



## *Final report RS 2022:02e*

NATALY – fatal workplace accident on  
25 March 2021 off Landsort,  
Stockholm County

File no. S-62/21

2022-03-02

SHK investigates accidents and incidents from a safety perspective. Its investigations are aimed at preventing a similar event from occurring in the future, or limiting the effects of such an event. The investigations do not deal with issues of guilt, blame or liability for damages.

The report is also available on SHK's website: [www.havkom.se](http://www.havkom.se)

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## General observations

The Swedish Accident Investigation Authority (Statens haverikommission – SHK) is a state authority with the task of investigating accidents and incidents with the aim of improving safety. SHK accident investigations are intended to clarify, as far as possible, the sequence of events and their causes, as well as damages and other consequences. The results of an investigation shall provide the basis for decisions aiming at preventing a similar event from occurring in the future, or limiting the effects of such an event. The investigation shall also provide a basis for assessment of the performance of rescue services and, when appropriate, for improvements to these rescue services.

SHK accident investigations thus aim at answering three questions: *What happened? Why did it happen? How can a similar event be avoided in the future?*

SHK does not have any supervisory role and its investigations do not deal with issues of guilt, blame or liability for damages. Therefore, accidents and incidents are neither investigated nor described in the report from any such perspective. These issues are, when appropriate, dealt with by judicial authorities or e.g. by insurance companies.

The task of SHK also does not include investigating how persons affected by an accident or incident have been cared for by hospital services, once an emergency operation has been concluded. Measures in support of such individuals by the social services, for example in the form of post crisis management, also are not the subject of the investigation.

## The investigation

SHK was informed on 25 March 2021 that a marine casualty involving the vessel NATALY, IMO number 9370288, had occurred earlier that same day.

The accident has been investigated by SHK, represented by Jenny Ferm, Chairperson, Jörgen Zachau, Investigator in Charge, Björn Ramstedt, Operations Investigator, and Per Jakobsson, Technical Investigator.

The investigation has been conducted in cooperation with the Cypriot investigation authority, the Marine Accident and Incident Investigation Committee (MAIC).

Patrik Jönsson and Ulf Holmgren have participated as coordinators for Swedish Transport Agency and the Swedish Maritime Administration, respectively.

A fact finding presentation meeting with the interested parties was held on 21 October 2021. At the meeting SHK presented the facts discovered during the investigation, available at that time.

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### Ship particulars

Flag/register	Cyprus
Identification	NATALY
IMO identification/call sign	9370288/5BRE5
Vessel data	
Type of ship	General cargo
New building shipyard/year	Damen Shipyard, Bergum, Netherlands/2007
Gross tonnage	2545
Length, over all	88.6 m
Beam	12.52 m
Draught, max.	4.5 m
Deadweight at max. draught	3859 tonnes
Main engine, output	1520 kW
Propulsion arrangement	1 variable-pitch propeller
Lateral thruster	1 forward
Service speed	11.5 knots
Ownership and operation	Hermann Lohmann Schiffahrtsverwaltung GmbH
Classification society	DNV GL

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### Voyage particulars

Ports of call	Ridham Dock, UK to Södertälje, SE
Type of voyage	International voyage
Cargo information	Woodchips
Manning	6

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### Marine casualty information

Type of marine casualty	Very serious
Date and time	2021-03-25, 13:50 hrs. LT <sup>1</sup>
Position and location	N 58° 35.6' E 017° 47.3'
Consequences	
Personal injuries	1 fatality
Environment	None
Vessels	None

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<sup>1</sup> Certain other, similar, times appear in the reports.

## SUMMARY

On 25 March 2021, the dry cargo carrier NATALY was at anchor off Landsort, Sweden, waiting for berth and loaded with woodchips. When anchoring, one of the anchor chains had kinked, and the chief mate and the two deck hands, one AB and one OS, had subsequently opened the chain box. The work was prepared through issuing of an enclosed space entry permit.

During the work it was noted that a working light was out of order, and one of the two deck hands, the AB, was asked to fetch a replacement. At the same time, the OS was on the forecastle for further preparations. A sound made him go down from the forecastle, and he then saw the hatch down to the forward shaft of the cargo hold being opened. The shaft, that from a ventilation perspective was part of the cargo hold and consequently an enclosed space, was not to be entered until atmosphere was deemed to be safe. All the way down at the bottom, he saw the AB lying and realized that BA set was necessary to assist him. Hence, the OS immediately called for emergency assistance.

After a great deal of problems, the AB was brought up on deck through the narrow space while the master called for assistance. Though CPR commenced directly as the AB was on deck, he was still unconscious when the rescue helicopter arrived, and the AB was announced dead upon arrival at the hospital. The post mortem suggests that the deceased was subjected to severe hypoxia and that the cause of death is suffocation as a result of spending time in the shaft.

An audit of the vessel's SMS that was conducted after the occurrence revealed several non-conformities. Furthermore, one observation was made by the auditor showing that communication between the vessel and the shipping company, Hermann Lohmann Schiffahrtsverwaltung GmbH, regarding safety management issues may be regarded as too limited. This leads to the conclusion that the SMS was not effectively implemented, which in turn constitutes an underlying factor to the occurrence.

The direct cause of the accident was that the AB went down into an enclosed space where there was a lack of oxygen. The hatch to the shaft was not cordoned off, which means that a safety barrier was broken. It has however not been possible to establish why the victim went down into the cargo hold shaft.

The incomplete implementation of the shipowner's and the vessel's safety management systems is an underlying factor

### **Safety recommendations**

#### **Hermann Lohmann Schiffahrtsverwaltung GmbH is recommended to:**

Due to the occasion, continue to develop its safety management system in such a way that a continuous improvement of the safety culture may be obtained (see section 3.3). (*RS 2022:02e R1*)

## 1. FACTUAL INFORMATION

### 1.1 Sequence of events

On Thursday 25 March 2021, the dry cargo carrier NATALY had anchored off Landsort while waiting to dock with her cargo of woodchips, which was to be unloaded in Södertälje. The plan was for the vessel to dock two days later, i.e. the following Saturday. When anchoring, the starboard anchor chain had kinked<sup>2</sup> and become stuck in the hole between the deck and the anchor windlass. Consequently, the crew had to re-anchor using the port anchor. After anchoring, work on arranging the chain in the starboard chain locker began. Before this work, which began at approximately 13:00 hrs. and was considered work in an enclosed space, the crew had arranged a work permit (enclosed space entry permit) in order to mitigate the risks associated with such work. Three people participated in this work: the chief mate (in the capacity as supervisor of the deck department) and the two deckhands (an ordinary seaman – OS - and an able bodied seaman – AB).

Before opening the hatch to the chain locker, working lights had been arranged for the otherwise totally dark space, but it appeared that these did not function. One of the deckhands, the AB, was then asked to fetch another work lamp or a new bulb for the broken lamp. The AB therefore went away from the ongoing work.

A short time later, the OS went up to the forecandle in order to prepare the windlass for the forthcoming job. When he arrived at the forecandle, he suddenly heard a sound, which has been described as a stifled scream. He went back down from the forecandle and noticed that the hatch of the shaft down to the cargo hold was open. This had been closed during the voyage. When the OS arrived at the hatch and looked down, he saw the AB all the way down at the bottom of the shaft, almost eight metres down. The OS knew immediately at the hatch that the air was bad and understood that the environment in the shaft could be hazardous. He realised that breathing apparatus was required in order to go down. The OS immediately informed the master over VHF radio, who sounded the general alarm, activating the vessel's emergency organization.

Two of the crew were equipped with breathing apparatus. The first who went down into the cargo hold shaft was the OS, who was unable to find a pulse on his colleague. After a great deal of problems (including having to replace a rope because it was too weak) and after having got the unconscious AB up through the narrow shaft, cardiopulmonary resuscitation (CPR) began. During this period, the master made an emergency call to Sweden Rescue<sup>3</sup> over VHF. Sweden Rescue sent a helicopter, which arrived at the location just after 15:00 hrs. The helicopter was carrying healthcare personnel who were able to begin

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<sup>2</sup> Kinked means that the chain had become disordered and was not running freely.

<sup>3</sup> Sweden Rescue is the verbal call sign for the Joint Rescue Coordination Centre (JRCC).

treatment and relieve the crew, who were still performing CPR. The AB, who was still unconscious, was taken to hospital by helicopter approximately 20 minutes later. He was pronounced dead upon arrival at the hospital.

## 1.2 Ship particulars

### 1.2.1 General

NATALY (formerly BLUE DRAGON, registered in Antigua & Barbuda) was a just less than 90 metre-long general cargo vessel without specific deck facilities for loading or unloading to her single cargo hold. The engine room and deck structure were aft of the cargo hold, while forward of this, in the forebody, there were conventional spaces for, among other things, mooring equipment and storage. The anchor chains were also stored in the forebody in the chain lockers intended for this purpose. At the bottom of the forebody was the fore-peak and space for the bow thruster. NATALY was a single hull vessel with a double bottom, where there were bunker and ballast tanks.



Fig. 1. NATALY moored at Igelstaverket after the occurrence.

### 1.2.2 Shafts to the cargo hold

The cargo hold was reached using ladders in tube-like shafts, one on the forward end of the cargo hold (see Fig. 2) and one on the aft end. The shafts were reached through a hatch that must be kept closed at sea if it is not established to be risk free. At the bottom of the shafts there was an opening in the form of a door hole from the passageway out into the cargo hold. There was no door in the opening, and to prevent the cargo in the form of bulk products streaming into the shaft, there were timber boards that were mounted in tracks on the side of the door hole (see Fig. 3 and 4). The wooden boards thus acted as an unsealed separation between the shaft and the cargo hold. Consequently, from the perspective of ventilation, the shaft must be regarded as part of the cargo hold.





Fig. 2. The picture is aimed obliquely forward to starboard from the cargo hatch. The hatch for the forward shaft is open and can be seen on the right in the picture. Image: the shipowner.



Fig. 3. The picture, which is aimed forward from the aft side of the cargo hold, shows the cargo hold after a large part of the cargo has been unloaded. The exit (marked yellow) from the forward shaft out into the cargo hold is seen in the middle of the picture. The wooden boards that are intended to prevent the cargo from getting into the shaft are still mounted in the tracks in the door hole. The inside of the door hole is seen in Fig. 4.

The hatches for the shafts were square with the dimensions 75 x 75 cm. The ladders took up 19 cm, and the usable space between the ladder and the opposite bulkhead was thus 56 cm (see Fig. 5). There was also a fire extinguisher and some shelves in the shaft, which further reduced the available space. The depth of the shaft was 7.8 m. Being stored at the bottom of the passageways was some equipment, which was used when cleaning and sweeping the cargo hold, along with the wooden boards for the door hole (See Fig. 6). According to certain information from witnesses, there was also a light available if needed.



Fig. 4. The temporarily built wall in the door hole from the cargo hold shaft in to the cargo hold. The picture is taken at the bottom of the shaft and shows the inside of the door hole that is shown in Fig. 3. Image: Swedish Police Authority.



Fig. 5. The forward shaft viewed from above.

### 1.2.3 *The cargo*

The cargo consisted of 1,956 tonnes of woodchips from residual waste (which means it did not consist entirely of pure woodchips) and was classified as waste fuel. The cargo was supplied by Countrystyle Recycling, Ridham, England. The fuel was ordered by Söderenergi AB, which operates Igelstaverket in Södertälje, where the fuel was to be delivered.

NATALY departed Ridham on 21 March and the cargo had been in the closed hold since then. When cargo arrives at Igelstaverket, it goes directly into the plant's fuel system via open conveyor belts into enclosed silos. From the silos, the fuel is then transported directly using open conveyor belts into the boilers for incineration. Handling of the fuel is entirely automated and the plant's staff do not need to spend time in the enclosed spaces where the fuel is stored. When a fuel silo is to undergo internal inspection, staff have specific procedures and must, for example, wear personal oxygen monitoring equipment when they are in a silo.

When unloading each cargo, samples are taken of the cargo that are analysed by a third party. The analysis encompasses the energy content of the fuel, water, heavy metals and a range of other substances. According to the analysis of the cargo from NATALY, there was no abnormal presence of hazardous substances.

There was nothing to suggest that this cargo would have had a different origin to previous cargoes. According to Söderenergi AB, the supplier is well-known and has been supplying Igelstaverket regularly for several years.

#### **1.2.4 Crew**

The crew consisted of six people, three from Russia (master, chief mate and chief engineer), one from Ukraine (cook/deck rating) and two from Cape Verde (an AB and an OS). All those on board had many years' experience of working at sea.

The deceased AB was 32 years old and had been working at sea for many years. He had been working on NATALY for several months (See 1.6.1).

#### **1.3 Meteorological information**

According to the vessel's notes, the wind at the time of the occurrence was south-westerly 3–6 m/s, wave height 1.25 m, daylight, good visibility and scattered clouds.

#### **1.4 Emergency response**

An emergency response can be divided up into rescue services in accordance with the Swedish Civil Protection Act (2003:778) and other emergency responses. In the Civil Protection Act, rescue services means those emergency responses the central government or municipalities shall be responsible for in the event of accidents in order to prevent and limit harm to people and damage to property or the environment. "Other emergency responses" includes prehospital medical care and the actions of the police and others.

During the emergency response in question, central government maritime search and rescue and prehospital medical care from Region Stockholm were initiated. The Swedish Maritime Administration's search and rescue helicopter and the region's ambulance personnel participated in this response.

According to the master, the occurrence took place at approximately 13:50 hrs. (the time 13:45 hrs. also appears in the vessel's documents). The unconscious AB was discovered at the bottom of the cargo hold shaft and the alarm was activated immediately after this. Two of the crew were equipped with breathing apparatus to allow them to go down in order to bring the AB up. At the same time, the alarm was raised with Sweden Rescue, which has the first note in its report at 14:04 hrs.<sup>4</sup> when the rescue helicopter in Norrtälje was called out.

It took the crew approximately 20 minutes to get the unconscious AB up from the deep and narrow shaft. Cardiopulmonary resuscitation was then started immediately, which proceeded continuously until the helicopter arrived.

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<sup>4</sup> The times given in the JRCC report (the SAR log) indicate the time the note was entered in the log with an expected correction, not the actual time of the occurrence. However, the difference should not be great.

An ambulance arrived at the helicopter base (note in the SAR log 14:20 hrs.) before the helicopter took off with the ambulance staff on board. The helicopter arrived at the vessel at 15:10 hrs. (the vessel's log), at which point the healthcare personnel were able to take over responsibility for the CPR procedure. At approximately 15:30 hrs. (the vessel's log), the helicopter departed heading for a hospital, where the SAR log has noted its landing at 15:50 hrs.

The AB was pronounced dead upon arrival at the hospital.

## **1.5 Relevant international rules**

### **1.5.1 *Safety management system***

Shipowners that conduct international traffic using vessels with a gross tonnage of more than 500 must have a safety management system (SMS) for their on-board operations. The system is based on agreements reached by the International Maritime Organization<sup>5</sup>, which sets requirements and guidelines for maritime safety in the SOLAS Convention<sup>6</sup>. The ISM Code<sup>7</sup> deals specifically with the safety organization on board vessels and the vessel's relationship to the shore organization.

Familiarization training is an important part of work involving on-board safety. The purpose of this training is to give the crew the right prerequisites in order to function in their role on board in both the safety organization and their day-to-day duties. On a vessel like NATALY, the entire crew are part of the safety organization and therefore have to have undergone familiarization training. The crew members' various roles and duties have to be set out in a muster list.

Other important functions in the SMS are the identification of risks associated with work on board and taking action in order to mitigate these risks in day-to-day work. One further part is maintaining the knowledge and preparedness of the crew. This is done through actions such as drills and safety meetings on board. In addition, high-risk elements are to be implemented in accordance with set routines and procedures.

### **1.5.2 *Enclosed spaces***

In compartments where the air circulation is low, lack of oxygen may emerge. If the compartment also contains organic material that can biodegrade, the likelihood rises since the process consumes oxygen. Wooden material and waste, but also rusting, may cause biodegradation. A person, exposed for such environment, will quickly experience symptoms as the content of oxygen drops, and unconsciousness will occur after a few minutes when the oxygen level drops to 12 %. When

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<sup>5</sup> IMO: International Maritime Organization, the UN's maritime agency.

<sup>6</sup> SOLAS: Safety of Life at Sea. The convention contains safety rules for international maritime transport.

<sup>7</sup> The ISM (International Safety Management) Code is an overarching regulatory framework for safety management systems within maritime transport.

the oxygen level reaches around 7 %, unconsciousness and mortality appears already after less than a minute.

Resolution A.684(20) was adopted by the IMO general assembly in 1997, establishing recommendations for entry to enclosed spaces. This states, among other things, that a risk assessment shall always be conducted by a competent person, that permission to enter is required, that staff shall be trained for this task and have the right equipment, and that the atmosphere shall be tested. Wood products are specifically mentioned as a potential hazard. The recommendation contains an example checklist. The general assembly replaced this resolution with a new one, A.1050(27), in 2011. In this recommendation it is added and emphasised that the rules shall be connected to the safety management system and that doors or hatches to enclosed spaces shall be secured against entry if the spaces have not been established to be risk free.

Resolution MSC.350(92)<sup>8</sup>, which was adopted in 2013, amended SOLAS, Chapter III, Part B, Regulation 19, which entails a requirement for drills at least every other month for crew members in dealing with enclosed spaces. The amendments entered into force on 1 January 2015.

The wording of a new SOLAS regulation, XI-1/7, was agreed in the DSC<sup>9</sup> subcommittee in 2013, which requires testing equipment on board for, among other things, oxygen concentrations, and guidelines for choosing such equipment. This regulation entered into force on 1 January 2016.

A specific information poster, which the Swedish Transport Agency was involved in financing, has been distributed to vessels in order to inform as many crew members as possible about this problem and the danger of spending time in enclosed spaces<sup>10</sup>. In addition, specific regulations for entry to enclosed spaces has been issued for certain types of vessel, e.g. passenger vessels.

## **1.6 The shipowner's and the vessel's safety organization**

### **1.6.1 The vessel's SMS**

Those parts of the vessel's SMS and documentation that are now relevant and that concern work in enclosed spaces, training, drills and risk management consist of the following.

- HLB-ISM<sup>11</sup> procedure No. 5 Risk Assessment.
- HLB-ISM procedure No. 30 Enclosed Space Entry & Use of Gas Detection Devices.

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<sup>8</sup> MSC: the Maritime Safety Committee is a decision-making body within the IMO.

<sup>9</sup> DSC: Sub-Committee on Dangerous Goods, Solid Cargoes and Containers. Its 18th session was held on 16–20 September 2013.

<sup>10</sup> See <https://maif.org/wp-content/uploads/2017/08/MAIIF-Enclosed-Space-Entry-A3-Poster.pdf>

<sup>11</sup> HLB stands for H. Lohmann Bereederungen, which is responsible for technical management.

- Work permit for enclosed spaces, document MR 18 Enclosed Entry Permit.
- Safety meetings, document MR 26 Report of safety meetings.
- Drill report, document MR 21 Report of drill.
- Risk assessment/stocktaking, document MR 09 Formal risk assessment.
- Drill schedule, document MR xx<sup>12</sup> Emergency Situations Drills.
- Training manual “SOLAS Training Manual, Life Saving Appliances & Survival Techniques” published by L.C Brindle & Co Ltd.
- Training manual “Fire Safety Operations”.
- Training manual “SOLAS TRAINING MANUAL Supplement to the 3<sup>rd</sup> (2013) edition Enclosed Space Entry”.
- Small brochure “Welcome on board, HLS Crew familiarization”.
- Three different lists of completed familiarization trainings “List of Familiarization”.
- List of various reporting forms (MR xx) “Index of reporting form”.
- Muster list “Muster list m/v NATALY”.
- Various notices and warning signs concerning the danger of enclosed spaces.

The SMS document “Enclosed Space Entry & Use of Gas Detection Devices” No 30 describes the risks of work in enclosed spaces and what action has to be taken before such work can begin. The document states that a risk assessment document (“Formal risk assessment” MR 09) and a permit to enter an enclosed space (“Enclosed entry permit” MR 18) shall be filled in before work begins. There is one further SMS document “Risk Assessment” No. 5, which describes what a risk analysis is and identifies general risks and measures for minimising the risks of work on board a vessel. This document also states how a risk analysis and assessment shall be conducted.

There are some differences between SMS documents No. 30 and No. 5 and the underlying documents MR 09 and MR 18. For example, the name of the documents are different. MR 09 is not referred to in SMS document No. 30, which instead refers to the fact that a “risk assessment” shall be conducted. The checklist MR 18 is mentioned in SMS document No. 30 as “permit to work”, but is called “enclosed space entry permit” in MR 18. SMS document No. 5 does not refer to any other document at all.

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<sup>12</sup> The number is illegible in the copies SHK received. This is not deemed to be of significance to the investigation.

### *Training, preparedness and drills*

On board NATALY there were three different lists of completed familiarization trainings. The AB is registered on two different dates, two on 15 September 2020 in Hamburg and one on 9 December 2020. On the latter occasion there is no note about where the training was conducted. All three familiarization trainings are signed with the AB's name.

A safety meeting was conducted on board on 27 December 2020, at which the SMS and risk analysis (MR 09) have been gone through with the crew. The AB has participated in this meeting.

The number of drills that shall be conducted in accordance with the drill schedule on board is 27. These include a drill in "enclosed spaces". The drill shall be conducted every other month and the most recently conducted drill has been registered on 21 March 2021. Before this, one was conducted on 18 January 2021. Accordingly, drills have been registered in accordance with the planned drill interval. The AB is registered in both drills.

The crew member who was tasked with putting on the breathing apparatus and fireproof equipment in the event of a fire was the crew member who is the victim. The OS and the cook were to assist him and the chief mate was to lead the group. It is likely that the AB would have had the same task in the event a person had to be rescued from an enclosed space as in the event of a fire.

### *Preparations ahead of work in the chain locker*

A "Formal risk assessment" in accordance with the form MR 09 was conducted ahead of the work in question, which was to be carried out in the chain locker. The form is a vessel-specific document in which the risk of a specific piece of work has to be identified, assessed and action taken in order to minimise the risk. This form was signed by the master and the chief mate.

In the preparations ahead of the work in the chain locker in document MR 09, the crew has recorded the approved oxygen concentration of the air as 20 % (in SMS document No. 30, the approved level is specified as 21 %). Other actions identified by the crew as necessary to conduct to make the work safe were to ventilate the space, arrange extra lighting, have access to VHF communications, have breathing apparatus ready to use, a safety line and having a person standing ready outside the space.

At 12:50 hrs. the master signed the permit to enter the chain locker and at 13:00 hrs. the chief mate signed the same document. The chief mate was the person who was responsible for execution of the work. The crew has also filled in an "Enclosed space entry permit" MR 18, which is a checklist that is filled in by the person responsible for the work. MR 18 states that the oxygen level was 20.9 % and that there were no



hydrocarbons in the space. It also states that there was a lack of satisfactory lighting.

#### *External SMS audit*

As a consequence of the occurrence, the Swedish Transport Agency conducted a Port State Control of the vessel. The Port State Control detected deficiencies that required independent audit before the vessel was allowed to depart. As a result, DNV<sup>13</sup>, at the request of the shipowner, Hermann Lohmann Schiffahrtsverwaltung GmbH, conducted a full audit of the vessel's safety organisation, which resulted in four non-conformities and one observation. At this time, the vessel was subject to an interim certificate as a result of a recent change in flag (from Antigua & Barbuda to Cyprus). According to DNV, the deficiencies nor the observation have arisen as a result of the accident.

The non-conformities consisted of: a) one of the two gas meters was not calibrated, b) there was low pressure in some of the air tanks in one of the fire stations, 3) a hatch to an emergency exit from the engine room was rusted shut, d) there were differences in the documentation of the procedure for work in enclosed spaced (see 1.6.1 above).

The observation was that the most recent master's review was only performed by ticking boxes on a form, i.e. it did not contain any running text. Accordingly, the auditor argues that the shipowner had limited opportunities to assess the actual status on board.

#### **1.6.2 External audit of the shipowner**

At the time of the occurrence, the shipowner had 37 different vessels in Europe and the Mediterranean, flagged in Antigua & Barbuda, Cyprus, Portugal (Madeira) and Liberia. The shipowner's DOC (Document of Compliance) was issued by DNV.

The audit of the shipowner that preceded the occurrence was conducted by DNV GL's station in Bremerhaven on 1 September 2020. The protocol states, among other things, that the shipowner has a method for ensuring that crews have undergone adequate familiarization training, that necessary education and training are being identified and provided, and that a register of internal audits, master's reviews, management of non-conformities, implementation of corrective and preventive measures, and reports from Port State Controls have been reviewed. The audit noted no non-conformities or observations.

An audit was conducted after the occurrence on 14 July 2021, also by DNV's station in Bremerhaven. The aforementioned points that were noted in the audit of 1 September 2020 were repeated with the same wording. In addition, the latter protocol also mentions that personal accidents on board were discussed during the audit but without any

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<sup>13</sup> DNV and GL merged in 2013 under the name DNV GL. The name was changed to simply DNV in 2021.

details being noted (“Personal accidents on board the vessels having being [*sic*] discussed during the audit”). This audit also resulted in no non-conformities or observations.

The audit of 1 September 2020 concerned a yearly control of the safety system. The one that was performed 14 July 2021 concerned a renewal of the DOC, and DNV issued thereafter a new DOC, valid for five years for all four flag states.

Both of the aforementioned audits were conducted on one single day by the same, sole auditor.

## 1.7 Interviews

SHK has conducted interviews with all of the crew. SHK has also studied transcripts of interviews with the crew conducted by the Swedish Police Authority.

The interviews indicate that the working language was English and that there may generally have been some language confusion. However, it has been assessed that the victim spoke good English. According to the interviews, it does not appear that there have been any problems or conflicts among the crew.

According to details from the interviews, several problems have arisen during the occurrence, including the crew having been forced to switch the person who has been sent down the shaft in order to help the AB in distress because the person being sent down has felt unwell themselves due to the mask not fitting particularly well. The second person who was sent down also felt unwell while performing the task. A total of three descents took place. In conjunction with the occurrence, the crew have measured the oxygen concentration in the shaft using the oxygen meter that was in place because of the ongoing work in the chain locker. The oxygen concentration in the shaft to the cargo hold has been as low as 7 % (even the figure 1 % appears in the testimony of one witness). There was also a strong smell in the space.

The interviews also indicate that all of the crew have been aware of the risks associated with the cargo and that this has been announced in conjunction with loading. This is also confirmed by the vessel’s logbook, where a note from 09:00 hrs. on 21 March 2021 states that the crew were informed of the risks of the cargo in an “enclosed space drill”.

It emerges from the interviews that it was not permitted to be in the cargo holds or the shafts that lead down to them. The hatches have been marked with signs about this and have been locked when the vessel was in port and the shafts not being used. However, the lock has been removed while at sea because the assessment was made to prioritise immediate access in the event of an emergency.

## 1.8 Cause of death

The post mortem conducted on the deceased AB shows some minor external injuries, which have not been of significance to the outcome of the occurrence. The external injuries are deemed to have potentially been caused during a fall or when the body was brought up through the ladder shaft.

It was not possible to establish any cause of death on the basis of the examination of the body. However, the tests performed demonstrate the absence of pathological changes and chemical substances that could in any way be of significance to the sequence of events.

In summary, the conclusion is that the result of the post mortem suggests that the deceased was subjected to severe hypoxia and that the cause of death is suffocation.



Fig. 6. The bottom of the cargo hold shaft, seen from above. It was here that the victim was found. Image: Swedish Police Authority

## 1.9 Similar occurrences

Similar occurrences have happened repeatedly in Sweden. In 2005, the then *Sjöfartsinspektionen* (The Swedish Maritime Directorate) investigated EKEN (SjöI 080201-05-16631) a death that occurred in a ladder shaft down to a cargo hold. Two occurrences were investigated in 2006: SAGA SPRAY (SjöI 080202-06-17470) which involved a death and a serious personal injury in a shaft down to a cargo hold, and STOC REGINA (SjöI 080201-06-17819), where personal injury occurred due to gas from a liquid bulk cargo. In 2018, SHK investigated DECLAN DUFF (SHK report 2019:01, file no. S-42/18). Also this occurrence involved a death in a shaft down to a cargo hold. In addition, other occurrences have also taken place, which have however not been investigated.

Internationally, this type of occurrence has been noted because they happen frequently and result in deaths each year. Efforts to deal with this problem are continually taking place within the IMO.

## 2. ACTIONS TAKEN

The shipping company has stated that after the accident, a bulletin has been issued within the company, where the accident is briefly referred to and actions presented. Further, the company has requested proposals from the crews of safety increasing actions in order to make them involved in the safety process, to prevent correction measures viewed as dictates.

Further, HLB-ISM procedure No 30 Enclosed Space Entry & Use of Gas Detection Devices has been updated together with the document for work permit in enclosed spaces (document MR 18), which now is called Enclosed Space Entry Permit. Also, a new procedure has been developed, HLB - ISM procedure No 46 Dangerous Cargo – DO NOT ENTER, where the master is requested to mark shafts to cargo holds with warning signs.

### **3. ANALYSIS**

#### **3.1 Fundamental aspects**

With regard to the emergency response, SHK is able to note that this was conducted in a way that might be expected and that there is no reason for further analysis of the sequence of events. It has also not been possible to define any obvious need to alter or influence the international regulations as a result of the occurrence.

Instead, the investigation has concentrated on the occurrence itself, the vessel's safety management system and issues pertaining to this.

#### **3.2 Sequence of events**

The results of the post mortem suggest that the cause of the AB's death was suffocation as a result of spending time in the shaft. However, it has not been possible to determine why the AB chose to go down into the cargo hold shaft. Given the familiarization training, SMS training courses and participation in exercises, and in his capacity as a designated firefighter who uses breathing apparatus, he should have had the necessary knowledge of the risks associated with entering enclosed spaces. Although there was a light stored in the shaft, this would not have constituted a fact that forced him to go down there as there were lights available in other places on board the vessel.

The cargo hold shaft is a small, narrow space and the chances of getting a person up from this space quickly were very limited. Without an extra breathing apparatus for the unconscious or special equipment for winching someone up, there was little chance of getting anyone up unharmed, even if someone else had been there and able to react immediately. The fact that the equipment used was not working and that those who acted had to change tasks during the sequence of events has impeded the situation further and prolonged the time taken.

#### **3.3 The vessel's and shipowner's safety organization**

The vessel had procedures for work in enclosed spaces and there is also documentation to prove that these procedures were applied. Exercises have been conducted in which equipment and personnel were trained in managing the risks associated with spaces where there is a suspected lack of oxygen. Something that further indicates there has been a safety culture on board is the fact that three people were involved in the work to enter the chain locker and that the chief mate participated in this work. This indicates that the safety management system was functioning adequately.

What indicates this was not the case is the fact that the hatch to the shaft was not locked or cordoned off, despite a requirement to do so. The potential need to access the space for safety reasons is a dubious reason for the hatch to be unlocked because it is still not possible to go down there without having to take extensive safety precautions. In addition,

it would be possible without major difficulty to arrange a way for the hatch to be opened reasonably quickly if the need were to arise.

Furthermore, the difficulties involved in getting down the shaft suggest that proper full-scale exercises that included evacuation from this space had not been conducted to a sufficient extent.

One circumstance that also suggests the safety culture was not developed well enough is that the SMS documents do not correspond to one another. There is a risk that this creates confusion for those who have to use these documents and train others or be trained in the system.

The weaknesses in the safety management system are amplified by the results of the Port State Control and the demand for an independent audit, along with the result of the audit a few days after the occurrence. In addition to deficiencies related to the occurrence, this audit identified that it was not possible to open one emergency exit.

The shipowner's safety organization influences the safety organization of each vessel at an overarching level. Purely physical deficiencies on a vessel, such as an emergency exit hatch that is rusted shut, are not an unambiguous indication of weaknesses in the shipowner's organization. Nevertheless, it is the assessment of SHK that it is not possible to ignore the fact that there is a link between deficiencies in a vessel's document management, for example documents that do not correspond and far too simple communication regarding the master's review, and the shipowner's safety organization.

The overall conclusion is that the vessel's safety management system was not effectively implemented and that some details also suggest that there have been deficiencies in the shipowner's safety organization. The circumstance that the SMS is approved does not guarantee that it is effectively implemented. It is not possible to exclude this having had some impact on the likelihood of the occurrence taking place, which is demonstrated primarily by the unlocked hatch to the shaft.

## **4. CONCLUSIONS**

### **4.1 Findings**

- a) Prior to work in the enclosed space consisting of one of the chain lockers, a permit to work had been issued.
- b) This work was to be carried out by three people.
- c) One of these, the AB, went to get a light.
- d) For some unknown reason, the AB, without taking safety precautions, went down into one of the cargo hold shafts, where he was suffocated by lack of oxygen.
- e) The evacuation of the AB was difficult and took time.

- f) Despite continual life-support measures from the time at which the AB was brought up out of the shaft, he was pronounced dead upon arrival at hospital.
- g) The crew were trained in and aware of the risks associated with enclosed spaces.
- h) The cargo hold shaft constituted a defined enclosed space.
- i) The hatch to the cargo hold shaft was not cordoned off.
- j) The vessel's safety management system has not been effectively implemented.
- k) The shipowner's safety management system has had some deficiencies.
- l) It cannot be ruled out that the incomplete implementation had an impact on the sequence of events.

#### 4.2 Causes and contributing factors

The direct cause of the accident was that the AB went down into an enclosed space where there was a lack of oxygen. The hatch to the shaft was not cordoned off, which means that a safety barrier was broken. It has however not been possible to establish why the deceased AB went down into the cargo hold shaft.

The incomplete implementation of the shipowner's and the vessel's safety management systems is an underlying factor.

## 5. SAFETY RECOMMENDATIONS

**Hermann Lohmann Schiffahrtsverwaltung GmbH is recommended to:**

Due to the occasion, continue to develop its safety management system in such a way that a continuous improvement of the safety culture may be obtained (see section 3.3). *(RS 2022:02e R1)*

The Swedish Accident Investigation Authority respectfully requests to receive, by **3 June 2022 at the latest**, information regarding measures taken in response to the recommendations included in this report.

On behalf of the Swedish Accident Investigation Authority,

Jenny Ferm

Jörgen Zachau