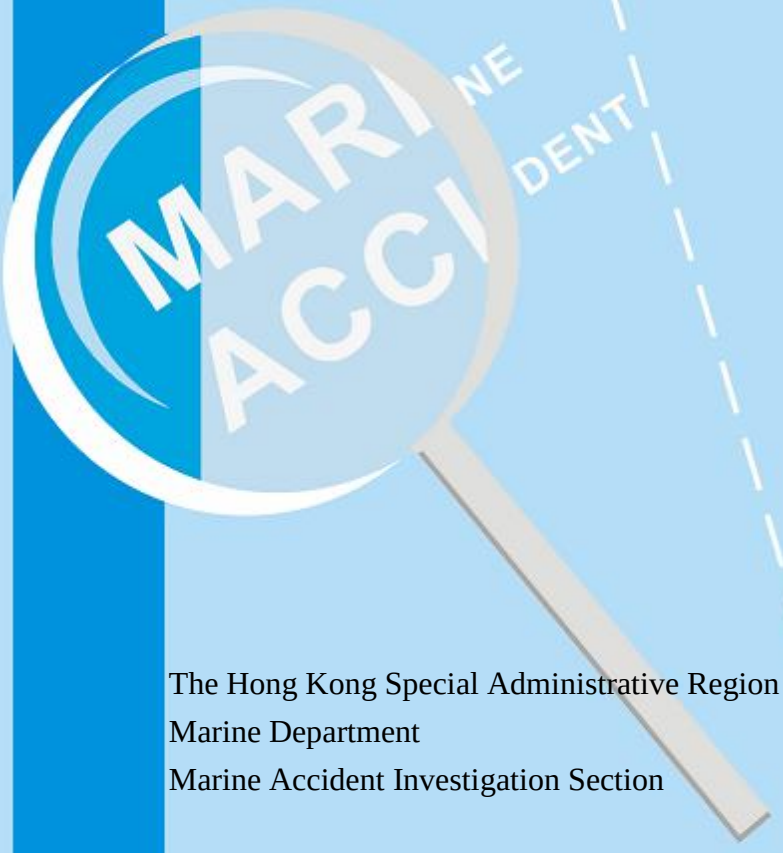
Report of investigation into the fatal accident on board Hong Kong registered chemical tanker "*Alpine Magic*" at sea on 14 November 2015



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

6 March 2018

Purpose of Investigation

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.

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 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

All times are local (UTC+ 7) unless specified otherwise.

1.1 On 14 November 2015, the Hong Kong registered chemical/oil tanker *Alpine Magic (the vessel)* under ballast condition was en-route at Bay of Bengal from Tanjung Pelepas, Malaysia to Fujairah, United Arab Emirates (UAE). Cargo oil tank (COT) cleaning operations were in progress preparing for loading clean petroleum product.

1.2 After the cleaning and gas-free operations were completed for No.3 port cargo oil tank (3P COT), atmospheric checks were carried out as per company's procedure for entry into enclosed space.

1.3 At 1442 hours, the company's "Checklist for entry into enclosed space" was completed and signed by the chief officer for entry into 3P COT. After verification, the master authorized the entry into 3P COT at 1455 hours. The entry team consisted of an Able Body Seaman (AB) as the team leader and a Trainee Ordinary Seaman (TOS). At 1458 hours, the entry team entered 3P COT for tank inspection and cleaning of residue on the tank top and bellmouth area.

1.4 The inspection and cleaning inside 3P COT were completed in about 20 minutes. Chief officer was informed over portable radio by the AB that the work was finished and the TOS would leave the tank first.

1.5 About 1 to 2 minutes later, at about 1520 hours, the AB heard a shout followed by a thud and saw the TOS lying on the tank top with severe injury near abdomen area. Emergency response and rescue operation were activated immediately. *The vessel* was diverted to the nearest port of refuge Campbell Bay, India to evacuate the TOS. Unfortunately, the TOS was declared dead by the port medical officer at 0245 hours on 15 November 2015.

1.6 The investigation had identified the main contributory factor that the risk of fall from cargo oil tank access ladder was not assessed properly thus failing to prevent the falling of the TOS from height.

1.7 The following safety issues were also found in the investigation:

(a) the vertical ladder had no guard rings and the gap of the side rail of inclined ladder near the uppermost platform might allow the TOS to fall sideway if he

lost his balance on the ladder; and

(b) the company's procedure for using fall arrestor devices had not been strictly followed by ship's crew.

2. Description of the vessel

Name of vessel	:	***Alpine Magic*** **(**figure 1)
Flag	:	Hong Kong, China
Port of registry	:	Hong Kong
IMO No.	:	9392793
Ship type	:	Chemical/Oil Tanker
Year built, shipyard	:	2009, STX Offshore and Shipbuilding Co., Ltd
Gross tonnage	:	29,266
Net tonnage	:	12,026
Summer deadweight	:	47,128 metric tonnes
Length (Overall)	:	183.21 metres
Breadth (moulded)	:	32.20 metres
Main engine & power	:	1 x MAN B&W 6S50MC-C, diesel engine, 9,480 kW
Classification society	:	Korean Register of Shipping (KR)
Registered owner	:	Heroic Bootes Inc
Management company	:	Fleet Management Limited

Fig.1 – Alpine Magic

3. Sources of Evidence

3.1 The management company.

4. Outline of Events

4.1 On 11 November 2015, a tank cleaning plan was prepared by the chief officer in line with the voyage instructions after completion of the cargo offloading operation in port of Tanjung Pelepas, Malaysia. The plan was approved by the master and agreed by the company. A meeting was held and all staff involved in the tank cleaning operation were briefed by the chief officer and master.

4.2 At 0236 hours on 12 November 2015, *the vessel* departed from Tanjung Pelepas of Malaysia with no cargo on board for her loading port of call Fujairah, UAE. When *the vessel* was en-route, tank cleaning operation commenced at 1100 hours on the same day starting from COT No. 1 port and starboard side tanks and then following the sequence of the COT to the last No. 6 port and starboard side tanks.

4.3 On 14 November 2015, cargo tank cleaning operations were in progress. After completion of the 2nd stage of washing by hot sea water, it was planned to inspect No.3 port cargo oil tank (3P COT). The tank 3P COT was gas freed and atmospheric checks of the tank were completed as per the company's procedures for entry into enclosed space.

4.4 At 1442 hours on 14 November 2015, the company's "Checklist for entry into enclosed space" for the tank entry operation was completed and signed by the chief officer. As per the checklist, rescue equipment for enclosed space was also kept ready for use at the tank entrance. After verification of the checklist, the master authorized the entry into the 3P COT at 1455 hours.

4.5 At 1458 hours, an AB and a TOS entered the 3P COT for tank inspection and residue cleaning at the bottom. A pump man was at the tank entrance as the designated attendant. The chief officer was also on the deck near the tank entrance to supervise the overall operation.

4.6 The inspection and cleaning were completed in about 15 to 20 minutes. At about 1520 hours, the chief officer was informed through portable radio by the AB that the work was finished and TOS would leave the tank first. The chief officer then peeped through the tank dome and saw the TOS ascending the lowest (bottom most) inclined ladder.

4.7 After that, the chief officer continued discussion with the pump man regarding tank

cleaning operation while standing few meters away from the tank dome. The AB was near the middle part of the tank top of 3P COT, collecting the remaining rags and tools.

Fig.2-(Re-enactment) Scene of chief officer and pump man near the tank dome of 3P COT.

4.8 Shortly afterwards, the AB heard a loud scream and a thud. He saw the TOS lying on the forward port side tank top of 3P COT near the access ladder. The AB immediately rushed towards the TOS and reported to the chief officer over radio that the TOS had fallen from the access ladder. The AB tried to assist the TOS and assured him that rescue was on the way.

4.9 The TOS was bleeding severely. The AB observed a severe laceration on the left side abdomen of the TOS through which he could see that the intestines had come out. Shocked by the wound, the AB panicked and rushed outside the tank. After the chief officer received the report of man falling, ship's alarm was immediately raised and a public address announcement was made for rescuing the TOS from the tank. The master, who was in the cargo control room, immediately arrived on the scene. As per the master's instructions, the chief officer together with another able bodied seaman (AB2) and an ordinary seaman (OS2) entered the tank to rescue the injured TOS.

Fig.3-(Re-enactment) Scene with approximate positions of the fallen TOS and the AB.

4.10 After entering the tank, the chief officer examined the injured TOS. The TOS was bleeding profusely and was not in full consciousness to speak. The chief officer immediately advised the master over radio to divert *the vessel* for medical evacuation. First aid was administered by using clean rags/pads in an attempt to stop the bleeding. In the meantime, a stretcher was lowered into the tank and at 1548 hours, the TOS was lifted out of the tank using the pre-rigged rescue hoist on deck and was taken to the ship's hospital. In the hospital, the chief officer, 2nd officer and chief cook started administering first aid and the TOS was put on oxygen mask. The TOS' pulse was very feeble and his breathing was shallow.

4.11 As instructed by the master, the duty officer on the bridge also reported to the company immediately of the incident via company's 24 hours casualty response number. The duty officer also contacted the nearest Maritime Rescue Co-ordination Centre (MRCC) of Port Blair, India by telephone call to arrange evacuating the casualty for medical treatment ashore. *The vessel* altered its course and proceeded at the maximum speed towards the nearest port of refuge. MRCC of Port Blair informed *the vessel* that

rescue helicopter was not available to reach that distance and instructed *the vessel* to proceed to the nearest evacuation point i.e. Campbell Bay, about 160 NM (nautical miles) from *the vessel*'s position.

4.12 Meanwhile, radio medical advice was provided by the doctor at Port Blair and first aid was applied to the TOS based on the advice received. *The vessel* had also tried to contact MRCC Indonesia and MRCC Malaysia over phone for rescue helicopter but in vain. The International Radio Medical Centre (CIRM) was also contacted for radio medical advice.

4.13 The company's Emergency Response (ER) was also activated. A local agent was immediately appointed at Port Blair. As helicopter was not available at Port Blair, the company tried to arrange air evacuation (private air ambulance) from mainland India through the local agents. However, the effort was in vain because no helicopter was available to travel for that distance for evacuation.

4.14 The master reported that sometime between 1645 hours and 1700 hours, TOS' body had stopped responding and showed no vital signs. His pupils dilated and body commenced to show signs of stiffness. However, the ship's crew continued to monitor vital signs and provide medical aid as instructed by the doctor from the MRCC of Port Blair and the CIRM. The TOS was kept on oxygen mask in the ship's hospital. *The vessel* continued to proceed to the evacuation point at her maximum speed. At 0136 hours on 15 November 2015, *the vessel* arrived at Campbell Bay. Coast guard boarded *the vessel* at 0230 hours along with a doctor who declared at 0245 hours that the TOS was dead. The remains of the casualty were landed along with the coast guard and the doctor.

5. Analysis

Ship certificates and crew members on board

5.1 All statutory certificates of *the vessel* were valid at the time of the accident.

5.2 *The vessel* was adequately manned by 23 qualified crew members of India nationality as per safe manning requirements.

5.3 The master joined *the vessel* on 27 June 2015, and was in his first command service. He had joined the company since he was a deck cadet and had more than 4 years' experience as a chief officer. He had sailed on *the vessel*'s sister vessels as well as vessels of similar type.

5.4 The chief officer joined *the vessel* on 2 August 2015. It was his 2nd tenure with the company with a previous contract on a sister vessel. He had more than 5 years' experience in rank and had sailed on vessels of similar type.

5.5 The pump man joined the vessel on 27 June 2015. This was his 9th tenure with the Company. He had more than 28 months experience in rank and had also served as Bosun and AB respectively in previous contracts. He had sailed on vessels of similar type before.

5.6 The AB (in tank with the TOS) had joined *the vessel* on 2 August 2015. He had 13 months working experience as an AB. He had sailed on vessels of similar type before and had experience of working inside cargo tanks.

5.7 The TOS was 23 years old. He was on his first tenure with the company. Before joining the company, he completed a 7-month service as a training ordinary seaman on an oil tanker. He joined *the vessel* on 3 May 2015 and had served more than 6 months on board *the vessel* prior to the incident. After joining *the vessel*, he completed safety familiarization which included familiarization of equipment on deck, cargo operations and steering procedures. He performed similar operation of entering cargo tanks on three earlier occasions. The TOS had attended various company specific internal courses prior to joining *the vessel*, including the enclosed space entry course conducted by the company's training institute.

Risk assessment and company procedures of entering into cargo tanks

5.8 The company's procedures had identified enclosed space entry as a high risk operation. As such, the procedures required a "Checklist for entry into enclosed

space" to be completed for such operation. The checklist included a series of checks for various aspects, e.g. continuous atmospheric checks, ventilation, adequate illumination, readiness of rescue equipment near the tank entrance prior making an entry into the tank and a risk assessment to cover the hazards as detailed in section HSM 9.2.1.1 of the company's procedures. However, the risk assessment did not cover the element of cargo oil tank access ladder.

5.9 It was understood that since the year 2011, all vessels managed by the company were provided with "fall arresting / retrieving device". The company required that fall arrestor should be used mandatorily while using first vertical ladder of any COT. If cargo oil tank access ladder is covered by the risk assessment mandating the use of fall arrestor when accessing ladder, the death of the TOS might be prevented from happening.

5.10 The "Checklist for entry into enclosed space" was duly completed and signed by the chief officer and verified by the master. The "Enclosed space entry permit" was also duly signed by the master, chief officer, AB and TOS.

Tank Condition of 3P COT

5.11 The cargo oil tanks were gas-freed before the cleaning and inspection operation. Natural ventilation of cargo oil tanks was maintained with all the openings to the tanks opened. Before entering the 3P COT, the tank condition had been checked by the chief officer and verified by the master.

5.12 The atmosphere inside 3P COT was monitored continuously and the records were given below:

Date/Time 14/11/2015	Oxygen in % Vol.	Hydrocarbon in % LEL	CO in PPM	H_2S in PPM	Toxic Gases (Specify)
1442	20.9	0	0	0	0
1512	20.9	0	0	0	0

5.13 The tank temperature taken after the incident was dry 32 / wet 29 degree Celsius. The relative humidity measured after the incident was 77%. Forced ventilation was provided by a portable blower with a ventilation duct lowered through one of the Butterworth hatches of 3P COT.

5.14 Lighting was provided by a pneumatic light lowered from one of the Butterworth hatches. Tank dome was kept fully opened so that natural day light could shine into the tank and on the access ladder which was located below the tank dome.

5.15 It was noisy inside the tank due to the running of the pneumatic light, the portable fan and the cleansing wash machines in the adjacent 2P & 2S COT.

5.16 The inner surface of the tank was epoxy coated. After the second stage of hot water wash, there were still some minor oil stains of previous cargo (fuel oil) left on the inner surface of the tank. However, the tank condition was suitable for ship's crew to enter for the intended job.

5.17 The general condition of 3P COT was not considered as a contributory factor to the accident.

Access ladder inside cargo oil tank

5.18 The configuration of the access ladder of the 3P COT comprised of several sections of fixed steel ladder (figure 4) with a total height from the deck to the bottom about 16.81 metres. The top section of the access ladder was a vertical ladder, followed by three inclined ladders at angle about 57 to 58 degrees in different directions to reach the tank top floor. There were a total of forty-seven steps for the inclined ladders and nine steps for the vertical ladder, and three platforms between the 4 ladders.

5.19 The access ladder was maintained in good condition with no sign of damage or corrosion.

5.20 Ascending along the 3 inclined ladders from the bottom, it was the uppermost platform connecting to a vertical ladder. This uppermost platform was fitted with two horizontal railings located at height of 1.0 metre and 0.5 metre above the platform floor respectively. For the purpose of rescue of persons from the tank, the grating plate of the platform floor was openable to its upside direction only and hinged on forward end, and provided with a toggle safety pin to prevent accidental opening (figure 5). No evidence was found that the grating plate was opened before the accident.

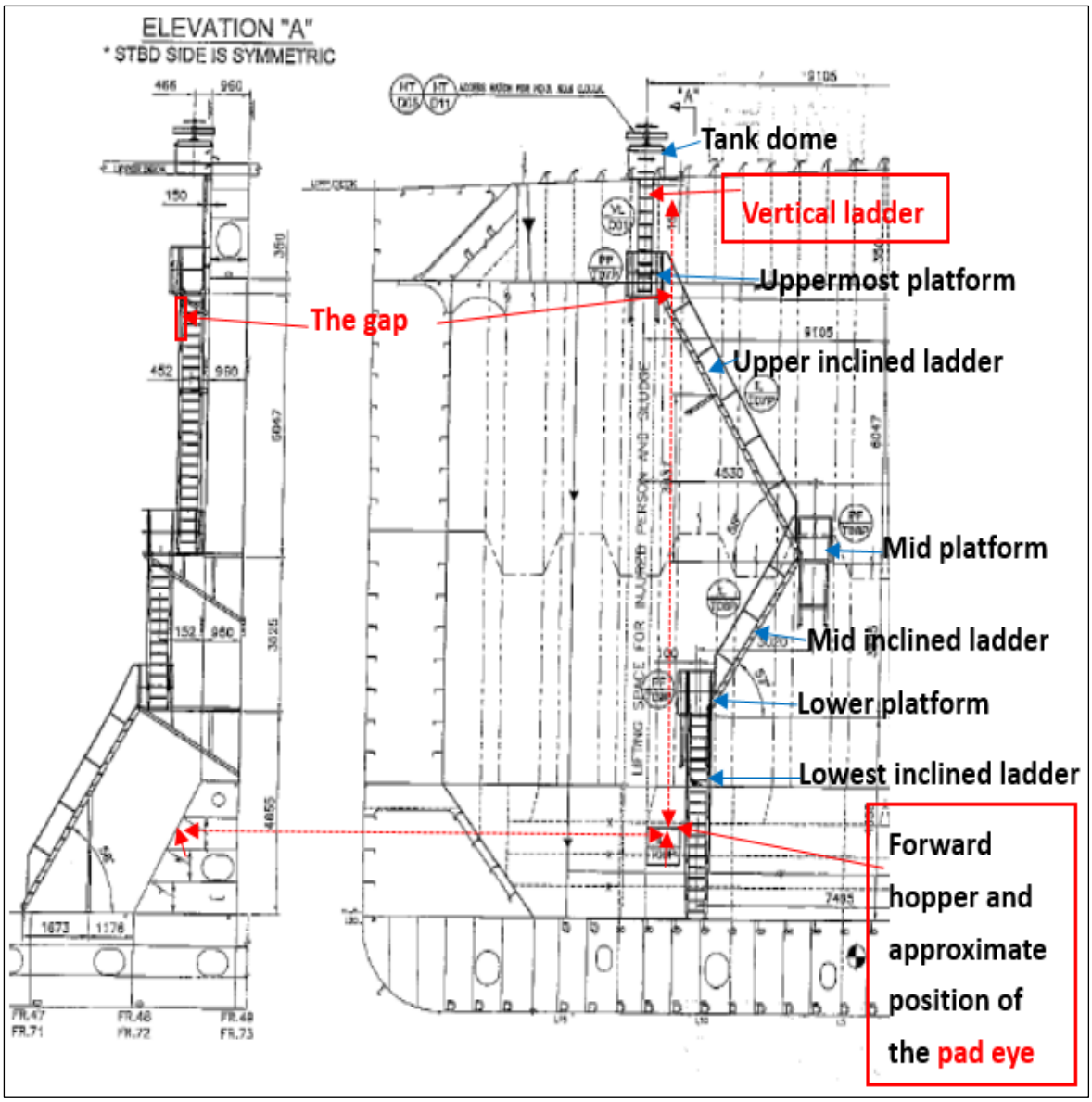

Fig. 4- Schematic and details of the access ladder for 3P COT

5.21 Figure 5 also shows that the side railing and vertical stanchions of the upper inclined ladder on the end connection to the uppermost platform had an opening of ultimate dimensions of 1.33 metres high x 1.2 metres wide (the gap). There was no intermediate bar to reduce the gap size (figure 6).

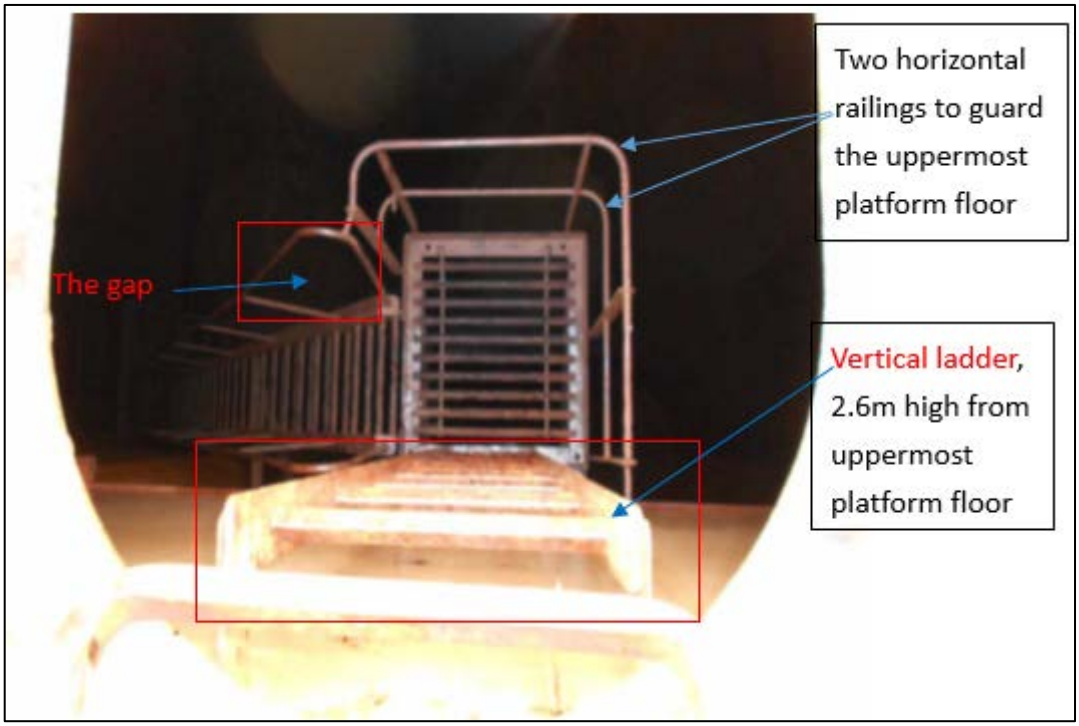

Fig. 5- Viewing down from tank dome at the vertical ladder, uppermost platform floor and the inclined ladder.

Fig. 6- Photo taken from uppermost platform to show the opening dimensions (i.e. the gap).

Injury to the TOS and the likely cause of the fall

5.22 There was no eye witness to confirm how and where the TOS was fallen from the access ladder, but he was found lying on the port side forward tank top near the lowest inclined ladder (figure 7).

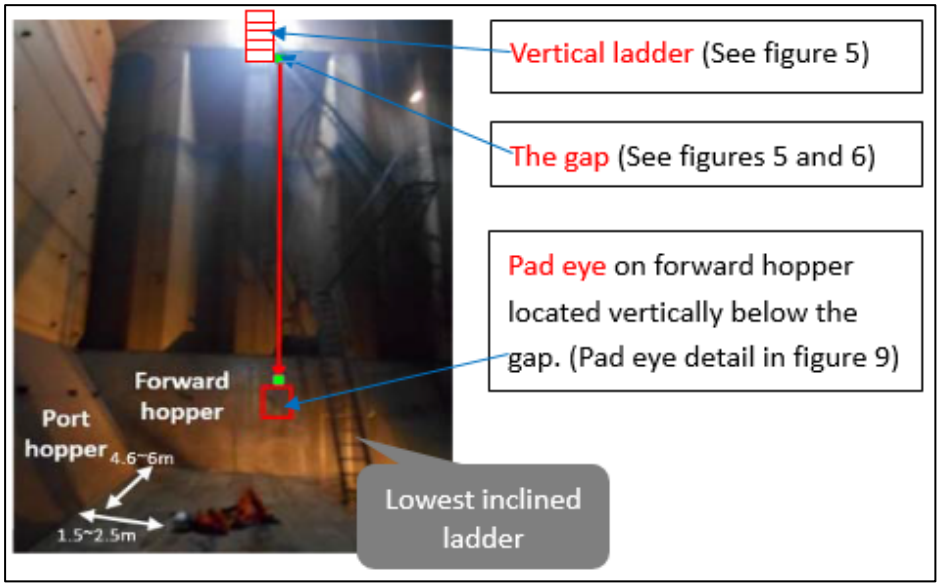

Fig. 7- Relative position of the casualty, vertical ladder, the gap and the pad eye.

5.23 There was one pad eye welded on the forward hopper at a height of about 2 metres above tank top. This pad eye was directly below the vertical ladder and the gap (figure 7).

5.24 Some rubbing marks and oil stains were found above the pad eye and that the edge of the pad eye was adhered with filth appearing as blood stains (figures 8 and 9).

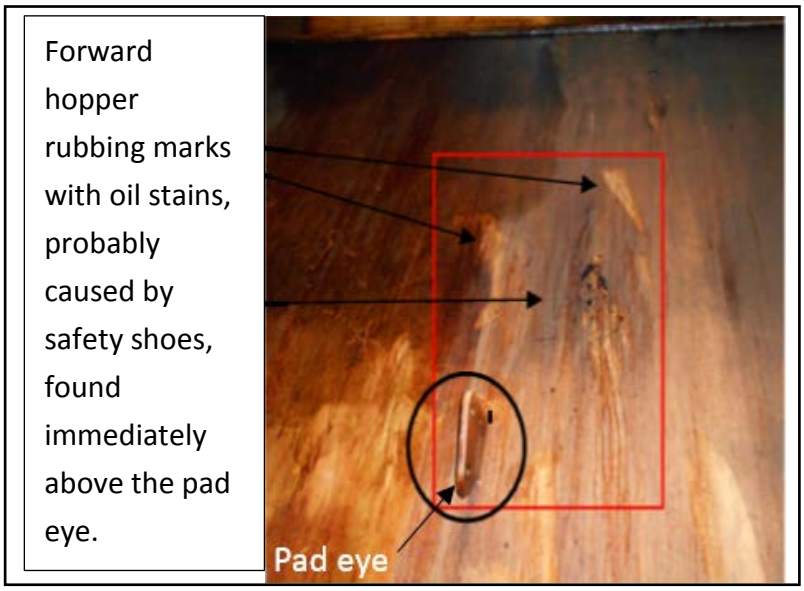

Fig. 8- Forward hopper had marks indicating body contact.

Fig. 9- Pad eye close up - Located vertically below the gap.

5.25 From the pad eye to the lying position of the injured TOS, two distinct parallel skidding marks (blood streaks) running in a fore-and-aft direction from the pad eye were found (figure 10). The finding evidenced that the body of the TOS during the fall had hit the pad eye thus causing the fatal lacerating to his abdomen upon landing on the tank top. The landing force had caused the TOS to slide on the floor to his final lying position.

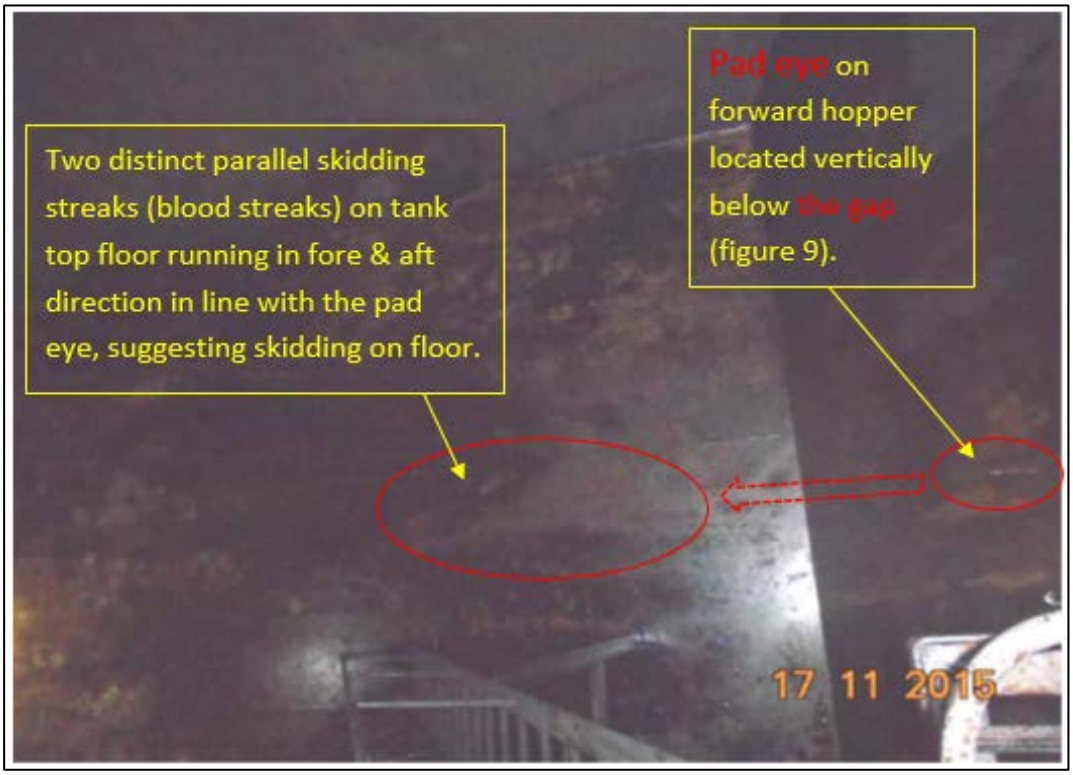

Fig. 10- Photo taken showing the parallel skidding marks on tank top floor.

5.26 About one to two minutes before the accident happened, the chief officer saw the TOS had started to ascend the lowest inclined ladder. Given the age of the TOS and the time elapsed, the chief officer considered that the TOS could have reached the uppermost platform and been climbing the vertical ladder.

5.27 It was therefore deduced that the TOS might have fallen either through the gap or directly from the vertical ladder with the result of hitting the pad eye and finally, landed and slid on the tank top. (figure 11)

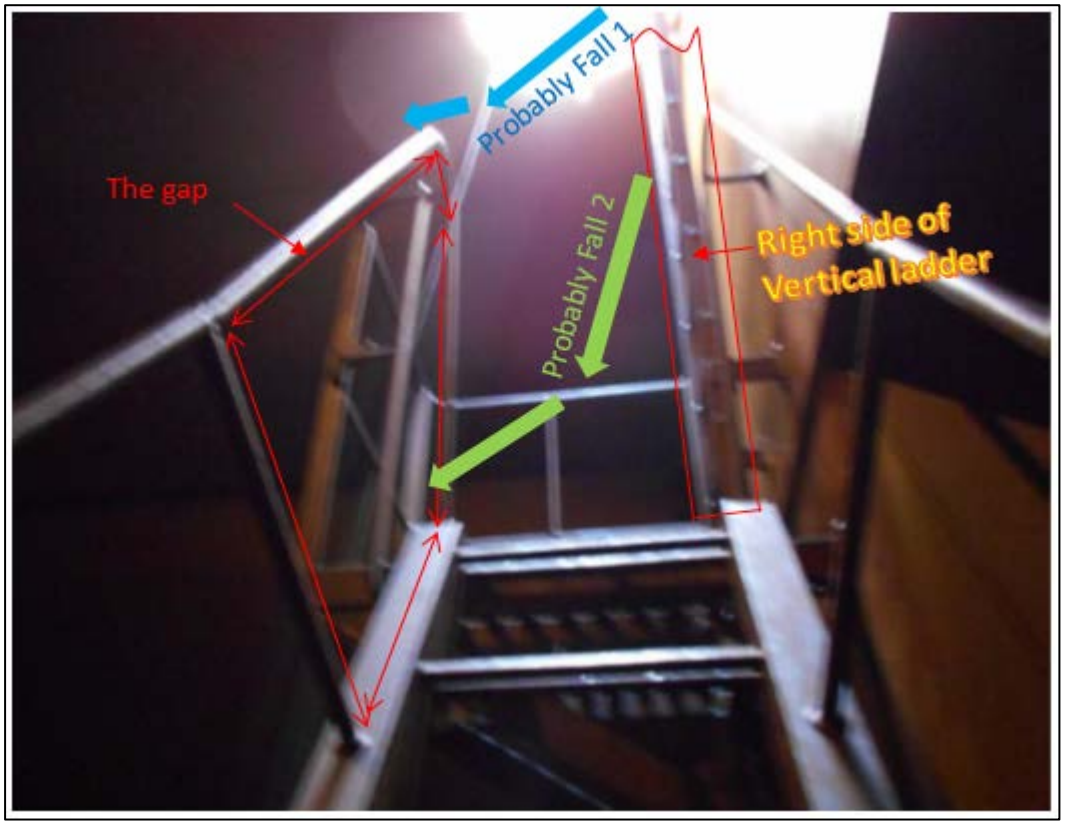

Fig. 11- View looking up from uppermost inclined ladder- probably falling manners.

Autopsy and Medical Observation of Doctor

5.28 Formal postmortem report of the casualty was not available. The TOS was declared dead by the port medical officer at 0245 hours on 15 November 2015 on board *the vessel* at Campbell Bay of India. The forensic report mentioned the cause of death to be “shock and hemorrhage consequent to injury to the abdomen”.

Personal protection equipment

5.29 The TOS wore proper personal protection equipment, i.e. a coverall boiler suit, a safety helmet with chin strap, a pair of cotton safety gloves with palm coated anti-skid, a pair of anti-skid safety shoes and a personal gas alarmer for Oxygen and Hydrogen Sulphur contents. The personal protection equipment was considered

appropriate for entering into and working inside the tank.

Personal factor, fatigue, alcohol and drugs abuse

5.30 It was reported that the TOS was a sincere and responsible man. He was a teetotaler. He was sociable and had good relations with other personnel on board. Suicide and foul play could be ruled out.

5.31 The TOS was usually kept on day work at sea. During cargo operation and tank cleaning operation, he used to be on duty on the shifts of 00-06 and 12-18 hours respectively. The duty records indicated that he rested for 16 hours on 12 November 2015 and 12 hours on 13 November 2015.

5.32 On 14 November 2015, he completed the shift of 00-06 hours with pump man for tank cleaning operation. During this shift, he assisted in line setting and operating tank washing machines on deck. There was no enclosed space entry in tank in evening. He resumed his shift at 1200 hours for tank cleaning operation on deck prior to entering 3P COT at 1458 hours. No fatigue was observed by his colleagues.

5.33 The master of *the vessel* immediately conducted an alcohol test of all concerned persons after the accident. Urine samples of concerned persons were also taken and landed ashore for laboratory test. No alcohol effect, narcotics or psychotropic substances were found in the forensic reports of all concerned persons. There was no drug or alcohol abuse related to the incident.

Weather conditions

5.34 Weather conditions were good. Wind southerly force 4, swell southerly 1.5 m. The course of *the vessel* was 262° and her speed was about 12 knots. There was slight rolling and pitching extent of which was safe to allow tank entry.

Emergency response to rescue casualty

5.35 After the incident happened, the master had promptly activated shipboard contingency response and crew members immediately rescued the casualty from the tank and provide first aid. The time taken for rescue the TOS out of the tank was about thirty minutes. Prior to transferring him on to the stretcher, most of the time was spent on first aid to stop the bleeding, and containing the exposed internal organs to prevent from flowing outside through the large wound on the abdomen.

5.36 The company was promptly alerted by the master and *the vessel* was diverted to the nearest port of refuge to evacuate the TOS. The company had activated the

emergency response team ashore and all necessary assistance was provided to *the vessel*. Immediate attempts were made by the company and owners to get the TOS to a medical facility, but helicopter was not available for immediate evacuation due to the lack of facilities in the region.

Access ladder design review

5.37 The access ladder in 3P COT was a typical ladder which was installed in all cargo oil tanks of *the vessel* (see figure 4). Comparing with the ladders in sister vessels of the same company and in other vessels built by the same shipyard, it was noted that some ladders of these vessels were provided with an intermediate bar (figure 12). The classification society of *the vessel* was consulted on this issue with the understanding that the *vessel* complied with all applicable regulations of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC code) Chapter 3/3.4 with regard to the requirements for "Access to spaces in the cargo area". However, the requirements did not include detailed specifications for the access ladders inside cargo tanks.

5.38 SOLAS regulation II-1/3-6 requires that applicable oil tankers and bulk carriers shall comply with the technical provisions for means of access to cargo and other spaces under the resolution MSC.133(76) as amended. The said resolution specifies that guard rails shall be 1000 mm in height and consist of a rail and an intermediate bar 500 mm in height and of substantial construction. Although *the vessel* was not an oil tanker or bulk carrier, consideration should be given to adopt the principle of the said resolution whereby an immediate bar should be provided between the stringer and top handrail of the inclined ladders to reduce the gap size.

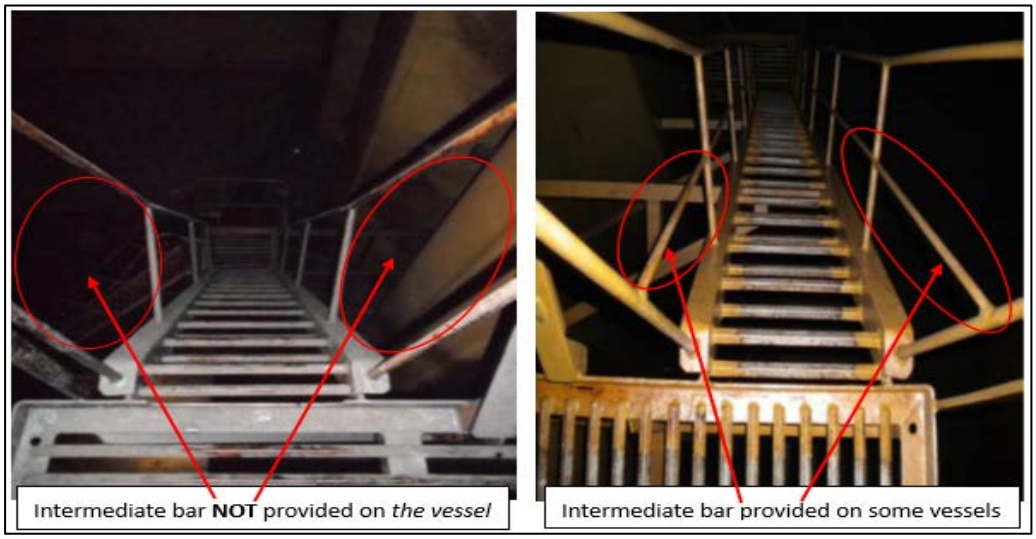

Fig.12- The gap on uppermost inclined ladder -some vessels are fitted with intermediate bar to reduce gap.

6. Conclusions

6.1 On 14 November 2015, the Hong Kong registered oil/chemical tanker Alpine Magic, under ballast condition, was en-route at Bay of Bengal from Tanjung Pelepas, Malaysia to Fujairah, UAE. Cargo oil tank cleaning operations were in progress preparing for the loading of clean petroleum product at the next loading port.

6.2 After verifying the tank conditions of the 3P COT, the master authorized tank entry into 3P COT for tank inspection. A team consisted of an AB and the TOS entered into the 3P COT. After completion of tank inspection and cleansing, the TOS left the tank but fell from the access ladder at height and died eventually.

6.3 The investigation had identified the main contributory factor that the risk of fall from cargo oil tank access ladder was not assessed properly thus failing to prevent the falling of the TOS from height.

6.4 The following safety issues were also found in the investigation:

(a) the vertical ladder had no guard rings and the gap of the side rail of inclined ladder near the uppermost platform might allow the TOS to fall sideway if he lost his balance on the ladder; and

(b) the company's procedure for using fall arrestor devices had not been strictly followed by ship's crew.

7. Recommendations

7.1 The ship management company should consider fitting arrangements, such as guard rings on the vertical ladders and intermediate bar for the inclined ladder, inside cargo oil tanks on all vessels in order to prevent recurrence of similar accident.

7.2 The ship management company should review its Safety Management System (SMS) and relevant procedures or guidelines to include the element of ladder access in risk assessment.

7.3 To avoid any lapses when implementing SMS, the ship management company should issue safety instructions to remind all its officers and crew members that the company's procedures or guidelines should be strictly followed. Particularly that fall arrestor devices should be used mandatorily while using first vertical ladder of any COT.

7.4 A Hong Kong Merchant Shipping Information Notice is to be issued to promulgate the lessons learnt from the accident.

8. Submission

8.1 Copies of the draft report had been sent to the following parties for comments:

a) the shipowner/management company; and

b) the master and the chief officer of *Alpine Magic*;

8.2 After the end of the consultation, comments had been received from the management company of *the vessel*. The draft report had been amended as appropriate according to the comments.