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

Investigation Report 439/16

Serious Marine Casualty

Grounding

of the CMV HANNI off Mühlenberger Loch

in Hamburg on 4 December 2016

29 November 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). 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.

Issued by:
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1 Summary

At 0628[1] on 4 December 2016, the German-flagged container ship HANNI ran aground off Mühlenberger Loch in Hamburg while sailing for Bremerhaven. The master and chief officer were on the bridge. An overspeed protection alarm was issued for the main engine at 0621. The main engine then stopped automatically. At 0623, the FINJA (a tanker) approached from the opposite direction on the Elbe fairway and it was just possible to avoid a collision with her by setting the rudder to hard to starboard. After the failure of the main engine, the HANNI drifted to the other side of the fairway in an arc toward her port side and ran aground within seven minutes. The main engine was operational again only one minute earlier and both anchors ready to drop. There were no injuries and no pollutants escaped. The unsuccessful first salvage attempt involving two tugs began at 0700 with the tide already running out. The second salvage attempt at 1830 on the next high tide was successful.

[1] Unless stated otherwise, all times shown in this report are local = UTC + 1.

2 FACTUAL INFORMATION

2.1 Photo

Figure 1: Photo of the ship

2.2 Ship particulars

Name of ship:	HANNI
Type of ship:	Container ship
Nationality/Flag:	Germany
Port of registry:	Hamburg
IMO number:	9188506
Call sign:	DHMW
Owner:	Ohle Jürgen Reederei KG
Year built:	1998
Shipyard/Yard number:	J. J. Sietas KG Schiffswerft/1156
Classification society:	Bureau Veritas
Length overall:	118.30 m
Breadth overall:	18.15 m
Gross tonnage:	5,056
Deadweight:	6,867 t
Draught (max.):	7.10 m
Engine rating:	5,760 kW
Main engine:	8L 40/54 MAN B&W Diesel AG
(Service) Speed:	17.0 kts

Hull material:	Steel
Hull design:	Double bottom
Minimum safe manning:	11

2.3 Voyage particulars

Port of departure:	Hamburg
Port of call:	Bremerhaven
Type of voyage:	Merchant shipping, international
Cargo information:	Containers
Manning:	11
Draught at time of accident:	F: 6.10 m A: 6.90 m
Pilot on board:	No
Canal helmsman:	No
Number of passengers:	None

2.4 Marine casualty or incident information

Type of marine casualty:	Serious marine casualty, grounding
Date, time:	04/12/2016 at 0628
Location:	Hamburg, Mühlenberger Loch
Latitude/Longitude:	φ 53°33.03'N λ 009°48.51'E
Ship operation and voyage segment:	Estuary trading
Place on board:	Underwater hull
Human factors:	No, technical fault
Consequences (for people, ship, cargo, environment, other):	None

Excerpt from Navigational Chart 48, Federal Maritime and Hydrographic Agency (BSH)

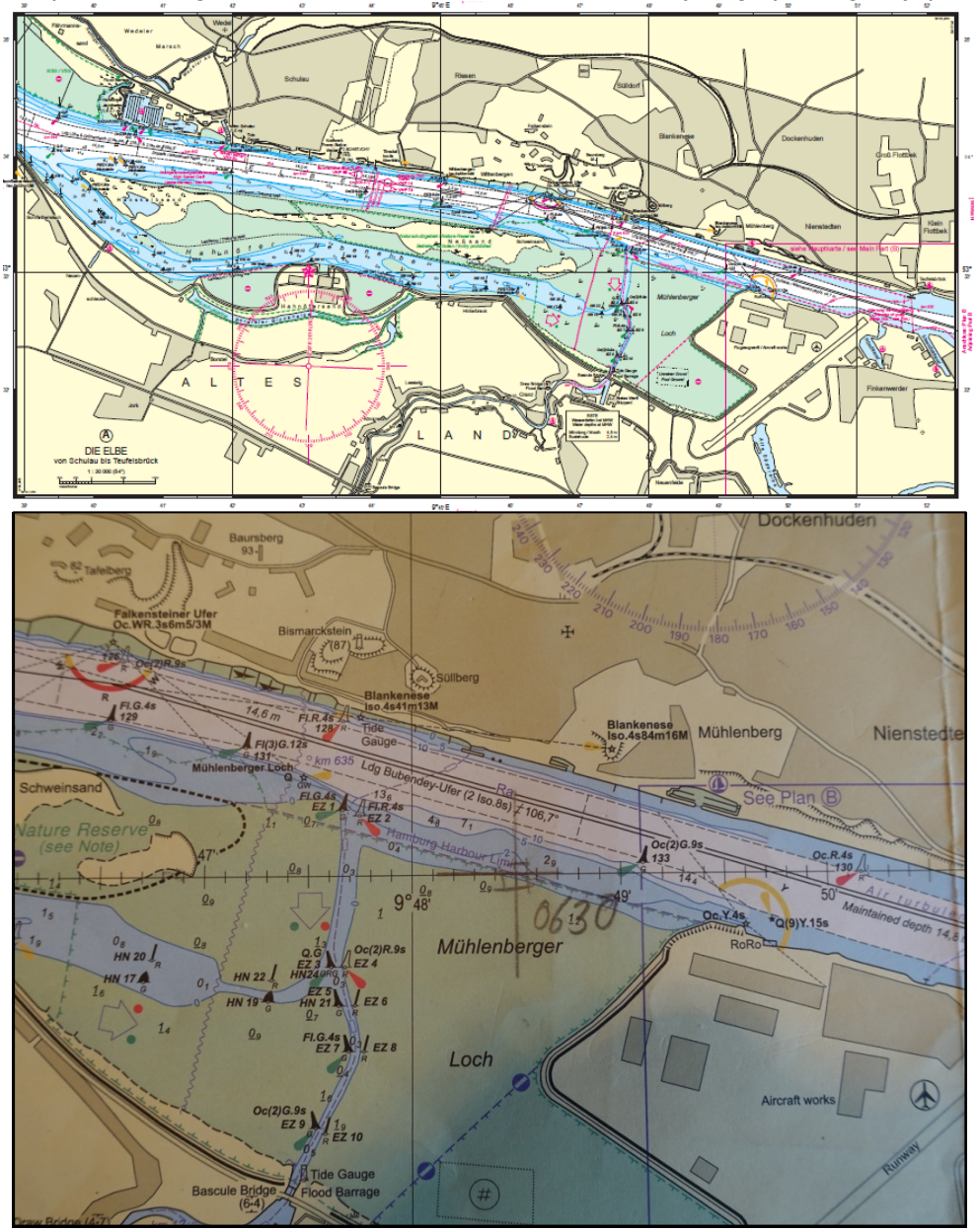

Figure 2: Navigational chart on the HANNI

2.5 Shore authority involvement and emergency response

Agencies involved:	Waterway Police (WSP) Hamburg, Hamburg Port Authority (HPA), Lütgens & Reimers, Bugsier
Resources used:	Initially two tugs, later a launch, sounding boat, bed leveller, four support tugs with towing supply vessel
Actions taken:	Re-floated
Results achieved:	Second attempt successful

3 COURSE OF THE ACCIDENT AND INVESTIGATION

3.1 Course of the accident

At 0628 on 4 December 2016, the German-flagged HANNI, sailing seaward, ran aground off Mühlenberger Loch in Hamburg. The master and chief officer were on the bridge. An overspeed protection alarm was issued for the main engine at 0621. Following that, the main engine automatically reduced the revolutions from 514 to 420 r/min and finally stopped.

At 0622, the bosun was ordered to proceed to the forecastle to operate the anchor. At 0623, the FINJA approached from the opposite direction and it was just possible to avoid a collision with her by setting the rudder to hard to starboard. At 0625, the main engine's control system was switched over to the engine control room (ECR). The anchors were ready to drop at 0626. The HANNI then drifted to the other side of the Elbe. Further engine alarms followed, including the shaft generator. The ship's lack of main engine meant she was not under command and only her momentum made steering possible.

They were only operating with starboard rudder and the main engine did not start until 0626 (now controlled from the bridge again). At 0628, the HANNI's speed over ground stood at zero and she was grounded to the south of the other side of the fairway with a draught of 6.1 m fore and 6.9 m aft. The propeller's pitch was set to zero and the vessel traffic service (VTS/Hamburg Port) informed about the accident on VHF channel 74, which ordered the two tugs RASANT and PROMPT, each with a bollard pull of 71 t maximum, as well as a harbour pilot.

In the meantime, the cargo holds were sounded. No water ingress was found in any of the three holds and no pollutants were escaping. According to the tide table, high tide at St. Pauli was at 0702 and at the mouth of the River Este at 0648 (-16 minutes), i.e. the ebb current was gradually setting in. The harbour pilot was on the bridge at 0700. The tug RASANT was made fast aft at 0706 with a draught of 5.60 m and 2 m of water beneath the keel. The forward tug PROMPT was made fast at 0718 with a draught of 5.60 m and 4 m of water beneath the keel. The pilot's strategy was to haul the HANNI off the sandbank at an angle to the fairway. This involved him using the generalised sounding chart on his portable pilot unit (PPU). A shallow was reportedly astern.

The HANNI was initially operated with her bow thruster set full to starboard and the engine commands *dead slow* and *slow ahead*. Even with each tug's bollard pull of 65 t (taking into account the HANNI's maximum bollard load), the HANNI barely moved in the hour that followed. The double bottom tanks 5 port and starboard and the centre tanks 4 and 5 were then drained and the forepeak filled until the air pipe started to overflow. At 0743, a water depth of 5.40 m was measured at the middle of the HANNI and the salvage was aborted at 0800. The water level stood at 3.30 m based on chart datum (CD), i.e. 0.6 m below maximum high tide. Both tugs were stood down at 0804. The main engine was switched off at 0814.

The WSP boarded the ship to record the accident at 0818. The harbour pilot disembarked at 0824. After the double bottom tanks were drained and the forepeak was filled, the draught at 0854 was calculated at 6.08 m fore and 6.18 m aft, thus almost an even keel. The next high tide at St. Pauli was at 1926 and at the mouth of the River Este at 1910.

At the invitation of the harbour master's office of the HPA, a meeting was held in the VTS at Bubendey-Ufer at 1500. In addition to the harbour master and a representative of the department responsible for shore-based port infrastructure, salvage experts from Lütgens & Reimers and Bugsier, the HANNI's owner, a representative of the Association of Hanseatic Marine Underwriters (Verein Hanseatischer Transportversicherer e.V. – VHT), and a harbour pilot were present. The HPA presented an up-to-date sounding chart. This indicated that the HANNI's forward third was in a water depth of 1.80-2.00 m based on low tide. After the most recent stability calculation of the HANNI and draining, as well as filling the forepeak, the draught was calculated at 6.24 m fore and 6.44 m aft, after 6.10 m fore and 6.90 m aft prevailed previously. The draught readings made by the launch HAFENAUFSICHT at 1600 stood at 3.90 m fore, 4.85 m middle and 5.65 m aft on the port side, and 3.80 m fore, middle unreadable and 5.70 m aft on the starboard side at a water level of 2.20 m. The heel was estimated at 2-3°. According to the sounding chart, the forward water depth was 1.80-2.00 m. This indicated a water depth of 4.00 m on the starboard side and 4.20 m on the port side at low tide. Based on the remaining tidal rise of 1.10 m up until high tide (predicted at 1926 -0.30 m), it was calculated that the HANNI would still be grounded at 1.14 m on the starboard side and 0.94 m on the port side at high tide. A calculation made by the VHT indicated that at a friction factor of 0.4, a bollard pull of 180-200 t would be sufficient to re-float the ship. Using these data and the up-to-date sounding chart, a decision was made to re-float the HANNI with four tugs and the support of the main engine, initially by hauling her half her length astern and then forward across the starboard shoulder. To this end, plans were also made to clear a channel toward the deep fairway. Moreover, an order was issued to close the River Elbe for the period concerned. While tugging the HANNI astern, it was important to ensure she was kept under control and could be stopped to avoid running onto the aft shallow.

The BUGSIER 11 made fast aft on the port side at 1720 with a draught of 6.0 m and bollard pull of 85.5 t, the BUGSIER 22 on the starboard side (spring forward) at 1754 with a draught of 5.35 m and bollard pull of 70.0 t, the BUGSIER 9 on the starboard side (spring aft) at 1755 with a draught of 6.11 m and bollard pull of 84.5 t, and the Bugsier 7 forward in the middle at 1811 with a draught of 6.20 m and bollard pull of 72.0 t. In the process, the towing supply vessel STUBBENUK transferred the tow lines due to her shallow draught. At 1815, the water level stood at 3.38 m based on CD. In addition, using the HPA's up-to-date sounding chart the bed leveller KEES JR[2] cleared a channel in front of the HANNI to allow her to be hauled back into the fairway.

[2] The KEES JR (see Fig. 3) lowers a plough bar into the water to churn up segments. The natural flow then carries the segments into deeper water, thus creating a channel.

Figure 3: Bed leveller KEES JR

At 1818, the attempt to re-float the ship started according to plan, initially astern with the help of the main engine. At 1830, the HANNI moved, was afloat again and could be tugged through the cleared channel. After the tanks and cargo holds were sounded, the HANNI was towed to Ellerholzhafen port, where she made fast at Berth 77a at 1942.

The propeller and bottom plating were surveyed in the water on 5 December 2016. A decision was taken to discharge the cargo at the Altenwerder Container Terminal and then shift the vessel to the Norderwerft shipyard in Hamburg unladen. She arrived at Berth 1 there at 2254 on 6 December.

Figure 4: Damage to the propeller

Figure 5: Damage to the bottom

3.2 Investigation

The HANNI was surveyed in the Norderwerft shipyard's floating dock on 13 December 2016. The master, the owner, a service engineer from the engine's manufacturer (MAN Diesel & Turbo Hamburg), and two investigators from the BSU were present.

The course of the accident and salvage were discussed initially. No pollutants escaped during the accident. The HANNI suffered damage to her underwater hull and propeller. The grounding was caused by the failure of the main engine and then drifting in the Elbe current. There were several alarms prior to the failure of the engine. The very powerful overspeed protection alarm caused the main engine and shaft generator to stop automatically. The two auxiliary diesel generators continued to run. The automated stop is comparable with a crash-stop, where the supply of fuel is ultimately discontinued. It took five to six minutes to restart the main engine (until control from the bridge was again possible). Recordings of the engine operation and any accumulated alarms were not available. During the accident, the alarm data recorder was out of service and the simplified voyage data recorder (S-VDR) did not record rudder and engine data. The speed governor was responsible for the error. The service engineer from MAN brought new replacement relays and pickups for this. A crack was found in a Hall generator. It was not possible to establish what caused this defect or how long it had existed. This crack caused incorrect rated speed synchronisation (see figure below). The speed measurement is set to a threshold of 15% at 514 r/min. The main engine shuts down automatically if this threshold is exceeded to avoid potential mechanical or thermal damage resulting from high centrifugal forces, which could lead directly to the total loss of the engine. Two independent pickups measure the rated speed. The cabling leads to two relays built into the alarm and monitoring system in the ECR. As soon as a pickup exceeds the pre-set threshold, either due to actual overspeed or a false value, the main engine is stopped automatically. The defective part must be replaced if a false value is transmitted (incorrect number of cycles).

Figure 6: Pickup

Figure 7: Crack in Hall generator

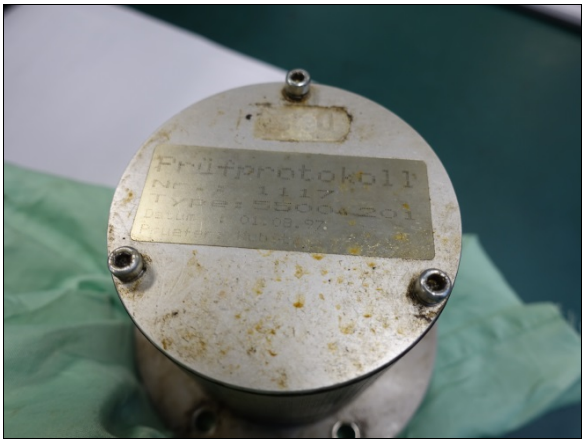

Figure 8: Hall generator
Test report of 1 August 1997

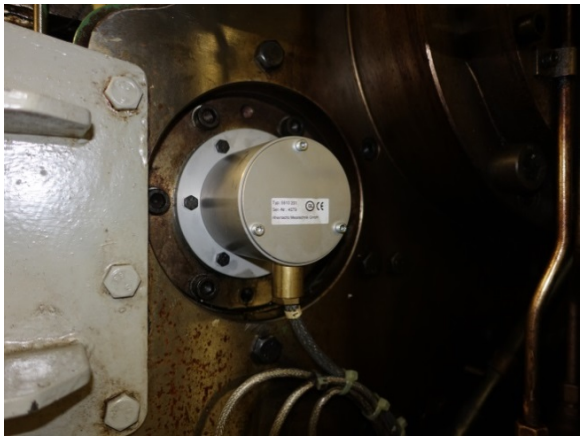

Figure 9: New Hall generator

After the failure of the main engine, the HANNI drifted to the other side of the fairway in an arc toward her port side and ran aground within seven minutes off Mühlenberger Loch, even though the master claimed they were only operating with starboard rudder. The wheelhouse poster and the pilot card, in which the manoeuvring characteristics should be entered, was only completed very sparsely. In the case of the HANNI, a steering effect to port (Hoovgard-effect) was to be expected with a right-handed controllable pitch propeller (CPP) when moving ahead. However, small rudder angles would be sufficient to compensate for the steering effect of the propeller and hull. This would have been possible with the installed flap rudder even at low speed. There are no recordings of rudder angle or propeller pitch on the S-VDR and the manoeuvring recorder in the ECR failed to record due to a fault. During an automated crash-stop, the revolutions are gradually reduced to zero and the pitch is adjusted to neutral. This can disturb the laminar flow at the rudder and influence the rudder effect.

The FINJA, which has a length of 67 m, width of 12 m and deadweight of 1,335 t, was passing at a distance of 80 m and had hardly any impact on the HANNI's track. Yaw-moments acted on both vessels during the pass. Due to the FINJA's low mass and the relatively large distance between one another, the yaw-moments could have been easily compensated for with low rudder angles, so as to stay on course. The alternating forces and moments between one another follow each other in short succession, meaning virtually the old track is reached after the pass, without having to correct the rudder. However, the HANNI actually only turned to port. Almost slack water and NNW winds of 3 Bft prevailed at this point.

The engine room log indicated that the main engine was started at 0600 shortly before casting off in Hamburg. According to a check list, the second auxiliary diesel generator (480 kW) is switched on while preparing for estuary trading in harbour mode. This is switched to the on-board power supply network automatically. The system pumps are started, high- and low-temperature port service pumps are switched off and the main engine is started after its lubricating oil temperature reaches 66 °C. As soon as the shaft generator is at full power (770 kW), a selector switch on the main switchboard is used to separate shaft and diesel generators.

Only then is it possible to switch on the shaft generator and equalise it with the on-board power supply network. The power required to operate the bow thruster (550 kW) is then available and the vessel ready to cast off.

The vessel can proceed without the auxiliary diesel generators in sea mode. Energy demand is controlled by the energy management system. For example, in the event of a blackout the emergency diesel generator should start automatically first so as to restore basic energy supply. This should make it possible for the auxiliary diesel (with the associated supply peripherals) to start immediately afterwards, which can then supply the steering gear.

The wheelhouse poster (see Fig. 10) is only completed very sparsely. It was hanging in the companionway to the bridge during the BSU's survey. Key manoeuvring data, including turning circles when in laden state, as well as the emergency manoeuvre and advance distance characteristics were absent. The turning circle in ballast is specified at 195 m and takes 3.38 minutes when the momentum is 4.2 kts. A course alteration of 90° would have taken 0.9 minutes when the distance covered was also 195 m and the momentum 10.5 kts. After 100 m, the HANNI would turn after about 30 seconds. The wheelhouse poster gave no indication of the propeller's steering effect. A right-handed CPP was rather unusual for the year in which the vessel was built. This information was also absent.

It was noted during the inspection of the timesheets that the chief officer and second officer's sea watch schedule was organised such that each was on watch at six-hourly intervals. During unfavourable times at sea/in port in feeder service, this can quickly cause fatigue, unless the master takes over regularly. No irregularities were found during the formal inspection of hours of work and rest in the last four days.

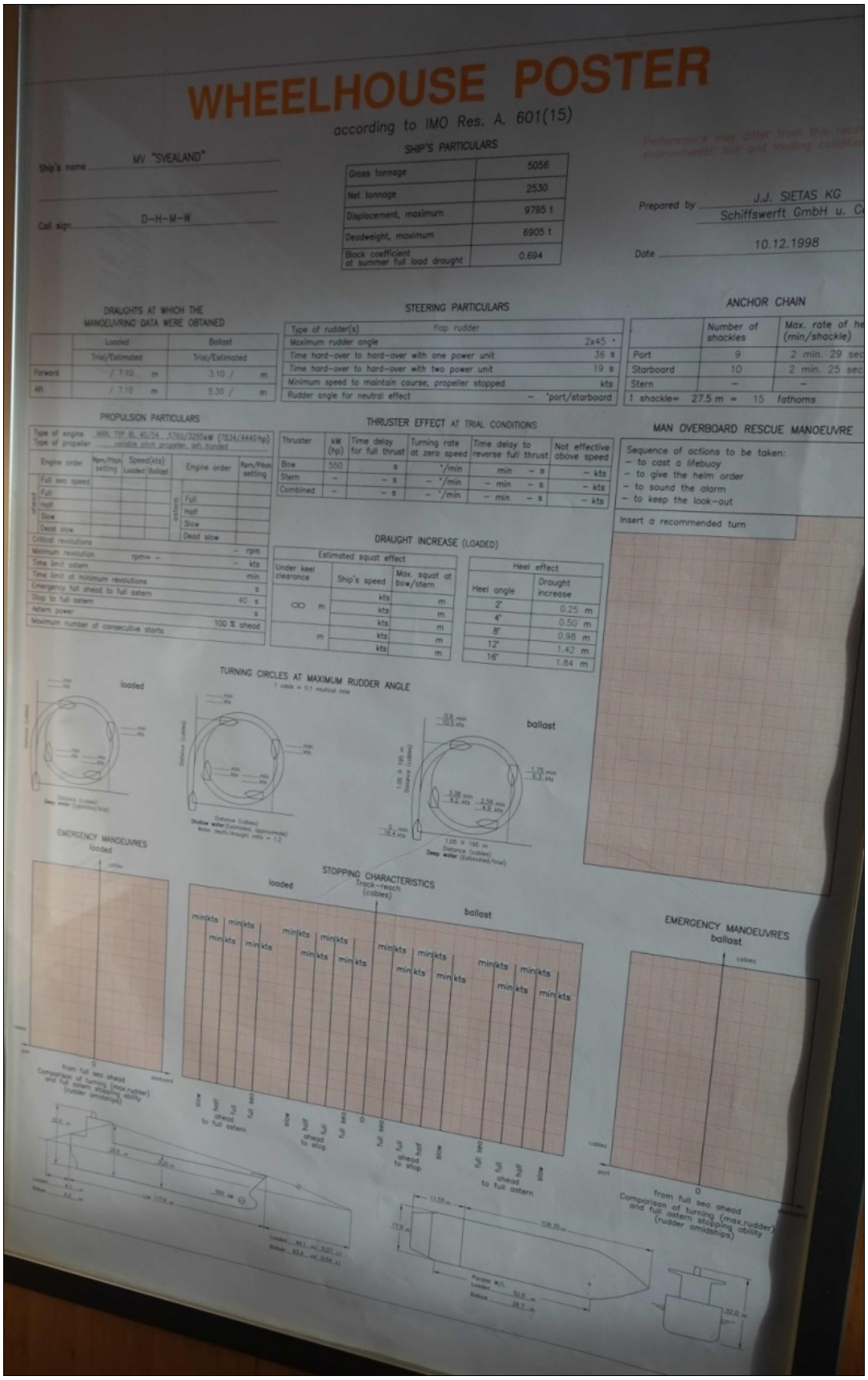

Figure 10: Wheelhouse poster

3.2.1 Visit to the Harbour Pilots' Association and VTS

On 24 January 2017, the BSU visited the Harbour Pilots' Association and the VTS in Hamburg. On the day of the accident, the harbour pilot was already on board the HANNI at 0700, half an hour after she grounded, and the two tugs were made fast at 0706 and 0718. According to the PPU, which refers to CD, only the forward section of the HANNI was grounded between two shallows. It was unclear how the HANNI arrived at this position. Therefore, it was first planned to attempt to re-float her forward at an angle from the edge of the shallows on the ebb tide, which was now setting in. This attempt failed, as did ensuing attempts to move her with the support of the main engine and tugs operating at almost maximum bollard pull (taking into account the HANNI's maximum bollard load), and the water continued to recede. In the end, the salvage attempt had to be aborted after one hour.

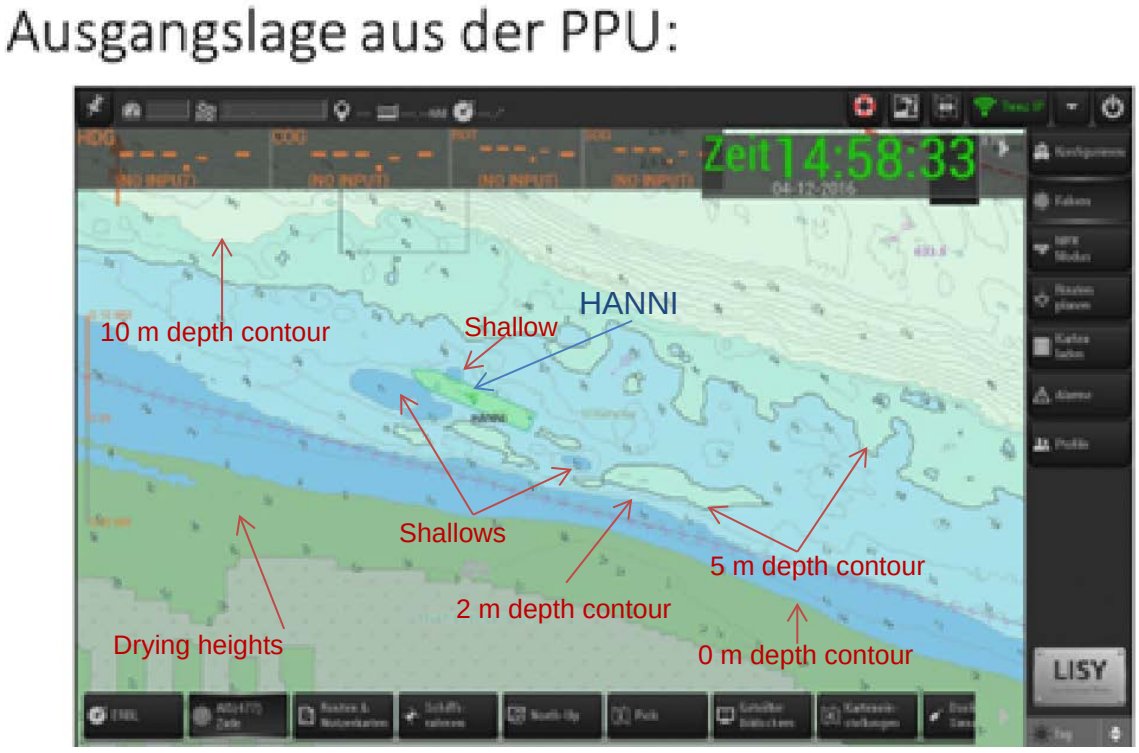

Figure 11: Portable Pilot Unit (PPU)

New knowledge about the situation only came to light after the HPA had prepared a new sounding chart using the sounding boat DEEPENSCHRIEWER 1 between 1100 and 1230 on the day of the accident. The generalised depth contours and areas on the harbour pilot's PPU were no longer up to date, even though new sounding data from the HPA are used to adjust them on a monthly basis. According to the DEEPENSCHRIEWER 1's sounding chart, the HANNI's fore section was grounded completely and her port side up to the middle.

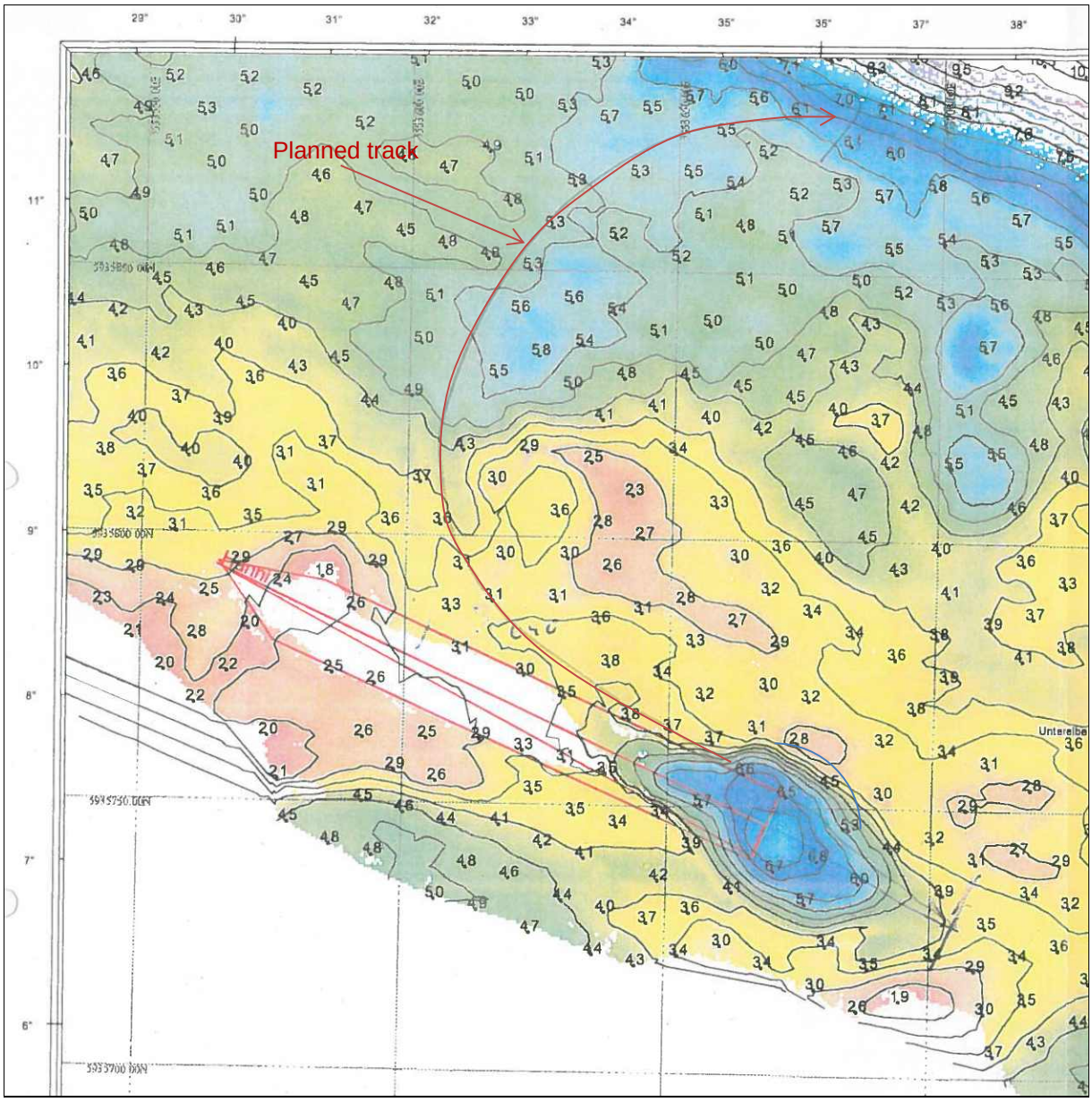

Figure 12: DIEPENSCHRIEWER 1's sounding chart[3]

Using the current sounding chart, it was possible to draw up a salvage plan in the VTS of the HPA on the afternoon of the day of the accident. The second salvage attempt with four tugs and a bed leveller was successful. At 1830, about an hour before the next high tide and 12 hours after she grounded, the HANNI was re-floated and, on condition that she be escorted by two tugs, shifted to Berth 77A in Ellerholzhafen port. Damage to the propeller was found during the dive at the berth, meaning the HANNI had to call at a shipyard after she was unloaded. She was escorted by a tug when she was shifted there. The cause of the accident had to be identified first.

[3] The sounding chart refers to mean sea level – 1.6 m (mean low tide). The blue polygons behind the plotted outline of the HANNI are depth areas created by her propeller vortex prior to or during the first salvage attempt.

4 ANALYSIS

4.1 Radar and radio recordings of the VTS, data from the HANNI's VDR and statements from the crew

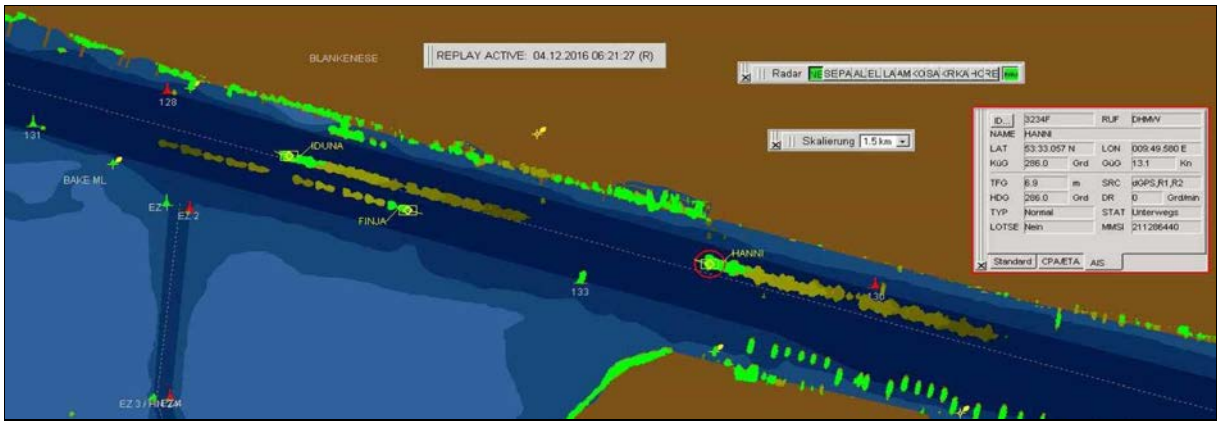

Figure 13: VTS radar 062127, first alarm, 13.1 kts

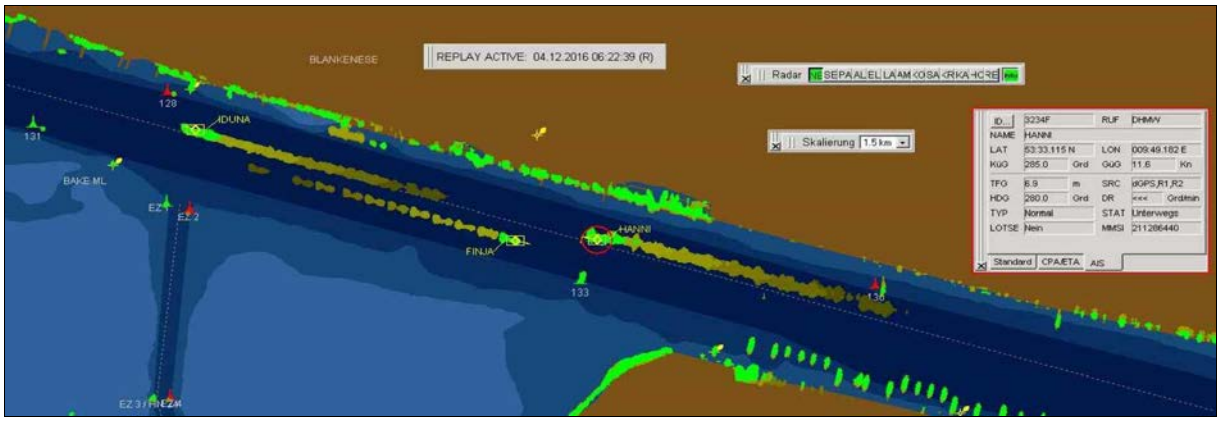

Figure 14: VTS radar 062239, control in engine room, 11.6 kts

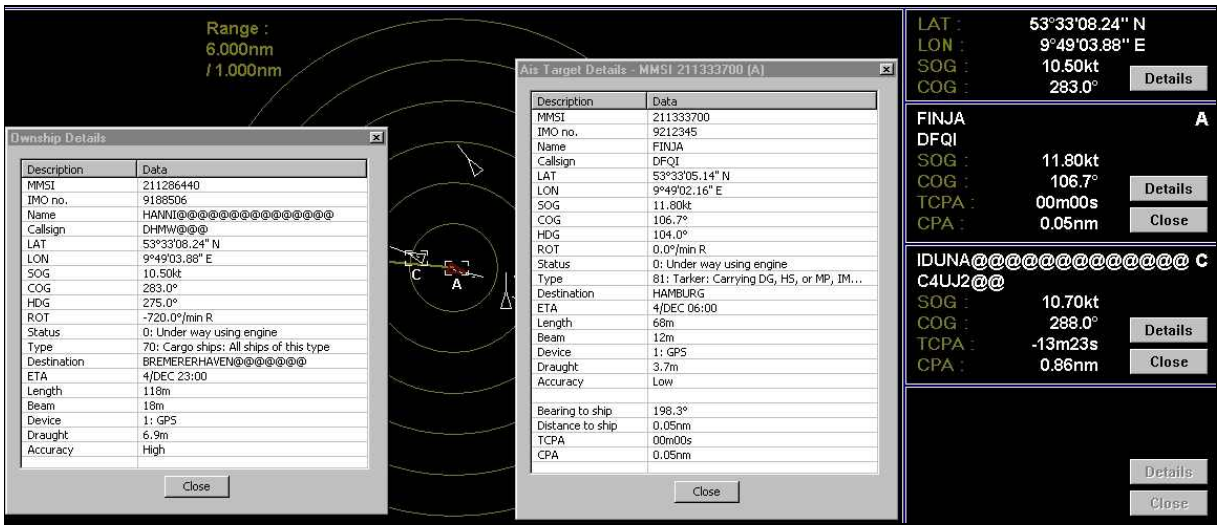

Figure 15: HANNI's AIS at 062316, the FINJA passed at a distance of about 80 m from the ship's side

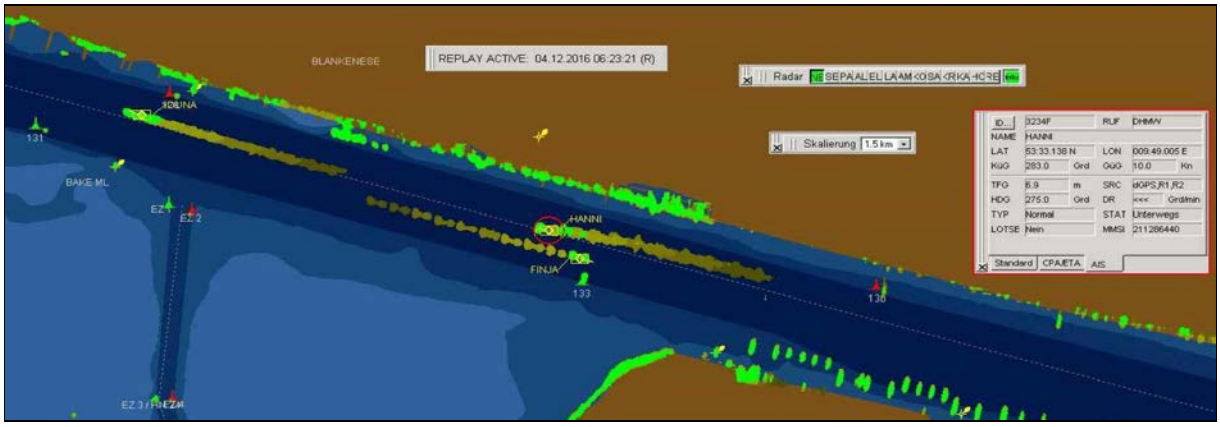

Figure 16: VTS radar 062321, second alarm, 10.0 kts

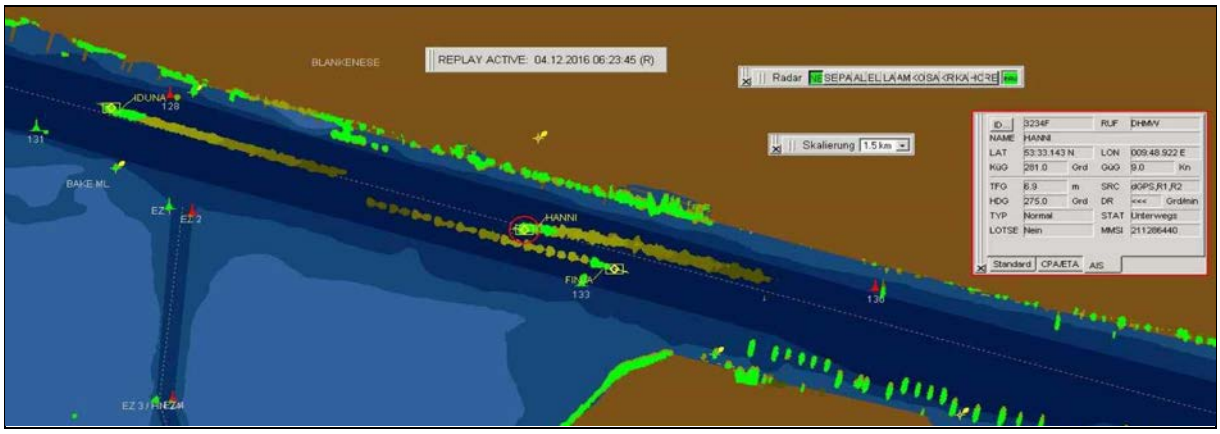

Figure 17: VTS radar 062345, third alarm, 9.0 kts

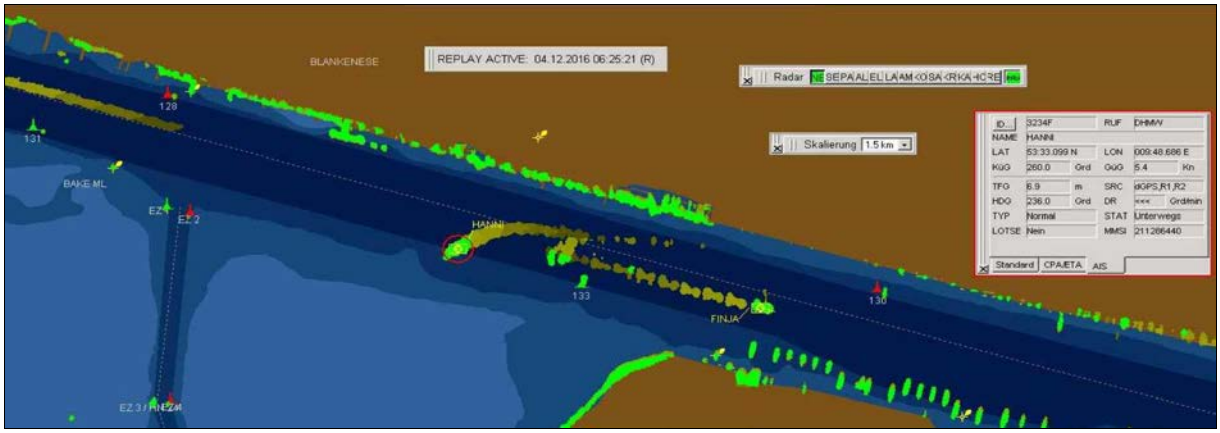

Figure 18: VTS radar 062521, fourth alarm, 5.4 kts

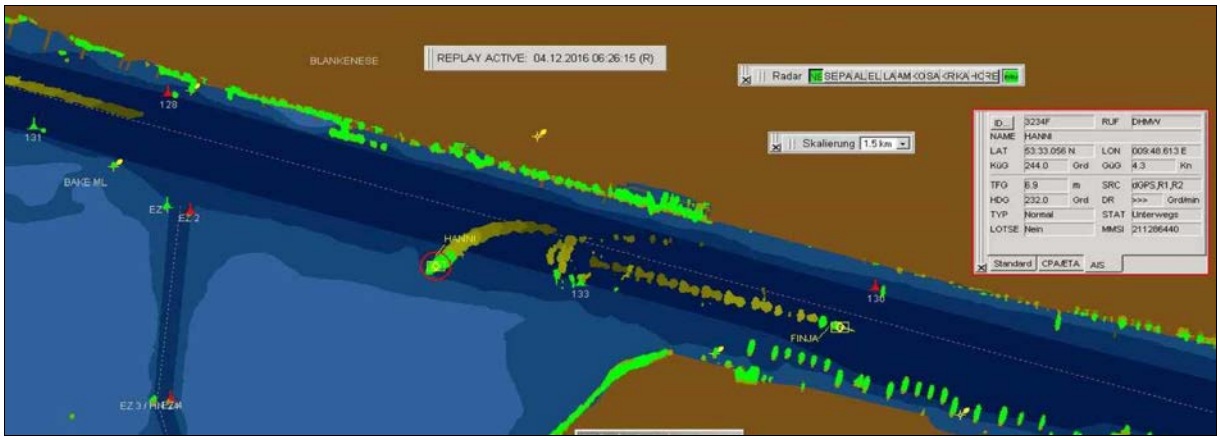

Figure 19: VTS radar 062615, anchors ready to drop, 4.3 kts, engine running

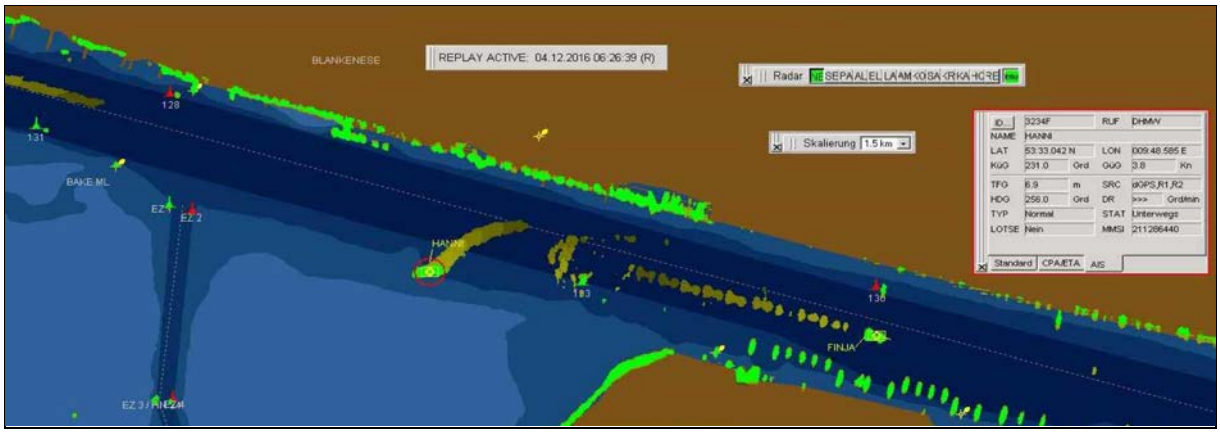

Figure 20: VTS radar 062639, VTS call (What is wrong with the HANNI?), 3.8 kts

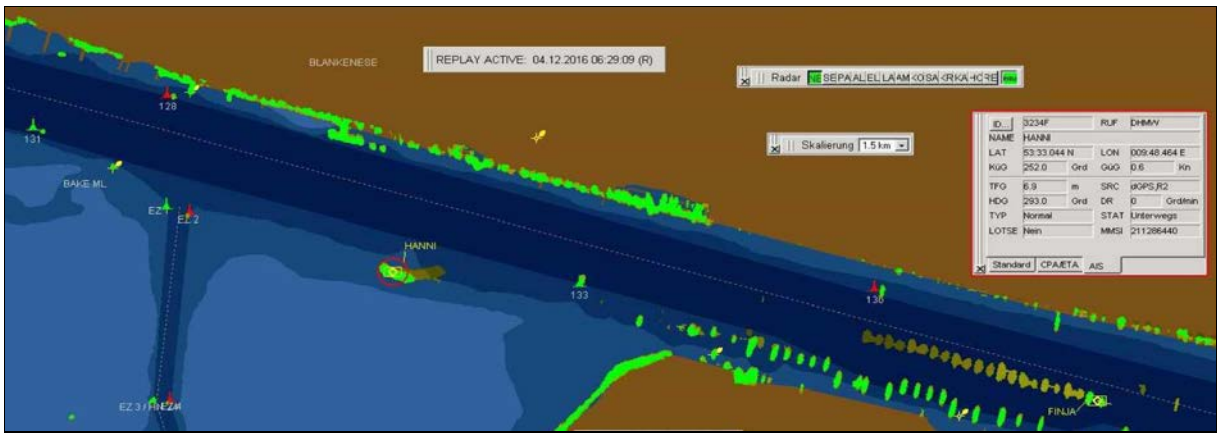

Figure 21: VTS radar 062909, HANNI contacts the VTS, 0.6 kts

4.2 HANNI's VDR

UTC (universal time coordinated), HDG (heading), COG (course over ground), SOG (speed over ground)

UTC	HDG	COG	SOG	Audio analysis
051959	286.4	286	13.1	Main engine running with shaft generator
052104	285.8	286	13.2	
052109	285.8	286	13.2	
052114	286	285	13.2	
052120	286.2	285	13.2	
052124	286.2	285	13.2	1st overspeed alarm and shaft generator alarm
052130	286.1	286	13.2	Statement that they were reportedly only operating with starboard rudder
052135	286.1	286	13.2	
052139	286.1	286	13.2	
052144	286	286	13.2	
052149	285.8	286	13.2	
052154	285.8	286	13.2	
052159	285.7	286	12.9	
052210	284.8	286	12.2	Statement that two gen-erators were reportedly in operation
052215	284.1	286	11.8	
052220	283	286	11.5	
052224	282.1	286	11.1	
052229	281.3	285	10.8	
052234	280.7	283	10.5	
052240	279.8	283	10.2	Manoeuvring control switched over to the ECR
052244	279.5	282	9.9	
052250	278.8	281	9.7	
052255	278.1	280	9.3	
052300	277.7	280	9.1	
052305	277.1	279	8.9	Anchors ready to drop command
052311	276.3	278	8.7	
052315	275.8	278	8.4	The FINJA passed at an AIS distance of 0.05 nm (about 80 m from ship's side to ship's side)
052320	275	277	8.2	2nd alarm
052325	274.1	277	8	
052330	272.8	277	7.8	
052335	271.6	276	7.7	
052340	270.3	275	7.5	
052345	268.6	275	7.3	3rd alarm
052350	267	275	7.1	
052355	265.1	273	6.8	
052400	263.1	272	6.7	
052405	261	271	6.5	
052410	258.8	269	6.3	
052415	256.6	267	6.1	
052420	254.6	264	6	
052425	252.8	262	5.8	

052430	251	259	5.7	
052435	249.1	256	5.5	
052440	247.5	254	5.4	
052445	245.8	251	5.2	
052450	244.3	249	5.1	
052455	242.6	248	5	
052500	241	246	4.9	
052505	239.3	245	4.8	
052510	237.6	243	4.6	
052515	236.1	241	4.5	
052520	234.6	239	4.4	4th alarm
052525	233.1	236	4.3	
052530	231.8	235	4.2	
052535	230.5	234	4.1	
052540	229.7	230	4.1	
052545	229.5	226	4.1	
052551	230.7	217	4.2	
052555	232.2	214	4.3	
052601	234.9	210	4.5	
052606	238.4	208	4.6	
052611	242.2	208	4.8	Anchors ready to drop, main engine running
052620	249.7	216	4.7	
052625	253.7	220	4.7	
052631	258	226	4.6	
052636	261.5	232	4.5	
052641	264.8	236	4.4	VTS: What is wrong with the HANNI?
052646	267.9	242	4.4	
052651	270.9	248	4.3	
052656	273.8	254	4.3	
052700	275.9	256	4.3	
052706	278.2	260	4	
052711	279.9	263	3.8	
052716	281.7	263	3.5	
052721	283.4	267	3.2	
052726	285.4	269	3	
052731	287.2	269	2.9	
052736	289.4	268	2.7	
052741	291.2	267	2.4	
052746	292.4	263	1.9	
052751	292.9	245	0.9	
052756	293	245	0.3	
052801	293	245	0.1	Firmly aground
052807	293	245	0	
052811	293	245	0	
052817	293	245	0	
052822	293	245	0	
052827	293	245	0	
052831	293	245	0	
052836	293	245	0	
052841	293	245	0	
052846	293	245	0	
052851	293	245	0	
052856	293	245	0	
052902	293	245	0	
052907	293	245	0	HANNI contacts the VTS with rudder and engine failure
052912	293	245	0	Aground, two tugs ordered

Figure 22: Table showing VDR data

5 CONCLUSIONS

The grounding incident was triggered by an overspeed protection alarm causing the main engine to stop automatically, similar to a crash-stop, so as to avoid potential mechanical or thermal damage resulting from excessive centrifugal forces, which could lead directly to the total loss of the engine. The alarm was due to a defective pickup. The rated speed is measured with two independent Hall generators. In the event of excessive deviations in the rated speed measured or overspeed, the main engine's rated speed is slowly reduced, the CPP's pitch is adjusted to zero, and the shaft generator is automatically disconnected from the on-board power supply network. In estuary trading, as was the case here, only the two diesel generators, which also drive the steering gear, are then running. Without a shaft generator, there is not enough power to operate the bow thruster.

The pickups are maintenance-free according to the manufacturer. Replacement is only required when a sensor is defective. The defective Hall generator was tested on 1 August 1997, i.e. before the ship was put into service. According to the manufacturer's specifications, bypassing makes operation with one Hall generator possible. This procedure cannot be carried out during estuary trading, however. A greater degree of safety could be achieved if the existing Hall generators and their sensors were included in a periodic maintenance plan.

It took five to six minutes to restart the engine after the first alarm at 0621, i.e. an appropriate time that merits no criticism. During this period, the forecastle was manned by the bosun and the anchors were ready to drop. One minute later, at 0628, the HANNI is grounded to the south of the other side of the fairway. Prior to that, at 0623, the approaching FINJA was passed at a lateral distance of 80 m. By their own account, they were only operating with starboard rudder during the engine failure. The master had only one minute to prevent the vessel from grounding by anchoring or manoeuvring. At 0627, the HANNI's SOG was still 4 kts. In this situation, the master decided to continue instead of dropping the anchor and stopping. The heading altered just slightly to starboard, while the vessel was only turning to port as she was drifting beforehand (see table). According to the navigational chart, the HANNI was located between the 2 m and 5 m depth contour. Almost slack water prevailed at a mean tidal range of 3.5 m and draught of 6.1 m fore and 6.9 m aft in light NNW winds. The manoeuvre could have just succeeded.

The reason why the HANNI drifted to the other side of the fairway – even though she was still making headway and only operated with starboard rudder angles – can only be established through extensive hydrodynamic studies that would be applicable only to this situation and type of ship. Moreover, the hydrodynamic effect of the oncoming FINJA, the CPP's right-handed screw, and the sudden stop with the propeller set to neutral would need to be considered in the process. Following a cost/benefit analysis, the BSU dispensed with examining the effects of the HANNI.

It is important to remember here that the rudder angles and engine manoeuvres were not recorded because the HANNI is only equipped with a S-VDR. Consequently, a blackout cannot be ruled out entirely. The rudder would then cease to be available immediately. Furthermore, the VTS was advised that the HANNI had suffered rudder and engine failure during the accident report at 0628. Neither the crew nor the owner assisted the BSU with its investigation of this aspect.

The actions taken by the VTS and other departments of the HPA after the HANNI grounded and the salvage were rapid and appropriate. Two tugs started the first salvage attempt only half an hour after the vessel grounded. The ebb current was just setting in according to the tide table of the BSH. Although the sounding charts in the harbour pilot's PPU are updated on a monthly basis and far more accurate than navigational charts, soundings made subsequently by the HPA revealed that more of the HANNI's fore section was grounded than indicated by the PPU. Therefore, the first attempt to re-float the HANNI across the starboard bow failed. It was also unclear which track had taken the HANNI to this position. They only succeeded in hauling the HANNI into the fairway – first astern and then across the starboard bow through the channel made by the KEES JR – during the second salvage attempt made on the next high tide with additional tug capacity after reducing the draught by pumping and trimming.

6 SAFETY RECOMMENDATIONS

6.1 Owner of the HANNI

The Federal Bureau of Maritime Casualty Investigation recommends that the owner include the pickups and associated speed sensors in a periodic maintenance plan and/or wherever appropriate take the precaution of exchanging them on its ships in accordance with empirical values specified by the manufacturer.

6.2 Owner of the HANNI

The Federal Bureau of Maritime Casualty Investigation recommends that the owner revise the wheelhouse poster and the pilot card and supplement all queried data, as well as include the CPP's direction of rotation.

6.3 Master of the HANNI

The Federal Bureau of Maritime Casualty Investigation recommends that the master change the underway watch schedule so that officers are not on watch for more than ten hours each day.

6.4 Engine manufacturer

The Federal Bureau of Maritime Casualty Investigation recommends that MAN Diesel & Turbo SE configure the main engine's pickups for newly-built craft such that a plausibility check of the measurements is made between the sensors.

7 SOURCES

- Investigations of WSP Hamburg (WSPK1)

- Written statements
  - Ship's command
  - Harbour master's office of the HPA
  - Hamburg Harbour Pilots' Association
  - MAN Diesel & Turbo Hamburg

- Witness testimony
  - Master and pilot

- Navigational charts and ship particulars, BSH

- Radar recordings, ship safety services/VTSs
  - VTS Hamburg of the harbour master's office