

Final report RS 2019:01e

DECLAN DUFF – Accident in conjunction with discharging of cargo in Oxelösund, Södermanland County on 16 March 2018

File no. S-42/18

12 February 2018

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 web site: 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 19 March 2018 that a very serious casualty involving the vessel DECLAN DUFF with the call sign HPZH had occurred in Oxelösund in on 16 March 2018.

The accident has been investigated by SHK represented by Mr Mikael Karanikas Chairperson, Mr Dennis Dahlberg, Investigator in Charge, Mr Rikard Sahl, Operations Investigator up until 5 September 2018, and Mr Tomas Ojala, Investigator specializing in Fire and Rescue Services.

The investigation was followed by Ms Linda Eliasson of the Swedish Transport Agency.

Investigation material

Interviews have been conducted with crew members of the DECLAN DUFF and employees of Oxelösund Hamn AB. Information has been obtained from the Swedish Police Authority, the rescue services and ambulance paramedics.

A fact finding presentation meeting with the interested parties was held on 02 October 2018. At the meeting SHK presented the facts discovered during the investigation, available at that time.

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Ship particulars

Flag/register	
Identification	Panama
IMO identification/call sign	9476525/HPZH
Vessel data	
Type of ship	Bulk carrier
New building shipyard/year	New Yangzi Shipbuilding/2012
Gross tonnage	51,265
Length, over all	229.20 metres
Beam	38.0 metres
Draft, max	14.90 metres
Deadweight at max draft	93,252 tonnes
Main engine, output	13,560 kW
Propulsion arrangement	Fixed-blade propeller
Rudder arrangement	Conventional
Service speed	12.4 knots
Ownership and operation	Wallem Ship Management
Classification society	American Bureau of Shipping
Minimum safe manning	

Voyage particulars

Ports of call	Oxelösund
Type of voyage	International
Cargo information/passengers	Coal
Manning	20 people

Marine casualty or incident information

Type of marine casualty or incident	Death in conjunction with discharging of cargo
Date and time	16 March 2018, at around 22.00 local time.
Position and location of the marine casualty or incident	Lat. N58° 39,6N long. E017° 06,9E Oxelösund port
Other factors	
Consequences	
Personal injuries	One dock worker deceased
Environment	None
Vessels	None



Figure 1. DECLAN DUFF docked at Oxelösund. Photo: Swedish Police Authority.

SUMMARY

In conjunction with discharging of coal from the bulk carrier DECLAN DUFF, a casual labourer died from oxygen deficiency when he entered an unventilated spiral ladder leading down to one of the cargo holds. Information that the spiral ladders were enclosed, and that this entailed a risk, had been sent by the vessel to the port in preparation of the discharging. The information that the spiral ladder was enclosed and that the vertical ladder had to be used had not been passed on to all the dockworkers involved. It has not been possible to establish when and by whom the entry hatch to the spiral ladder was opened.

The investigation also shows that the dockworker's introductory training had not included the element Large bulk – discharging coal and coke, and he had not previously discharging coal. He also lacked certain training and full machine operator qualifications. The hatch foreman of the shift in question did not have cargo manager training, and the resource planning manager did not have full information regarding the training and experience of the deceased dockworker. There have also been several indications of procedural drifts at the port.

The reason why the dockworker went down a hatch to the cargo hold where there was a lack of oxygen was likely a combination of being unaware of the risks, due to lack of training and experience in discharging coal, and not being given the information regarding the spiral ladder being enclosed and the risks that this entailed. The fact that the entry hatches to cargo hold 7 are in reverse order has likely contributed to the choice of the hatch in question.

Underlying factors included a lack of sufficiently structured methods for provision of safety-critical information and robust systems for discovering and rectifying procedural drifts.

Safety recommendations

Given the extensive action programme that the Port of Oxelösund is planning to implement, and which SHK deems to be adequate in order to eliminate the identified faults, SHK is not issuing any specific safety recommendations to the Port of Oxelösund. However, SHK assumes that the findings of this report will be taken into consideration in the work with the action programme.

The Work Environment Authority is recommended to:

- review and, if necessary, develop its inspection procedures for dock work in terms of how the ports work to prevent and discover risky procedural drifts. Refer to section 2.7. (RS 2019:01 R1)

1. FACTUAL INFORMATION

1.1 Account of the sequence of events

The bulk carrier DECLAN DUFF, loaded with coal, arrived to the Port of Oxelösund on the morning of 14 March 2018. Once the vessel was moored, a production coordinator¹ from the port came on board to go over the discharging plan and safety checklist with the ship's chief officer. During this briefing, the ship's master entered and underlined that the vessel had enclosed spiral ladders (Australian ladder) that end at the bottom of the cargo holds, and that there was a risk of oxygen deficiency in these spaces. The entry hatches to be used, i.e. the vertical ladders, would be opened by the crew of the vessel at the request of the port personnel.

The discharging of the DECLAN DUFF, which was scheduled to be carried out around the clock in three shifts, began immediately after the production coordinator had finished the briefing. The planning manager had requested personnel for the assignment from the resource planning manager. Since the port's regular staff was not large enough to man the night shift, the resource planning manager also hired a number of casual labourers. The resource planning manager is to ensure that there is sufficient competence to complete an assignment, which involves at least two crane operators. The teams then decide amongst themselves who will do what. The resource planning manager had not compiled a complete list of what training the personnel had completed.

When the second shift started at 14:00 the following day, it was brought up during the shift change that the vessel had enclosed spiral ladders, and that only the vertical ladder was to be used.

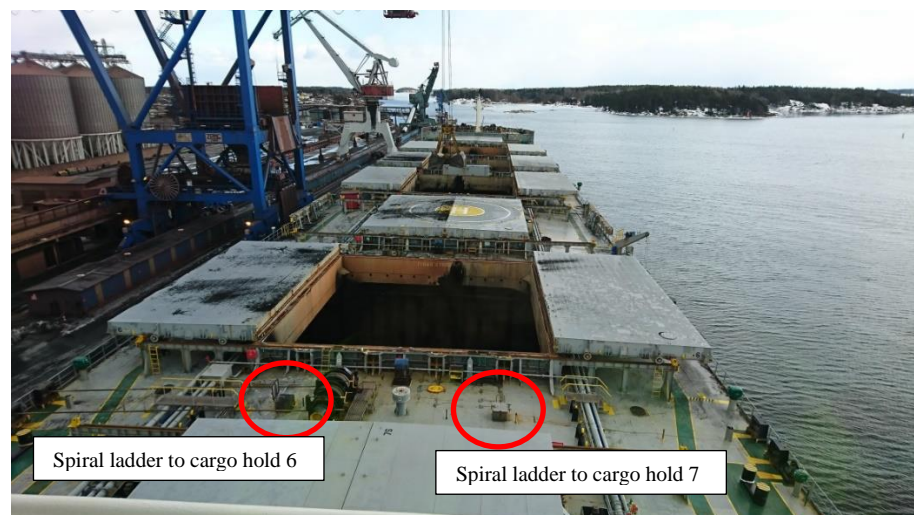


Figure 2. DECLAN DUFF. Photograph taken by the Swedish Transport Agency inspector the day before the accident.

¹ The port's organisation and roles are described in more detail in section 1.5.1.

The discharging proceeded according to plan. On 16 March 2018 at 17:30, the loading hatch for cargo hold 7 was opened by the vessel crew at the request of the port. When the discharging of cargo hold 7 was to begin, at 17:55, the crane operator noted that the entry hatches to the cargo hold were closed, communicating this to the cargo manager. The entry hatches to the vertical ladders to cargo hold 7 were then opened by the port personnel. A loader was then lowered into the cargo hold and an operator went down using the vertical ladder. It was noted at this point that the entry hatch to the spiral ladder was closed. The discharging then continued until 21:45, when the dockworkers disembarked for the shift change.

The night shift team had a meeting before the work began to decide who would do what in conjunction with the discharging. There is normally a team leader to do this, but since the team leaders do not work nights, the work duties were divided by the group according to the normal procedure for the night shift. On this night shift, there was a deputy team leader, but they were not acting as team leader during the shift in question. Given the competencies available in the team, it was self-evident who would operate the crane and the conveyor system respectively, and who would monitor the conveyor system. The remaining five dockworkers, one of whom were chosen to act as hatch foreman,(signalman) would be working on board the vessel.

Before the night shift started working, there was a briefing between the shift leaders of the afternoon and night shifts. The briefing has been described as normal and only concerned how much had been unloaded and that the loader was in place in the cargo hold. One of the dockworkers on the outgoing shift said that they were working in cargo hold 7, and that they were using the aft entry hatch to enter the cargo hold. However, no information that the spiral ladders were not to be used to enter the cargo hold was provided at this time.

The hatch foreman and the dockworker that would be operating the loader in the cargo hold (worker A) boarded the DECLAN DUFF at around 22:00 to prepare and start the work before the remaining team members arrived. They went to the fore edge of cargo hold 7, and the hatch foreman told worker A how he was to operate the loader inside the cargo hold (see figure 3).

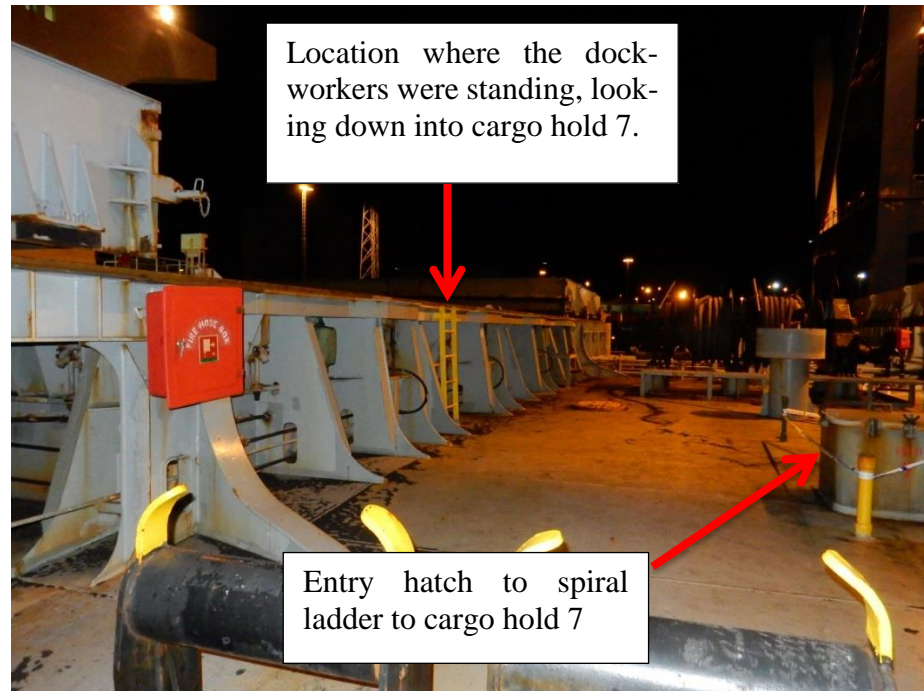


Figure 3. The deck of the DECLAN DUFF between cargo holds 6 and 7.

The hatch foreman did not note which entry hatches were open, and at the time did not consider which entry hatch was to be used for cargo hold 7. During discharging on other coal carriers, he knew that they had used the spiral ladders, as these were easier and safer to use when going down into the cargo hold. However, in those cases, the spiral ladders had not been enclosed, but hanging “open” in the cargo hold.

After their conversation, worker A left to enter the cargo hold. The hatch foreman did not think about which entry hatch worker A would use.

The hatch foreman looked down into the cargo hold to see when worker A would enter the space. When he did not appear, the shift leader called him on the radio, but there was no response. The hatch foreman then headed to the entry hatch to the spiral ladder and went down. On the platform before the spiral ladder begins (see figure 4), he found worker A, who appeared to be lifeless.



Figure 4. Entry hatch to cargo hold 7.

The hatch foreman does not believe that the dockworker had opened the entry hatch himself, as he should have noticed this. In addition, the time between the dockworker leaving and the hatch foreman starting to look for him was short, and would not have been sufficient to unscrew the four lock nuts (see figure 5).



Figure 5. Entry hatch to spiral ladder.

The hatch foreman tried to get a response from worker A by shouting and slapping him, while he was calling for help on the radio. Suddenly, the hatch foreman felt that his legs started to tremble and he felt dizzy. He started to climb out of the hatch, but on his way up, he fainted on the upper platform. Another colleague (worker B), who had arrived on the site, helped the hatch foreman out of the hatch and up on the deck.

Worker B then went into the hatch, but fainted and in doing so hit his head. Another colleague (worker C) arrived with an emergency escape breathing device (EEBD²), which he had collected from the onshore office, as they had brought none on board. The hatch foreman and worker C were unsure how the breathing device worked, but worker C put the mask on and went down into the hatch.

After a short while, worker C started feeling dizzy. However, he managed to wake worker B so that he could get out. Worker C then also exited the hatch.

At this point, the rest of the shift and some of the ship's crew arrived at the site. The crew immediately started bringing rescue equipment to the fore edge of loading hatch seven. A dockworker informed the third officer of the accident at around 22:20, who in turn informed the master.

There were several attempts to enter the hatch to retrieve worker A, but none were successful. It was only when the ship's crew brought an oxygen mask that one of the dockworkers, equipped with the oxygen mask, managed to climb down and tie a rope around worker A, thereafter pulling him out of the hatch.

Cardiopulmonary resuscitation was started immediately and continued until the ambulance crew arrived.

1.2 Emergency response

At 22:19, someone at the Port of Oxelösund called SOS Alarm, saying that "a guy is passed out on a coal carrier". After a few questions from the operator, he was connected to the emergency response unit in Eskilstuna.

When the caller was connected to the emergency response unit, he was again questioned by the operator and again gave an account of what had happened. According to the emergency response unit log, the ambulance was dispatched at 22:23.

² EEBD – Emergency Escape Breathing Device.

Before the ambulance arrived, SOS Alarm was contacted again by the same person who had called before. The call was not forwarded to the SOS operator who received the first call, and the caller was again asked about what had happened. As there was no oxygen where the unconscious person was lying, and the caller assumed that the ambulance did not have the equipment to enter a space without air, the caller suggested that there may be a need to send rescue services.

However, the caller interrupted the call after approximately two minutes, as he needed to go meet the ambulance, which had just arrived. At that point, no measure had been taken by the SOS operator. A brief discussion ensued at the SOS Alarm command centre regarding how they would handle the caller's request. The decision was to await a possible request from the ambulance crew for help from rescue services.

At 22:32, the ambulance arrived at the guardhouse by the entrance to the port, where they were met by a person who showed them the way to the vessel. When the ambulance arrived at the vessel, there were people standing on the deck shouting that cardiopulmonary resuscitation (CPR) had been started. The paramedics requested another ambulance to the site and brought out medical equipment and a board (simpler and lighter stretcher). They went up a gangway to the deck and continued to the injured person.

The paramedics continued the CPR that had been initiated by the personnel on board. They also administered fluids by drilling a catheter into one of the injured person's legs by the knee. The procedure was disconcerting to some of the people on board, but it is commonly used when it is difficult to find a good vein to insert the needle in.

The path to the injured person, which included ladders, had been very difficult, and the paramedics therefore made the assessment that they would need help to carry the injured person off the vessel. They called the emergency response unit, which in turn called SOS Alarm at 22:37 to request rescue services for an IVPA response [t/n: IVPA relates to response by fire and rescue services pending the arrival of an ambulance]. The local rescue services in both Oxelösund and Nyköping were alerted at 22:39. Shortly thereafter, it was decided that only the Oxelösund crew needed to be dispatched and that they would bring a rescue vehicle with a skylift.

Rescue services arrived at the vessel at 22:46. Using the skylift, the injured person was lifted off the vessel and one of the paramedics went along on the platform to continue treatment. The injured person was moved to the ambulance and brought to Nyköping hospital, arriving at 23:17. During the night, the injured person was transferred to Karolinska University Hospital in Solna for continued treatment. However, they were unable to save his life, and he was declared dead the day following the accident.

1.3 Injuries

The dockworker died from brain injuries due to oxygen deficiency.

1.4 Ship particulars

1.4.1 General

The DECLAN DUFF is a bulk carrier with seven cargo holds and a total cargo capacity of 110,330.1 cubic metres (CBM), see figure 6. The vessel has not previously had any near-accidents or accidents similar to this one.

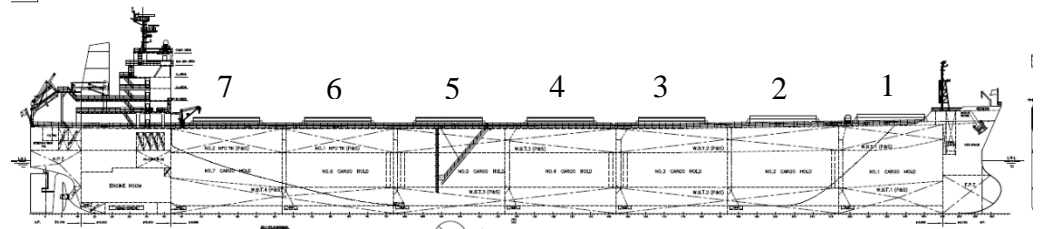


Figure 6. DECLAN DUFF's cargo hold.

1.4.2 Cargo hold entry hatches

For each cargo hold, there are two entry hatches: one vertical ladder and one enclosed spiral ladder (see figures 7–11). All the ladders are placed in the same way in relation to the cargo hold, except in cargo hold 7 where the accident occurred, where the position is the reverse compared to cargo holds one through six. The enclosed spiral ladders had no ventilation.

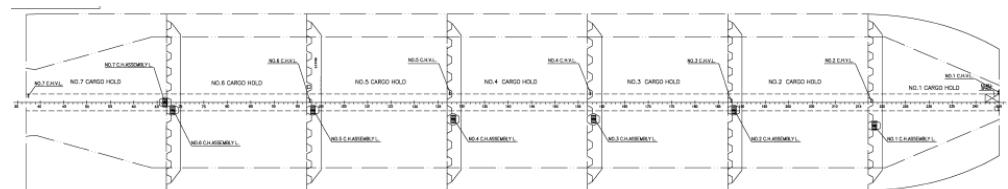


Figure 7. DECLAN DUFF's cargo hold entry hatches.

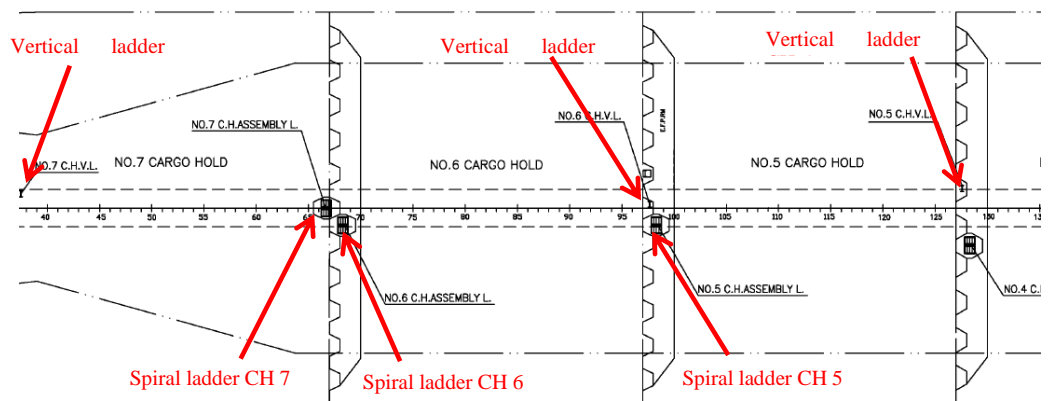


Figure 8. DECLAN DUFF's cargo hold entry hatches.

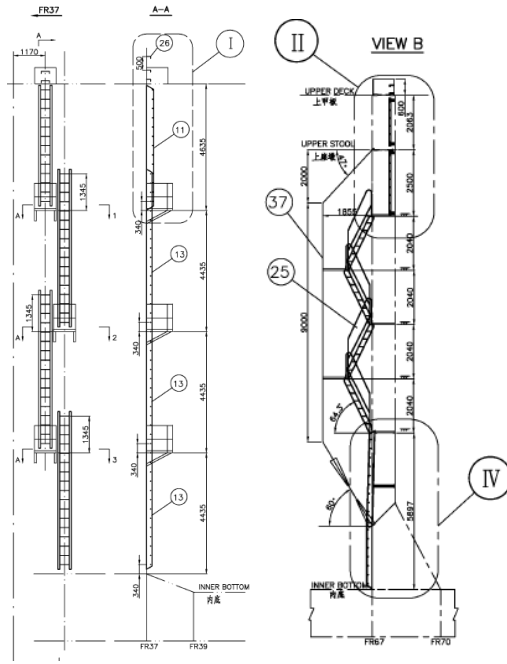


Figure 9. Vertical ladder

Spiral ladder

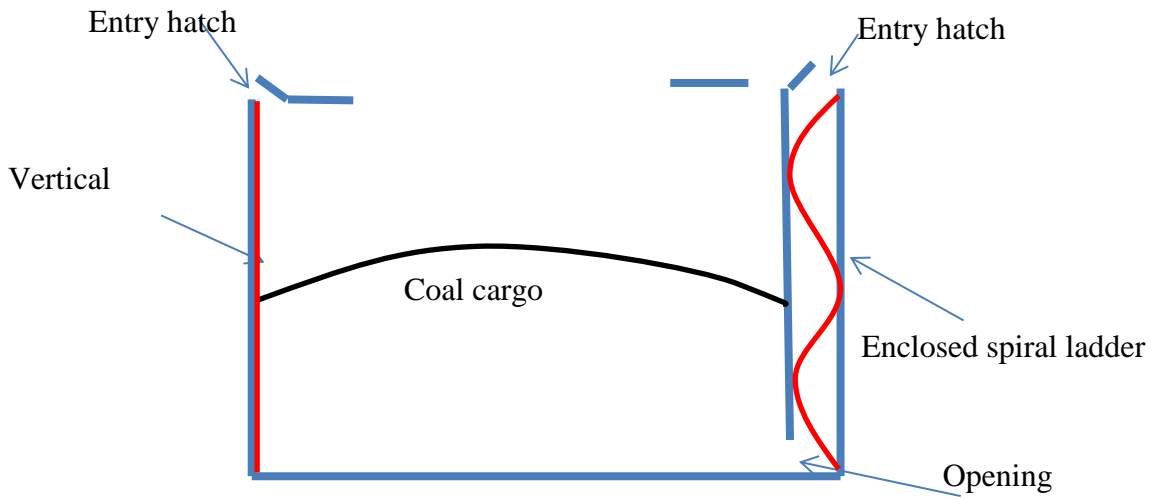


Figure 10. Schematic of the cargo hold and the two ladders.



Figure 11. DECLAN DUFF, cargo hold 7. The vertical ladder is circled in red. Image: Swedish Police.

1.4.3 *The crew*

The crew of the DECLAN DUFF comprised 20 persons.

At the time of the accident, the master had been working for the shipping company for 33 years, and as master since 1995. He had served a total of seven months on board as master of the DECLAN DUFF.

At the time of the accident, the chief officer had been working for 6 years as chief officer. He had been working for the shipping company for 17 years and had served a total of 5 months on board the DECLAN DUFF.

At the time of the accident, the third officer had been at sea since 2011, serving as a deck officer since 2013. He had been working for the shipping company since 2015 and had served a total of 4 months on board the DECLAN DUFF.

1.4.4 *Procedures*

The vessel's discharging procedures include representatives of the vessel and the port going through a checklist together regarding the safety at the interface between vessel and port (see section 1.6.2). The checklist includes the risk of oxygen-deficient atmospheres. In connection with this, the crew and dockworkers go over the discharging plan, at which time the parties decide in what order to unload the vessel.

The crew is meant to show the dockworkers which entry hatches to use. The crew is to open the entry hatches to the cargo holds approximately two hours before they are to be used and when the stevedoring team is finished in the cargo hold, the crew is to close the entry hatches. The ship crew does not participate in the discharging, other than in opening the loading and entry hatches for the dockworkers to use.

1.5 Port of Oxelösund

The Port of Oxelösund comprises several terminals and quays that handle oil, steel and bulk cargo, among other things. DECLAN DUFF was moored at the large bulk terminal, where the total length of the quay is 388 metres, and the depth is 16.5 metres.

1.5.1 Roles and responsibilities at the port

Manager

Each operation at the port is supervised by a manager. The manager is the employer representative and has overall responsibility for the entire operation. This includes responsibility for work environment, environment, quality and safety, management, working method, roles and delegation of responsibilities.

Operations manager

The operations manager has the operative responsibility for a certain process. The manager and the operations manager can be the same person. The role of the operations manager includes leading the work in the process and ensuring that results are achieved according to the set objectives. The operations manager shall also ensure that management, planning, administration, follow-up and deviation handling is working on a day-to-day basis. The operations manager must have a profound knowledge of their process and the people involved in it.

Production planning manager and production coordinator

A production planning manager is responsible for the preparation and planning of vessels and internal transports, whereas the production coordinator is responsible for day-to-day planning and prioritisation of staff and similar matters.

Team leader and deputy team leader

The team leader is appointed by the company in consultation with the group for a period of no more than two consecutive years in the working groups where this is needed. The team leader is a member of the working group, but has an extended responsibility and partially different tasks. The role of team leader includes coordinating and leading the group's different daily activities, and to have a general overview of the operation in order to make necessary prioritizations.

Working groups that have a team leader must also have a deputy team leader. The deputy team leader assists the team leader in their assignment and fills in for them when needed. Deputy team leaders are appointed in the same manner as regular team leaders.

Resource planning manager

The task of this function is to plan staffing and coordinate the operations in all production areas in consultation with the managers responsible for each area. The resource planning manager is responsible for planning internal training for auxiliary personnel.

Hatch foreman

Depending on the needs of the operations, some employees may need to act as hatch foremen. The hatch foreman is appointed by the working group and the group is responsible for ensuring that the appointed person has the necessary expertise. The role of the hatch foreman includes planning and leading the implementation of a certain assignment in accordance with an established plan and to submit a report when the assignment has been completed.

When discharging large bulk or coal, the hatch foreman shall also communicate with deck officers, check access routes, lift equipment containers on board, organise lighting and monitor the working area.

1.5.2 Port procedure for discharging of coal

According to the port's instructions,³ certain preparations need to be made before a vessel arrives at the quay. It must be clarified who will do what, i.e. who will be hatch foreman, who will operate the loader, etc. The instructions also state that:

The basic staff to unload a coal carrier consists of ten people.

- One operator for the appropriate conveyor system.
- One person to monitor the conveyor system.
- Two crane operators.
- One hatch foreman on board the vessel.
- One replacement for the hatch foreman on board the vessel.
- Four workers divided into two clean-up crews on board the vessel.

When the vessel has docked at the quay and the gangway is in place, the port's production coordinator shall go on board to meet with an officer to review the discharging plan and the vessel and terminal regulations. Once the discharging plan is signed, the production coordinator meets with the hatch foreman at the hatch that will be used in order to go over the plan.

Before the loader is placed in the cargo hold, the manholes must be properly aired out.

³ Discharging coal from PANAMAX class vessels, version 3, last revised on 9 December 2015.

The procedure especially states that cargo hold 7, furthest astern, will often be designed differently to the other holds of the vessel, and that the spiral ladder is often located at the fore end of the hold. It is also stated that “we thus begin [*the cleaning*]⁴ from there”.

The port also has a written instruction regarding the measuring of oxygen and CO before working on board all vessels at the port. According to the instruction, the oxygen and CO levels must always be measured before you enter a cargo hold, ladder well or other previously sealed area. The measurement is to be carried out in direct conjunction with access and again if the hatch has been closed.

However, according to interviews with dockworkers, this procedure was rarely completed. They would normally wait at least 15 minutes before entering a space after the hatches had been opened, in order to air it out.

1.5.3 Port procedures when hiring auxiliary personnel

When additional resources are needed, the port hires casual labourers. The casual labourer is placed into a shift in the organisation, where there are a predetermined number of casual labourers.

Competence to carry out the task is always a basic requirement, and it is part of the preliminary work before hiring additional resources to investigate whether this competence can be found elsewhere within the company.

There is a list of competencies in the form of an Excel sheet that the Resource Planning Unit is responsible for updating.

1.5.4 Introduction and training of dockworkers

All new employees complete a three-week introductory training programme, where the first two days are the same for all departments. This part is focused on safety and general knowledge, including salary and work hours. The rest of the first week focuses on department-specific safety and knowledge issues.

For the next two weeks, the new employee works alongside an instructor to learn the different stations at the port. If there is no opportunity to complete all steps of the training during the introductory training, the remaining steps are completed with an instructor at a later date.

There is an instruction checklist containing more than 50 steps to go through, including port organisation, salary, reporting sick, alcohol and drug policy, escape routes, work environment and different work areas. The new employee keeps and fills out the checklist on their own (see

⁴ The instruction says “nergörningen”, which is likely a typo.

figure 12). The checklist is then submitted to the resource planning manager.

- Storbulk – Kol och kokslossning
- Storbulk – Järnpellets lossning
- Storbulk – Rengöring
- Småbulk – Bulkhantering inkl. provtagning m.m.
- Småbulk – styckegods, Big-bag, coils, ämnen
- Småbulk – Rengöring kaj och kaj band, kabelgrav osv

Figure 12. Parts of the introduction checklist.

The port also has a training programme for hatch foremen, which includes all the different steps taken by the hatch foreman, including safe access routes on board and secured entry cargo hold hatches. Hatch foremen are also informed that all manhole covers must be opened and secured, and that the ship's crew needs to be notified for this to happen. The training also includes a briefing on gas meters.

1.5.5 Port personnel

At the time of the accident, the hatch foreman had been hired on an hourly basis at the port since 27 May 2017. He had completed the port introduction programme for new employees. However, according to his checklist, he was lacking certain steps, including practical signalling diagrams and large bulk – discharging coal and coke. He had been involved in discharging nine coal carriers before and also had prior experience as hatch foreman. There is no documentation to indicate that he had completed hatch foreman training, however, he had worked alongside an instructor for internal training as hatch foreman.

The dockworker who died in the accident had been hired on an hourly basis at the port since 23 October 2017, but it was the first time he participated in the discharging of coal from large bulk. He normally worked in the port workshop, but he had been involved in discharging other cargo from vessels. He had completed the port introduction programme for new employees. However, according to his checklist, he was lacking certain steps, including large bulk – discharging coal and coke. He was also lacking complete training and authorisation to operate the loader.

The production coordinator had been working at the port for 23 years and had been the production coordinator since 2008.

The resource planning manager had been working at the port since 1980 and as resource planning manager since 2003.

1.6 Regulations, inspections and oversight, etc.

1.6.1 *Act (2003:367) on loading and discharging of bulk carriers*

The Act (2003:367) on loading and discharging of bulk carriers (hereafter LLB) applies to all bulk carriers, regardless of where they are registered, which call at a terminal to load or unload solid bulk cargo, as well as for all terminals where such bulk carriers call. The provisions of this act are based on Directive 2001/96/EC of the European Parliament and of the Council establishing harmonised requirements and procedures for the safe loading and discharging of bulk carriers.

LLB states that the master as well as the terminal operator have an obligation to ensure that bulk carriers can be loaded and unloaded safely, for example in regard to inspection of vessels and terminals and information transfer between vessel and terminal operator.

The Swedish Transport Agency has been authorised to issue more detailed provisions in this area, which can be found in the Swedish Transport Agency's regulations and general advice (TSFS 2010:174) on maritime transport of cargo and terminals called on by vessels loading or discharging solid bulk cargo.

1.6.2 *Swedish Transport Agency's regulations and general advice (TSFS 2010:174) on maritime transport of cargo and terminals called on by vessels loading or discharging solid bulk cargo.*

Chapter 3, Section 3 of TSFS 2010:174 states that, in order to be considered suitable for loading and discharging of solid bulk cargo, the terminal must meet the requirements set out in appendix 12.

Appendix 12 states, among other things, that terminal personnel must be trained in all aspects of safe loading and discharging of bulk carriers, in a manner consistent with their individual area of responsibility. The training must be designed to impart knowledge of the general risks associated with loading and discharging of solid bulk cargo and of the negative consequences that incorrect loading and discharging conduct can have on vessel safety. The terminal personnel involved in loading and discharging must furthermore be equipped with and use personal protective equipment, and they must be given sufficient opportunity to rest in order to avoid accidents as the result of exhaustion.

In accordance with Chapter 3, Section 17 of TSFS 2010:174, the checklist regarding safety in the intersection between vessel and port must be jointly filled out and signed by the master and the terminal representative before loading or discharging begins. The checklist and guidelines for how to fill it out can be found in appendices 19 and 20 to the regulations.

Item 13 of the checklist reads as follows.

If the atmosphere safe in holds and enclosed spaces to which access may be required; have fumigated cargoes been identified and has the need for monitoring of the atmosphere been agreed by ship and terminal?

The guidelines state the following.

Rust formation on a steel construction or the properties of the cargo can create a hazardous atmosphere. Consideration must be given to the following: oxygen consumption in the cargo holds; the effect of gas development, either from cargo that is to be unloaded or from cargo in a silo prior to loading, which can bring gas on board along with the cargo without warning to the vessel; and gas leaks, toxic or explosive, from adjacent cargo holds or other spaces.

In the checklist signed by the master and the port, this item was included and ticked off (see figure 13).

WALLEM SHIPMANAGEMENT LTD. SAFETY MANUAL	CHAPTER NINETEEN CHECK LISTS 19.5 2/4	Prepared by: [Signature] Issue date: April 2019 Revised by: [Signature] Date: March 2019 Approved by: [Signature] Managing Director
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12 Has the shipper provided the Master with the properties of the cargo in accordance with the requirements of Chapter VI of SOLAS? <input checked="" type="checkbox"/> <input type="checkbox"/>	17 Has the need for trimming of cargo in the holds been discussed, and the method and extent been agreed? <input type="checkbox"/> <input checked="" type="checkbox"/>
13 Is the atmosphere safe in holds and enclosed spaces to which access may be required have fumigated cargoes been identified and has the need for monitoring of atmosphere been agreed by ship and terminal? <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	18 Do both ship and terminal understand and accept that if the ballast programme becomes out of step with the cargo operation, it will be necessary to suspend cargo operation until the ballast operation has caught up? <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
14 Has the cargo handling capacity and any limits of travel for each loader/unloader been passed to the ship/terminal? <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	19 Have the intended procedures for removing cargo residues lodged in the holds while unloading been explained to the ship and accepted? <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
44 Loader No <u>1-750 NY 42</u> Rate tonnes/hr Loader No _____ Rate tonnes/hr Loader No _____ Rate tonnes/hr Loader No _____ Rate tonnes/hr	20 Have the procedures to adjust the final trim of the loading ship been decided and agreed? <input type="checkbox"/> <input checked="" type="checkbox"/>
15 Has a loading/unloading plan been calculated for all stages of loading/deballasting or unloading/ballasting? <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	21 Has the terminal been advised of the time required for the ship to prepare for sea on completion of cargo work? <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Copy lodged with _____	THE ABOVE HAS BEEN AGREED [Signature]
16 Have the holds to be worked been clearly identified in the loading or unloading plan, showing the sequence of work, and the grade and tonnage of cargo to be transferred each time the hold is worked? <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	[Redacted Signature]

Figure 13. Checklist regarding safety in the intersection between vessel and port.

1.6.3 *International Maritime Solid Bulk Cargoes Code (IMSBC)*

IMSBC is a set of international regulations applicable to all vessels transporting solid bulk cargo at sea. ISMBC entered into force on 1 January 2009 and became compulsory on 1 January 2011 through IMO Resolution MSC.268(85). The Code is incorporated in Swedish legislation through the Swedish Transport Agency's regulations and general advice (TSFS 2010:174) on maritime transport of solid bulk cargo.

IMSBC underlines that there are certain solid bulk cargoes that can result in oxygen depletion, release of toxic gases or fumes and spontaneous heating. When transporting these cargoes, special attention must be paid to personal protection and the need for special cautionary measures prior to loading and after discharging.

It is highlighted that cargo spaces and adjacent spaces may be depleted in oxygen or may contain toxic or asphyxiating gases.

Many solid bulk cargoes can deplete the oxygen in cargo holds and tanks. These include, but are not limited to most vegetable and forest products, iron alloys, metal sulphide concentrate and coal. When carbon oxidises in an enclosed space, the oxygen in the air decreases and the concentration of carbon dioxide or carbon monoxide increases.

Before entering an enclosed space on board a vessel, appropriate measures must be taken considering the recommendations produced by IMO.⁵ Even after a cargo hold or tank has been examined and proven generally safe to work in, there may still be small pockets of oxygen depleted air or toxic fumes.

1.6.4 *Recommendations regarding work in enclosed spaces*

IMO Resolution A 1050(27) with recommendations on entering enclosed spaces aboard ships emphasises the importance of having procedures in place for entering enclosed spaces and of the crew being familiar with these. It furthermore states that doors and hatches must be secured when not in use. A door or a hatch to an enclosed space that is opened for ventilation may be mistaken for an indication of a safe atmosphere. For this reason, a watch should be placed at the entrance, or a mechanical barrier, such as a rope or a chain with a warning sign, should be placed across the opening to prevent people from entering.

1.6.5 *Work Environment*

Fundamental work environment regulations are found in the Work Environment Act (1977:1160, AML). The aim of this act is to prevent ill-health and accidents in the workplace, but also to otherwise achieve a good work environment. The Work Environment Act is applicable to any activity where an employee is carrying out work on behalf of an employer.

⁵ Refers to IMO Resolution A1050(27), see section 1.6.4.

The Work Environment Act's work environment requirements include:

- The work environment must be satisfactory in terms of the nature of the work and the social and technological development in society, and with regard to the requirements of maritime safety (Chapter 2, Section 1, first paragraph of AML).
- Work shall be planned and arranged so that it can be carried out in a safe and sound environment (Chapter 2, Section 2, AML).
- Machines, equipment and other technical facilities must be constructed, located and used in such a way as to provide a satisfactory level of protection against ill health and accidents (Chapter 2, Section 5, AML).

Chapter 3, Section 2 of AML states that the employer must take all necessary measures to prevent the employee from being subjected to risk of ill-health or accident. One point of departure is that anything that can lead to ill-health or accident must be altered or replaced in order to eliminate the risk of ill-health or accident. Premises as well as machines, equipment, safety equipment and other technical facilities must be well maintained.

Chapter 3, Section 2 a of AML states that the employer must systematically plan, direct and monitor activities in a manner that ensures that the work environment meets the prescribed requirements for a good work environment. The employer must investigate work-related injuries, continuously investigate the risks involved in the activities and take the measures required as a result.

What is stated in Chapter 3, Sections 2 and 2 a of AML regarding the employer's obligations is also applicable to the master (Chapter 4, Section 9 of the Ship Safety Act).

If a permanent place of business is a shared workplace for several businesses, the party that is in control of the workplace is responsible for the coordination of work environment issues (Chapter 3, Section 7 d of AML). If a ship is a shared workplace for several businesses, the ship-owner is responsible for such coordination. However, if a ship has been taken into a shipyard in Sweden, the party responsible for operating the shipyard is responsible for such coordination. The responsibility for coordination of safety measures required for the loading or discharging of a ship in a Swedish port rests with the employer responsible for this work. The responsibility for coordination can be transferred to a party conducting activities at the workplace or, where the loading or discharging of a ship in a Swedish port is concerned, at the port, or to the ship-owner.

Pursuant to Chapter 3, Section 7 e of AML, the party responsible for coordination of work environment-related matters must ensure that:

- the work to prevent risks of ill health and accidents is coordinated in the shared workplace,
- work is scheduled as necessary to prevent risks of illness and accidents resulting from differing activities being conducted at the workplace,
- general safety equipment is set up and maintained and general safety regulations are issued for the workplace, and
- the party responsible for the special safety equipment that may be needed for a certain type or certain types of work is clarified.

1.6.6 Systematic work environment management

In accordance with Chapter 2, Section 57 of the Swedish Transport Agency's regulations and general advice (TSFS 2010:119) on work environment on board vessels, the Work Environment Authority's regulations (AFS 2001:1) on systematic work environment management are applicable to all Swedish vessels, with the exception of warships, where employees carry out ship work on behalf of an employer.

According to the Work Environment Authority's regulations (AFS 2001:1) on systematic work environment management, the employer must investigate, carry out and follow up activities in such a way that ill health and accidents related to the work are prevented and that a satisfactory working environment is achieved. The employer must also regularly investigate the working conditions and assess the risks of someone being subjected to ill health or accident at work. The risk assessment must be documented in writing. Furthermore, the employer must ensure that the employees' knowledge of work and risks involved in the work is sufficient to prevent ill-health and accidents and to achieve a satisfactory work environment. When the work entails serious risks, there must be written instructions for the work.

1.6.7 Regulations on dock work in Sweden

Work Environment Authority's regulations (AFS 2001:9) on dock work and general guidelines on their application states that during work on board a vessel, the land-based employer must cooperate with ship representatives to achieve coordination between on-board and land-based employees. Before the work begins, permanent and casual labourers must have been given the instructions necessary to safely carry out the work. Written instructions for how to carry out the work facilitates the introduction of new employees and casual labourers. The introduction should also be given verbally.

Personnel and equipment must be easily available to rescue persons in danger, and for transport of injured persons.

1.6.8 Chemical hazards in the work environment

Pursuant to Work Environment Authority's regulations (AFS 2011:19) on chemical hazards in the working environment, the air must be examined and assessed each time work is to begin inside a cistern, well, silo cargo hold or similar. If it is not evident that the air is safe, the air content of oxygen and hazardous substances must be measured and the risk of explosion must be assessed by measuring the levels of combustible gases and fumes. No work may begin before examination and risk assessment are completed and the necessary measures have been taken to prevent ill-health and accidents at work.

1.7 Previous accidents of a similar nature

The International Bulk Terminals Association (IBTA) has conducted a review of fatal accidents in conjunction with transport, loading or discharging of bulk cargo.⁶ The review shows that from 1999 and April 2018, 88 people had died in 55 accidents as the result of asphyxiation or carbon monoxide poisoning. Of these, 76 persons died on cargo hold ladders, 9 persons in cargo holds, and 3 persons in adjacent spaces. 20 of the accidents occurred on vessels carrying coal.

IBTA has also proposed changes to the IMSBC and IMO Resolution A 1050(27) with recommendations on entering enclosed spaces aboard ships, primarily in regard to the implementation of risk assessments.

1.8 Actions taken

1.8.1 Port of Oxelösund

One week after the accident, the Port of Oxelösund updated the applicable instruction for all port personnel, which relates to all vessels in the city port where organic materials are handled. The instruction states that employees have a personal responsibility to secure the spaces they enter on board the vessels. Everyone must carry a gas meter/gas detector and use it to ensure that the work space is safe.

The Port of Oxelösund has also planned measures to be taken in regard to person protective equipment, organisation, training, production preparation, safety equipment and rescue efforts, handling contractors and alarm procedures. These measures include the following:

- The temporary instruction must be evaluated and supplemented if it is to be applicable to all vessels handled by the company.
- A new management function is to be established under the head of production, which will be responsible for all casual labourers and for the company-wide resource planning.

⁶ IMO Sub Committee on Carriage of Cargoes and Containers, 5th session Agenda item 5 (CCC 5/INF.12, 14 June 2018)

- The training process for employees is to be reviewed and quality-assured in regard to:
 - The structure of training.
 - Placement and follow-up of the checklist and training documentation.
 - Handover and communication between instructor and resource planning manager.
 - Shift change.
 - Secure reference to current governing documents in the checklist.
 - Procedure for how governing documents and work instructions are made available and known to the concerned personnel.
 - Training of hatch foremen.
- Clarify the responsibility and assure the quality for procedures relating to safety analysis in the production preparation, and ensure that the interaction between production planning manager, operations manager, production coordinator and team leader is working, so that the results of the safety analysis includes their joint knowledge and that they are safely communicated.
- Training rescue operation safety when at risk of gas exposure. The risk of rescue operations where there is a risk of gas exposure must be clarified and communicated throughout the organisation. Necessary safety equipment and its placement must be reviewed. CPR training is to be expanded to also include handling of evacuation breathing device or similar.
- Review of procedures to ensure that rescue services are always alerted in the event of workplace accidents.

1.8.2 Swedish Transport Agency

In a proposal for a new edition of the Swedish Transport Agency's regulations and general advice (TSFS 2010:119) on work environment on board vessels, the Transport Agency has suggested that AFS 2001:9 on dock work should be applicable to work on board Swedish vessels. All to clarify the risks and responsibilities, as well as the need for collaboration in conjunction with loading and discharging of vessels.

The Swedish Transport Agency will furthermore propose that Sweden should support the International Bulk Terminals Association (IBTA) on its proposed changes to the IMSBC and IMO Resolution A 1050(27) with recommendations on entering enclosed spaces aboard ships.

2. ANALYSIS

2.1 Initial observations

The loading and discharging of ships is an operation which involves many different parties. When discharging bulk cargo, assistance is often required from dockworkers on the quay, on board the vessel and in the cargo hold. It is against this background that the Act (2003:367) on loading and discharging of bulk carriers, the Swedish Transport Agency's regulations and general advice (TSFS 2010:174) on maritime transport of cargo and terminals called on by vessels loading or discharging solid bulk cargo, and the Work Environment Authority's regulations (AFS 2001:9) on dock work and general guidelines on their application all contain special requirements for coordination, information transfer and training (see sections 1.6.1, 1.6.2 and 1.6.7).

High demands must therefore be made on planning and coordination of work, on all involved personnel having the training and safety equipment required and being aware of the special conditions that apply to a certain vessel and discharging operation. This applies especially to cargoes of organic material, such as coal, which produces carbon monoxide and other gases as well as reduces the oxygen levels in the air when stored in enclosed spaces.

Questions that arose during the investigation are primarily how the work was planned in regard to ensuring that personnel had sufficient training and safety equipment, how information about planning was communicated, when and by whom the entry hatch to the spiral ladder was opened and why the dockworker chose the hatch in question.

2.2 Resource planning

According to the port's procedures, competency to complete the assignment is always a basic requirement when choosing to bring in additional resources in the form of casual labourers. In the present case, both the hatch foreman and the late dockworker were casual labourers who had been working at the port for a relatively brief period. According to their introduction checklists, they had not completed the steps "large bulk – discharging coal and coke", even if the hatch foreman had unloaded coal from other vessels before. The dockworker was also chosen by the team to operate the loader in the cargo hold, which he was not fully trained or qualified to do. There was no documentation to show that the hatch foreman had undergone hatch foreman training.

The investigation shows that the resource planning manager did not have access to compiled complete information on what training and experience the deceased dockworker had. This of course makes it more difficult to ensure that there is sufficient competency to carry out the task at hand. As there was no team leader on duty for the night shift, who would otherwise be responsible for the division of responsibilities between the team members, the team members were also allowed, as customary, to divide tasks between themselves. There was a deputy

team leader on the shift, but they were not acting as team leader. Even if the team chosen for the shift had sufficient competence to complete all tasks in conjunction with discharging, it is not certain that the individual training and experience of each member is known within the team when handing out tasks; for example in this case, where the deceased dockworker was not fully qualified to operate the loader on board a vessel.

In SHK's opinion, such a system increases the risk of personnel ending up working with tasks that they do not have sufficient knowledge or experience of. The port should therefore take measures to ensure that these shortcomings in the system are rectified. It is SHK's assessment that this is also included in the measures that the port plans to take. No safety recommendation is therefore issued in the report in this regard.

2.3 Communication of safety information

In the present case, it appears that the initial planning between the ship and the terminal has been satisfactory, in the sense that the ship's master explicitly pointed out to the port production coordinator that the vessel had enclosed spiral ladders, and that there was a risk of oxygen depletion in these spaces. The entry hatches to be used would be opened by the crew of the vessel at the request of the port personnel. This information was also passed on, at least during the first shift change after the discharging had begun.

Despite this, a dockworker died from oxygen deficiency at a later stage of the discharging operation when he went down one of these spiral ladders. The hatch foreman at the time has stated that he was unaware of the risks of enclosed spiral ladder, and it can certainly be assumed that the deceased dockworker was also unaware of those risks. Nor did the dockworkers who arrived to attempt a rescue realise the danger entailed by entering the enclosed ladder.

The investigation has shown that the information provided by the master to the port production coordinator that the spiral ladders were enclosed and that there were risks involved, and which had been passed on at least in one previous shift change, was not given to the night shift in question. However, the previous shift had informed the night shift that they had been using the aft entry hatch to get into the cargo hold.

As far as the investigation has shown, it is uncommon for vessels to have enclosed spiral ladders. In such cases, i.e. in rare situations associated with particular and serious risks, it is especially important to ensure that all personnel is given adequate safety information. The port should therefore take measures to ensure that such information is always communicated from one shift to the next. It is SHK's assessment that this is also included in the measures that the port plans to take. For this reason, no safety recommendation in this regard needs to be issued here.

2.4 When was the entry hatch to the spiral ladder opened?

From the photograph (see figure 2) taken by the Swedish Transport Agency inspector the day before the accident, it is clear that the entry hatch to the spiral ladder in cargo hold 7 was closed at the time of inspection. It is furthermore clear from the interviews with the port personnel that both the entry hatch to the vertical ladder and the entry hatch for the spiral ladder were closed after the loading hatch to cargo hold 7 had been opened by the ship's crew and the discharging was to begin. The entry hatch to the vertical ladder had then been opened by the port personnel. However, the port personnel have stated that it was only the entry hatch to the vertical ladder that they opened, and not the entry hatch to the spiral ladder.

No-one in the ship's crew or among the port personnel that SHK has interviewed have said they were aware of when or by whom the entry hatch to the spiral ladder was opened, or if it was open at all. Nor has the investigation been able to answer this question in any other way. It appears unlikely, however, that the deceased dockworker would have had time to open the hatch himself, with its four lock bolts, in the short time that passed before the hatch manager started looking for him, and without the latter even noticing (see figure 3). This would indicate that the hatch for the spiral ladder was open when the deceased dockworker left the hatch foreman to enter cargo hold 7.

It can be questioned whether entry hatches that are not supposed to be used, and which are associated with lethal danger, should be marked before and during discharging with the aim to ensure that no crew or port personnel opens the wrong hatch by mistake. The port personnel should not be opening any entry hatches at all, but as the investigation has shown, they did, at least when it comes to the entry hatch to the vertical ladder. It is not inconceivable that this could happen again in another port in the future.

A more explicit marking could function as another barrier to prevent accidents (cf. IMO Resolution A 1050(27)). The investigation conducted by the International Bulk Terminals Association (IBTA) clearly shows that this type of accident is not uncommon. The shipping company should therefore look into the possibilities of taking the measures described above. Similarly, the port should consider setting corresponding requirements in conjunction with the initial planning with the vessel in preparation of discharging.

2.5 Why did the dockworker go down the hatch in question?

Based on SHK's conclusions in sections 2.3 and 2.4, the dockworker was likely unaware of the risks entailed by enclosed spiral ladders, and it appears likely that the hatch was open when he and the hatch foreman came on board. There is also the circumstance of the entry hatches to cargo hold 7 being reversed, meaning that in the other cargo holds, the corresponding hatch would lead to a vertical ladder. If you are not aware of or consider this, it may – based on the conditions described above –

appear natural to choose the same hatch as the dockworker to enter cargo hold 7. In this context, it can also be noted that this was the hatch where the hatch foreman went to look when the dockworker did not respond to his calls. Had it been clear that the aft ladder was to be used, the hatch foreman would likely have started there when looking for the dockworker.

2.6 Port procedures

The port's instruction for discharging coal carriers (see section 1.5.2) specifically states that cargo hold 7 is often different in design compared to the other cargo holds of the vessel, that the spiral ladder is often at the fore end of the hold, and that cleaning therefore starts there. In this regard, the instruction thus gives the impression that the spiral ladder is to be used to enter the cargo hold.

The fact that the spiral ladders were normally used for entry, as they were perceived to be safer, has also been confirmed in the interviews conducted during the investigation. However, in these cases, the spiral ladders involved have been "open" in relation to the cargo hold, and consequently did not entail the same risk of oxygen depletion.

The port's instruction had thus not taken precautions for the fact that spiral ladders can be designed differently and thereby be associated with different risks. It is therefore SHK's opinion that the instruction should be reviewed. It is SHK's perception that this is also included in the measures that the port intends to take. For this reason, no safety recommendation in this regard needs to be issued here.

Pursuant to the regulations of the Work Environment Authority, the air quality shall be examined and assessed each time work in a cargo hold or similar space is to begin. If it is not evident that the air is safe, the air content of oxygen and hazardous substances must be measured and the risk of explosion must be assessed by measuring the levels of combustible gases and fumes. No work may begin before examination and risk assessment are completed and the necessary measures have been taken to prevent ill-health and accidents at work.

There was no examination of the air quality in cargo hold 7 before the night shift began its discharging work. This can possibly be explained by the fact that the previous shift had already started discharging that hold, and it was therefore deemed that the air was safe and that there were no particular risks involved in entering the cargo hold.

There was a written work instruction regarding the measurement of oxygen and CO prior to work on board any vessel at the port (see section 1.5.2). However, it has emerged that this instruction was not always followed; instead the practice was to wait 15 minutes before entering a space after the hatch had been opened, in order to air out the space. However, such a measure has no effect in an enclosed space with no ventilation, such as an enclosed spiral ladder of this type.

2.7 Procedural glide

In all types of activity based on rules or standards, there is a risk of a gradual increase in the discrepancy between how the duties are intended to be undertaken and how they are actually executed. If this process continues without an attempt being made to understand and counteract it, a clear gap will emerge between the desired and actual outcome. This is known as procedural drift and it often takes place in very small steps, which are in themselves difficult to detect. In the long run, however, procedural drift can lead to accidents.

There can be several reasons why procedural drift arises. Rules or procedures may, for example, be “over or under-designed” so that they become difficult or impossible to comply with or various elements and goals in a working process may be incompatible. Over time, departures from procedures that do not lead to any detrimental impact reinforce the belief that these departures are safe and there is thus a risk of them becoming standardised.

In organisations and systems where there are targets that are at risk of conflicting with one another, for example, when efficiency must be balanced against safety, there is always a certain breeding ground for procedural drift.

People tend to pursue more efficient working practices, at the same time as efficient work is usually rewarded, directly or indirectly, by managers. Only when something unwanted happens, such as someone hurting themselves, does this type of departure from the applicable rules or procedures get noticed.

The investigation has found several indications of procedural glide, for example that the port personnel opened entry hatches themselves even though this was to be done by the crew, and that no gas meters were used before entering enclosed spaces. The port’s competency requirements to be allowed to carry out a certain task have not always been complied with. The deceased dockworker did not have full machine operator qualifications, for example. According to his own introduction checklist, he had not completed certain steps, such as the one for large bulk – discharging coal and coke. The hatch foreman also did not have this step ticked off his checklist, and there is no documentation to show that he had undergone the hatch foreman training.

In recent years, SHK has noted similar conditions when investigating accidents at other ports⁷. There may thus be cause for the Work Environment Authority to review and, if necessary, develop its inspection procedures for dock work in terms of how the ports work to prevent and discover risky procedural drifts.

⁷ Final Report RS 2016:04, OSLO WAVE – collapsed loading crane in Bollstabruk, Sweden, 9 of June 2015, and Final Report RS 2016:09, FINNPARTNER – Workplace accident, near-miss of a very serious casualty, Port of Malmö, 24 November 2015.

2.8 Rescue services

When analysing the rescue operation, no shortcomings have emerged that would prompt SHK to issue any recommendation. However, SHK finds cause to comment on the condition that two dispatch units need to be involved in order to dispatch resources for emergency care.

In Sörmland County, which includes Nyköping and Oxelösund, the county council has its own central for dispatching medical resources, the emergency response unit in Eskilstuna. SOS Alarm still receives 112 calls, but when emergency care is needed, the call is connected to the emergency response unit.

When the person who called about the accident on board the DECLAN DUFF called 112, the SOS operator interviewed the caller, and as it became clear that an ambulance was needed, the call was connected to the emergency response unit. However, the information that the SOS operator had received was not forwarded to the other unit. The operator at the emergency response unit therefore had to interview the caller again to gain an idea of which resources needed to be dispatched.

The handling of the call is not assessed to have deviated from the current procedure, however, the system of “double” dispatch units meant that it took around one minute from the call being connected from SOS Alarm until the emergency response unit started dispatching an ambulance. One minute can make a great difference when life-saving measures are required. The reasonability of having such a delay built into a system for dispatching medical resources is questionable.

3. CONCLUSIONS

3.1 Findings

- a) The deceased dockworker's introductory training had not included the element *Large bulk – discharging coal and coke*, and he had not previously unloaded coal.
- b) The deceased dockworker was not fully qualified to operate the loader.
- c) The hatch foreman did not have foreman training.
- d) The dockworkers were not using personal gas metres.
- e) No measurement of the gas levels in the cargo holds was conducted before starting to unload.
- f) The dockworkers independently opened the entry hatch to the vertical ladder on board the vessel.
- g) Cargo hold 7 is reversed compared to the other holds.
- h) The handover between the shifts did not cover all the necessary safety information.
- i) There are several indications of procedural drift at the port.
- j) The resource planning manager did not have access to complete information on what training and experience the deceased dockworker had.
- k) There was no team leader working on the night shift, and the team divided tasks amongst themselves.

3.2 Causes

The reason why the dockworker went down a hatch to the cargo hold where there was a lack of oxygen was likely a combination of being unaware of the risks, due to lack of training and experience in discharging coal, and not being given the information regarding the spiral ladder being enclosed and the risks that this entailed. The circumstance that the entry hatches to cargo hold 7 are in reversed order compared to the other cargo holds has likely contributed to the choice of the hatch in question.

Underlying factors included a lack of sufficiently structured methods for provision of safety-critical information and robust systems for discovering and rectifying procedural drifts.

4. SAFETY RECOMMENDATIONS

Against the background of the extensive action programme that the Port of Oxelösund is planning to implement, and which SHK deems to be adequate in order to eliminate the identified faults, SHK is not issuing any specific safety recommendations to the Port of Oxelösund. However, SHK assumes that the findings of this report will be taken into consideration in the work with the action programme.

The Work Environment Authority is recommended to:

- review and, if necessary, develop its inspection procedures for dock work in terms of how the ports work to prevent and discover risky procedural drifts. Refer to section 2.7. (*RS 2019:01 R1*)

SHK respectfully requests to receive, by **13 May 2019 at the latest**, information regarding measures taken in response to the recommendations included in this report.

On behalf of the Swedish Accident Investigation Authority,

Mikael Karanikas

Dennis Dahlberg