Report of investigation into the fatal accident on board Hong Kong registered chemical tanker "*Alpine Maya*" at Fujairah, UAE on 18 April 2014

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

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Purpose of Investigation

This incident is investigated in accordance with the Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (the Casualty Investigation Code) adopted by IMO Resolution MSC 255(84).

The purpose of this investigation conducted by the Marine Accident Investigation and Shipping Security Policy Branch (MAISSPB) of Marine Department, in pursuant to the Merchant Shipping Ordinance Cap. 281, the Merchant Shipping (Safety) Ordinance (Cap. 369), the Shipping and Port Control Ordinance (Cap. 313), or the Merchant Shipping (Local Vessels) Ordinance (Cap. 548), as appropriate, 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 At 0840 on 18 April 2014, the Hong Kong registered chemical tanker *Alpine Maya*, under ballast condition, arrived at and anchored in the offshore anchorage in Fujairah, UAE. Prior to arrival, all cargo oil tanks and the starboard slop tank were cleaned and gas-freed for inspection of the condition of tank coatings.

1.2 At 0900 on 18 April 2014, the ship owner's technical consultant (the superintendent) and two paint supervisors from the maker of cargo tank coatings boarded the vessel. The superintendent, who was in attendance to carry out an Environmental Audit, also intended to inspect the cargo oil tank (COT) for tank coating condition and deep well for evidence of any suction well pitting.

1.3 After all the preparation work was completed, which included the risk assessment and issuance of enclosed space entry permits, the tank inspection commenced.

1.4 During the day and prior to the accident, the superintendent had entered into three COTs and spent a total of 73 minutes staying inside the tanks. At 1422, the chief officer entered into 4S COT followed by the superintendent. Firstly, the chief officer climbed down the vertical ladder and reached the landing platform. He stayed on the platform to wait for the superintendent. The superintendent then entered into the tank and climbed down the vertical ladder. Suddenly, at about 1424, he fell down from the vertical ladder to the bottom of the cargo oil tank.

1.5 The chief officer immediately shouted and informed the Bosun, who was the responsible person at the entrance of the cargo oil tank, through walkie-talkie. The Bosun relayed the message to the duty officer on the bridge and the ship's master immediately. He was rescued and sent to hospital ashore for treatment. At about 1615 on 18 April 2014, the superintendent was declared dead by a local doctor.

1.6 At the time of the accident, the weather was fine and sea was calm. The vessel was in stable condition. The ambient temperatures on deck and inside the tanks of the vessel were about 33^0C and 37^0C respectively.

1.7 The investigation into the accident revealed the main contributory factors as follows:

i) the superintendent might have suffered from heat exhaustion that caused him losing his grabbing on the vertical ladder while he was entering into 4S COT in the afternoon under high ambient temperature; and

ii) the vertical ladder without guard rings could not prevent him from falling sideway after he lost his grabbing on the ladder.

2. Description of the vessel

Name of vessel	**:**	*Alpine Maya* **(**Fig. 1)
IMO No.	:	9387932
Call Sign	:	VRGM6
Flag	:	Hong Kong, China
Port of Registry	:	Hong Kong
Classification Society	:	Korea Register of Shipping
Trade of Vessel	:	International Trading
Ship Type	:	Oil / Chemical Tanker
Gross Tonnage	:	29733
Net Tonnage	:	13661
Length (LOA)	:	183.00 m
Breadth (molded)	:	32.20 m
Depth (molded)	:	19.10 m
Draft (Design)	:	11.00 m
Main Engine & Power	:	Diesel Engine, 9,480 kW x 1 set
Propulsion	:	Screw (Single)
Ship Builder	:	STX Offshore and Shipbuilding Co., Ltd
Year of Built	:	2009

Fig.1 – Alpine Maya

3. Sources of Evidence

3.1 Information provided by the management company.

3.2 Witness statements of the ship’s crew members.

3.3 Autopsy report.

4. Outline of Events

All times are local (UTC+ 4) if not specified otherwise

4.1 On 17 April 2014, after unloading of crude degummed soybean oil at Banda Abbas, Iran, the Hong Kong registered chemical tanker *Alpine Maya* sailed for Fujairah, UAE under ballast condition.

4.2 During en-route to Furjairah, UAE, the ship's crew carried out pre-wash cleaning of cargo oil tanks (COT) with seawater. All slops from tank washing were pumped into port side slop tank. All COT and the starboard slop tank were gas freed for inspection at Fujairah, UAE.

4.3 At 0840 on 18 April 2014, the vessel was anchored at Fujairah offshore anchorage. Several activities were planned at Fujairah including bunkering, de-slopping, underwater hull cleaning, tank cleaning and crew change. The vessel was expected to be in port for two to three days to complete all operations. The ship owner's technical consultant (the superintendent) was assigned to visit the vessel at Fujairah for inspection.

4.4 At 0900 on 18 April 2014, the superintendent and two paint supervisors boarded the vessel. The superintendent, who was in attendance to carry out an Environmental Audit, also intended to inspect the COT for tank coating condition and deep well for evidence of any suction well pitting.

4.5 The environmental audit opening meeting and the pre-tank-inspection meeting were held by the ship's master with attendance of the chief officer and the superintendent.

4.6 At 0930, the enclosed space entry permits for 1P COT and 2P COT were issued. From 0932 to 1010, the chief officer and the two paint supervisors checked the paint condition in 1P and 2P COT.

4.7 At 1050, the enclosed space entry permit for 4P COT was issued. At 1054, the superintendent, the chief officer and the two paint supervisors entered into the tank for inspection. At 1114, they came out of the tank.

4.8 At 1115, the enclosed space entry permits for starboard slop tank was issued. The superintendent, the chief officer and the two paint supervisors entered into the tank for inspection at 1115 and finished at 1130. After that, all of them went for lunch.

4.9 After the lunch break, the enclosed space entry permit for 4S COT and 5P COT were issued. From 1333 to 1411, the superintendent, the chief officer and the two paint supervisors entered into the 5P COT for inspection.

4.10 At 1422, the chief officer entered into 4S COT followed by the superintendent. Firstly, the chief officer climbed down the vertical ladder and reached the landing platform. He stayed on the platform to wait for the superintendent. The superintendent then entered into the tank and climbed down the vertical ladder. Suddenly, at about 1424, he fell down from the vertical ladder to the bottom of the cargo oil tank. The chief officer immediately shouted and informed the Bosun, who was the responsible person at the entrance of the cargo oil tank, through walkie-talkie. The Bosun relayed the message to the duty officer (i.e. the second officer) on the bridge and the ship's master immediately.

4.11 All crew rushed to 4S COT in response to the emergency. At the time of the accident, the chief officer and the two AB inside the cargo oil tank did not hear any shouting, screaming or calling from the superintendent. The two AB who were working on the bottom of the cargo oil tank ran to provide immediate assistance to the superintendent. Blood was seen coming out profusely from his head, mouth and ears. The two AB tried to stop the bleeding by applying pressure with rags but in vain

4.12 At 1426, the duty officer on the bridge contacted Fujairah Port Control to ask for assistance. At 1436, the superintendent was placed on a stretcher and lifted out from the cargo oil tank. His airway was cleared and crew made efforts to resuscitate him. He was then moved to the ship's hospital and oxygen resuscitation was applied to him. At 1440, the duty officer was informed that the port control would deploy a pilot boat to attend the vessel.

4.13 Considering that the pilot boat could only reach the vessel in about 30 minutes the earliest, the master contacted the diving team for assistance, whose boat was moored alongside the vessel for conducting of underwater hull inspection and cleaning. At about 1450, the boat of diving team picked up the superintendent and sent him ashore for medical treatment.

4.14 On the way to the hospital ashore, oxygen resuscitation was continuously applied to the victim by the escorting second officer on the boat. After the boat arrived at pier, the victim was immediately taken over and shifted to the port clinic by ambulance staff of shore terminal. At about 1615, the victim was declared dead by a local doctor.

4.15 At the time of the accident, the weather was fine and sea was calm. The vessel was in stable condition. The ambient temperatures on deck and inside the tanks of the vessel were about 33^0C and 37^0C respectively.

5. Analysis

Ship certificates and crew and personnel on board

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

5.2 The master had served as a master on chemical tankers for more than 3 years. He worked for the management company of the vessel for more than 10 years.

5.3 The chief officer had more than six years of experience working as a chief officer on tankers. He joined the vessel in February 2014 as a chief officer.

5.4 The superintendent was about 40 years old. He had worked for the ship owners about six months, during which he had inspected four vessels including two dry dockings. Prior to that, he had had 12 years of sea going experience from 1998 to 2011. From 2008 to 2011, he was in the capacity of chief engineer. From 2011 to 2013, he worked as a Technical Superintendent.

Risk assessment

5.5 The cargo oil tanks were cleaned and gas-freed before the inspection. Natural ventilation of cargo oil tanks was maintained with all the openings to the tanks opened.

5.6 The risk of entering into the cargo oil tanks for inspection was assessed by the chief officer. With the presence of carbon monoxide (CO), the hazard was rated as medium. The CO contents inside the tanks as measured were between 5 to 11 ppm.

5.7 According to the Occupational Safety & Health Administration (OSHA) of the United States, the Permissible Exposure Limit (PEL[1]) for CO is 50 ppm TWA (Timed Weighted Average). Also, according to American Conference of Governmental Industrial Hygienists (ACGIH), the Threshold Limit Value (TLV[2]) for CO is 25 ppm TWA.

5.8 In view of above, with continuous ventilation of the cargo oil tanks during inspection, the chief officer reduced the risk level to low in his risk assessment.

5.9 The risk assessment conducted by the chief officer did not consider the hazard of crew working under high temperature environment. According to the ship's logbook entries at noon on 18 April 2014, the temperatures were 29^0C dry and 26^0C wet. At the time of the accident at 1424, the temperatures were to 37^0C inside cargo

[1] Refer to website https://www.osha.gov/dts/chemicalsampling/data/CH_225600.html

[2] The threshold limit value (TLV) of a chemical substance is a level to which it is believed a worker can be exposed day after day for a working lifetime without adverse health effects.

oil tank and 33^0C on deck.

5.10 During the tanks inspection, the superintendent and the crew complained about the hot working environment (both on deck and inside tanks) that caused their boiler suits totally wetted with sweat. High ambient temperature and humidity could cause heat exhaustion and/or heat stroke. Symptoms of heat exhaustion and heat stroke include dizziness, nausea, vomiting, headache, excessive thirst, feeling of weakness, mental confusion, disorientation, and loss of consciousness.

Superintendent's exposure to CO during tank inspection

5.11 As a control measure to monitor the crew and other personnel's exposure to CO, the durations of each person staying inside the cargo oil tanks were recorded. Regarding the superintendent's exposure to CO, it is tabulated as below:

	4P COT	Starboard Slop	5P COT	4S COT	Total (mins)
CO Content	7 ppm	5 ppm	6 ppm	6 ppm	---------
duration (min)	20*	15**	38***	Accident	73

* refer to paragraph 4.7;
** refer to paragraph 4.8; and
*** refer to paragraph 4.9.

5.12 The atmosphere inside 4S COT was monitored continuously and the records are given below:

Date/Time 18/04/2014	Oxygen in % Vol.	Hydrocarbon in % LEL	CO in PPM	H_2S in PPM	Toxic Gases (Specify)
1316	20.9	0	6	0	0
1420	20.9	0	6	0	0

5.13 The total duration of exposure to CO by the superintendent with CO content of about 5 to 7 PPM was 73 minutes. According to the Occupational Safety & Health Administration (OSHA), the Permissible Exposure Limit (PEL) for an employee's exposure to CO shall not exceed the 8-hour Time Weighted Average (TWA) of 50 ppm in any 8-hour work shift of a 40-hour work week. According to American Conference of Governmental Industrial Hygienists (ACGIH), the Threshold Limit Value (TLV) is 25 ppm TWA.

5.14 Based on a total duration of 73 minutes exposure to CO by the superintendent (paragraph

5.11), the calculated Time Weighted Average was 0.92[3] ppm which was below the limit of PEL and TLV of 50 ppm and 25 ppm respectively. Therefore, the exposure to CO by the superintendent was not a contributory factor to the accident.

Autopsy

5.15 The autopsy report indicated the superintendent, due to hitting on the bottom of the cargo oil tank, sustained fractures of skull and rib and laceration of the brain and lung. The bleeding resulted in a sharp drop of blood circulation and respiratory functions. His death was caused by traumatic injuries. No narcotics and psychotropic substances were found. No CO poisoning of the deceased was found.

Entry into enclosed space

5.16 In the Safety Management System manual under the "precautions while entering enclosed spaces", it stipulated that, among other parameters, a place was safe for entry when no toxic or other contaminants were present.

5.17 Hence, the presence of toxic CO gas inside cargo oil tanks should have rendered them not suitable for entry by person in accordance with the SMS manual. Nevertheless, such non-compliance with the SMS manual did not contribute to the accident.

Access ladder inside cargo oil tanks

5.18 The access ladder into 4S COT, which was typical in other cargo oil tanks of the vessel, is shown in figure 2. The height from deck to the bottom of 4S COT was about 17.50 m. The length of the vertical ladder, which had no guard-rings, was about 3.9 m. It ended at the landing platform the size of which was about 950 mm by 1000 mm.

5.19 After the accident, it was confirmed that there was no damage to the vertical ladder.

5.20 For convenience of moving up and down inside cargo oil tank, the crew on board did not use safety harness and safety belt or lifeline while using the access ladder.

5.21 After the accident, the management company revised the relevant procedures and instructed the crew on board the vessel and all other vessels under its management to use fall arrestor when climbing a vertical ladder of 2.5 m in length or above. Also, the company would consider fitting guide rings on the vertical ladders inside cargo oil tanks of all similar vessels managed by the company during dry docking in order to prevent re-occurrence of similar accident.

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[3] The Time Weighted Average = (7 ppm x 20 min + 5 ppm x 15 ppm + 6 ppm x 38 min) / (8 hr x 60 min) = 0.92 ppm

Fig.2 – Access ladder inside 4S COT

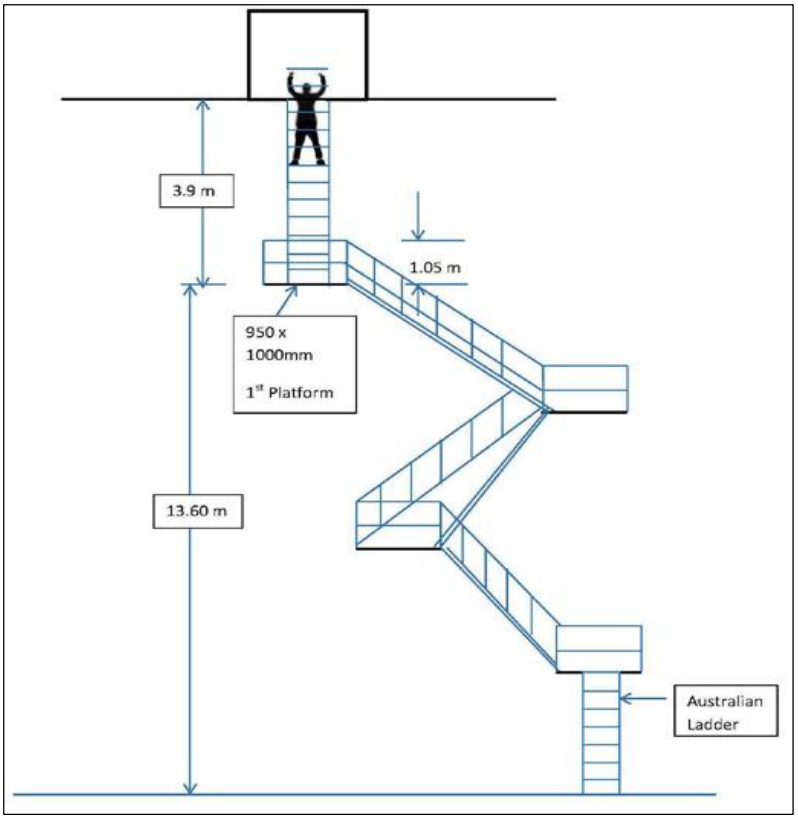

Fig.3 – Access ladder inside 4S COT

Personal safety equipment

5.22 The superintendent wore proper boiler suit, safety helmet, safety gloves, anti-skid safety shoes and carried an intrinsically safe hand torch.

5.23 After the accident, it was confirmed that his safety shoes were in good condition.

Fatigue, alcohol and drugs abuse

5.24 The superintendent stayed in a hotel at the port for about two days before boarding the vessel. He left the hotel at about 0600 on 18 April 2014. Prior to the accident happened at about 1424, he spent a total of about 2.4 hours for the inspection of three cargo oil tanks and inspection on the deck. Intermittently, he had several breaks of rest. The superintendent should not have suffered fatigue at work.

5.25 No alcohol effect and narcotics and psychotropic substances were found in the forensic report.

5.26 The superintendent's prolonged period of exposing himself under high ambient temperature might have caused him heat exhaustion and/or heat stroke, which could be a contributing factor of the accident.

The probable cause of the accident

5.27 From the analysis, based on the evidence and information available, it was deduced that the main contributory factors to the accident was that the superintendent who might have suffered from heat exhaustion that caused him losing his grabbing on the vertical ladder while he was entering into 4S COT in the afternoon under high ambient temperature. The vertical ladder without guard rings could not prevent him from falling sideway after he lost his grabbing on the ladder.

6. Conclusion

6.1 At 0840 on 18 April 2014, the Hong Kong registered chemical tanker *Alpine Maya*, under ballast condition, arrived at and anchored in the offshore anchorage in Fujairah, UAE. Prior to arrival, all cargo oil tanks and the starboard slop tank were cleaned and gas-freed for inspection of the condition of tank coatings.

6.2 At 0900 on 18 April 2014, the ship owner's technical consultant (the superintendent) and two paint supervisors from the maker of cargo tank coatings boarded the vessel. The superintendent, who was in attendance to carry out an Environmental Audit, also intended to inspect the cargo oil tank (COT) for tank coating condition and deep well for evidence of any suction well pitting.

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ii) the vertical ladder without guard rings could not prevent him from falling sideway after he lost his grabbing on the ladder.

7. Recommendations

7.1 A copy of the investigation report into the accident should be provided to the management company and the master of *Alpine Maya* informing them the findings of the accident investigation.

7.2 The ship management company should consider fitting guard rings on the vertical ladders inside cargo oil tanks on all vessels under the management in order to prevent re-occurrence of similar accident.

7.3 The management company should issue safety instructions to all officers and crew, and to remind other personnel working on board their vessels, of the followings:

a) take extra precaution to avoid falling when climbing on a vertical ladder without fitting guard rings, and use fall arrestors as far as practicable; and

b) the impact of heat exhaustion on human body under prolong period of work in hot climate.

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

8. Submissions

8.1 In the event that the conduct of any person or organization is criticized in an accident investigation report, it is the policy of the Marine Department that a copy of the draft report should be given to that person or organization so that they can have an opportunity to express their comments on the report or offer evidence not previously available to the investigating officer.

8.2 Copy of the draft report has been sent to the following parties for comments:

a) the management company, the master and the chief officer of *Alpine Maya*.

8.3 No submission was received from above parties.