



Preliminary Inquiry No.1 of 2009

Report of investigation
into the engine room fire
on board Hong Kong registered
M.T. “*An Tai Jiang*”
on 9 January 2009



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

Preliminary Inquiry No.1 of 2009

In accordance with Section 51(1) of the Merchant Shipping Ordinance (Chapter 281), on 12 January 2009, the Director of Marine appointed Mr. LEUNG Fuk-pui, Surveyor of Ships (Engineer and Ship), to carry out a Preliminary Inquiry into the circumstances attending the casualty.

Purpose of Investigation

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

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

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

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1. Summary

- 1.1 At about 1230 local time on 9 January 2009, a fire accident happened onboard the Hong Kong registered asphalt tanker "*An Tai Jiang*" when she was en route from Ulsan to Ningbo. The fire started inside the engine room and spread into accommodation spaces. The accident resulted in the deaths of the Third Engineer and a motorman inside the engine room, and another motorman lost at sea after falling into water. The engine room and crew accommodation sustained serious damage. There was no oil pollution to marine environment.
- 1.2 The investigation into the accident deduced that the most probable cause of the accident was main engine crankcase explosion. The explosion resulted into release of large quantity of hot oil mist and/or flammable vapour from the main engine crankcase into engine room, which was ignited and caused the fire. The fire spread from engine room into crew accommodation and burnt out the combustible materials in its path causing serious damage.
- 1.3 The investigation also identified the following contributing factors to the casualty:
- problem existed in the main engine and its lubrication system for a long time without attention;
 - the main engine oil mist detector was defective and failed to give out alarm before explosion occurring inside the main engine crankcase;
 - the engine room fire detection and alarm system was defective, therefore the crew members were not alerted of the fire when it started;
 - the self-closing device of the port engine room entrance door might have failed or the door had not been properly closed by the crew members resulted into extensive fire damage to the crew accommodation;
 - leadership displayed by the Master and senior officers in handling emergency situations was poor and crew members onboard were not adequately trained, through regular and systematic drills and exercise, in dealing with emergency situations;
 - implementation of safety management system onboard was not effective, which resulted into major non-conformities in the areas of crew trainings, emergency preparedness, maintenance of ship's firefighting and life saving equipment. Also, the shipboard internal audits failed to identify and rectify these non-conformities at an earlier stage.

2. Description of the Vessel

2.1 Particulars of M.T. “An Tai Jiang”

Port of Registry	: Hong Kong
IMO No.	: 8601288
Official No.	: HK- 0699
Call Sign:	: VRXA9
Classification Society	: China Classification Society
Type of Ship	: Oil Tanker
Year of Built	: 1984
Built At	: Huangpu Shipyard, Guangzhou, China
Ship Manager	: COSCO Southern Asphalt Shipping Company Limited
Length	: 99.50 metres
Breadth	: 16.00 metres
Depth	: 9.00 metres
Gross Tonnage	: 3,951
Net Tonnage	: 1,285
Dead Weight	: 4,926 tonnes
Engine Power	: 2,867 kW
No. of Crew	: 25



Fig. 1: M.T. "An Tai Jiang" Berthed at Ningbo after Fire Incident

2.2 "An Tai Jiang" (hereinafter referred as the *Vessel*), is a four-hold asphalt tanker. The *Vessel* was keel laid on 30 August 1984 and built in Huangpu Shipyard, China as a general cargo ship. She was converted into asphalt tanker in 2001. The *Vessel* is powered by a Pielstick 6PC2-5L marine diesel engine, capable of developing power of 2,867 kW. At the time of incident, the *Vessel* was manned by Chinese crew.

2.3 Engine Room of the *Vessel*

2.3.1 The engine room is located in the aft part of the *Vessel* (see Fig.2). One diesel main propulsion engine is located at the lower level of engine room. The main engine exhaust manifold is connected to a turbocharger fitted at the aft end of the main engine. The exhaust gas exiting from the turbocharger passes through a vertically rigged exhaust gas duct up to the funnel. Three diesel generators are also located at the lower level of engine room in front of the main engine (see Fig.3).

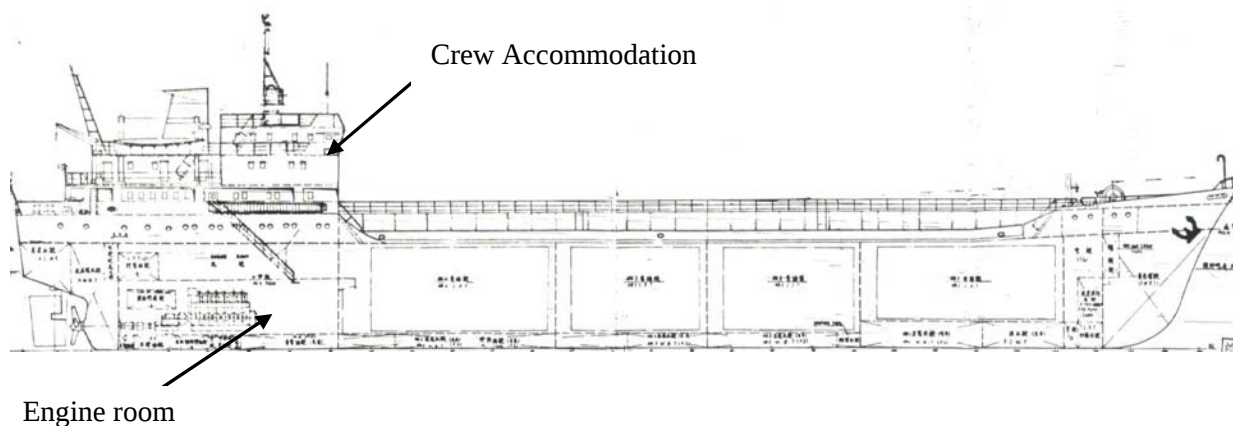


Fig. 2: General Arrangement Plan of *Vessel*

2.3.2 An emergency escape trunk is sited in the aft part of the engine room providing direct access to open area at the boat deck. The engine control room is sited on No.2 deck just above the generators flat. A mechanical workshop and an electrical workshop are located at the starboard side of No.2 deck in the engine room.

2.3.3 A diesel oil service tank, a heavy fuel oil settling tank and a heavy fuel oil service tank are located in the aft part of the engine room on No.2 deck. The engine room has two entrance doors, one at the starboard side and the other at port side, located inside the crew accommodation on the main deck (see Fig.4).

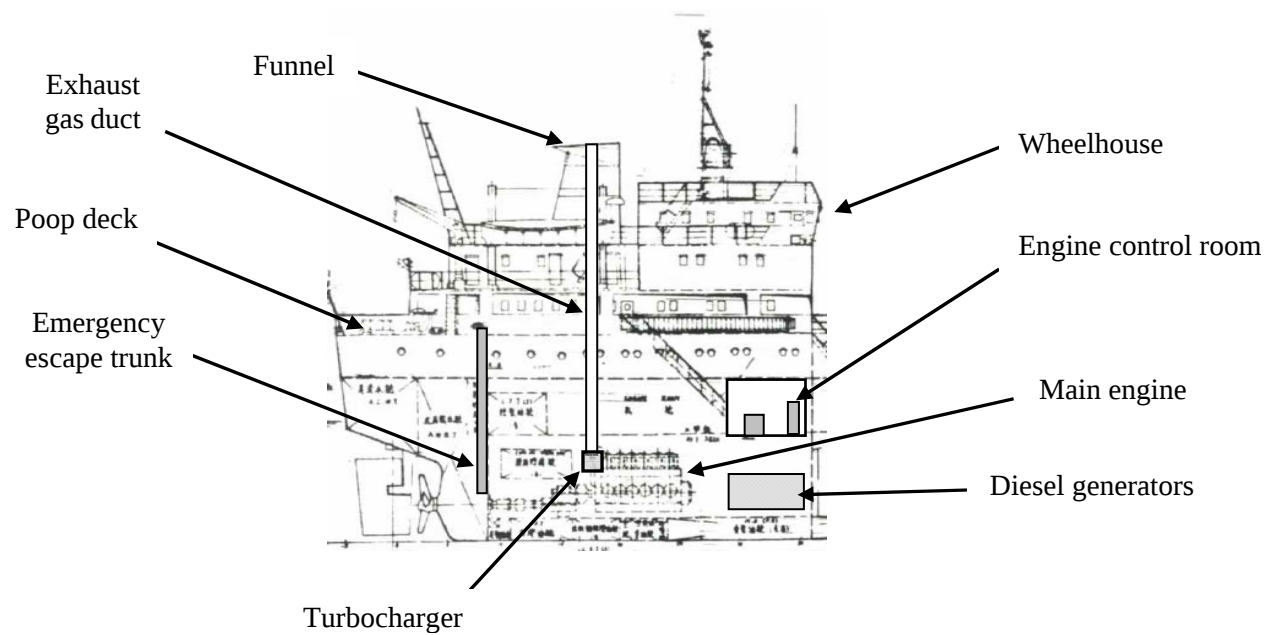


Fig. 3: General Arrangement Plan of Aft Part of Vessel

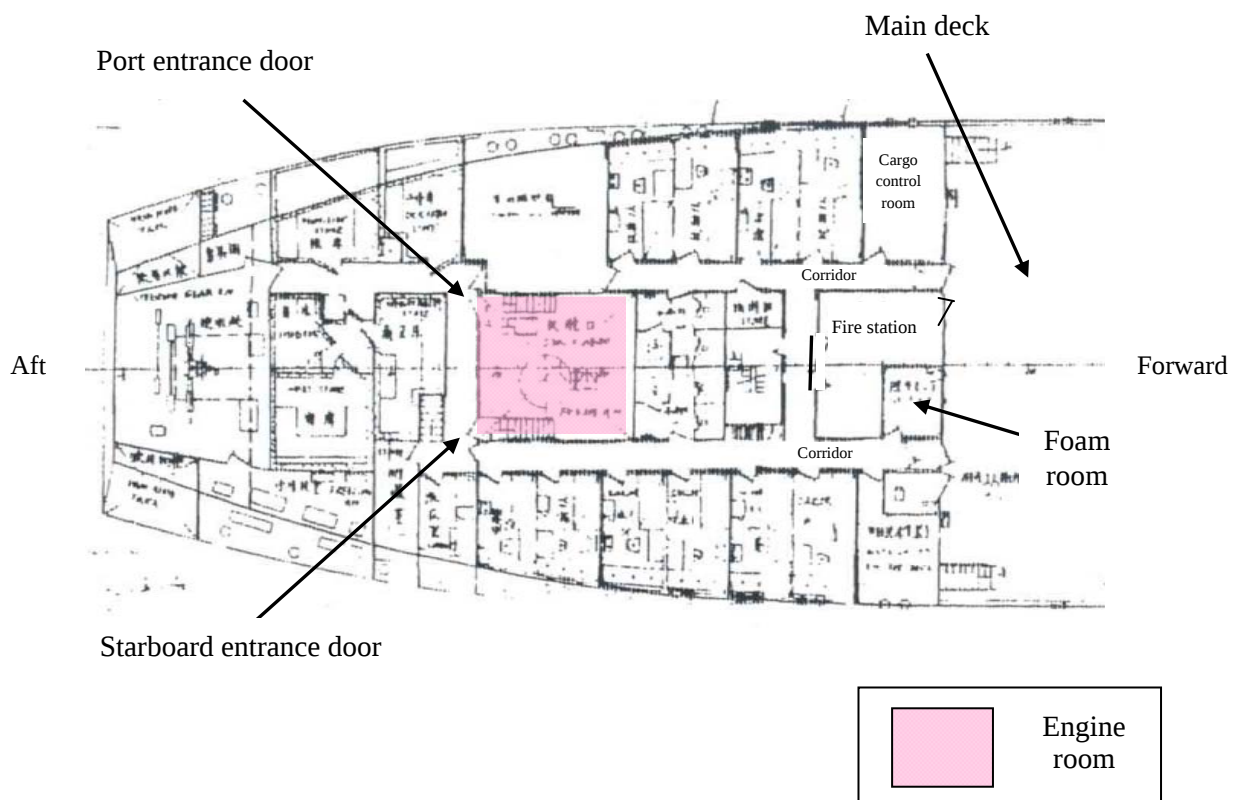


Fig. 4: Entrance Doors of Engine Room at Main Deck

2.4 Crew accommodation of the Vessel

2.4.1 The crew accommodation is sited in the aft part of the Vessel. Crew cabins are arranged on the main deck, poop deck and boat deck. The wheelhouse is located on the bridge deck (see Fig.5).

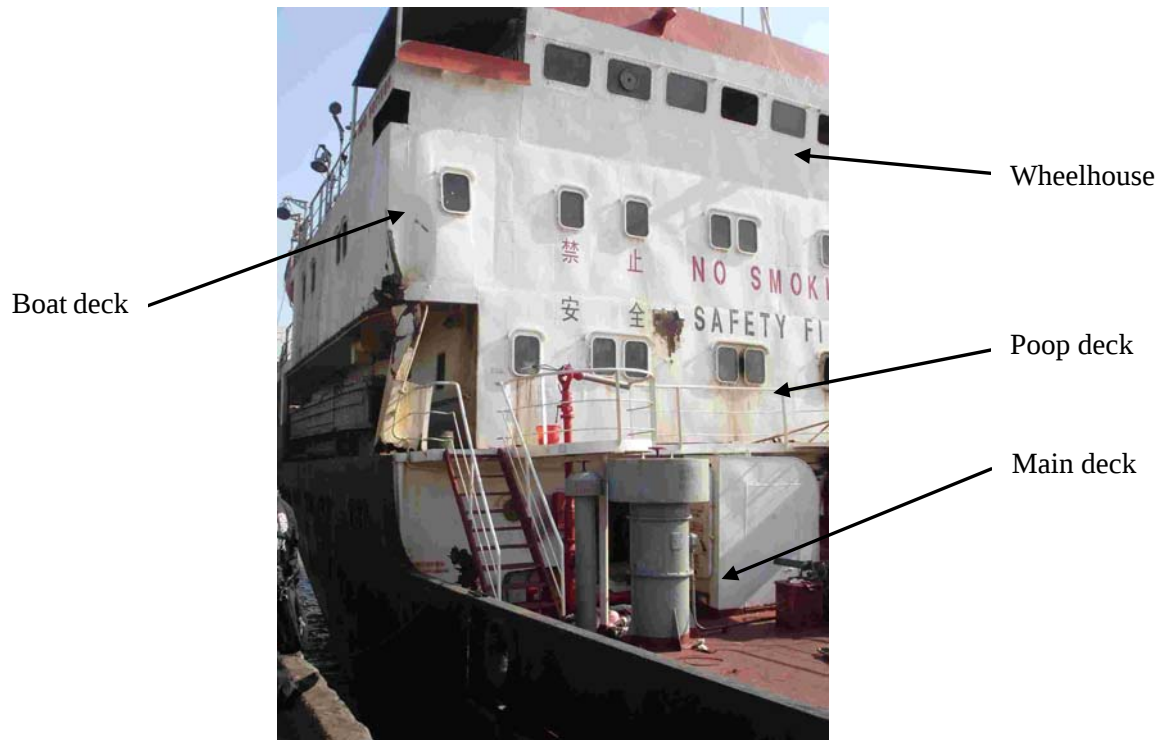


Fig. 5: Crew Accommodation of Vessel

Main Deck

2.4.2 Ratings' cabins, storerooms and a laundry room are located on the main deck level. The cargo control room, the foam room, and the carbon dioxide gas bottles storage room for the fixed fire fighting system which also serves as the fire control station are located at the forward part of the accommodation superstructure on main deck (see Fig.6).

Poop Deck

2.4.3 Cabins for the Second Engineer, Third Engineer, Fourth Engineer and Chief Officer are located on the poop deck forward (see Fig.7). On the starboard, there are cabin for Chief Cook and the mess room. The thermal oil heater room is on the port side. The galley is located at the mid-aft.



Fig. 6: Fire Station and Cargo Control Room on Main Deck

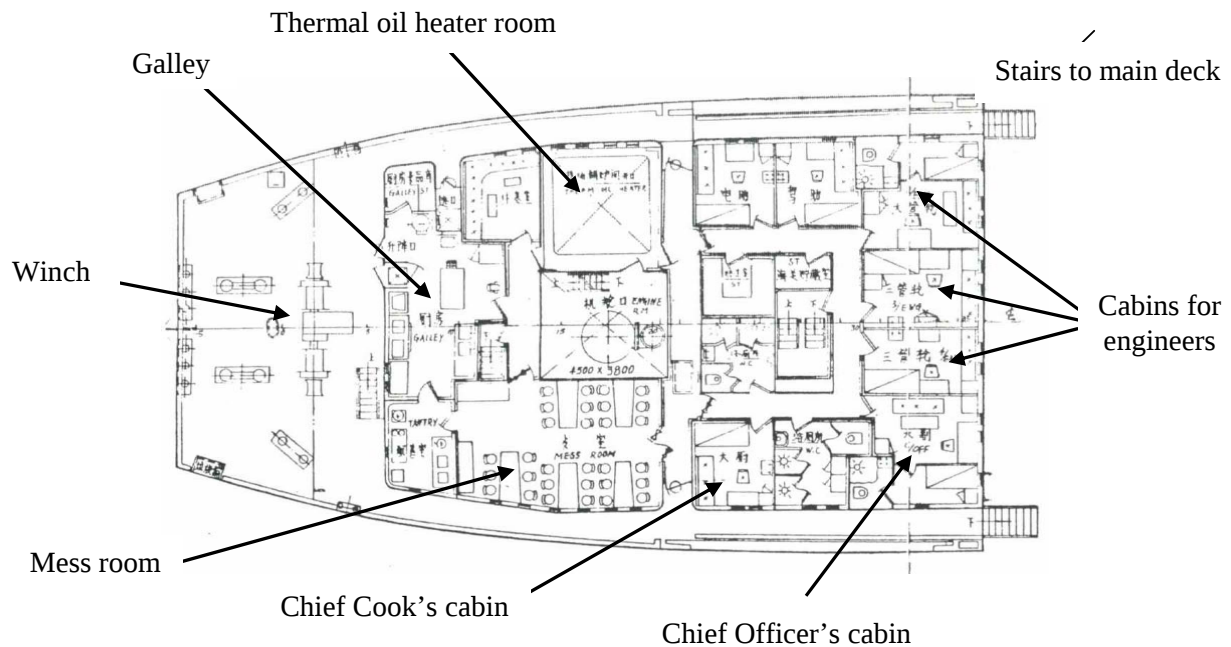


Fig. 7: Arrangements of Crew Accommodation on Poop Deck

Boat Deck

2.4.4 Cabins for Master, Chief Engineer and deck officers are located on boat deck. Two open type lifeboats, one at port side and one at starboard side, with launching appliances are rigged on the boat deck (see Figs.8 & 9).

Bridge Deck

2.4.5 The wheelhouse is located on bridge deck.

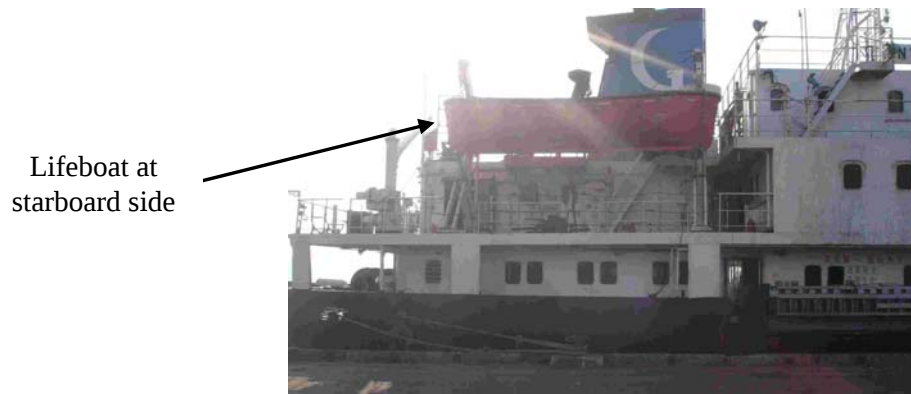


Fig. 8: Lifeboat on Boat Deck

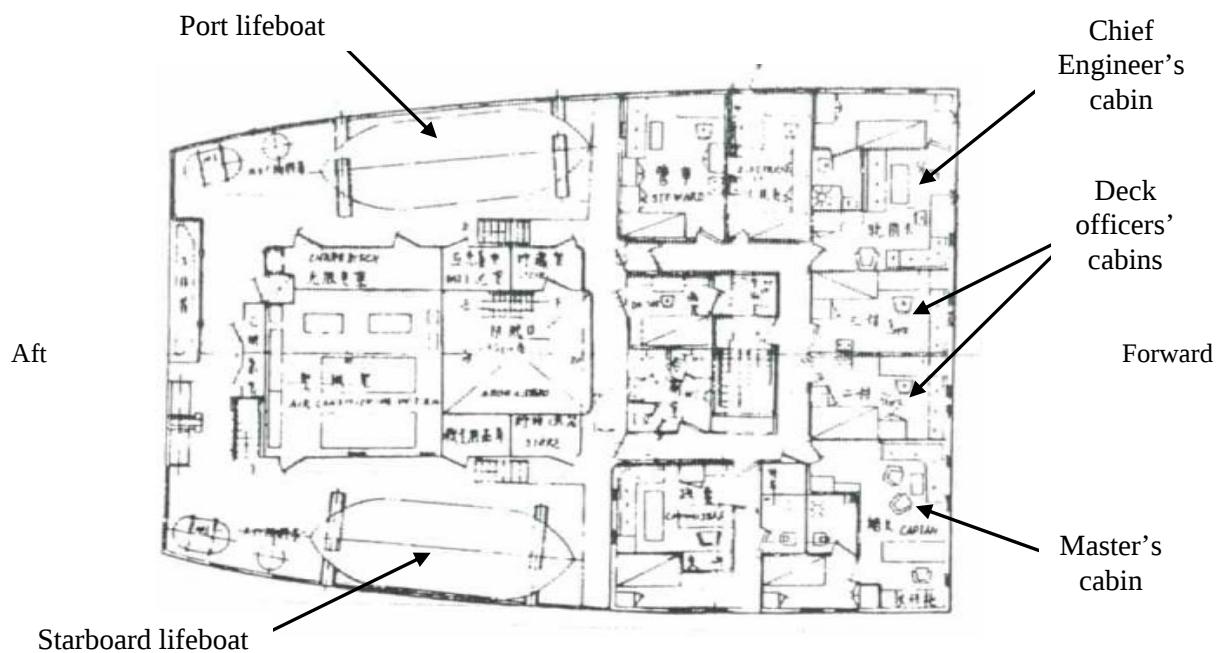


Fig. 9: Arrangements of Crew Accommodation on Boat Deck

2.5 Fire protection requirements

2.5.1 The *Vessel* was keel laid before 1 September 1984 with gross tonnage below 4000 tons. The use of non-ignitable deck coverings within accommodation spaces on the deck forming the crown of machinery spaces, and the prohibition of the use of flammable based paints, varnishes and other surfaces materials in accommodation spaces, machinery spaces or control stations were not mandatory requirements for the *Vessel*. Such requirements remain unchanged when the *Vessel* was converted into an oil tanker in 2001 for carrying asphalt of flash point higher than 60°C.

3. Sources of Evidence

- 3.1 The Master and crew of the *Vessel*.
- 3.2 Drawings and plans of the *Vessel*.
- 3.3 Manufacturer of the crankcase oil mist detector.
- 3.4 Investigation report of Zhejiang Maritime Safety Administration.

4. Outline of Events

(All times shown in this report were local time.)

- 4.1 On 7 January 2009, the *Vessel* loaded with 4080 tonnes of asphalt departed Ulsan, Korea and sailed to Ningbo, China.
- 4.2 On 9 January 2009 at about 1230, while the *Vessel* was under way at approximate position 31°25.7'N, 124°35.8'E, about 120 nautical miles east of mouth of Changjiang, the Second Officer on duty in wheelhouse noticed dense smoke came out from the entrance door at port side of the funnel. Immediately he informed the Master who was in the wheelhouse.
- 4.3 Then the Second Officer heard the main engine telegraph ringing, he answered the telegraph by pulling its handle to "STOP" position. The Second Officer telephoned to the engine control room at once and the Third Engineer on duty in engine room answered him that the exhaust gas duct of the main engine was on fire. Then the main engine was stopped.
- 4.4 The Second Officer made announcement through the public address system informing all the crew members that the exhaust gas duct was on fire and everyone should respond in accordance with the emergency firefighting plan. At about 1232, the Second Officer pressed the fire alarm and announced through the public address system again requesting the crew to respond in accordance with the emergency firefighting plan.
- 4.5 The Second Engineer operated the remote control devices on poop deck to shut off the quick-closing valves of the fuel oil tanks in engine room in order to stop fuel oil supply to the main engine and diesel generators. Then he went to the port entrance door of engine room in the crew accommodation on main deck. At there, he joined the Chief Motorman and Third Officer to open the entrance door to check the condition of engine room. Dense smoke and flame were found coming out from the engine room.
- 4.6 The duty able seaman ("Able Seaman A") and a motorman ("Motorman A") wearing fireman's outfit also came to the port entrance door of the engine room. As the fire inside the engine room was intense at the time, it was found too risky for them to enter into the engine room. They decided to retreat and stay outside the crew accommodation
- 4.7 At about 1234, the Chief Officer reported to the Master who was in the wheelhouse that the engine room was on fire and the fire was fierce. The Second Officer in wheelhouse announced through the public address system informing all crew members that the engine room was on fire.
- 4.8 At that time, the emergency fire pump located in the forward of the *Vessel* was started by the Fourth Engineer. The fire had spread into the crew accommodation and the Third

Officer and other crew members used fire hoses to provide boundary cooling to the forward bulkhead of accommodation superstructure.

- 4.9 At about 1236, the Second Officer instructed the sailor trainee (“Trainee A”) to hoist the “Vessel Not Under Command” shape at the mast above the wheelhouse, but that was not done as there was too much smoke and hot air draughts coming out from the funnel towards the mast.
- 4.10 At about 1237, the Master instructed Chief Officer to carry out heads count. He also telephoned to engine control room ordering the crew on duty to evacuate, but nobody answered his call. After heads count, it was found that the Third Engineer and the motorman (“Motorman B”), who were on duty in engine room, were missing.
- 4.11 At about 1238, the engine room fire had spread to the accommodation spaces and was out of control. As the Chief Engineer forgot to bring the walkie talkie with him, he through the Chief Officer asked Master’s permission to release carbon dioxide gas into the engine room for smothering the fire.
- 4.12 As the Third Engineer and Motorman B were still inside the engine room, the Master refused the release of carbon dioxide gas. He instructed Chief Officer and Chief Engineer to send a rescue team into engine room for the rescue. But the fire was so fierce that they were not able to organize the rescue operation since it was too risky for the team to enter into engine room.
- 4.13 At about 1244, as smoke was found coming out from the fire station where the carbon dioxide gas bottles were stored, the Chief Officer asked Master again for his permission to release carbon dioxide gas into engine room for smothering the fire. The Master agreed.
- 4.14 The Chief Officer then instructed Third Officer to go into the fire station to trigger release of carbon dioxide gas into engine room.
- 4.15 There were 30 bottles of carbon dioxide gas for smothering engine room fire. However, the pulling wire for the linked release had been disconnected rendered the gas had to be released individually. According to the Third Officer’s statement, the Third Officer released only 4 bottles of carbon dioxide gas because he was aware that the Third Engineer and Motorman B had not evacuated from the engine room yet.
- 4.16 At about 1248, the Master ordered all the crew members to muster at boat stations and lower the port and starboard lifeboats to embarkation deck ready for launching. The Second Officer called nearby ships for assistance through VHF radio.
- 4.17 At about 1251, as the fire was still out of control, the Chief Officer instructed the Bosun and Third Officer to enter the fire station again to release more carbon dioxide gas into

the engine room. At that time, there was a lot of smoke in the fire station. After released 13 bottles of carbon dioxide gas, the Bosun and Third Officer came out of the fire station, exhausted by the dense smoke inside. They then closed the door and ventilator cover of the fire station.

- 4.18 At about 1252, digital selective calling (DSC) messages asking for help were sent out through Inmarsat-C from the *Vessel*.
- 4.19 At about 1300, as the fire was still out of control, the crew decided to launch the lifeboats. The Bosun and an able seaman (“Able Seaman B”) tried to lower the starboard lifeboat. As strong wind was blowing towards starboard side of the *Vessel* and the gearbox of propulsion engine of the lifeboat was out of order, they abandoned launching of the starboard lifeboat.
- 4.20 The majority of the crew was then mustered at port lifeboat station to launch the port lifeboat. The lifeboat was lowered to sea level with the Chief Officer, Third Officer, Chief Engineer and some other crew members on board the boat. They tried to start the lifeboat propulsion engine several times but were in vain.
- 4.21 The lifting hooks of the port lifeboat were then disengaged and the boat was moored at midship of the *Vessel* with the assistance of some other crew members on the main deck of the *Vessel*. Several crew members also climbed down to board the lifeboat using the rope ladder. At that time, the emergency fire pump became malfunction and stopped.
- 4.22 At about 1330, when the Master found that the Chief Officer, Chief Engineer and other crew members were on the port lifeboat, he shouted to the crew saying that he had not ordered abandoning ship. He ordered them all back to the *Vessel*.
- 4.23 Then the majority of the crew members on the boat climbed back to the *Vessel* using the rope ladder but three trainees (“Trainee B”, “Trainee C” and “Trainee D”), two motormen (“Motorman C” and “Motorman D”), an able seaman (“Able Seaman C”) and the Steward remained in the lifeboat and refused to go back onto the *Vessel*.
- 4.24 At about 1425, the smoke coming out from the accommodation spaces had subsided.
- 4.25 After the Master had received instructions from the ship management company, he ordered the Chief Officer to drop anchors. At about 1435, two anchors of the *Vessel* were dropped. Once the *Vessel* was anchored, the bow pointed against the strong wind, and together with high waves, the port lifeboat swayed excessively.
- 4.26 At about 1443, the two mooring ropes of the lifeboat were parted and the boat drifted astern. The Master instructed Chief Officer and other crew members to save the crew members on board the lifeboat.

- 4.27 When the boat drifted to the port side aft and abreast with the engine room of the *Vessel*, Trainee B, Trainee C, Motorman C and the Steward grasped the manropes and the lifting hooks that had been left suspended from the port lifeboat's launching appliance of the *Vessel*. They intended to climb back on the *Vessel* using the manropes and lifting hooks.
- 4.28 The Trainee D, Motorman D and Able Seaman C were remained on board the lifeboat, which eventually drifted away from the *Vessel*.
- 4.29 Crew members on board the *Vessel* operated the winch at the lifeboat station at once to winch up the lifting hooks and rescued Trainee B and the Steward back on the *Vessel*. While Trainee C and Motorman C lost their grips of the manropes and fell into the sea.
- 4.30 The Bosun threw a rope with knots into the sea immediately. Trainee C grasped the rope in water and he was eventually lifted up and back on the *Vessel* with the assistance of the crew members. However, Motorman C, who failed to grasp a mooring rope thrown to him in the water, was drifted away by strong current and lost in the sea.
- 4.31 The lifeboat, which drifted away with three crew members onboard, was found later and they were rescued by a Korean cargo ship.
- 4.32 At about 2130, the salvage tug "*Dong Hai Jiu 112*" arrived at the scene for the salvage.
- 4.33 In the morning of the next day, on 10 January 2009, towing preparation work was carried out by the tug but it was subsequently abandoned due to too rough sea condition (see Fig.10 the damage caused by too rough sea condition).

Damage caused by
salvage tug collided
with the *Vessel*



Fig. 10: Damage on Crew Accommodation of *Vessel* Caused by Collision

- 4.34 In the morning of 11 January 2009, when the sea condition improved, the rescue team

from the salvage tug successfully embarked the *Vessel*. They entered into the crew accommodation and engine room to extinguish the smouldering fire completely. The bodies of Third Engineer and Motorman B were found lying at the starboard stairway leading from engine room to the starboard entrance door on main deck.

- 4.35 In the afternoon of 11 January 2009, with the assistance of another salvage tug “*Dong Hai Jiu 198*”, the two tugs commenced towing the *Vessel* to the waters off Ningbo. In the afternoon of 13 January 2009, the *Vessel* was alongside No.9 Berth, Zhenhai port, Ningbo.

5. Analysis of Evidence

Damage due to fire

- 5.1 The fire had caused serious damage to the engine room and crew accommodation of the *Vessel*.
- 5.2 Inside engine room, the fire burned the crankcase oil mist detector located at starboard side of the main engine crankcase (see Fig.11). The steel claddings of main engine exhaust manifold above the oil mist detector and in the aft part starboard of main engine were also burnt (see Fig.12).

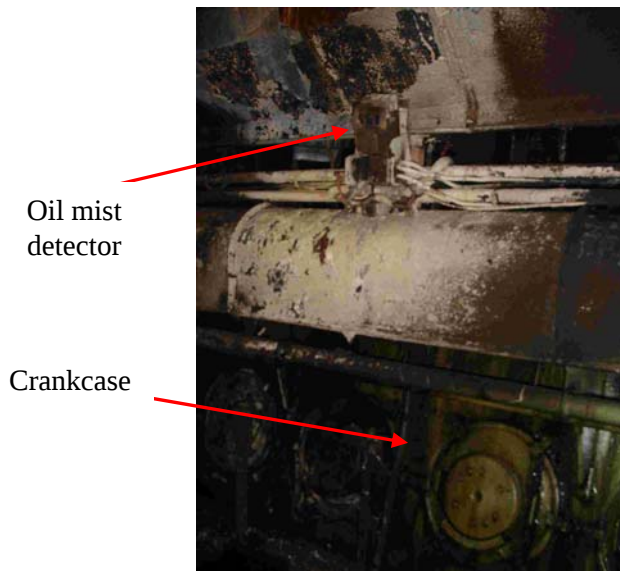


Fig. 11: Burnt Oil Mist Detector of Main Engine

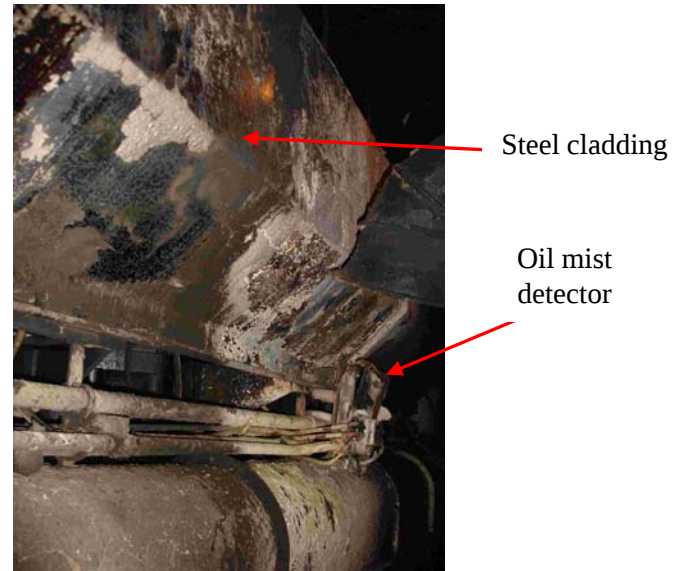


Fig. 12: Burnt Steel Cladding of Main Engine

- 5.3 Part of the steel casing of the turbocharger and the exhaust gas duct located at aft of the main engine were burnt (see Figs.13 & 14). An electric distribution panel located near to the port entrance door of engine room on main deck was also damaged by fire and the wirings all melted together (see Fig.15).
- 5.4 The inside panel of the port entrance steel door of engine room was burnt (see Fig.16).
- 5.5 No damage by fire was found to the diesel generators and the engine control room, which are located at the forward part of the engine room.

Turbocharger



Fig. 13: Turbocharger of Main Engine

Exhaust gas duct

Top part of
main engine

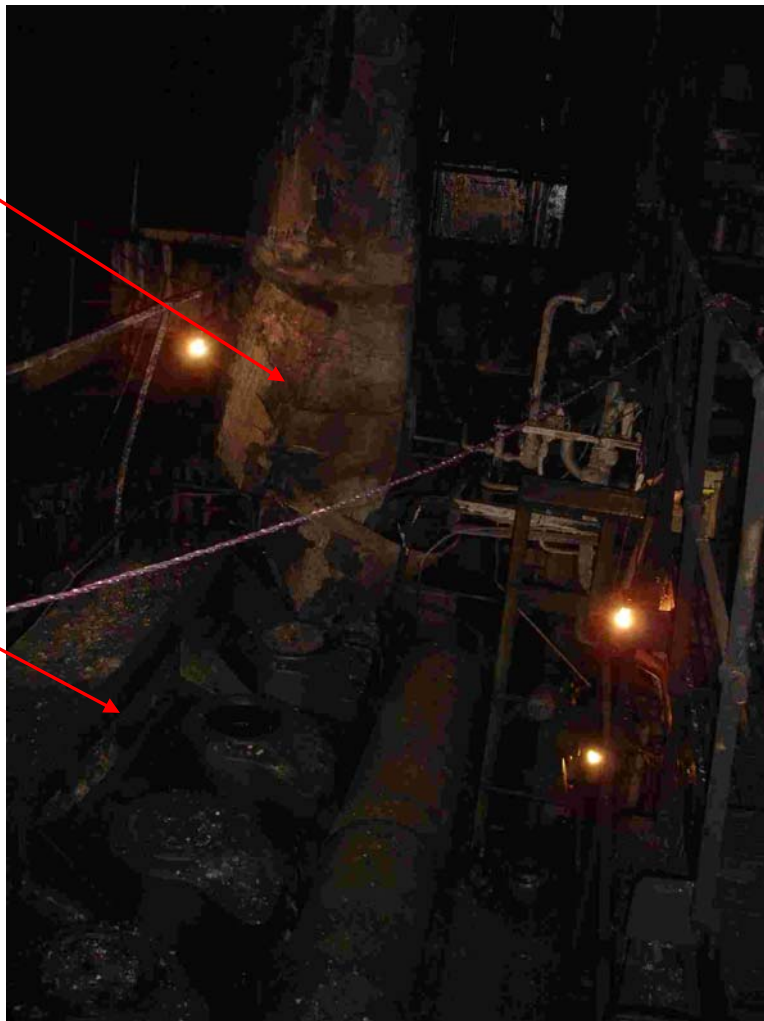


Fig. 14: Exhaust Gas Duct of Main Engine



Fig. 15: Damaged Electric Distribution Panel in Engine Room

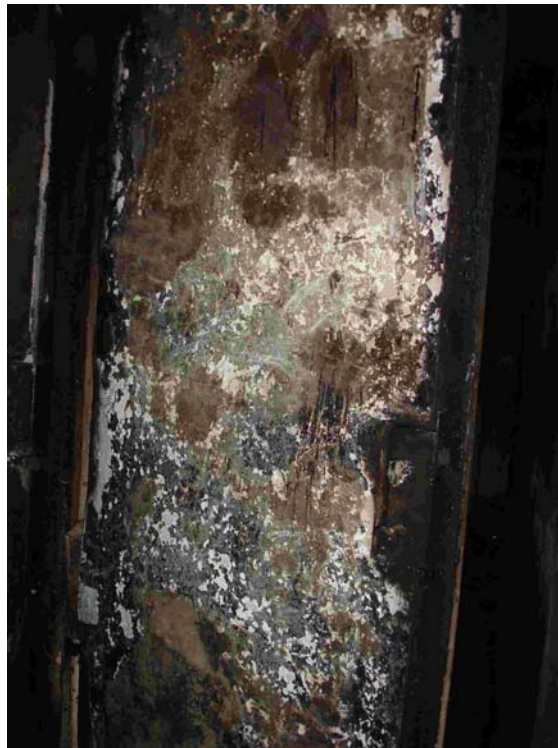


Fig. 16: Burnt Inside Panel of Port Entrance Steel Door of Engine Room

5.6 The fire damaged the ceiling and part of wall linings in the port side corridor of accommodation spaces on the main deck (see Fig.17). The panels of crew cabins' doors facing the corridor were burnt (see Fig.18). The cargo control room at the forward end of the corridor was damaged (see Fig.19). The fire also damaged the ceiling, part of wall

linings in the fore athwartship corridor inside the accommodation spaces and behind the fire station (see Fig.20). Due to intense heat, fumes were generated from part of the fire insulation materials at the ceiling of the fire station and the ceiling were darkened (see Fig.21).



Fig. 17: Port Side Corridor on Main Deck

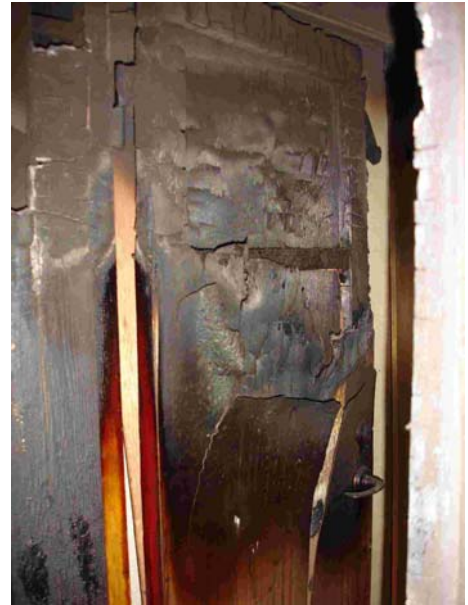


Fig. 18: The Door of a Crew's Cabin



Fig. 19: Cargo Control Room



Fig. 20: Corridor behind Fire Station



Fig. 21: Ceiling of Fire Station



Fig. 22: Starboard Side Corridor on Main Deck

- 5.7 Very mild fire damage was found in the starboard side crew cabins and the corridor on main deck (see Fig.22).
- 5.8 Cabins at port side forward part on poop deck and boat deck were also damaged by fire (see Figs.23 & 24).



Fig. 23: Cabin on Poop Deck

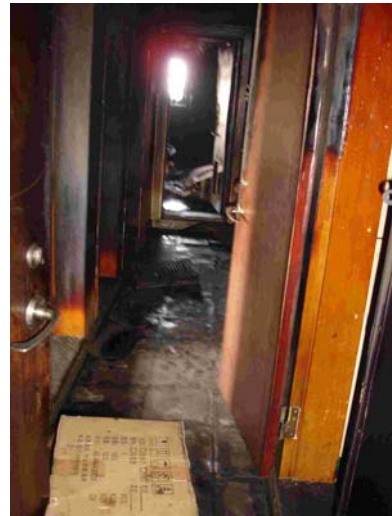


Fig. 24: Cabin on Boat Deck

The probable causes of the fire

- 5.9 The exhaust gas duct of the main engine was first found caught fire by the engine room crew members who were on duty inside the engine control room.
- 5.10 Inspections carried out after the accident could not identify any bursting of oil pipelines in the vicinity of the main engine exhaust gas duct. It was not possible to determine whether or not there had been dripping of oil onto hot surfaces of main engine. However,

it was evident from the extent of fire damage inside engine room that the fire had not been supported by a continuous supply of fuel oil or lubricating oil. Therefore, it was unlikely that the fire was caused by splashing of flammable oil onto hot surfaces of main engine exhaust gas pipe.

- 5.11 There was no hot work carried out in the engine room before the fire accident. Also, as it was lunch break at the time of the accident, there was no other crew member in the engine room except the duty Third Engineer and Motorman B, who were in the engine control room. Therefore, the possibility of the fire caused by carelessness of crew members in engine room was very low.
- 5.12 Superficial inspection of the pattern of fire damage to the main engine and engine room, appeared that the fire was started in position just above the crankcase oil mist detector because the burnt surface pattern on the steel cladding of main engine caused by fire was in V-shape (see Fig.25). It appeared that electrical faults arising from the detector had ignited oil stains and paints in its vicinity and caused the fire.

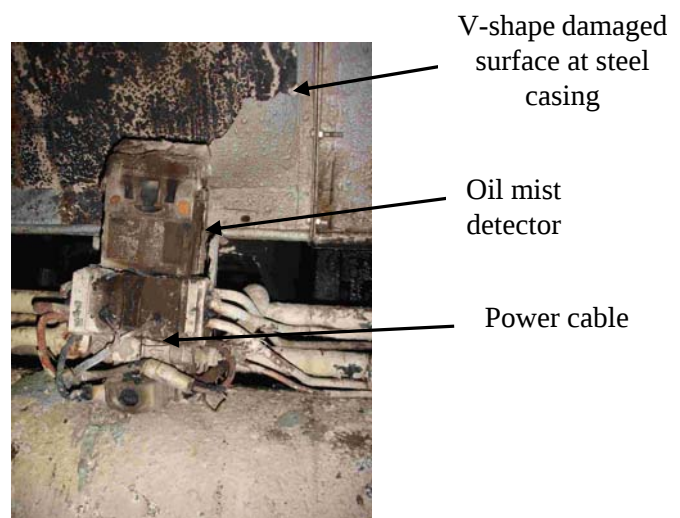


Fig. 25: Crankcase Oil Mist Detector

- 5.13 The main engine crankcase oil mist detector was of model Visatron VN215 made by Schaller Automation Industrielle Automationstechnik KG in Germany. It was operated by 24V direct current and the electric circuit was protected by a 2A fuse inside the detector. The detector was manufactured in 1980s. It was an old type detector without the function of auto slow down of the main engine. There was no record showing that it had been regularly inspected, maintained or repaired before the fire incident.
- 5.14 The proposition of the fire caused by electrical faults of the oil mist detector was questionable as it could not explain the phenomenon of rapidity in the spreading and intensity of the fire in this incident.

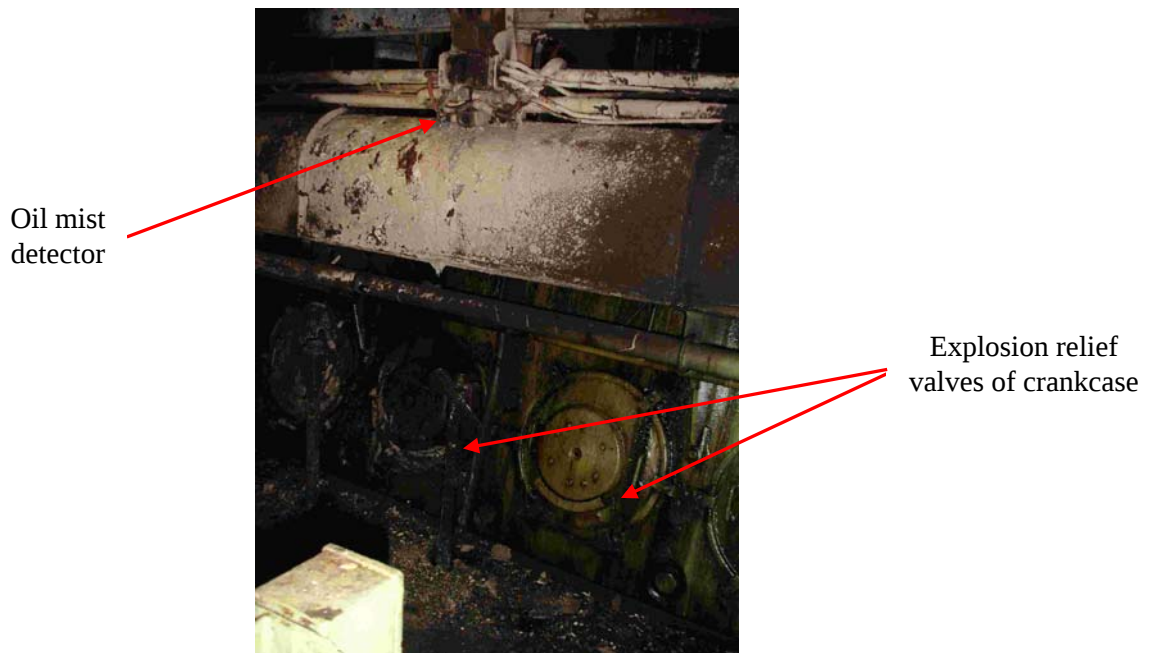


Fig. 26: The Main Engine Crankcase

- 5.15 Just below the crankcase oil mist detector, there was a row of main engine crankcase explosion relief valves for protecting the engine from crankcase explosion (see Fig.26).
- 5.16 During engine running, oil mists and flammable vapour might be generated and accumulated in the main engine crankcase. For example, oil mist generated from hot spots on faulty main engine bearings, due to insufficient lubrication to internal engine moving parts or flammable vapour entering into the engine crankcase due to blow-by of hot gas through faulty piston rings in the cylinder units.
- 5.17 When the concentration of the oil mist and flammable vapour inside the engine crankcase fell within the explosion limits, any heat source such as hot spots on engine bearings or sparks in the blow-by gases would cause gas explosion inside the crankcase of the main engine, called the primary explosion. Under such circumstance, the crankcase explosion relief valve would protect the main engine by opening the spring-loaded valve-lids to release pressure inside the crankcase. After that, the valves would close automatically to prevent oxygen-rich air from entering into the crankcase so as to protect the main engine from secondary explosion that could be disastrous.
- 5.18 The crankcase explosion relief valve is designed with flame arrester to prevent flame passing into the engine room from inside the crankcase. When the primary explosion occurs, the crankcase explosion relief valves should only allow hot gases and oil mist / flammable vapour to release. However, in case of the flame arrester become less effectiveness, it is possible that flame could come out from the engine crankcase.

- 5.19 The analysis reports of the main engine lubricating oil before the incident revealed that the water content in the lubricating oil was at alarming levels for several years. Under such condition, insufficient lubrication to internal engine moving parts might have occurred. Hence during engine running, oil mists and flammable vapour might be generated and accumulated in the main engine crankcase. It was probable that at the time of incident, a crankcase explosion happened inside the main engine crankcase. The release of hot gases, oil mist / flammable vapour and together with the flame front from the inside of crankcase rendered the fire in engine room.
- 5.20 As shown in Fig. 26, the paint of the crankcase relief door under the oil mist detector had slightly scorched by flame. And the paint of the metallic cover below the oil mist detector had scorched by fire. Therefore, it was probable that oil mist and flame had been released through that explosion relief door.
- 5.21 As there was no apparent structural damage to the main engine crankcase, it was believed that the crankcase relief valves were closed properly after the release of internal pressure and thus prevented the secondary crankcase explosion from occurring.
- 5.22 The fire due to burning of oil mist would be very intensive. It would burn oil stains, paints and electrical wirings in the vicinity including the oil mist detector. The fire would spread quickly to the aft part of the main engine and engine room due to air suction effect of the main engine turbocharger (see Fig. 27)

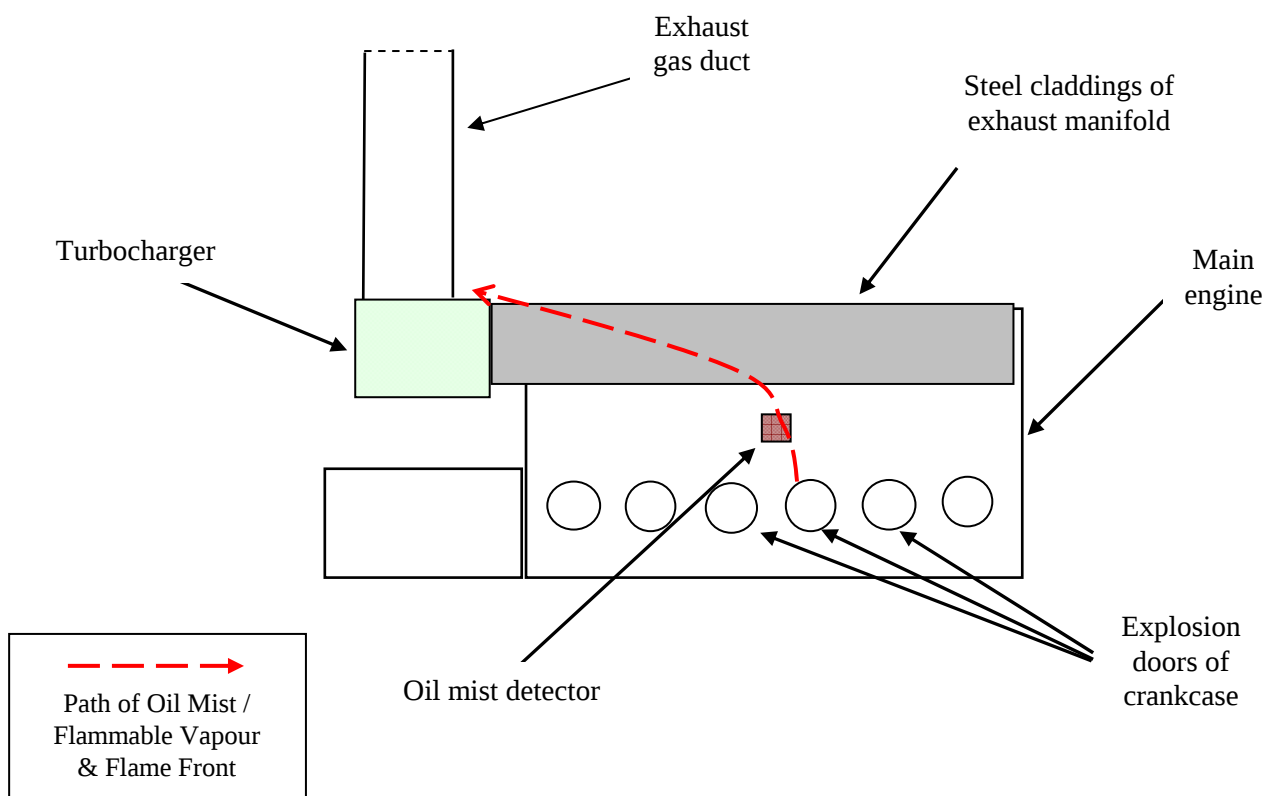


Fig. 27: The Path of Oil Mist / Flammable Vapour & Flame Front

- 5.23 Between 1231 and 1232, the Third Engineer in the engine control room pulled the engine telegraph to “STOP” when he saw the exhaust gas duct of the main engine was on fire. The telegraph in the wheelhouse rang and the Second Officer answered it accordingly.
- 5.24 Therefore it was evident that the blaze was large, and once started it spread quickly in the engine room. This phenomenon suggested that oil mist and / or flammable vapour were on fire rather than ignition of oil stains and paints due to electrical fault of the oil mist detector.
- 5.25 There was no evidence to show that before the outbreak of fire, the *Vessel* had been slowed down due to high concentration of oil mist inside main engine crankcase. The main engine crankcase oil mist detector might have been defective at the time of the accident and it failed to give alarm to the engine room crew on duty.

Propagation of fire

- 5.26 When the fire started, the blaze was drawn upward towards the turbocharger due to its suction effect.
- 5.27 The exhaust gas duct of main engine was located above the main engine turbocharger and faced the engine control room at the forward end of the engine room. When it caught fire, it could easily be seen by the engine room crew, who were on duty inside, through the window of engine control room.
- 5.28 The smoke and hot air draughts generated by the fire quickly went up along the exhaust gas duct to the funnel and came out from the entrance door of the funnel at port side on bridge deck (see Figs.28 & 29) and was noticed by the Second Officer on duty in the wheelhouse.
- 5.29 The fire also spread to and burned other flammable/combustible materials in its path including the electric distribution panel in the engine room on main deck near to the port side entrance door, and generated a lot of dense smoke and heat. When the crew members came to open the port entrance door to check the condition of engine room, they retreated immediately when they found dense smoke and hot air draughts came out from the engine room.
- 5.30 Extensive fire damage was found in the port side corridor on main deck but only mild damage was found in the starboard side. It was due to the port entrance door of engine room on main deck was not shut properly by the crew members after they retreated. It was a self-closing door but the self-closing device might have become malfunction or it might have been forced opened by the hot air draughts. It was evident that the smoke and hot air draughts came out from engine room through that door and spread the fire into crew accommodation (see Fig.30).

Entrance door
at funnel



Fig. 28: The Funnel on Bridge Deck

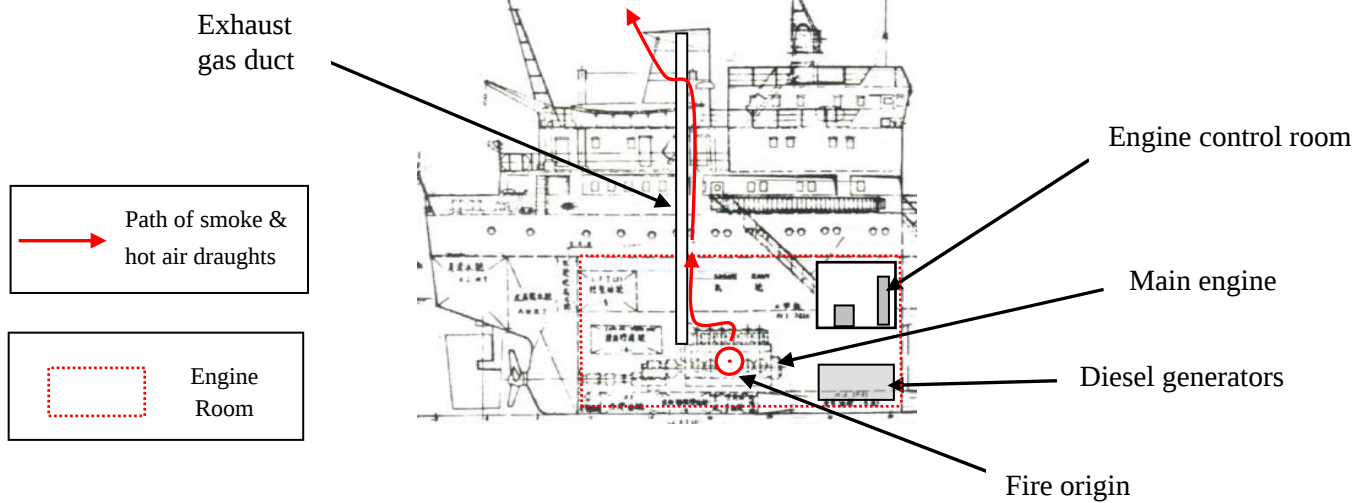


Fig. 29: Path of Smoke and Hot Air Draughts

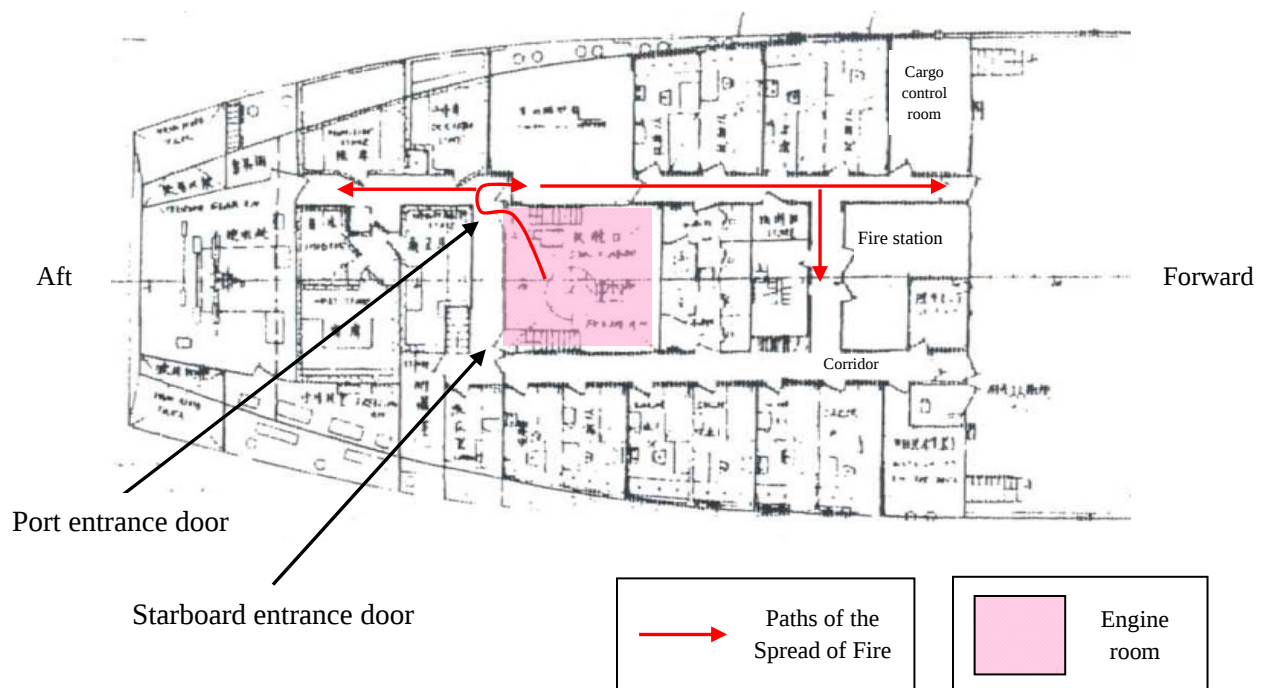


Fig. 30: The Spread of Fire at Main Deck

- 5.31 The accommodation spaces have enclosed stairways at each deck. Such construction had prevented smoke and hot air draughts spreading directly from main deck to poop deck and above. However, the heat generated by the fire in accommodation space on main deck was so fierce that the heat transmitted through the steel ceilings ignited the combustible materials inside the cabins directly above (i.e., cabins at port side forward part on poop deck and boat deck). Several vinyl floor tiles on the deck of wheelhouse were found distorted due to heat of the fire in the cabins on boat deck.
- 5.32 Part of the fire insulation materials mounted on the inside bulkheads of the fire station on main deck was heated up by the fire at the corridor behind the fire station as well as the fire in crew cabins above the ceiling on poop deck. Due to the intense heat, the insulation materials generated dense smoke inside the room. It prevented the crew members from entering into the fire station to release carbon dioxide gas.

Fire detection and firefighting

- 5.33 The engine room of the *Vessel* is installed with a fire detection and alarm system. Smoke and heat detectors are fitted in various locations in the engine room for fire detection. But

it was evident that the fire detection and alarm system have failed at the time of accident since there was no fire alarm sounded. The fire detection and alarm system was found defective in a Port State Control (PSC) inspection of the *Vessel* carried out on 24 October 2008. Although the defect was rectified within one week after inspection, the system could have failed again without proper maintenance.

- 5.34 The Third Engineer and Motorman B had not started the engine room fire pump and used fire hoses nor used any portable fire extinguishers to tackle the fire. It was probable that the fire was discovered at a later stage making them no time to tackle the fire. So they tried to evacuate the engine room.
- 5.35 In the fire incident, the firefighting and rescue operations were not coordinated and executed properly by the crew of *Vessel*. The Chief Engineer did not take responsibilities to lead the firefighting team. There was no rescue team organized to rescue the missing engine room crew members before the release of carbon dioxide gas into engine room. It was probably due to the fire was discovered too late and the large quantity of heat and smoke had made entry into the engine room not possible. There was also evidence that crew members had inadequate training in handling emergency situations. The crew admitted that fire drills had not been carried out for several months.
- 5.36 The remote control quick-closing valves for shutting off the fuel oil supply to diesel generators was malfunction and the valves could not be closed. A diesel generator in the engine room was kept on running until the rescue team from the salvage tugs came on board to shut it down locally at the valve in the engine room with the assistance of the Chief Engineer. It was probable that the engine room had not been sealed properly with fresh air entered into the engine room to support the diesel generator running.
- 5.37 The emergency fire pump ran less than an hour and malfunctioned. It was evident that the pump had not been maintained properly.

Emergency escape from engine room

- 5.38 At the outbreak of fire, the Third Engineer and Motorman B were on duty in the engine control room. Since the fire detection and alarm system of the engine room was not working, they were not aware of the fire at the early stage and thus not able to evacuate the engine room in time.
- 5.39 According to the records of voyage data recorder fitted in the wheelhouse of the *Vessel*, at about 1231 on the day of incident, the Third Engineer told Second Officer on the phone that the exhaust gas pipe of the main engine was on fire. At about 1244, the Master agreed to flood the engine room with carbon dioxide gas. There was about thirteen minutes for the Third Engineer and Motorman B to evacuate.

- 5.40 There were two sets of emergency escape breathing device (“EEBD”) kept in the engine control room. They had taken out one set and placed it on the engine control console without using it. The EEBD had not been used for escape probably because the Third Engineer and Motorman B did not know how to use the equipment.
- 5.41 The length of the steel walkway, including the stairway from No.2 deck to main deck, from engine control room to the starboard entrance door of engine room on main deck is less than 13 m. It is the shortest exit route from engine control room to the main deck. They decided to evacuate through this route. However one was found lying dead at the stairway and the other on the landing platform by the rescue team from the salvage tugs.
- 5.42 Their bodies, clothes and shoes were blackened. The cause of their death was suffocation due to inhalation of carbon monoxide, carbon dioxide and fumes. In an environment with carbon monoxide gas of concentration reaching 1.3%, a person would become unconscious after taking two to three breaths. It was probable that such quantity of carbon monoxide gas was present during the fire incident.
- 5.43 The stairway and the landing platform at the starboard side in the engine room were near to the exhaust gas pipe, which was on fire. At that location, the smoke was dense and the temperature was high. Both unfavourable conditions might have obstructed their escape.
- 5.44 There is an emergency escape trunk fitted with vertical ladder inside with the entrance door located at the aft part bottom level port side of the engine room (see Figs.3). The length of the walkway, including port side stairway from No.2 deck to bottom level, from engine control room to the emergency escape trunk is about 19 m. The fire in engine room did not affect the engine control room and the port side walkway in the bottom floor of the engine room.
- 5.45 Due to dense smoke inside the engine room the two crew members could not judge whether or not there was fire in the vicinity of the emergency escape trunk, hence they chose the shortest exit route, i.e., via the starboard entrance door of engine room on main deck to evacuate.
- 5.46 The main cause leading to the death of the two crew members is that the fire had not been discovered at the early stage due to the fire detection and alarm system was defective, hence they could not evacuate the engine room in time.

Abandon ship

- 5.47 After the second round of releasing of carbon dioxide gas into the engine room, there was no sign showing that the ship fire was under control. The crew of *Vessel* started to panic.
- 5.48 Without the Master’s command, the port lifeboat was launched to water and the majority of the crew, including Chief Engineer, Chief Officer, Second Engineer and Third Officer

boarded the boat. They abandoned the effort to fight the fire.

- 5.49 Later when the Master realized that they had left the *Vessel* and boarded the lifeboat, he ordered them all back on to the *Vessel*. But seven of the crew members refused.
- 5.50 Once the mooring ropes of the lifeboat parted due to rough sea, the seven crew members on the boat started panic again. They realized the risk that the boat would drift away since the propulsion engine of the boat was not working.
- 5.51 While the lifeboat was drifting towards the stern of *Vessel*, four of the crew members on board the boat managed to catch the manropes and lifting hooks suspended from the port side lifeboat station of the *Vessel* and tried to use them for climbing back on the *Vessel*. But two (i.e., Motorman C and Trainee C) of the four lost grips of the manropes and fell into the sea. Later Trainee C was rescued by the crew members on board the *Vessel* but Motorman C, who worn lifejacket, drifted away and lost.
- 5.52 It was evident that both port and starboard lifeboat engines had not been maintained properly and put the crew members in peril at sea during emergency.

Emergency preparedness

- 5.53 The crew admitted that from May to September 2008, two to three times of abandon ship drills / fire drills had been conducted on the *Vessel*. From October 2008 to January 2009 (i.e., in the three months period before the occurrence of the fire), no abandon ship drills or fire drills had been conducted. No practice of using EEBD or the emergency escape trunk of engine room had been carried out.
- 5.54 In December 2008, eleven crew members (i.e., more than 40% of the crew) of the *Vessel* had been changed but no abandon ship drills or fire drills were conducted after the crew change.
- 5.55 The Merchant Shipping (Safety) (Musters and Training) Regulations stipulates, “the master of a ship shall ensure that every crew member participates in at least one abandon ship drill and one fire drill every month; and if more than 25% of the crew have not participated in one abandon ship drill and one fire drill on the ship in the preceding month, these drills are held within 24 hours of the ship leaving a port.”
- 5.56 Without adequate abandon ship drills and fire drills, the crew of the *Vessel* had performed very unsatisfactorily during the fire incident. Without adequate emergency preparedness, the Third Engineer and Motorman B failed to use the EEBD for escape via the emergency escape trunk during the fire incident. All shipboard officers displayed poor competence and discipline in firefighting and rescue actions.
- 5.57 The crew of *Vessel* admitted that incorrect entries had been made in the deck logbook

stating that drills had been done in time and satisfactorily.

Certification of ship staff and working experience

- 5.58 All the deck and engineer officers of the *Vessel* held proper certificates of competency issued by Maritime Safety Administrations in China and licenses issued by Hong Kong Marine Department. The deceased Motorman B and missing Motorman C held proper certificates of competency for watch-keeping issued by Guangdong Maritime Safety Administration. All of them complied with the STCW requirements.
- 5.59 The Master had about three years sea-going experience as master and he joined the *Vessel* five months before the fire incident. The Chief Engineer had about seven years sea-going experience as chief engineer and he had been the chief engineer of the *Vessel* since 2007. He re-joined the *Vessel* 10 days before the fire incident. The Chief Officer had about two years sea-going experience as chief officer and he joined the *Vessel* seven months before the fire incident. The Second Engineer joined the *Vessel* seven months before the occurrence of the fire and he was the third engineer of the *Vessel* four years ago. The Third Engineer joined the *Vessel* four months before the fire incident.
- 5.60 All of them had had at least several months working experience on board the *Vessel*, they should be familiar with the operation of the *Vessel*.

Leadership in emergency situation

- 5.61 In the first hour after the outbreak of fire, the Master was busy in the wheelhouse communicating with ship management company and rescue authorities, etc., through satellite telephone. He could not closely monitor the execution of emergency teams for firefighting and rescue. He also did not realize his crew's panic behavior and hence failed to maintain discipline in the incident.
- 5.62 In the emergency situation, the Master who was in overall command of the *Vessel*, did not actively communicate with his crew members and motivate them to carry out emergency response actions.
- 5.63 The Chief Engineer had not taken up his responsibilities to lead the firefighting and rescue operations, thus significantly weakened the emergency response actions.

Safety Management System

- 5.64 The Safety Management Certificate of the *Vessel* was issued by China Classification Society on 25 June 2008 with expiry date of 22 April 2010.
- 5.65 The inadequate shipboard training on abandon ship drills and fire drills for emergency preparedness, false training records as well as poor maintenance of ship equipment such

as fire detection and alarm system and lifeboat engines, etc., revealed in this accident reflected existence of major non-conformities in the shipboard safety management of the *Vessel*. It also reflected that the Company had failed to monitor effectively the implementation of its safety management system.

The environment

- 5.66 At the time of fire incident, there were near gale and moderate high waves at the sea. Under such rough sea condition, the mooring ropes of the port lifeboat inevitably parted.
- 5.67 The adverse sea condition made the rescue of the crew who fell into water difficult. It had also hindered the rescue actions made by the salvage tugs.

6. Conclusions

- 6.1 At about 1230 local time on 9 January 2009, a fire accident happened onboard the Hong Kong registered asphalt tanker "*An Tai Jiang*" when she was en route from Ulsan to Ningbo. The fire started inside the engine room and spread into accommodation spaces. The accident resulted in the deaths of the Third Engineer and a motorman inside the engine room, and another motorman lost at sea after falling into water. The engine room and crew accommodation sustained serious damage. There was no oil pollution to marine environment.
- 6.2 The investigation into the accident deduced that the most probable cause of the accident was main engine crankcase explosion. The explosion resulted release of large quantity of oil mist and/or flammable vapour from main engine crankcase into engine room which were ignited and caused the fire. The fire spread from engine room into crew accommodation and burnt out the combustible materials in its path causing serious damage.
- 6.3 The investigation also identified the following contributing factors to the casualty:
- problem existed in the main engine and its lubrication system for a long time without attention;
 - the main engine oil mist detector was defective and failed to give out alarm before explosion occurring inside the main engine crankcase;
 - the engine room fire detection and alarm system was defective, therefore the crew members were not alerted of the fire when it started;
 - the self-closing device of the port engine room entrance door might have failed or the door had not been properly closed by the crew members resulted into extensive fire damage to the crew accommodation;
 - leadership displayed by the Master and senior officers in handling emergency situations was poor and crew members onboard were not adequately trained, through regular and systematic drills and exercise, in dealing with emergency situations;
 - implementation of safety management system onboard was not effective, which resulted into major non-conformities in the areas of crew trainings, emergency preparedness, maintenance of ship's firefighting and life saving equipment. Also, the shipboard internal audits and master review failed to identify and rectify these non-conformities at an earlier stage.

7. Recommendations

- 7.1 A copy of this report should be sent to the ship management company and the master of the *Vessel* advising them the findings of this accident.
- 7.2 The Company's safety policy should be subjected to extensive review and it is required to critically review the adequacy of relevant procedures and guidelines in the safety management system in order to ensure:
- proper inspections and maintenance of ship equipment are carried out at all times;
 - shipboard personnel are trained systematically through regular drills and exercises to enhance their competence in handling emergency situations; and
 - internal audits and management reviews are conducted systematically to identify system deficiencies for improvement/rectification at an early stage;
- 7.3 The incident showed that the *Vessel* was basically a substandard ship and such kind of ship should not be tolerated in the Hong Kong Ship Register. The Shipping Division should consider enhancing its measures to identify substandard ships more effectively such that flag state control actions could be taken to rectify the situation at an early stage.
- 7.4 A copy of this report should be sent to the Zhejiang Maritime Safety Administration for their information.
- 7.5 A copy of this report should be sent to the Shipping Division of Marine Department for their information and necessary follow-up actions with the ship management company.
- 7.6 A Merchant Shipping Information Note (MSIN) should be issued to promulgate the lessons learnt from this accident, drawing the attention of ship owners, operators, management companies, Masters and Officers to the risk of crankcase explosion and engine room fire due to improper maintenance of main engine and its systems.

8. Submissions

- 8.1 In the event that the conduct of any person or organization is commented in an accident investigation report, it is the policy of the Hong Kong Marine Department that a copy of the draft report is given to that person or organization so that they have the opportunity to rebut the criticism or offer evidence not previously available to the investigating officer.
- 8.2 The draft report was forwarded to the following:
- COSCO Southern Asphalt Shipping Company Limited
- Master of the *Vessel*
- Chief Engineer of the *Vessel*
- 8.3 No submission was received from the above-mentioned parties.

