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

Investigation Report 268/15

Very Serious Marine Casualty

Fatal accident on board the CMV DUBLIN EXPRESS on 14 July 2015 en route from Caucedo to Rotterdam

1 March 2017

The investigation was conducted in conformity with the Law to improve safety of shipping by investigating marine casualties and other incidents (Maritime Safety Investigation Law – SUG) of 16 June 2002, amended most recently by Article 22 of 24 May 2016, BGBl. (Federal Law Gazette) I p. 1217.

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

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

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

Issued by:
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1 Summary

An occupational accident with fatal consequences occurred on the German-flagged full-container carrier DUBLIN EXPRESS while en route from Caucedo, Dominican Republic, to Rotterdam on 14 July 2015.

At about 1553[1], a Philippine welder fell from a ladder while carrying out repair works in the ship's engine room. The seaman had probably been standing at a height of about 1.40 metres on the platform of the aluminium stepladder, which was not very well secured due to the design, and is likely to have been inspecting the proper bolting of a pipe connection that ran above his head after pipe cleaning works. Precautions against falling from the ladder had neither been taken in terms of personnel (safety watch at the ladder) nor in respect of special personal protective equipment (a belt system, for example).

For reasons unexplained, the welder lost his grip (probably while working overhead), fell backwards to the ground, and started to bleed from the nose and mouth. The two other crew members involved in the maintenance works became aware of the accident, which they did not observe directly, from the sound of the fall and notified the ship's command immediately.

Any action necessary to help the severely injured and unconscious welder was taken on board immediately. The casualty was transported to the ship's medical centre and cared for using all means available on board. While the first aid was ongoing, the ship's command contacted the telemedical maritime assistance service MEDICO Cuxhaven.

The master immediately altered the course of the ship toward the nearest coastline (Puerto Rico), which was about 410 nautical miles away, and contacted the coast guard to request a rescue helicopter.

Despite the many activities on board, the condition of the seaman deteriorated dramatically during the hours that followed. Attempts at resuscitation were necessary shortly before 1900 ship's time. This was continued up until 2021 ship's time but then stopped in consultation with MEDICO Cuxhaven due to the apparent lack of success.

The DUBLIN EXPRESS then went back on her original course toward Rotterdam. After calling at Rotterdam, the ship arrived at the port of Hamburg on 24 July 2015, where the deceased seaman was taken off the ship and transferred to his home country after the autopsy.

[1] All times shown in this report are the ship's time on the day of the accident = UTC-3.

2 FACTUAL INFORMATION

2.1 Photo of the CMV DUBLIN EXPRESS

Figure 1: Photo of the DUBLIN EXPRESS

2.2 Ship particulars: CMV DUBLIN EXPRESS

Name of ship:	DUBLIN EXPRESS
Type of ship:	Full-container carrier
Nationality/Flag:	Germany
Port of registry:	Hamburg
IMO number:	9232577
Call sign:	DDSB2
Owner:	Hapag-Lloyd AG
Year built:	2002
Shipyard/Number:	Daewoo Shipbuilding & Marine Engineering Co., Ltd./4083
Classification society:	DNV GL
Length overall:	281.00 m
Breadth overall:	32.23 m
Gross tonnage:	46,009
Deadweight:	54,157 t
Draught (max.):	12.50 m
Engine rating:	51,433.4 kW
Main engine:	Sulzer 9RTA96C-B two-stroke diesel engine
(Service) speed (max.):	24.9 kts
Hull material:	Steel
Manning:	24

2.3 Voyage particulars: CMV DUBLIN EXPRESS

Port of departure:	Caucedo, Dominican Republic
Port of call:	Rotterdam, the Netherlands
Type of voyage:	Merchant shipping, international
Cargo information:	Containers

Draught at time of accident:	No details
Manning:	24
Pilot on board:	No
Number of passengers:	None

2.4 Marine casualty information

Type of accident:	Very serious marine casualty; fatal accident
Date, time:	14 July 2015, 1553
Location:	Atlantic Ocean (about 410 nautical miles east of Puerto Rico)
Latitude/Longitude:	φ 24°20.6'N λ 062°06.2'W
Ship operation and voyage segment:	Crossing from Central America to Europe
Consequences:	Fatal injuries to a seaman (fall from a stepladder)

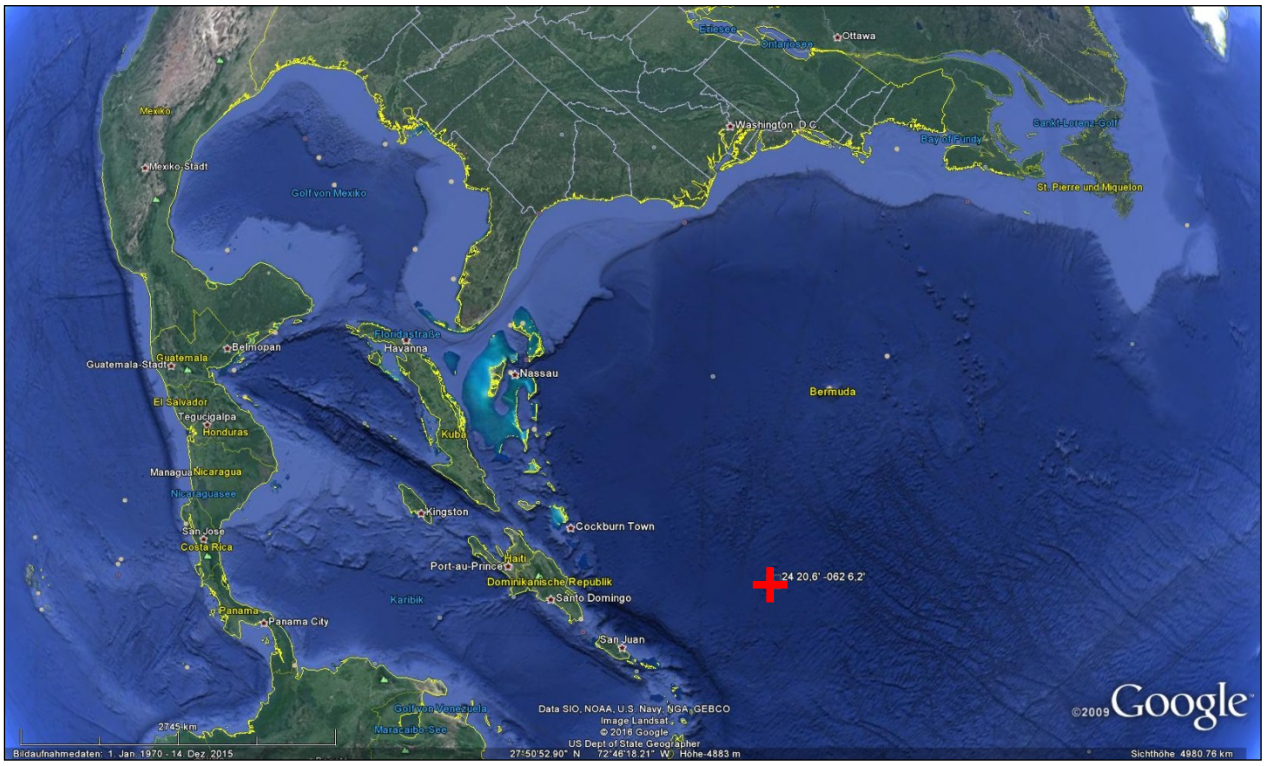

Figure 2: Scene of the accident

2.5 Shore authority involvement and emergency response

Agencies involved:	US Coast Guard Puerto Rico; MEDICO Cuxhaven; MRCC Bremen
Resources used:	Medical devices from the ship's medical centre; medication from the ship's first aid kit; telemedical consultation
Actions taken:	First aid; casualty taken to the ship's medical centre; course altered toward Puerto Rico; contact with the telemedical maritime assistance service MEDICO Cuxhaven; helicopter requested; MRCC initiated a GMDSS enhanced group call to request medical assistance from any vessels in the vicinity
Results achieved:	Seaman succumbed to his severe head injuries before the arrival of external assistance

3 COURSE OF THE ACCIDENT AND INVESTIGATION

3.1 Course of the accident

3.1.1 Events in the engine room prior to the accident

At about 0800 in the morning, the second engineer tasked the ship's mechanic (SM), the subsequent casualty (fitter)[2], and another crew member from the technical department (wiper)[3] with locating and removing a blockage in a discharge pipe in the galley. The SM directed the works at the scene in the course of the day.

Eight channels flow into the discharge pipe. These include a double sink, dishwasher, two large and three small drain outlets (see **Figure 3** by way of example).

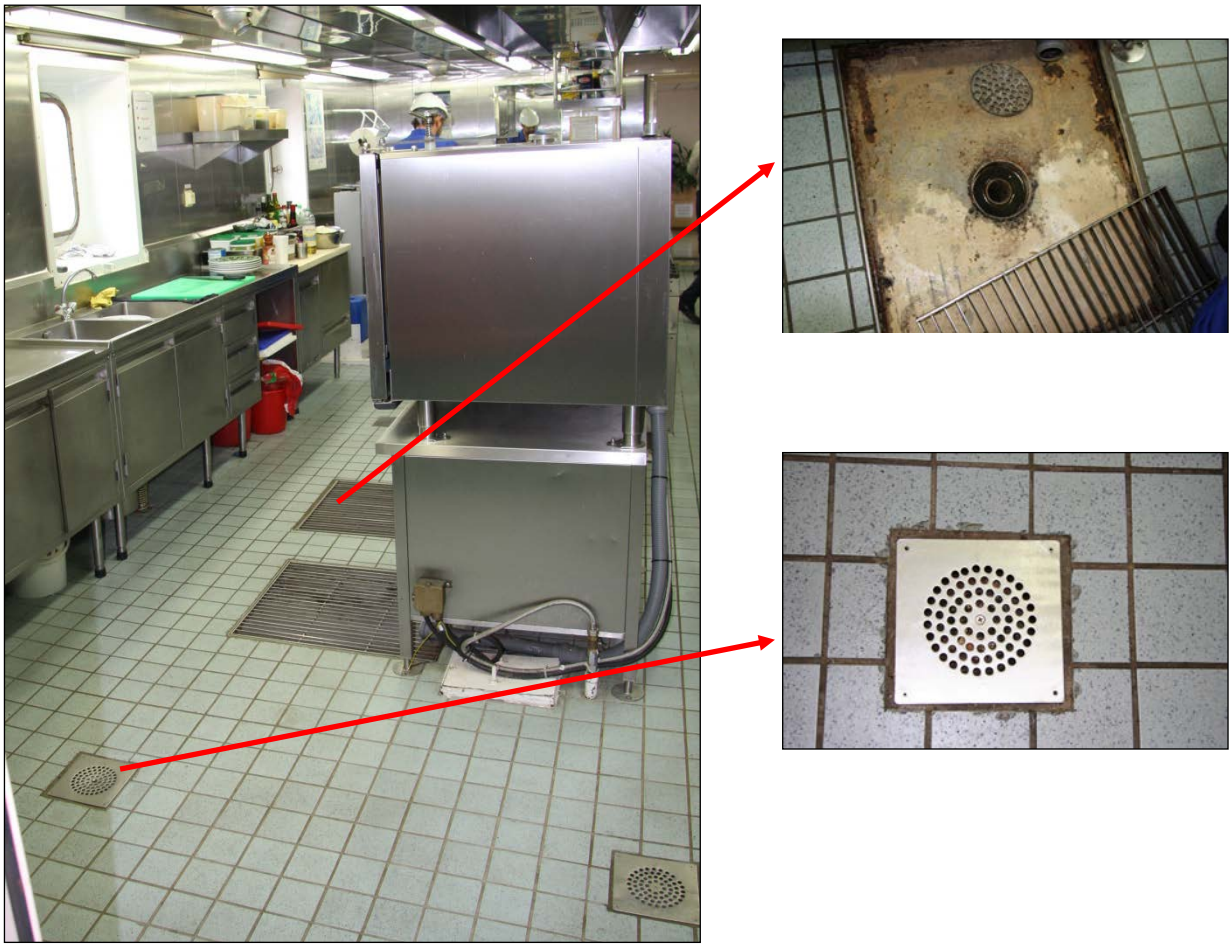

Figure 3: Drains in the galley

The discharge pipe has a diameter of 8 cm and runs from the galley to the engine room. It then runs (together with various other pipes) in the ship's transverse direction beneath the ceiling from port to starboard. The pipe makes a 90-degree turn at a longitudinal bulkhead on the starboard side and then bends downward in the ship's

[2] Fitter (welder) is the common designation on board for ordinary seamen from the engine department.
[3] Wiper is the common designation on board for an assistant from the engine department.

longitudinal direction in the immediate vicinity of a working platform on a cascade tank.

The following figures illustrate the position at the scene of the accident and the routing of the discharge pipe (marked red)[4] within the engine room from various perspectives.

Figure 4: Upper section of the engine room in the ship's longitudinal direction[5]

Figure 5: Upper section of the engine room in the ship's transverse direction[6]

[4] Note: In the interest of clarity, the pipe's routing is continuously marked in the following figures, including when views of individual sections are obstructed by pipes.
[5] Taken from the port side of the engine room facing aft.
[6] Taken from the port side similar to Figure 5, but facing starboard.

Figure 6 shows an overall view of the immediate scene of the accident, which is visible only in the background of **Figure 5**. The ladder the casualty fell from stood in the vicinity of the vertical steel beam visible in the front of the figure (see also Figure 7 below: close-up A) at the time of the accident.

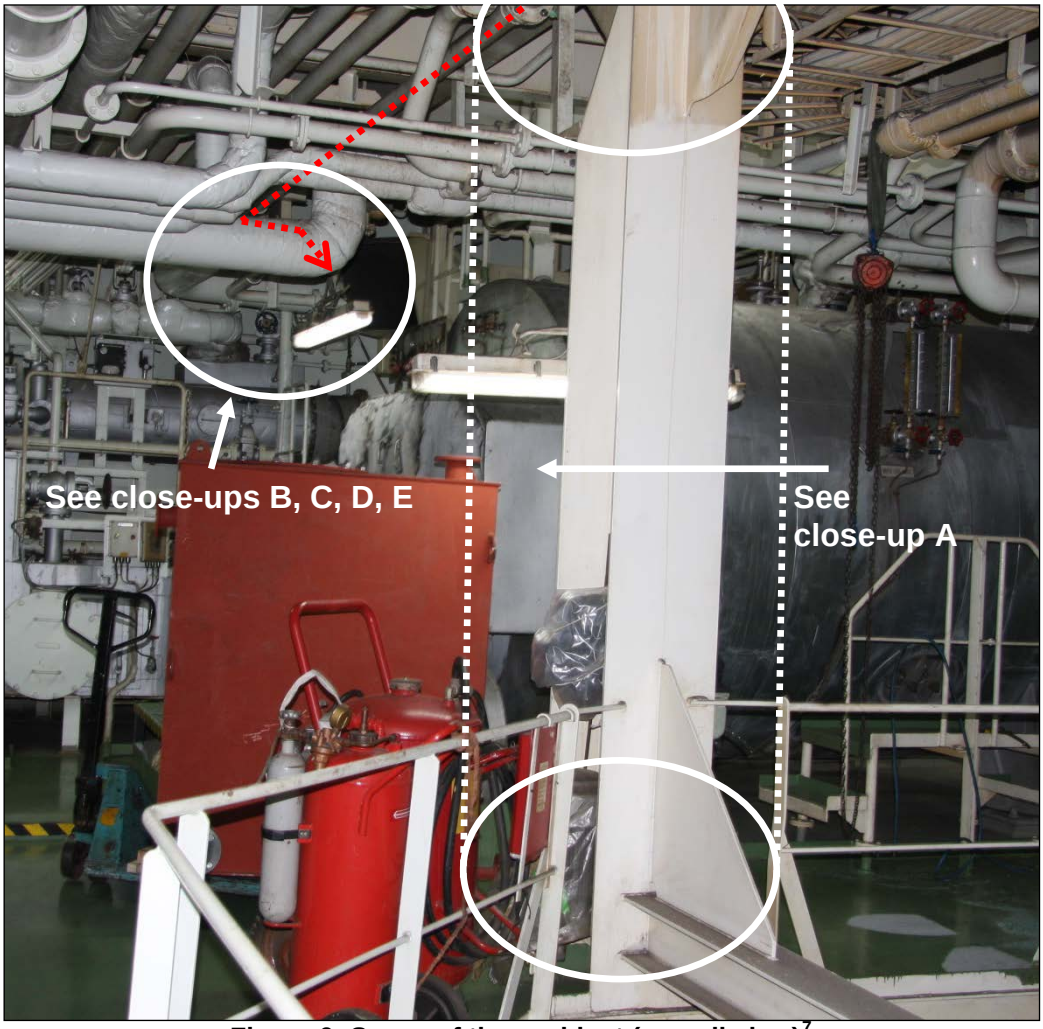

Figure 6: Scene of the accident (overall view)[7]

[7] Note: The pallet jack loaded with a red replacement part visible to the left of the vertical steel beam was not in the area in question at the time of the accident.

During the investigation in the port of Hamburg, the relevant stepladder was positioned for **Figure 7** where it stood at the time of the accident. The blue circle marks the flange connection[8] the casualty was probably working on overhead.

Figure 7: Scene of the accident (close-up A)

Figures 8 ff. below (close-ups B, C, D and E) show the remaining routing of the discharge pipe toward the starboard side of the engine room. The change in direction of the discharge pipe's routing and the guard rail of the working platform immediately adjacent to the pipe bend are visible in **Figure 8**.

[8] Note: Flange marked with the letter 'X' by the author of the report. The other flange connections were marked with the letters 'Y' and 'Z' in the figures below. These letters are merely used to facilitate orientation when looking at the photographs and an understanding of the stages of the work described in the report.

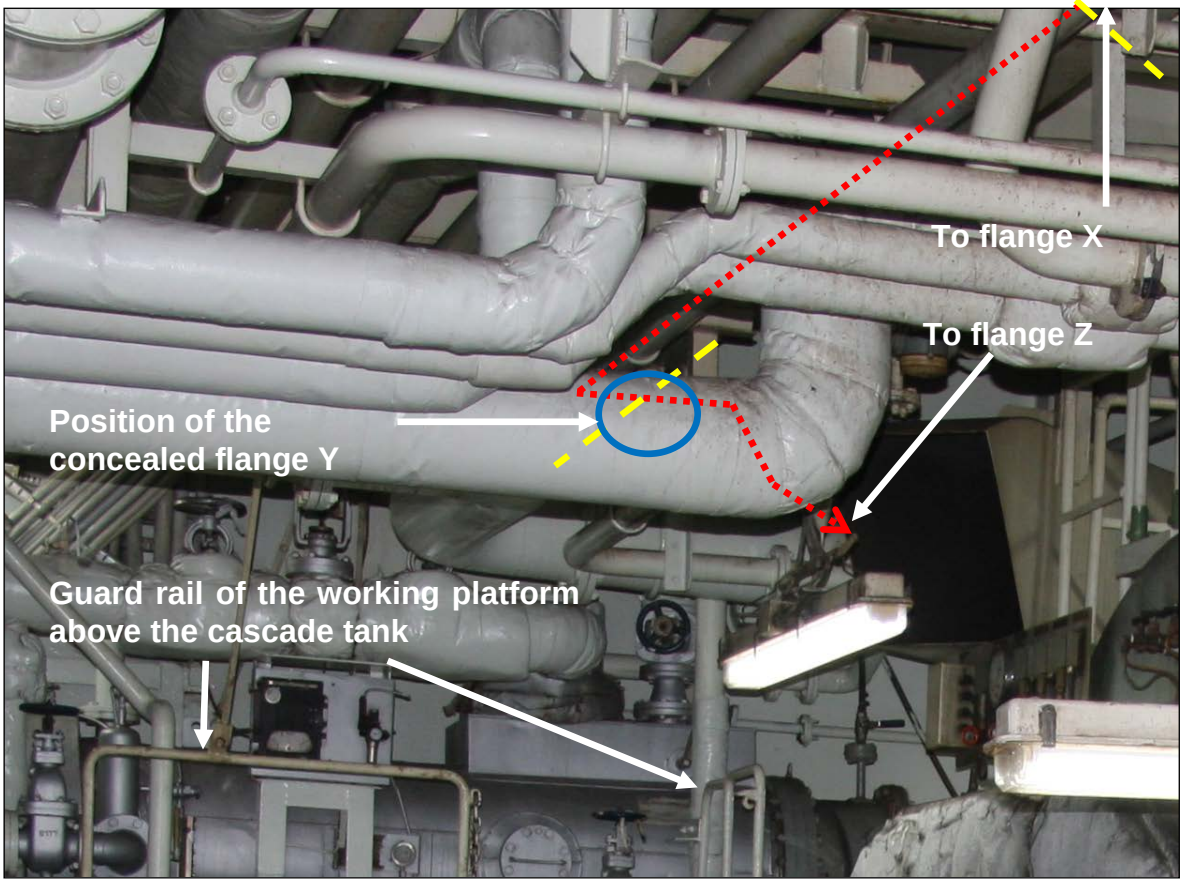

Figure 8: Routing of the discharge pipe – close-up B (transition of ship's transverse and longitudinal direction)

Figure 9: Routing of the discharge pipe (close-up C)

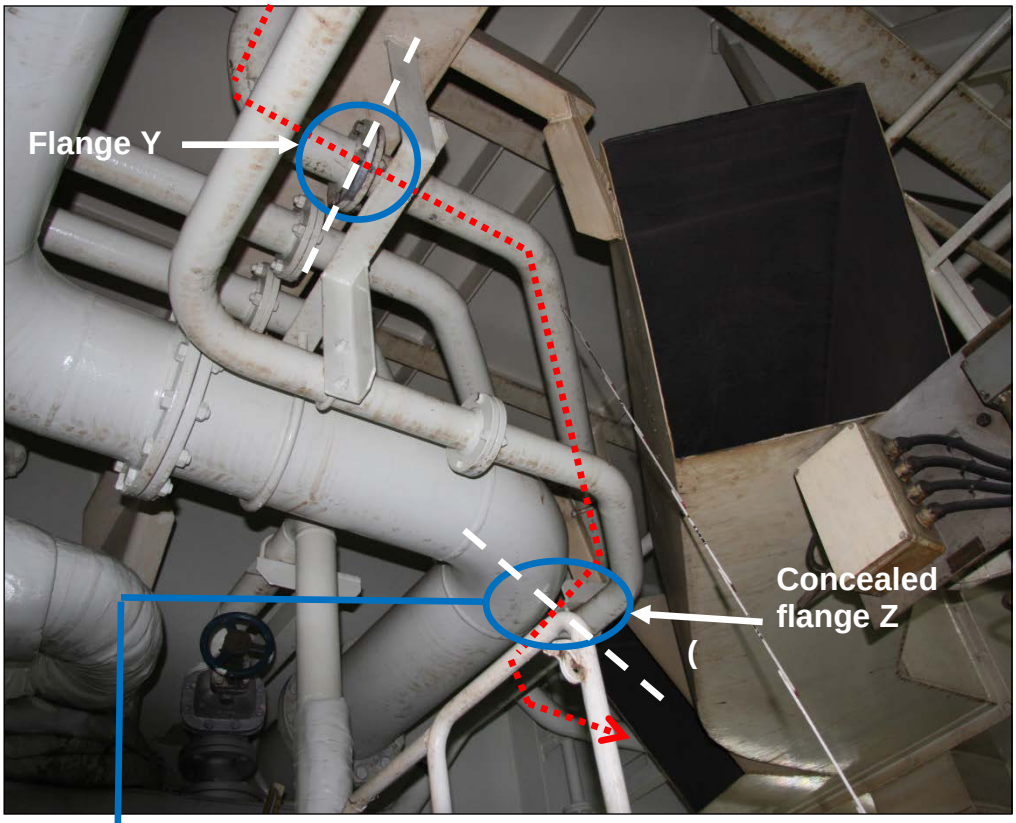

Figure 10: Routing of the discharge pipe (close-up D)

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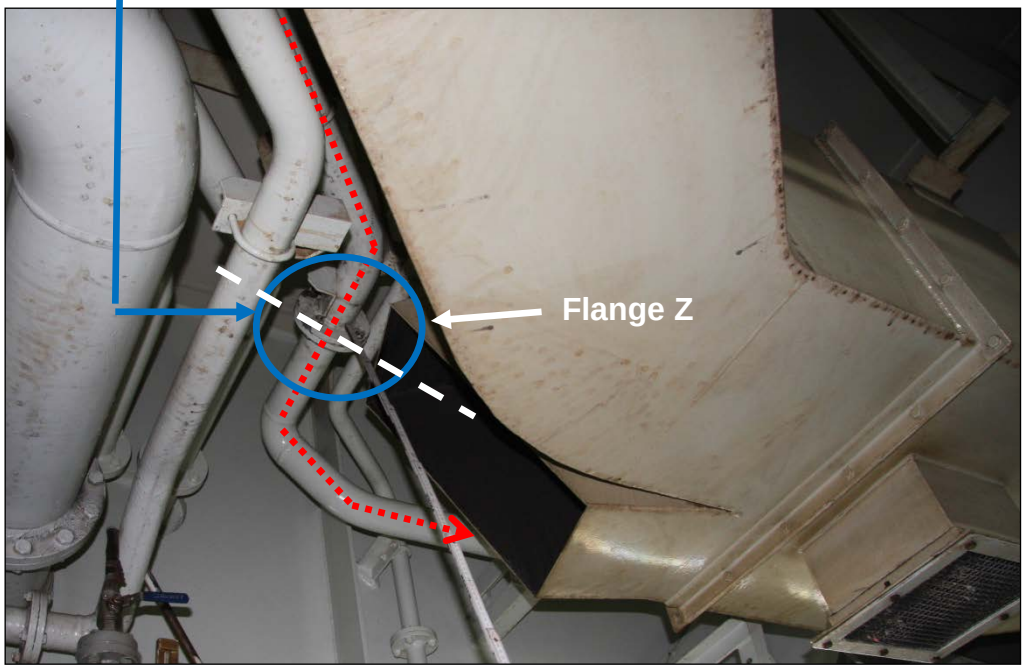

Figure 11: Routing of the discharge pipe (close-up E)

The bend in the discharge pipe in the vicinity of the longitudinal bulkhead on the starboard side of the engine room and the flange connections Y and Z located there (each circled blue) are visible from different angles in **Figures 10 and 11**.

It was initially thought that the discharge pipe was blocked in this area. Consequently, on the morning of the day of the accident the pipe joints at flanges Y and Z were first loosened and the curved pipe section marked with white lines in Figure 10 then removed. This pipe section was then cleaned and the remainder of the piping flushed with seawater. The ensuing check of the drain in the galley revealed that the blockage still existed. For that reason, the three seamen tasked with the works decided to remove another pipe section. This was the straight section of several metres in length between the vertical steel beam shown in **Figure 6** and the 90-degree bend (see yellow boundary marker in **Figure 8**). In addition to the previously unscrewed flange connection Y, flange connection X (see **Figure 7**) also had to be loosened to achieve this. It was only possible to reach this flange by ladder.[9] The long pipe section was not completely removed after the flange connection was loosened, but rather left in the ceiling mount because it was so heavy.

With the exception of one large drain, the drains in the galley were dummy flanged after the lunch break (from about 1300). The SM and wiper then tried to flush clear the waste water pipe via the only drain still open with the help of compressed air and water. The subsequent casualty was in the engine room. They managed to clear the blockage after about five minutes. The residual matter responsible for the blockage and the water used for flushing escaped from the discharge pipe opened at flange X and gushed onto the ladder standing beneath and the floor.

After the cleaning works that were thus necessary, they started to close the piping system again. To this end, flange connection X was first bolted (in reverse order). The fitter (subsequent casualty) stood on the stepladder to do this, while the SM and the wiper worked at the platform above the cascade tank. Using gentle rotations, the wiper and the SM attempted to bring the long pipe section above the platform, which was still not flanged together, into a position that would permit easy insertion of the bolts at flange X from there. Standing on the ladder, the fitter bolted flange connection X, which was located above his head, once this had been achieved.

Immediately afterwards, the SM and the wiper focused on the task of refitting the significantly shorter curved pipe section in the vicinity of the cascade tank's platform. At about 1553, the SM suddenly heard a muffled tremor. When he looked around, he saw the fitter lying on the floor bleeding next to the ladder, which was still standing upright beneath flange X. The wiper then also became aware of his injured colleague.

[9] See the comments in section 3.3.2 of this investigation report for detailed information on the ladder.

3.1.2 Events after the accident

3.1.2.1 Notification of ship's command; movement of casualty to medical centre

While the SM initially remained with the casualty, the wiper immediately rushed to the engine control room (ECR) to seek assistance.

Witness accounts differ in respect of the further sequence of events surrounding the notification of the ship's command. On the one hand, it was reported that the wiper encountered the chief engineer, the second engineer and the fourth engineer in the ECR and was the first to tell the persons referred to about the accident. On the other hand, the testimony of some of the crew members involved indicate that the SM was reportedly the first person to relay the news of the accident to the engineers in the ECR.

Having said that, it was consistently reported that the second engineer went to the scene, where he reportedly found the injured fitter lying unconscious on his back and bleeding from the nose but without any external injuries visible, immediately after notification of the accident. The second engineer reportedly first put the fitter in the recovery position, made it easier for him to breathe, and checked his vital signs. It was stated that he then hurried back to the ECR and reportedly notified the chief engineer of the situation.

Apart from that, the fourth engineer had visited the scene of the accident in the meantime. He too immediately recognised the gravity of the situation and went to get a stretcher from the cargo office, where he encountered the third officer sitting at a PC and notified him of the accident in the engine room.

The third officer then also went to the scene of the accident immediately and after seeing the casualty lying unconscious on the floor hurried back to the cargo office, from where he called the bridge and asked the second officer, who was on watch, as to the whereabouts of the master. The second officer informed him that the master had reportedly called the bridge several minutes earlier and notified that he would be doing a round of the ship's main deck. Together with a seaman who happened to be in the cargo office and equipped with a VHF radio, the third officer immediately went to the main deck to find the master. He was encountered next to bay 6 and informed about the accident.

Together with the third officer, the master immediately went to the scene of the accident to get a picture of the situation and set the necessary measures in motion. While proceeding to the scene, he instructed the officer to put together a team of four crew members and gather in the cargo office.

In the meantime, the chief officer was notified by the second officer of an accident involving a person in the engine room when he arrived on the bridge at about 1555 to take over the navigational watch. The chief officer immediately left for the scene of the accident, where he found the casualty in the recovery position. At this point, the fitter was still unconscious and bleeding from his nose and mouth. The chief officer

asked the SM, who was caring for the fitter, about the course of the accident and then went to the ECR and on to the cargo office, where he encountered the crew members assembled to move the casualty and instructed them to accompany him to the scene of the accident with the prepared stretcher. The master arrived at the scene of the accident at about the same time as the chief officer and crew members accompanying him.

Shortly afterwards, the casualty was carried to the ship's medical centre on the stretcher. The chief officer hurried ahead to prepare the medical centre for the arrival of the casualty.

3.1.2.2 Treatment of the casualty in the medical centre

The rescue team arrived at the ship's medical centre with the casualty lying on the stretcher at about 1625. In the hours that ensued, several crew members cared for the casualty intensively and in alternating teams under the direction of the chief officer, who was responsible for medical care on board. Blood pressure, pulse, body temperature and breathing were checked at short intervals.

After a preliminary examination of the patient, the chief officer made contact with the telemedical maritime assistance service MEDICO Cuxhaven between 1655 and 1709, which instructed him to maintain the recovery position, continue checking blood pressure, pulse and breathing at regular intervals, and to prepare an intravenous drip.

Since it was not easy to find a vein, inserting the intravenous drip proved difficult but finally succeeded, making it possible to administer the patient a saline solution intravenously from about 1800. While these efforts were ongoing, they started to give the casualty oxygen due to the onset of respiratory interruptions.

The patient started to suffer convulsions between 1830 and 1850. The respiratory interruptions increased. From about 1850, pulse and breathing failed permanently. In the ensuing period of nearly 1.5 hours, attempts were made to resuscitate the casualty using a defibrillator, inter alia. Adrenaline was also administered repeatedly on the advice of MEDICO Cuxhaven.

At 2021, the aforementioned measures were discontinued following a final consultation with MEDICO Cuxhaven at 2010, intense attempts at resuscitation for a further ten minutes, and subsequent performance of all the measures recommended by MEDICO to determine existing vital functions. The casualty showed no signs of life whatsoever.

The chief officer confirmed the death of the fitter in the presence of the master, the chief engineer, the second engineer and the fourth engineer.

After a moment of silence for the deceased crew member, he was cleaned, placed in a body bag, and taken to a cold room on the stretcher.

3.1.2.3 Other rescue activities

While the chief officer fought for the life of the fitter with the support of other crew members in the medical centre, the master immediately ordered a course alteration of the ship toward the coastline that could be reached fastest, i.e. toward the coast of Puerto Rico, which was about 410 nautical miles away.

At the same time, the ship was increased to maximum speed and radio contact made with US Coast Guard Puerto Rico San Juan at 1653 to request a rescue helicopter.

In the ensuing period, various radio calls were held between the bridge and MEDICO Cuxhaven, the US Coast Guard and MRCC[10] Bremen. MRCC Bremen initiated an area enhanced group call (EGC) with the aim obtaining medical support from a vessel possibly in the vicinity of the DUBLIN EXPRESS.

After the death of the fitter was confirmed, the efforts made to facilitate a rescue from the air were aborted and the ship put back on her original course toward Rotterdam at 2115.

3.2 Consequences of the accident

The crew member suffered severe head injuries when he fell from the ladder and succumbed to them a few hours after the accident.

3.3 Investigation

3.3.1 Course, sources and material particulars

The owner of the ship informed the Federal Bureau of Maritime Casualty Investigation (BSU) about the accident on 15 July 2015. The owner forwarded various items of information about the ship and course of the accident to the BSU electronically without delay before the DUBLIN EXPRESS arrived in Hamburg. An investigator from the BSU surveyed the ship after she arrived in Hamburg. During the visit on board, he took photographs of the scene of the accident and the stepladder, inspected documents, and interviewed crew members.

In the interest of a comprehensive review of all the available sources of information, the BSU also referred to the findings of Waterway Police (WSP) Hamburg's accident investigation in the course of its own investigation. Moreover, the report on the forensic examination of the casualty was evaluated. To ascertain whether swell-induced ship movements could have played a role in the fall from the ladder, the BSU requested a weather report from Germany's National Meteorological Service (DWD). One focal point of the investigation was an inspection of the requirements, regulations and instructions for occupational health and safety that should be observed when handling ladders.

[10] MRCC: Maritime Rescue Co-ordination Centre.

All in all, the sources referred to above provided a sound means of understanding the course of the accident and its causes, as well as drawing the necessary conclusions from this tragic accident.

There was no evidence of technical problems on board the ship, structural deficiencies on the ladder or fundamental deficiencies in the shipboard working arrangements, meaning detailed investigative steps were not necessary in this regard.

3.3.2 Ladder

3.3.2.1 Specifications

To facilitate working on the discharge pipe that ran beneath the ceiling, an aluminium stepladder with six steps, including platform, on one side was used (see **Figure 13** below). The ladder is certified[11] by TÜV Nord[12] and made by the long-established German company Günzburger Steigtechnik GmbH, which specialises in the development and production of ladders, rolling platforms, and special structures for the maintenance of technical equipment. The manufacturer furnishes its products with a 15-year quality guarantee.

The platform (the top or sixth step) on the ladder used is located 1.40 metres above the ground. The overall height of the ladder is 2.07 metres. According to the manufacturer's specifications, the ladder should be used up to a work height of about 3.50 metres.[13]

Usage of the ladder is explained by means of affixed pictograms (see **Figure 12**) in accordance with the requirements of industry standard DIN E 131-3. Inter alia, the following safety aspects to be observed when using the ladder are indicated by 17 simple and easily understandable illustrations:

- Face the ladder when ascending and descending
- Ensure the stepladder is opened fully before use
- Do not place stepladders on uneven surfaces
- Do not reach out to the side
- Ensure the stabiliser bar is engaged
- Maximum number of users on the ladder
- Check the ladder's feet
- Wear suitable footwear when climbing the ladder
- Only one person on each ascendable side
- Do not step off the side of the ladder
- Visual inspection of the ladder before use
- Discard damaged ladders immediately

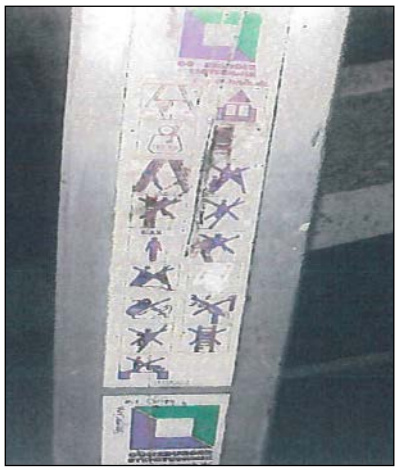

Figure 12: Safety instructions

[11] Note: The certification confirms that the ladder complies with the requirements of Germany's product safety act (Produktsicherheitsgesetz) in respect of ensuring health and safety.
[12] TÜV Nord: A German testing organisation that operates internationally in such business segments as mobility, industry service and IT and e.g. assesses products with regard to compliance with safety requirements.
[13] Source: Manufacturer and product specifications at http://www.steigtechnik.de.

Figure 13: Position of the ladder at the time of the accident (reconstruction)

Although the ladder's condition was not new when the survey took place in Hamburg, it exhibited no damage and looked technically sound.

3.3.2.2 Actual use of the ladder by the casualty

At the time of the accident, the ladder stood under flange X so that its steps were parallel to the direction of the discharge pipe's routing. Flange X was about 1.85 metres above the top step (the platform) of the ladder. Accordingly, the work height was 3.25 metres from the ground and thus within the limits specified by the manufacturer (3.50 metres).

This means that while working on the flange connection, the 1.79-metre tall fitter had to raise his arms above his head to reach it (see **Figure 14**). The investigation delivered no evidence that would suggest use of the ladder did not comply with the technical specifications or that the usage instructions affixed to the ladder were disregarded.

Figure 14: Casualty's working position on the ladder

According to the information given by the two colleagues working in the vicinity, they did not see the fitter fall from the ladder. Moreover, there are no eyewitnesses to the period immediately before the fall who are able to attest to the fact that the fitter was actually on the platform of the ladder before or during the accident and working overhead from there. However, the position in which he was found next to the ladder and, in particular, the findings of the forensic examination of the body of the fitter support the assumption that he must at least have been standing well toward the top of the ladder before he fell. Apart from the involvement of a third party, for which there is no evidence, a fall from a greater height is the only feasible explanation for the serious and ultimately fatal head injuries of the fitter.

3.3.3 Occupational health and safety – rules/practical implementation

3.3.3.1 Ship safety manual/ISM

The measures laid down in chapter IX of the Convention for the Safety of Life at Sea (SOLAS) for the International Safety Management Code (ISM) are mandatory for German maritime shipping companies and thus for ships flying the German flag. Based on this body of requirements, all shipowners are obliged to implement and maintain a comprehensive and seamless system for safety management. The company is required to keep a written record of any functions and activities pertaining to safety or protection of the environment on board its ships and ensure that they are planned, organised, executed and monitored in compliance with legal and operational requirements. This involves the implementation of procedures for the preparation of plans and instructions for key shipboard operations concerning the safety of the ship. The safety management system (SMS) should provide for

measures with which it is ensured that the relevant stations can respond to hazards, accidents and emergency situations at any time. The documents used to describe and implement the SMS (emergency plans) may be referred to as the safety management manual.

At the time of the accident, the DUBLIN EXPRESS was in possession of a valid safety management certificate and thus also a ship safety manual approved by the Administration.

In addition to many other safety-related topics, various aspects of occupational health and safety from a wide range of perspectives relevant to on-board operations are shown in English in an extremely clear manner that is easy to understand in different chapters of the manual prepared by the owner for the DUBLIN EXPRESS. All the chapters of the manual are laid out according to a uniform system. Cross-references are included in the individual chapters in cases where factual connections exist.

With regard to the course of events surrounding the accident under investigation, important requirements can be found in the manual at **chapters 7.4.03** (Personal Protective Equipment), **7.4.04** (Permit to Work System), **7.4.05** (Performance and Supervision of Hazardous Works) and **3.4.2** (ISM-Position Responsibilities), in particular.

Chapter 7.4.03 explicitly specifies safety belts and harnesses as personal protective equipment, inter alia. Moreover, an obligation of all crew members to use personal protective equipment if necessary for the works assigned is laid down in the chapter referred to.

Chapter 7.4.04 describes the special safety procedure required when works involving particularly high risks are to be carried out. Insofar as they involve hazardous works in the engine room, such activities may be carried out only after special approval. This must be made in writing by the chief engineer, who is required to visit the site beforehand and obtain information on the work environment, on local compliance with any safety measures necessary in the specific case, as well as on the use of personal protective equipment, in particular. Chapter 7.4.04 contains various specimen forms in the shape of four annexes, which must be completed and signed in the event of certain activities requiring approval. Annex 04 concerns the approval of works at a height (Permission for Working at Height). This form includes the following aspects:

- Scope of Work: name(s) of the crew members assigned, validity period of the approval, place of work, description of work
- Checklist: list of the safety measures required before the work begins, including checking ladders and fall prevention equipment
- Person in charge (signature field): confirmation by the person responsible for carrying out the works that they will be executed properly and safely
- Authorization Permit to Work (signature field): approval of the chief engineer or chief officer; statement that he is satisfied that the safety precautions have been complied with

Chapter **7.4.05** contains definitions, establishment of responsibilities, and rules in connection with the execution and monitoring of hazardous works. For the purposes of the chapter referred to, hazardous works are activities of the crew carried out under dangerous circumstances and/or health, ship safety or the environment may be exposed to risks during their execution.

As regards the question as to what activities are considered hazardous works for the purposes of chapter 7.4.05, nine annexes to the chapter are referenced, in which special directions are laid down for various fields of activity that involve risk. However, it is explicitly emphasised that the list of hazardous activities referred to in the annexes is not exhaustive.

In addition to the generally applicable requirements that must be observed in respect of all hazardous activities and which contain, inter alia, specific advice on the mandatory use of personal protective equipment, e.g. for the prevention of falls, the specific safety precautions required for various hazardous work areas are described in detail in the (nine) **annexes to chapter 7.4.05** already discussed above.

The occupational health and safety rules set out in **annexes 02** (Work in the Engine Room) and **05** (Working at Heights) are possibly of significance in respect of the accident under investigation.

Rule 5 of annex 02 lays down that floor plates and other flooring must be kept clear of fuel, oil and lubricants. **Annex 05** describes under what circumstances and in what manner precautions against falling must be taken when working at height in great detail. The very first sentence of the rule states that it applies only to falling heights of more than two metres.

Finally, in addition to the chapters referred to above, the responsibilities associated with the various functions on board laid down in **chapter 3.4.2** of the ship safety manual are also of significance. Besides a description of the area of responsibility, the various annexes to the chapter also contain requirements in respect of the qualifications necessary and professional experience, as well as rules of substitution and powers for each specific function on board.

With regard to the repair works on the discharge pipe, it follows from annex 01 to chapter 3.4.2 that the assignment and monitoring thereof fell within the area of responsibility of the second engineer. Annex 09 describes the areas of activity of the engine room ratings, i.e. crew members involved in the technical operation of the ship who report to the engineers. The provisions laid down there and a comparison with the existing qualification documents show that the seamen, including the casualty, tasked with removing the blockage in the discharge pipe were competent both in terms of their position on board and their qualification and experience.

3.3.3.2 Germany's Ordinance on industrial health and safety (Betriebssicherheitsverordnung)

Germany's Ordinance on industrial health and safety (Betriebssicherheitsverordnung – BetrSichV)[14] deals with the safe use of work equipment for operational purposes and applies on sea-going ships flying the German flag, inter alia. Article 9(1)(6) of the Ordinance generally provides that the employer must ensure that protective measures are taken to prevent a worker from falling. Annex I to the Ordinance contains special (specific) requirements for the safe handling of certain work equipment. In this respect, paragraph 3 of annex I deals, inter alia, with the use of ladders and paragraph 3.1.4 lays down that the use of ladders as work stations for work at a height is permissible only in cases where the use of other, safer work equipment is not proportionate due to the low level of risk and short duration of use, and the risk assessment indicates that the works can be carried out safely. Moreover, paragraph 3.3.4 includes the requirement that ladders must be used in such a way as to ensure that a secure handhold and secure support are available to workers at all times.

3.3.3.3 Technical rules for industrial health and safety; TRBS 2121, part 2

The technical rules for industrial health and safety (in this case TRBS 2121, part 2; Risk of injury due to falling – provision and use of ladders)[15] were drawn up by the Committee on Industrial Health and Safety[16]. They reflect its interpretation of the rules corresponding to the state of the art, occupational medicine and hygiene and other established findings of ergonomics for the provision and use of work equipment, as well as for the operation of systems requiring monitoring.

The technical rules expand upon the BetrSichV in respect of the determination and assessment of hazards, as well as the inference of appropriate measures.

[14] See the BetrSichV of 3 February 2015 (BGBl. (Federal Law Gazette) I p. 49), as last amended by Article 2 of the Ordinance of 15 November 2016 (BGBl. I, p. 2549).
[15] See GMBl. (Joint Ministerial Gazette) No 16/17 of 16 March 2010, p. 343.
[16] The Committee on Industrial Health and Safety advises the Federal Ministry of Labour and Social Affairs in matters of health and safety when using work equipment. The legal foundation arises from Article 21 BetrSichV.

To this extent, in applying the measures referred to by way of example, the employer may assert the presumption of compliance with the requirements of the BetrSichV.[17]

Paragraph 4.2.3 of the aforementioned TRBS addresses the safety requirements when using a ladder as a work station for work at height and states that ladders must be used in such a way as to facilitate a secure handhold and secure support for workers at all times. According to the rule referred to, secure handhold and support are given when the worker stands on the rungs or steps with both feet and can hold onto the ladder with one hand or his legs have sufficient contact with the ladder.

Paragraph 3 of the TRBS also points to the need for a risk assessment. Quoted verbatim, paragraph 3 also states:
"Based on the hazards identified, information from the manufacturer, findings of the statutory accident insurance institution, standards, operational experience, and other information on the state of the art can be used as sources of information for possible solutions."

3.3.3.4 Handbuch See (sea manual)

In releasing Handbuch See in 2014, which is designed to help officers and crew members to identify and evaluate dangerous situations in on-board operation, the prevention division of BG Verkehr[18] supplemented the requirements for occupational health and safety that are generally applicable on German sea-going ships.[19] Handbuch See has a modular structure and is available in German and English. It contains information and illustrations that address the key aspects of occupational health and safety arranged by the various fields of activity and risk factors in a compact form.

One chapter deals with working with ladders[20] and addresses the aspects of common accident causes, selecting ladders, positioning ladders, and using ladders in summary form. The directions for handling ladders and steps in DGUV Information 208-16 are also referred to for further information.

3.3.3.5 DGUV Information 208-016

In its capacity as the umbrella organisation of the institutions for statutory accident insurance and prevention in Germany, the German Social Accident Insurance (Deutsche Gesetzliche Unfallversicherung e. V. – DGUV) issued directions for handling ladders and steps. The directions provide explanatory notes to the BetrSichV's requirements for the provision and use of portable ladders and steps.[21]

[17] See the preliminary notes section of TRBS 2121, part 2.
[18] Note: As of 1 January 2016, the official name of this social accident insurance institution is: Berufsgenossenschaft Verkehrswirtschaft Post-Logistik Telekommunikation [German Social Accident Insurance Institution for Commercial Transport, Postal Logistics and Telecommunication] (BG Verkehr)
[19] See preface to Handbuch See.
[20] See section B 3.1 of Handbuch See.
[21] See the preliminary notes section of DGUV Information 208-016.

DGUV Information 208-016 consists of seven chapters and defines the addressee group, the responsibilities, the technical requirements (in terms of usage criteria), and the aspects of briefing workers, handling ladders properly, checks and maintenance, as well as the procedure when ladders or steps are damaged.

3.3.3.6 DIN EN 131-3:2007

The European Committee for Standardization issued another body of rules in the form of the European EN 131-3:2007 standard, which includes safety-related provisions for accident prevention when handling ladders. This standard addresses such aspects as the provision and content of user instructions, reasons for accidents, marking, and aims to standardise terminology and safety requirements in Europe.

3.3.3.7 Manufacturer's user information

Günzburger Steigtechnik GmbH, the manufacturer of the ladder used by the casualty, labelled it in accordance with the requirements of the DIN EN 131-3:2007 standard with the pictograms recommended, which showed the main requirements for proper and safe use of the ladder (see **section 3.3.2.1** above). Moreover, user information on the proper use of ladders, which is closely based on the requirements of the DIN EN 131-3 standard, can be accessed on the company's website in 26 languages, inter alia.[22]

3.3.3.8 Implementation of the rules on occupational health and safety

A comparison of the aforementioned rules, regulations and instructions concerning the safe use of ladders with the manner in which the ladder was most likely used at the time of the accident reveals that the relevant requirements of the BetrSichV, the TRBS, the ship safety manual, and information and instructions contained in Handbuch See and DGUV Information 208-016 were observed for the most part.

The competent second engineer instructed technically qualified crew members, who were equipped with sturdy footwear and proper protective clothing, to carry out the works on the discharge pipe.

The special provisions of the ship safety manual on hazardous works at height, including the resulting increased safety requirements (chief engineer's written approval and checklist concerning the safety requirements to be observed, use of special fall protection equipment, monitoring of the works) did not apply to the maintenance activities on the discharge pipe, as they only need to be observed when there is a risk of falling from a height of more than two metres. The discussed limit of two metres is taken up in Handbuch See in respect of the aspect of working safely on ladders in that the use of personal protective equipment against falling is also recommended only from a height of more than two metres.

[22] See http://www.steigtechnik.de/service/downloads/download-info/benutzerinformation-leitern-alle-sprachen/.

Whether the ladder and the floor in the area of the accident were completely cleared of the contaminants (which would have escaped and spilled onto them when the discharge pipe was flushed out at flange X) at the time of the accident pursuant to rule 5, annex 02 of chapter 7.4.05 of the ship safety manual can only be speculated on.

It is also unclear whether or in what intervals the second engineer, who was responsible for monitoring maintenance works in the engine room, checked the works of the repair team at the scene. However, it is important to note here that despite the sequence of events to the contrary, the activities in question were basically neither particularly hazardous nor in need of monitoring.

The ladder used was in a satisfactory condition and in terms of actual use essentially met the largely identical or as regards substance similar criteria shown in Handbuch See, DGUV Information 208-016, DIN EN 131-3:2007, and the manufacturer's user manual.

A comparison of the usage rules contained in the aforementioned sources did reveal that despite the considerable degree of concordance found, there were certainly differences of significance to the actual course of events surrounding the accident, however.

While the manufacturer's user information and its underlying DIN EN 131-3:2007 contain the explicit requirement that additional safety measures must be taken if it is not possible for the user to hold onto a ladder with one hand when working, Handbuch See and DGUV Information 208-016 contain no such advice. On the contrary, chapter 5.2 of DGUV Information 208-016 actually explicitly refers to and depicts working on a ladder without holding on as proper use with no additional safety precautions, regardless of design (see Figure 15).

Figure 15: Safe position on a stepladder with platform according to DGUV 208-016[23]

Quoted verbatim, the beginning of chapter 5.2 of the directions (instructions on proper use regardless of design) states in this regard:

"It must be possible to hold on and stand safely when working on ladders.
This method has equal importance when using suitable ladders:
– Stand with at least one foot on the platform of a stepladder with simultaneous support from the handhold. […]"[24]

Another significant difference – this time between the advice in Handbuch See and all other sources relating to special occupational health and safety when handling ladders – is that only Handbuch See (and inasmuch by way of derogation from the content of the other sources) explicitly recommends not to stand on the top step or platform of ladders.[25]

Although, as shown above in detail, the mandatory (overarching) requirements of the BetrSichV, the TRBS, as well as DGUV Information 208-016 and the advice in Handbuch See basically permit working on ladders without holding on, they nonetheless contain the mandatory requirement that this is only acceptable if a risk assessment has revealed that the works can be carried out safely.

[23] Source: Figure 43 on page 33 of DGUV Information 208-016.
[24] See page 33 of DGUV Information 208-016.
[25] See section B 3.3 of Handbuch See.

3.3.4 Weather conditions (DWD report)[26]

A summary of the DWD's official report of the weather conditions in the area and at the time of the accident follows:

"Mean wind (at a height of 10 m above the water surface)/gusts:
The vertical temperature profile at the St. Juan station (Puerto Rico, 1200 UTC) may be regarded as representative of the north-east sea area. Accordingly, a stable stratified atmosphere is visible. Easterly mean winds of 11 to 16 knots (force 4 Bft) were measured in the area of the accident. Gusts did not exceed the mean wind by more than force 2 Bft. Wind forces of 4 Bft were expected in the area of the accident.

Significant sea state
The sea state analysis of the Ocean Prediction Center (NOAA, USA) indicates significant wave heights of less than 1.5 metres."

In view of the size of the DUBLIN EXPRESS and the fact that the accident occurred relatively low in the ship, it is reasonable to assume that there were no weather-induced ship movements of a scale that could have contributed to the fitter's fall from the ladder at the time of the accident.

3.3.5 Time spent on board/professional experience of the casualty

The 48-year-old casualty had been on board for 49 days at the time of the accident. According to entries in his seaman's passport, the fitter had worked in this capacity on the ships of various owners since at least July 2011. Therefore, he was qualified to do the works carried out by him in the engine room on the day of the accident.

3.3.6 Qualifications, workload

In some cases, the two other crew members assigned to carry out the repair works, as well as the master, the officers and the engineers had many years of professional experience. The master and the officers and engineers primarily involved in caring for the casualty in the ship's medical centre were in possession of internationally valid certification for the purposes of the requirements concerning medical care on sea-going ships at the time of the accident.

The evaluated timesheets delivered no evidence of fatigue or stress being contributory factors in the accident.

3.3.7 Autopsy of the deceased/cause of death

An autopsy was carried out on the body of the fitter after the DUBLIN EXPRESS arrived in Hamburg on 24 July 2015 in the Institute of Forensic Medicine, Hamburg-Eppendorf University Clinic. It was found that death was caused by a severe craniocerebral trauma. Moreover, the casualty suffered a fracture in the area of the cervical spine when he fell from the ladder. The diagnostic findings corresponded

[26] Source: Official report by Germany's National Meteorological Service (DWD) of 25 September 2016 on the weather and sea conditions some 410 nautical miles east of Puerto Rico (24°20.6'N; 062°06.2'W) between 1600 UTC and 2200 UTC on 14 July 2015.

with the chronological sequence of the events surrounding the accident and subsequent medical care on board the ship unequivocally.[27]

4 Analysis

4.1 Assessment of the accident situation/cause

There are no eyewitnesses to the marine casualty. Consequently, findings as to the actual sequence of events immediately prior to and during the fatal occupational accident cannot be made with certainty. The witness accounts and the findings of the forensic examination indicate that the fitter was in all likelihood standing on the platform of the ladder and working overhead on the discharge pipe, when he suddenly stumbled or lost his balance and unfortunately fell to the ground. During the works in question, the fitter was neither protected against falling through technical precautions nor by the assistance of a colleague.

It was not possible to determine why the casualty stumbled. It is clear that the ladder used was in safe working condition. It is only possible to speculate on whether the ladder was contaminated by residual matter that spilled on it while the discharge pipe was being flushed. Such residual matter could have caused the casualty to slip on the platform or a step and then fall.

4.2 Assessment of the action taken after the accident

It was not possible to reconstruct the chronological sequence of the notification of the ship's command after the accident, either. However, while analysing the relevant witness statements, it is important to consider that the situation in which all involved found themselves after the fall was dramatic and exceptional and several seamen were traumatised by the tragic loss of their colleague. With that in mind, it is no surprise that information given by those crew members directly concerned was at times inconsistent in the subsequent accounts of the initial activities.

Be that as it may, after analysing all the available sources it is clear that immediately after the accident – and evidently even before the coordination measures started – the people involved initiated the proper and necessary steps intuitively. The involvement of the third officer, who immediately took it upon himself to inform the master, merits special mention here. In this context, it also proved extremely helpful that the master notified the officer on watch on the bridge before his round of the ship.

[27] Source: Autopsy Report S 0740-15 (L2448-15) of the Institute of Forensic Medicine (Hamburg-Eppendorf University Clinic) of 1 August 2015.

As far as can be ascertained, the subsequent activities on board were also marked by a high degree of professionalism. The decision to alter the ship's course toward the nearest coast and proceed at maximum speed, as well as to make contact with the coast guard and the telemedical maritime assistance service without delay underlines the fact that the ship's command literally made every effort to save the life of the casualty with all available means from the outset.

The continuous and intensive treatment of the casualty in the ship's medical centre, during which the members of the ship's command trained in medical treatment on sea-going ships supported one another, also warrants great recognition.

4.3 Occupational health and safety

A differentiated approach is necessary in respect of the assessment of occupational health and safety (or associated deficits that made the course of events leading up to and during the accident possible).

On the one hand, it is important to stress that the likelihood of falls from a ladder being fatal or leading to serious injuries at a height of *only* 1.40 metres is probably very low based on general life experience. On the other hand, the incident investigated here shows that no particular additional circumstances are needed to turn a fall from such a height into a fatal accident.

The ostensibly marginal but considered in detail significant differences between the applicable occupational health and safety regulations pertaining to the safe use of ladders, the manufacturer's instructions, and the relevant DIN standard, as well as the ensuing recommendations, instructions, and information published within the area of responsibility of the DGUV and, in particular, BG Verkehr reflect the field of conflict in which individuals find themselves if it is necessary to weigh up whether and what safety precautions are required to protect people from the risk of falling from an apparently moderate height (considerably less than two metres in the present case).

While Handbuch See at least still expresses the hardly practicable recommendation not to stand on the top step or platform of ladders, the directions of the DGUV (Information 208-016) completely dispense with a special safety notice based on height. On the contrary, the DGUV sees no particular risk or problem in people working on ladders of various heights and design without special safety precautions. Consequently, the 51 figures in DGUV Information 208-016 include no less than 11 photographs showing examples of the proper employment of people on various types of ladder in different situations. Viewed objectively, the 11 situations in question actually seem to be more or less capable of causing the person working to fall catastrophically, however.

By contrast, the risk assessment in the European DIN EN 131-3:2007 standard and the ladder manufacturer's user information, which closely reflects the safety requirements expressed in this standard, goes considerably further with the recommendation that additional safety measures must be taken if it is not possible to hold on with one hand when working on a ladder.

If this requirement is applied to the manner in which the stepladder was used on the day of the accident, it is evident that use of the ladder in accordance with DIN 131-3:2007 or the manufacturer's user information would have inevitably required that the fitter be additionally secured against falling when working on the ladder without holding on. While the use of relevant personal protective equipment or a safety net appears to be somewhat impractical in view of the specific circumstances at the scene of the accident, it would have been easy to place a safety watch, who could pass tools or in the worst case at least decelerate a fall, next to the ladder.

In this context, the BSU is of course aware that an assistant positioned next to a ladder could be exposed to grave danger if the crew member working on the ladder stumbles, especially when sizeable working heights are involved. However, the working height on the ladder was moderate in this specific case and the assistant could have made physical contact (even permanently where necessary as a precautionary measure) with the crew member working on the ladder simply by extending his arms.

BG Verkehr also evidently acknowledges that it can be useful to post a person next to a ladder for safety reasons and/or to assist depending on the situation. Although this is not explicitly addressed in the written content of the relevant section of Handbuch See, it is shown on two figures.[28]

Apart from the figures in Handbuch See referred to above, which are devoid of any explanatory comments, the applicable occupational health and safety instructions of the DGUV (and their supplementary notes in Handbuch See) pertaining to the safe use of ladders, which must be observed by the crew, dispense with the recommendation of additional safety measures of the aforementioned type.

On the other hand, the owner of the ship is required to observe the BetrSichV, which states that ladders may only be used as a work station for work at height if a risk assessment has shown that the works can be carried out safely. In this regard, the technical rules for industrial health and safety (in this case TRBS 2121, part 2), which put into concrete form the BetrSichV's requirements concerning the determination and assessment of hazards and assist in the inference of appropriate measures, lay down (but only in a generalised form) that ladders must be used in a manner that enables workers to stand and hold on safely at all times.

[28] See sections B 3.1 and B 3.3 of Handbuch See.

To this extent, in applying the measures referred to by way of example, the employer may assert the presumption of compliance with the requirements of the BetrSichV according to the preliminary notes to the discussed technical rules.

Consequently, neither the owner nor the crew of the ship can be criticised for the fact that special safety measures were not defined in the ship safety manual or for this specific work order for the use case of working on a ladder at a working height of less than two metres without holding on by the second engineer, who was responsible, or the actual crew members working at the scene.

5 Conclusions

5.1 Primary cause of the accident

Despite all remaining uncertainties regarding the specific course of the accident, it is clear with a probability bordering on certainty that the fatal marine casualty was caused by the fitter falling from the ladder.

The tragic outcome of the accident would not have happened if the fitter was protected against falling while working on the ladder. Since the use of personal protective equipment against falling or a safety net can hardly be regarded as practicable in relation to this specific work order, the posting of a safety watch was the most feasible safety measure in this particular work situation, especially when considering the moderate platform height. Although such a safety watch would not necessarily have been able to prevent a fall, he would probably at least have been in a position to decelerate the fall of his colleague decisively.

5.2 Consequences

For reasons the BSU finds difficult to understand, the relevant accident prevention regulations and ensuing instructions and recommendations published contrast with the European standard and the ladder manufacturer's user information in that they contain no advice on the need to take special safety precautions when working on ladders without holding on. Inasmuch, harmonisation between the BetrSichV and the European DIN EN 131-3:2007 standard on one hand and the instructions and recommendations of the accident insurance institution on the other hand, which are insufficient as regards the safe use of ladders, is urgently needed in the interest of workers.

Regardless of the foregoing, the investigation into the very serious marine casualty on board the DUBLIN EXPRESS emphasises the need for shipowners and ship's commands to consider potential hazards even when the risks in question have not been explicitly addressed thus far in the relevant requirements and instructions when making a risk assessment of the activities on board.

6 Safety recommendations

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

6.1 German Social Accident Insurance Institution for Commercial Transport, Postal Logistics and Telecommunication (BG Verkehr)

6.1.1 Revision of Handbuch See

The Federal Bureau of Maritime Casualty Investigation recommends that BG Verkehr adapt section B 3.3 (Using ladders) of its publication Handbuch See to account for the requirements of the European DIN EN 131-3:2007 standard (Ladders – User instructions) and the BetrSichV, pointing to the need for a relevant risk assessment for working on ladders without holding on and recommending any ensuing additional safety precautions if necessary.

6.1.2 Information to the companies insured

The Federal Bureau of Maritime Casualty Investigation recommends that BG Verkehr advise in an appropriate manner the German shipping companies it insures of the need for additional safety measures to be taken when working on ladders without holding on, extending previous recommendations.

6.2 German Social Accident Insurance (Deutsche Gesetzliche Unfallversicherung e. V.– DGUV)

The Federal Bureau of Maritime Casualty Investigation recommends that as the umbrella organisation of the institutions for statutory accident insurance and prevention, the DGUV revise its publication DGUV Information 208-016 (directions for handling ladders and steps) and adapt it to account for the requirements of the European DIN EN 131-3:2007 standard (Ladders – User instructions) and the BetrSichV. As regards working on ladders without holding on, the ensuing obligation of preparing a risk assessment arising from the BetrSichV should be pointed to and – at least in certain cases – the need for additional safety measures should be included in the directions.

6.3 The owner, Hapag-Lloyd AG

The Federal Bureau of Maritime Casualty Investigation recommends that the owner, Hapag-Lloyd AG, supplement the ship safety manuals of the ships of its fleet in respect of using ladders or working at a height to the effect that special safety precautions are required not only from a height of more than two metres, but rather when working without holding on from a position from which a fall is possible.

7 SOURCES

- Written and oral statements/documents/records
  - CMV DUBLIN EXPRESS
  - The owner, Hapag-Lloyd AG
- Photo of the CMV DUBLIN EXPRESS, Dietmar Hasenpusch Photo-Productions, Hamburg
- Findings and photos of WSP Hamburg
- Autopsy Report S 0740-15 (L2448-15) of the Institute of Forensic Medicine (Hamburg-Eppendorf University Clinic) of 1 August 2015
- Official report by Germany's National Meteorological Service (DWD) concerning a marine casualty involving the DUBLIN EXPRESS some 410 nautical miles east of Puerto Rico (24°20.6'N; 062°06.2'W) between 1200 LT (1600 UTC) and 1800 LT (2200 UTC) on 14 July 2015
- DIN EN 131-3, Ladders – Part 3: User instructions, German version, European Committee for Standardization, Brussels
- Handbuch See – Arbeitssicherheit und Gesundheitsschutz in der Seeschifffahrt und Fischerei (sea manual – occupational health and safety in maritime shipping and fisheries), publisher: Berufsgenossenschaft für Transport und Verkehrswirtschaft (BG Verkehr), Prevention Division, Hamburg
- DGUV Information 208-016: Directions for handling ladders and steps, publisher: Deutsche Gesetzliche Unfallversicherung e. V. (DGUV)
- Manufacturer's information, Günzburger Steigtechnik GmbH, www.steigtechnik.de