SWEDISH MARITIME SAFETY INSPECTORATE

Swedish Maritime Administration report series B 2007-1

Bulk Carrier SAGA SPRAY, VRWW5 - Fatal Accident on 16 November, 2006

REPORT

Bulk Carrier SAGA SPRAY - VRWW5 – Fatal Accident on 16 November, 2006

2007-04-24

REPORT

Bulk Carrier SAGA SPRAY - VRWW5 – Fatal Accident on 16 November, 2006

Date:	2007-01-10
Our reference	080202-06-17470
Maritime Casualty Investigation Division	Sten Anderson, +46 (0)11 191269
The report is also published on our web site	www.sjofartsverket.se >Marititime Safety Inspectorate >Accidents and Near-Misses >Accident investigation reports

SE-601 78 Norrköping, Sweden
Phone +46 (0)11 19 10 00
Fax: +46 (0)11 23 99 34

Table of Contents

1 Summary **1**
Recommendations 1
2 Account of Facts **2**
2.1 The ship 2
2.2 Access to the cargo holds 4
2.3 The crew 7
2.4 Fatigue 8
2.5 The stevedoring company 8
2.6 Collection of facts 9
3 Information About the Cargo **9**
3.1 Description of the cargo 9
3.2 The potential risks of the cargo 10
3.3 Safety measures for pellet cargoes 10
4 The Ship's Safety Manual **11**
4.1 The manual 11
4.2 Gas meter 14
4.3 Measuring for the purpose of checking after the accident 15
4.3.1 Carbon monoxide 16
5 Act and Regulations on Loading and Discharging of Bulk Carriers **16**
6. Course of Events **18**
6.1 Course of events according to the ship 18
6.1.1 Narrative of the officer of the watch (OOW) 19
6.2 Course of events according to the stevedoring company 20
6.2.1 Narrative of the stevedore foreman 20
6.2.2 Narrative of the stevedore workers 20
6.3 The rescue action 21
7 Analysis **22**
7.1 The cargo 22
7.2 The crew and the stevedoring company 22
7.3 Rules and regulations 23
7.4 Miscellaneous 25
8 Port State Control **25**
9 Cause and Factors **26**
10 Observations **26**
11 Recommendations **27**
12 General Recommendation **28**
13 Personal Injury **28**
14 Miscellaneous **28**

Addition made on 31 January, 2007 ..... **30**

The Swedish Maritime Safety Inspectorate investigates accidents and near-misses from a safety point of view. The aim of the investigations is to avoid future accidents. The purpose of the investigations is not to apportion blame or liability.

1 Summary

The SAGA SPRAY was in the port of Helsingborg to discharge wood pellets. The discharging had been without problems until a front end loader should be put down in the second last cargo hold in order to collect the remaining pellets; that hold was difficult to reach with the crane from the wharf.

In order to catch and disconnect the front end loader down in the hold a crew member, an ordinary seaman, would first open the upper door from the access trunk to the cargo hold, and then he and a stevedore would climb down through the enclosed trunk leading to the bottom of the cargo hold (the tank top).

On his way down the crew member collapsed first and then the stevedore. Ambulance was called and other crew members hurried to help the two in distress. The crew member was found at the bottom of the access trunk and the stevedore on a landing a bit higher up.

The ambulances arrived; two of the ambulance crew who hurried to rescue, two stevedores and five other crew members had to be taken to hospital for treatment since they had inhaled the air which was deficient in oxygen and injurious to health.

The ordinary seaman died from his injuries and the stevedore was seriously injured. The remaining seven persons did not suffer serious injuries.

The discharging was stopped immediately at the accident and was not resumed again until safe entry had been secured to the access trunk and cargo hold.

Recommendations

The investigation shows that the ship owner as well as the stevedoring company had neglected the legislation in force and their own routines. The recommendations issued mainly concern these matters.

2 Account of Facts

2.1 The ship

Name:	SAGA SPRAY
IMO No.:	9014078
Call sign:	VRWW5
Port of registry:	Hong Kong
Ship owner:	Scorpio Carriers Ltd
Operator:	Patt, Manfield & Co. Ltd, Hong Kong
Charterer:	Saga Forest Carriers, Tönsberg Norge
Gross weight:	29 381
LOA:	199.2 m
Breadth:	30.5 m
Draught:	11.82 m
Classification society:	DNV
Year built:	1994
Construction material:	Steel
Propulsion power:	7 609 kW
Crew:	25

The SAGA SPRAY was built at Oshima Shipbuilding Co Ltd in Oshima, Japan, in 1994 and was delivered to the current owners. At the delivery she was given the name SAGA SPRAY, which she has kept since.

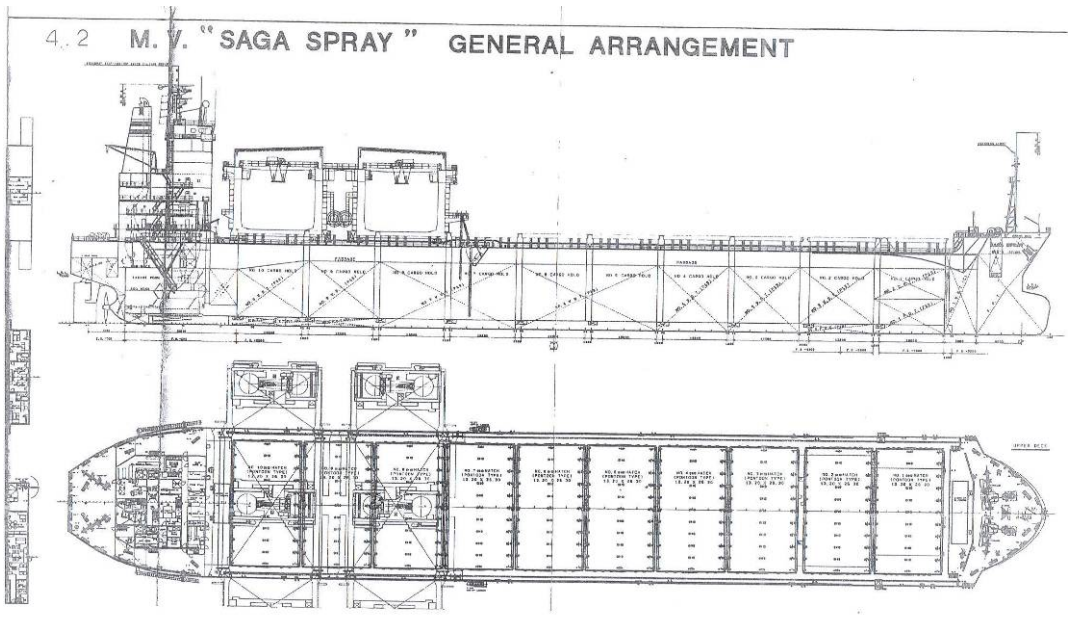
The accommodation area and the bridge were in the deck house by the ship's stern with the engine room underneath. The propulsion machinery was a diesel of make Sulzer, type 7RTA52, which generated 7 609 kW and which was connected to a fixed-pitch propeller.

The ship's cargo space, forward of the deck house, was divided into 10 hatches, the forward one of which had the dimensions 13.2 x 12.3 metres and the remaining 9 were dimensioned by 13.2 x 25.3 metres (13.2 metres being the length of the hatches). The distance from the top of the hatch coaming to the bottom of the hold (the tanktop) was just over 16 metres. All the hatches were box-like which means that the hatches had the same length and width as the hatch coaming, which was about 2 metres high.

Each hatch was covered by one single, huge steel cover, which was about 60 cm high. To remove or fit the covers the ship's two gantry cranes were used (see cover picture). When a hatch was opened, the cover was placed upon one of the covers of the other hatches.

A gantry crane is a trestle crane which runs on rails with one leg on each side of the ship's weather deck wingwards. The cranes could be run along the cargo space and were covered so they could be used for loading and discharging even in rain. Each of the cranes had a lifting capacity of 40 tons.

The SAGA SPRAY was a so called double hull ship, which means that the cargo hold was enclosed by a number of bottom and side tanks for ballast and bunker or dry areas. Nowhere did the cargo get in touch with the shell plating.



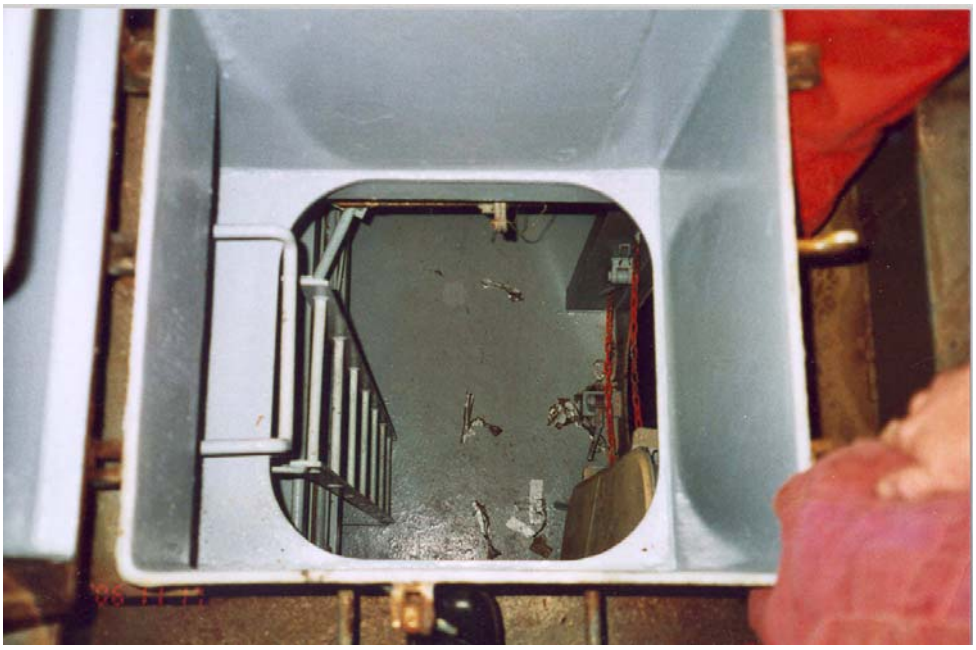
2.2 Access to the cargo holds

There were two possibilities to go down in a cargo hold via fixed arrangements from weather-deck (see sketch page 7). The first one would be to use a vertical ladder that was mounted in a recess in bulkhead in the aft end of the hold. The ladder was constructed from welded steel treads.

The other possibility, the one which was most frequently used and which was used in this case, was an enclosed access trunk with fixed steep staircases. The access opening to the trunk was located on weather-deck ahead of the hatch, between the hatch coamings of holds 8 and 9. The distance between the coamings was about 1 metre.

The access opening with its coaming had the approximate dimensions 0.7 x 0.7 and 0.6 metres high. The cover over the opening was made of steel and was pivoted on one side so it could be opened and fixed in a vertical position. It also had a rubber gasket so that the opening could be closed watertight by the use of clamps.

Inside the opening was a vertical ladder, about 2 metres high, which ended at a platform (landing) where there was a door to the cargo hold. The door was mounted so that it opened to the trunk.

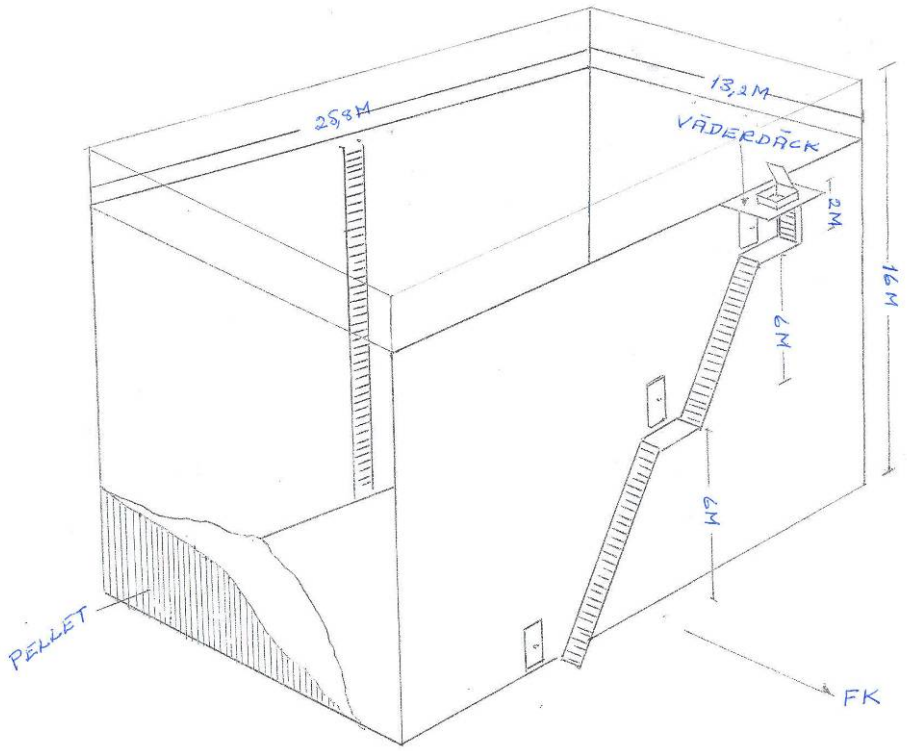


From the first platform there was a steep staircase, which also ended at a platform with a similar door to the hold. Yet another steep staircase ended on the tanktop with a door which led to the bottom of the cargo hold and which also opened to the trunk (see sketch page 7).

The function of the two upper doors was to give access to the cargo hold at different levels of cargo. From the access opening on weather-deck it was not possible to see the lower entrance to the cargo hold since the platforms and the staircases blocked the view.

There was no mechanical ventilation, neither in the cargo holds nor in the access trunks. Neither was there a sign or a warning on the access openings to warn of the potential hazard when entering these enclosed spaces.

After loading the wood pellets all three doors had been tightened with silver tape to make them as tight as possible. The lower door was taped up on the cargo hold side, and at the other two doors the tape was on the trunk side, which was the standard procedure.



The details of the sketch do not correspond in detail with reality.

2.3 The crew

The crew onboard the SAGA SPRAY consisted of master, chief officer, second officer, third officer, chief engineer, third engineer, fourth engineer, fifth engineer, electrician, boatswain, 4 able seamen (AB), 5 ordinary seamen, 2 engine crew, cook, messman and 2 naval cadets.

The master was of Croatian nationality, the chief engineer and the electrician were British and the rest of the crew were Filipinos.

The Filipino ordinary seaman who died was 33 years old and was on his first voyage with the SAGA SPRAY. His voyage started on 26 May. His time-at-sea was 12 months as a naval cadet and 10 months as an ordinary seaman.

From 28 to 31 May the ordinary seaman had gone through a safety training which was led by another third officer than the one who was on board at the time of the accident. This day the ordinary seaman had started his working period at 0500 hours.

This was the first time since the ordinary seaman came on board that the ship was loaded with wood pellets.

Four other crew members, all Filipinos, were slightly injured. These were the boatswain, 47 years old, two ABs, 35 and 25 years old, and one ordinary seaman, 26 years old.

2.4 Fatigue

On board the ship a three watch system was applied. She had been in Helsingborg for two nights when the accident happened. No discharging took place between 2200 and 0600 hours.

Based upon the working time records shown, it seems not likely that fatigue has been a contributing factor to the accident.

2.5 The stevedoring company

The team of stevedores for discharging the SAGA SPRAY comprised 9 workers, consisting of 1 foreman, 1 extra supervisor on-the-job training, 1 docker at the plant ashore, 2 crane operators, 1 signal man, 1 truck operator and 2 trimmers.

The discharging procedure starts by a land based crane discharging by means of a grab from the cargo hold in question. When discharging with the grab there is only one signal man from the stevedoring company on board. He is located on deck and communicates with the crane operator.

When the crane can no longer manage to get the grab full, a front end loader is put into the hold and the operator enters the cargo hold to operate the machine. Finally the trimmers go down to shovel the last parts of the cargo which the front end loader cannot reach.

Discharging of pellet is a frequent job at the stevedoring company in Helsingborg.

2.6 Collection of facts

The investigation is based on the following sources, inter alia:

- Ship's data and ISM manual
- The shipper's information about the cargo
- Act and Regulations on loading and discharging of bulk carriers
- Results from measurings made after the accident
- Police interrogation
- Information from visit on board

3 Information About the Cargo

3.1 Description of the cargo

The shipper of the pellets was Premium Pellet Ltd., West Vanderhoof, Canada.

The cargo, which was a part delivery, consisted of 13 077 metric tons of wood pellets divided between the cargo holds 1, 5, 6 and 9. In cargo hold No. 1 there was 2 200 tons, in No. 5 there was 3 625 tons and in Nos. 6 and 9 there was 3 626 in each room.

The pellets had been loaded in Vancouver, British Columbia, (the Pacific Ocean coast of Canada) on 26 September and had thus been on board for about seven weeks without, to the investigators' knowledge, the hatch covers had been removed or the covers of the access trunks had been opened.

Wood pellet is made from saw dust, shavings and bark. The material is compressed 3.5 times its original volume to small rods, 6 mm thick, which stay together without additives or binding agents. The pellets have a moisture content of 5–7 % and an angle of repose of 35º.

The product can be used, as in this case, for fuel in combined power and heating plants. It is important to maintain a low humidity in order to preserve a high calorie value.

The pellets in question had a stow factor of 1.3–1.5 m^3 per ton and the self ignition temperature was 260º C.

3.2 The potential risks of the cargo

In the Shipper Cargo Information Sheet which was handed over on board in the port of loading the risks involved in transporting wood pellets are described.

- The cargo swells in contact with water.
- The wood pellets consume oxygen and emit carbon monoxide.
- A fermentative process may start if the cargo is exposed to humidity for some time. This may generate combustible gases and cause suffocation.
- There is a risk for explosion in case of a high concentration of dust.

3.3 Safety measures for pellet cargoes

The Shipper Cargo Information Sheet mentioned above also comprises one part that deals with safety measures to be taken. Those applicable in this case are the following:

- Due to the fact that the cargo consumes oxygen, all spaces in direct or indirect connection with the cargo spaces shall be ventilated before personnel is admitted.
- Doors and access openings to spaces mentioned above shall be supplied with signs ”Low Oxygen Risk Area” or corresponding text.
- Access to spaces mentioned above is allowed only after an authorization from the ship’s Officer in Command has been obtained.

- Before entry in enclosed areas the contents of oxygen and carbon monoxide shall be measured.
- When entering enclosed spaces without ventilation a breathing apparatus shall be used.
- Stevedores, surveyors and temporary personnel shall be informed about safety measures that have to be taken.

The person who had signed the Shipper Cargo Information Sheet was representing the shipper, Premium Pellet Ltd.

4 The Ship's Safety Manual

4.1 The manual

In one section the manual deals with the problem of entry into enclosed or confined dangerous spaces.

Under the headline "Entering enclosed or confined dangerous spaces" can be read:

> "Entering any confined space is hazardous and can result in rapid death from harmful gases and/or lack of oxygen. NEVER ASSUME A TANK OR HOLD IS SAFE. It is the master's responsibility to identify hazardous spaces and to establish procedures for safe entry.
>
> Any tank, cargo hold or space which has contained a liquid or which has been sealed must be assumed to have a dangerous atmosphere and consequently be unsafe for entry without the protection of breathing apparatus. Unprotected entry should not be attempted until a competent person has made an assessment and taken the appropriate measures to ensure the space is safe for man entry.
> …..
>
> The master or Chief Mate MUST ensure that it is safe to enter an enclosed space by:
>
> 1. Identifying potential hazards.

2. Ensuring the space is prepared for entry and has been thoroughly ventilated by natural or mechanical means.

3. Testing the atmosphere of the space at different levels for oxygen deficiency and harmful vapor (where suitable instruments are available).

5. Ensuring Officer and crew on watch carry a pocket size oxygen content meter.

…..

In all cases and prior to entry the enclosed space check list must be completed (see below). Whenever entry is first made into a recently opened tank/hold there should be a qualified man positioned on deck tending the required life line and monitoring the situation."

If a crew member should need to access any of the ship's cargo spaces he shall contact an officer, who shall provide the crew member with the above mentioned check list and an oxygen meter.

The crew member shall then climb down through the access trunk opening on deck to the first landing, where the cargo hold door shall be opened. Before then the access trunk opening shall have been open for at least two hours.

If the oxygen meter shows the correct value and the check points on the list are answered YES he can continue to the middle landing, where the procedure is repeated. Finally he goes down to the lowest level while measuring the oxygen content and ticking off the check list and then he opens the door to the bottom of the cargo hold.

After this procedure he returns to weather deck, where the Officer in Command signs the list, which shall also be signed by the master. The space is then to be considered safe to enter.

The Officer in Command then gives permission to the stevedoring company to access the checked space.

The completed check list shall then be kept in a binder on site, so that anyone who will enter the space knows that it is checked and safe.

PATT MANFIELD & CO. LTD.

SAFETY MANAGEMENT MANUAL

Issue Date: 7th January, 2004
Issue Status: Issue 2
Authorisation: Yung Man - Tak

ENTRY INTO ENCLOSED/DANGEROUS SPACE CHECKLIST

ACTION CHECK LIST Before entry into an enclosed space the appropriate safety checks listed below must be carried out by the Officer on Duty AND by the person who is to enter. NB For entry into cargo pumprooms only those items marked with an asterisk need to be checked. Date: ..... Time:	DELETE AS APPLICABLE
Section 1 The safety of personnel requires all questions be answered affirmatively. To be checked by the Master or Chief Officer.	
1.1 Has the space been properly ventilated and tested where equipment is available and found safe?	YES/NO
1.2 Have arrangements been made to continue ventilation during occupancy of the space and at breaks?	YES/NO
1.3 Have arrangements been made to repeat, where applicable, testing at regular intervals during occupancy and after breaks?	YES/NO
1.4 Are rescue and resuscitation equipment available for immediate use at the entrance to the space?	YES/NO
15. Have arrangements been made for a responsible person to be in constant attendance at the entrance to the space?	YES/NO
1.6 Has a system of communication between the person at the entrance and those entering the space been agreed and tested?	YES/NO
1.7 Are access and illumination adequate?	YES/NO
1.8 Are portable lights and other equipment to be used of an approved type?	YES/NO
Section 2 To be checked by the person who is to enter the space after the relevant checks in Section 1 have been made:	DELETE AS APPLICABLE
2.1 Have you been given instructions or permission by the Master or chief Officer to enter the space?	YES/NO
2.2 Are you satisfied all relevant checks in Section 1 have been completed?	YES/NO
2.3 Are you aware you should leave the space immediately in the event of failure of the ventilation system?	YES/NO
2.4 Do you understand the arrangements made for communication between yourself and the responsible person in attendance at the entrance to the space?	YES/NO
Section 3 Where breathing apparatus is to be used, this section must be checked jointly by the Chief Officer and the persons who are to enter the space.	DELETE AS APPLICABLE
3.1 Are you familiar with the apparatus to be used?	YES/NO
3.2 Has the apparatus been checked as follows?	YES/NO
(a) Adequacy of air supply; (b) Low pressure audible alarm; (c) Face masks, air supply and tightness?	YES/NO
3.3 Have the emergency signals and other emergency arrangements been agreed?	YES/NO
3.4 Has "ENCLOSED SPACE - POTENTIAL HAZARD" notice been displayed?	YES/NO
Where instruction have been given that a responsible person be at the entrance to the space, the persons entering the space should show him their completed card before entering. Those entering an enclosed space should always wear appropriate protective equipment and avoid loose fitting clothing which might snag on obstructions.	

Under the headline ”Testing the Atmosphere” there is one section with the following wording:

> “Testing should be carried out before entry and at regular intervals. Testing should be carried out from deck level. However, on occasions

additional testing may be required from within the tank/hold in which case the tester must use a breathing apparatus and be secured with a life line tended by a qualified man positioned on deck. Communications should be maintained via portable walkie-talkies."

In one section with the headline "Oxygen Deficiency" is stated that "Depletion of oxygen may occur in cargo spaces from oxygen absorbing cargoes such as oil cake, steel products, swarf, etc. "

4.2 Gas meter

According to the safety manual an oxygen meter shall be used and be carried by the person who intends to enter an enclosed space.

On board there were two apparatuses for measuring the oxygen content of the air. The result of the measuring was easily read as digits in a display. The apparatuses were easy to manage and were as a rule kept in the deck office in the aft part of the deck house.

On this occasion, however, one apparatus was on the bridge where the master intended to clean it since it was said to give "false information". The other one was available in the deck office but was not used at the moment.

4.3 Measuring for the purpose of checking after the accident

On 18 November 2006 the Port of Helsingborg arranged to make measurings on board the SAGA SPRAY in a cargo hold that had not yet been discharged. The measuring was made in connection with the opening of the hatch. The hold was filled with pellets up to about 1 metre under the cover. The weather was cloudy, the wind approximately 3B and the temperature 9ºC.

The purpose of the measuring was to check if the cargo of wood pellets, shipped out from Vancouver in Canada, had generated hazardous environment in the cargo hold.

For the measuring an instrument named VISA was used, manufactured by Gas Measurement Ltd, Renfrew PA 4 9RG, United Kingdom. This electronic instrument measures three values of the atmosphere simultaneously, i.e. percentage of oxygen, carbon monoxide (ppm) and lower explosive limit (LEL).

	% oxygen	CO (ppm)	% LEL
At opening of the hatch	15	1 000*	Max
After 5 min. of discharging by grab	20.9**	0	0

*Maximum value of the apparatus
** Standard value

The carbon monoxide content exceeded the hygienic limit by at least 10 times and the reduction of oxygen content was substantial.

The result of another measuring was 5 416 ppm carbon monoxide, which is miles above the upper limit of 35 ppm and the short period limit (15 minutes exposure) of 100 ppm.

It was noted by the use of thermo photography (heat camera) that no temperature rise or hotspots could be detected on the surface of the cargo.

At the measuring five minutes after the discharging was started the cargo hold atmosphere showed normal values.

The next day the measurings were repeated in another cargo hold that had not been discharged. The results were identical.

4.3.1 Carbon monoxide

Carbon monoxide (CO) is a chemical combination of one carbon atom and one oxygen atom. The gas is inodorous and tasteless and slightly lighter than air. The mechanism of the toxicity of CO, namely to bind to hemoglobin and thereby push the oxygen aside, has been known since long.

Studies have shown that CO has got more than 200 times greater inclination to react chemically to hemoglobin than has oxygen. When CO binds to hemoglobin, carboxihemoglobin is formed, which causes a highly limited ability in the blood to transport oxygen.

Initially the toxication symptoms are increased breathing frequency, headache, dizziness and a feeling of sickness. Stronger reactions are cramps, unconsciousness, circulatory disturbance, difficulty in breathing and finally death. To persons with heart disease and vascular disorders the symptoms are stronger.

Exposure to a high degree of concentration can quickly lead to suffocation.

5 Act and Regulations on Loading and Discharging of Bulk Carriers

The Act (2003:367) on loading and discharging of bulk carriers and the subsequent regulations of the Swedish Maritime Administration (SJÖFS 2003:10) apply to all bulk carriers that call at a Swedish terminal to load or discharge solid bulk cargoes, regardless of what country they are registered in.

The stipulations of the Act are based on the Directive 2001/96/EC of the European Parliament and of the Council of 4 December 2001 establishing harmonized requirements and procedures for the safe loading and discharging of bulk carriers.

The Act and the regulations also apply to all terminals to which calls are made by such bulk carriers.

Section 6 of the Act deals with the obligations of the terminal operator and of the master. They are mutually responsible for the safe loading or discharging of a bulk carrier.

In their regulations SJÖFS 2003:10 the Swedish Maritime Administration provides i.a. the following concerning loading and discharging of bulk carriers: “Section 7 To be considered suitable for loading and discharging of solid cargoes a terminal shall comply with the requirements stated in Enclosure 2”.

Enclosure 2 states the following, i.a.:

> “3. The terminal personnel shall be trained in all aspects that deals with the safe loading and discharging of bulk carriers in a way that is consistent with his or her field of responsibility. The training shall give knowledge about the general hazards that are associated with loading and discharging of solid bulk cargoes as well as the consequences to the ship’s safety that may be the result of incorrect loading and discharging procedures.
>
> 4. The terminal personnel that participate in loading and discharging shall be supplied with and use personal safety equipment and shall be given the opportunity to sufficient rest in order to avoid accidents caused by fatigue. “

Section 18 deals with the check list that shall be filled out and signed by both the terminal personnel and the responsible person of the ship:

> “Before loading and discharging is started the check list for the safety in the borderland between the ship and the port, enclosure 10, shall be jointly filled out and be signed by the master and the terminal representative following the directions in enclosure 11.”

Enclosure 11 states i.a.:

> *”13. Is the atmosphere safe in cargo holds and enclosed spaces to which access may be required, have cargoes which emit gas been identified and has the need for surveillance of the atmosphere been agreed between the ship and the terminal?*
>
> Rust formation on steel constructions or the characteristics of the cargo may cause a hazardous atmosphere. The following shall be considered: consumption of oxygen in the cargo holds; the influence

of development of gas either from cargo to be discharged or from cargo in a silo before loading, from where gas may be brought on board together with the cargo without any warning to the ship; and leakage of gas, toxic or explosive, from adjacent cargo holds or other spaces."

6. Course of Events

6.1 Course of events according to the ship

All times stated are local time.
From 26 to 29 September the SAGA SPRAY was in Vancouver, Canada, to load 13 077 tons of wood pellets to be discharged in Helsingborg.

Cargo holds 1, 5, 6 and 9 were filled. The ship left at 0720 hours.

The SAGA SPRAY arrived in Los Angeles on 2 October at 1250 to complete the loading with timber and borax. The latter is a salt of boric acid and sodium with a variety of uses, for example for washing powder.

On 9 October at 0210 hours the ship left Los Angeles and passed the Panama Canal on 18 October.

The first port for discharging was Rotterdam, where the ship arrived on 3 November at 0515 hours; she left on 8 November at 1340 hours. The SAGA SPRAY also discharged in Flushing, the Netherlands, on 9 November, in Antwerp, Belgium on 9 and 10 November and in Brake, Germany on 11 and 12 November. After the discharge in Brake only the pellets cargo was left on board.

At 1442 on 14 November the ship was berthed in the West harbour, Port of Helsingborg, at berth 903 with her port side alongside. No. 1 hatch was opened at 1600 hours and the discharging started at 1606 hours. Also the covers of the access openings to all holds were opened, but the covers were placed on the wing nuts (which were turned up) in order to let fresh air in.

At 2145 hours the discharging was finished for the day and was resumed at 0605 on the next day, also No. 1 cargo hold which was finished at 1150 hours on the same day.

At 1330 hours No. 9 cargo hold was opened for the first time in seven weeks, and the discharging started 5 minutes later. At the same time the access trunk cover was fully opened. After a break for rain in the afternoon the discharging was stopped for the day at 2055 hours, when the hatch was closed and also the access cover was put down on the wing nuts.

On the next day, which was the day of the accident, the hatch and the access trunk entrance of hold No. 9 were opened at 0545 hours, and 25 minutes later the discharging continued. The hatch cover was placed upon the cover of hold No. 7.

The day was on the whole cloudy but now and then the sun came through. The wind was south-westerly about 5 m/sec. (3B).

6.1.1 Narrative of the officer of the watch (OOW)

At 0755 hours a crew member (ordinary seaman) came to tell the deck officer that the stevedoring company would put a front end loader in the cargo hold to collect the remaining pellets to finalize the discharging.

It then turned out that one had to move the No. 9 hatch cover from cover No. 7 to No. 5 so that the land based crane could lift the front end loader on board. The boatswain did this by using the gantry crane under the supervision of the deck officer.

A stevedore shouted to the deck officer that one needed the door of the cargo hold to be opened for a man to go down to detach the front end loader. At the same time the boatswain asked the deck officer for assistance to remove the cover from hold No. 4. The deck officer therefore asked the stevedore to stand by while he, at the same time, asked the ordinary seaman to go down to open the uppermost door in the access trunk, but not to go further down since the concentration of oxygen was not checked.

Before the deck officer went to assist with the removal of the cover of hold No. 4 he told the ordinary seaman to come up on deck and wait for him, he would then return with the checklist and an oxygen meter.

When the removal of the cover was finished and the deck officer was on his way back to hatch No. 9 someone shouted that two men had collapsed in the access trunk.

The deck officer shouted the same message in his VHF and then hurried to the bridge where he activated the general alarm to make the crew go to their muster stations.

6.2 Course of events according to the stevedoring company

6.2.1 Narrative of the stevedore foreman

The foreman of the stevedoring company was informed by the signal man that it was time to put down the front end loader. He then went on board and asked that the access to the cargo hold should be opened and that the cover of the cargo hold should be moved by the ship's gantry crane since the cover would be in the way of the front end loader to be lifted on board.

The foreman saw a crew member going down in the trunk and that he opened the door to the cargo hold on the first landing. The truck operator of the stevedoring company, who just arrived, was shown the way to the access trunk of the cargo hold. The foreman then left the ship since he was summoned about a conveyor that caused trouble.

Down on the quay the foreman heard in his radio that the crew member had collapsed and needed help. He understood from the radio traffic that first the truck operator and then the signal man had gone down in the access trunk to help the man in distress.

The foreman then heard in the radio that the truck operator shouted that there was gas in the trunk. Soon afterwards the signal man shouted that the truck operator had collapsed.

At that moment the foreman got contact over the phone with SOS Malmö after having called 112 (national emergency telephone number).

6.2.2 Narrative of the stevedore workers

The truck operator was told by the foreman to go down in the cargo hold. He remembered that he started climbing down the ladder, but thereafter he knows nothing more. He did not remember that a crew member had gone down before him.

The signal man was at hatch No. 9 on the ship's seaside. He saw a crew member going down through the access opening and then opened the

uppermost door of the cargo hold and hooked up two chains as protection against fall in front of the opening. After a while he heard knockings from the lower door.

The signal man was then called on the radio by the truck operator who told him that the crew member had collapsed in the trunk. Then the truck operator disappeared in the trunk. The signal man hurried to the access trunk and followed the truck operator down.

When the signal man had gone down a bit he was told by the truck operator to turn back since there was a smell of gas. He turned but noticed that the other man had collapsed and did not respond to his calls.

The signal man started to feel a pricking sensation in his legs and returned to deck.

6.3 The rescue action

When the alarm sounded the ship's fire group and three crew members gathered, picked up breathing apparatuses and went down in the access trunk to help the persons in distress.

Two men stopped on the second landing where the truck operator was lying, whereas the third one went down to the bottom of the trunk to help the ordinary seaman who was on his knees, leaning forward with his head resting on his arms and with no perceptible pulse.

He tried to open the door to the cargo hold to get fresh air in but did not manage since the door was tightened with tape on the cargo hold side. He tried to carry the ordinary seaman up, but failed and therefore he leaned him onto the bulkhead.

The crew member who had hurried to help then returned to the unconscious truck operator and had him breathe through his breathing mask. After a while ambulance personnel arrived and took care of both the crew member, who felt dizzy, and the truck operator. Both were taken to hospital.

One of the two wearing breathing masks went with an ambulance operator to the bottom of the trunk, where they together managed to open the door and pull the man in distress into the cargo hold. He was then lifted to shore by the land based crane.

7 Analysis

7.1 The cargo

It is a well known fact that pellets develop carbon monoxide and other gases, and also reduces the content of oxygen when stored in enclosed spaces. It has been assumed that for this a biological process is needed, that heats the pellets to a level where the chemical process follows.

On her voyage between Vancouver and Sweden the SAGA SPRAY had passed tropical areas with high temperatures and sunshine on the deck of steel and on the hatch covers of steel. This has probably contributed to the temperature rise that triggered the formation of carbon monoxide that, in spite of closed and tightened doors, had found its way down in the ship's access trunks.

7.2 The crew and the stevedoring company

As mentioned earlier it was an imperative requirement that the crew should use a gas meter and tick off a check list when an enclosed space was to be entered. The crew member and the deck officer were well aware of the regulations on board.

In spite of this the deck officer ordered the ordinary seaman to climb down to the uppermost landing, open the door to the cargo hold and then return to deck. There he would wait for the gas meter and the check list.

The deck officer claims that it sometimes happened that one went down to the uppermost level, provided that the access trunk had been open for ventilation. One should have realized that the period of time that the trunk had been fully or partly open, with no draught at all, was completely insufficient.

There is reason to wonder why the regulations in force were violated, considering the knowledge that the space could be hazardous. A space that had been closed since the loading in Vancouver seven weeks earlier was by definition a suspect space, something that should have been obvious to both the crew and the stevedoring company.

The ordinary seaman knew that the stevedoring company would go down in the hold with a front end loader and that the deck officer at least initially

was busy with other matters. It is not impossible that he therefore was under stress and as soon as possible wanted to carry out the request from the stevedoring company to open the entrance to the cargo hold.

The fact that the deck officer got something else to do and left may also have contributed to the ordinary seaman taking the wrong decision.

Experience shows that Philippine seamen as a rule are anxious to carry out given orders without delay. This may have been one reason why the ordinary seaman disregarded the hazards in order to carry out the expressed wish of the stevedoring company for quickest possible access.

The reason why the truck operator of the stevedoring company went down may have been that he considered it to be without any risk, since one crew member was already on his way down.

It is hard to give credence to the statement that he went down because he saw that the crew member had collapsed, since the latter was found in the bottom of the trunk, a space that due to ladders and landings was not visible from the access opening on deck.

The absence of the stevedore foreman may have contributed to the fact that the truck operator interpreted it so that it was OK to go down.

The Port of Helsingborg has previously discharged wood pellets from the same shipper. The personnel of the port say that they cannot recall having received a Shipper Cargo Information Sheet from those ships on any occasion.

In the eyes of the trade union representative of the stevedoring company this is strange, since he together with personnel from the port at a meeting after the accident saw a substantially identical document that was dated the year 2003.

7.3 Rules and regulations

Both the Act and the Regulations clearly state that they are applicable to both the ship and the terminal and deal with the obligations and responsibilities of the terminal operator and the master. The Regulations also require a checklist to be filled out and signed by both the ship’s master and the person responsible for the terminal before the discharging starts and enclosed spaces are entered.

In the course of the investigation it has become apparent that the stevedoring company has not considered themselves to be obliged to pay attention to the sections of the Swedish Maritime Administration's regulations that apply to the discharging of bulk carriers. It seems as if they have been under the delusion that the regulations apply only to the ships.

The stevedoring company also claimed that from their side it is presumed that the ships' crews have taken necessary measures and complied with the regulations applicable for all types of transports so that the safety of the port personnel is secured. They considered it to be intolerable if this was not the case, since stevedoring companies are working in ships.

The consequence of responsibility being shared by the stevedoring company and the ship is that the possibility for foreign ships to take part in otherwise unfamiliar legislation increases. The representative of the ship owner and the ship on site, the shipbroker, might properly speaking take that function. However, there are no regulative requirements for this.

Thus one neglected own instructions by entering the room without waiting for an OK from the ship's crew.

Both the ship's crew and the terminal personnel have experience from wood pellets.

The ship's crew has passed safety training which, among other things, has focused on the hazard of entering enclosed spaces and the measures that then need to be taken.

The stevedore team of workmen were experienced stevedores who claim to have been involved in discharging of wood pellets earlier.

In spite of manuals, check lists, rules and requirements for procedures the safety was neglected by both the crew and the stevedoring company when a space was entered, that more or less had been closed for about seven weeks without any kind of mechanical or natural ventilation.

It is true that the access opening of the trunk had been partly open since the discharging started 40 hours earlier, and it had been fully open for at least two hours before the accident. In spite of this there was no noticeable ventilation since the door in the lower part of the access trunk had not been opened. Had both ends of the trunk been open there is a possibility that a stack effect would have been obtained by draught.

7.4 Miscellaneous

The lowest door between the trunk and the cargo hold was tightened with tape from the cargo hold side. The signal man of the stevedoring company heard the ordinary seaman knocking inside the door. This may indicate that he was working on the handle of the door but did not have the strength to open because the tape resisted. Had he managed to open the door the course of events might have been different since he would then have come out in fresh air in the cargo hold and fresh air would also have come in the access trunk.

Neither did the crew member who came to rescue with a breathing apparatus manage to open the door.

8 Port State Control

In the last three years the ship has been subject to port state controls in various ports 17 times, 10 of which by the US Coast Guard. A few deficiencies have been noted, but no detention.

At his visit on board due to the accident the ship surveyor made a port state control which resulted in 3 deficiencies:

- Access to hazardous spaces has been made incorrect. Warning signs were not posted on the access cover.
- The plan according to ISM concerning ship activites was not satisfactory implemented.
- The responsibility and authority of the master was not in accordance with the ship’s SMS (Ship Management System).

The ISM (International Management System) was revised after a similar accident in another of the ship owner’s ships in 2003 (see below).

9 Cause and Factors

The immediate cause of the accident was that the written routines of neither the ship nor the stevedoring company was adhered to in the practical work.

Contributing factors were that both the ship's deck officer and the stevedore foreman got other tasks and therefore left the area.

Another contributing factor was that the bottom door was tightened with tape on the cargo hold side, which made it impossible for the ordinary seaman and also for the crew member who hastened to the place to open the door.

10 Observations

- The master and the crew of the SAGA SPRAY did not observe the regulations of the SMS of the ship. This particularly applies to what is said in SMS, section 1, chapter 4.1, that concerns entrance in enclosed or dangerous spaces.

- The master and the stevedoring company failed to jointly fill out the checklist as directed in the Swedish Maritime Administration's Regulations SJÖFS 2003:10, section 18, enclosures 10 and 11.

- The terminal personnel seems not to have been ”trained in all aspects concerning safe loading and discharging of bulk carriers” as per SJÖFS 2003:10, section 7, enclosure 2.

- According to statements from certain responsible terminal personnel they have not been aware of the fact that the Swedish Maritime Administration's Regulations SJÖFS 2003:10 applies also to the terminal and its personnel.

- Stevedores were of the opinion that it must be presumed that the ships' crews have taken necessary measures and complied with regulations in force to ensure the safety of the stevedores.

- Although he had participated in discharging such ships “a countless number of times” the truck operator, who was the first from the stevedoring company to go down in the access trunk, did not know that one should carry an oxygen meter when entering enclosed spaces.

11 Recommendations

- The ship owner of the SAGA SPRAY should see to it that the access trunk covers are supplied with signs ”Low Oxygen Risk Area” or the equivalent.

- The ship owner is requested to give the master such instructions that the regulations of the ISM manual are complied with.

- The ship owner is urged to request that the management order which was issued after the previous fatal accident (see Miscellaneous) with a similar course of events is complied with. It was then pointed out that the masters shall see to it that enclosed spaces are carefully ventilated with a portable ventilator before entry.

- The ship’s master shall introduce strict routines so that the crew does not, as was the case here, go to the first landing without having established that the concentration of oxygen in the air is sufficient.

- The stevedoring company is urged to improve knowledge and routines as regards loading and discharging work.

- The stevedoring company must inform and train their employees to be aware of the hazards that access roads and other spaces may constitute.

- The Swedish Maritime Safety Inspectorate should work in the IMO to introduce regulations so that enclosed spaces which are frequently used should be designed and/or be equipped so that the risk of suffocation does not arise.

12 General Recommendation

This case has shown that there was a great concentration of carbon monoxide. It is therefore important to measure not only the content of oxygen. There should also be instruments onboard for measuring hazardous gases.

13 Personal Injury

Five crew members had to be taken to hospital, one of which was diseased before treatment.

Two ambulance personnel had increased content of carbon monoxide in the blood and were treated in hospital.

Two stevedores were also taken to hospital. One of them was seriously injured.

14 Miscellaneous

In the last four years at least five similar accidents have happened.

In 2003 one crew member died in another one of the ship owner’s ships, the SAGA VOYAGER, when discharging timber in the US. One crew member was ordered to open the door to the cargo hold. He was found dead on the second landing in the access trunk to hold No. 8. The cargo had been on board for three weeks.

In 2002 another accident took place when wood pellets were discharged in Rotterdam. One man died and three were injured.

In August 2005 the Swedish ship EKEN was at Gruvön, Sweden, to discharge pulpwood. One crew member went down in the access trunk to a cargo hold where gear for cleaning the holds were kept. He was found dead in the bottom of the trunk. The cargo had been on board for four days only. After the accident a mechanical ventilator was installed, which sucked from the bottom of the space.

On 19 December an accident with fatal outcome happened in Skellefte-hamn, Sweden, on board the Swedish ship NOREN, when an ordinary seaman died. The accident seems to be confusingly like the fatal accident in the EKEN mentioned above.

The remaining two occurrences have been collected from the de-identified information system on near misses at sea – INSJÖ.

The legal representative of the ship has informed in the course of the investigation that the stevedoring company had got a formal permission from the ship to go down in cargo hold No. 1 when that was discharged.

Addition made on 31 January, 2007

In connection with the fatality on board the Hong Kong registered ship SAGA SPRAY in Helsingborg in November last year, the Maritime Casualty Investigation Division of the Swedish Maritime Safety Inspectorate performed an investigation (registration No. 080202-06-17470).

The purpose of the investigation is only to establish from a safety point of view what was made right or wrong and to provide against repetition. There is no intention whatsoever to establish who is to blame or who is responsible.
However, in case there is a lack of taking responsibility this shall be accounted for. This principle is governed by IMO Resolution A.20/846, which is the guidance for the activities of the Maritime Casualty Investigation Division. Thus it is not the intention or task of the Maritime Casualty Investigation Division to influence the activities of other Authorities as regards taking of responsibility, if any. The Maritime Casualty Investigation Division, however, assists with information and knowledge of the activities.

In their report the Maritime Casualty Investigation Division refer to the Swedish Maritime Administration's Regulations (SJÖFS 2003:10) on loading and discharging of bulk carriers. These regulations impose on the personnel of the port terminal as well as on the ship's crew among other things to follow a certain check list, one item of which is to check/secure the atmosphere in cargo holds. One purpose of those regulations is to cover the borderland between terminal and ship. In the regulations in question the responsibility is divided on both parties, thereby avoiding the absurd situation that might arise if the full responsibility was on the ship only, which in some cases is not familiar with details in Swedish legislation.

The Maritime Casualty Investigation Division can establish that the regulations SJÖFS 2003:10 are not applicable in this specific case, since the ship SAGA SPRAY as per the definition in those Regulations is not a bulk carrier since there are no top side tanks/hopper tanks. The Maritime Casualty Investigation Division could not and should not have referred to the Regulations which impose upon the terminal personnel the responsibility to take certain measures.

The Regulations bring in force Directive 2001/96/EC of December 4 establishing harmonized requirements and procedures for the safe loading and discharging of bulk carriers. By the Directive the so called BLU Code, adopted by IMO, is brought into force as a part of the Community Law. The BLU Code was primarily intended to prevent damage on a certain type of ships when loading and discharging, but it also comprises certain regulations of importance to the work environment of terminal personnel as well as of ships' crew. The Maritime Safety Investigation Division can however establish that that type of ship is of no importance in this case.

It is the strong opinion of the Maritime Casualty Investigation Division that it is the type of cargo that causes the hazardous atmosphere, not the type of ship. An adjustment of the rules and regulations has therefore been initiated.

The Swedish Maritime Safety Inspectorate has in this case, as often, been in cooperation with other Authorities, e.g. the Swedish Work Environment Authority. In this case opinions on the actions of the terminal personnel have been considered to be relevant. Since it has been established that the Regulations SJÖFS 2003:10 are not applicable, the relevance of the statements referring to those Regulations lessen. The sections of the report which are concerned are:

Passage 5 Dealing with "rules and regulations on loading and discharging of bulk carriers". The text describes the contents of the Regulations but has got no formal relevance since the SAGA SPRAY by definition was not a bulk carrier.

Passage 7.3 Analysis – the part of the passage that concerns the stevedoring company (parts 1 and 2).

Passage 10 Observations – second, third and fourth Items.

As to the rest the Maritime Casualty Investigation Division stand by the consequences and statements made in the report.

The Maritime Casualty Investigation Division regrets the inconveniences that may have occurred in this connection.