



Investigation Report

B1/2011M

M/S ANDANTE (GIB), accident leading to death and a close-call in cargo hold on 30.9.2011

Translation of the original Finnish report

This investigation report has been written to improve safety and prevent new accidents. The report does not address any possible responsibility or liability caused by the accident. The investigation report should not be used for purposes other than the improvement of safety.

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SUMMARY

An Ordinary Seaman belonging to the crew of the M/S ANDANTE entered a closed cargo hold in the small hours on 30 September 2011. It is not known why he entered the cargo hold and he did not tell anybody about his intentions. The hold was loaded with raw timber. The OS went down through the manhole of the cargo hold to the tween-deck level where he died from the lack of oxygen. The Officer who was looking for the OS noticed the open hatch and the OS who was lying on the bottom. The Officer put on a compressed air line breathing apparatus and went down in order to help the OS. The Officer noticed, however, that he was not able to breathe properly. He tried to climb back to the deck but was not able to do it. Other crewmembers had come to the scene and assisted the Officer back to the deck. The Officer was unconscious after the lift. He revived after resuscitation.

The accident proves that adequate measures have not yet been taken in the prevention of these kinds of accidents. There is enough information and enough instructions but there are shortcomings in their implementation on the practical level.



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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

EEBD	Emergency Escape Breathing Device
ISM	International Safety Management (Code)
IMO	International Maritime Organisation
SMS	Safety Management System
STCW	Standards of Training, Certification and Watchkeeping

FOREWORD

The Marine Accident Investigators' International Forum (hereafter referred to as the MAIIF) has made a study on 101 accidents in enclosed spaces leading to 93 deaths and 96 injuries after 1997. Of these cases only 28 occurred on tankers, and that leads to the conclusion that this concern affects all kinds of vessels. The study has proceeded to the IMO's DSC¹ subcommittee, which published it on 17 July 2009 in the form of document DSC 14/INF.9. The study only deals with the cases which come to the MAIIF's knowledge, and thus the real number of accidents is probably higher.

The starting point for compiling statistics, 1997, derives from the fact that the IMO gave the same year the Resolution 864(20) which included instructions on enclosed space entry. These instructions are rather detailed and observing them would probably have prevented most of these 101 accidents. The Resolution 864(20) is like a recommendation which apparently has meant that everyone has not deemed it necessary to comply with it. Enlightened seafarers and authorities think, however, that non-compliance with IMO recommendation equals with bad seamanship.

This accident led to death, and as has been stated in the Summary, enough has not been done in order to prevent these kinds of accidents. Therefore the Safety Investigation Authority of Finland (hereafter referred to as the SIA) decided to initiate an investigation of the case. Marine Safety Investigator, Captain Risto **Repo** was appointed as team-leader and Captain Juha **Sjölund** was appointed as investigator.

The time used in the investigation report is UTC+3h.

Statements of the Investigation Report. The final draft of the Investigation Report was sent for statements according to the 28§ of the Safety Investigation Act (525/2011) to the Finnish Transport Safety Agency, the Department for Occupational Safety and Health (Finland), the owner of the vessel as well as to the flag state administration. The Investigation Report has been finalised on the basis of the statements and it has been reviewed when this has been considered necessary. A summary was compiled on the basis of the statements, see Appendix 2.

The investigation report has been translated into English by Minna Bäckman.

The sources used in the investigation are filed at the SIA premises.

¹ Dangerous goods, Solid cargoes and Containers

1 EVENTS AND INVESTIGATIONS

1.1 The vessel



Figure 1. M/S ANDANTE

(Source: Briese Schifffahrt)

1.1.1 General information

Name	M/S ANDANTE
Call sign	ZDGU3
Operator	Briese Schifffahrts GmbH & Co. KG, Germany
Flag state	Gibraltar
Type	Multipurpose Cargo vessel
Construction time and place	04/2005 Xingang Shipyard Tianjin, China
IMO number	9341108
Length, max.	115.46 m
Breadth	16.5 m
Draught	5.7 m
Deadweight	6419 mt (without the tween-deck)
Gross tonnage	5232
Net weight	2382
Speed	13 knots
2 cargo holds	No.1: 2,409 cbm, No.2: 7,062 cbm
Cargo hold ventilation	6 air changes per hour

1.1.2 Manning

The vessel had a multinational crew consisting of 10 persons. The Master was German, three officers were Ukrainian and one officer was a Filipino. The rest of the crew were Filipinos. The vessel's working language was English.

1.1.3 Navigating bridge and bridge equipment

Not relevant concerning the accident.

1.1.4 Engines and the engine room

Not relevant concerning the accident.

1.1.5 Other systems

The vessel operated under the Safety Management System of the shipping company². The shipping company had sent to its vessels a 6-page circular letter concerning its audit. A revised version of the shipping company's Quality and Safety Manual³ was enclosed with the circular letter. The letter emphasized e.g. the importance of risk assessment when handling cargo hatches. Work permit practice was dealt with as to hot works, work at a height and enclosed space entry. The Manual includes a schematic model for risk assessment and permit procedure when entering enclosed spaces (Appendix 1). The model is similar to the one available as an appendix in IMO-resolution A 27/Res.1050⁴.

1.1.6 Cargo

The vessel was laden with raw timber. The cargo holds were full of raw timber and there was also raw timber as deck cargo on the hatches. The discharging of the deck cargo was in progress at the time of the accident event.

1.2 Accident event

The discharging of the cargo stowed on the cargo hold hatches had proceeded so far that there was cargo only on the aft hatch of the 2nd cargo hold. The crew started cleaning the bark waste and pieces of timber left on the hatches at the bow with brooms so that the hatches could be opened.

² ISM, IMO's International Safety Management Code

³ QS-Manual

⁴ Revised Recommendations for Entering Enclosed Spaces aboard Ships



Figure 2. The situation after the deck cargo stowed on the foredeck had been discharged.



Figure 3. Deck cargo at the aft part of cargo hold 2.

1.2.1 Circumstances

The accident occurred in the small hours after midnight. The illumination of the quay and the vessel's deck illumination served as lighting. The cargo hold had been closed for over seven days, i.e. since the loading and lashing of deck cargo for the duration of the entire voyage and in Kotka during the discharging of the foremost deck cargo.

1.2.2 Accident voyage and preparations for it

The vessel had loaded the timber cargo in Southern France, in the Port of Bayonne. The voyage to Kotka took seven days. Nothing out of ordinary happened during the voyage.

1.2.3 Scene of the incident

The manhole⁵ of cargo hold number 2.



Figure 4. The manhole of the cargo hold to the left. The ladder leading to the hold and the landing, photo taken towards the bow.

There was no kind of warning against the dangers in the cargo hold or a prohibitory sign in the manhole (Figure 4 to the left). The hatch to the right is the emergency exit of the engine room. The landing which can be seen to the right in Figure 4 is the place where the OS died from the lack of oxygen.

⁵ entrance to the cargo hold

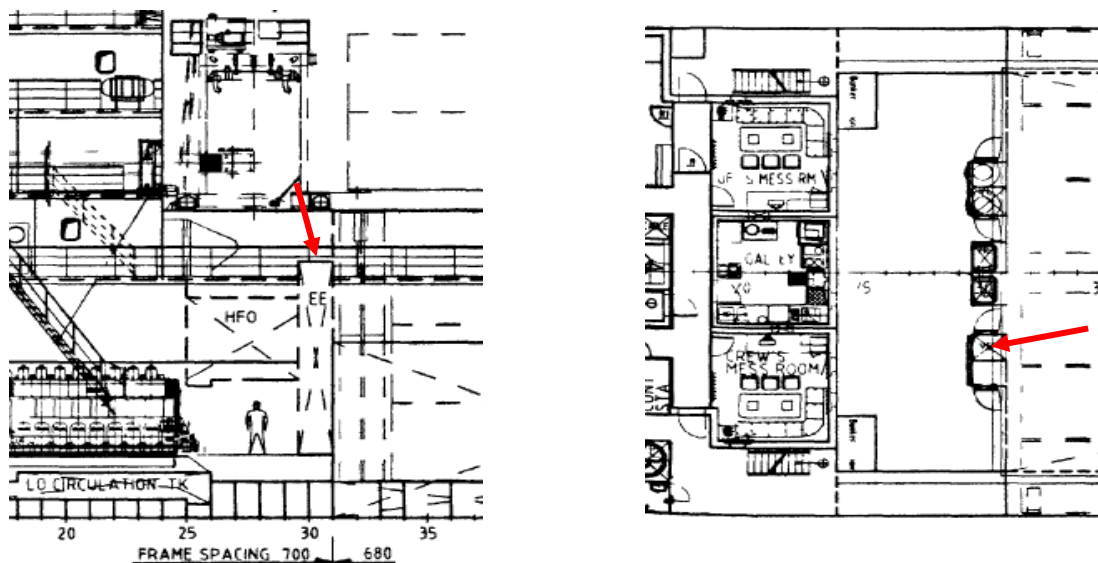


Figure 5. The red arrows point to cargo hold No 2 and indicate the location of the manhole. The arrow to the right points to the emergency exit of the engine room as the drawing is from the starboard side of the vessel. It gives, however, an idea of the depth of the passages in question.

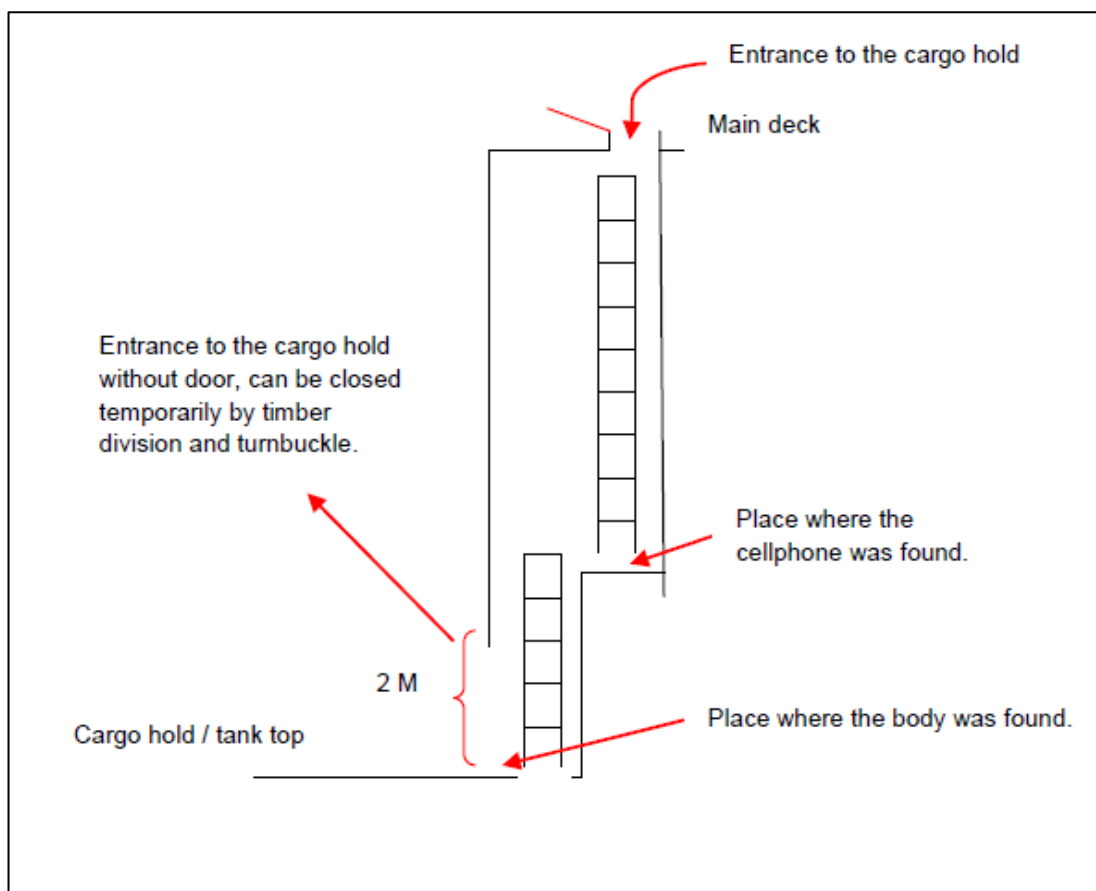


Figure 6. Drawing of the scene of the accident.

1.2.4 Accident event

The OS acting as the gangway watch⁶ had entered the tween-deck level for unknown reason. He died from the lack of oxygen. The Officer who was looking for the OS noticed the open hatch and the OS who was lying on the bottom. The Officer put on a compressed air line breathing apparatus and went down in order to help the OS. The Officer noticed, however, that he was not able to breathe properly. He tried to climb back to the deck but was not able to do it. Other crewmembers had come to the scene and assisted the Officer back to the deck. The Officer was unconscious after the lift, but revived after resuscitation.

1.2.5 Injuries to persons

The OS died. The Officer lost consciousness and was taken to hospital.

1.2.6 Damages to the vessel

No damages.

1.2.7 Other damages

The discharging of the cargo was delayed.

1.2.8 Registration equipment

There was an oxygen content meter on the vessel. It was not used.

1.3 Rescue activities

The deck watch was not at his post at the gangway when he was needed on the fore-deck to clean bark waste from the hatches. The crew started to look for him and the No 2 manhole of the cargo hold nearby was soon discovered to be open. Three men came to the scene and the Second Officer put on a breathing apparatus and went down in order to save the OS. He started to tie a rope around the OS but felt that his oxygen supply decreased. He tried to climb up the ladders but was not able to do it.

The deck cadet also put on a breathing apparatus and went down. He pushed the Officer upwards from down under and the crew members who were on the deck pulled the Officer up. He was unconscious during the lift. The mask of the breathing apparatus was taken off and the men started giving first aid/resuscitating by pressing the chest. The Officer revived due to the resuscitation and started to breathe.

⁶ Gangway watch is a watchman who supervises the gangway and makes sure that unauthorised persons do not embark the vessel (ISPS Code requirement; International Ship and Port Facility Security Code)

A phone call on what had happened was made from the vessel to the emergency number 112 at 03.25. An ambulance (K190) arrived first at the port at 03.37 and another (K191) soon after this, at 03.40. Another three units arrived at the scene at 03.45-03.47.

The rescue workers lifted the OS onto the deck and declared him dead. The Officer was taken to the Kotka Central Hospital by an ambulance. He was able to return to the vessel on the evening of the same day.

An inspection was made on the breathing apparatus used by the Officer. No defects were found and the bottle was not empty.

1.4 Special investigations

The personnel of the rescue department assisted the police in accident investigation by measuring the quality of the atmosphere in the cargo hold. The conclusion was that oxygen depletion was the most dangerous feature of the cargo hold. The measurement result indicated an oxygen content of 7%. The discharging of the cargo was interrupted.

1.4.1 Investigations on the accident vessel and at the scene of the event

Various authorities carried out investigations on the vessel on the accident day as follows: The police investigated the case as an occupational accident and carried out an inquest into the cause of death. A representative from the maritime authority made a PSC⁷ inspection on the vessel. A representative from the Occupational Safety and Health Administration investigated what had happened as an occupational accident.

An investigator from the SIA visited the vessel for the first time on the evening of the accident day and initiated a preliminary investigation. The investigators have obtained for their use the reports and investigation material of the other authorities.

1.4.2 Technical investigations

An investigator visited the vessel on 1st and 2nd October to familiarize himself with the vessel and the scene of accident. The course of events and the procedures related to different tasks considered with the Master. The Officer's actions on the night of the accident were discussed with him.

1.4.3 Organization and management

The Master of a vessel is responsible for the safety of the vessel and the personnel and acts as the shipping company's representative on the vessel. The Flag State Authority is the highest organ supervising the vessel and its operations. It lies with the shipping company to define safe policies with reference to the operating of the vessel, to create a safe work environment and to supervise that these policies are complied with.

⁷ Port State Control

1.5 Rules and regulations guiding the operations

1.5.1 International agreements and recommendations

Rule 3 in Chapter 6, “Carriage of cargoes”, in the IMO SOLAS Convention⁸. The following is stated on the analysis of oxygen content and measuring of gas contamination:

When transporting a bulk cargo which is liable to [...] cause oxygen depletion in the cargo space, an appropriate instrument for measuring the concentration of gas or oxygen in the air shall be provided together with detailed instructions for its use.

The raw timber that the ANDANTE carried was bulk cargo, and its natural characteristic is that oxygen depletion occurs in the cargo hold as the time passes.

The IMO Resolution A.864(20), which was adopted on 27th November 1997, puts forth recommendations on measures to be taken before entering an enclosed space and working in such a space.⁹

The above mentioned Resolution was replaced by the Resolution A.1050(27) which came into effect on 30 November 2011. In this Resolution the guideline for working in enclosed spaces was revised and a new chapter 3, which points out the company responsibility, was also added.

Risk Assessment is a manner of proceeding which can be used to determine safe and environmentally friendly lines of action as far as it is possible in practice. **This has been a mandatory procedure after 1st July 2010** (IMO Revised ISM Code 2010, para. 1.2.2)

All enclosed spaces on the vessel should be identified in the risk assessment of the Safety Management System of the company. An assessment should be made on the dangers, and measures to eliminate or minimise these dangers should be compiled.

A risk assessment was carried out on the ANDANTE on 5 March 2011 on the risk of enclosed space entry, and a code of practice to improve safety has been defined. After the accident in question, a more detailed risk assessment on the same issue was carried out on 9 October 2011 and the code of practice was specified. It does not become apparent in the analysis how this code of practice is implemented and how its realisation is monitored.

The IACS¹⁰ has published A Guide to Risk Assessment in Ship Operations 26.3.2004. The vessel’s classification society Germanischer Lloyd is a member of this association.

The Safety Management System should include descriptions of safe procedures for entering enclosed spaces, for working there and for the preparedness to act in emergency situations. (ISM Code, Section 7).

⁸ SOLAS Chapter VI, *Carriage of cargoes*

⁹ RESOLUTION A.864(20) adopted on 27 November 1997

¹⁰ RECOMMENDATIONS FOR ENTERING ENCLOSED SPACES ABOARD SHIPS

International Association of Classification Societies

A poster on the entry to enclosed spaces produced by the MAIIF can be seen on the next page.

Enclosed Space Entry

STOP

You must not open or enter an ENCLOSED SPACE unless authorized by the master or the nominated responsible person and unless the appropriate safety procedures laid down for the particular ship have been followed

THINK

Before entering an ENCLOSED SPACE, you must have a Permit to Enter completed by the master or responsible person and by any persons entering the space

ASK

Have I received instructions or permission from the master or nominated responsible person to enter the enclosed space?

IF YOU DO NOT HAVE A PERMIT TO ENTER AND HAVE NOT RECEIVED INSTRUCTIONS OR PERMISSION FROM THE MASTER OR NOMINATED RESPONSIBLE PERSON, THEN DO NOT ENTER ANY ENCLOSED SPACE

What is an ENCLOSED SPACE?

ENCLOSED SPACE means a space which has any of the following characteristics: limited openings for entry and exit; inadequate ventilation; and is not designed for continuous worker occupancy.

Adapted from IMO Resolution X/950, Recommendations for Entering Enclosed Spaces

SA Marine Accident Investigators' International Forum project, sponsored by [The Bahamas Shipowners' Association] and the Swedish Transport Agency, supported by the International Maritime Organization and The Nautical Institute

Figure 7. A poster by the MAIIF.

1.5.2 National legislation

In the legislation of the vessel's flag state, Gibraltar, there is a regulation on "Entry into Dangerous Spaces"¹¹ concerning merchant shipping. According to it "Dangerous space" means any enclosed or confined space in which it is foreseeable that the atmosphere may at some stage contain toxic or flammable gases or vapours, or be deficient in oxygen, to the extent that it may endanger the life or health of any person entering that space.¹²

Entry into dangerous spaces¹¹

*The master of a ship shall ensure that all **entrances to unattended dangerous spaces on the ship are either kept closed or otherwise secured against entry.***

The employer shall ensure that procedures for ensuring safe entry and working in dangerous spaces are clearly laid down; and

(ii) The master shall ensure that such procedures are observed on board the ship.

(2) No person shall enter or remain in a dangerous space except in accordance with the procedures laid down pursuant to paragraph (1) of this regulation.

(3) In fulfilling their duties under paragraph (1) and (2) above the employer, master and any other person shall take full account of the principles and guidance contained in the Code.

Drills¹¹

The master of (a) any tanker or gas carrier of 500 tons and over, and (b) any other ship of 1000 tons and over shall ensure that drills simulating the rescue of a crew member from a dangerous space are held at intervals not exceeding two month, and that a record of such drills is entered in the official log book.

A training session¹³ had been held on the vessel at the end of July 2011. The participants had confirmed their partaking by signature. The person who had died in the accident now under investigation and the injured person had both participated in the training. The training did not include rescue from an enclosed space.

Testing equipment¹¹

The employer shall ensure that each ship where entry into a dangerous space may be necessary shall carry or otherwise have available an oxygen meter and such other testing device as is appropriate to the hazard likely to be encountered in any dangerous space on board. The master shall ensure that such meter and any such other testing device are maintained in good working order and, where applicable, regularly serviced and calibrated according to the manufacturers` recommendations.

¹¹ The Merchant Shipping (Entry into Dangerous Spaces) Regulations 1988 (SI 1988 No 1638).

¹² "Dangerous space" means any enclosed or confined space in which it is foreseeable that the atmosphere may at some stage contain toxic or flammable gases or vapours, or be deficient in oxygen, to the extent that it may endanger the life or health of any person entering that space

¹³ Entering Enclosed Spaces Training

1.5.3 Operator's orders

The shipping company had updated its Quality and Safety Manuals and rather detailed instructions on their use had been sent to the vessels. Risk assessment, training and work permit policies were required e.g. concerning enclosed space entry.

1.5.4 Effect of oxygen content

The fact that oxygen depletion cannot be noticed and its fast effects are factors which one must be especially aware of.

Oxygen is a very important gas for vital functions so it is imperative that the oxygen content of the breathing air is adequate. A healthy human being has better chances to survive a moment in an atmosphere with reduced oxygen content.

The table below describes the symptoms a person suffers from in conditions with different oxygen content. The symptoms are only indicative and they should not be applied to all cases.

Table 1. Symptoms suffered in conditions with different oxygen content.

Oxygen content %	Symptoms
16–18	Deep breathing, increased heart rate, reduced level of consciousness, reduced judgement and coordination without the person himself/herself noticing anything different in his/her condition. The person can be revived if he/she is quickly brought into fresh air.
12–10	Very reduced judgement and coordination. Quick loss of consciousness which can lead to permanent heart damage. Discontinuous breathing.
10 and under	Nausea, vomiting, unable to take effective action or loss of the ability to function. In a few minutes loss of consciousness followed by death.
Less than 6	Spasmodic breathing and movements, death in the course of a couple of minutes.

Source: Griffiths R.2011, adapted from Fundamentals of Aerospace Medicine 4th edition

Time of useful consciousness is defined as the amount of time in which an individual is able to perform flying duties efficiently in an environment of inadequate oxygen supply (Dehart & Davis, 2002). It is the period of time from the interruption of the oxygen supply or exposure to an oxygen-poor environment to the time when useful function is lost, and the individual is no longer capable of taking proper corrective and protective action. It is not the time to total unconsciousness. The time of useful consciousness was also known as effective performance time.

The carriage of logs at sea and in bulk was covered in the IMO's BC Code which was first published in 1965. The Code had been revised and republished several times since then. In the latest revision the BC Code was replaced by the IMSBC Code, which came into effect on 1 January 2011 (IMO Resolution MSC.269(85)).



Section 3 of the BC Code was concerned with the safety of personnel and ships and gave general information on the safety precautions to be taken and information to be passed to the master before the commencement of loading. Section 3 also referred to the general precautions to be taken when an enclosed space was entered which were contained in Appendix 7 of the BC Code. Paragraph 3.2.4 of the BC Code specifically mentioned timber logs and stated:

Many cargoes frequently carried in bulk are liable to cause oxygen depletion in a cargo space or tank; these include most vegetable products, grains, timber logs and forest products, ferrous metals, metal sulphide concentrates and coal cargoes.

Organic materials are subject to decomposition over time, principally due to either microbiological (anaerobic or aerobic) or autoxidative processes. Various gaseous products are then formed, including carbon monoxide (CO), carbon dioxide (CO₂), hydrogen sulphide (H₂S) and hydrocarbons.

When organic materials are stored in confined spaces, these decomposition products will accumulate in the air and may eventually reach toxic levels. Oxygen depletion will occur simultaneously (Urban Svendberg, 2009).



2 ANALYSIS

2.1 Working in enclosed spaces

For example the following can be listed as enclosed spaces or spaces dangerous to health:

- cargo spaces
- pipe systems
- pressure vessels
- ballast tanks
- fuel and lubricator tanks
- cofferdams¹⁴
- spaces with a significant leakage or a suspected significant leakage of exhaust gas, extinguishing gas or cooling agent because of e.g. a malfunction
- machinery crankcases
- exhaust piping including waste heat boiler
- sewage treatment plants
- waste water tanks
- chain boxes
- on tankers naturally cargo tanks and the spaces in their imminent proximity
- pump house
- any other space without mechanical ventilation and with only one entry
- generally speaking any space which has been closed and the atmosphere of which has not been measured/which had not been ventilated

Working in enclosed spaces requires premeditated safety measures, communication, cooperation and adequate ventilation of the enclosed space. Work in enclosed spaces is carried out on almost all kinds of vessels, which means that not on any vessel should risks related to enclosed spaces be undermined.

2.2 Informing of the risks and policies

On a vessel transporting cargo with properties which are dangerous to health, the vessel's personnel must be informed of this in an efficient manner. The distribution of information must take place in writing in the Safety Management System, on the vessel's notice board and verbally, but it has to be taken into account that a verbal notification has the tendency to be easily forgotten. Information distribution must absolutely take place in writing and include all precautions against health risks. Entering a cargo space must be entirely forbidden in the notice and it must be prevented both by prohibitory signs and by locks installed to manholds.

When necessary, the cargo space must be washed and ventilated carefully and the atmosphere must be measured from outside the space before entering it by using a

¹⁴ an empty space between two compartments, a dry tank

measuring device calibrated in accordance with the manufacturer's instructions. The measurements of the atmosphere of an enclosed space must be registered and a work permit to an enclosed space must be issued in writing. Such a permit is granted by the master of the vessel or by a qualified person authorised by the master. Measurements must be taken also when someone is working in an enclosed space and ventilation must be uninterrupted. The persons working in an enclosed space should have personal multi-gas detectors which measure oxygen content, hydrocarbons and gases.

If ventilation is for some reason interrupted during the work or if the measuring results are not within permissible limits, the space must be exited immediately. There are no universal numerical guideline values for adequate ventilation, because enclosed spaces differ considerably from another. The measuring of the atmosphere gives an indication of adequate ventilation. If the work is interrupted for e.g. eating, the permit procedure must be carried out anew.

2.3 Training

Rescue training for enclosed spaces must be given on vessels. The training must include using a compressed air line breathing apparatus and lifting the victim from an enclosed space.

Only trained personnel are permitted to work in an enclosed space or be a hatch access watch. In addition to the personal protective equipment including safety harnesses, the rescue equipment must be ready for use in the imminent proximity of the work site. Using EEBD¹⁵ in rescue operations is not to be recommended because of its short operating time.

Rescue attempts in enclosed spaces without proper protective equipment have been made far too often and they have led to an increasing number of victims¹⁶.

2.4 Operations on the ANDANTE

The risks related to an enclosed space were at least partly understood on the ANDANTE. The matter had been discussed on the Master's order in a verbal drill at least once during the year 2011. The deceased OS and the seriously injured Officer had participated in the training. There is a written confirmation on the matter as an appendix to the exercise log. The risks related to the cargo transported on the accident voyage (oxygen depletion) had been recounted verbally during the voyage. There were, however, no prohibitory signs near the manholds leading to the cargo hold or prohibitions against entering the cargo hold, and the manholds were not locked.

The investigators have deliberated upon the possible reasons why the OS opened the manhold and went down from it. The victim had first worked as a cadet on the vessel

¹⁵ EEBD, Emergency Escape Breathing Device

¹⁶ *Investigation 10-201*

Marine inquiry 10-201 Bulk carrier TPC Wellington, double fatality resulting from enclosed space entry, Port Marsden, Northland, 3 May 2010

and had later on been promoted to OS. The Master had been happy with the OS who could expect to be promoted to an able-bodied seaman.

Why the OS opened the hatch of the cargo hold and entered the enclosed space is mere speculation. One possible reason may be that he as an active person wanted to speed up the cleaning of the remains of the deck cargo from the cargo hatches. For this reason he might have gone down to fetch brooms to the deck. This would not have been necessary as there were also brooms in the bow storeroom.

It is possible that he only wanted to open the manhole in order to start ventilating the space. Both hands are needed in order to open the hatch. The hatch is heavy and when one opens it, the body stretches forward when the hatch is pushed till it becomes locked. Two telephones were found next to the victim, one of which was broken. It is possible that the telephone had been in the breast pocket of the overall and fallen down onto the tween-deck level when the hatch was opened. In the case of a mishap it is only human to try to fix its consequences immediately. The victim might have gone to fetch the telephone and forgotten or not been aware of the risks of the enclosed space.

2.5 Rescue activities

During the rescue activities the fact that the Officer had difficulties in breathing might have been due to the mask being put on hastily so that air devoid from oxygen could enter into the mask. The mask was new. It was not discovered whether the person in question had practised its use earlier. The drill on 30th July 2011 did not include user guidance concerning the breathing apparatus.

Training of emergency situations is of uttermost importance because it has proved that rescue measures which have been started hastily and without due consideration have often increased the number of casualties, which also almost happened in this case.

After the rescue department received the emergency call, adequate resources were sent to the scene. The action was early-oriented.

2.6 Instructions

Rules, regulations and instructions themselves or their repetition do not as such increase the compliance with them. The responsibility for the compliance with the laws and regulations lies with the shipping company. The Master together with the rest of the officers are in charge of their implementation and of motivating the personnel. The crew also have their own responsibility to comply with these regulations and instructions. This kind of a division of responsibilities follows the objective of the ISM Code. If any link in this safety chain fails, the probability of an accident is mainly directed to the person entering an enclosed space.

2.7 The master's assessment of the SMS

Section 5 of the ISM Code requires that the master assess the appropriateness and effectiveness of the Safety Management System and report on the deficiencies he notices.

On the general level and on the basis of the investigators' experience, these assessments are regrettably often realised in a manner which does not comply with the purpose of the assessment. The results of these assessments are far too often "mainly stories ingratiating the shipping company". The masters seldom dare to bring forth their own opinions. When this is true, even serious defects in the system may be disregarded.

2.8 Information distribution and communication

Communication creates safety. It is of uttermost importance that every member in the vessel's organisation informs of his/her intentions and doings in which case the party receiving the particular piece of information can assess the safety of the intentions and doings of the informing party.

It is obvious that this kind of procedure creates a clearer and safer operational culture. When both parties are of the opinion that the intention/task is safe, realising it can be considered. There are certainly situations when quick actions are required, but even then one should not act without informing about his/her intentions.

3 CONCLUSIONS

This accident proves that regardless of the code of practice and information distribution a crew member could enter an enclosed space. Anybody had free access to the cargo hold because the entry hatch was not locked. There was no prohibition or warning about the risks of the cargo hold. This leads to the conclusion that the preventive measures taken by the shipping company and the Master have been inadequate.

3.1 Safety observations in general

Accidents like this occur too often. It seems that the preventive measures taken by the shipping companies have been inadequate despite the regulations/instructions and the knowledge gathered of these accidents is not passed from the older generation of seafarers to the younger generation.

Often it is all about how the instructions are implemented in practical working life on-board vessels. External or internal audits should always verify this, but it is very likely that the audits do not always cover the applications in practical situations. Audits are often realised according to a pre-written check list, in connection with a port call, sometimes according to a quick schedule, and shipping company may think that it has executed the annual internal audit as required by the ISM Code. It is obvious that it is impossible to get a clear picture of the realisation of the system in practice in a short time.

Younger generation has a tendency to understate work-related risks. Underestimating the risks should be eliminated already in the connection with recruiting. In addition to the shipping company, also the older crew members have to be aware of their responsibility to distribute information of the hidden risks related to working onboard.

The accident now under investigation involves the safety of shipping on a global scale. Thus everybody working in this trade should be aware of their possibilities to act in order to prevent accidents like this.

Lessons to be learned from this case:

- An enclosed space can kill.
- Do not ever enter an enclosed space without checking the atmosphere.
- Always follow the pertinent instructions on enclosed space entry.
- Manuals and instructions alone do not prevent accidents, but training and assessment would probably ensure that they are understood and followed.

4 IMPLEMENTED MEASURES

In consequence of the accident, the shipping company sent to its vessels a circular letter (N 90) on 5th October 2011 in which it was emphasized that if the vessels carry cargo which causes oxygen depletion, the entries to the cargo hold must be locked and supplied with appropriate warnings.

In addition, as mentioned earlier, a new risk assessment was ordered to be carried out on the ANDANTE. It was carried out in more detail on 9th October 2011 and detailed instructions have been compiled on the basis of it.

The shipping company told that it has sent to its vessels the publication Personal Injury Prevention, A Guide to good practice, Second Edition, by North of England P&I Association.

5 RECOMMENDATIONS

It is obvious that effective measures have not been taken to adequately prevent accidents like the one now under investigation. The preventive measures carried out by the shipping company and on the vessel prior to the accident were inadequate.

International Labour Organisation's Maritime Labour Convention has been ratified in Finland in year 2012. The SIA's understanding is that the supervisory authorities can take action on unsafe conditions onboard whilst a foreign flag vessel is in Finnish Port.

The **safety observation** from this investigation is that the *Health and Safety Authorities and the Finnish Transport Safety Agency as supervisory authorities should actively target the working safety in enclosed spaces onboard ships*. Attention should be paid, among other things, to the appropriate warning signs of enclosed spaces. There should be also a very strict permit procedure related to working in enclosed spaces. The procedure should contain also an extensive risk assessment.

Helsinki, 11 December 2012

Risto Repo

Juha Sjölund

SOURCES

The following sources are filed at the SIA premises:

1. Kymenlaakso Police Department, Investigation Report 8150/S/4635/11
2. Kymenlaakso Rescue Department, Accident Description 1100177781
3. Record of Rest times Sept/2011 M/V ANDANTE
4. Briese Schiffahrts GmbH & Co.KG; the shipping company's circular letter on the ISM audit on 18.8.2010
5. Training Record/Safety meeting/ANDANTE 30.7.2011 (Entering Enclosed spaces Training)
6. ANDANTE, Risk Assessment Form 05.03.2011; Cargo holds, tanks void spaces, ballast tanks, cofferdams, pipe trunks, chain lockers & etc.
7. Finnish Transport Safety Agency/ Paris MOU Inspection Report 30.9.2011, Kotka

APPENDIX 1. THE SHIPPING COMPANY’S FORM FOR RISK ASSESSMENT AND PERMIT PROCEDURE WHEN ENTERING ENCLOSED SPACES

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APPENDIX

EXAMPLE OF AN ENCLOSED SPACE ENTRY PERMIT

This permit relates to entry into any enclosed space and should be completed by the master

or responsible person and by any persons entering the space, e.g. competent person and attendant.

GENERAL

Location/name of enclosed space

Reason for entry

.....

This permit is valid from: hrs Dateto: hrs Date

SECTION 1 – PRE-ENTRY PREPARATION

(To be checked by the master or nominated responsible person)

Yes No

- Has the space been thoroughly ventilated by mechanical means?
- Has the space been segregated by blanking off or isolating all connecting pipelines or valves and electrical power/equipment?
- Has the space been cleaned where necessary?
- Has the space been tested and found safe for entry? (See note 2)
- Pre-entry atmosphere test readings:
 - oxygen % vol (21%)* By:
 - hydrocarbon % LFL (less than 1%)
 - toxic gases ppm (less than 50% OEL of the specific gas) Time: (See note 3)
- Have arrangements been made for frequent atmosphere checks to be made while the space is occupied and after work breaks?
- Have arrangements been made for the space to be continuously ventilated throughout the period of occupation and during work breaks?
- Are access and illumination adequate?

* Note that national requirements may determine the safe atmosphere range.

- Is rescue and resuscitation equipment available for immediate use by the entrance to the space?
- Has an attendant been designated to be in constant attendance at the entrance to the space?

APPENDIX 1/2 (3)

- Has the officer of the watch (bridge, engine-room, cargo control room) been advised of the planned entry?
- Has a system of communication between all parties been tested and emergency signals agreed?
- Are emergency and evacuation procedures established and understood by all personnel involved with the enclosed space entry?
- Is all equipment used in good working condition and inspected prior to entry?
- Are personnel properly clothed and equipped?

SECTION 2 – PRE-ENTRY CHECKS

(To be checked by each person entering the space)

Yes No

- I have received instructions or permission from the master or nominated responsible person to enter the enclosed space
- Section 1 of this permit has been satisfactorily completed by the master or nominated responsible person
- I have agreed and understand the communication procedures
- I have agreed upon a reporting interval of minutes
- Emergency and evacuation procedures have been agreed and are understood
- I am aware that the space must be vacated immediately in the event of ventilation failure or if atmosphere tests show a change from agreed safe criteria

SECTION 3 – BREATHING APPARATUS AND OTHER EQUIPMENT

(To be checked jointly by the master or nominated responsible person and the person who is to enter the space)

Yes No

- Those entering the space are familiar with any breathing apparatus to be used
- The breathing apparatus has been tested as follows:
 - gauge and capacity of air supply
 - low pressure audible alarm if fitted
 - face mask – under positive pressure and not leaking
- The means of communication has been tested and emergency signals agreed
- All personnel entering the space have been provided with rescue harnesses and, where practicable, lifelines

Signed upon completion of sections 1, 2 and 3 by:

Master or nominated responsible person Date Time

Attendant Date Time

Person entering the space Date Time

SECTION 4 – PERSONNEL ENTRY

(To be completed by the responsible person supervising entry)

Names

Time in Time out

SECTION 5 – COMPLETION OF JOB

(To be completed by the responsible person supervising entry)

Job completed Date Time

- Space secured against entry, Date Time
- The officer of the watch has been duly informed, Date Time

Signed upon completion of sections 4 and 5 by:

Responsible person supervising entry Date Time

THIS PERMIT IS RENDERED INVALID SHOULD VENTILATION OF THE SPACE STOP
OR IF ANY OF THE CONDITIONS NOTED IN THE CHECKLIST CHANGE

Notes:

- 1 The permit should contain a clear indication as to its maximum period of validity.
- 2 In order to obtain a representative cross-section of the space's atmosphere, samples should be taken from several levels and through as many openings as possible. Ventilation should be stopped for about 10 minutes before the pre-entry atmosphere tests are taken.
- 3 Tests for specific toxic contaminants, such as benzene or hydrogen sulphide, should be undertaken depending on the nature of the previous contents of the space.

SUMMARY OF THE RECEIVED STATEMENTS

Statement by the Finnish Transport Safety Agency

The investigation report's safety observation, working safety in enclosed spaces onboard ships should be actively targeted by the supervisory authorities, was regarded as a good idea by the Finnish Transport Safety Agency. However, it was pointed out that the working safety inspections are, as a rule, done by the Health and Safety Authorities. During the PSC inspections (Port State Control) onboard foreign flagged vessels the Finnish Transport Safety Agency's inspectors can remind the crew of risks related to the working in enclosed spaces. However more detailed inspections can only be made if a finding onboard the vessel justifies the inspection.

Furthermore, the Finnish Transport Safety Agency made few corrections to the rule references in the investigation report. Also the forthcoming revision to the IMSBC code was mentioned.

Statement by the Flag State Administration

The Flag State Administration reported that it had no statement to make.