



Bundesstelle für Seeunfalluntersuchung
Federal Bureau of Maritime Casualty Investigation

**Summary Investigation Report
359/22 and 513/22**

Less Serious Marine Casualty

**Accidents involving a person on board the
ROBIN HOOD
in the Baltic Sea
on 19 June 2022 and on 26 June 2022**

30 August 2023

This summary report within the meaning of Section 27(5) of the Law to improve safety of shipping by investigating marine casualties and other incidents (Maritime Safety Investigation Law – SUG) is a simplified report pursuant to the second sentence of Article 14(1) of Directive 2009/18/EC of the European Parliament and of the Council of 23 April 2009 establishing the fundamental principles governing the investigation of accidents in the maritime transport sector.

The investigation was conducted in accordance with the above legislation. According to said legislation, the sole objective of this investigation is to prevent future accidents. This investigation does not serve to ascertain fault, liability or claims (Section 9(2) SUG).

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

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

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1 FACTUAL INFORMATION

1.1 Photograph of the ship



Figure 1: Photograph of the ROBIN HOOD¹

1.2 Ship particulars

Name of ship:	ROBIN HOOD
Type of ship:	Ro-ro passenger vessel
Flag:	Germany
Port of registry:	Emden
IMO number:	9087477
Call sign:	DHNT2
Owner (according to Equasis):	TT-Line Nr. 411 Eigentums GmbH
Shipping company:	TT-Line GmbH & Co. KG
Year built:	1995
Shipyard:	Finnyards Oy
Classification society:	Det Norske Veritas
Length overall:	179.3 m
Breadth overall:	27.20 m
Draught (max.):	8.70 m
Gross tonnage:	26,790
Deadweight:	6,504 t
Engine rating:	13,000 kW
Main engine:	MAK 4 x 6M552C on two electric motors, each with 6,500 kW
Service speed:	18.5 kts
Hull material:	Steel
Hull design:	Double bottom, six decks
Minimum safe manning:	17

¹ Source: TT-Line.

1.3 1st incident²

1.3.1 Voyage particulars

Port of departure:	Rostock, Germany
Port of destination:	Trelleborg, Sweden
Type of voyage:	Merchant shipping/international
Cargo information:	Passengers and vehicles of every category
Crew:	37
Draught at time of accident:	Df = 5.90 m, Da = 5.70 m
Pilot on board:	No – exempted from obligation to engage a pilot
Number of passengers:	275
Number of HGV drivers:	51

1.3.2 Marine casualty information

Type of marine casualty:	Less serious marine casualty; accident involving a person
Date, time:	19 June 2022, 2009 CEST ³
Location:	Port of Trelleborg, Sweden
Latitude/Longitude:	$\phi = 55^{\circ}21.80'N$, $\lambda = 013^{\circ}09.06'E$
Voyage segment:	Berthing
Consequences:	One injured female passenger

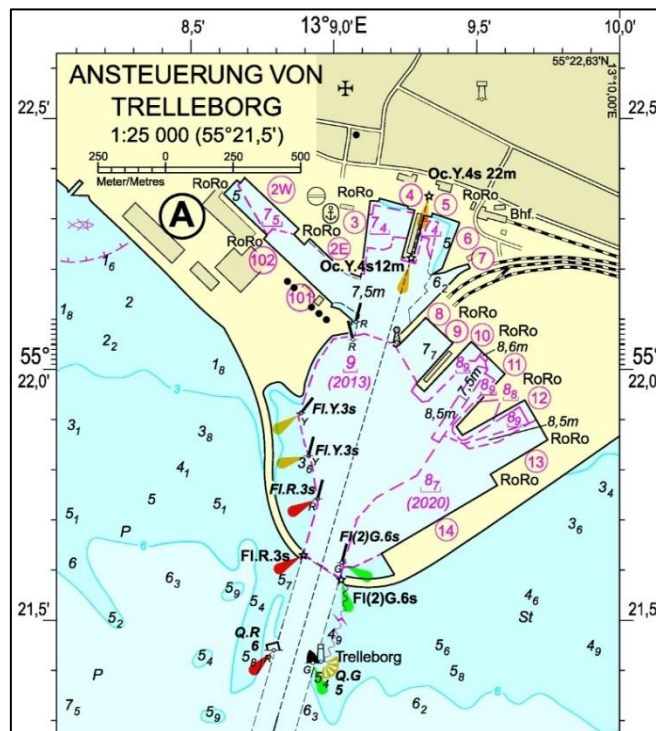


Figure 2: Navigational chart. Scene of the accident within the jetties⁴

² The marine casualty of 19 June 2022 is referred to below as the 1st incident and that of 26 June 2022 as the 2nd incident.

³ All times shown are Central European Summer Time (CEST) = UTC + 2 hours.

⁴ Source: Extract from Navigational Chart 40 Plan A of the Bundesamt für Seeschifffahrt und Hydrographie (BSH).

1.4 2nd incident

1.4.1 Voyage particulars

Port of departure:	Travemünde, Germany
Port of destination:	Rostock, Germany
Type of voyage:	Merchant shipping/international
Cargo information:	Passengers and vehicles of every category
Crew:	40
Draught at time of accident:	Df = 5.20 m, Da = 5.60 m
Pilot on board:	No – exempted from obligation to engage a pilot
Number of passengers:	173

1.4.2 Marine casualty information

Type of marine casualty:	Less serious marine casualty; accident involving a person
Date, time:	26 June 2022, 1300
Location:	Port of Rostock, Germany
Latitude/Longitude:	$\phi = 54^{\circ}09.38'N$, $\lambda = 012^{\circ}06.05'E$
Voyage segment:	Berthing
Consequences:	One injured female passenger

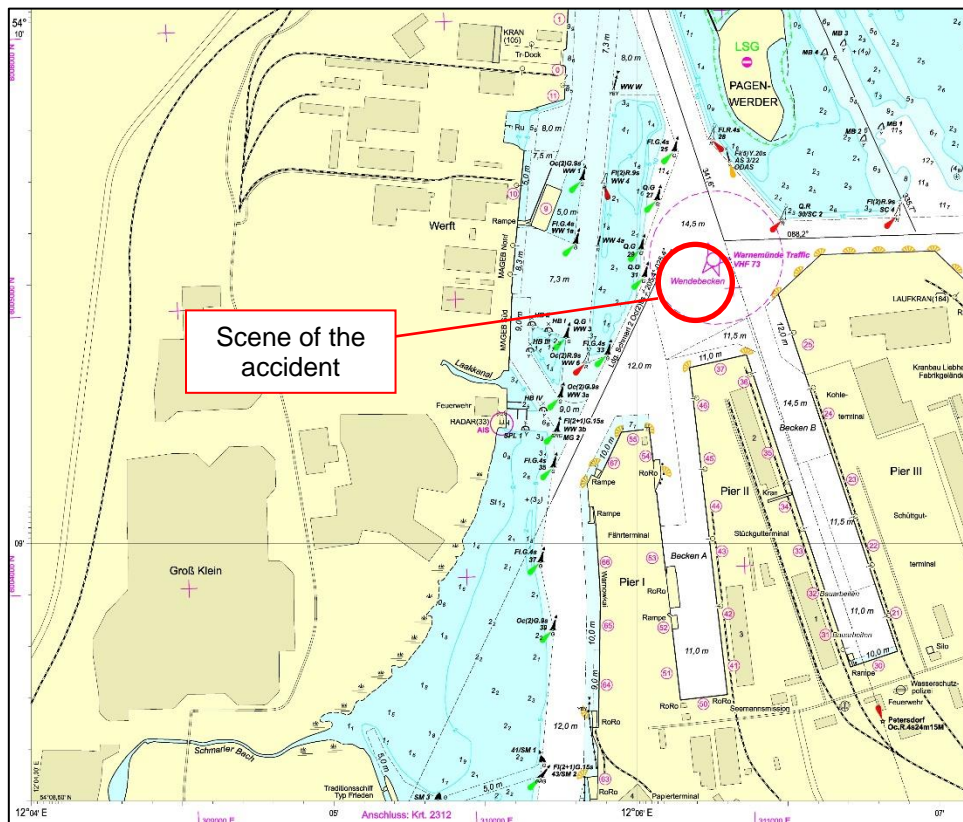


Figure 3: Navigational chart showing the scene of the accident⁵

⁵ Source: Extract from Navigational Chart 2311, BSH.

2 COURSE OF THE ACCIDENT AND INVESTIGATION

2.1 1st incident

2.1.1 Course of the accident

On 27 July 2022, the Federal Bureau of Maritime Casualty Investigation (BSU) became aware of an accident involving a person on board the ROBIN HOOD on 19 June 2022 following receipt of a letter from the injured party. The following account is based on this letter and the statement of the master.

The 75-year-old casualty was travelling to Sweden with her husband on the day in question. They were using their motorhome, which had been parked on the lower of the three vehicle decks for the crossing from Rostock to Trelleborg. The couple were basically familiar with the conditions on board the ROBIN HOOD, as they had already made several voyages on similar ships. The accident victim had a physical limitation commensurate with her age. However, she did not need a walking aid.

Passengers are not able to access the three vehicle decks during the crossing. Vehicle decks doors are re-opened from the bridge of the ship shortly before docking. A corresponding public announcement is made at the same time. The doors are not opened by the central release system. This must be done individually each time someone passes through a doorway. The opening operation is triggered by pressing the pushbutton mounted on the inside and outside near the doorway. During the opening operation, the sliding door opens without stopping.

The ferry reached the port of Trelleborg at about 2000. The couple then went to their vehicle via the stairs. When they arrived at the door to the vehicle deck, the opening operation of sliding door 110 had already been triggered by a previous passenger, who had already passed through the doorway. The door continued to move slowly towards the right-hand side to open fully. The casualty was on the right-hand side of her husband and their arms were linked. They began to pass through the doorway before it had opened fully. The wife sought additional support on the door frame with her right hand when she started to cross the higher threshold at the latest. In the process, she put three fingers into a gap, which at this point still existed, between the door leaf and door frame (see Figures 11 and 12). The investigators assume that the couple had not completely passed through the doorway before its opening operation was completed. Accordingly, the wife's right hand was still on the door frame. When the door was fully opened, the gap closed and her fingers were crushed.

She was only able to release her fingers after some time when the sliding door started to automatically close again. Other passengers came to the aid of the couple and also told the crew at the ship's reception about the accident.

The ship's command on the bridge of the ROBIN HOOD became aware of the accident at 2009 after receiving a call from a member of the reception staff. The master sent the chief mate and another deck officer who was off duty to the scene of the accident. After it was determined there that transport to a hospital would be necessary due to the severity of the injury, an ambulance was requested via the specified reporting channels. Initial care of the casualty had already been administered by trained passengers, who had applied a pressure bandage. To make it easier for the rescue services to reach the casualty, she was carried onto the pier on a stretcher via the stairwell and middle vehicle deck. Before the casualty could be taken ashore, several HGVs had to be driven off the ship to make room. When the casualty was ashore, she had to wait under the care of two deck officers for more than 30 minutes until the ambulance arrived. The casualty was then taken to a hospital in Malmö where her three fingers had to be partially amputated.

2.1.2 Findings of the investigation

The ROBIN HOOD is a German-flagged ro-pax vessel⁶. She operates as a ferry between various ports in the Baltic Sea. The ship has several decks. Road vehicles can be carried on the three vehicle decks. Accommodation, lounges and supply facilities are available for the carriage of passengers.

The shipping company initially provided various documents and photographs, which enabled the investigators to establish the circumstances. The ship was surveyed on 1 September 2022 in the port of Rostock.



Figure 4: Watertight door number 110 on deck 1 in the open condition⁷
The yellow circle marks the warning sign indicating a risk of crushing.

⁶ Ship used for transporting passengers and rolling cargo.

⁷ Source: BSU.

The doors in the lower vehicle deck (deck 1) are watertight, hydraulically moved sliding doors. The watertight integrity of the sliding doors is established by pressing the door leaf onto the door frame at the end of the closing operation by means of wedges mounted on three sides. Four of these doors are used for public access to this deck. Doors 107 and 109 are located on the starboard side and doors 108 and 110 on the port side of the vehicle deck. Doors 108 and 110 are installed mirror-inverted to the doors on the opposite side.

Each watertight bulkhead door has a horizontally movable door leaf. The surface of the door leaf consists of a wave-shaped steel plate. A welded flat steel frame surrounds this steel plate.



Figure 5: Watertight door number 110 on deck 1 in the open condition⁸

The red tubing is installed to protect the door mechanism. The guide at the top of the door is also red. The stairwell is visible on the other side of the doorway.

The sliding door runs on rollers mounted on the upper and lower edge of the door leaf. The hydraulic cylinder for moving the door is located near the floor on the side of the vehicle deck. Accordingly, there is a threshold of some 20 cm in height due to the design.

⁸ Source: BSU.

After the pushbutton for opening the door has been operated, a recurring audible signal (beeping) sounds until the door is fully closed again. The opening and closing operations take about 14 seconds and 24 seconds, respectively. The door remains open for about 21 seconds. The opening operation and period for which the door remains open cannot be interrupted or switched to a closing operation by pressing the pushbutton again. However, pressing the pushbutton interrupts the closing operation and the door opens again.

Awareness and volume of the audible signal depends on location. Since the signalling device is located in the stairwell, this is where the signal is at its loudest. Awareness in the vehicle deck is impaired by various 'interference noises'. On the one hand, these noises are caused by the ventilation system on the vehicle deck. On the other hand, the sliding door's hydraulic system also generates noise, which differs in volume depending on the operating condition. Awareness can also be impaired by running vehicle engines or the refrigeration systems in articulated trailers, for example.

A visual warning signal is not installed.

The operator of the vessel did not install any notices at the sliding door or in the vicinity of the doorway on either the stairwell side or vehicle deck side stating that people should not and were not permitted to pass through the doorway until it had opened fully. The sign indicating a risk of crushing was on the stairwell wall (see Figures 8 and 9) and on the vehicle deck side of the sliding door (see Figure 4). Since the warning sign in the stairwell is installed on the side on which the door closes, a hazard is only immediately evident to the user on the closing side.

Although the sign used (Figure 6) is understandable in terms of the intended warning, it is actually the 'Hand Injury in Press'⁹.



Figure 6: Warning sign W030: Hand Injury in Press

The investigators believe that warning sign W019 ('Crushing by Moving Parts' – Figure 7) would have been more appropriate but that the choice of warning sign had no effect on the course of the accident.

⁹ Warning sign W030 as per EN ISO 7010.



Figure 7: Warning sign W019: Crushing by Moving Parts¹⁰

There were no other signs relating to the operation of the sliding door or in connection with the door or passing through the doorway and the possible dangers involved. Only a sign on the stairwell side of the sliding door contained a written warning in four languages that cars or HGVs may be moving behind the door.

The sliding door has two independent safety systems designed to prevent a person or object from becoming trapped when the door closes. One is a non-contact light barrier, which is installed on the stairwell side. The light barrier monitors the area of contact between door leaf and door frame, i.e. between the main and counter closing edges, from an upper position.

¹⁰ibid.

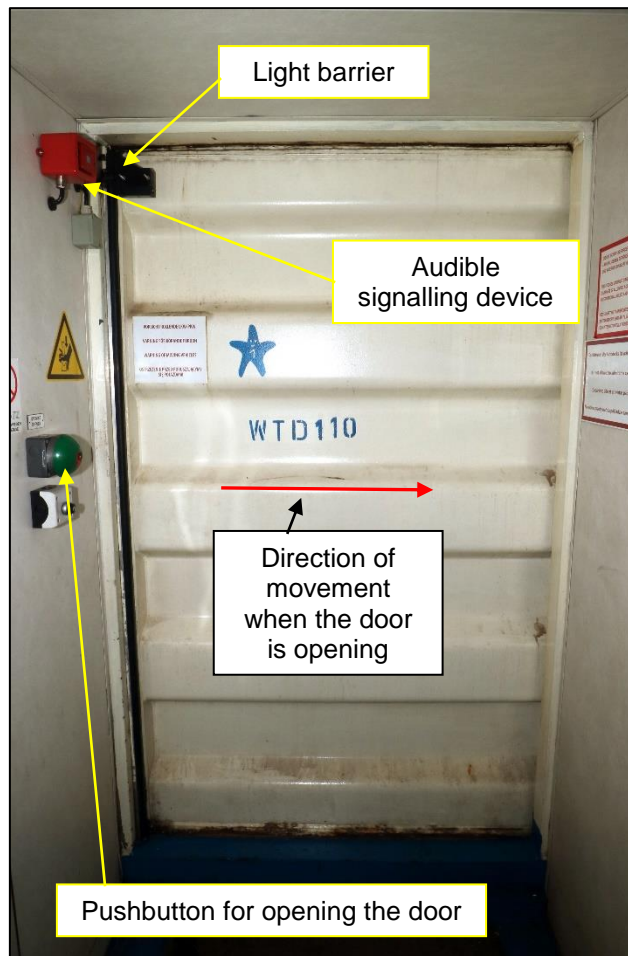


Figure 8: View of watertight door number 110 from the stairwell¹¹



Figure 9: Pushbutton for opening the door and 'Risk of Crushing' warning sign¹²

¹¹ Source: BSU.

¹² Source: BSU.

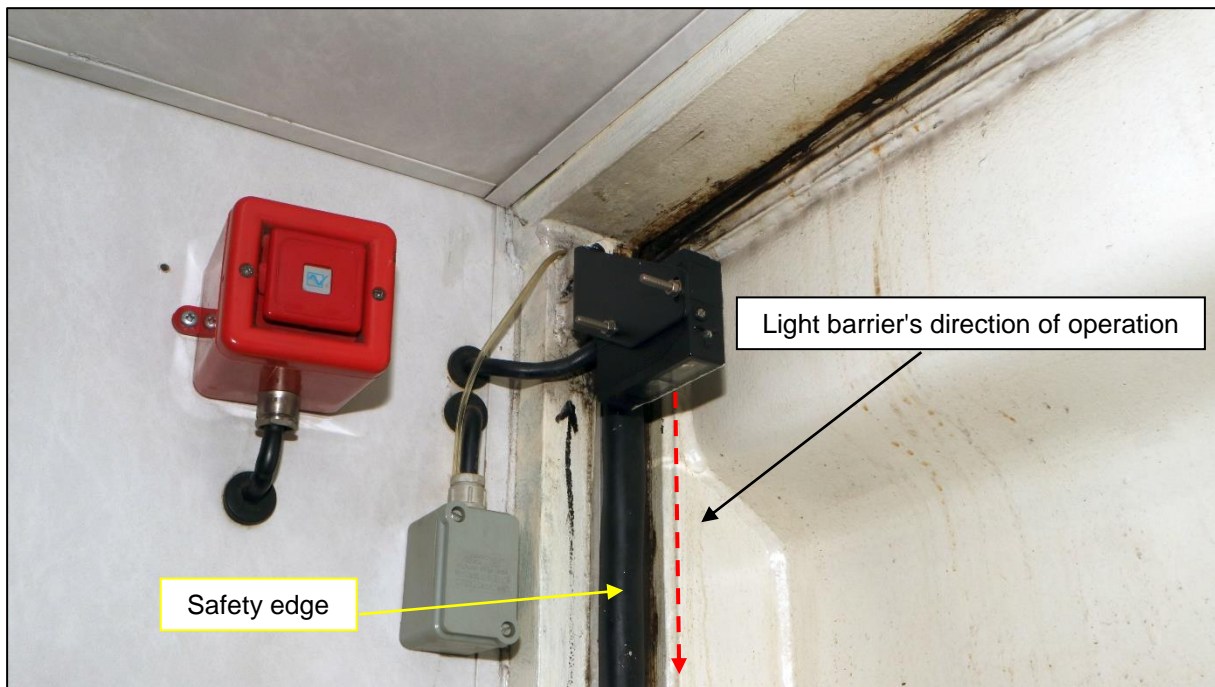


Figure 10: Audible signalling device, light barrier and safety edge¹³

The other safety system is a pressure-sensitive safety edge. This safety edge stops the sliding door closing when the rubber-encased edge is pressed in with minimal force.

The door stops moving immediately when either safety system is triggered. There is no overrun. The door then opens again.

Since there was evidently no risk of crushing when the door was opened, there were no structural or technical safeguards on the side towards which the door moves when it opens. However, when the sliding door was closed and closing, the wave-shaped design of the door leaf made it possible to reach into the free space that existed on this side until the door was fully opened. At the same time, the smallest gap between door leaf and door frame was about 2.3 cm. The biggest gap was about 10 cm. After the door was fully opened, a gap of about 0.3 cm remained between door leaf and door frame. Accordingly, the risk of crushing a finger only existed in the final phase of the door opening operation.

¹³ Source: BSU.

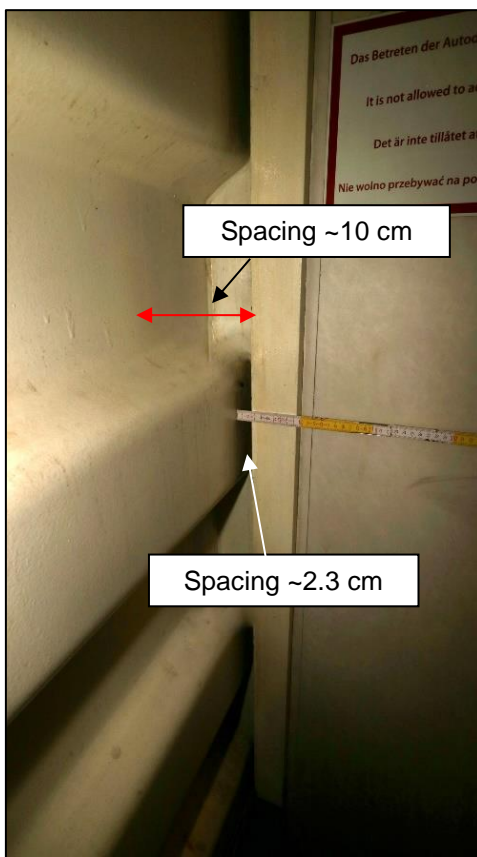


Figure 11: Gaps between door leaf and door frame when the door is closed¹⁴



Figure 12: Watertight door number 110 when it is opening¹⁵

¹⁴ Source: BSU.

¹⁵ Source: BSU.

2.2 Subsequent events

In connection with the investigation of the first incident discussed above and following a corresponding request, the shipping company advised that two other accidents had occurred on the ROBIN HOOD.

2.2.1 2nd incident

2.2.1.1 Course of the accident

The second accident investigated by the BSU occurred on 26 June 2022. A coach tour group was also on board the ferry during the crossing from Travemünde to Rostock on this particular day. While the ferry was approaching the port of Rostock, the subsequent casualty, who was a member of this tour group, made her way to the coach, which was parked on the upper vehicle deck (deck 3). The 83-year-old woman was accompanied by an acquaintance.

This woman also had a mobility impairment commensurate with her age but did not need a walking aid. It was the second trip of this kind that she had been on.

Since both women were disorientated, the casualty first entered the lower vehicle deck via the watertight sliding door number 109 on the starboard side of the ship. In the process, fingers on one of her hands were crushed.

The casualty and her acquaintance then left the lower vehicle deck. She then met other passengers on the upper vehicle deck, who informed the crew about the incident and administered first aid. Rescue service personnel took the casualty to a hospital after the ship had made fast.

An interview with the casualty by phone and later in person did not bring to light the actual course of the accident. The accident report prepared by the ship's command did not contain any information about which hand had been injured. The investigators therefore originally assumed that the casualty had already gone through the doorway and was looking for the bus on deck 1. The investigators also assumed that the casualty had held onto one of the wedges with her right hand, giving rise to the theory that when the door closed again behind the woman, the fingers on her right hand were crushed.

2.2.1.2 Findings of the investigation

As it took some time for the BSU to establish the identity of the casualty due to data protection concerns of the respondents at the coach company and the rescue services, it was still unclear which of the casualty's hands was injured when the investigators surveyed the ROBIN HOOD. Therefore, the causes of the accident and measures to be taken were discussed with the crew and those responsible at the shipping company on the basis of the above assumptions.

During the inspection of the ship, it was found that the light barrier on the stairwell side of the sliding door did not cover the area around the wedges. Accordingly, there was neither a technical nor a structural safeguard against the risk of being crushed there. Since the wedges protruded somewhat and one of them was at hand height, it could not be ruled out that the wedge was grasped for use as a handhold.



Figure 13: Assumed location at which the injury occurred¹⁶

This figure is based on door number 110 on the opposite side. All four sliding doors in the lower vehicle deck that can be used by passengers are technically comparable.

¹⁶ Source: BSU.

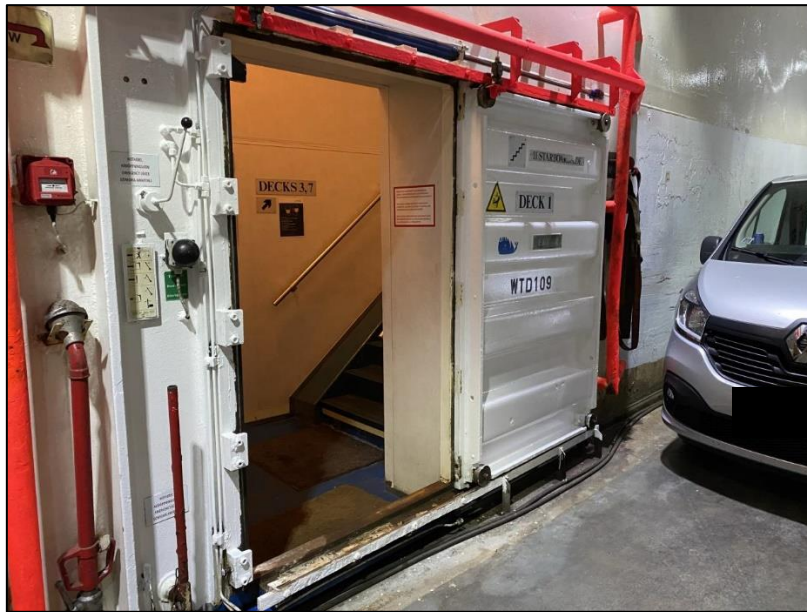


Figure 14: Watertight sliding door number 109 on the day of the accident¹⁷

In the course of the investigation, it was found that the left hand, on which four fingers were crushed, was injured during this accident. The surgical intervention ensured that all the fingers were saved. However, mobility is severely restricted.

The finding that the left hand was injured gave rise to a reassessment of the course of the accident by the investigators. They now assume that the second accident occurred in a similar manner to the first one.

2.2.2 3rd incident

The other accident reported by the shipping company following a corresponding request occurred on 12 September 2021. A coach passenger suffered a hand injury during the approach to the port of Trelleborg. Since crew members stated that the passenger was heavily intoxicated and there were evidently no witnesses to the accident, the BSU did not initiate an investigation into this incident.

2.3 Regulations for watertight doors

A review of which regulations or technical specifications existed for the construction and installation of such doors was carried out in the course of the investigation.

During the investigation it became clear that only SOLAS Chapter II-1, Part B-2, Regulations 13-1 to 15 and 16¹⁸ are referred to for this purpose. The SOLAS requirements concern the watertight integrity of doors, monitoring watertight integrity from a central position and the type of operation at sea, *inter alia*. The SOLAS regulations do not contain any requirements for technical safety devices designed to prevent crush injuries when a door closes, for example.

¹⁷ Source: TT-Line.

¹⁸ Chapter II-1 Construction - Structure, subdivision and stability, machinery and electrical installations, Part B-2 Subdivision, Watertight and Weathertight Integrity.

The rules of the Det Norske Veritas classification society were also referred to for illustrative purposes. These did not point to any requirements for safety devices designed to prevent crush injuries on watertight sliding doors, either.

The investigators also referred to the technical rules for workplaces (ASR), specifically ASR A1.7 on doors and gates, to gain an impression of how various doors should be secured. The ASR puts into specific form the requirements of the ArbStättV¹⁹ for their particular scope. However, since the ArbStättV does not apply to ships, this was only of an informative nature.

As a result, it should be noted that there are no technical requirements for watertight doors beyond those in SOLAS. Accordingly, any safety devices requiring installation are the responsibility of the operator of the respective ship.

2.4 Manufacturer of the watertight sliding door

Contact was also made with the manufacturer of the watertight sliding door, Schoenrock Marine Systems GmbH, in the course of the investigation. At the time of installation on the ROBIN HOOD during her construction, the company had already equipped the doors with all the safety equipment still in place when the accident happened (light barrier, electrical safety edge). During this contact, the changes made by the shipping company to the doors were presented and proposals as to how the manufacturer could reportedly improve the safety of this type of watertight sliding door independently were requested. A higher level of safety on these special watertight doors could thus already be achieved through an adapted production process. Moreover, the shipping companies would avoid subsequent adjustments. However, the manufacturer initially withdrew, pointing out that its product would comply with SOLAS and the requirements of classification societies.

¹⁹ ArbStättV: German Ordinance on Workplaces.

3 Actions taken

3.1 The TT-Line shipping company

The shipping company involved the BSU in the development of measures to prevent future accidents at the watertight sliding doors on all its ships. The shipping company has already implemented the following measures:

- to comply with the obligation to notify the BSU in the event of an accident under Section 7 of the German Ordinance on the Safety of Shipping in the future, the internal instructions were adapted to include the reporting obligation to the BSU after the accident of 19 June 2022 became known and the ensuing criticism of the BSU;
- in the vehicle deck, the vertical wedges were furnished with a protruding handrail (see Figure 15). This is to prevent the wedges from being used as a handhold, providing something of a passive safeguard against crush injuries in the process. The colour of the handrail and the pushbuttons was chosen to make them easier to distinguish from other components;

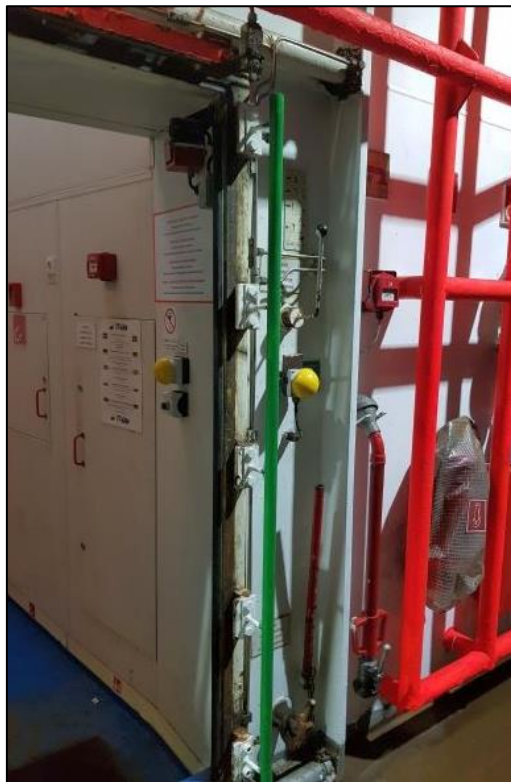


Figure 15: Watertight door number 110 with the new green handrails on the vertical wedges²⁰

- on the side of the stairwell, the sliding door wings were completely clad with a panel, which produced a smooth surface. The existing small gap between the door leaf and door frame (about 0.2 cm) was covered by a brush strip (Figure 16);

²⁰ Source: TT-Line.

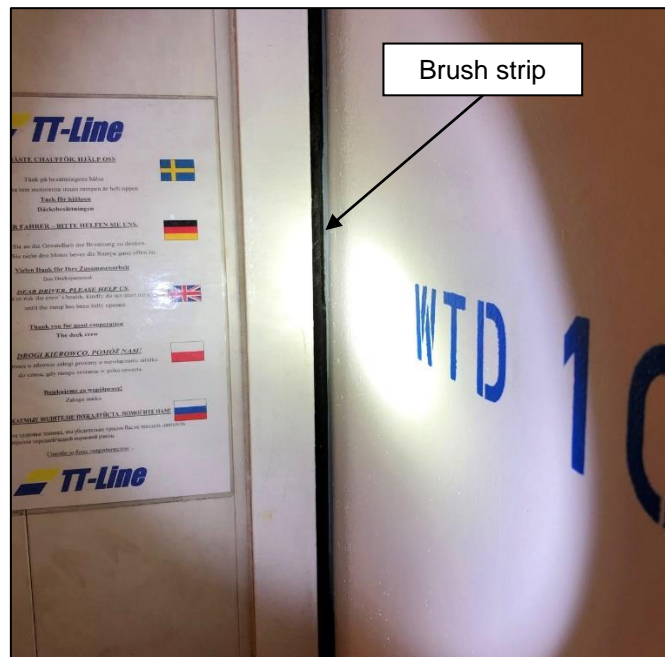


Figure 16: Watertight door number 108 with a smooth surface on the inside and brush strip on the side to which the door opens²¹

- the inner handrail in the stairwells was extended so as to reach around the corner, meaning it now provides a handhold for a longer period. Installation of a handrail or other handhold in the door frame was rejected, as the ensuing reduction in the width of the doorway would have been too great;



Figure 17: Watertight door number 108 with the new extended handrail reaching around the corner²²

²¹ Source: TT-Line.

²² Source: TT-Line.

- the shipping company has installed another sign on the stairwell side in front of the watertight sliding doors. It states in four languages that the door closes automatically, that neither the door nor the door frame should be touched, and that the doorway should be passed quickly;
- the BSU also spoke with the shipping company about increasing the volume of the signalling device that sounds when the sliding door starts to open until it has closed again. Although the representatives of the shipping company considered the volume to be sufficient for various reasons, they agreed to increase the volume by 1 to 2 db.

3.2 Schoenrock Hydraulik Marine Systems GmbH

In the course of coordinating the design, the company stated that the door would be reviewed with the following points in mind:

- use by passengers with no knowledge of seafaring;
- use by passengers with reduced mobility.

After the review, measures comparable to those already implemented by the TT-Line shipping company could be introduced. Such additional measures should then be offered as an option to shipping companies and shipyards (for new builds). At the same time, these should be confined to doors used by passengers. The company believes that the review will take some 3-4 months.

3.3 Industry association

In the course of the investigation, an examination as to whether an industry association existed for manufacturers of watertight doors was made with a view to distributing the findings of the investigation via such an association. In the process, an article released by Gard – a company operating in the marine insurance sector – in its Insight²³ brochure caught the attention of the investigators. It discusses a conference held in 2013 at which representatives of watertight door manufacturers, classification societies, shipyards, flag States and shipowners assembled to raise awareness of safety issues and reduce the risks posed by watertight doors on ships and offshore installations. As a result, an industry association was formed during the event.

However, due to waning interest among most of the members, the association was dissolved after just over a year. The representative of IMS Technologies AS, one of the former members of the industry association, provided a list of European watertight door manufacturers. To achieve a broad impact, the completed report is also being sent to these manufacturers.

²³ <https://www.gard.no/web/updates/content/20736155/seeking-an-industry-solution-to-safety-issues-around-power-operated-watertight-doors>. INSIGHT 211, 2013. Retrieved on 1 June 2023.

4 CONCLUSIONS

The investigation shows that potential limitations in the mobility and stability of passengers and the ensuing need to find a handhold on components of the ship were not given sufficient consideration before the accident. The risk analysis of hazards during operation of the watertight sliding doors evidently only focused on the closing operation. Moreover, this was the only operation that the manufacturer of the sliding door safeguarded by technical means.

The Federal Bureau of Maritime Casualty Investigation believes that the measures taken by the shipping company to improve safety at the doors are appropriate. The BSU assumes that the manufacturer of the watertight sliding doors will implement corresponding changes on its product. Accordingly, safety recommendations are not necessary. This investigation will be closed with a summary investigation report.