



Report of Investigation
into the fatal accident on board
the Hong Kong Registered ship
“Saga Spray”
on 16 November 2006



The Hong Kong Special Administrative Region
Marine Department
Marine Accident Investigation Section

Purpose of Investigation

This incident is investigated, and published in accordance with the IMO Code for the Investigation of Marine Casualties and Incidents promulgated under IMO Assembly Resolution A.849(20). The purpose of this investigation conducted by the Marine Accident Investigation and Shipping Security Policy Branch (MAISSPB) of Marine Department is to determine the circumstances and the causes of the incident with the aim of improving the safety of life at sea and avoiding similar incident in future.

The conclusions drawn in this report aim to identify the different factors contributing to the incident. They are not intended to apportion blame or liability towards any particular organization or individual except so far as necessary to achieve the said purpose.

The MAISSPB has no involvement in any prosecution or disciplinary action that may be taken by the Marine Department resulting from this incident.

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1. Summary

- 1.1 An accident happened onboard the Hong Kong registered ship "*Saga Spray*" in the port of Helsinborg, Sweden on 16 November 2006. While an Ordinary Seaman and a bulldozer operator were entering the No. 9 cargo hold via the enclosed stair trunk, they were overcome by the atmosphere and collapsed inside the trunk. The two persons were sent to hospital. The Ordinary Seaman died and the bulldozer operator seriously injured in the incident. Eleven persons who served in the rescue team felt physically uncomfortable and admitted to hospital for observation.
- 1.2 The investigation revealed that the enclosed stair trunk was not properly ventilated before the entry. The Ordinary Seaman and the bulldozer operator were overcome by the high concentration of carbon monoxide in the enclosed stair trunk.

2. Description of the Vessel

a) Particulars of *the Vessel*

Name of the Vessel	:	" <i>Saga Spray</i> "
Port of Registry	:	Hong Kong
IMO No.	:	9014078
Official No.	:	HK- 0663
Call Sign	:	VRWW5
Classification Society	:	Det Norske Veritas
Type of Ship	:	General Cargo Ship
Year of Built	:	1993
Built At	:	Oshima Shipbuilding Co. Ltd.
Ship Manager	:	Patt, Manfield & Co. Ltd., Hong Kong
Length	:	191.09 metres
Breadth	:	30.50 metres
Depth	:	16.40 metres
Gross Tonnage	:	29,381
Net Tonnage	:	14,155
Engine Power	:	7,609 kW

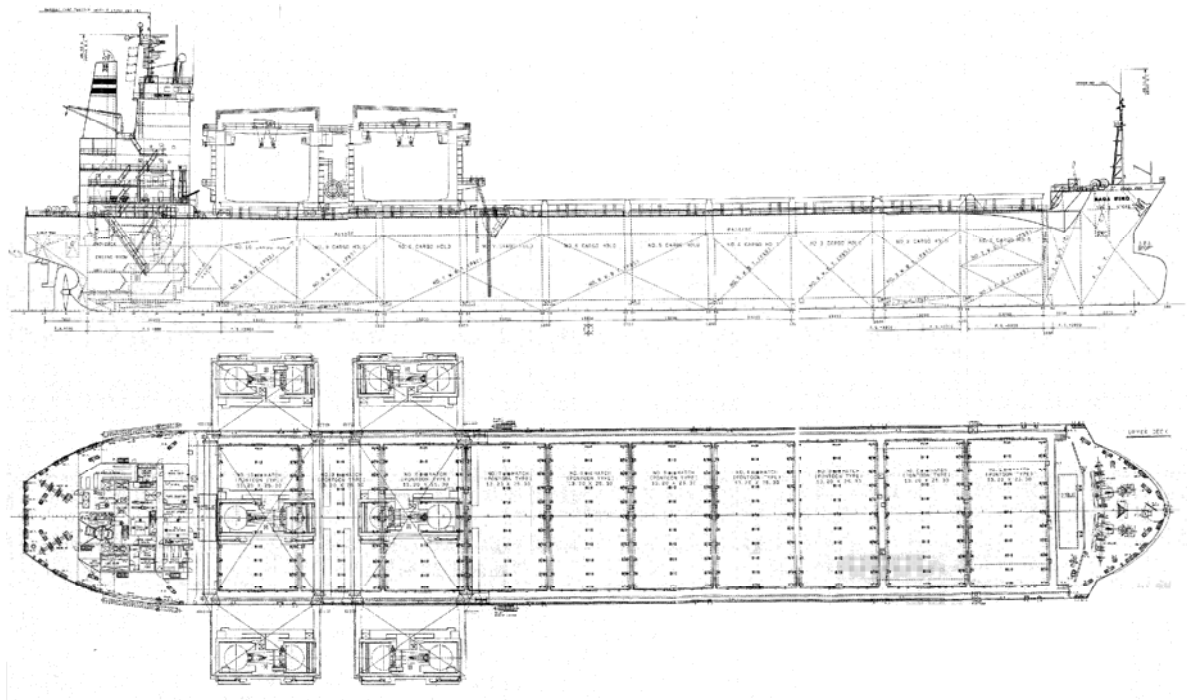


Fig. 1: The general arrangement of M.V. "*Saga Spray*"

- b) "*Saga Spray*" (hereinafter referred as *the Vessel*), is a double hull, ten-hold general cargo ship built by Oshima Shipbuilding Co. Ltd, Japan in 1994. She is powered by a seven-cylinder marine diesel engine, Sulzer 7RTA52, capable of developing engine power of 7,609 kW. *The Vessel* was owned by Scorpio Carriers Ltd and managed by Patt, Manfield & Co. Ltd., Hong Kong. At the time of the accident, *the Vessel* was chartered by Saga Forest Carriers, Tonsberg Norge.
- c) The cargo holds of *the Vessel* are separated by enclosed stair trunks fitted with 2 straight stairways, 3 access doors and 3 landing platforms at different levels for accessing the cargo holds (see figure 2).

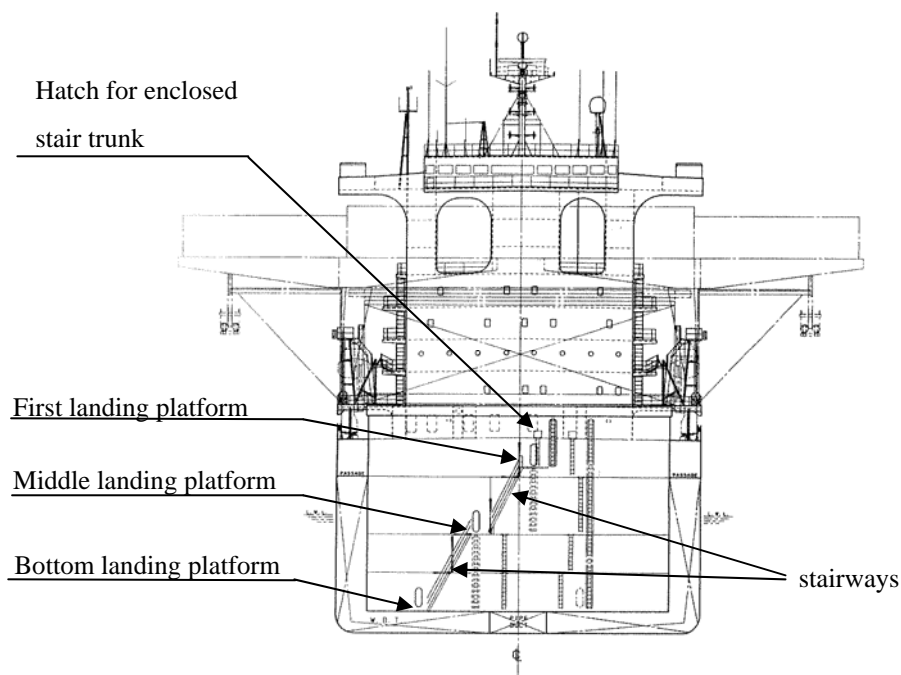


Figure 2: Cross section view of "*Saga Spray*"

- d) *The Vessel* is fitted with two gantry cranes that run on fixed rails. Each gantry crane has a lifting capacity of 40 tonnes.

3. Sources of Evidence

- a) The Master and Crewmembers of “*Saga Spray*”
- b) The management company of “*Saga Spray*”
- c) Swedish Maritime Administration

4. Outline of Events

- 4.1 *The Vessel* loaded with 13,077 metric tons of wood pellets into the cargo holds Nos.1, 5, 6 and 9 in Vancouver, Canada from 26 to 29 September 2006.
- 4.2 *The Vessel* arrived Los Angeles on 2 October for further loading of timber and borax in the cargo holds Nos. 2, 3, 4, 7, 8 and 10. She departed for Europe on 9 October and arrived Rotterdam on 3 November.
- 4.3 From 3 to 12 November, *the Vessel* as per the unloading schedule started unloading of timber and borax cargoes first at Rotterdam then Antwerp and Brake. On 12 November, *the Vessel* with only wood pellets on board departed Brake for Sweden.
- 4.4 At 1442 on 14 November, *the Vessel* went alongside at berth 903 at West Harbour, Port of Helsingborg, Sweden for discharging of wood pellets. Cargo discharging started at about 1600 on the same day.
- 4.5 At about 0610 on 16 November, No. 9 cargo hold was opened for cargo work. A small amount of wood pellets was left inside the cargo hold, the crane was not able to reach the edges of the cargo hold to clear up all wood pellets. It was a normal practice to use a bulldozer to group the remaining wood pellets at the centre of the cargo hold for grabbing. At 0755, a bulldozer was lifted into the No. 9 cargo hold. An Ordinary Seaman and a bulldozer operator entered the cargo hold via the enclosed stair trunk (see figure 3) to release the hoisting sling attached to the bulldozer. A signalman was standing by at the access hatch of the enclosed stair trunk.



Figure 3: The enclosed stair trunk

- 4.6 When the Ordinary Seaman reached the bottom of the stairway, he collapsed and lost consciousness. The bulldozer operator immediately informed other workers via his hand held radio. Soon afterward he also collapsed inside the enclosed stair trunk. The signalman entered the enclosed stair trunk in order to help the persons inside. However, he felt breathing difficult and returned back to the deck. The stevedore foreman called 112 (the national emergency telephone number) for assistance.
- 4.7 After being alerted of the incident, the Chief Officer raised general alarm and informed all crewmembers to muster at emergency stations. Three crewmembers equipped with a self-contained breathing apparatus entered the enclosed stair trunk to effect rescue operation. Two crewmembers picked up the bulldozer operator from the middle landing platform while the remaining crewmember went down to the bottom landing platform to rescue the Ordinary Seaman. However, he was not able to retrieve the Ordinary Seaman.
- 4.8 Later on, a shore rescue team arrived and retrieved the unconscious Ordinary Seaman via the access door between the trunk and cargo hold. Both the Ordinary Seaman and the bulldozer operator were sent to hospital. The Ordinary Seaman was certified dead in the hospital while the bulldozer operator suffered serious injuries.
- 4.9 After the rescue operation, two ambulancemen, two stevedores and seven other crewmembers of the rescue team felt physically uncomfortable. They were sent to hospital for observation and were later on discharged from hospital without any health problems.

5. Analysis of Evidence

The Ordinary Seaman

5.1 The Ordinary Seaman was a Filipino of aged 33. He joined *the Vessel* on 26 May 2006 and received shipboard safety training upon joining *the Vessel*. He had about two years of sea-going experience as deck cadet and ordinary seaman.

The No. 9 cargo hold and its enclosed stair trunk

5.2 There are two means of access to No. 9 cargo hold from the main deck. The first was a vertical ladder that was mounted at the aft of the cargo hold. The second was an enclosed stair trunk located at the forward of the cargo hold (see figure 4). The enclosed stair trunk fitted with stairways and access doors for personnel to get entry into the cargo hold. To enter the cargo hold, the enclosed stair trunk would be used whenever cargo work was in progress.

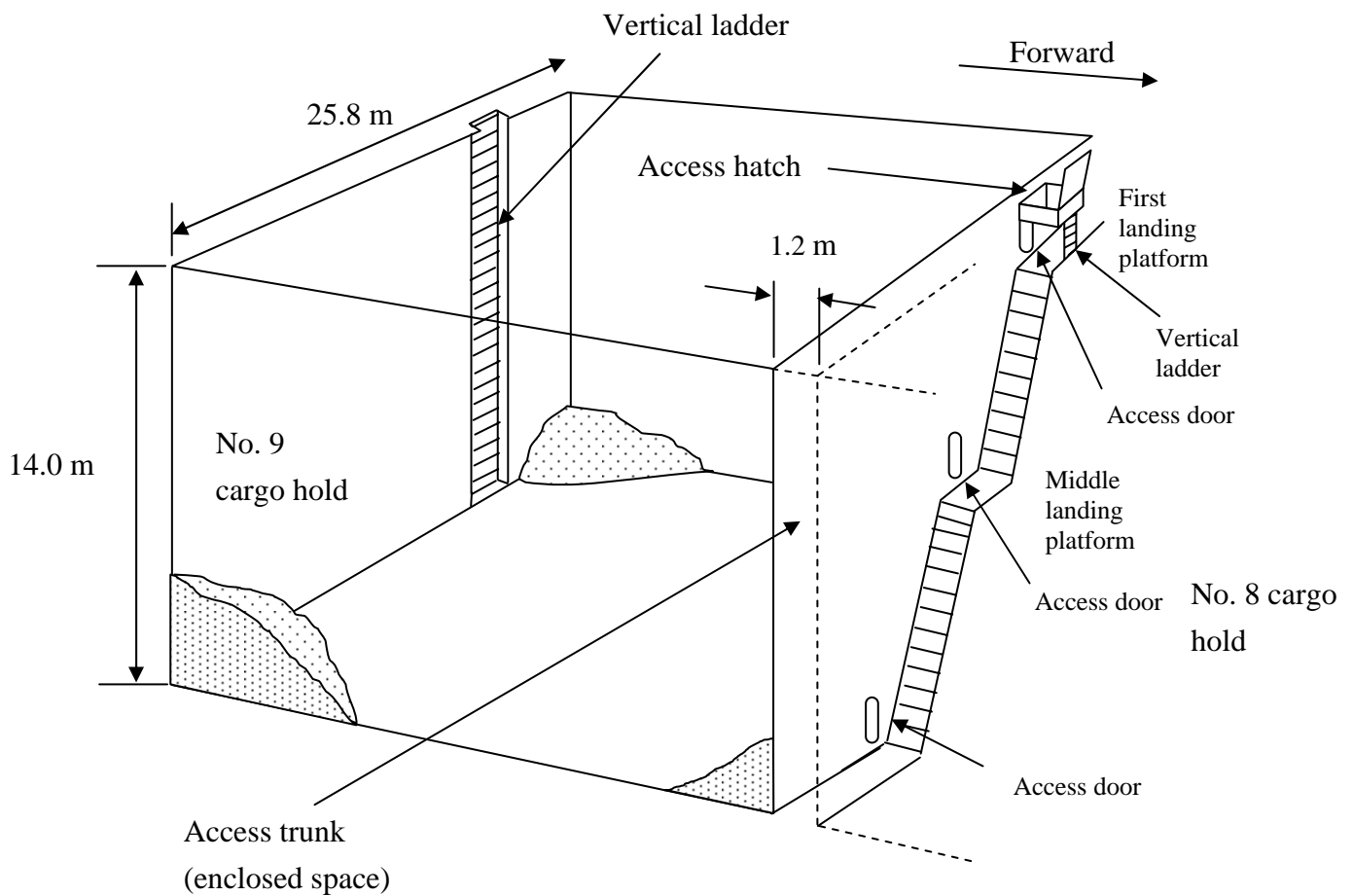


Figure 4: Sketch of the access trunk and cargo holds.

- 5.3 The enclosed stair trunk was about 1.2 m width and 14 m depth. There was no means of mechanical ventilation fitted.
- 5.4 The access doors were non-watertight steel doors. The atmosphere of the cargo hold could get into the enclosed stair trunk through the gaps between the bulkhead and the doors (see figure 5). Gases could be trapped inside the trunk even the hatch was opened for a period of time.

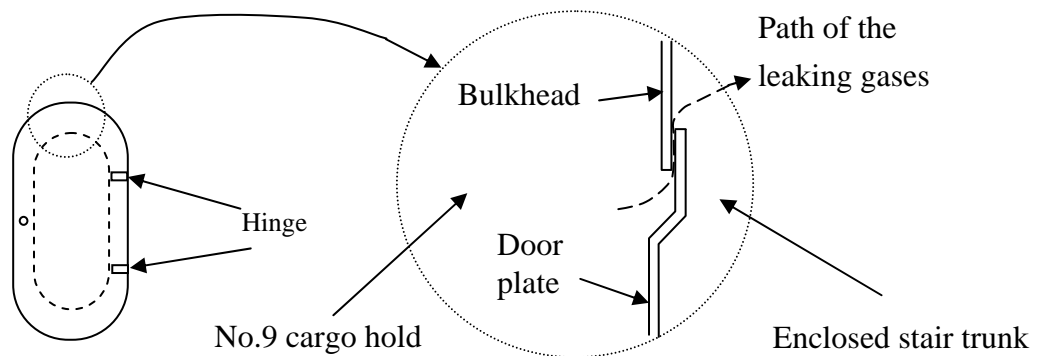


Figure 5: Sketch showing gases may leak through the gap into the enclosed stair trunk

- 5.5 Warning sign “Low Oxygen Risk Area” had been painted on top of the access hatches of all enclosed stair trunks. However, the painting was found to have faded away over time and the words were illegible.

The wood pellets

- 5.6 The wood pellets are made by compressing sawdust, planer shavings and bark into tiny stick of 6 mm in diameter. The wood pellets have a bulk density of 600 to 750 kg/m³ and are normally used as fuel in stoves, fireplaces, district heating and electrical power generation.
- 5.7 According to the Code of Safe Practice for Solid Bulk Cargoes, 2004 (BC Code), the wood pellets are classified as Group B cargoes which possess a chemical hazard which could give rise to a dangerous situation on a ship. The wood pellets may be subject to oxidation, leading to depletion of oxygen and increase of carbon monoxide and carbon dioxide in cargo spaces or communicating spaces. The following safety guidelines should be observed:

- *Oxygen and carbon monoxide meters should be used before entering confined*

spaces; and

- *Entry of personnel into cargo spaces or communicating spaces should not be permitted until tests have been carried out to ensure the spaces are safe.*

The enclosed stair trunk was a communicating space with the cargo hold. As such, proper ventilation and test should be carried out prior to the entry of the enclosed stair trunk.

Safety management manual

- 5.8 The shipboard safety management manual (SMM) stipulates the requirements on the entry of enclosed spaces or confined dangerous spaces including the enclosed cargo hold and access trunks with the following safety precautions:

“Tanks holds, hatch access trunks, void spaces, double bottoms, duct keels, pump rooms, cofferdams, chain lockers, CO₂ rooms, sewage tanks, pressure vessels, battery lockers, inter barrier spaces, IG scrubbers, etc.

Entering any confined space is hazardous and can result in rapid death from harmful gases and/or lack of oxygen...

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 vapour (where suitable instruments are available).*
- 4. Ensure procedures are instituted before and after entry. If any doubt as to adequacy of ventilation or testing ensure breathing apparatus is worn by all persons entering the space.*
- 5. Ensuring Officer and crew on watch carry a pocket size oxygen content meter. ...*

In all cases and prior to entry the enclosed space checklist must be completed (see the checklist in the appendix). 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. ...”

According to the SMM, enclosed hatch access trunks, are identified as enclosed or confined dangerous spaces. Following non-conformities were observed:

- The enclosed stair trunk had not been thoroughly ventilated and tested; and
- The “enclosed space checklist” had not been completed.

It appeared that the SMM procedures had not been complied with by the Master and Crewmembers.

The atmosphere of the cargo hold and the enclosed access trunk

5.9 The port authority of Helsingborg had carried out measurements on the atmosphere of the cargo holds that containing wood pellets (cargo holds No. 5 and No. 6 of *the Vessel*) in different conditions. Following results were recorded:

	Oxygen (%)	Carbon monoxide (ppm ¹)	LEL ² (%)
At time of opening of hatch	15	> 1000	Max
After 5 minutes of discharging	20.9	0	0

When the cargo holds containing wood pellets had been closed for a period of time, the wood pellets would consume oxygen and emit carbon monoxide. The atmosphere inside the cargo hold could get into the enclosed stair trunk through gaps of the three access doors. Apparently, the atmosphere in the enclosed stair trunk contained a high level of carbon monoxide and depleted in oxygen.

5.10 The normal oxygen content in the atmosphere is 20.9 %. When the oxygen content in the enclosed stair trunk had been dropped down to 15 %, persons there would get feelings of dyspnea, emotional instable and extreme tiredness. If the oxygen content was further reduced to 10%, death would occur in minutes.

5.11 The atmosphere normally contains a small trace amount of carbon monoxide (about 9 ppm). When the concentration of carbon monoxide in the atmosphere increases above 150 ppm, unconsciousness and death are possible. At the time of the accident, the carbon monoxide content in the enclosed stair trunk was above 1000 ppm, a high risk of carbon

¹ ppm – parts per million

² LEL – lower explosive limit

monoxide poisoning to personnel existed. The atmosphere of the enclosed stair trunk was lethal to personnel.

Nature of the injury of the deceased

- 5.12 Autopsy of the deceased was conducted by Forensic Medicine Department, Lund, Sweden. The cause of death was carbon monoxide poisoning.

Oxygen and gas meter

- 5.13 *The Vessel* was equipped with two oxygen meters and one multi-gas detector for measuring the oxygen and toxic gas content including carbon monoxide inside the confined spaces. One of the oxygen meters was inoperable and awaiting repair. The other oxygen meter and the multi-gas detector were functioning but had not been used prior to the entry of the confined space.

Similar occurrence

- 5.14 On 18 November 2003, similar accident happened on board “*Saga Voyager*”, a sister ship of *the Vessel* which was also managed by Patt, Manfield & Co. Ltd., Hong Kong. While “*Saga Voyager*” was discharging timber at Port Everglades, USA, an able seaman was killed inside an enclosed stair trunk due to depletion of oxygen.

6. Conclusions

- 6.1 An accident happened onboard the Hong Kong registered ship "*Saga Spray*" in the port of Helsinborg, Sweden on 16 November 2006. While an Ordinary Seaman and a bulldozer operator entering the No. 9 cargo hold via the enclosed stair trunk, they collapsed inside the trunk. The Ordinary Seaman died and the bulldozer operator seriously injured in the incident. Eleven persons served in the rescue team felt physically uncomfortable and admitted to hospital for observation.
- 6.2 The investigation revealed that the enclosed stair trunk was not properly ventilated before entry. The Ordinary Seaman and the bulldozer operator were overcome by the high concentration of carbon monoxide inside the enclosed stair trunk that was lethal to personnel.
- 6.3 The investigation has also identified the following contributory factors to the accident:
- The Crewmembers of *the Vessel* did not observe the guidelines stipulated in the BC Code nor the procedures in the SMM for entry into enclosed spaces;
 - Crewmembers were unaware that wood pellets inside cargo holds could emit carbon monoxide; and
 - The warning sign "Low Oxygen Risk Area" on access hatches was faded and illegible.

7. Recommendations

7.1 A copy of this report should be sent to the management company and the Master, advising them the findings of this incident. It is recommended that the SMM should included the following safety procedures for the carriage of wood pellets:

- The enclosed stair trunks should be properly ventilated preferably by mechanical means and tested for the safety levels of oxygen and carbon monoxide prior to the entry of personnel;
- Wood pellets are classified as Group B cargoes, the Master and the Crewmembers should be well aware the safety requirements stipulated in the BC Code.
- Appropriate warning signs should be displayed at the entrances of the stair trunks.

7.2 A copy of this report should be sent to the Swedish Maritime Administration advising them the findings of this incident.

7.3 A Merchant Shipping Information Note should be issued to promulgate the lessons learnt from this fatal accident, drawing the industry's attention on the safe entry of confined spaces.

8. Submissions

- 8.1 In the event that the conduct of any person or organization is criticized in a casualty investigation report, it is the policy of the Hong Kong Marine Department that a copy of the draft report is given to that person or organization so that they have the opportunity to rebut the criticism or offer evidence not previously available to the investigating officer.
- 8.2 The final draft report was sent to the following parties:
 - a. Patt, Manfield & Co. Ltd.
 - b. The Master of *the Vessel*
- 8.3 Submissions were received from Patt, Manfield & Co. Ltd. The draft report was amended as appropriate according to the submissions. No submission was received from the Master of *the Vessel*.

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

<u>ACTION CHECK LIST</u>	DELETE AS APPLICABLE
<p>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.</p> <p>NB For entry into cargo pumprooms only those items marked with an asterisk need to be checked. Date: Time:</p>	
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
1.5 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:	
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.	
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;	YES/NO
(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.	