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

Investigation Report 140/14

22 May 2015

**Very Serious Marine Casualty**

# Fatal accident in the port of Goole, England, on board the MV SUNTIS on 26 May 2014

The investigation was conducted in conformity with the Law to improve safety of shipping by investigating marine casualties and other incidents (Maritime Safety Investigation Law – SUG) of 16 June 2002, amended most recently by Article 1 of 22 November 2011, BGBl. (Federal Law Gazette) I p. 2279.

According to said 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.

BSU wishes to acknowledge the contribution to this investigation made by the Marine Accident Investigation Branch of the UK and thank it for its co-operation and support.

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

Issued by:
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# 1 Summary

At about 0645[1] on 26 May 2014, three crew members were found unconscious on board the MV SUNTIS in the port of Goole, UK, in the tween deck in the area of the cargo hold access hatch. The crew members were recovered but did not survive despite rigorous attempts at resuscitation.

[1] All times shown in this report are local (UTC + 1)

# 2 FACTUAL INFORMATION

## 2.1 Photo


© Hasenpusch Photo-Productions

Figure 1: Photo of ship

## 2.2 Ship particulars

| | |
|---|---|
| Name of ship: | SUNTIS |
| Type of ship: | General cargo ship |
| Nationality/Flag: | Germany |
| Port of registry: | Itzehoe |
| IMO number: | 8513314 |
| Call sign: | DIXS |
| Owner: | Frank Hagenah |
| Year built: | 1985 |
| Shipyard/Yard number: | Peters Schiffswerft, Wewelsfleth, No 614 |
| Classification society: | Germanischer Lloyd |
| Length overall: | 82.31 m |
| Breadth overall: | 11.30 m |
| Gross tonnage: | 1,564 |
| Deadweight: | 2,010 t |
| Draught (max.): | 3.858 m |
| Engine rating: | 441 kW |
| Main engine: | MWM, type TBDE 440-6 K |
| (Service) Speed: | 10 kts |
| Hull material: | Steel |
| Hull design: | 1 cargo hold (49.80 x 9.0 m) |
| Minimum safe manning: | 5 |

## 2.3 Voyage particulars

| | |
|---|---|
| Port of departure: | Riga, Latvia |
| Port of call: | Goole, England |
| Type of voyage: | Merchant shipping, international |
| Cargo information: | Sawn timber |
| Manning: | 5 |
| Pilot on board: | No |
| Canal helmsman: | No |
| Number of passengers: | None |

## 2.4 Marine casualty or incident information

| | |
|---|---|
| Type of marine casualty/incident: | VSMC, three seamen lost their lives |
| Date, time: | 26/05/2014, approximately 0645 |
| Location: | Port of Goole, England |
| Latitude/Longitude: | φ 53° 42.8'N λ 0° 52.6'E |
| Ship operation and voyage segment: | At the pier; discharge operation had just started |
| Place on board: | Tween deck |
| Human factors: | Yes, violation |
| Consequences (for people, ship, cargo, environment, other): | Three seamen lost their lives |

Excerpt from Nautical Chart BA 3497

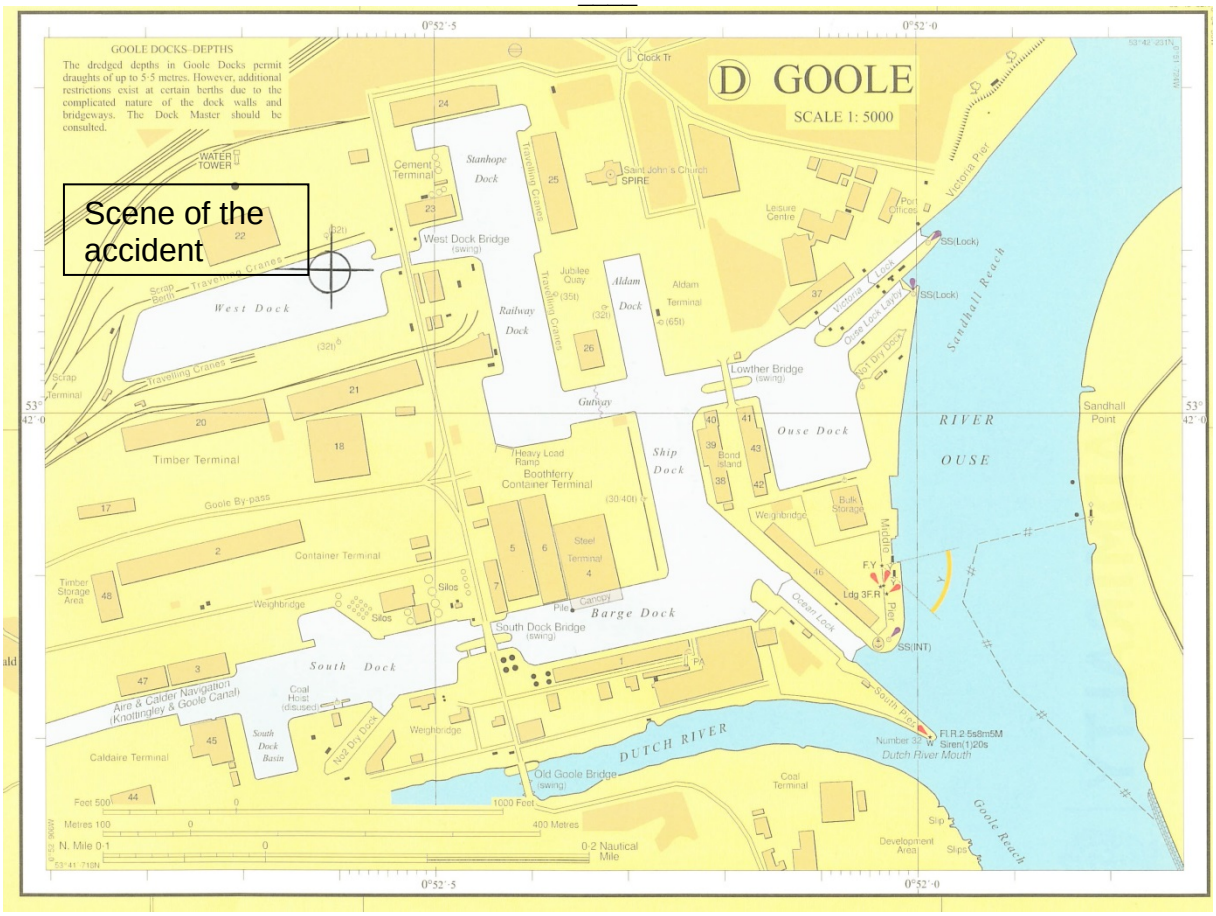


Figure 2: Nautical chart

## 2.5 Shore authority involvement and emergency response

| | |
|---|---|
| Agencies involved: | Humberside Fire and Rescue Service (HFRS)<br>Hull and East Yorkshire Hospitals<br>Maritime & Coastguard Agency (MCA)<br>Marine Accident Investigation Branch (MAIB)<br>BSU |
| Resources used: | Breathing apparatus, oxygen |
| Actions taken: | People rescued, first aid, cardiopulmonary massage, resuscitation |
| Results achieved: | Resuscitation was not successful, three people lost their lives |

# 3 COURSE OF THE ACCIDENT AND INVESTIGATION

## 3.1 Course of the accident

MV SUNTIS left the port of Riga in Latvia on 19 May 2014 and reached the port of Goole in the United Kingdom on the evening of Saturday 24 May 2014. The crew was composed of a 67-year-old German master, a 60-year-old German chief officer, and three Philippine seamen (38, 33 and 30 years old). The ship was laden with timber.

The discharge operation began with the unloading of deck cargo by a shore-based crane and stevedores at about 0545 on Monday 26 May. Two OS[2] were assigned to remove the tarpaulins that were attached to protect the deck cargo on board. One crew member (possibly both) climbed into the forward tween deck hatch during the discharge operation. The chief officer and a third seaman (AB[3]) noted the absence of the two other crew members and proceeded to look for them. Since the two of them were not found in the aft superstructure, the AB and the chief officer proceeded forward (the AB via the wood loaded main cargo hatch cover and the chief officer on the starboard weather deck). On arriving at the end of the hatch, the AB saw the chief officer call and then climb into the forward hatch to the tween deck. When the AB arrived at and looked into the hatch, he saw the chief officer collapse. The AB immediately climbed into another hatch to forecastle's access hatch and switched on the cargo hold's ventilation fan from there. After that, he ran back to the superstructure and alerted the master at about 0645. At the same time, the stevedores were informed that something was reportedly not right on board the SUNTIS. The AB collected his EEBD[4], which was stored in the cabin, and a breathing apparatus (BA) set from the aft store. In the confusion, he forgot the full-face mask, however. On arrival back at the forecastle, lifting slings were passed around the three collapsed crew members with the assistance of the two stevedores and they were pulled on to the deck. This involved the two stevedores, one with and one without an EBBD, and the AB with the BA set climbing down the ladder alternately. Although the BA also worked to some degree without wearing a mask, the AB and the two stevedores suffered severe breathing difficulties.
None of the three crew members who climbed into the hatch survived despite immediate attempts at resuscitation.

## 3.2 Investigation

The owner informed the Federal Bureau of Maritime Casualty Investigation about the accident by phone at about 0850 on the day it occurred. The joint investigation with the MAIB in the port of Goole started on the following day.
On arriving in Goole on 27 May 2014, the area around the ship was cordoned off and access was possible only to the aft of the ship and superstructure. Access to the other part of the ship was possible only with respiratory protective equipment and the HFRS's special unit for gas investigation was in the process of measuring the concentration of gas in the tween deck and hatch.

[2] OS: Ordinary seaman
[3] AB: Able bodied seaman
[4] EEBD: Emergency escape breathing device

MV SUNTIS was laden with 2,335 cbm of moist, partly impregnated, as well as fresh sawn timber. The above included 1,661 cbm of spruce or fir, which was stowed in the 2,823-cbm cargo hold. The external condition of the ship is evident from the following figure.


Figure 3: MV SUNTIS at 1000 on 27 May 2014

The deck cargo was already completely discharged. The protective tarpaulins were still on the hatch and on the main deck in places; one green tarpaulin hung overboard.
The hatch was opened at about 1400, enabling the investigators to access the forecastle from 1400 and tween deck hatch from 1500.

Figure 4: Open hatch and timber cargo

When the hatch was opened, a strong odour of freshly cut timber disseminated, which made breathing normally difficult even before entering the hatch. The remainder of the survey on the forecastle revealed a cut yellow rain jacket, a cut T-shirt, and a galley knife next to the access to the tween deck. The galley knife was being used to cut the clothing on the collapsed seamen. A subsequent interview revealed that the clothes of the collapsed seamen were cut up with a kitchen knife for resuscitation.

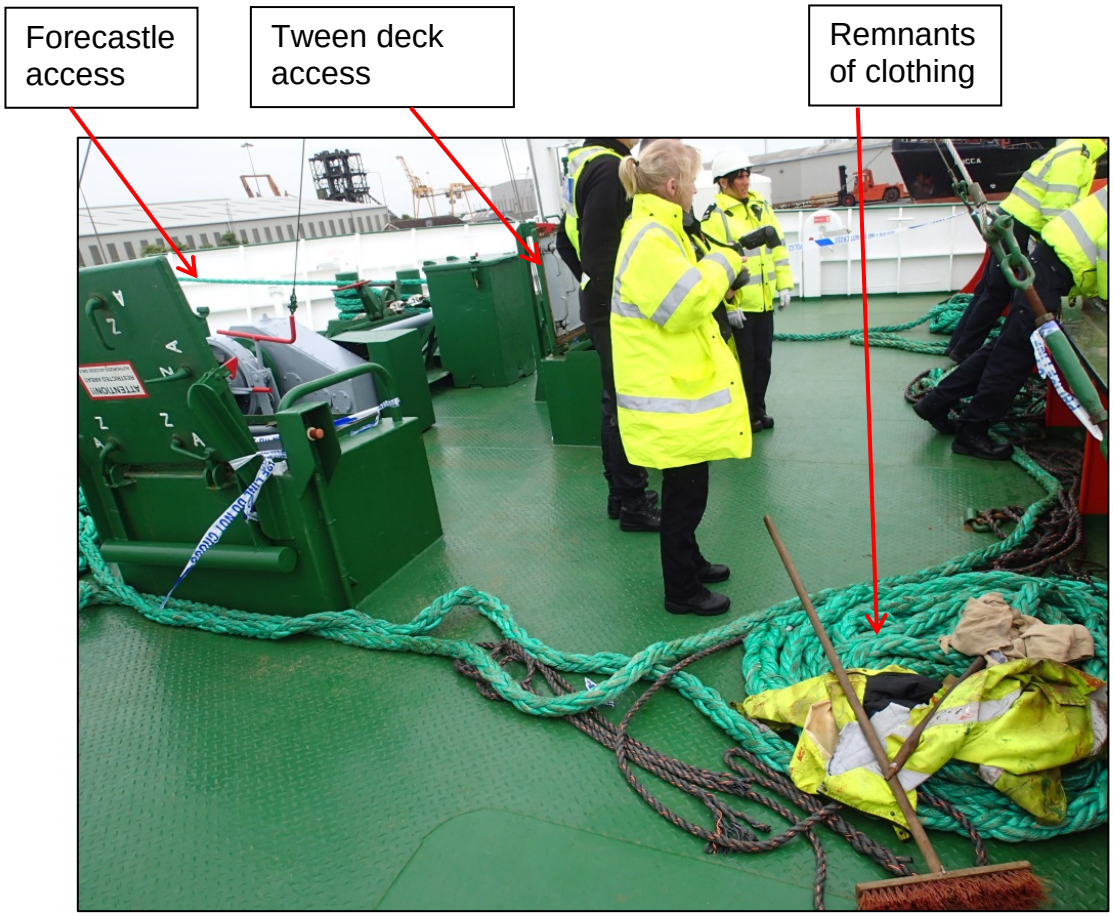


Figure 5: Forecastle with access points

The forecastle's access hatch, which is used as a cable-tier/paint store/bosun's store, can be locked with a padlock. However, the tween deck's (forecastle store deck) hatch was secured against unauthorised access only by a bolt and eye nut. The tween deck's hatch was marked clearly with warning signs:


Figure 6: Tween deck access

Figure 7: Means of preventing access

Two green tarpaulins were found below on the tween deck directly next to the ladder. Immediately next to them were two pairs of gloves and a winter hat. A safety helmet was next to the ladder on the bulkhead behind the tarpaulin. A partly smoked cigarette was later found behind the ladder (see figure 15).

Figure 8: Tween deck

The area between frames 112 and 117 on the tween deck below the forecastle is used for storing tarpaulins, dunnage, lines, and all sorts of other items. This compartment is about 3 m long, 10 m wide, and 3 m high. There is only one access point to the cargo hold from this compartment.
Another helmet was found on the port side next to the cargo hold's access. The access can be secured with chains to prevent people from falling and closed completely with timber planks. This was not done, however.

Figure 9: Cargo hold access with second helmet

A second winter hat was found directly below the access on the timber stack in the cargo hold.

Figure 10: Winter hat on the timber cargo

The position of the three collapsed crew members is shown on the below drawing:

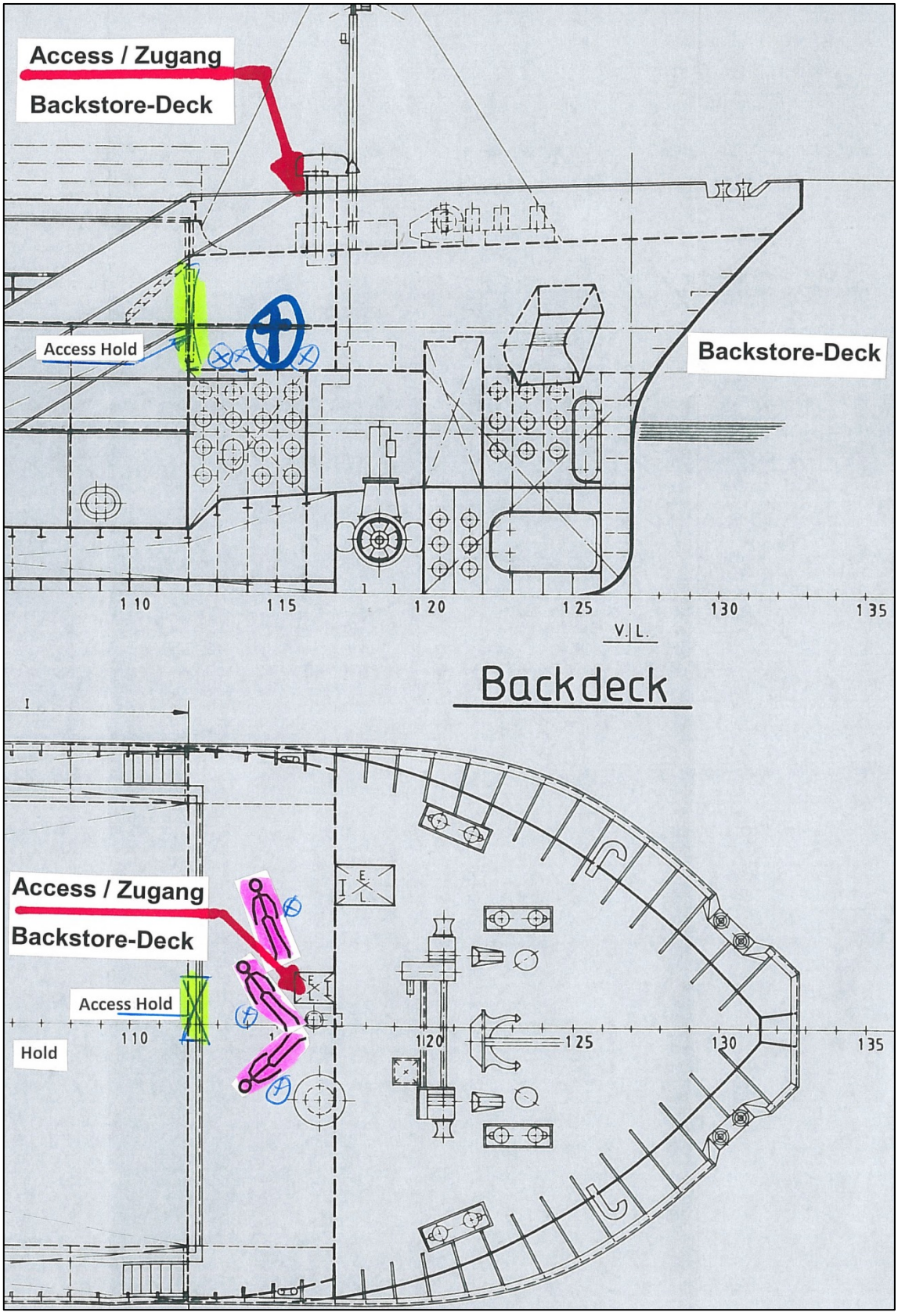


Figure 11: Position of the crew members

# 4 ANALYSIS

The following analysis deals with the causes of death, the circumstances that led to the accident, and the action taken to rescue the people.

## 4.1 Weather report

The Maritime Division of Germany's National Meteorological Service (DWD) was requested to prepare an official report on the weather conditions in the area of the port of Goole for the period 0000 to 1000 UTC.

Weather situation

A moderate high pressure system was situated over Denmark on 26 May 2014. An associated wedge reached across the North Sea to the east of England. Set against the high pressure was a low pressure system that stretched from the central North Atlantic across Ireland to central Europe. Integrated with this low pressure system, roughly over the Irish Sea (or the North Channel), was the remains of an earlier storm front. The differences in atmospheric pressure were only moderate, however.

Wind

A light, mainly southerly breeze prevailed in the Goole area throughout the period. Wind speeds of 2-4 knots were measured at about 0400 UTC; the prevailing wind direction was south to south-east. The southerly wind gradually increased as the morning progressed and reached speeds of 5-10 knots at 1000 UTC.

Precipitation

Rainfall stood at 0-0.1 mm.

Temperature

Temperatures of 9-10°C were measured at the beginning of the period under review. The temperature dropped to 5-8°C as the night progressed. It then increased again and reached 13-16°C at the end of the period under review.

## 4.2 Measurements by the HFRS

The hatch was closed and the access sealed immediately after the three seamen were recovered, meaning the condition of the tween deck compartment was almost the same as when the casualties were found.

The HFRS used various devices to determine the atmospheric causes of the accident. An RAE Systems ppbRAE 3000 photo-ionisation detector (PID) was used as a portable leakage detector for VOCs[5]. This device measures various gas compounds within the range of 1-10,000 ppm (parts per million).

[5] VOC: Volatile organic compound

One other VOC (and SVOC[6]) measurement device was a HAPSITE Smart gas chromatograph/mass spectrometer (GC/MS). Finally, a portable gas detector (GasAlertMicro 5PID made by BW Technologies) was used.

Samples were measured and analysed at various positions.

VOCs

The following five VOCs were registered in the tween deck compartment and on the top of the tank in the cargo hold:

- Ethanol $C_2H_6O$
- Pentane $C_5H_{12}$
- Xylene $C_8H_{10}$
- Pinene $C_{10}H_{16}$
- 3-Carene $C_{10}H_{16}$

The first three compounds are often found in industry, including on board ships. The two last compounds are found in conifers, such as spruce or pine. These compounds are evident through their intense pine aroma and sweet taste.
However, the sum total of the measurements of all five compounds was less than 200 ppm, meaning they can be ruled out as the cause of the crew members collapsing.

Oxygen content ($0_2$)

The oxygen content in the access hatch dropped from 20.9% to 19.5%. Half way down the ladder, about two metres below the hatch, the oxygen content was only 10%. The oxygen content was only 5-6% on the floor of the tween deck next to the ladder and 3-5% at the sides. At less than 3%, the lowest value in the compartment was detected at the bottom of the cargo hold's access opening.
The natural composition of the dry air is about 21% oxygen, 78% nitrogen, 1% argon, and trace amounts of other gases. Any reduction to less than 21% $O_2$ is considered a risk and appropriate precautions must be taken.
The following table shows the effects of oxygen starvation:

| **$O_2$ percentage in respiratory air** | **Risk and effect of decreasing oxygen concentration** |
|---|---|
| 21-18% by volume | Affected parties are unable to detect any symptoms. |
| 18-11% by volume | Physical and mental capacities are impaired without affected parties noticing. |
| 11-8% by volume | Possible onset of unconsciousness within a few minutes without warning. Lethal risk at less than 11%. |
| 8-6% by volume | Rapid onset of unconsciousness. Resuscitation possible if implemented immediately . |
| 6-0% by volume | Immediate onset of unconsciousness. Brain damage even if rescued. |

[6] SVOC: Semi-volatile organic compound

Examples of the consequences of inhaling atmospheres deficient in oxygen are, without warning, spells of dizziness, headache, unconsciousness or death due to asphyxiation. Human sensory organs are unable to detect oxygen starvation.

Carbon monoxide (CO)

Carbon monoxide was present. Measurements revealed a maximum level of 183 ppm and long-term measurements levels of 160-180 ppm.
At the existing concentration, crew members would need to be exposed to the CO for about 30 minutes to notice its effect. Death due to carbon monoxide poisoning would have taken about 2-3 hours when inhaling in excess of 400 ppm.
Therefore, carbon monoxide poisoning can be ruled out as the cause of death, as shown as the following table:

| Carbon monoxide level* | Possible symptoms of poisoning |
|---|---|
| 35 ppm | Maximum permissible level for persistent exposure to CO over a period of 8 hours** |
| 150 ppm | Slight headache after 1.5 hours |
| 200 ppm | Slight headache, fatigue, dizziness, nausea after 2-3 hours |
| 400 ppm | Frontal headache within 1-2 hours, life threatening after 3 hours. Also the maximum ppm in flue gas (free from air) according to the United States Environmental Protection Agency |
| 800 ppm | Dizziness, nausea and convulsions within 45 minutes. Unconsciousness within 2 hours. Death within 2-3 hours |
| 1,600 ppm | Headache, dizziness and nausea within 20 minutes. Death within 1 hour |
| 3,200 ppm | Headache, dizziness and nausea within 5-10 minutes. Death within 25-30 minutes |
| 12,800 ppm | Death within 1-3 minutes |

*Concentration of carbon monoxide in the atmosphere in ppm
**According to the OSHA (Occupational Safety & Health Association)

Sulphuretted hydrogen (hydrogen sulphide) $H_2S$

The maximum level of hydrogen sulphide was measured at 2 ppm over a period of six minutes. $H_2S$ is quickly noticeable from the typical odour of rotten eggs in very small amounts (0.01 ppm).

Any increase in concentration in excess of 200 ppm is no longer perceived by means of smell because $H_2S$ has the capacity to deaden the olfactory receptors. $H_2S$ is lethal at some 500 ppm and above over a period of 30 minutes and at more than 5,000 ppm within a few seconds.
The low concentration of hydrogen sulphide present did not cause the crew members to collapse.

Carbon dioxide $CO_2$
Unfortunately, the percentage of carbon dioxide was not measured by the devices of the HFRS. However, it is reasonable to assume that the $CO_2$ content in the atmosphere was much higher than normal because $CO_2$ and water are released during the energy transformation process within the wood cells due to the consumption of oxygen.

$CO_2$ concentration (% by volume) in the atmosphere and the effect on humans:

- 0.038%: average concentration in the atmosphere;
- 0.15%: *recommended sanitary value* for interior fresh air;
- 0.3%: TLV below which there are no health concerns at permanent exposure;
- 0.5% (9 g/m³): TLV for daily exposure of eight hours per day;
- 1.5%: increase in the ventilation per unit time of more than 40%;
- 4%: respiratory air during exhalation;
- 5%: episodes of headache, dizziness and unconsciousness;
- 8%: unconsciousness, death after 30-60 minutes.

Rather than a low concentration of oxygen in the body, a human's respiratory reflex is caused by a high concentration of carbon dioxide. The ventilation per unit time increases by more than 40% in excess of 1.5% (shortness of breath). In a physiological and slightly increased concentration, carbon dioxide in the blood activates the respiratory centre of the brain. At a higher concentration of more than 8%, it leads to the reduction or neutralisation of the breathing reflex and eventually to respiratory arrest.

Summary
The crew members collapsed because of the extremely low concentration of oxygen coupled with the presence of other non-harmful gases.
Based on the measurements of only about 10% $O_2$ halfway up the ladder – which corresponds roughly to the height of the head of a person standing on the tween deck – it is reasonable to assume that unconsciousness occurred quickly and without warning. Since the crew members were found on the tween deck where the oxygen content was measured at less than 6%, it is reasonable to assume they fell into a coma within 40 seconds due to respiratory arrest.
The carbon dioxide in the atmosphere was not measured. The carbon dioxide would have the same effect on a person as low oxygen concentration and lead to death quickly if its concentration exceeded 10%.
The deceased did not have symptoms of dangerous carbon dioxide poisoning subsequently.

The three seamen lost their lives due to asphyxiation as a result of being starved of oxygen.

### 4.3 Forensic examination

The forensic examination of the three deceased crew members was conducted by the forensic pathologist responsible (Senior Coroner for Kingston upon Hull and the East Riding of Yorkshire), Professor Paul Marks, on 2 June 2014 in Hull and East Yorkshire Hospital.

According to the findings of the autopsy, the three people examined did not suffer from carbon monoxide, cyanide nor hydrogen sulphide poisoning.

The senior coroner concludes that death was caused by the presence of a low-oxygen environment.

### 4.4 Scene of the accident

Access on the forecastle to the tween deck is made via a hatchway cover and with a ladder. This hatchway cover is secured against unauthorised access merely by means of eye nut and bolts. The hatchway cover was provided with the following labels:

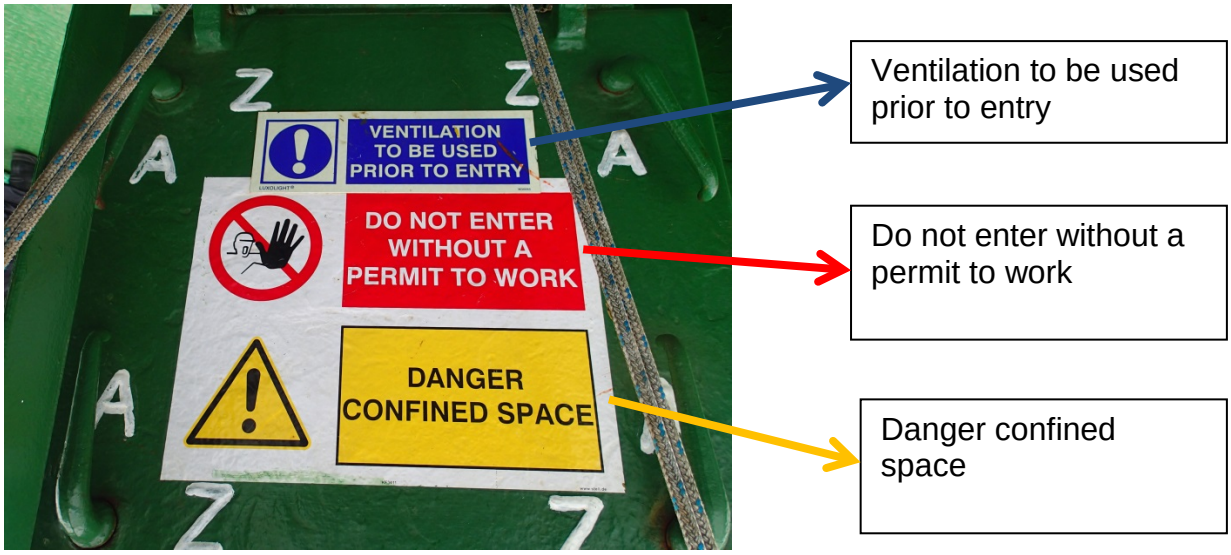


Figure 12: Labels on the hatchway cover

<u>Ventilation</u>

A large electric fan ventilates the cargo hold and compartment on the tween deck. On the forepeak, it can only extract from the tween deck. The fan is switched on at a switch cabinet on the port side forward in the cable-tier. Additional ventilation is provided via the aft access door to the cargo hold or via a ventilation flap, which is installed next to the aft door to the cargo hold. In the main, ventilation is provided by opening the cargo hatchway.

Figure 13: Forward cargo fan


Figure 14: Cargo hold access and ventilation flap

The cargo hold door bears the same warnings and labels as the forward access hatch to the tween deck.

Access to enclosed spaces only with a permit

According to the SMS (safety management system) manual carried on board, any compartment or tank that is isolated from the outside air for an extended period is, without exception, defined as an enclosed space and may be entered only with the approval of a ship's officer. The ship's officer must work through and complete a checklist ('Entering a confined space') prior to approving entry to any such compartment. That requires measurement of the ambient air and only then will the master or ship's officer responsible approve entry into the compartment.

## 4.5 Entering the tween deck and cargo hold

The two OSs were neither instructed nor ordered to climb down into the cargo hold. It was initially assumed that the reason the two crew members were found on the tween deck was that one of the OSs, who was known as a chain smoker, climbed down into the cargo hold to smoke there. This is supported by the fact that a partly (1/3) smoked cigarette of the brand he smoked on board was found behind the ladder. The second OS would have then climbed down to rescue his colleague when he saw that something was not right.

Figure 15: Cigarette on the tween deck

This assumption is opposed by the fact that the superstructure and main deck behind the superstructure are the areas designated for smoking on board. There is a clear instruction not to smoke on the deck, especially during loading and discharging operations. There is also a strict instruction not to smoke in the cargo hold and tween deck and this instruction is applied restrictively.

The temperatures on the deck and fact that there was no rain also oppose the idea that someone sought protection below deck to smoke there. Therefore, the assumption that a smoker climbed into the cargo hold to smoke does not stand up. Moreover, the possibility that this cigarette had already been there for a prolonged period could not be clarified.
The two seamen were regarded as very conscientious. Consequently, it is more likely that they climbed into the cargo hold to work there. Two folded protective tarpaulins, which were not required after the loading operation in Riga and thrown into the hatch because of time constraints, were on the tween deck (see Figure 8). It is quite possible that the two OSs wanted to stow the tarpaulins properly at the sides of the tween deck. There were no eyewitnesses to support these assumptions. It was established only that the AB saw the chief officer when he climbed into the hatch to assist.

## 4.6 Rescue operation

BAs are provided for firefighting and rescue operations. All the crew members are usually trained on operating these devices and receive regular refresher training. The full-face masks that belong to the self-contained breathing appliances are stored separately in a box for protection. The lung governed demand valve is connected only after the mask is donned and leak tested using the ball of the thumb. This procedure is described in the ship safety services manual of the Ship Safety Division (BG Verkehr). If a mask is (as in this case) forgotten or not used, it is still technically possible to breathe using the lung governed demand valve. However, harmful gases are inevitably inhaled through the corners of the mouth and nose.

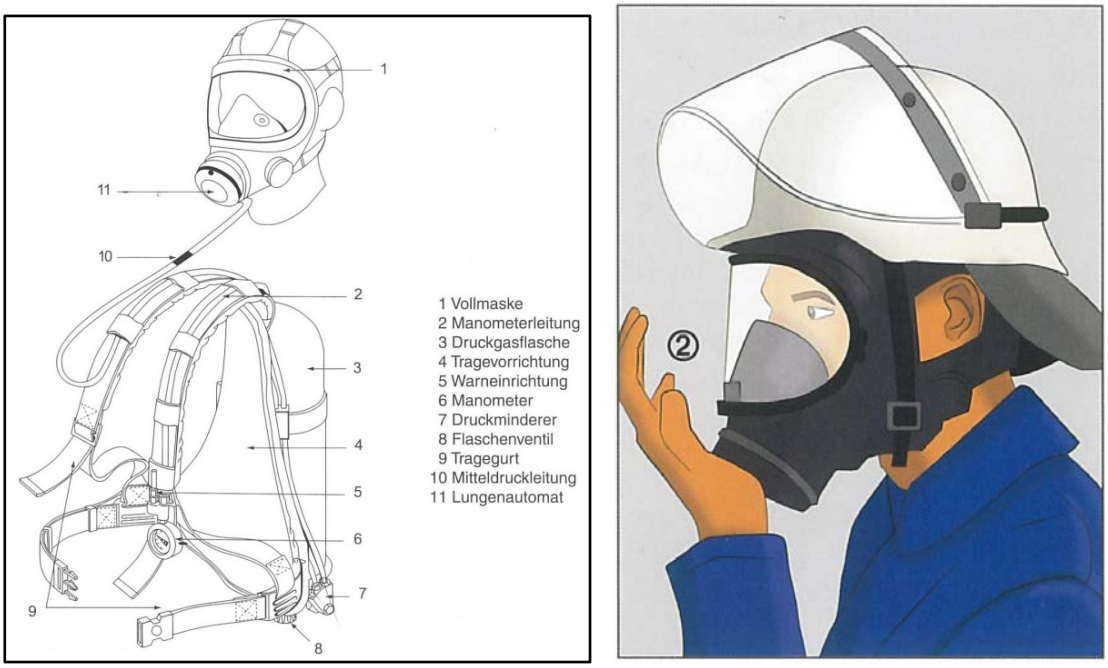


Figure 16: BA and full-face mask leak test

An EEBD is a device supplied with air or oxygen, which is intended for a period of use of at least ten minutes. EEBDs should be used to escape from a compartment containing a hazardous atmosphere. They should never be donned to re-enter or work in a compartment containing a hazardous atmosphere.
On the SUNTIS, the EEBDs are stored in the cabin of each crew member.

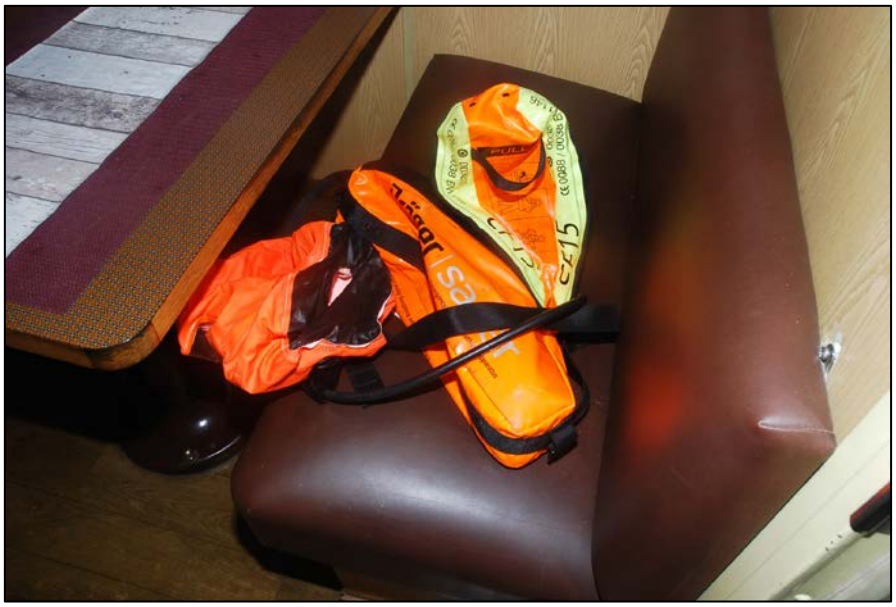

Figure 17: EEBD

## 4.7 Cargo documents

That cargo documents do not include data sheets with information on impregnation with wood preservatives. It is reportedly common practice when carrying sawn timber. The SUNTIS was laden with different types of timber that were impregnated either to varying degrees or not at all.
Based on the various colours of the timber and according to the information of the timber merchant on the Internet, it is reasonable to assume that the following fungicidal wood preservatives were used:

Copper carbonate
Copper hydroxide
Propiconazole
Tebuconazole
Boric acid

Figure 18: Various colours of the timber

During the investigation in the port of Goole, it was noted that the wood was extremely moist. It is quite possible that the wood preservatives caused this moisture. It was not possible to determine the amount of wood preservative in the timber or atmosphere during the investigation.

# 5 CONCLUSIONS

## 5.1 Analysis of the accident

Cargo holds laden with timber are regarded as hazardous spaces because the organic digestion process of timber draws oxygen from the atmosphere. There are no warning signs for compartments deficient in air, such as a foul odour, meaning the natural awareness of hazards is absent.
The crew has carried timber cargo for quite some time and is familiar with the risks posed by deoxygenating cargo. Sufficient clarification as to why the OS (or both OSs) entered the cargo hold nonetheless was not possible. Although the rescue operation immediately initiated by the chief officer was understandable, it was fatal for him. It is essential that self-protection be given priority during an accident in an enclosed space, i.e. over the urge to enter a compartment without respiratory protection to rescue an unconscious colleague. Other lives are inevitably endangered if that is not observed.
Immediate activation of the fan by the AB probably prevented other rescuers from being injured or killed. After all, the rescue operation involving the AB and two shore-based workers was also reckless. The cargo hold should not have been climbed down into without respiratory protection by means of a BA and full-face mask.

## 5.2 Action taken after the accident

The Ship Safety Division (BG Verkehr) issued Circular 08/2014 (ISM/MLC) on 3 July 2014 and pointed to the ship-specific procedures for entering enclosed spaces (Annex 7.1)
The MAIB issued Safety Bulletin 3/2014 in August 2014 as a result of the accident on board the SUNTIS and once again emphasised (Annex 7.2) the risks involved in entering enclosed spaces.

## 5.3 Safety measures taken on board after the accident

Part of the ISM involved an extensive review of the accident by the owner, which has taken various measures to prevent such an accident in the future. The BSU surveyed the ship in Brunsbüttel on 10 January 2015 and observed the following measures that were introduced to enhance safety.

1.) A second DRÄGER X-am 2500 portable electric gas monitor was acquired. A permanently operational device with fully charged batteries and the required DRÄGER gas detector with sampling tube is hanging in the superstructure directly in the access area. A notice board bearing the type and hazards of the current cargo as well as special instructions for safety has been installed in this access area.


Figure 19: Gas monitors and data sheets

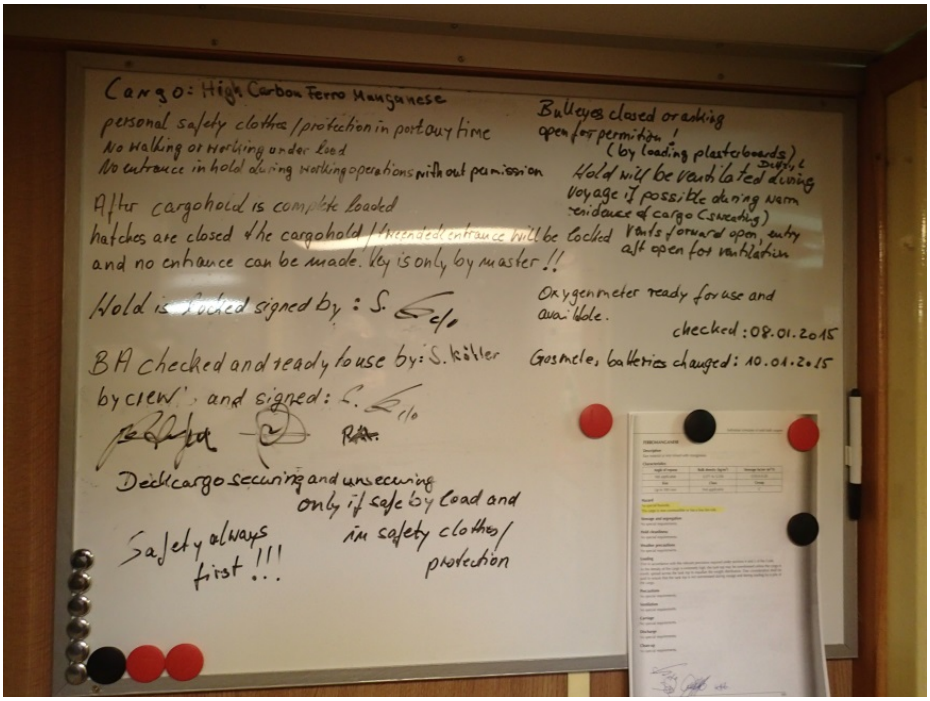


Figure 20: Notice board

2.) A lock at the aft access door and at the forward hatch secures access to the cargo hold. The master keeps the key on the bridge.

Figure 21: Access secured by a lock

3.) The below checklist ('7.5.1 Entry in enclosed spaces') must be worked through prior to allowing entry into the cargo hold or any other enclosed space. Moreover, the compartment must be examined for hazardous atmosphere.

| | CHECKLIST & FORMS<br>7.5 WORK PERMITS | DOC.NO. : FO7.501<br>PAGE : 1 OF 1<br>DATE : 30.05.2014<br>PREPARED: OW<br>EDITION : 1 |
|---|---|---|

*This checklist is not intended to be exhaustive or in any way limiting necessary steps and actions. You may take additional actions based upon the circumstances of the actual situation.*

## 7.5.1 ENTRY IN ENCLOSED SPACES

Issued: Date/hour _____ Validity: hours _____ Cancelled: Date/hour _____

**Work permits to be issued for max. 10 hrs. If breaks for more than 2 hrs. new permit shall be issued.**

Space: _____

Job description: _____

| | | |
|---|---|---|
| *1.* | ***To be checked by Master or responsible Officer*** | |
| **1.1** | Is the space been thoroughly ventilated and, where testing equipment is available, has the space been tested and found safe for entry? | ☐ |
| **1.2** | Have arrangements been made to continue ventilation during occupancy of the space and at intervals during breaks? | ☐ |
| **1.3** | Are rescue and resuscitation equipment available for immediate use beside the compartment entrance? | ☐ |
| **1.4** | Have arrangements been made for a responsible person to be in constant attendance at the entrance to the space? | ☐ |
| **1.5** | Has a system of communication between the person at the entrance and those in the space been agreed? | ☐ |
| **1.6** | Are access and illumination adequate? | ☐ |
| **1.7** | Are portable lights or other equipment to be used of an approved type? | ☐ |
| | ***When the necessary safety precautions in SECTION1 have been taken, this list should be handed to the person who is to enter the space for completion!*** | |
| **2.** | **To be checked by the person who is to enter the space** | |
| **2.1** | Have instructions or permission been given by the master or a responsible officer to enter the enclosed tank or compartment? | ☐ |
| **2.2** | Has SECTION 1 been completed as necessary? | ☐ |
| **2.3** | Are you aware that you should leave the space immediately in the event of failure of the ventilation system? | ☐ |
| **2.4** | Do you understand the arrangements made for communication between yourself and the responsible person in attendance at the entrance to the space? | ☐ |
| *3.* | ***Where a breathing apparatus should be used, this section must be checked jointly by the responsible officer and the person entering the space*** | |
| **3.1** | Are you familiar with the apparatus to be used? | ☐ |
| **3.2** | Has the apparatus been tested as follows? | |
| | • Gauge and capacity of air supply | ☐ |
| | • Low pressure audible alarm | ☐ |
| | • Face mask - air supply and tightness | ☐ |
| **3.3** | Has the means of communication been tested and emergency signals agreed to? ☐ | ☐ |
| | ***Where instructions have been given that a responsible person is in attendance at the entrance to the compartment, the person entering the space should show their completed card to that person before entering. Entry should only be permitted providing that allof the appropriate questions have been correctly checked.*** | |

**Gas gauging to be carried out (where necessary and appropriate):** Oxygen: _____ %
Explosive gas: _____ %
Toxic gas: _____ %

| Person in charge of work | Officer for gas gauging | Master |
|---|---|---|

***To be stored on board for 6 month and entry in Lo0g Book compulsory***

**In addition to the safety measures taken, the owner intends to acquire a defibrillator and train the crew on operating the device.**

## 5.4 Conclusion

The accident could have been prevented if the SMS procedural instructions, which were known to all the crew members, had been observed. The summarised organisational and technical measures below should be noted:

- hazardous compartments must be closed securely (with padlocks, for example);
- as a general rule, enclosed spaces may be entered only with the permission of the master or the officer responsible;
- before entering, the atmosphere is measured to determine whether hazardous vapours or gases are present and whether oxygen content is sufficient;
- expected hazards and countermeasures are discussed prior to the start of the work;
- a crew member responsible for monitoring, coordinating, and supervising works shall be designated prior to the start of the work;
- a second crew member shall be posted at and guard the entrance, as well as maintain permanent contact with the people in the compartment. The guard can seek assistance at all times if something unforeseen happens, and
- thorough ventilation and adequate lighting must be ensured.

The publication of safety recommendations is dispensed with given the circular of the Ship Safety Division (BG Verkehr) dated 3 July 2014 (see Annex 7.1) and the procedural instructions with the additional measures taken by the owner stated above.

# 6 SOURCES

- Investigations of the MAIB and the HFRS
- Written statements
  - Ship's command
  - Owner
- Witness accounts
- Expert opinion/technical paper
- Nautical charts and ship particulars, Federal Maritime and Hydrographic Agency (BSH)
- Official weather report by the DWD
- Documentation, Ship Safety Division (BG Verkehr)
  - Accident Prevention Regulations (UVV See)
  - Guidelines and codes of practice
  - Ship files

# 7 ANNEXES

## 7.1 Circular of the Ship Safety Division (BG Verkehr) dated 3 July 2014

Bundesrepublik Deutschland
*Federal Republic of Germany*

Berufsgenossenschaft für Transport und Verkehrswirtschaft
Dienststelle Schiffssicherheit

**Rundschreiben 08/2014 (ISM/MLC)**
***Circular 08/2014 (ISM/MLC)***

| | |
|---|---|
| **Betreff/*Subject*:** | Entering enclosed spaces |
| **Referenz/*Reference:*** | ISM-Code 7, § 114 SeeArbG |
| **Anlagen/*Attachments:*** | — |
| **Datum/*Date:*** | 03.07.2014 |

Aus aktuellem Anlass möchten wir darauf hinweisen, dass Reedereien Verfahren für wichtige Betriebsabläufe hinsichtlich der Sicherheit des Personals und des Schiffes einführen müssen. In diesem Zusammenhang sind schiffsspezifische Verfahren für das Betreten von geschlossenen Räumen in den Safety Management Systemen umzusetzen. Die Verfahren sollten insbesondere die folgenden Schritte beinhalten:

- Ermittlung von geschlossenen Räumen[1] im Rahmen einer Gefährdungsbeurteilung
- Sicherheitsmaßnahmen vor und während des Betretens von geschlossenen Räumen
- Notfall- und Rettungsmaßnahmen
- Training und Unterweisung von Besatzungsmitgliedern

In diesem Zusammenhang ist zu beachten, dass ab dem 01.01.2015 alle zwei Monate dokumentierte Übungen zum Betreten von und Bergung aus geschlossenen Räumen durchzuführen sind. Wir verweisen hierzu auf unser Rundschreiben 02/2014 (ISM).

Bei der Erstellung der Verfahren sind die folgenden Unterlagen zu berücksichtigen:

- REVISED RECOMMENDATIONS FOR ENTERING ENCLOSED SPACES ABOARD SHIPS (Resolution A.1050(27))
- Handbuch See der BG Verkehr, Teil B 13 Gefährliche Räume

Due to recent events, we would like to point out that companies should establish procedures for key shipboard operations concerning the safety of the personnel and the ship. In this context ship specific procedures for entering enclosed spaces shall be implemented within the Safety Management System. The procedures should include in particular the following steps:

- Identification of enclosed spaces[2] within the scope of a risk assessment
- Safety measures before and during entry into enclosed spaces
- Emergency and rescue measures
- Training and instruction of crew members

[1] Punkt 2.1 der Resolution A.1050 (27) beinhaltet eine nicht abgeschlossene Auflistung von möglichen geschlossenen Räumen.

[2] Paragraph 2.1 of Resolution A.1050 (27) contains a non-exhaustive list of possible enclosed spaces

2

In this context it should be noted that, from 1 January 2015, enclosed space entry and rescue drills shall be carried out and documented every two months. We refer to our circular 02/2014 (ISM)

When developing the procedures, the following documents are to be considered:

- REVISED RECOMMENDATIONS FOR ENTERING ENCLOSED SPACES ABOARD SHIPS (Resolution A.1050(27))
- Handbuch See der BG Verkehr, Teil B 13 Gefährliche Räume

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*You may find this circular on our homepage:*
http://www.deutsche-flagge.de/de/sicherheit/ism-code/ism-infos

## 7.2 MAIB Safety Bulletin

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

SAFETY BULLETIN

SB3/2014 August 2014

**Extracts from The United Kingdom Merchant Shipping (Accident Reporting and Investigation) Regulations 2012**

**Regulation 5:**
"The sole objective of a safety investigation into an accident under these Regulations shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of such an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

**Regulation 16(1):**
"The Chief Inspector may at any time make recommendations as to how future accidents may be prevented."

**Press Enquiries:**
**020 7944 3387/3248**

**Out of hours:**
**020 7944 4292**

**Public Enquiries:**
**0300 330 3000**

**NOTE**
This bulletin is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.



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# Entry of a confined space on board the cargo ship *SUNTIS* in Goole Docks, Humberside on 26 May 2014 resulting in three fatalities


1

## MAIB SAFETY BULLETIN 3/2014

This document, containing safety lessons, has been produced for marine safety purposes only, on the basis of information available to date.

*The Merchant Shipping (Accident Reporting and Investigation) Regulations 2012* provide for the Chief Inspector of Marine Accidents to make recommendations at any time during the course of an investigation if, in his opinion, it is necessary or desirable to do so.

In co-operation with the Marine Accident Investigation Branch (MAIB), the German Federal Bureau of Maritime Casualty Investigation (BSU) is carrying out an investigation into the deaths of three crew members from the German flagged cargo vessel, *Suntis*, in Goole Docks on 26 May 2014.

The MAIB will publish a copy of the full report on completion of the investigation.

**Steve Clinch**
**Chief Inspector of Marine Accidents**

**NOTE**

This bulletin is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall not be admissible in any judicial proceedings whose purpose, or one of whose purposes, is to apportion liability or blame.

**This bulletin is also available on our website: www.maib.gov.uk**

**Press Enquiries: 020 7944 3387/3231; Out of hours: 020 7944 4292**

**Public Enquiries: 0300 330 3000**

## Background

At approximately 0645 (UTC+1) on 26 May 2014, three crew members on board the cargo ship, *Suntis*, were found unconscious in the main cargo hold forward access compartment, which was sited in the vessel's forecastle (f'ocsle). The crew members were recovered from the compartment but, despite intensive resuscitation efforts by their rescuers, they did not survive.

The vessel was carrying a cargo of sawn timber and, at the time of the accident, shore stevedores were discharging the timber loaded on top of the forward hatch cover. Two of the ship's crew were standing by to clear away the deck cargo's protective tarpaulins as the timber discharge progressed aft. During this time, the two crewmen entered the forward main hold access compartment. The chief officer, who was looking for the two crewmen, found the compartment hatch cover open and shouted down to them before climbing into the space. A third crewman saw the chief officer enter the compartment. When he looked down the hatch, he saw the chief officer collapse.

The alarm was raised and an initially frantic rescue operation was undertaken by the vessel's two remaining crew, and two stevedores. One of the two crew started the hold ventilation fan, and brought a breathing apparatus (BA) set and an emergency escape breathing device (EEBD) to the f'ocsle. He donned the BA set, which did not have a face mask fitted, and entered the compartment. Despite having the breathing regulator in his mouth, it was not supplying him with sufficient air. Two stevedores also entered the compartment during the rescue: one using the EEBD and another without any breathing apparatus whatsoever. While there, they were able to pass lifting slings around the fallen crew so they could be recovered to the deck. The crewman and stevedores suffered severe breathing problems when they returned to deck.

Ambulance paramedics, fire and rescue services and the police subsequently attended. Despite the best efforts of all involved, none of the three crew who were recovered from the compartment survived.

## Initial findings

With a timber cargo loaded in the hold and the hatch covers closed, access to the compartment was subject to a permit-to-work and confined space entry procedures. The lid of the hatch into the compartment had signs indicating the potential dangers **(Figure 1)**.


**Figure 1**

At this stage of the investigation no reason has been identified for the crew to enter the forward access compartment to undertake tasks they had been set. However, it is almost certain that the chief officer and, possibly one of the deceased crew entered the compartment in an attempt to rescue the other(s).

The Fire and Rescue Service analysis of the atmosphere after the accident showed normal readings (20.9%) of oxygen content at the access hatch; the readings reduced to 10% just below main deck level inside the hatch opening and to between 5% and 6% at the bottom of the ladder into the compartment **(Figure 2)**. Such low levels of oxygen cannot support life. Anyone exposed to such levels will faint almost immediately, followed by convulsions, coma and respiratory seizure within a few minutes. It is likely that the timber cargo caused the deprivation of oxygen in the cargo hold and access compartments.

**Figure 2**

## Safety lessons

- The atmosphere within an enclosed space, such as a ship's cargo hold can change rapidly and become lethal dependent on the conditions inside and what is being stored or transported (as the tragic circumstances above illustrate).
- **NEVER** enter a confined space if safer alternatives for carrying out the work are available. If entry into a confined space is unavoidable, robust procedures should be put in place which should include emergency arrangements. These are often referred to as "Safe System of Work" or "Permit-to-Work".
- Warning signs should not be ignored.
- If you are not part of the team designated to work in a confined space DO NOT ENTER. However compelling the desire to enter an enclosed or confined space to attempt to rescue an unconscious colleague is, it must be resisted.
- A ship should have a pre-arranged plan for the rescue of a person who has collapsed within an enclosed or confined space and regular drills should be conducted to test the plan and ensure the crew are familiar with it.
- BA is provided for fire-fighting and rescue; all crew should be trained, drilled and capable of using such critical safety equipment properly in an emergency.
- EEBDs provide a short term air supply to enable crew to escape to fresh air from a hazardous atmosphere. They should never be worn to enter, re-enter or work in a hazardous atmosphere.

Further guidance can be found in the Maritime and Coastguard Agency's (MCA) Code of Safe Working Practices for Seamen (COSWP), Chapter 10, Emergency Procedures, and Chapter 17, Entering Confined Spaces.

**Issued August 2014**