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

Investigation Report 172/07

Very Serious Marine Casualty

Fatal personal accident on board TMS SEACOD on 27 April 2007 North West of the Azores

1 February 2008

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.

According to this the sole objective of the investigation is to prevent future accidents and malfunctions. The investigation does not serve to ascertain fault, liability or claims.

The present report should not be used in court proceedings or proceedings of the Maritime Board. Reference is made to art. 19 para. 4 SUG.

The German text shall prevail in the interpretation of the Investigation Report.

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1 Summary of the marine casualty

On 27 April 2007 the German tanker SEACOD was on passage from Immingham (United Kingdom) to Savannah (USA) when north-west of the Azores a Philippine able-bodied seaman was fatally injured while carrying out maintenance work on a mooring line on the main deck after edge forecastle. In doing so an eye splice on a synthetic wire rope of Atlas type was to be rigged on deck. Due to spray water washing overboard at a course of 249°, a speed of 13,7 kn, a wind from west to north-west at 5-6 Bft and wave heights of 1,5 – 2 m, 47 m rope were unrolled from the forward port spring winch and several times deflected by an auxiliary construction and mounted at a ventilation pipe at the after edge forecastle and tightened[1]. In the process a ladder rung broke to which a strop was attached, which deflected the Atlas rope by 90°. The rebounding rope hit the casualty and hurtled him on deck or, rather, onto a deck stringer. Despite rescue measures being promptly started and an emergency physician being flown in by helicopter, the life of the casualty could not be saved.

[1] In maritime language tighten: pull tightly

2 Scene of the accident

Type of event:	Very serious marine casualty
Date/Time:	27 April 2007, 11:00 UTC
Location:	At sea, North West of the Azores
Latitude/Longitude:	φ 44°34,5' N λ 036°49,1' W

Section of the Chart 379 North Atlantic Ocean, route map,
Federal Maritime and Hydrographic Agency

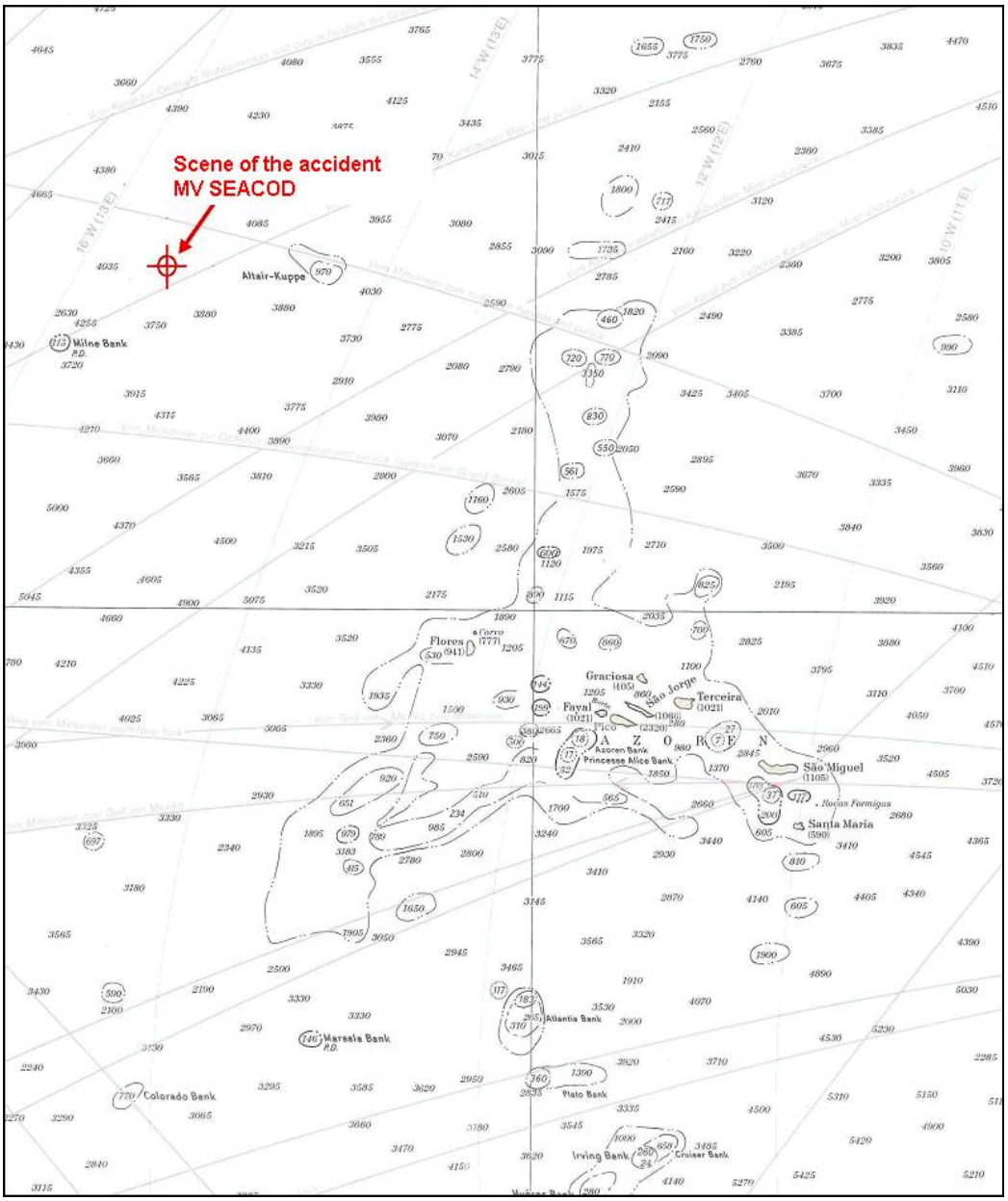

Figure 1: Chart

3 Vessel particulars

3.1 Photo

Figure 2: Photo of the vessel

3.2 Particulars

Name of the vessel:	SEACOD
Type of the vessel:	Tanker
Nationality/flag:	Federal Republic of Germany
Port of registry:	Bremen
IMO number:	9352315
Call sign:	DDPW
Vessel operator:	German Tanker GmbH & Co KG
Year built:	2006
Shipyard/yard number:	Lindenau GmbH / S273
Classification society:	Germanischer Lloyd
Length overall:	188,33 m
Breadth overall:	32,20 m
Gross tonnage:	26.548
Deadweight:	40.600 t
Draught:	11 m
Engine rating:	11.200 kW
Main engine:	MAN B&W 8L58/64
Speed:	15,5 kn
Hull material:	Steel
Hull construction:	Double hull
Number of crew	18

4 Course of the accident

The SEACOD, loaded with gasoline, was en route from Immingham (UK) to Savannah (USA). At 11:00 h board time (UTC – 2 hrs.) at a position of 44° 34,5' N 036° 49,1'W (course: 249°, speed: 13,7 kn, wind: WNW 6, sea 5) north-west of the Azores the Officer on Watch on the bridge received information that an accident had occurred on deck and promptly alerted the Master, officers and crew. A rescue team was assembled in accordance with the emergency plan. The 43 year old able-bodied seaman from the Philippines lay on the foreship and had obviously suffered injuries to his head and shoulder when he attempted to rig a mooring line. First Aid measures were initiated and the patient was brought to the ship hospital and treated.

The Master then proceeded to the bridge and informed the shipping company superintendent about the accident. Reacting to this emergency, the decision was taken to promptly deviate from the present route and head for the Azores. The course was changed to 138° and the vessel proceeded at maximum speed towards the island of Flores.

At 13:30 h the Master contacted MRCC[2] Delgada, gave a description of the accident and requested assistance.

At the same time, the shipping company superintendent appointed an agent on the Azores in order to support the rescue operation from shore.

MEDICO Cuxhaven was then contacted. They were informed about the accident and were requested for advice on the further treatment of the able-bodied seaman. The rescue team on board worked in co-operation with MEDICO, the able-bodied seaman was given oxygen and remained under the supervision of two crew members throughout the whole period.

MRCC Delgada informed the vessel that a helicopter with a physician on board was being dispatched and agreed on a rendezvous manoeuvre.

At 17:30 h UTC the patient's breathing failed. His breathing was revived after his airways had been freed.

At approx. 20:15 h UTC his breathing failed again and his natural breathing could not be resuscitated. Artificial respiration was then initiated.

At 21:10 h UTC his heart stopped beating but was resuscitated by means of cardiac massage. This happened four times until 22:12 h UTC, when the physician from the MRCC Delgada arrived by helicopter.

Upon examination of the able-bodied seaman the doctor confirmed that he was brain dead. At this point in time, his pulse and heartbeat were extremely weak and there was no natural breathing. Shortly afterwards, his heart stopped beating again and he could not be resuscitated. The vessel's position was 42° 58,3'N, 034° 57,9'W.

[2] Maritime Rescue Coordination Centre

The MRCC Ponta Delgada rescue operation was recorded as follows:

- National Medical Authority contacted MS SEACOD to give medical advice.
- Confirmation received from Codumar (Medical Authority) about MEDIVAC.
- Helicopter EH-101 Merlin of the Portuguese Air Force (FAP) was requested to rescue the injured crew member.
- MS SEACOD requested to head for the island of Flores in order to meet the helicopter.
- On 27 April 2007 at 15:35 h UTC the helicopter left the airbase on Terceira Island.
- On 27 April 2007 at 18:55 h UTC the helicopter left the island of Flores after refuelling.
- On 27 April 2007 from 21:45 h UTC to 22:25 h UTC the helicopter was airborne and the medical team on board MS SEACOD at position 42° 57'N 034° 48'W.
- The medical team decided not to continue with medical evacuation as the patient was brain-dead and his vital functions were being preserved artificially.
- Helicopter EH-101 MERLIN; communication via VHF 16 and other operating channels.
- MS SEACOD headed for the port of Horta on the island of Faial in order to transfer the crew member, estimated time of arrival 29 April 2007, 01:00 h UTC.

At 22:30 h UTC the helicopter had to pick up the physician due to fuel shortage.

The vessel headed for Horta on the island of Faial, where it arrived on 29 April 2007 at 03:00 h UTC in order to transfer the corpse and personal belongings to the Portuguese Port Authorities. The SEACOD then resumed its voyage. According to the requirements of the shipping company's quality management system, further investigations were carried out on board and the crew were questioned in order to clarify the cause of the accident. The crew reconstructed the course of the accident at sea on 30 April 2007. According to this the accident occurred as follows:

After the coffee break in the morning of 27 April 2007 the able-bodied seaman and the ordinary seaman (on-deck assistant) were assigned the task of rigging the splice of the forward spring – the winches are located on the port side on the fore main deck. As usual both were wearing personal protective clothing which included gloves, overalls, hard hats and safety shoes.
Since spray was washing over the fore side of the port deck, the bosun said that the task could be carried out on another day should the rain and water washing over prevent the work from being carried out.

The bosun then continued his work in the forward workshop below the forecastle.

Both crew members began with the preparation of the line. The normal procedure would have been taking the spring from the winch through the Panama fairlead and then back to the bollard, throwing over the eye and holding the line tightly (see Fig. 3). At approx. 10:50 h they were exposed to rain and spray washing over on the port side of the spring winch when carrying out the work.

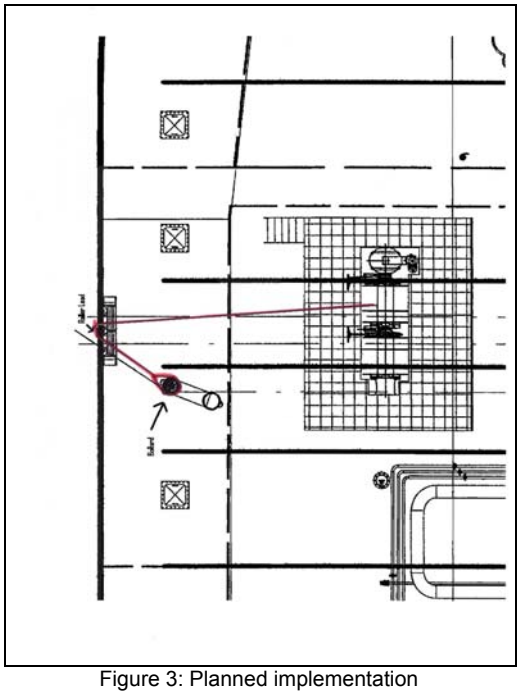

Figure 3: Planned implementation

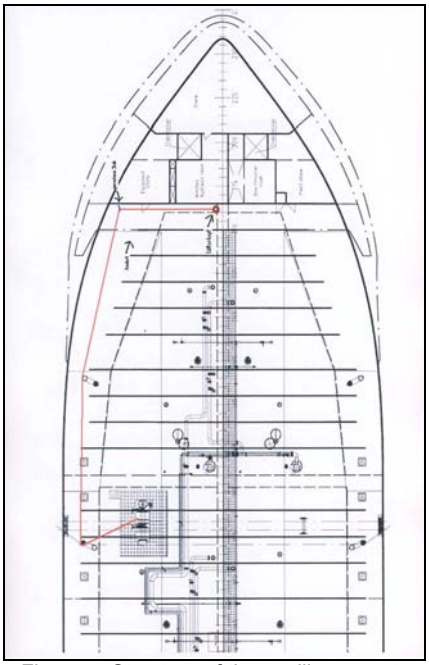

Figure 4: Structure of the auxiliary construction

When they were about to discontinuing work due to the adverse conditions, the able-bodied seaman suggested completing the work at another location. For this purpose the spring eye would have to be placed around a ventilation head in a protected area amidships behind the forecastle (see Fig. 4). The ordinary seaman objected to this procedure but the able-bodied seaman began to implement the plan. In order to tighten the spring as much as possible, he placed it around a centre roller and took it around another bollard with attached centre roller on port side to the fore stairs.
Then he passed the spring through a strop which was fastened to a ladder rung at the aft end of the forecastle and deflected it with this auxiliary construction at a right angle to the ventilation head (see Fig. 6-9). At approx. 11:00 h the line was tightened by the ordinary seaman on the instructions of the able-bodied seaman. When the ordinary seaman had secured the brake of the mooring winch, he unshipped the winch and then heard a bang. Initially he was not able to recognise anything in particular and proceeded forward. There he discovered the able-bodied seaman lying on deck (see Fig. 5). The bosun also heard the bang and began to rush to the spot immediately. He was not able to witness the accident from his place in the workshop.

Figure 5: Place where the casualty was found

It was ascertained that the ladder rung was broken. This probably resulted in the rope rebounding and striking the able-bodied seaman on his left arm and left side of his head. In view of the position in which he was found, it may be concluded that he could have been standing beside the strop at the stairs at the aft end of the forecastle at the time the rung broke.

Figure 6: Deflection around the centre roller and bollard

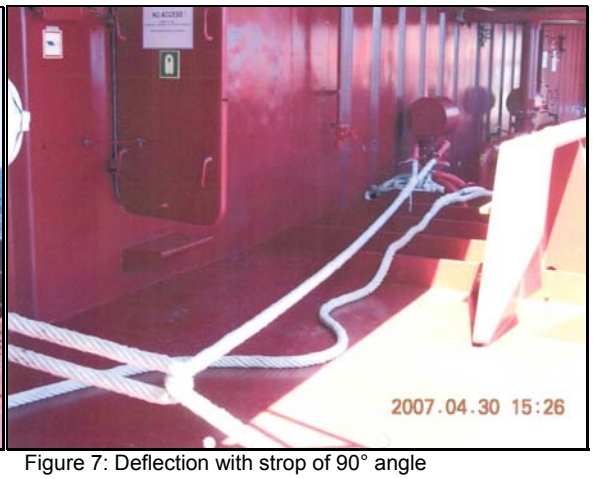

Figure 7: Deflection with strop of 90° angle

Figure 8: Strop fastening


Figure 9: Broken ladder rung

5 Investigation

The reconstruction of the course of the accident on 30 April 2007 on board the SEACOD is plausible and is deemed to be probable by the See-Berufsgenossenschaft (Marine Insurance and Safety Association) and the BSU. The organisational work carried out on board the vessel and within the shipping company based on the safety management system must be acknowledged. The measures taken after the accident have been detailed recorded in chronological order by the shore side and made available to the BSU.

5.1 Germanischer Lloyd Expertise

The investigation was conducted on behalf of the See-Berufsgenossenschaft and aimed at ascertaining the causes and circumstances of the fatal accident on board the SEACOD. Information was supplied by written statements, entries in the ship's log book and questioning of the crew members involved in the accident. The expert essentially confirmed the aforementioned course of the accident and the measures taken.

The able-bodied seaman who died had occupied his position for more than 5 years. He was considered to be an experienced seaman and, in the opinion of his colleagues, very safety-conscious. According to the crew members, the forward spring winch had worked properly and had also been used on mooring in Savannah.

During the accident the ladder rung broke because of the kinetic energy that was stored in the tightened spring. At this position the spring was deflected by 90°. According to crew member statements, the broken ladder rung was pointing upwards and was bent outwards. However, it is still not known, why the casualty was in the vicinity of the forward life raft at that time.

Although nobody witnessed how the able-bodied seaman got injured, it appears probable that the ladder rung gave way and the kinetic energy stored in the spring was released. At this place the spring was deflected by 90°. It is assumed that either the strop which was fastened to the ladder rung or the spring struck the able-bodied seaman's body and hurtled his body on deck or, rather, on a deck stringer.

Upon examination of the submitted documents, reports by the crew members interviewed and inspection of the site of the accident, it is obvious that the able-bodied seaman was carrying out normal rigging of a forward spring contrary to good seamanship. In particular, it appears that the safe work procedures (SWP) on the vessel were not complied with. In SWP EO1 – permit to work system, paragraphs 2 to 4 reads as follows:

Paragraph 2, special conditions:

“Everybody who instructs the crew regarding their task has to ensure the following:

- He/she has to be sure that the instructed crewmember has well understood his task.
- He/she has to explain the crewmember that in any case (weather condition, etc.), they cannot continue the work, the superior has to be informed immediately.
- Furthermore the superior has to enter the job of every crewmember in a “working log book”.
- The superior must know every time where the people are working and what they are doing.”

Paragraph 3, responsibilities for this procedure (last sentence)

“Deck and engine employees have to execute their given duties in a safe and good manner. All applicable safety rules and order gives by authorised persons have to be followed strictly.

Paragraph 4, discription of the procedure

4.1 General
“Before the work begins, it is necessary to identify the hazards and then to ensure that they are eliminated or effectively controlled. Sometimes automatic safeguards on machinery or electrical equipment, for example, may greatly reduce the hazards but normally reliance has to be placed on the people involved following a proper procedure. In those cases verbal instructions, requests response which might be misheard, misinterpreted or not fully remembered are not a satisfactory basis for activities in which human lives may be at risk. A more effective control can be achieved by the use of a written systems which system requires step by step formal actions by those responsible for work.
A permit to work does not in itself the job safe, but is a guide dependent for its effectiveness upon the conscientious observance of the set procedure by those involved in the job.”

The evidence clearly indicates a deviation from the above procedure prior to the accident. There was no monitoring of the job process by senior authority to ensure the tackling of the spring mooring line was being conducted in a safe manner.

The shipping company superintendent – as the designated person of the shipping company – arranged a meeting of the work group to be conducted by the Master and a safety meeting on board the vessel. The findings of this meeting resulted in appropriate measures being implemented on board which prohibited work on the mooring lines until further notice and until the investigations had reached their conclusion. Subsequently, the shipping company conducted further investigations on board.

In the course of a further analysis, the shipping company issued the internal circular No. 36 which was to be delivered to all vessels and which should result in an updating of the SMS procedure H-01 – Mooring Operations and Procedure.
In order to henceforth avoid such accidents the shipping company has decided to prohibit the use of mooring winches for purposes of maintaining “Atlas ropes”. Tightening of mooring ropes with objects other than mooring devices is strictly prohibited.
The surveyor fully supports the measures already taken after the fatal accident which have proven to be correct and appropriate.

5.2 Atlas rope (Synthetic wire rope)

“Synthetic wire ropes” have a total strain of approx. 18%. With a load of 55 % (maximum load recommended by the OCIMF[3]) of the total rupture stress, the stretching of the Atlas rope only amounts to approx. 6-7%. At the time of the accident when the length of the rope unrolled was 47 metres (see Fig. 4) the strain would have amounted to approx. 3 m or less depending on the load.

Impact loads from the swell, gusts of wind and passing vessels are very well absorbed by synthetic wire ropes. The Atlas ropes have very good stability by form, i.e. after an increased load they revert to their original state as they have a reversible expansion. Wear and tear is clearly visible and potential injury to the operating crew from defects to the ropes (such a meat hooks, for example) can largely be ruled out.

A requirement for the use of the aforementioned ropes is perfectly correct rope guidance by deflecting rolls and the use of mooring winches. Fastening on a bollard can already lead to premature abrasion. Deflection with conventional hawsers must be avoided as this can result in frictional heat which can then lead to the rope being damaged. For this reason, the use of the synthetic wire ropes as a towing line is not recommended. If a ship operator wants to equip a ship under construction with synthetic wires, then only winches with a split drum can be recommended (working and storage drum).

In addition, attention should be paid to correct rope guidance. It should be made sure that the line is only deflected with rolls. In comparison with all others, the Atlas lines are light and floatable.

The synthetic wire ropes are completely maintenance-free. In contrast with other synthetic mooring lines, fleece begins to form on the Atlas rope after a short usage period which protects the rope from insolation. If the fleece still hasn’t full formed, the mooring line should not be exposed to longer-lasting insolation during a voyage, but be covered.

Potential ruptures of the line can be easily and permanently repaired by using splices on the vessel. The life expectancy of an Atlas line is very high when used properly.

[3] Oil Companies International Marine Forum – Mooring Equipment Guidelines

The rope used on board the SEACOD during the accident had a total length of 220 m, a nominal diameter of 48 mm with a manufacture (form) of 6 * 9* 3,0 mm. The specific weight amounts to 1,14 Kg/dm^3. The required tensile strength amounts to 490,5 kN. According to the certification of the examination and approval of fibre ropes by Germanischer Lloyd, issued on 4 September 2006, a tensile strength of 514 kN was certified.

The total weight of the hawser amounts to 325,6 Kg. During the accident 47 m of the rope with a weight of approx. 70 Kg (1,48*47) was unrolled from the winch.

The Atlas rope was manufactured by Drahtseilwerke Bremerhaven (rope factory Bremerhaven) and delivered by Walter Hering Hanf- und Drahtseile, Hamburg (Walter Hering hemp and wire ropes, Hamburg). The splices of the eye ends are covered with a rigging produced at the manufacturer. The rope is tightened for this purpose (see Fig. 10). Rigging only serves to improve handling and is useful when heaving in in order to prevent possible catching at the edges. There is no maintenance manual for this work. When replacing the rigging on board, conventional seamanship is relied upon. A serving mallet must be used and the Atlas rope forced through a short way.

Figure 10: Manufacturer's rigging

5.3 Weather Expertise

The weather situation above the North Atlantic on 27 April 2007 and the preceding days was characterised by low pressure areas moving eastwards with the frontal systems. During the night of 27 April 2007 the relevant sea area north-west of the Azores was traversed by the cold front of a low pressure complex centring over Iceland. At lunchtime there was an interim light ridge of high pressure. The next prominent frontal system only approached and traversed this sea area during the night of 28 April 2007.

It was cloudy to very cloudy. Horizontal visibility lay between 10 and 20 km, the air temperature was almost 12° C and the water temperature 15°C.

The wind came from the West to north-west and blew with a medium strength of 5 to 6 Bft.

The values of the wind force in Beaufort (Bft) relate to the 10-min-average of the wind speed, measured at heights of 10 m. Isolated temporary gusts which only last a few seconds are mainly one to two Beaufort strengths above the average wind strengths.

The relative wind on the vessel near the position 44° 35'N 036° 49'W on 27 April 2007 at approx. 13:00 h UTC is a result of the true wind and the course of the vessel and the vessel's speed. The course of the vessel was 249°, the vessel speed 13,7 kn. For the true westerly wind direction, corresponding to 270° and true wind speeds of 20 or 25 kn (corresponding to 5 to 6 Bft) a relative wind of 12° or 13° resulted, on starboard 34 or 38 kn. For the true north-westerly wind direction, corresponding to 315°, and true wind speeds of 20 or 25 kn a relative wind of 39° or 43° resulted, on starboard of 29 or 33 kn.

Similar to the wind, the wind sea also came from the West to the north-west and had a significant wave height between 1.5 and 2.0 m with periods around 5 s. The swell came from a westerly direction with significant wave heights around 2,0 m and periods around 8 s. The significant wave height of the resultant total swell was approx. 3.0 m.

This result is confirmed by the swell plots which were compiled with the meteorological forecast models for the 00 UTC times: in the relevant sea area north-west of the Azores, the wave heights calculated for the swell on 27 April 2007/00 UTC were between 2.5 and 3.5 m and on 28 April 2007/00 UTC between 3 and 5 m.

6 Analysis

As part of their Safety Management System (SMS) the shipping company and the SEACOD have concise documentation which includes the guidelines, documents and procedures of the OCIMF as further applicable documents and which exceeds the requirements of the ISM Code[4]. The objective of the SMS is to ensure safety at sea, prevent accidents and protect lives and the environment. To achieve these goals it is of decisive importance that the crew and shipping company practise this safety culture and continue to develop it further. The GL expert came to the conclusion that disregard for the SMS led to the fatal accident.

The cause of the accident was the improper auxiliary construction for rigging a splice to the forward spring. A great friction loss resulted due to deflecting the spring by approx. 90° with the aid of a strop which distributed the power in a ratio 15:1 in front and behind the strop. This led to the ladder rung being broken and perhaps the strop as well. In the process the casualty was struck by the rebounding tightened Atlas line and hurtled onto the main deck or deckstringer and fatally injured.

The ordinary seaman (assistant deck hand) who was standing by the winch warned of an accident and expressed reservations about completing the task beforehand. Nevertheless he was not able to convince the able-bodied seaman who was subsequently fatally injured. According to the document HSE Policy of the SMS (All employees, ship-based and shore-based, are entreated to report non-conformities of the SMS and proposals for improvement and development of the system) he could have also expressed his reservations to a superintendent, e.g. the bosun working in the workshop or an officer. On the other hand according to SMS Safe Working Procedure E01, safety rules and work assignments that are issued by authorised persons must strictly be complied with. Respect for the experienced able-bodied seaman may possibly have been greater than reservations over safety which may have precluded intervention. In a formal sense, the ordinary seaman would also have been obliged according to procedure A03 (Reporting of non-conformities) to report his reservations to the Officer on watch.

The next officer available was the Officer on watch on the bridge. He was informed only after the accident had taken place. The auxiliary construction or the intent of this construction was not fully visible from the bridge. Written work assignment according to the SMS did not exist. In this respect it is doubtful whether the Officer on watch had been informed about the work on deck as a working log was not kept and the imminent work on deck are usually discussed between the Chief Mate and the bosun.

Rigging a mooring line is rope work which is what able-bodied seamen are classically trained to do. The rigging of a splice does not impair the strength of the Atlas rope and is not an urgent matter. The manufacturer does not provide instructions for this work nor is there any contained in SMS documentation.

[4] International Safety Management Code

Whereas the manufacturer carries out this work with a rigging device (see Fig. 11), a serving mallet is only provided on board. In this respect, basic reservation did not exist with regard to safety precautions, e.g. in the form of taking particular additional supervision. However, such auxiliary construction used here could not been forseen by the superintendents (bosun, officers). The superintendent placed his trust in the persons assigned the task of carrying out the rigging on own responsibility. This required tightening of the forward spring with a winch in order for the rigging to hold. The able-bodied seaman who was fatally injured was considered experienced and received a satisfactory rating in all concerns in his last letter of reference.

Figure 11: Manufacturer's rigging device

Revisions undertaken by the shipping company to the procedure H01 – Mooring Operation (The use of the Mooring Winches for any maintenance on Mooring Lines (Atlas Rope) is not allowed. To fasten „Mooring Lines" on others than Mooring Equipment is strictly forbidden). – must be appreciated. However, it must be borne in mind that the accident could have been prevented if the chain of information, starting with the initial safety reservations as expressed by the ordinary seaman via the able-bodied seaman, bosun and officer, and the measures then to be taken had functioned in accordance with the SMS. Special attention hereunto should be paid during the safety drills as part of the training plan DO3. Drills for mooring devices are scheduled every six weeks. Taking into account the comprehensive SMS, the BSU has no reason to issue further safety recommendations.

7 Sources

- Written explanations/statements
  - Ships command
  - Ships operator
  - HR agency Marlow Navigation
  - Safety Management System SEACOD
  - Drahtseilwerke Bremerhaven (wire rope factory, Bremerhaven)
  - Maritime Rescue Co-ordination Centre of Ponta Delgada

- Witnesses' accounts

- Expertise's/technical documents
  - Germanischer Lloyd
  - Master Kurd A.v. Ziegner, mooring lines

- Charts and vessel particulars by the Federal Maritime and Hydrographic Agency (BSH)

- Official Expertise Germany's National Meteorological Service (DWD)

- Documents of the See-Berufsgenossenschaft (Marine Insurance and Safety Association)
  - Accident Prevention Regulations for Shipping Enterprises (UVV-See)

- Photos
  - Crew, ships operator
  - Drahtseilwerke Bremerhaven (wire rope factory)