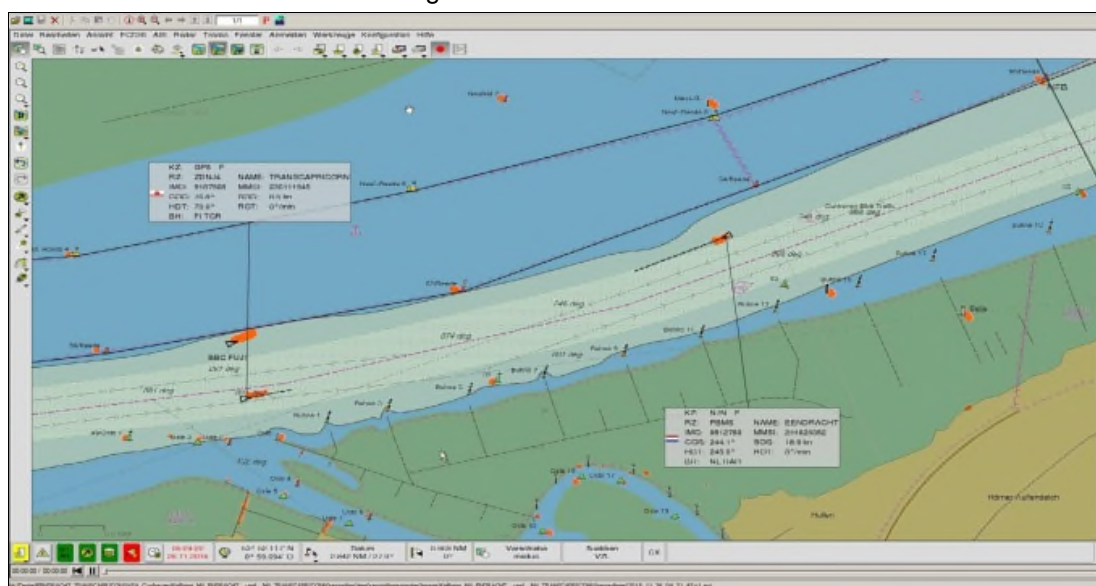


Figure 14: VTS at 052422

The TRANSCAPRICORN is located on the starboard side of the dredged channel and the EENDRACHT well outside the dredged channel at the edge of the fairway.

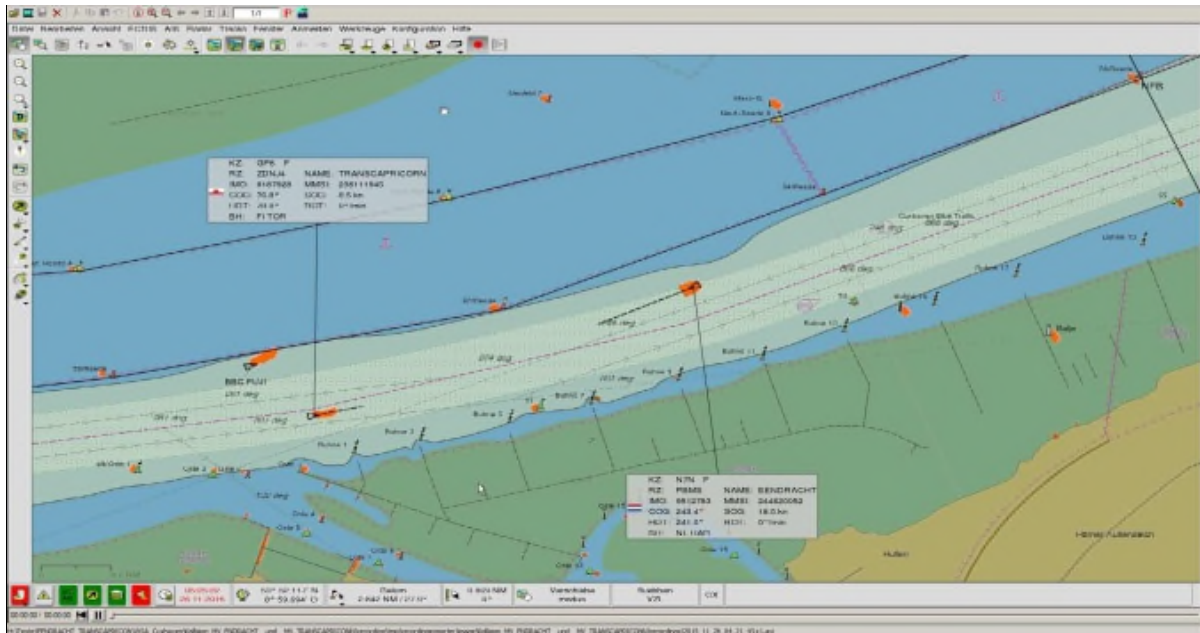


Figure 15: VTS at 052522

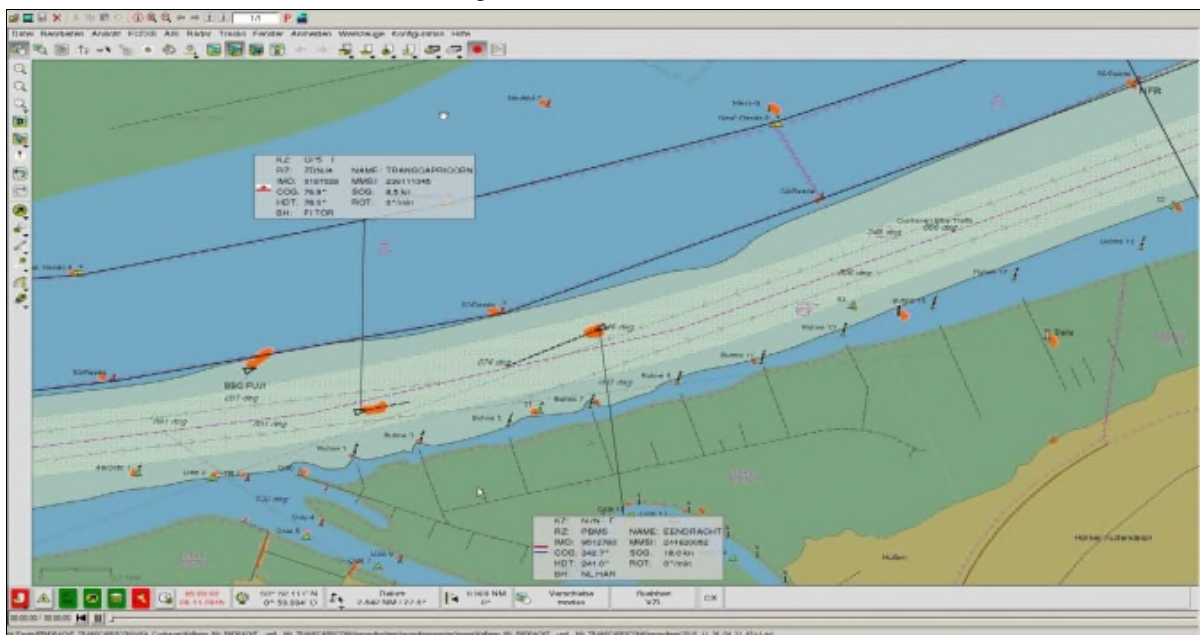


Figure 16: VTS at 052622

The TRANSCAPRICORN keeps her course on the starboard side of the dredged channel, while the EENDRACHT continues toward the dredged channel and the TRANSCAPRICORN. The vessels approach one another at a relative speed of 27 kts.

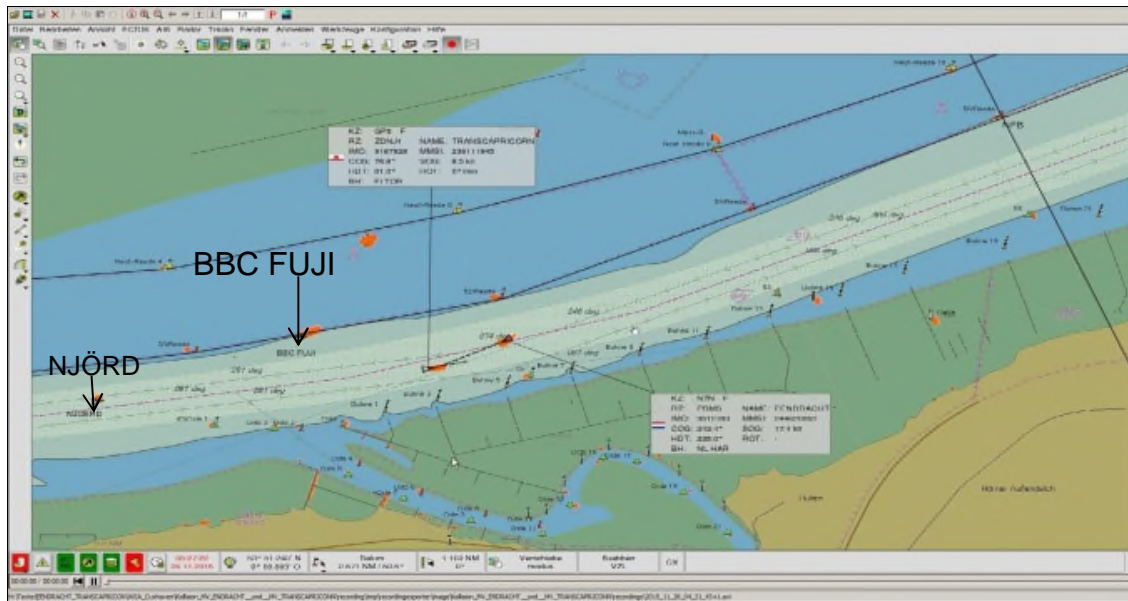


Figure 17: VTS at 052722

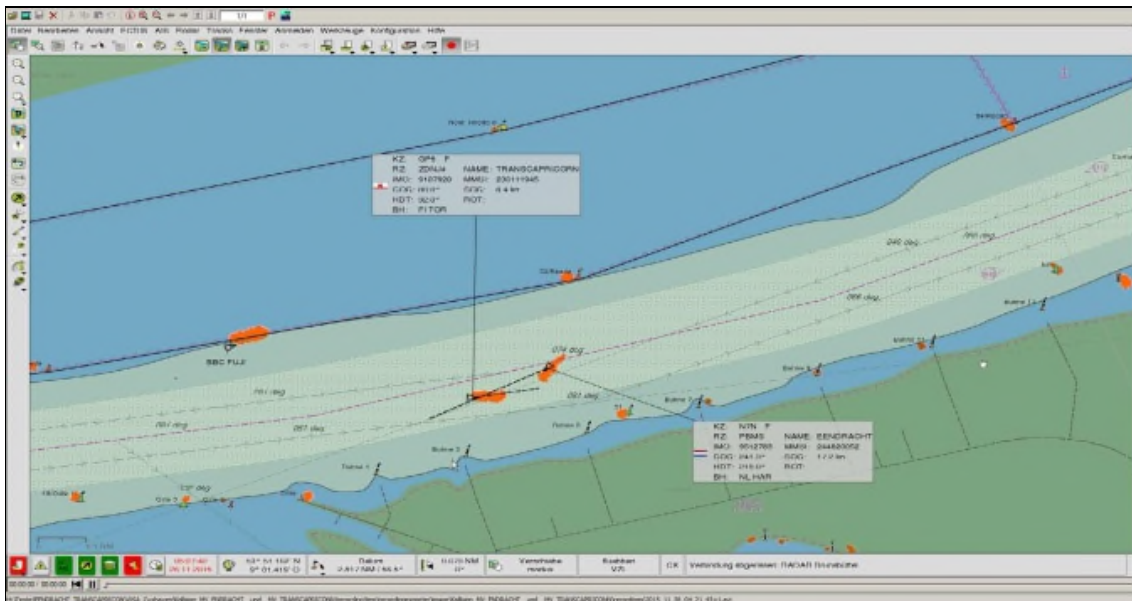


Figure 18: VTS at 052742

The EENDRACHT sails into the dredged channel and crosses the radar reference line. The collision is imminent.

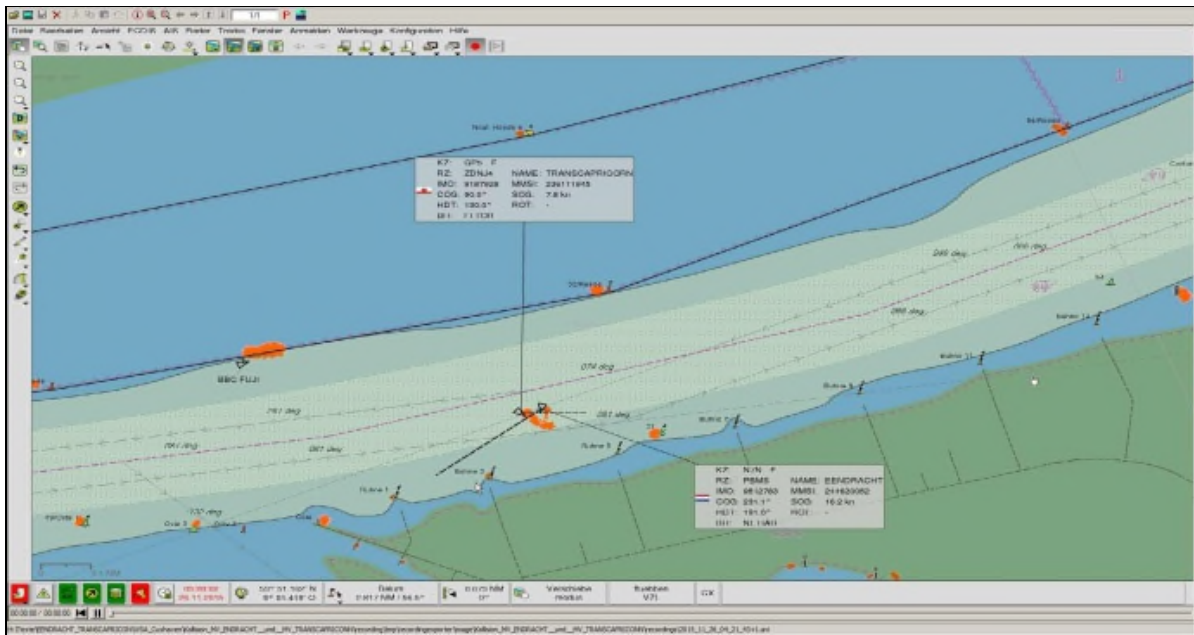


Figure 19: VTS at 052802, collision

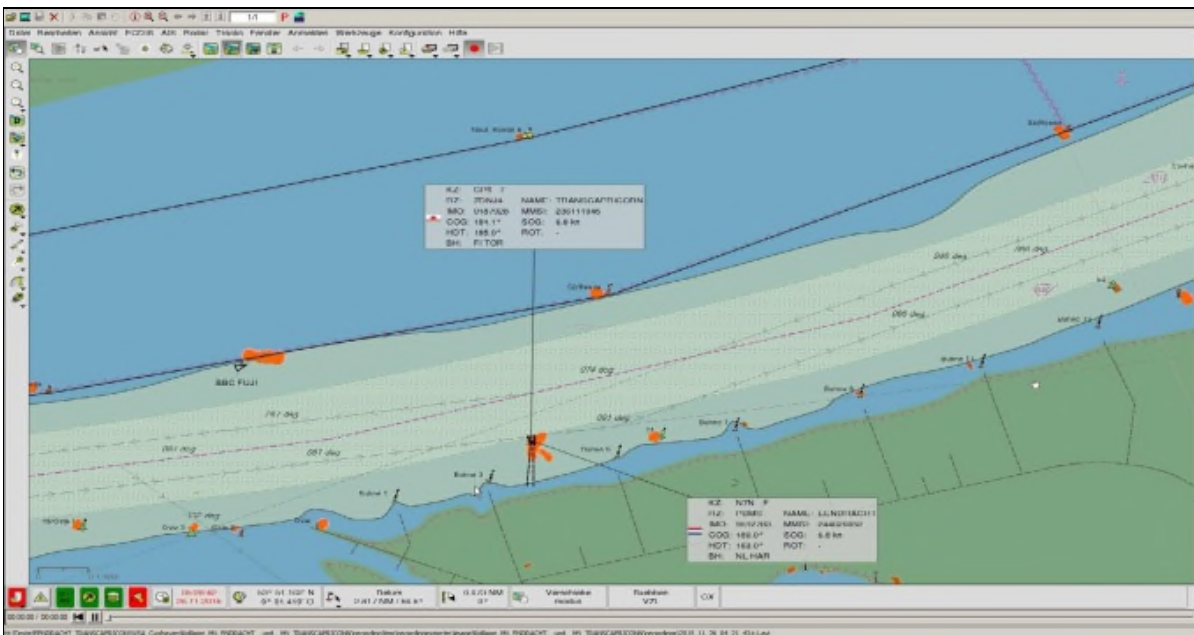


Figure 20: VTS at 052842

The TRANSCAPRICORN turns hard to starboard and the EENDRACHT hard to port. The vessels collide with their sides at an acute angle.

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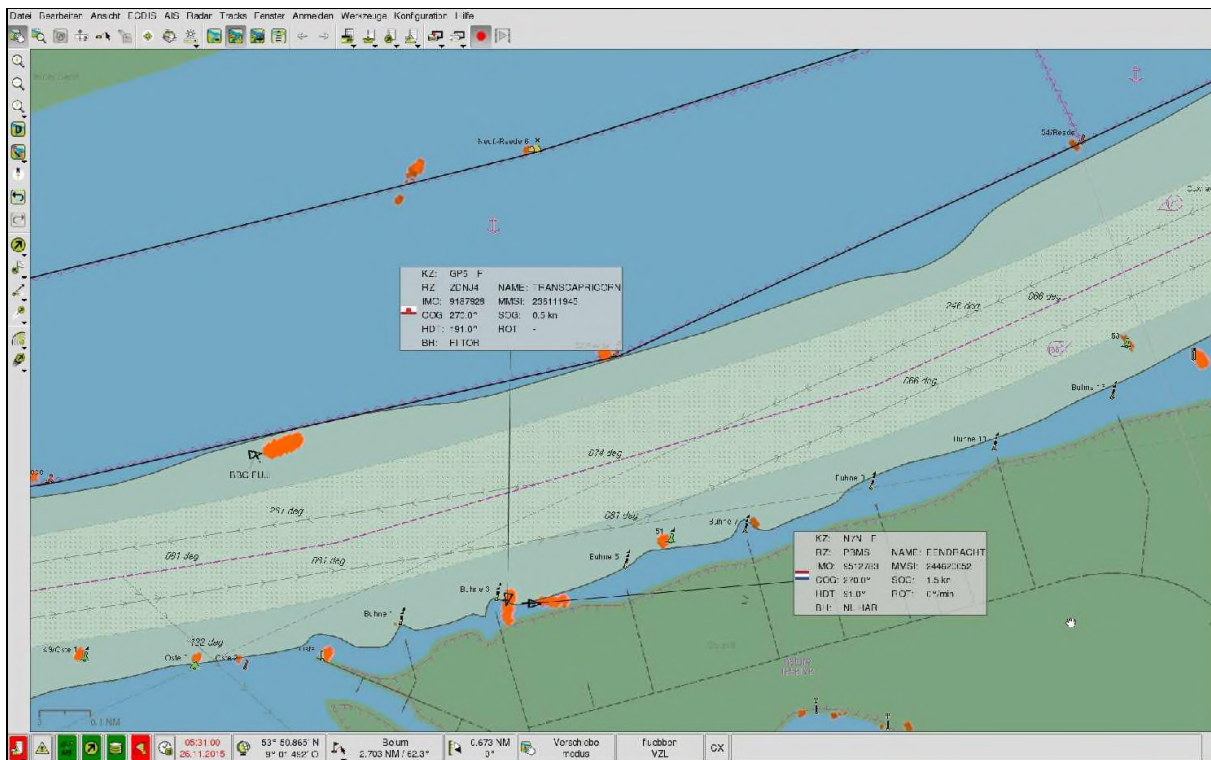


Figure 21: VTS at 053100

The TRANSCAPRICORN runs aground in mud, while the EENDRACHT is able to free herself and stay afloat.

4.3 BAW animation and analysis

The operational predictive model for the tidal Elbe, PROTEL, which is updated on a daily basis and operated by the BAW, was used to show the local current patterns (see *Kremp, C., Rudolph, E. and Sehili, A. (2012) OPTTEL-C: Entwicklung eines operationellen Tidemodells der Elbe sowie einer Modellkopplung mit dem BSH-Vorhersagemodell der Nordsee. Die Küste 79. [Development of an operational tidal model for the Elbe, as well as a model for coupling with the BSH's predictive model for the North Sea. The coast 79.] p. 141-168*). The model results were validated based on a comparison of the Cuxhaven water-level gauge measurement data over an extended period (see Figure 22). Extremely good consistency between the water levels was found. It is therefore reasonable to assume that the current velocities determined are also credible.

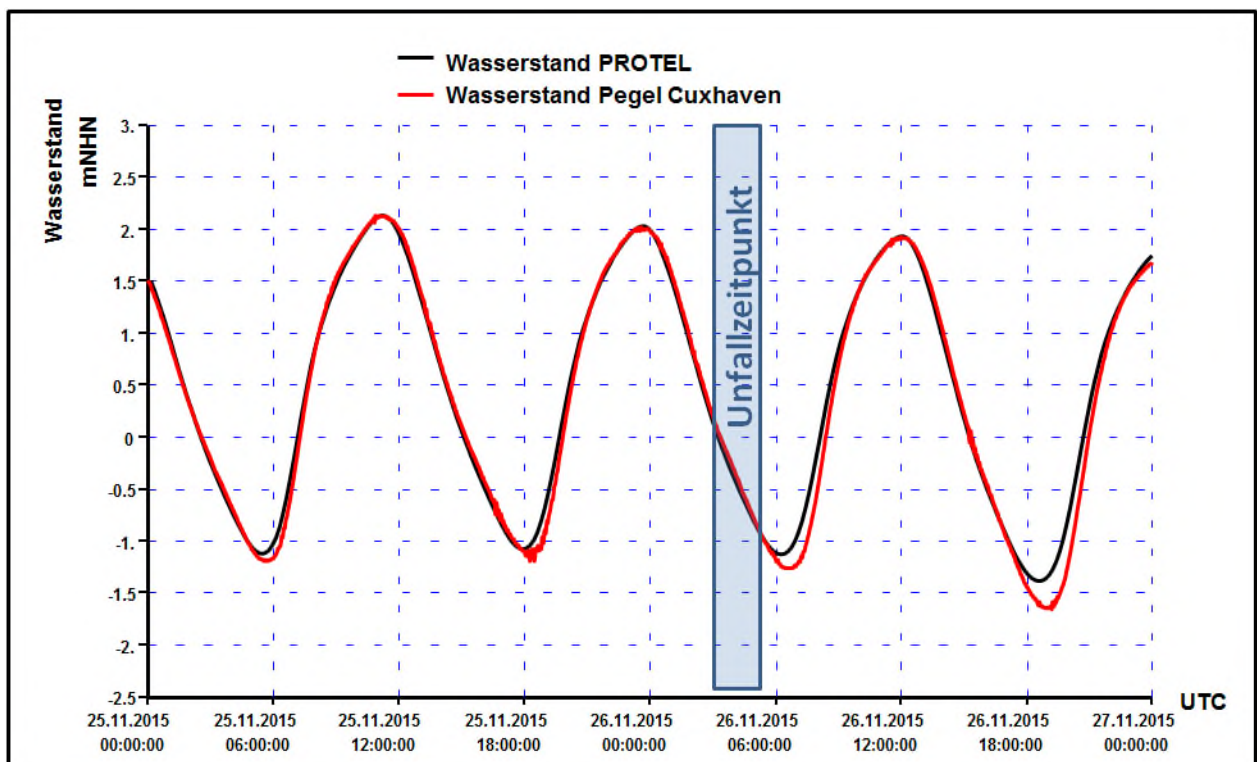


Figure 22: Comparison of the gauge data at the Cuxhaven water-level gauge

To illustrate the course of the accident, the data provided were prepared as time-dependent frames and animated. Vectors were attached to the ships in these figures to facilitate a better understanding of the sailing situation. The vector ahead is dependent on the speed and displays the heading and the resulting vector the course over ground.

For the assessment of conditions at the time of the accident, four sailing situations are considered separately below (see Figures 23-26). Figure 23 shows the situation about 90 seconds before the collision. The prows of the oncoming BBC FUJI and

TRANSCAPRICORN were still about 1,000 m apart. Neither vessel had altered her course for about ten minutes. At 78° and a consistent 8.4 kts over ground against the ebb current, the TRANSCAPRICORN (shown in red, draught 6.2 m) kept an almost parallel course to the Balje leading lights plotted on the navigational chart at 81° and steered 3°. The EENDRACHT (shown in blue, draught 5.2 m) steered a course of 242° at a slightly decreasing speed of about 18 kts over ground. The Otterndorf/Belum leading lights are shown at 245.5° in the navigational chart. Accordingly, the EENDRACHT steadily approached the middle of the fairway. The ebb current's velocity in the fairway was about 1.3 m/s (BAW PROPTTEL).

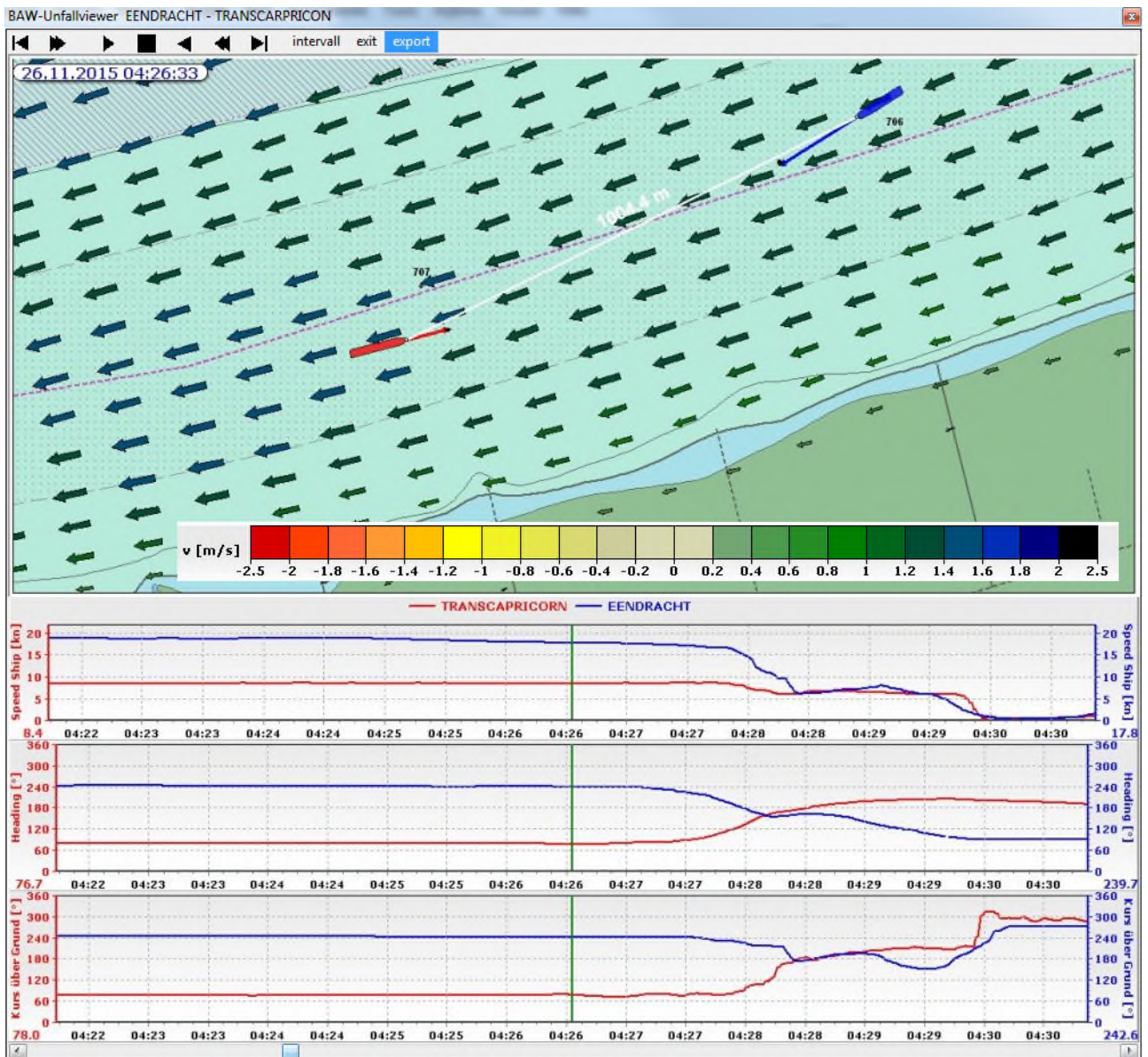


Figure 23: Situation at 052633

The EENDRACHT had almost reached the middle of the fairway about one minute (042704 UTC) before the collision. The distance between the prows was about 600 m. From this point, the bow of the EENDRACHT started to turn steadily to port and that of the TRANSCAPRICORN to starboard.

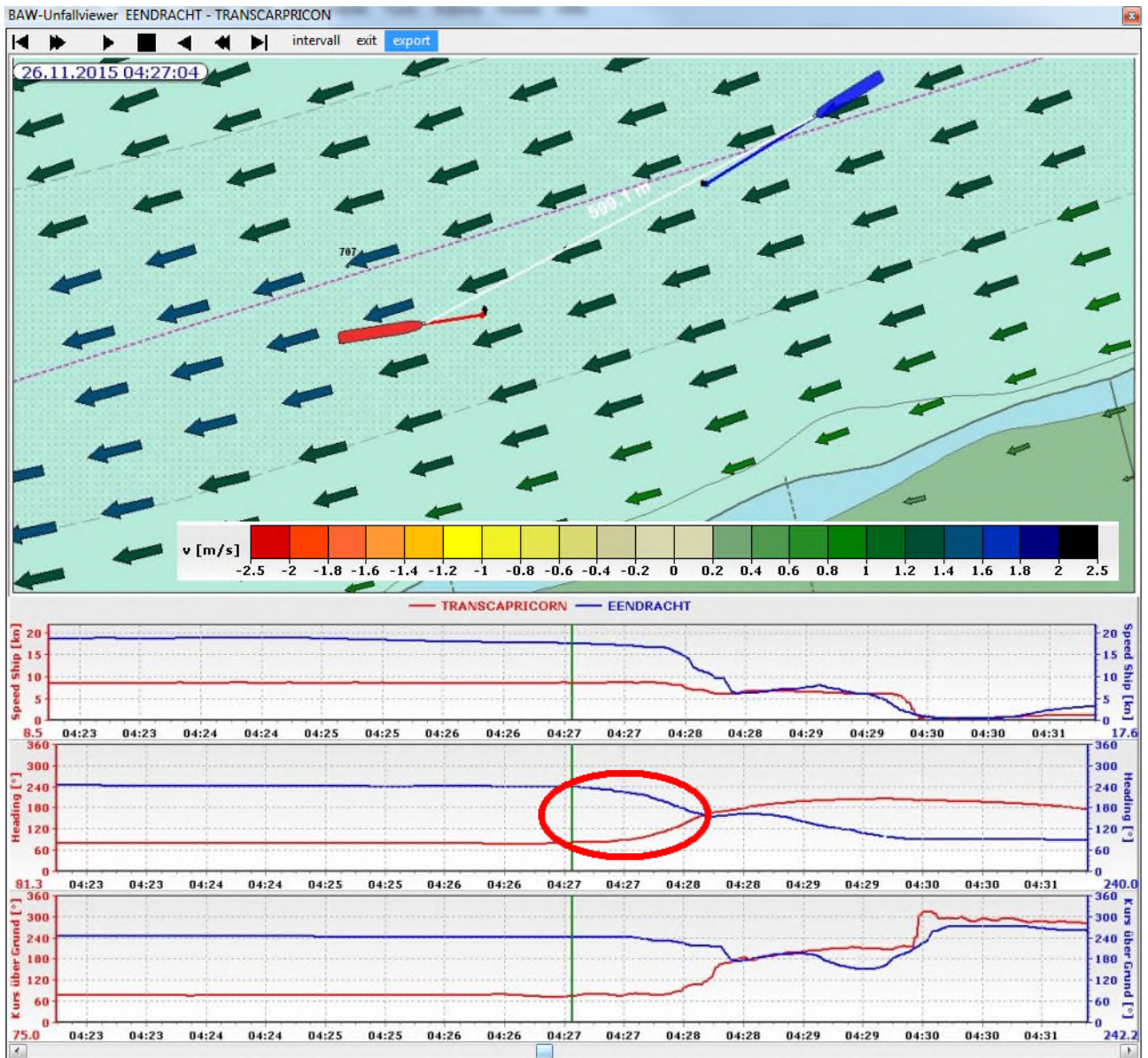


Figure 24: Situation at 052704, switched to manual steering

The whole of the EENDRACHT was on the opposite side of the fairway (Figure 25) approximately 30 seconds (042734 UTC) before the collision. The prows were now only about 200 m apart. Both vessels maintained their chosen directions of rotation. From this point, the course of each vessel altered significantly.

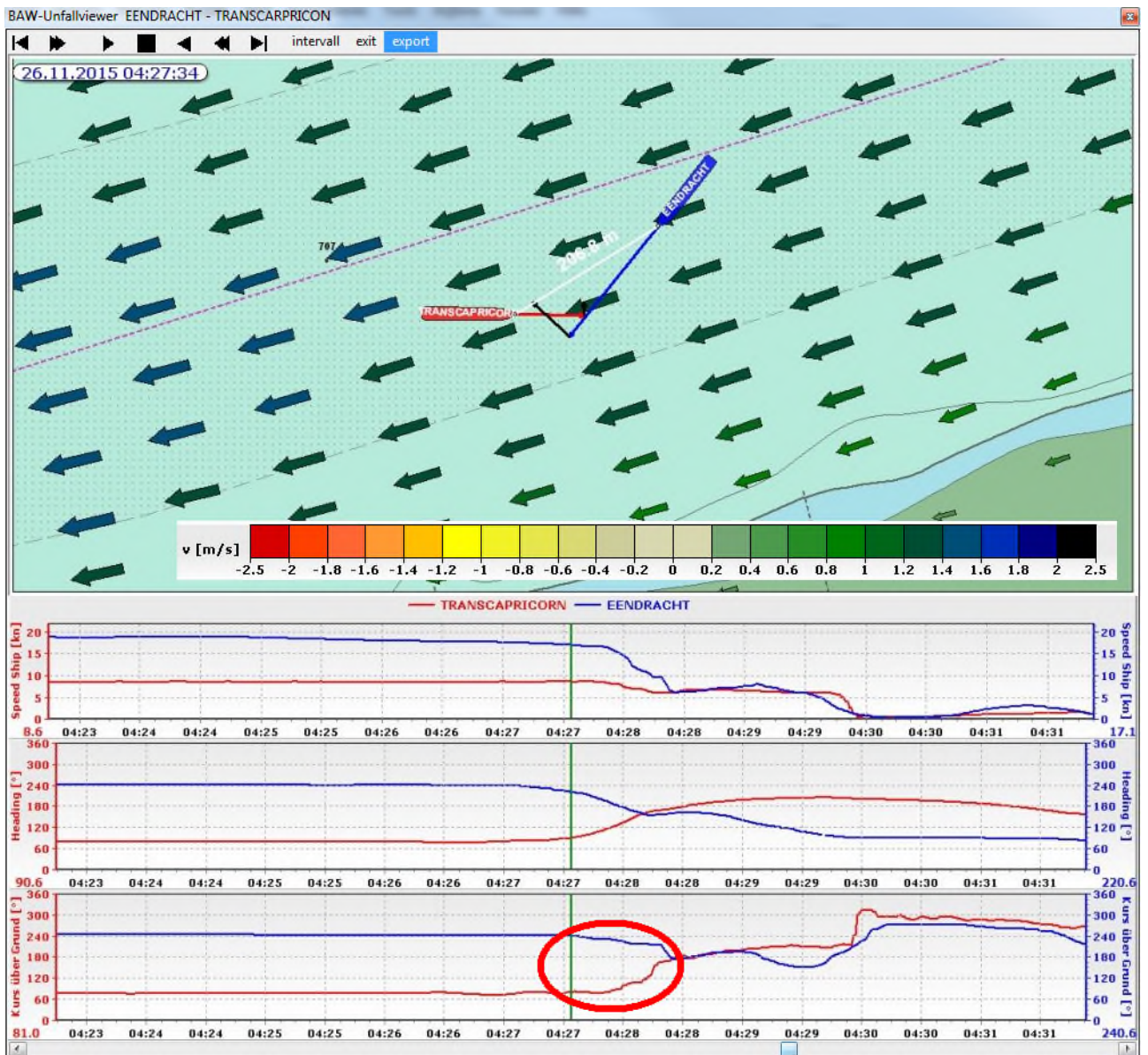


Figure 25: Situation at 052734

At about 052804, the vessels collided level with their fore sections (see Figure 26). The TRANSCAPRICORN's speed and that of the EENDRACHT at this point still stood at 6.9 kts and 12.2 kts over ground respectively.

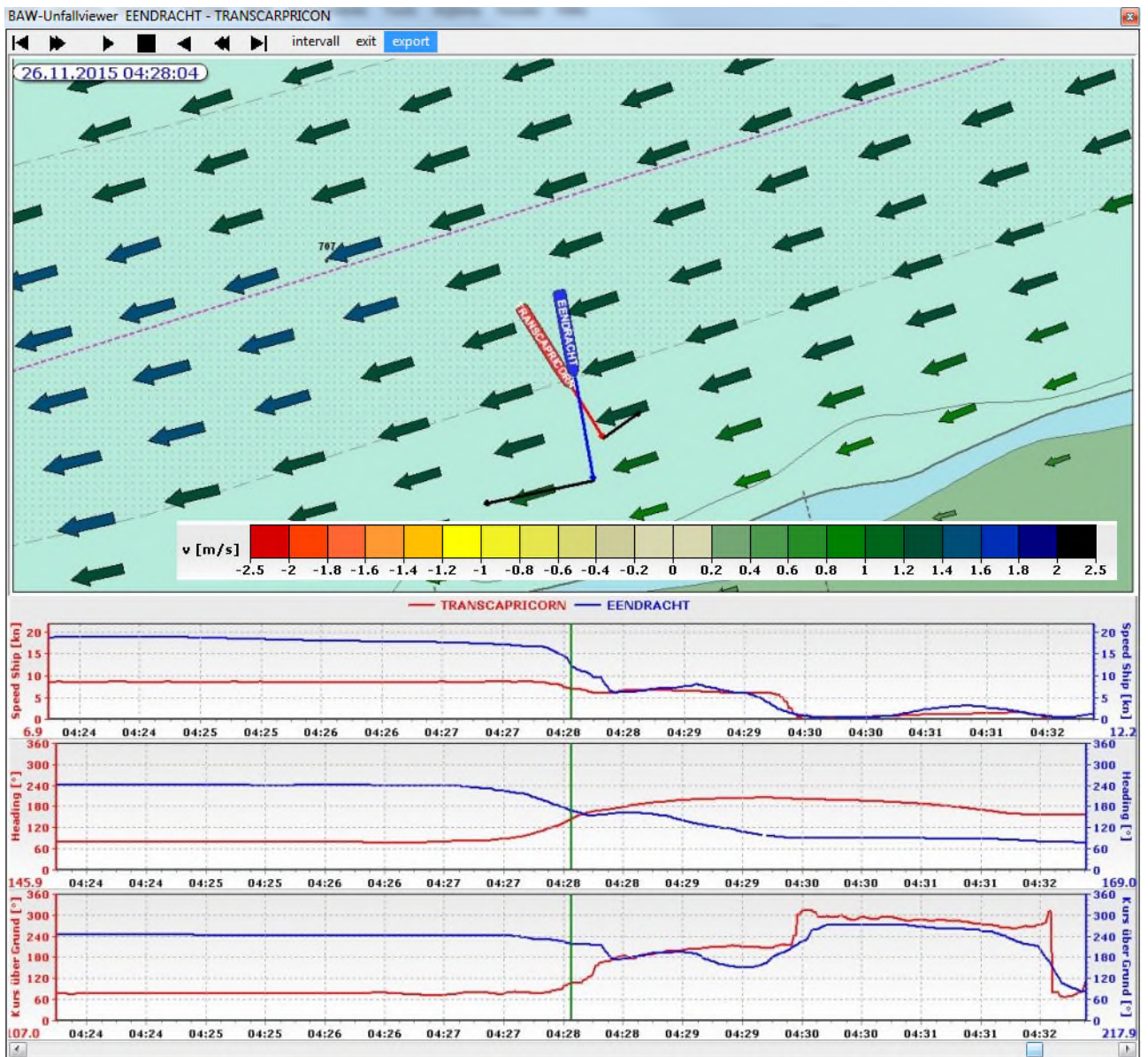


Figure 26: Situation at 052804, collision

The EENDRACHT's course alteration to port about one minute before the collision contributed to the accident significantly. A more detailed assessment of the course of the accident is not possible due to the underlying data available.

4.4 Survey by the BSU

The BSU surveyed the EENDRACHT in the port of Hamburg on 10 February 2017. The steering gear (with follow-up (or FU) and non-follow-up (or NFU) steering) was tested, as was the autopilot to manual steering switch.

Seagoing ships are equipped with follow-up and non-follow-up steering. In follow-up steering mode, the set value of the rudder is selected using the rudder angle indicator. The final control element of the steering gear is operated by an amplifier until the actual rudder angle coincides with the required rudder angle. The actual rudder angle is transmitted to the rudder angle indicator by the feedback unit.

In the case of non-follow-up steering mode, the steering gear is activated directly through contact connection at the non-follow-up tiller or button. The rudder angle depends on the duration of the contact connection at the tiller/button. The tracking of the actual rudder angle at the rudder angle indicator must be monitored during the steering process.

Hand-wheels and mini-hand-wheels are generally designed for follow-up steering, while tillers and buttons are designed for non-follow-up steering. When electrical steering gear systems are used, two independent systems must always be available. Separate cables and lines must be provided for these steering gear systems.

Switching over the steering mode can give rise to scenarios in which unintended turning manoeuvres are triggered on a ship:

- Rudder at the helmsman seat not in midships position
⇒ Rudder angle pre-selection is implemented directly
- Rudder at the port and starboard wing positions not in midships position
⇒ Rudder angle pre-selection is implemented directly
- Override button at the conning position
⇒ Rudder is set immediately after pressing the button

The non-follow-up steering on the EENDRACHT was equipped with an override function with buttons (push button) and additionally secured with transparent plastic flaps. The override function is a system that generally only has priority over the autopilot based on the guidelines of the classification society. On the EENDRACHT, the override buttons had priority over all other controllers, i.e. the steering selector is not required and the helm responds immediately when the button is operated.



Figure 27: Control console

The equipment on the EENDRACHT's bridge includes two X-band chart radar systems (SAM Radarpilot 1112/ARPA 1A5X and SAM Radarpilot 1112/ARPA 1A8X), the two autopilots (heading control systems) (SAM Trackpilot 1100 and Raytheon Pilotstar D), two ECDISs (SAM Chartpilot 1100), the speed log (Consilium SAL-R1a), the two gyrocompasses (Anschütz Standard 21 and Anschütz Standard 22 G/GM),

and the DGPS system (SAM DEBEG 4422D). The EENDRACHT therefore has modern navigational equipment. Amongst other things, the tracks and lubber lines can be displayed on the screens and the navigation sensor values via the conning display. AIS targets can be overlaid with the radar, the electronic chart display, or both.

The control console is only accessible from the sides. There is no separate position for the helmsman. It is only possible to perform this task sitting down, so as to operate the rotary knob (follow-up steering) or buttons (non-follow-up steering).



Figure 28: Control console with command positions (conning)

The screens can display either the radar image, the electronic chart display, both, or navigation data (e.g. rate of turn/min.).

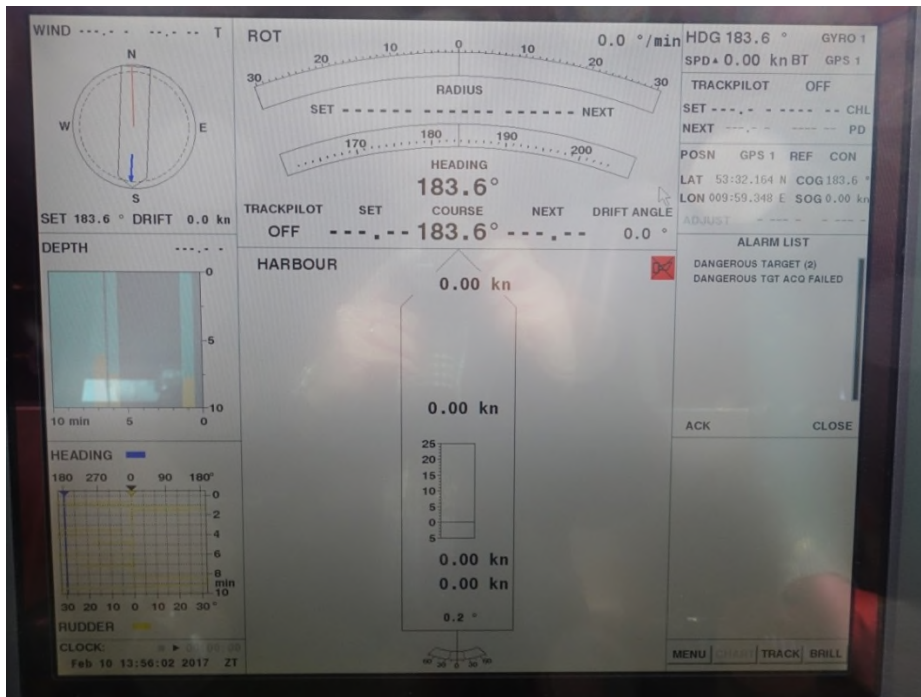


Figure 29: Conning display

The rotary knob is furnished with stepping that can be felt when it is held and a round marker, which indicates the midship position of the rudder angle pre-selection. There is also a rudder angle indicator on the ceiling before the control console.



Figure 30: Manual helm with stepping amidships (0)

Each wing also contains a conning position with controls.



Figure 31: Wing manoeuvring platform

The EENDRACHT is equipped with a balance type rudder, a right-handed controllable pitch propeller and a bow thruster. The maximum rudder angle is 45°. According to the wheelhouse poster, it takes 15 seconds to turn the rudder hard-over from port to starboard or vice versa when two steering gear pumps are running and 30 seconds when one pump is running. The BSU actually measured only 24 seconds and 12 seconds at the berth. A red warning sign on the steering position consoles indicates that rudder angles in excess of 35° may only be set when moving dead slow. The turning circle is specified at 541 m in shallow water and laden. The stopping distance is approx. 700 m after 129 s at a full speed of 17 kts when laden in a crash stop from full ahead to full astern. In a person-overboard manoeuvre with a Scharnow turn, the track deviation from a course made good of 536 m to the reciprocal course is 235 m. According to the wheelhouse poster, the EENDRACHT remains steady in a crash stop when moving ahead. She veers slightly to port in a stopping test. Both tracks are due to the right-handed controllable pitch propeller, the shape of the hull, and the balance type rudder. Facilitated by propeller walk², it is reasonable to assume that a turn to port will be faster than to starboard in a port turn with the screw pushing astern. The wheelhouse poster did not show this manoeuvre. The bow thruster is only effective when the speed is less than 5 kts.

² Propeller walk describes an indirect steering effect as a result of the asymmetrical propeller suction on the hull.

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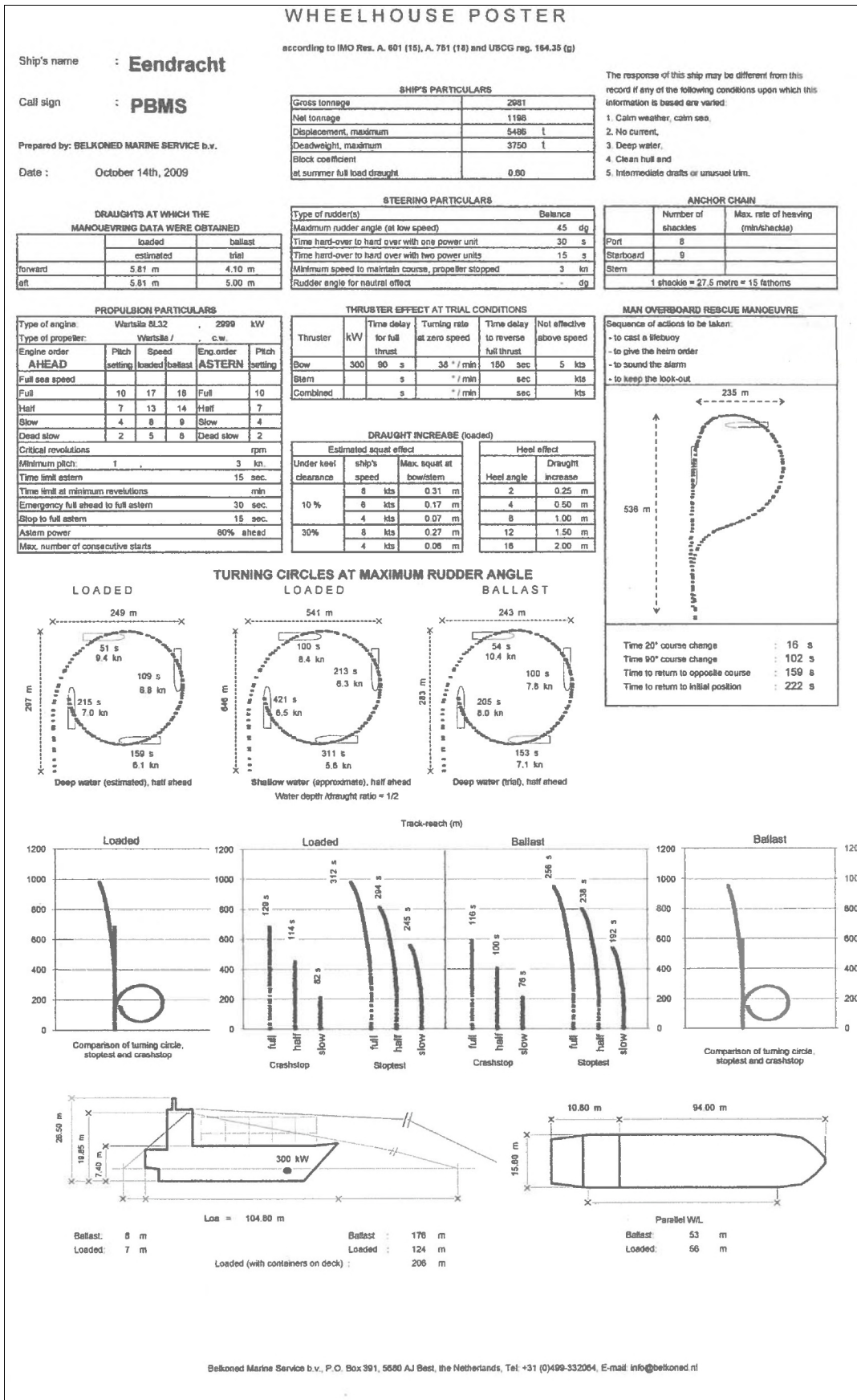


Figure 32: Wheelhouse poster

4.5 Time sheets

The watchkeeping plan must be consistent with the Seafarers' Hours of Work and the Manning of Ships Convention. The limits on hours of work are as follows: (a) maximum hours of work shall not exceed: (i) 14 hours in any 24-hour period; and (ii) 72 hours in any seven-day period; or (b) minimum hours of rest shall not be less than: (i) ten hours in any 24-hour period; and (ii) 77 hours in any seven-day period. Hours of rest may be divided into no more than two periods, one of which shall be at least six hours in length, and the interval between consecutive periods of rest shall not exceed 14 hours.

A three-watch system was exercised on the EENDRACHT at sea and a two-watch system in port on a six-hourly cycle. When at sea, the master is on watchkeeping duty from 0800 to midday and 1800 to midnight, while the two deck officers are on watchkeeping duty from midnight to 0400 and midday to 1500, as well as from 0400 to 0800 and 1500 to 1800. The two officers share the watch when in port during loading operations. In the 72 hours prior, there were no irregularities in the times recorded by the crew on the time sheets. Accordingly, the hours of work and rest were adhered to. The EENDRACHT sailed out of Norrköping on 23 November (at 1600 according to the log book entry), passed Brunsbüttel via the Kiel Canal at 1320 on 25 November, and made fast in Hamburg at 1725. On 26 November, she sailed for the port of destination, Harlingen, at 0130. Roughly four hours later, at 0528, she collided with the TRANSCAPRICORN off the Oste estuary. The master was in charge of the navigational watch outside of the watch rota. According to the time sheet, he worked from 0130 to 0600 and 1700 to midnight on the day of the accident, while the two officers were resting from casting off up until the accident. Prior to casting off in Hamburg, the master had a reported rest period of 7.5 hours.

5 CONCLUSIONS

The collision is attributable to a non-maintained track by the EENDRACHT and a missed course alteration to starboard. As can be seen from the analysis of the TRANSCAPRICORN's VDR and that of the AIS recordings of the VTS, the TRANSCAPRICORN, sailing upstream on the Elbe, and the EENDRACHT, sailing downstream on the Elbe, initially proceeded as they should on the right-hand side of the fairway. Here, the EENDRACHT was actually outside the dredged channel (see Figures 13-16). It was only when she approached the Neufeld-Reede West roadstead at buoy 54/roadstead that she steered for the middle of the fairway and made room for the BBC FUJI, which was located on the perimeter between buoy 50-52/roadstead. The dredger NJÖRD was not involved in the close-quarters situation at this point (see Figures 6, 7 and 27). At 0525, the TRANSCAPRICORN had just overtaken the BBC FUJI and the NJÖRD well beforehand. The EENDRACHT would have had sufficient time and space between the BBC FUJI on the boundary of the Neufeld-Reede roadstead and the dredger NJÖRD to pass safely on the right-hand side of the fairway. At 052722, (see Figure 17), the EENDRACHT crossed the radar reference line to the wrong side of the fairway according to the AIS recordings. According to the analysis of the BAW, the EENDRACHT made a turn to port immediately afterwards at 052734 (see Figure 25), which led to the collision. She had previously kept the Otterndorf/Belum leading lights ahead for too long on a true course specified in the navigational chart of 245.5°.

The BSU has not received a statement by the master of the EENDRACHT and a VDR was not installed on the EENDRACHT. Inasmuch, an analysis of the existing data indicates that the master switched from autopilot to manual steering deliberately at the starboard command position and initiated the EENDRACHT's relatively hard turn to port.³ The BSU believes it unlikely that an inadvertent course alteration to port occurred owing to a rudder angle pre-selected on the follow-up steering.⁴ A prompt course alteration to starboard would have defused the situation and been expected on the TRANSCAPRICORN. Such close-quarter situations happen every day on the River Elbe. In darkness, it is possible that the EENDRACHT's master recognised the unavoidable collision too late, as the TRANSCAPRICORN approached the EENDRACHT on a constant bearing and relative speed of 19 kts. A hard to port course alteration would then have been the last opportunity to minimise the impending damage.

³ According to the pilot and the owner, the master switched to manual steering and took charge of the helm, which supports this assumption.

⁴ The rotary knob for the follow-up steering was furnished with stepping that can be felt when it is held and a round marker for the midship position of the rudder angle pre-selection. The steering selector must be pressed before it is possible to switch from autopilot to manual steering. Control would also have been possible using the non-follow-up steering buttons. In the process, the helm setting last specified by the autopilot would have been adopted and reset (override).

The BSU was not able to establish why a timely course alteration to starboard with the autopilot was missed, especially since it was possible to follow each vessel's track on the chart radar almost in real time. Potentially a determined communication between the master and pilot was missing here.

The NJÖRD is a flushing dredger and requires special consideration during water injection operations. The original intention was to pass the NJÖRD to port and the BBC FUJI to starboard. Instead, the EENDRACHT steered extremely close to the middle of the fairway (radar reference line) and a close-quarters situation – during which the master decided to switch to manual steering – with the TRANSCAPRICORN rapidly developed in the immediate vicinity.

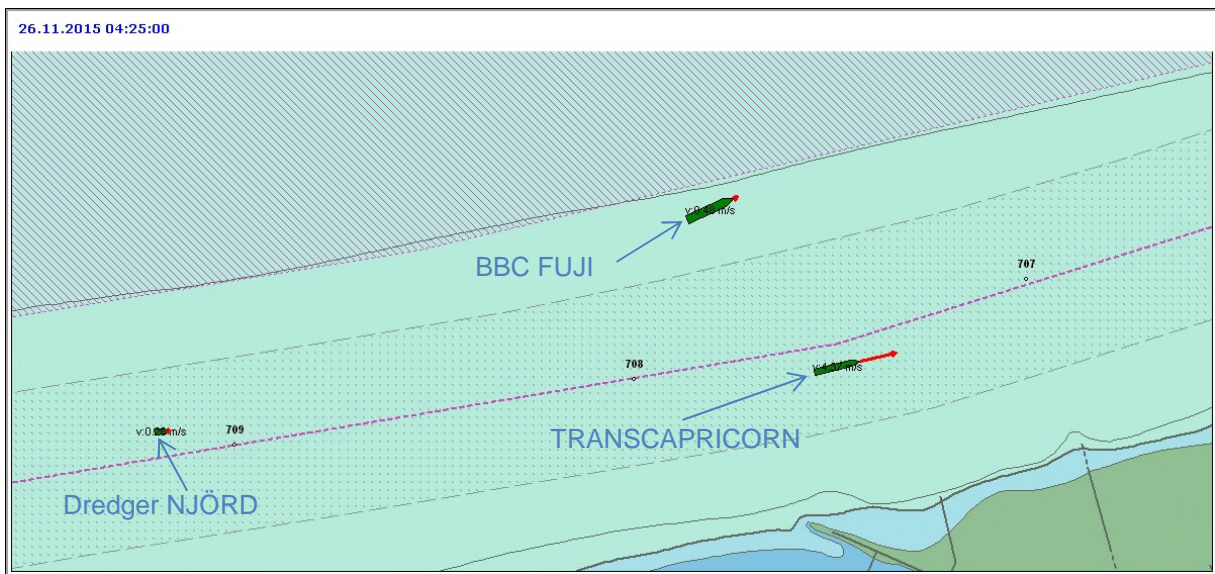


Figure 33: BAW at 052500

As shown in Figure 25, the EENDRACHT ran out of rudder at 052734 while crossing the radar reference line. The black SOG vector that has developed to starboard illustrates this in the animation. It was not possible to calculate the rate of turn reliably because only integers were available as heading data.

Between 052704 and 052734, the EENDRACHT made an abrupt course alteration to port. While the TRANSCAPRICORN maintained her heading on the right-hand side of the fairway in the dredged channel until 052633, the radar recordings on the VDR at a range of 1.5 nm indicate that the EENDRACHT had been heading for the TRANSCAPRICORN on a constant bearing since 052419, which is still not a cause for concern at this point.

The range marker on the TRANSCAPRICORN's radar system was set to 1.2 nm, which is assumed to be the defined close range. Oncoming vessels moving to within this range may cause a potential risk of collision in the area and it is necessary to respond within some two to three minutes, depending on the relative speed of the convergence.

At 052633 (see Figure 23), the distance between the two prows is calculated at 1,004.4 m on a constant bearing. It would have been necessary to respond immediately to prevent the collision. About 30 seconds later, the EENDRACHT's master switched to manual steering. Contrary to the intended course alteration to starboard, the EENDRACHT turned to port, however. This meant that a collision with the TRANSCAPRICORN, which according to the audio recordings on the VDR set her rudder to hard to starboard at 052724, was unavoidable. It was now a matter of preventing more severe damage and keeping the collision angle acute. The vessels collided at 052804. The EENDRACHT and TRANSCAPRICORN scraped past each other with the starboard and port side respectively. The impact caused material damage to the side of each vessel.

While the EENDRACHT remained afloat and could reach the Neufeld-Reede roadstead under her own steam, the TRANSCAPRICORN ran aground in mud on the Oste and was only able to refloat and shift to the Neufeld-Reede roadstead on the next high tide with tug assistance. No harmful substances escaped into the Elbe due to the collision. After a short stay in the Neufeld-Reede roadstead, the two vessels sailed on to Cuxhaven in the early afternoon to have the damage surveyed.

6 SOURCES

- Investigations of WSP Hamburg (WSPR4)
- Explanations/submissions of the Elbe Pilots' Association and the EENDRACHT's owner
- Expert opinion/technical paper
 - Federal Waterways Engineering and Research Institute Hamburg (BAW)
Dr. Frank Kösters, Dipl. Ing. Martin Wezel
- Navigational charts and ship particulars, German Maritime and Hydrographic Agency (BSH)
- Radar recordings, ship safety services/vessel traffic services
 - Waterways and Shipping Office Cuxhaven
- Documentation from the Ship Safety Division (BG Verkehr)
 - Port State control