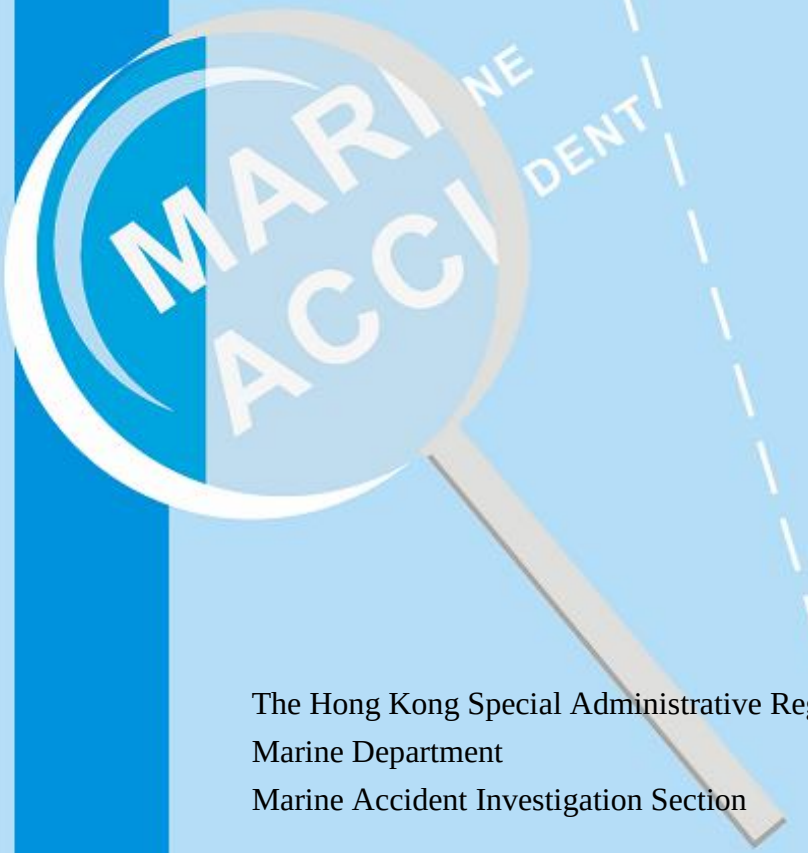
# Report of investigation into the fatal accident of the bosun onboard the Hong Kong registered bulk carrier *"Great Reward"* at sea on 17 May 2018




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

2 December 2020

## Purpose of Investigation

The purpose of this investigation, conducted by the Marine Accident Investigation Branch (MAIB) of Marine Department, is to determine the circumstances and the causes of the incident with the aim of enhancing the safety of life at sea and avoiding similar incidents in future.

It is not intended to apportion blame or liability towards any particular organization or individual except so far as necessary to achieve the said purpose.

The MAIB 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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**Summary**

The Hong Kong registered bulk carrier "Great Reward" (*the vessel*) departed from Picton port, New Zealand on 8 May 2018 with 31,000 tons of timber logs and sailed to Incheon, South Korea. Fumigation in transit was carried out by a fumigation technician (fumigator-in-charge) staying on board.

In the morning on 17 May 2018, the bosun informed the chief officer that he was going to measure the bilge water level of No. 3 cargo hold (*the C/H*) by opening the aft access hatch. Later at about 1015 hours, the chief officer found that the bosun was lying unconsciously on the upper stool shelf plate under the aft access hatch of *the C/H*. He was carried out from *the C/H* but was declared dead later on board.

The investigation revealed that the crew were lack of safety awareness and did not follow the safety procedures of carrying out a proper risk assessment before allowing the bosun to enter into the enclosed space (i.e. *the C/H*) through the aft access hatch. The fumigator-in-charge was also not being informed about the bosun's movement of preparing to enter into *the C/H*.

The investigation also identified a safety issue that phosphine gas readings were not recorded in *the vessel*'s logbook in accordance with IMO circular MSC.1/Circ. 1264.

## 1. Description of the vessel

| | | |
|---|---|---|
| Ship name | : | *Great Reward* (Figure 1) |
| Flag | : | Hong Kong, China |
| Port of registry | : | Hong Kong |
| IMO number | : | 9487067 |
| Type | : | Bulk Carrier |
| Year built, shipyard | : | 2011, CSSC Huangpu Shipbuilding, China |
| Gross tonnage | : | 19,994 |
| Net tonnage | : | 11,046 |
| Summer deadweight | : | 31,785 tonnes |
| Length overall | : | 177.50 metres |
| Breadth | : | 28.20 metres |
| Engine power, type | : | 6,480 kW, YMD-MAN B&W 6S42MC |
| Classification society | : | China Classification Society (CCS) |
| Registered owner | : | Great Reward Shipping Ltd. |
| Management company | : | Sinotrans Ship Management Ltd. |


Figure 1 *The vessel*

## 2. Sources of evidence

2.1 Information provided by the master, the crew and the management company of *the vessel*.

2.2 Death Certificate of the bosun issued by the Shanghai Water Public Security Bureau.

## 3. Outline of events

(All times were local time UTC + 11 hours)

3.1 On 8 May 2018, *the vessel* departed Picton port, New Zealand with cargo of 31,000 tons timber logs and sailed to Incheon, South Korea. All cargo holds were fumigated at Picton port with top up fumigation applied during the voyage by a fumigator-in-charge staying on board *the vessel*.

3.2 At 1800 hours on 11 May 2018, a special training session was held on board. The crew were trained to perform their daily duties with fumigated cargo holds during the sea voyage.

3.3 On 16 May 2018, the bosun found that No. 3 cargo hold (*the C/H*) port side bilge sounding was 11 metres but the reading of the starboard side was zero. He suspected that *the C/H* had water ingress and reported the finding to the chief officer. After confirming with engine room staff that there were no cargo hold bilge alarms, the chief officer did not think that water ingress had occurred in *the C/H*.

3.4 In the morning on 17 May 2018, the chief officer asked the bosun to clear *the C/H* sounding pipe by compressed air in order to determine if water ingress occurred in *the C/H*.

3.5 At about 0900 hours, the chief officer went to *the C/H* area on the main deck and found that the bosun could not clear the sounding pipe by compressed air. The bosun then suggested to use a 3-meter sharpened end steel bar with a tied rope to ram the bore of the sounding pipe with a view to clearing any blockage. The chief officer agreed with the suggestion.

3.6 Thereafter, the chief officer went to the forecastle to take photographs of the timber logs. He met the bosun again when returning to the accommodation and was told that the steel bar striking method was not successful. The bosun further suggested that he would wear a mask respirator (Figure 2) to open *the C/H* aft access hatch in order to lower a sounding tape directly into *the C/H*. Any water found on the tape would indicate that water ingress had occurred in *the C/H*. The chief officer agreed with the suggestion and asked the bosun to get a

mask respirator in the deck office. The chief officer indicated that he would join the bosun after wearing his safety helmet and safety shoes.

3.7 At about 1015 hours when the chief officer arrived at *the C/H* aft access hatch, he found that the bosun was lying on the upper stool shelf plate (*the stool shelf plate*) about three meters underneath the access hatch. The chief officer immediately contacted the bridge and the duty officer (third officer) informed the master at once. The master went to *the C/H* aft access hatch and the third officer summoned the crew through public address for rescue operation.

3.8 The chief officer, wearing an emergency escape breathing device (EEBD), went down to *the stool shelf plate* and tied the bosun with a rope. The master then pulled the bosun out from *the C/H*.

3.9 After the bosun was pulled out from *the C/H*, the master removed the bosun's mask respirator and found that his lips had turned purple and heartbeat could not be detected. Cardiopulmonary resuscitation (CPR) was applied to the bosun.

3.10 At about 1045 hours, the bosun still had no breathing and no heartbeat. The master instructed the crew to continue CPR and he went to the bridge to report the incident to the company.

3.11 As instructed by the company, the master phoned the Medical, Security and Travel Safety Services (MedAire) and reported that the bosun's complexion had turned purple; his body temperature was $36^{o}$C and he had no breath, heartbeat and pulse. The MedAire doctor advised that the bosun was not likely to be resuscitated.

3.12 The bosun was moved to *the vessel*'s hospital and his body temperature kept falling.

3.13 At about 1450 hours, MedAire advised that the bosun had passed away and the master declared the death of the bosun.

Figure 2 Mask respirator

## 4. Analysis

4.1 The master possessed a Class 1 Licence (Deck Officer) issued by the Hong Kong Marine Department (HKMD) on 19 July 2016. He joined *the vessel* on 28 August 2017 and was promoted to master in January 2018.

4.2 The chief officer had served the position as a chief officer for about 30 months. He possessed a Class 2 Licence (Deck Officer) issued by HKMD on 1 September 2015. He signed on *the vessel* as a chief officer on 28 January 2018.

4.3 The bosun joined the company in 2017 and was promoted to bosun on board *the vessel* in January 2018. He possessed a valid certificate of proficiency (CoP) as able seafarer (deck) on ships of 500 gross tonnage or more issued by China.

4.4 There was no abnormality noted with regard to the certification and experience of the crew concerned.

### Working hours and alcohol abuse

4.5 There was no evidence to show that any crew on board suffered from fatigue at work, alcohol or drug abuse.

### Weather and sea conditions

4.6 On the day of the accident, the weather was cloudy with east-southeasterly wind of Beaufort Wind Scale force 5, moderate swell and a visibility of 10 nautical miles. The weather and the sea conditions were not considered to be the contributory factors to the accident.

### Cause of death

4.7 According to the death certificate issued by the Shanghai Water Public Security Bureau, the cause of death of the bosun was suffocation.

4.8 The death certificate did not mention any other injury such as bone fracture. It could be deduced that the death of the bosun was unlikely caused by falling from height onto *the stool shelf plate*.

**Fumigation**

4.9 The *C/H* was fumigated by using Aluminum Phosphide tablets. When in contact with moisture, the tablets would be decomposed to release phosphine gas which was colourless and highly toxic. Phosphine gas is commonly used as fumigant to interfere the biological process of living organisms for cargoes such as timber logs carried on board cargo ships.

4.10 Subject to the exposure time and gas concentration, inhalation of phosphine gas may cause bleeding and liquid formation in lungs leading to respiratory discomfort / problem, nausea and ultimately suffocation.

4.11 In accordance with Section 3.3.1.9 of the Annex to the International Maritime Organization's (IMO) circular MSC.1/Circ.1264 *"Recommendations on the Safe Use of Pesticides in Ships Applicable to the Fumigation of Cargo Holds"* ("*Circ. 1264"*), entry into a space under fumigation should never take place except in the event of an extreme emergency. If entry is imperative, the fumigator-in-charge and at least one other person should enter, each wearing adequate protective equipment appropriate for the fumigant used and a safety harness and lifeline. Each lifeline should be tended by a person outside the space, who should be similarly equipped.

**Entry into enclosed space**

4.12 In accordance with section 15.1 of the Code of Safe Working Practices for Merchant Seamen (COP), an enclosed space is one that has limited openings for entry and exit; has inadequate ventilation; and is not designed for continuous worker occupation. As such, *the C/H* sealed under fumigated condition was an enclosed space.

4.13 Apart from poisonous phosphine gas occupying the fumigated *C/H*, the cargo of timber logs by itself would result in rapid and severe oxygen depletion as well as $CO_2$ formation inside the cargo hold. Ultimately, the atmospheric condition inside *the C/H* was life-threatening.

4.14 The company procedures of Form CL-SO1 in the Shipboard Safety Manual (SMS) of *the vessel*, as well as Annex 14.1 of the COP, stipulate the permit-to-work system including a proper risk assessment for entry into enclosed space. However, *the vessel* did not follow the required procedures and no permit was issued to allow the bosun to enter into *the C/H*.

**Improper protective gear worn by the bosun**

4.15 As shown in Figure 2, the mask respirator worn by the bosun belonged to the air-purifying type rather than the air-supplied type which could supply breathable air to the wearer. In accordance with the Material Safety Data Sheet of Aluminum Phosphide (Southphos), "*if engineering controls don't maintain airborne concentration to an acceptable level, a niosh- approved self contained breathing apparatus must be worn.*". With reference to *Circ. 1264*, the bosun did not wear adequate protective equipment appropriate for the fumigant used and was not accompanied by the fumigator-in-charge for entry into *the C/H*.

4.16 The chief officer stated that both the fumigator-in-charge and the ship's crew wore the same type of mask respirator used by the bosun when applying fumigant tablets. Furthermore, the chief officer considered that it would be safe to wear the mask respirator for entry into the fumigated *C/H* as the mask respirators were provided by the fumigator-in-charge. However, the chief officer failed to understand that during and soon after applying fumigant tablets inside a cargo hold, the phosphine gas in the cargo hold would not accumulate immediately to a sufficiently high concentration level which would affect human life. However, with the passage of time after the fumigant was applied, *the C/H* had been filled with poisonous phosphine gas. Wearing of wrong type mask respirator, coupled with oxygen depletion, the bosun was subsequently suffocated to his death inside *the C/H* (Figure 3).

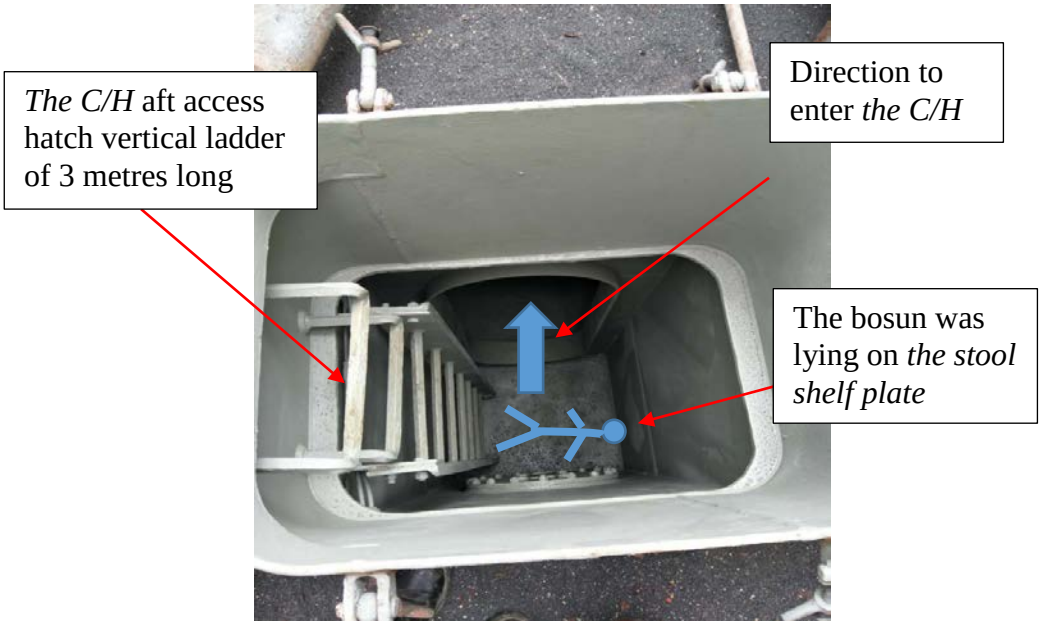


Figure 3 *The C/H* aft access hatch and *the stool shelf plate.*

**Warning signs**

4.17 *The C/H* was sealed and the aft access hatch cover was labelled with a warning sign ***"NO ENTRY WITHOUT PERMIT"*** and a placard ***"Under fumigation with PHOSPHINE GAS"*** (Figures 4 and 5). However, the fact that the chief officer allowed the bosun wearing inappropriate mask respirator to enter the C/H without notifying the fumigator-in-charge indicated that both the chief officer and the bosun were in lack of safety awareness.


Figure 4 Warning sign and placard on *the C/H* aft access hatch cover

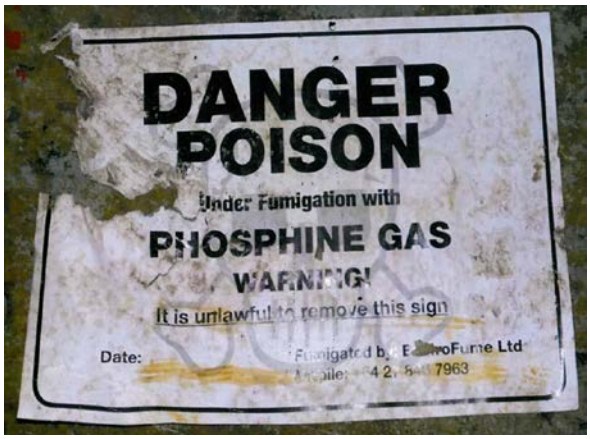


Figure 5 Placard

**Other safety issue**

4.18 Sections 3.2.2.5 and 3.3.2.13 of *Circ.1264* are extracted as follows:

*3.3.2.5 Accommodations, engine-rooms, areas designated for use in navigation of the ship, frequently visited working areas and stores, such as the forecastle head spaces, adjacent to cargo holds being subject to fumigation in transit should be treated in accordance with the provisions of 3.3.2.13.*

*3.3.2.13 Gas concentrations safety checks at all appropriate locations, which should at least include spaces indicated in 3,3.2.5, should be continued throughout the voyage at least at eight-hour intervals or more frequently if so advised by the fumigator-in-charge. <u>These readings should be recorded in the ship's log book</u>.*

4.19 The fumigator-in-charge carried out daily check of phosphine gas concentration in accommodations, store rooms, etc. However, he only conducted the check but did not record the readings. The fumigator-in-charge explained that if the concentration of phosphine gas did not exceed 0.3 ppm, it would not be recorded. It appeared that both the master and the fumigator-in-charge were not aware of the requirements of *Circ.1264*, thus failing to carry out checks at eight-hour intervals and record the readings in *the vessel*'s log book.

4.20 It was also revealed that there was no specific company procedures governing the operation of fumigation in transit. Since fumigation in transit may significantly affect the safety and health of crew and other persons on board, the company should establish relevant procedures.

## 5. Conclusions

5.1 In the morning of 17 August 2017 whilst *the vessel* carrying timber logs in fumigated cargo holds was en route from Picton port, New Zealand to Incheon, South Korea, the bosun told the chief officer that he would open *the C/H* aft access hatch cover and lower a sounding tape into the cargo hold in order to ascertain if *the C/H* had any water ingress. At about 1015 hours, the chief officer found that the bosun was lying unconsciously on *the stool shelf plate* underneath *the C/H's* aft access hatch cover. The bosun was pulled out from *the C/H* but was declared dead at 1450 hours.

5.2 The investigation revealed that the crew were in lack of safety awareness and did not follow the safety procedures to conduct a proper risk assessment before allowing the bosun to enter into *the C/H* through the aft access hatch. The fumigator-in-charge was also not being informed about the bosun's movement of preparing to enter into *the C/H*.

5.3 The investigation also revealed that phosphine gas readings were not recorded in *the vessel*'s logbook in accordance with IMO circular *MSC.1/Circ. 1264*.

## 6. Recommendations

6.1 The management company should issue circulars informing all masters, officers and crew of its fleet of the findings of the investigation and lessons learnt from this accident and instruct them to :

i) always conduct a full risk assessment before entering an enclosed space and issue entry permit in accordance with the requirements of the company's safety management system;

ii) seek prior advice from the fumigator-in-charge before opening sealed cargo holds under fumigation;

iii) provide training to the crew to enable them to understand the limitation of the use of mask respirator; and

iv) record phosphine gas readings in the vessel's logbook in accordance with IMO circular MSC.1/Circ.1264 for fumigation in transit on board vessels.

6.2 The management company should conduct internal audits on its vessels to ensure that the crew on board follow the entry into enclosed space procedures strictly.

6.3 The management company should establish company procedures for fumigation in transit on board vessels.

6.4 A Hong Kong Merchant Information Note is to be issued to promulgate the lessons leant from this accident.

## 7. Submission

7.1 The draft investigation report, in its entirety, was sent to the following parties for their comments:

i) the ship management company and the master of *the vessel*; and
ii) the Quality Assurance Section of the Marine Department.

7.2 By the end of the consultation, no comment was received from the above mentioned parties.