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

Investigation Report 154/12

Serious Marine Casualty

Collision between the ro-pax ferry NILS HOLGERSSON and the ro-pax ferry URD in the port of Lübeck-Travemünde on 3 May 2012

2 May 2013

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 act, 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

Director: Volker Schellhammer
Phone: +49 40 31908300 Fax: +49 40 31908340
posteingang-bsu@bsh.de www.bsu-bund.de

Table of Contents

Table of Figures

Table of Spreadsheets

1 Summary

On the evening of 3 May 2012, the German-flagged ferry NILS HOLGERSSON sailed into the port of Travemünde, where she was to make fast with her stern at pier 6a of the Skandinavienkai. The turning manoeuvre in the Siechenbucht (turning basin) necessary for this failed because the two pod propulsors[1] were still being operated in 'Sea mode'. Because of that, the rudder angle was limited to +/- 35° and the rotation of the pods retarded because only one hydraulic pump was activated per propulsor, instead of two. The ship's command was unable to stop in the turning basin and the ferry headed towards the opposite pier at a speed over ground of 6.51 kts. The Danish ferry URD, whose crew was occupied with making preparations for the scheduled voyage to Liepaja, Latvia, was made fast there at pier 3. Most of the passengers and the cargo were already on board.

The collision occurred at 181437[2]. The port side of the URD was pressed in by the bow of the NILS HOLGERSSON, causing the URD to take on water and heel to port. It was possible to stabilise the ship by flooding the forward ballast water tanks, which enabled the evacuation of people and much of the cargo via the stern ramp.

The NILS HOLGERSSON was able to move to her berth under her own power after the controls were switched to 'Harbour mode'.

Nobody came to physical harm and the environment was not damaged due to the collision.

---

1 Electric motors, each placed in a pod beneath the ship, which drive the propeller directly.
2 All times shown in this report are local (Central European Summer Time – CEST) = UTC + 2 hrs.

2 SHIP PARTICULARS

2.1 NILS HOLGERSSON

2.1.1 Photo

Figure 1: Photo of vessel NILS HOLGERSSON

2.1.2 Particulars

Name of vessel:	NILS HOLGERSSON
Type of vessel:	Ro-ro passenger vessel
Nationality/Flag:	Federal Republic of Germany
Port of registry:	Lübeck
IMO number:	9217230
Call sign:	DNPI
Owner:	TT-Line GmbH & Co. KG
Year built:	2001
Shipyard/Yard number:	SSW Fähr- und Spezialschiffbau GmbH, Bremerhaven/2000
Classification society:	Germanischer Lloyd SE
Length overall:	190.77 m
Breadth overall:	35.87 m
Gross tonnage:	36,468
Deadweight:	6,475 t
Draught (max.):	6.20 m
Engine rating:	20,118 kW

Main engine:	Dieselelectric propulsion via 2 pods SSP 10
(Service) Speed:	18.5 kts
Hull material:	Steel
Minimum safe manning:	18

2.1.3 Voyage particulars

Port of departure:	Trelleborg, Sweden
Port of call:	Travemünde
Type of voyage:	Merchant shipping International
Cargo information:	Passengers, freight
Manning:	43
Draught at time of accident:	6.2 m
Pilot on board:	No
Canal helmsman:	No
Number of passengers:	63

2.2 URD

2.2.1 Photo

© Hasenpusch Photo-Productions

Figure 2: Photo of vessel URD

2.2.2 Particulars

Name of vessel:	URD
Type of vessel:	Ro-ro passenger vessel
Nationality/Flag:	Danish
Port of registry:	Kalundborg
IMO number:	7826855
Call sign:	OUYL2
Owner:	Scandlines Deutschland GmbH
Year built:	1981
Shipyard/Yard number:	Nuovi Cantieri Apuania SpA/2119
Classification society:	Lloyd's Register
Length overall:	171.05 m
Breadth overall:	20.82 m
Gross tonnage:	13,144
Deadweight:	4,562 t
Draught (max.):	5.43 m
Engine rating:	8,826 kW
Main engine:	2 x Wärtsilä 12V32D
(Service) Speed:	17.5 kts

Hull material:	Steel
Minimum safe manning:	15

2.2.3 Voyage particulars

Port of departure:	Travemünde
Port of call:	Liepaja, Latvia
Type of voyage:	Merchant shipping International
Cargo information:	Passengers, freight
Manning:	23
Draught at time of accident:	Approx. 5.38 m
Pilot on board:	No
Canal helmsman:	No
Number of passengers:	Approx. 65[3]

[3] 65 passengers were already registered on board and another 10 to 15 people were still on the way from check-in to the ferry.

2.3 Marine casualty or incident information

Type of marine casualty:	Serious marine casualty, collision
Date, time:	3 May 2012, 1814
Location:	River Trave, Skandinavienkai
Latitude/Longitude:	φ 53°56.97'N λ 010°51.51'E
Ship operation and voyage segment:	Harbour mode
Place on board:	Bow
Consequences:	Material damage

Excerpt from Nautical Chart 51 (plan), BSH

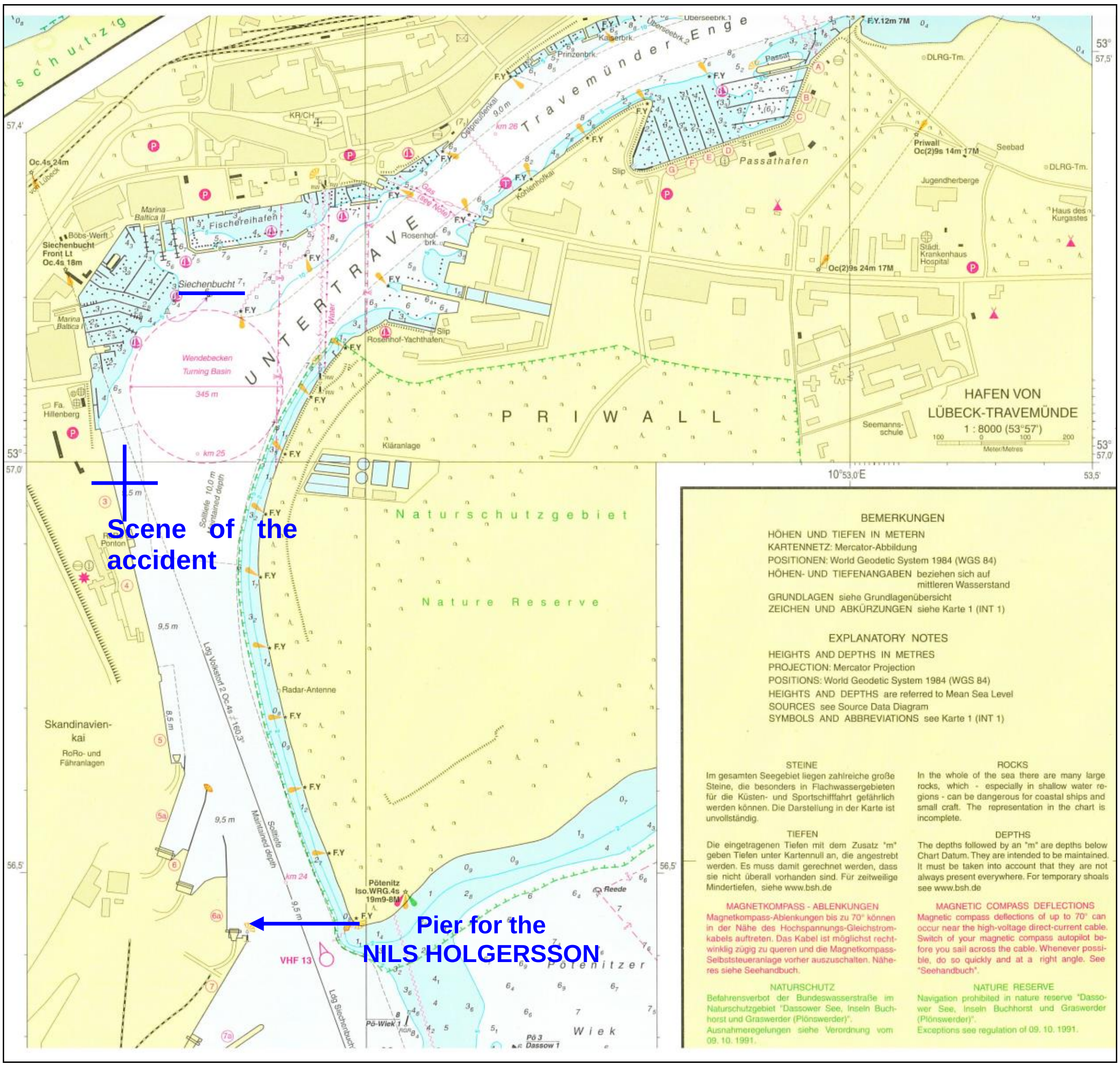


Figure 3: Nautical chart

2.4 Shore authority involvement and emergency response

Agencies involved:	Waterway Police Lübeck-Travemünde German Central Command for Maritime Emergencies (CCME) Lübeck fire brigade DGzRS[4] Federal Police Sea Division[5] THW[6] Lübeck and Oldenburg/Holstein LKN[7] Schleswig-Holstein Seamen's Mission Lübeck
Resources used:	Search and rescue vessel HANS INGWERSEN Rescue cruiser HANS HACKMACK Rescue cruiser BREMEN Fireboat SENATOR EMIL PETERS Customs boat PRIWALL Police boat HABICHT
Action taken:	Pumping work on the URD, precautionary measures for possible water pollution, traffic safety measures, care of the passengers and crew members
Results achieved:	The URD was pumped out successfully, no damage to the environment

[4] Deutsche Gesellschaft zur Rettung Schiffbrüchiger (German Maritime Search and Rescue Service)
[5] Federal Police Directorate Bad Bramstedt - Federal Police Sea Division
[6] Federal Agency for Technical Relief
[7] State Agency for Coastal Protection, National Park and Marine Conservation

3 COURSE OF THE ACCIDENT AND INVESTIGATION

3.1 Course of the accident

The NILS HOLGERSSON was in daily service on the Travemünde/Trelleborg ferry route. She cast off in Trelleborg at 1000 on 3 May 2012. The Trave approach buoy was passed at 1748. A corresponding report to Vessel Traffic Service Travemünde ('Trave Traffic') was made on VHF channel 13. At this point the bridge crew consisted of a deck officer (officer in charge of the navigational watch), the master, the chief officer and a helmsman. A service technician who was analysing recorded data from the propulsion plants was also on the bridge.

Both the master and the chief officer were exempt from the requirement to make use of a pilot for the approach to the port of Travemünde, thus navigating without a pilot. The weather and flow conditions were good. The wind blew from the east at 2 Bft. Good visibility prevailed and there was no rainfall. The water level in Travemünde stood at 5.11 m and the current was slowly receding.

The master assumed control of navigation after the Trave approach buoy had been passed. Shortly afterwards, the deck officer left the bridge. At 1755, the chief officer reported to Trave Traffic on VHF that Green Buoy 1 had been passed. The mood on the bridge was relaxed. Questions of the service technician regarding certain navigational manoeuvres were answered. At 1802, the NILS HOLGERSSON passed buoy pair 3/4. Speed over ground was just under 9 kts. The bridge crew, consisting of the master, the chief officer and the helmsman, cooperated proficiently during the approach. Communication on the bridge consisted almost exclusively of the setting and acknowledgement of courses.

At 1803, the NILS HOLGERSSON was level with the breakwater at Travemünde. According to the instructions in the owner's bridge handbook, 'Harbour mode' should have been activated from that point. This did not happen.

The jetty was passed at 1804. Speed over ground stood at 7.23 kts. It was planned to execute the turning manoeuvre in the Siechenbucht and then move sternward towards pier 6a of the Skandinavienkai. When the Priwall car ferries were passed, the master assumed control of the pod propulsors and the helmsman left the bridge. On the radar (head-up display, range 0.25 nm) the expected course alteration was monitored using the prediction function, which shows the position of the ship in 90 seconds.

At 181037, 'Tandem mode' was switched to 'Single mode' operation on the central control position. As a result, both pod propulsors could be controlled independently of each other. Speed over ground stood at 7.8 kts. The steering angle was set at + 90° (port pod) and – 90° (starboard pod) with a rated speed of 27 rpm by the master.

At 181053 steering angles of + 32° (port) and - 34° (starboard) were reached when the NILS HOLGERSSON was just off the first dolphin off the fishing port. As the ferry was still operating in 'Sea mode', the steering angles for both pods were limited to +/- 35° each, so that the order of +/- 90° was not executed by the steering system. The heading was 230.3° and the course over ground 229.9°. At 181130, control of the pod propulsors was switched to the port wing.

Due to the adjusted steering angle, the speed was slightly reduced. When the NILS HOLGERSSON reached the turning basin at 181203, the speed over ground still stood at 6.9 kts with a heading of 226° and a course over ground of 227°. The master instructed the chief officer to push 50 % to starboard with the bow thrusters. However, use of the bow thrusters had little effect due to the high speed. As a result, the NILS HOLGERSSON did not turn as expected, but continued to move towards the opposite pier (see Figure 4).

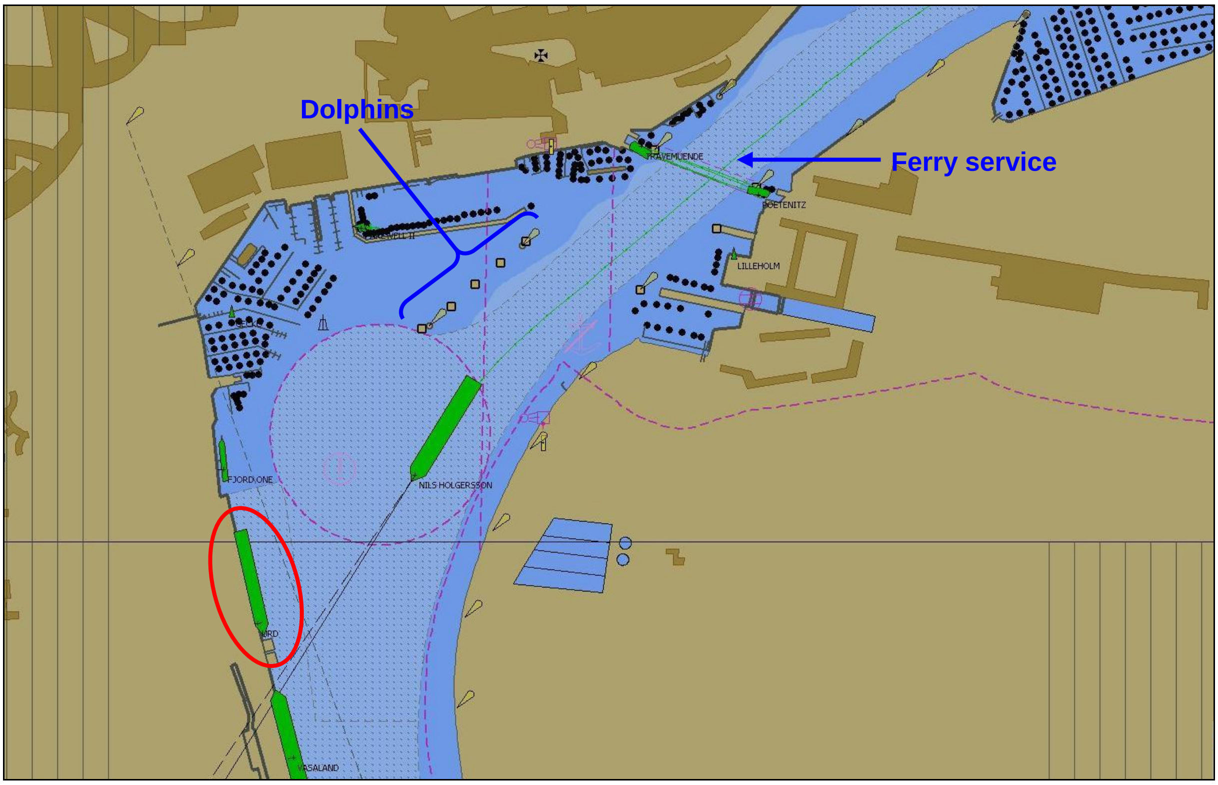


Figure 4: AIS recording from Trave Traffic

The URD had been made fast at pier 3 of the Skandinavienkai since 0730. The URD operated on the Travemünde/Liepaja[8] route and had been undergoing preparations for the next passage to Liepaja since 1230. The last HGVs[9] were already loaded at 1812. The drivers had left the cargo decks. Most of the passengers were already on board; 10 to 15 passengers were still on their way from check-in to the ferry. The master of the URD was finishing paperwork in the office when the turning manoeuvre of the NILS HOLGERSSON failed.

[8] On 1 January 2013, the ferry service was acquired by Stena Line Scandinavia AB.
[9] Heavy goods vehicle

The conversation on the bridge indicated that at 181200 they were confident they would be able to execute the turn successfully. This changed at 181211. The master noticed the inconsistency with usual turning manoeuvres of the turning speed and the speed reduction. Although a course alteration was displayed on the radar by means of the prediction function, this did not appear to be sufficient. Therefore, the pod propulsor emergency steering control was activated.

The chief officer was instructed to set the bow thrusters to starboard. This increased the power level to about 70-80 %, after which the ship started to vibrate severely. However, the NILS HOLGERSSON's speed over ground was still 5.85 kts.

It was possible to reduce the speed over ground slightly to 5.74 kts by 181345; however, a few seconds it climbed back to 5.89 kts. At 181413, a ship's deck rating on the forecastle reported a distance of approx. 30 m from the URD by ship radio.

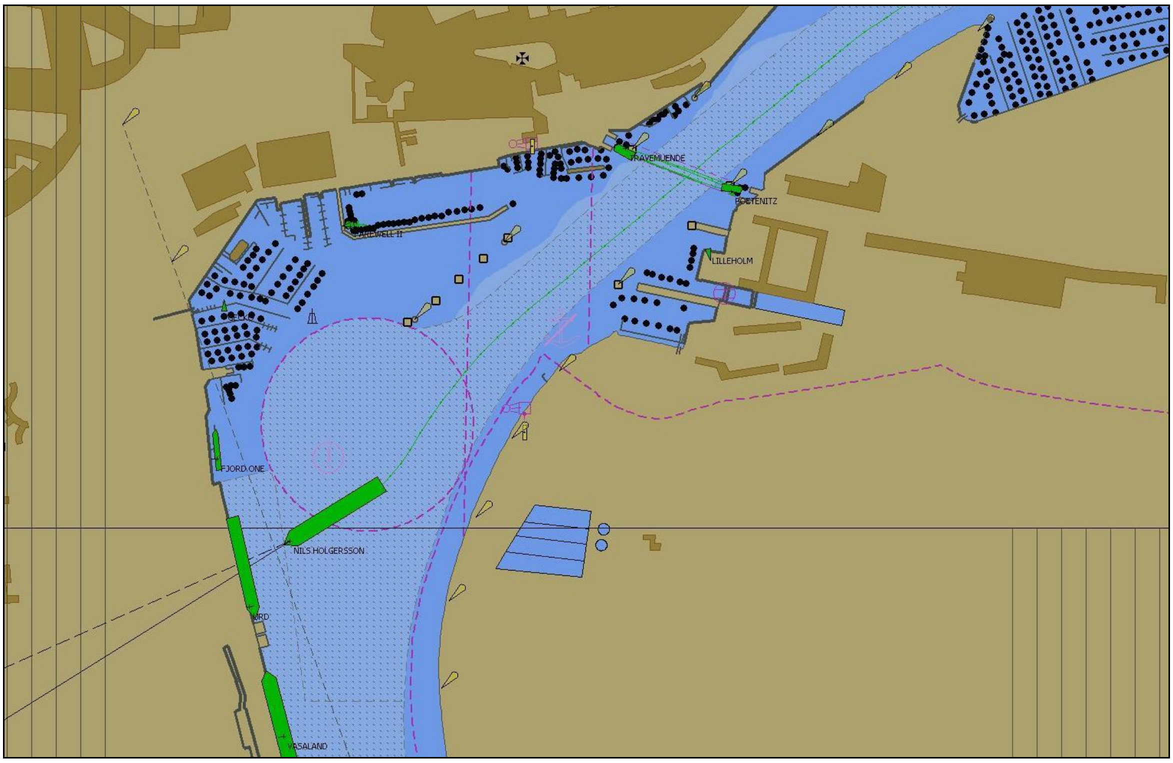


Figure 5: AIS recording from Trave Traffic shortly before the collision

At 181417, the NILS HOLGERSSON drew attention to the situation by means of the tyfon. In response to that, the master and third nautical officer on the URD went to the bridge.

The collision occurred at 181437. At that point, the NILS HOLGERSSON's speed over ground was 6.51 kts.

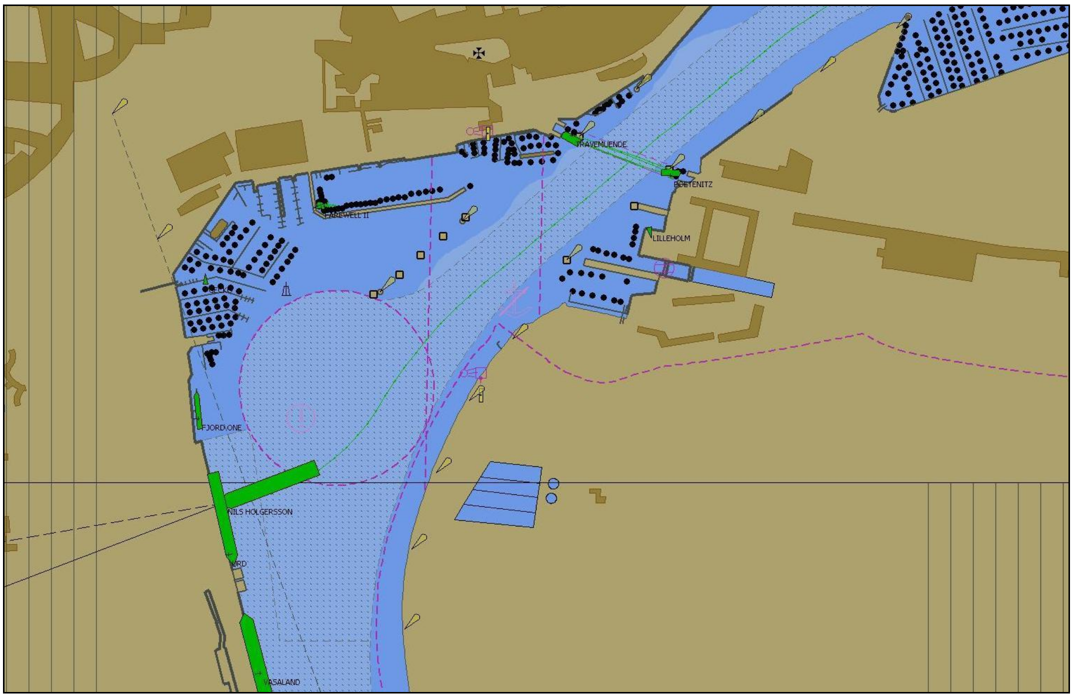
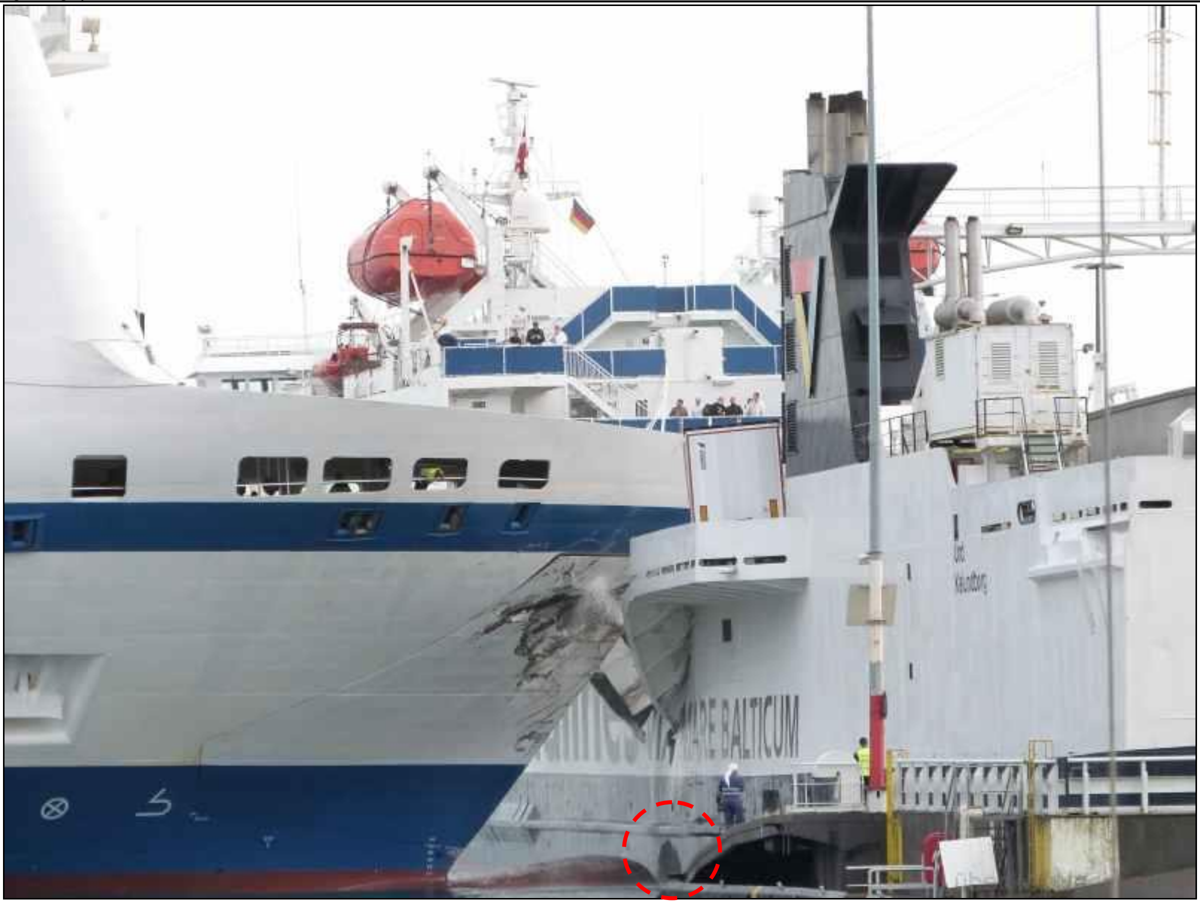


Figure 6: AIS recording from Trave Traffic, collision

The shell plate of the URD (to port level with the weather deck and main deck) was pressed in by the bow of the NILS HOLGERSSON. The bulbous bow of the NILS HOLGERSSON ripped a hole in the URD level with the water line.

© Dierk Boldt

Figure 7: Photo taken shortly after the collision



© Dierk Boldt

Figure 8: Photo taken shortly after the collision, close up

3.1.1 Subsequent events on the NILS HOLGERSSON

On the NILS HOLGERSSON, a ship's deck rating was instructed to assess the situation on deck 3 after the collision. The chief officer instructed another crew member by telephone to make a public announcement to inform passengers and gather them in the restaurant.

At 1818, the master called the URD, but did not receive an answer. Trave Traffic, which had tracked the collision by means of AIS, was then contacted. They had already prompted another ferry to stop before the jetty.

None of the persons on the NILS HOLGERSSON were injured due to the collision. According to a preliminary assessment, the ship had not suffered any major damage, which could have impaired the seaworthiness or the stability. After consulting with Trave Traffic, the master attempted to reach pier 6a under the vessel's own steam. After the collision, the NILS HOLGERSSON drifted off of the URD and turned slowly to starboard with her bow. 'Sea mode' was switched to 'Harbour mode' from the port wing at 182417. The remainder of the turn occurred at a speed over ground of 1.24 kts, enabling the NILS HOLGERSSON to then move slowly astern without tug assistance and under full control through propulsion and manoeuvring systems, to make fast at pier 6a at 1842 and unload.

In retrospect and contrary to the preliminary assessment, the ensuing material damage on the bulbous bow, and on the bow visor in particular (see Figure 9), proved to be substantial.

Figure 9: Damage to the bow visor of the NILS HOLGERSSON

3.1.2 Subsequent events on the URD

The master of the URD and the third nautical officer arrived on the bridge after the collision. After that, a public announcement was made in German by the master and he informed everyone about the collision. The public announcement was repeated by the third officer in Russian. A damage report by the chief officer was received on the bridge shortly after. The bow of the NILS HOLGERSSON had caused a v-shaped tear in the side of the URD (to port) about 8 m wide and about 4 to 5 m deep. The main deck and the weather deck were affected. In addition, the bulbous bow of the NILS HOLGERSSON had torn a hole of some 3 x 3 m in the side of the URD.

Figure 10: Damaged port side of the URD

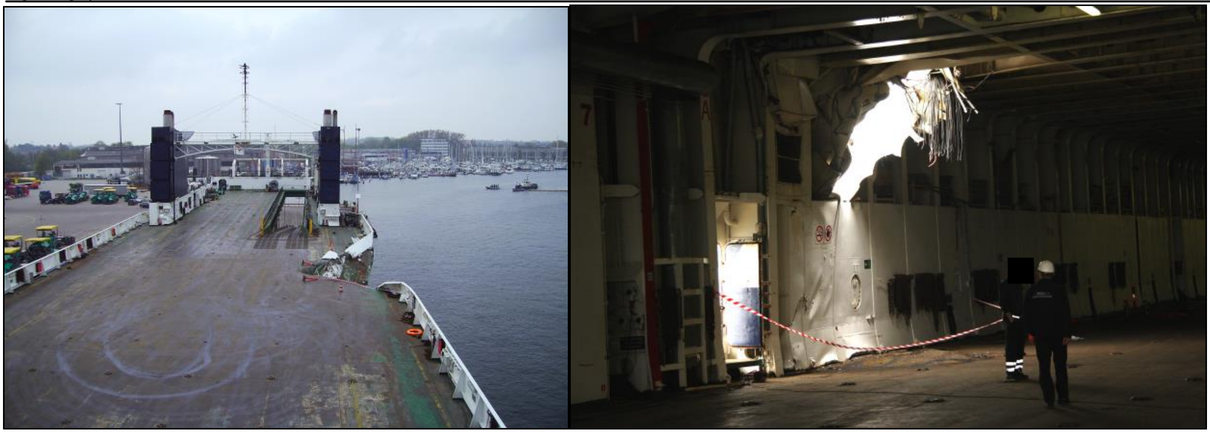


Figure 11: Photos of the v-shaped tear in the shell plate of the URD

Figure 12: Hole level with the waterline in the shell plate of the URD

While the engine crew checked the ship for damage from forecastle to stern, the chief engineer reported to the bridge that she was taking on water and he had reportedly closed the bulkhead. They then activated the emergency pump in the pump room of the lower cargo deck.

At 1823, the master of the URD called Trave Traffic and reported they were taking on water and the need for fire brigade pumps. At the same time he arranged the evacuation of the passengers, which was completed within about 10 minutes. The crew then searched the ship for any remaining people a second time. One HGV driver was temporarily thought to be missing. However, he was later found ashore safe and sound by the waterway police. The evacuated passengers were assisted by the port operator Lübecker Hafen-Gesellschaft. Nobody was injured due to the collision and this was immediately reported to Trave Traffic. Shortly after, two officers of the waterway police boarded the vessel.

The collision caused the head line of the URD to part when she was pressed aft. The stern ramp was slightly deformed when it struck the floating ramp pontoon. The ship was shifted back to her original position by means of the winches and in addition made fast with three head lines, two breast lines, and two stern lines. After consulting with the waterway police, the master of the URD decided to unload the ferry at 1855. The HGV drivers were permitted to board again individually and thus able to take the HGVs and trailers safely ashore. Altogether, 106 vehicles were on board the URD; 76 of these were accompanied. The main deck was unloaded by 2115. Since the fore section of the URD slowly dropped as a result of the water ingress, it was not possible to recover 14 HGVs stowed below the waterline. None of these HGVs were carrying dangerous goods.

3.1.3 Action taken ashore

Trave Traffic informed the waterway police about the accident at 1820. In the Maritime Emergencies Reporting and Assessment Centre (MLZ), the communications centre of the CCME, the accident report was received at 1835.

The Lübeck fire brigade was deployed at the URD with pumps from 1900 and subsequently joined by the THW with its own pumps. However, it became clear at 1930 that there was not enough pump capacity to stabilise the URD. The water ingress in the lower cargo hold resulted in the fore section of the URD slowly beginning to drop. Therefore, the CCME was requested to assume overall control of the operation. An oil barrier was deployed as a precaution to make it possible to contain any eventual water pollution (see Figure 13).

Figure 13: Deployed oil barrier

At 2000, the capacity of the pumps deployed on the URD by THW Oldenburg stood at 5 m^3/min. THW Lübeck was at the scene with a welding team. The master of the URD had also requested divers, who arrived at the scene at 2030. At this point, the forward draught of the URD was 7.10 m. The maximum forward draught was normally 5.43 m. The maintained depth at pier 3 is 9.50 m. After consulting with the waterway police and the Lübeck fire brigade, the master of the URD decided to flood the forward ballast water tanks to stabilise the ship and counteract the progressive heel.

CCME assumed overall control of the operation at 2045. The operational commander of the Lübeck fire brigade was assigned the role of on-scene coordinator.

At 2130, the forward draught of the URD was 7.50 m. The requested diving team began with the assessment of the underwater damage. Shortly afterwards, the emergency pump of the URD failed.

At 2220, the engine crew of the URD reported water ingress in the pump room and in the air conditioning system in front of the lower cargo hold (see Figure 14). The lower cargo deck stood at a height of 5 m below water; the deck height was about 6 m. After the report was received on the bridge, instructions were issued to close the valves. The shore-based operational units at the scene continued the pumping work with submersible pumps. There was evidence to show that the water that had been pumped out was not contaminated, meaning there had been no intermixing with fuels and lubricants. At this point, with the exception of an HGV and trailer that were heavily damaged during the collision, the weather deck was completely unloaded. The draught of the URD had dropped to 6.80 m at the bow and 5.20 m at the stern.

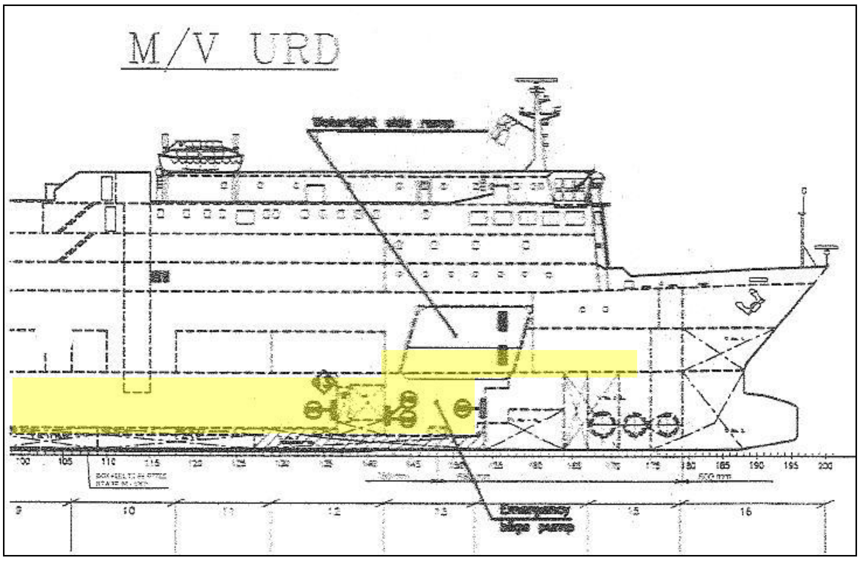


Figure 14: Excerpt from the damage card of the URD
with the area of the reported water ingress marked

After the assessment of the underwater damage, the diving team submitted a proposal to seal the hole in the side of the vessel. A collision mat initially requested from ashore was not used in the end because the hole in the side of the URD was too big (about 3 x 3 m). Instead, the hole was to be closed temporarily using welded on plates, which had to be cut first.

The numerous ships deployed for the purpose of traffic safety were stood down from the operation. At 0130 on the following day, a unit from the THW and one from the fire brigade as well as a fireboat and an ambulance on standby for emergencies were at the scene. 14 HGVs were still on the flooded lower cargo deck of the URD, which were still secured and therefore had not slipped despite the fore section lowering.

The welding work on the URD's leak began at 0200 and ended at about 0440. It was not possible to seal the leak completely. A small area above the waterline remained open (see Fig. 15).

Figure 15: Sealed leak on the shell plate of the URD

The divers were out of the water at 0515. The ship's position was stable. The fire brigade and THW were still deployed with four pumps. More of the people still involved in the operation were stood down by the CCME because the hazard prevention phase was completed. At the responsibility of the owner of the URD, the lower cargo deck was to be pumped out by a company it had appointed.

At 0545, the crew of the URD succeeded in putting the now repaired emergency pump back into service and continued pumping out the lower cargo deck. The diving team was stood down at 0600. At that point, the forward draught was 6.90 m. The draught decreased to 6.80 m within one hour due to the pumping work. Following that, preparations were made to unload the lower cargo deck after consulting with the port operator Lübecker Hafen-Gesellschaft. Since the situation was no longer dangerous, the ship was handed back to the master of the URD by the on-scene coordinator after consulting with the CCME. Only a small team from the THW remained on board to provide assistance until the arrival of the company appointed to carry out the rest of the pumping work.

From 0820, the URD pumped with her own equipment. Corresponding authorisation had been issued by the State Agency for Coastal Protection, National Park and Marine Conservation of Schleswig-Holstein. The CCME arranged for an absorbing barrier to be deployed around the URD as a precautionary measure.

The CCME transferred overall control of the operation to the Lübeck Port Authority at 1130.

3.1.4 Damage ashore

During the collision, the URD was pushed about 4 m sternward. This caused the stern door, which was resting on the floating ramp pontoon at pier 3, to strike a steel guard rail structure and the pontoon container that was there. Due to the displacement of the pontoon, a steel cable attachment was also torn out of the sheet piling (see Figure 16) and a steel cable was damaged.

Figure 16: Damaged guardrail and damaged sheet piling at the pier

Above and beyond that, due to the formation of swell as a result of the collision, minor damage occurred north of the scene of the accident in the Marina Baltica, mainly on recreational craft that had been pressed against the jetties.

3.2 Investigation

The on-call service of the Federal Bureau of Maritime Casualty Investigation (BSU) was informed about the events on the evening of the accident. The team of investigators started the investigation at the scene on the next morning.

All parties cooperated with the BSU transparently and in the spirit of trust. The Danish Maritime Accident Investigation Board (DMAIB) and Swedish Accident Investigation Authority (SAIA) were informed about the progress of the investigation.

The BSU essentially had the VDR recordings from the two ferries, the AIS recordings of Vessel Traffic Service Travemünde and the WSP control centre in Cuxhaven, witness statements, certificates of registry and other ship documents, recordings of VHF channel 13, the log book of the CCME and the investigation file of the WSP at its disposal for the investigation.

3.2.1 NILS HOLGERSSON

3.2.1.1 Wheelhouse

The port and the starboard wing are integrated with the bridge (see Figure 17) on the NILS HOLGERSSON.

Figure 17: View of the bridge of the NILS HOLGERSSON from the port wing

Practically any ship manoeuvre can be carried out from the control position in the port wing (see Figure 18). The exception is, inter alia, the emergency anchoring manoeuvre, which must be activated from the central control position.

Figure 18: Control position in the port wing

3.2.1.2 Bridge crew

Both the master and the chief officer of the NILS HOLGERSSON have years of professional experience. The master served on the NILS HOLGERSSON continuously from February 2001 until the end of August 2008, in the last three years as chief officer. From September 2008, he served as master on another of the owner's ferries, which was not equipped with a pod propulsor. While embarking the NILS HOLGERSSON, he was briefed on the controls by the disembarking master for the purpose of maintaining the pilotage exemption certificate. The form of this briefing is not laid down by the owner, but carried out individually. The familiarisation, which according to the bridge handbook of the NILS HOLGERSSON must be carried out after an absence of more than six months and documented accordingly in the bridge log book, did not take place.

To maintain the pilotage exemption certificate, the master served on the NILS HOLGERSSON for two weeks each year since 2008, which was also the case on the day of the accident. He embarked on 19 April 2012 and had thus already conducted numerous approach manoeuvres in Trelleborg and Travemünde successfully before the accident occurred on 3 May 2012. On the day of the accident, the master had been stood down between 1130 and 1700.

From March 2006 to the end of August 2008, the chief officer of the NILS HOLGERSSON had served as a deck officer on another ferry belonging to the owner. Up until the day of the accident, he has served as chief officer on the NILS HOLGERSSON since September 2008. He continued his service on the ferry on 25 April 2012 after a period of leave. He was stood down between 1130 and 1730 on the day of the accident.

The master, chief officer, and numerous other crew members of the NILS HOLGERSSON assisted in reconstructing the course of the accident with extensive statements.

3.2.1.3 Pod propulsor

The diesel-electric pod propulsor on the NILS HOLGERSSON is a joint development of SCHOTTEL GmbH and Siemens Marine Solutions. Each propeller in front of and behind the pod is installed on the propulsor shaft and rotates in the same direction. Each pod can be infinitely rotated on the vertical axis, meaning they take on the function of rudder at the same time.


© Siemens AG

Figure 19: SSP ship propulsion, press photo

The pods can operate in different modes. Selection of the operating modes is made via push-buttons on the control panel. Basically, the pods can be operated from the following control positions and/or panels:

- central control position
- port and starboard wing
- ECS[10]
- engine control room.

[10] Abbreviation for emergency control station; the ECS on the NILS HOLGERSSON is located aft on deck 2 between the pods.

On the day of the accident, the pods were operated from the control position in the port wing for the intended turning manoeuvre. The following figure (20) provides an overview of the pod displays available there as well as the arrangement of the control levers and push-buttons.

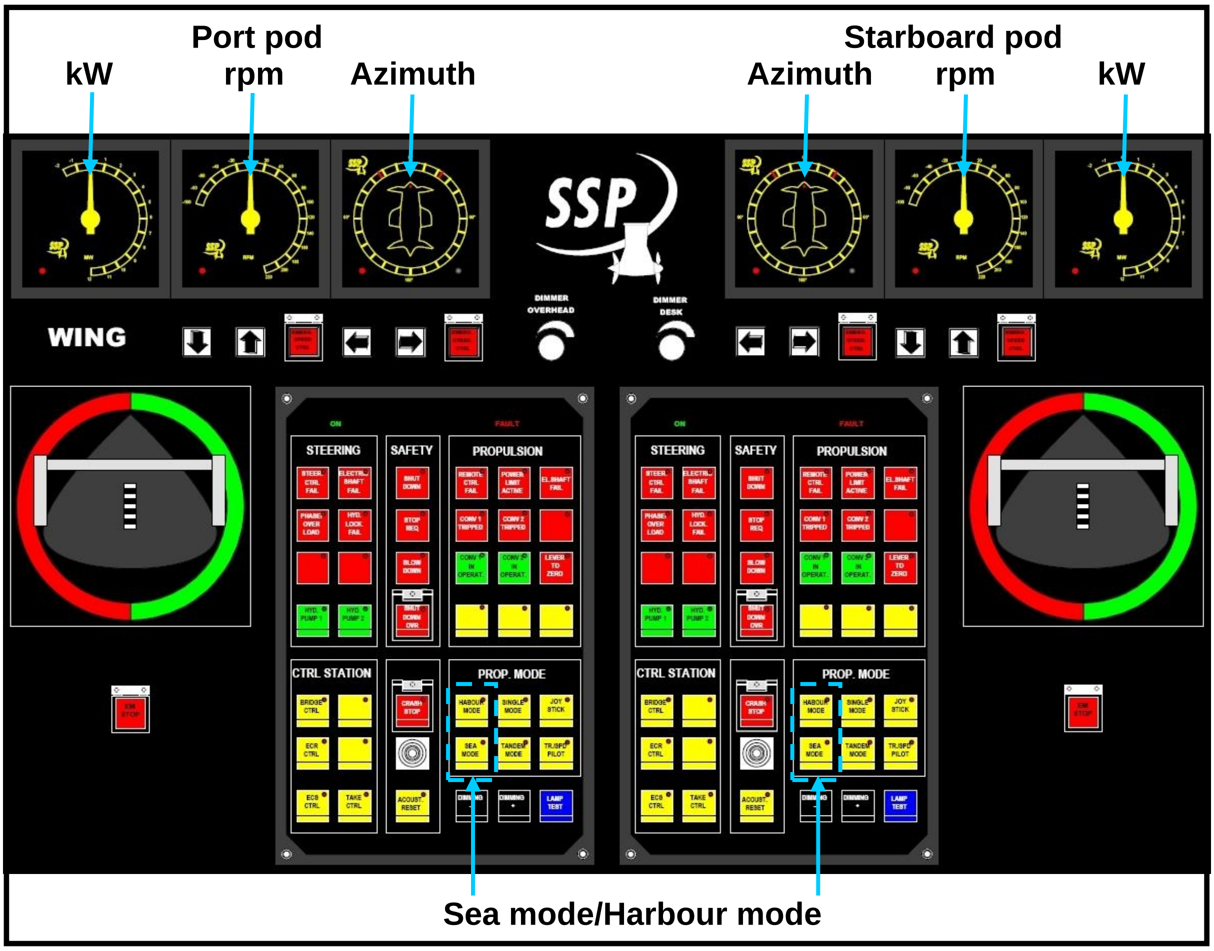


Figure 20: Control panel in the wing, schematic representation

Higher-level operating modes for the pod propulsors are 'Single mode' and 'Tandem mode'[11]. In 'Single mode', both pods are operated separately. The control commands for thrust direction and rated speed are specified for the relevant propulsor (port, starboard) from the control lever of the active control position. In 'Tandem mode' both pods run synchronously and are operated by one control lever.

The pods are run in 'Sea mode' or 'Harbour mode' during normal operation. 'Sea mode' is activated using a push-button in the 'Propulsion mode' field. The steering angle is limited to +/- 35° in 'Sea mode' to ensure the ship’s stability during the sea voyage. Thrust direction adjustment works only with one hydraulic pump per propulsor. The bridge handbook of the owner of the NILS HOLGERSSON stipulates that this mode is used when proceeding at sea. However, 'Harbour mode' is stipulated for manoeuvring in port or proceeding slowly at sea. The rotation angle of the pods is unlimited in 'Harbour mode'. The thrust direction adjustment (azimuth) is set to the maximum speed. This is achieved by starting the second hydraulic pump.

[11] The following comments on the functioning of the Siemens-SCHOTTEL Propulsor (SSP) are taken from the manufacturer's manual as well as the bridge handbook of the owner, TT-Line.

A maximum speed of 10 kts should not be exceeded in 'Harbour mode'. If this preset speed is exceeded, a warning signal sounds, which prompts the operator to switch to 'Sea mode'. At the time of the accident, the system did not provide for a warning signal when moving slower than a speed of 10 kts in 'Sea mode' (see section 4.5.2, p. 41).

In normal operation, especially when the control lever malfunctions, the emergency steering control can be activated separately for each pod by pressing the 'Emergency speed control' and 'Emergency steering control' buttons. Regardless of that, an automated sequence for executing the shortest advance distance can be initiated by pressing the 'Crash stop' button on the control panel. Both the 'Crash stop' and the buttons for activating the emergency steering control have protective covers to prevent unintentional operation (see Figure 21).

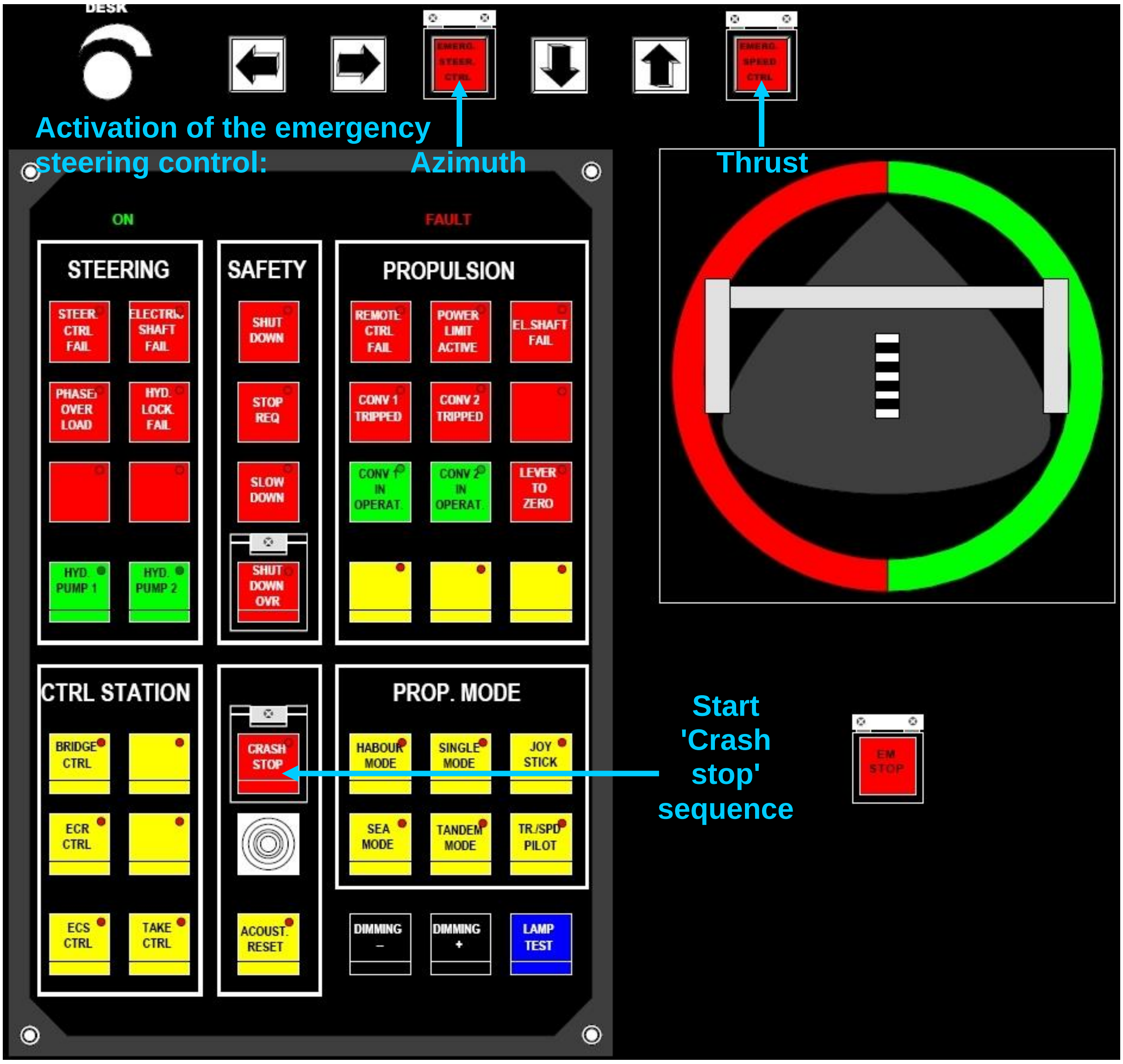


Figure 21: Excerpt from the wing control panel, starboard pod, schematic representation

After activation of the emergency steering control, the pods are controlled using the direction buttons: for each pod, two for the azimuth (thrust direction target 'Emergency steering control', left/right direction buttons) and two for the speed target

('Emergency speed control', up/down direction buttons for higher or lower thrust; see Figure 22).

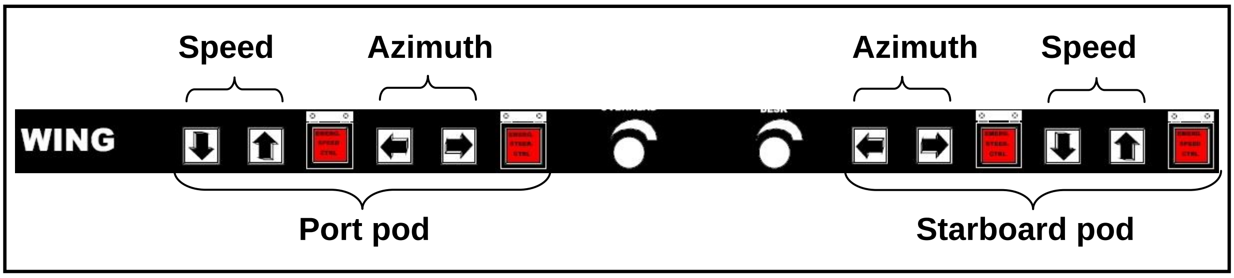


Figure 22: Excerpt from the wing control panel (emergency steering control for the pods), schematic representation

The buttons for the azimuth target act directly on the valves for the control hydraulics. The buttons for the thrust target are wired directly to the speed controller. At the moment that the emergency steering control is activated, the thrust direction target limitation (Azimuth) to +/- 35° in 'Sea mode' ceases to apply and the pods can be rotated freely using the azimuth push-buttons.

The following pod manoeuvres were recorded by the manoeuvre log of the NILS HOLGERSSON during the relevant period from switching from 'Tandem mode' to 'Single mode' (see Spreadsheet 1; arrangement, highlighting and comments by the BSU).

Time (LT)	Port pod Target	Port pod Actual	Stb pod Target	Stb pod Actual	Manoeuvre details
180527[12]	- 20°	- 10°			Executed from the central control position, in 'Tandem mode', 'Sea mode'
180528			- 20°	- 9°	
180539	+ 0°	- 18°			
180540			+ 0°	- 18°	
180541	+ 16°	- 9°			
180543			+ 16°	- 9°	
180553	+ 0°	+ 16°			
180555			+ 0°	+ 15°	
180741	+ 19°	+ 10°			
180743			+ 19°	+ 11°	
180824			+ 3°	+ 10°	
180825	+ 0°	+ 7°			
180925	- 18°	- 1°	- 13°	+ 2°	
180929	+ 0°	- 11°			
180937			+ 6°	- 3°	

[12] The time data stated in the Manoeuvre Log slightly differed from the VDR-recorded time data. In order to use consistent time specifications in the report, the ship's time (VDR) was stated as relevant and the time specifications in the Manoeuvre Log were altered accordingly.

(continued)					
Time (LT)	**Port pod Target**	**Port pod Actual**	**Stb pod Target**	**Stb pod Actual**	**Manoeuvre details**
181123 181125 181127 181128 181131	27 rpm + 22° 27 rpm	52 rpm + 7° 36 rpm	27 rpm + 23°	51 rpm + 8°	
Note: 1812 - NILS HOLGERSSON reaches the turning circle					
18:12:19 18:12:21	+ 0°	+ 28°	+ 0°	+ 26°	
18:12:29			0 rpm	35 rpm	
18:12:37 18:12:38	Control speed and Azimuth via **control lever**		Control speed and Azimuth via **control lever**		Executed from the central control position, pods from 'Tandem' to 'Single mode'
18:12:39 18:12:41	+ 90°[13]	+ 1°	- 90°[12]	- 2°	-
18:12:49 18:12:53	+ 90°[12]	+ 32°	- 90°[12]	- 34°	-
18:12:56 18:13:05 18:13:06 18:13:08 18:13:10 18:13:21	0 rpm	20 rpm	0 rpm 69 rpm 82 rpm 82 rpm 82 rpm	19 rpm 23 rpm 43 rpm 63 rpm 79 rpm	-
18:13:30 18:13:31	Control speed and Azimuth via **control lever**		Control speed and Azimuth via **control lever**		Executed from the **wing**; pods in 'Sea mode'
Supposedly at this point in time, the order for both pods was nearly '-180°'. According to the pod manufacturer, azimuth manoeuvres > 35° are not recorded in 'Sea mode', when the maximum steering angle of +/- 35° has already been reached, as it was the case at 181249 and 181253.					
18:13:37 18:13:39 18:13:41 18:13:43	55 rpm 57 rpm 93 rpm 97 rpm	18 rpm 34 rpm 54 rpm 73 rpm			-
18:13:52			104 rpm	97 rpm	-
18:14:07 18:14:09	163 rpm 112 rpm	84 rpm 83 rpm	142 rpm	103 rpm	-
18:14:11 18:14:14	Speed: **emergency control** Azimuth: control lever		Speed: control lever Azimuth: **emergency control**		Executed from the **wing**

[13] At this point, in the original printout of the manoeuvre log shows the restriction of + 35° in 'Sea mode'. In account with the submitted statements, the BSU assumes that instead orders of +/- 90° were given as usual for this manoeuvre, although these orders were not being recorded due to the automatic restrictions applying in the 'Sea mode'.

(continued)					
Time (LT)	**Port pod Target**	**Port pod Actual**	**Stb pod Target**	**Stb pod Actual**	**Manoeuvre details**
18:14:19 18:14:23 18:14:25	73 rpm 57 rpm 104 rpm	78 rpm 59 rpm 57 rpm	173 rpm	104 rpm	-
18:14:25 18:14:26	Control speed and Azimuth via **control lever**		Control speed and Azimuth via **control lever**		Executed from the **wing**
18:14:37	*Collision*				
(…)					
18:26:17	+ 117°	+ 116°			**„Harbour mode"** activated from the **wing**

Spreadsheet 1: Pod manoeuvres on the NILS HOLGERSSON

The 'Crash stop' sequence was not initiated as a manoeuvre for the 'shortest stopping distance'. Pressing the 'Crash stop' button (see Figure 21) would have caused the following steps to be automatically executed:

- speed target set to almost zero[14];
- torque limit of permanent magnet motor set to approx. 10%;
- for faster thrust direction adjustment, the second hydraulic pump is started for each propulsor;
- start of opposite rotation of the two propulsors at 180°;
- at a propulsor position of about 75°, the speed target is set to rated speed;
- from a propulsor position of 75° to 180°, the torque limit is gradually reduced;
- at a propulsor position of 180°, the speed target is at the rated speed and the torque limit at 70 % of the rated torque. The system will remain in this state until the operation is aborted by pressing the 'Crash stop' button again and then activating the 'Harbour mode'.

3.2.1.4 VDR audio data

The NILS HOLGERSSON is equipped with a type 100 VDR. This is a voyage data recorder of the first generation distributed by the Dutch Netwave Systems B.V. under licence from Rutter. The VDR recordings generally comply with the IMO[15] performance standards[16], but remain behind the recording scope of newer devices.

[14] The speed target is set to 10/20 rpm in order to maintain a positive rotation of the shaft when the ship proceeds with higher speed.
[15] International Maritime Organisation
[16] IMO Resolution A.861(20) - Performance Standards for Shipborne Voyage Data Recorders (VDRs) of 27 November 1997 and IMO Resolution MSC.214(81) - Amendments to the Recommendation on Performance for Shipborne Voyage Data Recorders (VDRs) of 12 May 2006

The bridge microphones were recorded on two channels on which the audio tracks of several microphones overlap each other:

Channel 1→ Microphone 1: bridge center, aft
Microphone 2: starboard wing
Microphone 3: central control position

Channel 2→ Microphone 1: port wing
Microphone 2: chart table/radio station on starboard side, aft
Microphone 3: port aft

VHF channel 13 was recorded on channels 3 and 4. This method of overlapping audio data storage is also common among newer VDR devices even though this impedes analysis considerably at times. In the present case, analysis of the audio files was almost impossible because the recordings of the two relevant channels, 1 and 2, were blanketed by interfering tones. In the course of the analysis of the audio data, which ultimately was possible only to a very limited degree, no peculiarities were found with regard to communication on the bridge. In particular, the bridge crew was not distracted during the approach phase. The communication was proficient and basically restricted to course-related information. The only striking factor was that during the approach manoeuvre, at 1811, the master specified an incorrect course, which was also acknowledged by the helmsman (118° instead of 218°). However, the correct course of 218° was steered.

3.2.1.5 Shipborne radar

The VDR recorded the information from both radar displays (X-band and S-band, see Figure 23).

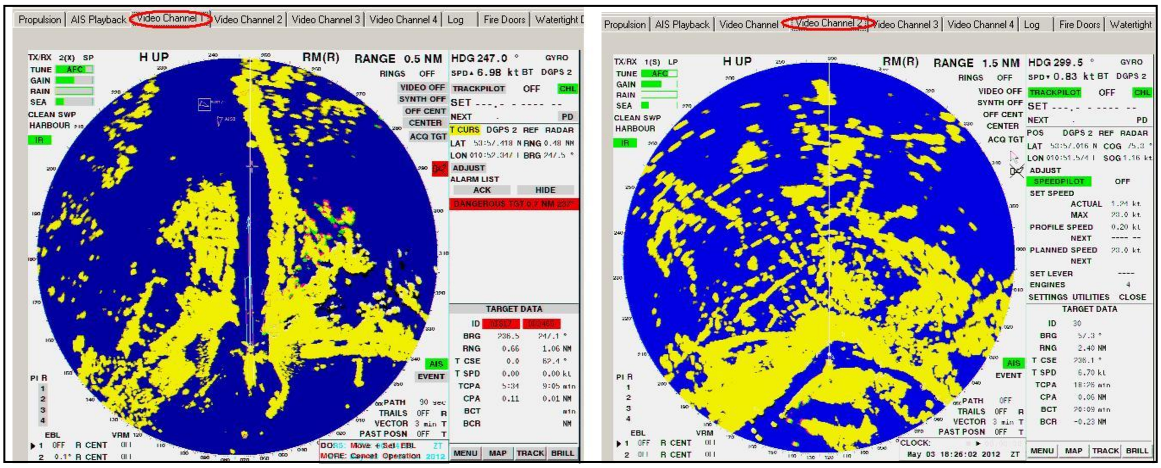


Figure 23: Radar recordings from the NILS HOLGERSSON

The master predominantly used the X-band radar during the approach and turning manoeuvre (head-up display, off-centre). In accordance with the instructions in the owner's bridge handbook, the radar range was adjusted to 0.5 nm and 0.25 nm with increasing proximity.

3.2.1.6 ECDIS

The course of the voyage of the NILS HOLGERSSON was stored by the ECDIS[17] and retrieved in the aftermath of the accident (see Figure 24).

Figure 24: ECDIS plot with accident track of the NILS HOLGERSSON

ECDIS devices are operated with official vector charts (ENCs[18]). The official paper nautical charts are also available for navigation. The ECDIS plots provided by the owner were included in the analysis of the accident.

3.2.2 URD

The URD was made fast at the pier of the Skandinavienkai at the time of the accident. The master and deck officers were occupied with coordinating the loading operation and administrative tasks. Therefore, reconstruction of the accident was carried out mainly on the basis of recordings made on board the NILS HOLGERSSON and ashore.

3.2.2.1 VDR recordings

No additional information was gained from the recordings of the VDR on board the URD (manufacturer: Sperry Marine).

[17] Abbreviation for electronic chart display and information system.
[18] Abbreviation for electronic navigational chart

3.2.2.2 Other documentation

The BSU's investigators essentially used the extensive statement of the ship's command and cargo lists, as well as documentation stemming from the port state control carried out on the URD on 4 May 2012, as a basis for the investigation.

3.2.3 AIS recordings

The VDR on the NILS HOLGERSSON did not record any AIS data. However, data from the waterway police control centre in Cuxhaven and Trave Traffic were available for the investigation (see Figures 25 and 26).

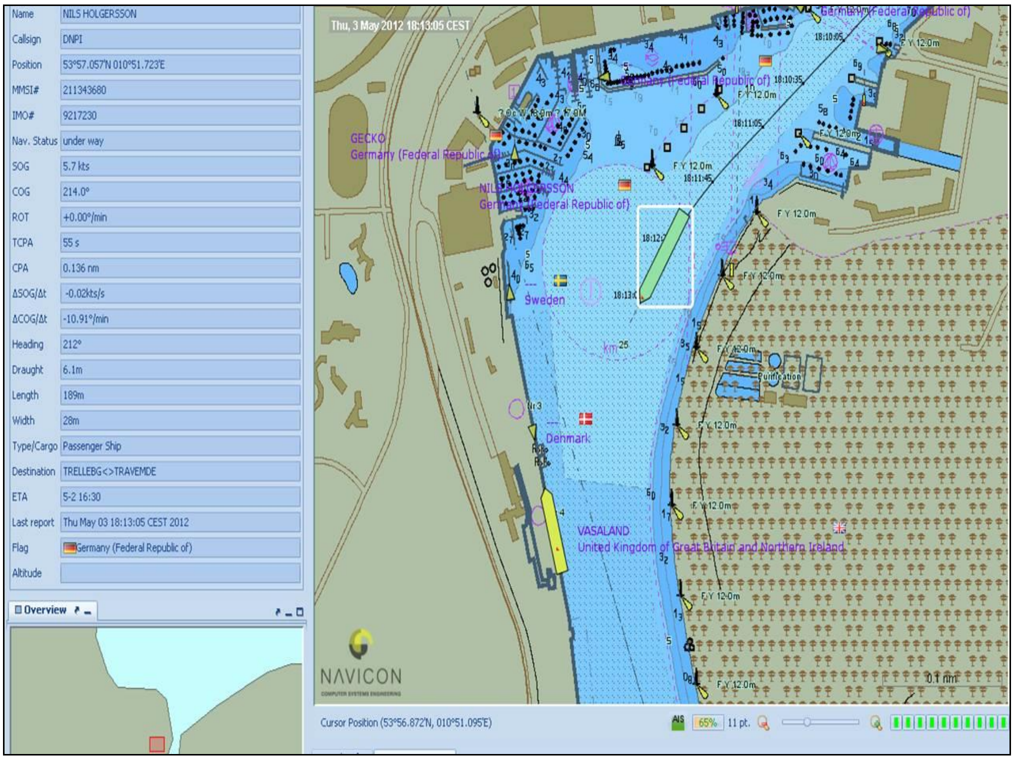


Figure 25: AIS recording from the WSP control centre

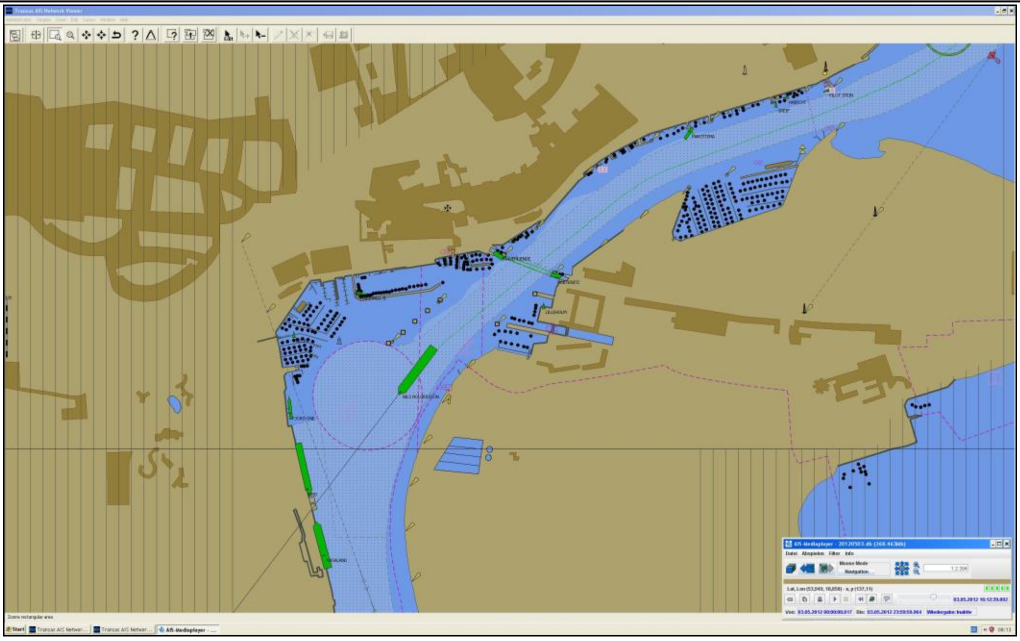


Figure 26: AIS recording from Trave Traffic

The recordings from Trave Traffic were used for the investigation report because for technical reasons it was not possible to depict the URD in hull shape in the plots of the WSP control centre.

The BSU's investigators also analysed AIS recordings of the turning manoeuvre of the NILS HOLGERSSON from the previous day, 2 May 2012. The successful manoeuvre was executed by the team that was also on the bridge on the day of the accident.

3.2.4 VHF recordings

Trave Traffic provided the recordings of VHF channel 13 for the investigation. These were used, inter alia, to trace the action taken ashore in response to the collision.

3.2.5 Documentation on the action taken ashore

The action taken ashore shortly after the collision comprised primarily:

- pumping work on the URD;
- pollution abatement measures;
- traffic safety measures;
- care of the passengers, and
- care of the crew members.

Coordination of the units deployed and initiation of the specific measures were reproduced by the BSU's investigators based on numerous reports and press releases of the agencies involved, the VHF recordings and essentially on the basis of the documents provided by the CCME.

4 ANALYSIS

Fortunately, in spite of the considerable material damage in certain areas, nobody came to physical harm and the Trave was not polluted due to the collision between the NILS HOLGERSSON and the URD. The shore-based operational units alerted immediately after the collision succeeded in stabilising the URD and averting further damage by means of pumps and other safeguarding action.

4.1 Bridge crew of the NILS HOLGERSSON

The bridge of the NILS HOLGERSSON was manned by an experienced and well-coordinated team consisting of the master, chief officer and helmsman. Based on the fixed times for berthing and departure in Trelleborg and Travemünde, the regular working hours on board as well as the other circumstances on the day of the accident revealed no signs of fatigue or other constraints among the bridge crew.

The fact that the required familiarisation of the master did not take place when he boarded the NILS HOLGERSSON had no impact on his grasp of the pod propulsor controls. 'Familiarisation' as defined by the SOLAS[19] Convention (Chapter III, Regulation 19.2.1) does not cover any training on operation or equipment, but rather, inter alia:

- querying the knowledge of safety guidelines;
- explanation of muster list;
- explanation of safety duties of the crew member (muster station, team allocation, etc.);
- explanation of the localities and arrangement of the life-saving appliances (physical inspection if necessary);
- instructions for immediate action in an emergency (escape route from cabin, closest fire extinguishers, emergency phone number on board);
- instructions for interacting with passengers (in general and with regard to safety/ISPS);
- orders regarding next safety manoeuvre;
- briefing on daily customs declaration, and
- documentation of briefing in the 'Safety Briefing' folder and in the deck log book.

The master was sufficiently familiar with the local conditions on the NILS HOLGERSSON. The BSU assumes that the mental transition from the conventional propulsion system of his usual place of work to the pod propulsor of the NILS HOLGERSSON did not present him with general difficulties, either. After all, from boarding up until the day of the accident, he had already completed 13 approaches into Travemünde as well as 14 approaches in Trelleborg without any problems.

[19] International Convention for the Safety of Life at Sea

The BSU attributes the accident to the performance of a constantly recurring task, in this case the approach manoeuvre in daily ferry service where on the day of the accident, a momentary lapse occurred when switching to 'Harbour mode' was overlooked. Under certain circumstances, the problem would have been detected and corrected in time had, in the course of good teamwork, communication been better on the bridge.

In actual fact, communication on the bridge was mainly confined to order and acknowledgement of the course during the approach manoeuvre. Reciprocal checks were performed just as little as general communication regarding the manoeuvres that had just been executed. Even the obviously wrong course order of 118° was acknowledged despite the fact that the proper course of 218° was steered. The wrong order did not give rise to a response from the chief officer, either. On the day of the accident, this monotony on board resulted in none of the three parties on the bridge realising that switching from 'Sea mode' to 'Harbour mode' had been overlooked.

None of the bridge crew noticed any difference with regard to the manoeuvrability of the ferry up to the time at which they entered the Siechenbucht. This is basically due to the weather and current conditions on the day of the accident because with wind of only 2 Bft and a slowly receding current, only minor adjustments to the course were necessary. Therefore, the time delay in the implementation of course alterations by only two instead of four hydraulic pumps was not conspicuous. The system did not provide for an alert when moving slower than a particular speed in 'Sea mode'.

Beyond the necessary hierarchical structures, the bridge handbook of the NILS HOLGERSSON's owner contains no instructions regarding cooperating in a team. There are no legal provisions for such bridge team management, either. However, it can contribute to safe navigation significantly. With regard to safe navigation, various publications spell out that increased communication and teamwork is one approach to minimising risk:

> "Teams do not replace structures and hierarchies, but they enable and facilitate cooperation beyond the required formal structures. The structure of the team should prevent the safe navigation of the ship from depending solely on the decisions of one person [...]. All decisions and instructions should be checked by other team members and their effectiveness must be monitored. Younger members of the team must be encouraged to ask questions and provide pointers [...].
>
> In many cases, accidents are not caused by a single error, but rather a sequence of many small errors and wrong decisions. An essential aim of any teamwork is to detect the start of such a chain of errors early on and to avoid disruptions. Compliance with the rules of good seamanship and

extensive communication between all team members are prerequisites for preventing the development of a chain of errors or minimising its impact."[20]

Both communication and cooperation as a team and the situational awareness of the bridge crew of the NILS HOLGERSSON could have been better on the day of the accident.

4.2 Pod steering control on the NILS HOLGERSSON

Both pod propulsors on the NILS HOLGERSSON were operated by the master in 'Single mode'. When the turning circle was reached at 1812, only a narrow time frame of 2.5 minutes remained until the collision. Beyond dispute is the fact that there was no time for an emergency anchoring manoeuvre after the problems were recognised. The master initially decided to stop by (believing he was) directing the pods to aft and increasing the thrust to more than 100 rpm. The actual pod position (+/- 35°, see Figure 24) was not verified by means of the azimuth display. This manoeuvre resulted in the forward speed of the ferry increasing again. The emergency steering control of the pods, which would help bypass a presumed problem with the pod steering control, was decided on as a last-minute avoiding action. Had the emergency control been resolutely operated immediately after entering the turning circle, then in all likelihood it would have been possible to execute the intended stop and turn in spite of 'Sea mode' being activated because the emergency steering control overrides the +/- 35° steering angle limitation.

At a speed over ground of more than 6 kts, the required turn could not be effected by using the bow thrusters.

On the other hand, it is beyond dispute that the manoeuvre that presumably would have been most effective in terms of avoiding the collision, starting the automated 'Crash stop' sequence, was not initiated. The VDR audio analysis indicates that the bridge crew only considered this option shortly after the collision.

4.3 Proper operation of the VDR on the NILS HOLGERSSON

The audio recordings of the bridge microphones were not of the quality required by IMO Resolution A.861(20). Together with L-3 SAM Electronics, which conducted the annual performance test (APT) of the VDR on board the NILS HOLGERSSON on 12 January 2012 on behalf of Netwave Systems, attempts were made to establish the cause of the interfering tones. According to that, the droning interference on channel 1 is probably due to a problem with the shielding or the occurrence of an interference current (hum pickup). However, the interfering tone that blanketed channel 2 could not be attributed to a specific source of error.

[20] Diestel/Huth, 'Schiffsführung und Organisation des Brückenteams' (navigation and organisation of the bridge team; quotes translated from German), p. 14 f., published in Berking/Huth (ed.), Handbuch Nautik, Hamburg 2010; the same approach is taken by Swift, 'Bridge Team Management', p. 3, 2nd Edition, London 2004, and the 'Bridge Procedures Guide' from the International Chamber of Shipping, sections 1.2.5 and 1.2.7.2, 4th Edition, London 2007.

This interfering tone is much louder than that on channel 1 and blanketed any conversation that took place in the area of the bridge relevant to the investigation (port wing) from the start of the recording (departure from Trelleborg). The attempt to improve the sound quality by technical means (audio filters) was unsuccessful. Accordingly, it was only possible to understand fragments of a large part of the communication, in particular, immediately prior to the collision.

It remains unclear how long the interference on channels 1 and 2 has existed. As a Netwave Systems (manufacturer) service company, L-3 SAM Electronics tested the operability of the VDR as part of the annual performance test and issued the certificate of compliance. During a performance test, the service technician creates and checks an emergency backup, amongst other things. Furthermore, all six microphones are tested individually. The quality of the audio recording is verified by means of test files created especially for that purpose. After the performance test, the test report and all test files are forwarded to the manufacturer, in this case Netwave Systems, for retention. A copy of the files was not available at L-3 SAM Electronics; therefore, the manufacturer of the VDR was requested to submit this by the BSU. Through the Dutch Safety Board, Netwave Systems provided the test report and audio files from the microphone tests. The test files for the six bridge microphones were checked by the BSU officials. Two test files were available for each microphone. The results are listed in the following spreadsheet; the microphones relevant to the investigation have been highlighted:

Channel	Microphone	Recording quality of the two test files
Channel 1	Microphone 1 Middle of the bridge, aft	1 x very good, 1 x very poor and blanketed by interfering tone
	Microphone 2 Starboard wing	1 x good in spite of slight noise, 1 x very poor and blanketed by interfering tone
	Microphone 3 Central control position	1 x good in spite of blanketing interfering tone, 1 x poor with slight noise
Channel 2	Microphone 1 Port wing	1 x good in spite of blanketing interfering tone, 1 x very poor and blanketed by interfering tone
	Microphone 2 Chart table/ radiotelegraph station on starboard side, aft	1 x good in spite of blanketing interfering tone, 1 x very poor and blanketed by interfering tone
	Microphone 3 Port aft	1 x very good, 1 x poor and blanketed by interfering tone

Spreadsheet 2: Recording quality of the VDR bridge microphones

Overall, only two of the 12 test files exhibited neither noise nor an interfering tone. Although each microphone recorded once with good quality, it was evident from the tests that recording quality was not perfect. The interfering tone identified was not the same as the interfering tones recorded subsequently on the day of the accident. It is similar to the interfering tone on channel 1 of the accident data backup (hum pickup). There is absolute certainty that the significantly louder interfering tone on channel 2 (microphone in port wing), which was relevant to the investigation, did not exist at the time of the annual performance test in January 2012.

L-3 SAM Electronics (as service company), Netwave Systems (as manufacturer), and the owner of the NILS HOLGERSSON were informed about the faulty audio recording. The next scheduled performance test was carried out by a different service company. According to the service report, the microphone level was raised in general so as to record more than before. After the performance test, the ship's command of the NILS HOLGERSSON was instructed by the owner to carry out a VDR test recording and to focus on the audio quality when replaying the file. The owner stated that reportedly no interference had been identified.

From the point at which the collision was probable, the discussions on the bridge are entirely unintelligible due to the onset of severe ship vibrations because of the bow thrusters.

4.4 Action after the collision

The action taken to ascertain damage and inform the passengers ran smoothly both on the NILS HOLGERSSON and on the URD. All the passengers and most of the cargo (on the URD) were able to leave the ferries without injury or damage. Cooperation between the shore-based operational units and the waterway police (and later the CCME) as well as the traffic safety measures were professional and successful. That also applies to arrangement of the appropriate stabilisation and pumping measures with the ship's command of the URD.

4.5 Actions taken

The owner, TT-Line, has taken or planned the following action in the course of its internal analysis of the accident.

4.5.1 Operational measures

An entry checklist has been introduced on all ships of the fleet with the proviso that this is worked through jointly by two responsible parties. The 'Bridge Ready Instruction Sheet', which was previously contained in the bridge handbook, has been converted into a departure checklist which must also be completed in accordance with the principle of dual control.

Departure and entry checklists, including a documented 'Engine Ready' report to the bridge, have also been introduced for the engine control room.

4.5.2 Technical measures

On the ships NILS HOLGERSSON and PETER PAN an audio alert has been supplemented, which triggers an audible warning when proceeding below 9.5 kts in 'Sea mode'.

The button for triggering the automated 'Crash stop' sequence has been made bigger on the ships NILS HOLGERSSON and PETER PAN and is no longer next to the other buttons on the panel, but positioned individually below the control levers (see Figure 27).

Figure 27: New position of the 'Crash stop' buttons below the control levers

4.6 Training measures

The owner has introduced regular manoeuvres for operation of the various emergency steering systems for the ships with pod propulsor. The results of the owner's internal analysis of the accident were discussed individually with each of the fleet's ship's commands. Attendance of external training courses for improving cooperation and communication between the bridge crew is planned.

5 CONCLUSIONS

Fortunately, in spite of heavy material damage, nobody came to physical harm due to the collision between the NILS HOLGERSSON and the URD. Ultimately, the failure of the turning manoeuvre on the NILS HOLGERSSON is due to the fact that activating 'Harbour mode' was overlooked on the bridge of the NILS HOLGERSSON. Therefore, each of the two pod propulsors were steered via one instead of two hydraulic pumps and thus retarded, with the azimuth being limited to +/- 35° in 'Sea mode'.

When the bridge crew noticed the unusual delay in steering during initiation of the turning manoeuvre, just two and a half minutes remained until the collision. An attempt was made to stop the ferry. When this failed, the emergency control was activated. However, the operation of the emergency control buttons was not carried out consequently, thereby having no effect. For reasons of stress, the bridge crew did not consider the easiest and – based on the confined manoeuvring space – best action until after the collision: initiation of the automated 'Crash stop' sequence.

5.1 Bridge crew of the NILS HOLGERSSON

The bridge crew was sufficiently familiar with the general manoeuvring behaviour of the NILS HOLGERSSON. However, uncertainty existed with regard to the emergency steering control options for the pod propulsors. This should be eliminated within the scope of the regular training courses already organised by the owner, TT-Line.

In the days leading up to the accident, the bridge crew had repeatedly executed the approach manoeuvre in Travemünde without any complications. Therefore, the collision was not due to lack of experience, but was the result of a momentary lapse (routine). With the regular entry and departure manoeuvres it involves, all crew members should give full attention to the various operations in recurring activities especially in ferry service traffic. A well established bridge team with open communication and mutual assistance can help to prevent similar accidents significantly. In this respect, the seminars for improving communication and cooperation planned with external providers by TT-Line are an appropriate contribution to the improvement of safe navigation.

5.2 VDR

The recordings of the voyage data recorder on the NILS HOLGERSSON were only partially suitable for tracing the procedures on the bridge before the collision because the audio recording was blanketed by interfering tones. As a result, they did not correspond to internationally recommended performance standards.

6 SAFETY RECOMMENDATION(S)

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

6.1 TT-Line

The Federal Bureau of Maritime Casualty Investigation recommends that TT-Line document the regular manoeuvres for operation of the various emergency steering systems for ships with pod propulsor that have been introduced and implement the regular training for improvement of communication and teamwork that is planned accordingly.

6.2 L-3 SAM Electronics

The Federal Bureau of Maritime Casualty Investigation recommends that L-3 SAM Electronics work toward eliminating interference identified when testing bridge microphones in the course of the VDR's annual performance test.

7 SOURCES

- Inquiries by Waterway Police Travemünde
- Written statements
  - Ship's commands
  - Owners
  - Classification societies
- Certificates of registry and other ship documents, logs and manuals
- Cargo documents
- VDR recordings
- Manufacturer's manual for the SSP propulsor on the NILS HOLGERSSON
- VHF recording from Vessel Traffic Service Travemünde
- Accident log, press releases and situation reports from CCME
- Nautical chart of the Federal Maritime and Hydrographic Agency
- AIS recordings from Vessel Traffic Service Travemünde and the waterway police control centre in Cuxhaven