# Report of investigation into the fatal accident on board the Hong Kong registered chemical/oil tanker "*Calm Lake*" at sea on 22 October 2020


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



04 January 2022

## 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

At about 1500 hours on 22 October 2020, a fatal accident happened on board the Hong Kong registered chemical/oil tanker "Calm Lake" (*the vessel*) at approximate position 02°10.2N, 104°40.9E, during her voyage in ballast condition from Mazhi anchorage, China to Khor Fakkan, UAE.

In the afternoon of 22 October 2020, the Bosun was carrying out tank cleaning inside the No. 2 port side cargo oil tank (COT) when the Fitter was welding the leakage bunker pipes on the main deck beside the No. 5 port side COT. Suddenly, a fire happened on the port side main deck spreading forward along the passageway. The Pump-man noticed the fire on the main deck and informed the Bosun to come out immediately. When the Bosun came out, his boiler suit was on fire and caused a severe burn. The Pump-man and an able seafarer deck assisted in extinguishing the fire on the Bosun and transferred him to the ship's hospital for first aid treatment.

Although the Bosun was evacuated to a hospital ashore through helicopter from Singapore, he was declared dead on the next day.

The investigation revealed that the main contributory factors causing the accident were the insufficient safety awareness of the crew members leading to the failure in carrying out risk assessment, control measures, and permit to work before allowing welding on deck; lack of coordination and communication between the deck and engine department and the COT cleaning was also conducted in an unsafe and irresponsible manner.

## 1. Description of the vessel

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|---|---|---|
| Ship name | : | *Calm Lake* (Figure 1) |
| Flag | : | Hong Kong, China |
| Port of registry | : | Hong Kong |
| IMO number | : | 9239460 |
| Type | : | Chemical/Oil tanker |
| Year built, shipyard | : | 2002, Hyundai Mipo Dockyard Co., Ltd Ulsan, South Korea |
| Gross tonnage | : | 25,063 |
| Net tonnage | : | 10,189 |
| Summer deadweight | : | 40165 tonnes |
| Length overall | : | 176 metres |
| Breadth | : | 31 metres |
| Engine power, type | : | 8,580kW, MAN B&W 6S50MC-Mk6 |
| Classification society | : | RINA |
| Registered owner | : | Autumn Fragrans Limited |
| Management company | : | Miracle Shipman Limited |


Figure 1 *The vessel*

## 2. Sources of evidence

2.1 The information provided by the crew and the management company of *the vessel* (the Company).

## 3. Outline of events

(All times were local time UTC +8 hours)

3.1 On 19 September 2020, *the vessel* berthed at Nanjing, China to discharge methanol cargo. *The vessel* completed discharging cargo from all COTs and departed on 22 September 2020, heading to Zhoushan, China.

3.2 From 27 September 2020 to 14 October 2020, *the vessel* was in a shipyard in Zhoushan, China for drydock and intermediate surveys.

3.3 On 15 October 2020, *the vessel* left the shipyard and anchored at Mazhi anchorage, China for bunkering. During the bunkering of the diesel oil, the bunker operation was suspended and eventually cancelled due to the leakage of diesel oil bunker pipes. *The vessel* was then directly bound for loading port in Khor Fakkan, United Arab Emirates (UAE).

3.4 At about 0650 hours on 22 October 2020, the Chief Officer (C/O) held a toolbox meeting on the bridge to assign jobs to the deck crew members, consisting of the Bosun and an able seafarer deck (AB), to carry out the No. 2 (P)[1] COT cleaning with fresh water and methanol.

3.5 At about 0800 hours on 22 October 2020, the Chief Engineer (C/E) held a toolbox meeting in the engine control room to assign jobs to the engine crew members, consisting of the Second Engineer (2/E), Fitter and Mechanic. The Mechanic was assigned to assist the C/E in repairing the leakage hydraulic pipes of the hydraulic power system on deck. The 2/E and Fitter were assigned to weld the leakage bunker pipes on deck.

3.6 After the meeting, the C/E and Mechanic proceeded to repair the leakage hydraulic pipes by renewing the sealing rings of the hydraulic pipe flanges beside the No. 2 (S)[2] COT and No. 4 (S) COT. After completing the repair work on the hydraulic pipes, the C/E went back to his cabin and the Mechanic proceeded to the engine room for his duty watch.

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[1] Port side

[2] Starboard side

3.7 After the toolbox meeting, the Fitter went to the main deck to weld the leakage bunker pipes beside the No. 5 (P) COT (Figure 2). The 2/E kept fire watch for the welding work, but he sometimes went to render assistance for the C/E and Mechanic on renewing the sealing rings of the hydraulic pipe flanges.

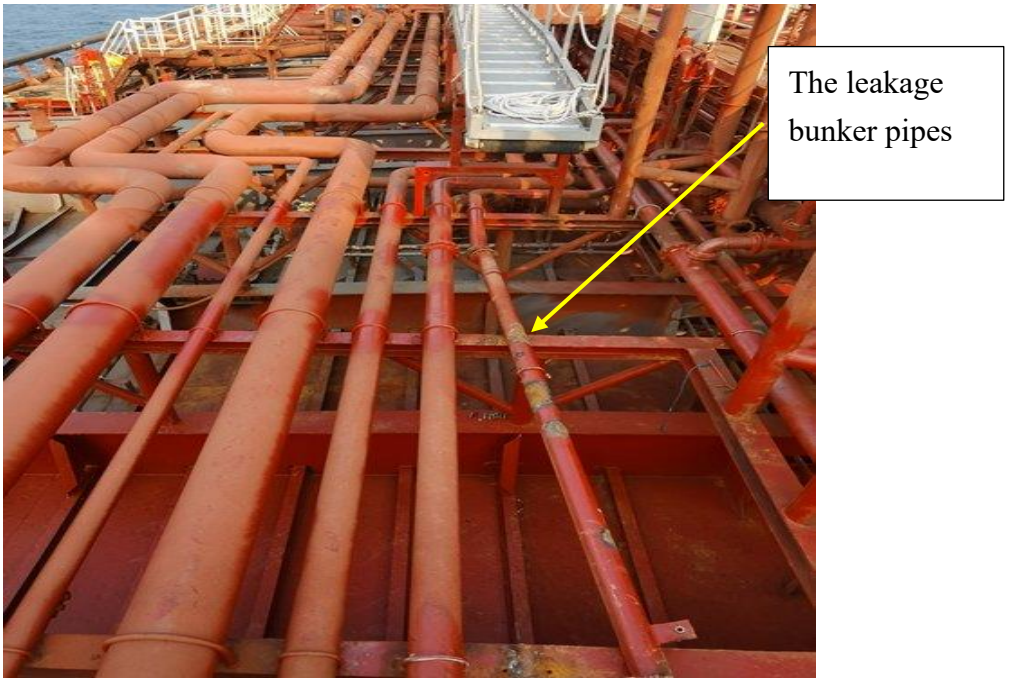


Figure 2 The leakage bunker pipes were welded on deck

3.8 On the forward part of the main deck, the Bosun, Pump-man (PM) and AB carried out No. 2 (P) COT cleaning by flushing fresh water. At about 1400 hours, they commenced cleaning the No. 2 (P) COT with methanol. The Bosun was working inside the No.2 (P) COT with assistance from the PM and AB on the main deck. Afterwards, the mixture of fresh water and methanol was pumped out from the No.2 (P) COT by portable air-driven pump (Figure 3) onto the port side main deck directly without collecting into drums. The deck crew members used about 80 liters of methanol for the No. 2 (P) COT cleaning.

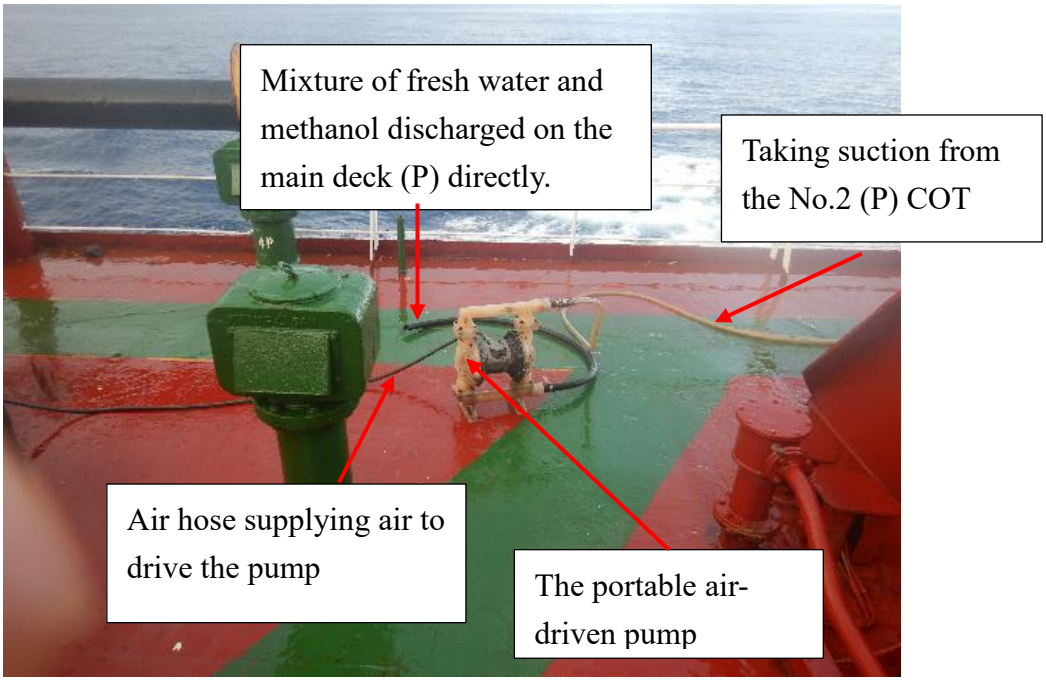


Figure 3 The portable air-driven pump

3.9 At about 1405 hours, the Fitter prepared to weld the leakage bunker pipes on deck again and the C/E checked the area around the pipes, and no abnormality was found. Afterwards, the Fitter commenced welding the leakage bunker pipes and the C/E kept the fire watch underneath the port side lifeboat for the welding work.

3.10 At about 1445 hours, the C/E went to check the welding condition of the leakage bunker pipes, and then he proceeded to the engine room, leaving the Fitter to continue the welding on deck alone.

3.11 At about 1500 hours, while *the vessel* was sailing approximately at position 02°10.2N, 104°40.9E, the Fitter was removing the slag of the welding on the leakage bunker pipes. The flammable liquid/vapor from the effluent mixture of fresh water and methanol on the main deck was ignited by the hot slag of the welding. The fire spread forward rapidly on the port side passageway to the No. 2 (P) COT due to the flammable liquid/vapor from the effluent accumulated on the passageway between the No. 2 (P) COT and No. 5 (P) COT. The Fitter noticed the fire and immediately asked for assistance by shouting and giving a hand signal to the crew member on the bridge. He then went to the accommodation block and looked for a portable fire extinguisher to fight the fire. Meanwhile, the PM also noticed the fire on deck. He and the AB went to get portable fire extinguishers after informing

the Bosun to come out because of the fire through his portable radio. The Master noticed the fire on deck from the bridge. He then sounded the fire alarm and organized the crew members to fight the fire.

3.12 When the Bosun came out from the No.2 (P) COT, his boiler suit was on fire and caused a severe burn. When returning with fire extinguishers, the PM and AB immediately extinguished the fire on the Bosun and transferred him to the ship's hospital for first aid treatment. The C/O and Fitter also took fire extinguishers to put out the fire on the main deck.

3.13 At about 1513 hours, after checking the condition of the Bosun, the Master contacted the Company and the Maritime Rescue and Coordination Centre (MRCC) Singapore, asking for emergency evacuation of the Bosun.

3.14 At about 2030 hours, the helicopter deployed by the MRCC Singapore arrived. At about 2106 hours, the Bosun was winched up to the helicopter and sent to hospital in Singapore for further medical treatment, but the Bosun was declared dead on the next day.

## 4. Analysis

### *Certification, training and experience*

4.1 The statutory trading certificates of *the vessel* were valid and in order. *The vessel* was manned by 20 crew members, including the Master.

4.2 The Master had worked in the Company for about 4 months and joined *the vessel* on 26 June 2020. He had more than 10 years of experience as a master. He possessed a Class 1 Certificate of Competency issued by China valid until 30 March 2021.

4.3 The C/E worked for the Company for the first time and joined *the vessel* on 11 October 2020. He had about 1 year of experience as a chief engineer. He possessed a Class 1 Certificate of Competency issued by China valid until 9 October 2023.

4.4 The C/O worked for the Company for the first time and joined *the vessel* on 11 October 2020. He had about 8 months of experience as a chief officer. He possessed a Class 2 Certificate of Competency issued by China valid until 27 March 2024.

4.5 The 2/E worked for the Company for the first time and joined *the vessel* on 21 September 2020. He had more than 1 year of experience as a second engineer. He possessed a Class 1 Certificate of Competency issued by China valid until 16 December 2024.

4.6 The Bosun worked for the Company for the first time and joined *the vessel* on 26 June 2020. He had about 26 years of experience as a bosun.

4.7 The PM worked for the Company for the first time and joined *the vessel* on 28 June 2020. He had about 2 years of experience as a pump-man.

4.8 The AB had worked for the Company for the first time and joined *the vessel* on 26 June 2020. He had about 6 years of experience as an able seafarer deck.

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

***Weather and sea conditions***

4.10 The weather was cloudy with north-easterly wind of Beaufort force 4. The sea was slight and the visibility was about 12 nautical miles. The weather should not be a contributory factor to the accident.

***Fatigue, alcohol, and drugs abuse***

4.11 There was no evidence to show that any crew members on board suffered from either fatigue at work or abuse of alcohol and drugs.

***Cause of death***

4.12 The death certificate of the Bosun was issued by the local authority of Singapore. The cause of death was due to extensive thermal burns which was consistent with the accident.

***Properties of last cargo methanol in cargo oil tanks***

4.13 According to the safety data sheet of methanol provided onboard in last laden voyage to Nanjing before entering shipyard in China, it is a highly flammable liquid and vapor with flash point[3] 10°C. Methanol vapor is slightly heavier than air which spreads along the ground allowing distant ignition. Vapor may form an explosive mixture with air.

***Preparation and control measures for safe hot work on deck***

4.14 In accordance with Chapter 14 "Permit To Work Systems" and Chapter 24 "Hot Work" of the Code of Safe Working Practices for the Merchant Seafarers (the Code)[4], when hot work, e.g., welding, is to be carried out, the following precautionary measures shall be taken as follows:

(a) Based on the findings of the risk assessment, appropriate control measures should be put in place to protect those who may be affected (paragraph 14.1.1 of Chapter 14 & paragraph 24.1.1 of Chapter 24).

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[3] The flash point of a volatile material at the lowest temperature which its vapour to be ignited once the ignition/heat source is available.

[4] In accordance with Section 4 of Cap.478M "Merchant Shipping (Seafarers) (Code of Safe Working Practices) Regulation", all Hong Kong registered vessels are required to carry the "Code of Safe Working Practices for Merchant Seafarers" onboard.

(b) Hot work in places other than the workshop should be the subject to permit-to-work (paragraph 24.2.1 of Chapter 24).

(c) Before welding, flame cutting, angle grinding, or other hot work is started, a check should be made that there are no combustible solids, liquids, or gases at, below or adjacent to the area of work that might be ignited by heat or sparks from work (paragraph 24.2.3 of Chapter 24).

4.15 The investigation revealed that the preparedness and control measures for safe hot work on deck failed to meet the above requirements of the Code as follows:

(a) There was no record showing that the risk assessment had been carried out before commencing the welding repair on deck:

(i) In the toolbox meeting, the C/E did not discuss the safety issues with the 2/E and Fitter before assigning the welding repair of the leakage bunker pipes to them. Hence, the inherent risks of explosion and fire caused by welding were not identified and the corresponding control measures, e.g., proper supervision and suitable fire extinguishers to be readily available as stated in the Code, were not implemented, resulting in the accident.

(ii) It is critical that welding repair on the deck should be properly supervised and kept under regular observation. Suitable fire extinguishers should be kept at hand, ready for use during work. A person with a suitable extinguisher should also be stationed to keep watch on areas that may be affected that are not visible to the seafarer doing the work.

(iii) The Fitter was generally working alone on the day of the accident. On the morning of 22 October 2020, the 2/E was assigned to assist the Fitter in welding the leakage bunker pipes. However, the 2/E also sometimes went to assist the C/E and the Mechanic to repair the hydraulic leakage pipes leaving the Fitter working alone most of the time.

(iv) In the afternoon, the C/E assisted the Fitter for the welding repair as well as keeping watch for the welding work, but he stayed remotely under the port side lifeboat. At the

material time of the accident, the C/E was in the engine room, leaving the Fitter working alone. Hence, there was insufficient supervision and inadequate fire watch when the Fitter was performing welding repair.

(b) When the fire happened on deck, the Fitter could only ask for assistance by shouting and giving a hand signal to the crew member on the bridge. There was no fire fighting equipment readily available on site and no crew member with a fire extinguisher to keep fire watch on the main deck resulting in the fire quickly spreading and the casualty eventually. There was no record showing that the permit-to-work of hot work on the deck was issued as reflected in the following:

(i) Before the day of the accident, the crew members had disconnected and moved some of the leakage bunker pipes to the engine room workshop for welding. As some of the pipes on deck were too long and unable to shift to the engine room, the crew members decided to repair those pipes on deck. However, there was no record showing that the permit-to-work of hot work on the deck was issued. As such, the general precautions, including fire watch, portable extinguisher to be at the site, and shielding to prevent the spread of sparks, as listed on the form of permit-to-work of hot work, were not taken by the crew members in advance.

(ii) Had the permit-to-work of hot work been arranged to issue, the above general precautions would have been drawn to the attention of the Master and the crew members involved. The general precautions would then be implemented, and the fire incident would have been detected and extinguished at the earliest moment.

(c) At the time of the accident, the Fitter was left alone for the welding work on deck. He might be concentrated in the welding work resulting in failing to ensure below or adjacent to the work area was free from the combustible solids, liquids or gas before commencing the welding work.

4.16 The Company had also established instructions for hot work, including welding in the Safety Management System (SMS) of *the vessel*. The procedure had explicitly required the following for hot work, but none were done by the crew members resulting in the accident as follows:

(a) A risk assessment together with an application shall be submitted to the marine/technical superintendent for approval. However, the company was not informed of the welding repair on deck in the accident.

(b) Hot work can be carried out only when the area around the hot work has been tested by a good condition explosimeter with a reading of less than 1% LEL[5]. However, before commencing the welding repair, no gas testing was carried out.

(c) The conduct of hot work onboard should follow the permit-to-work system to be prepared by the C/E and the C/O and authorized by the Master before commencement. However, the Master was not involved in the risk assessment for the safety precautions and the toolbox meeting of the welding repair on deck. Hence, the Master was not aware of both the hot work and COT cleaning being carried out at the same time and was not able to stop either one of them.

4.17 The investigation revealed that the crew members failed to comply with the safety requirements in the Code and SMS. Despite the C/E, 2/E and Fitter involved in the welding repair work, none of them was aware of following the safety requirements. It was probable that the safety awareness of the crew members was not sufficient and they underestimated the risks of carrying out welding repair on deck resulting in the fire and the casualty eventually.

***Coordination and Communication between the deck and engine department***

4.18 Prior to the accident, toolbox meetings were carried out in the deck and engine department respectively. However, there was no communication between the two departments on board for their work. Due to the lack of communication among the deck and engine departments, they did not know the work plan of each other, resulting in the deck crew members

[5] The Lower Explosive Limit (*LEL*) is the lowest concentration of a gas or vapor that will burn in air.

allowing the highly flammable liquid to flow freely on the port side main deck while the Fitter was carrying out the welding work. Subsequently, the fire accident happened on board causing the death of the Bosun.

4.19 The Human Resource and Health Manual (SMS-05) in the SMS of *the vessel* stated that the master should check the safety of the working area, operation tools and equipment and give guidance before any shipboard operation. In the accident, the Master had been walked around on the main deck and understood the COT cleaning to be carried out. However, there was evidence to show that the Master had given the safety guidance to the deck crew members to conduct the COT cleaning to follow the SMS. The C/E also failed to report the welding repair work to be carried out on deck. Hence, the Master was unaware of the COT cleaning and hot work on deck to be carried out simultaneously.

4.20 The accident might have been avoided if the deck and engine departments had exchanged their work plan on that day, and the deck and engine departments were aware that their jobs would be affected the safety of each other, e.g., fire risk. Hence, the lack of coordination and communication among the deck and engine department was apparent.

***Preparation of COT cleaning***

4.21 Before commencing the voyage, *the vessel* completed her drydock and intermediate surveys in a shipyard in which gas free in the COT of *the vessel* had been certified. Nevertheless, the No. 2 (P) COT cleaning operation several days after leaving the shipyard involved enclosed space entry and the use of flammable solvent methanol. Therefore, it was still potentially life threatening due to the potential oxygen deficient hazard and toxic or flammable gas hazard. As such, the COT cleaning operation should be carefully planned. All potential risks should be identified by a comprehensive risk assessment before commencing the COT cleaning operation. A responsible officer should supervise the cleaning operation, and appropriate control measures should be in place to protect the crew members.

4.22 The investigation revealed that the COT cleaning was conducted in an unsafe and irresponsible manner as follows:

(a) Instead of using the approved COT cleaning equipment, e.g., fixed tank washing machines for the tank cleaning, the Bosun was allowed to enter the tank with methanol in a portable container for

the COT cleaning. This work arrangement did not adhere to the approved Procedures and Arrangements Manual (the PA Manual) in accordance with MARPOL 73/78 Annex II[6]. Had the fixed tank washing machines been used for COT cleaning, the burning of the Bosun would have been avoided.

(b) No risk assessment was conducted before commencing the COT cleaning work. As such, the crew members failed to identify the risks involved and no safe working plan was established as a result of neglecting the permit to work system of the Code and the SMS. The accident might had been avoided if the deck crew members had been well aware of the risks of the fatal enclosed space entry and the fire in advance.

(c) COT cleaning was without sufficient supervision. The C/O as a person in charge of the work stayed in his cabin when the crew members were processing the COT cleaning operation in the morning. At the material time of the accident, the C/O was preparing paperwork in the cargo control room. The C/O failed to provide sufficient supervision of the COT cleaning.

(d) Warning signs were not posted or hung in public places, including the main passages as required by the shipboard operation and manual (SQI-505) in the SMS of *the vessel* during the COT cleaning operation. Hence, the engine crew members involved in the welding work lost a precious chance of knowing the potential appearance of flammable liquid/vapor on deck from COT cleaning and taking the corresponding control measures.

***Probable cause of the accident***

4.23 Deck crew members conducted the COT cleaning with fresh water and methanol. They pumped out the mixture of fresh water and methanol onto the main deck directly. At the time of the accident, the forward and aft draughts of *the vessel* were 5.4 metres and 8.2 metres respectively. As such, the effluent mixture of fresh water and methanol flew from the forward to aft direction on the port side main deck.

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[6] *MARPOL 73/78 Annex II*, Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk. Annex II came into force on 6 April 1987

4.24 As the Fitter was working alone and busy in welding the leakage bunker pipes, the Fitter failed to notice the flammable liquid/vapor flowing to him. The flammable liquid/vapor was ignited by the hot slag of the welding, and then the fire spread forward to the No. 2 COT. When the Bosun came out from the No.2 (P) COT, his boiler suit was on fire and caused a severe burn.

## 5. Conclusions

5.1 On 22 October 2020, a fatal accident happened on board *the vessel* while she was sailing approximately at position 02°10.2N, 104°40.9E. The Bosun was assigned to carry out No. 2 (P) COT cleaning. When the Bosun was working inside the No. 2 COT, a fire happened on the main deck beside the No. 5 (P) COT and spread to the No. 2 (P) COT. The PM noticed the fire on the deck and informed the Bosun to come out immediately. When the Bosun came out from the No. 2 (P) COT, his boiler suit was on fire and caused a severe burn. The PM and AB extinguished the fire on the Bosun and transferred him to the ship's hospital for first aid treatment. Despite the Bosun being evacuated to hospital ashore through helicopter deployed by the Singapore MRCC, the Bosun was declared dead on the next day.

5.2 The investigation revealed that the main contributory factors were the insufficient safety awareness of the crew members as follows:

(a) inherent risks of explosion and fire caused by welding were not identified and the corresponding safety control measures, e.g. proper supervision and suitable fire extinguishers to be readily available, were not implemented according to the Code and the SMS;

(b) lack of coordination and communication between the deck and engine departments;

(c) permit-to-work of hot work had not been arranged to be issued, causing the welding repair to proceed without safety precautions in place; and

(d) the COT cleaning was conducted in an unsafe and irresponsible manner which was not according to the PA Manal, the Code and SMS.

## 6. Recommendations

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

(a) enhance training on enclosed space entry and hot work outside engine room workshop, including the awareness of the fire hazard involved;

(b) enhance the communication between the deck and engine departments for the daily work plan;

(c) strictly follow the safety requirements in the Code and SMS of *the vessel,* in particular, the hot work and enclosed space entry; and

(d) strictly follow the tank cleaning procedure in the PA Manual.

6.2 The management company of *the vessel* should conduct an internal audit to ensure that the crew members follow the safety requirements strictly when entering enclosed space, cleaning cargo oil tanks and carrying out hot work outside the engine room workshop.

6.3 A Hong Kong Merchant Shipping Information Note is to be issued to promulgate the lessons learnt from this accident.

## 7. Submission

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

(a) the management company and the Master of *the vessel*; and

(b) the Shipping Division of Marine Department.

7.2 During the consultation period, comments from the management company and the Master of *the vessel* were received and the report had been amended as appropriate.