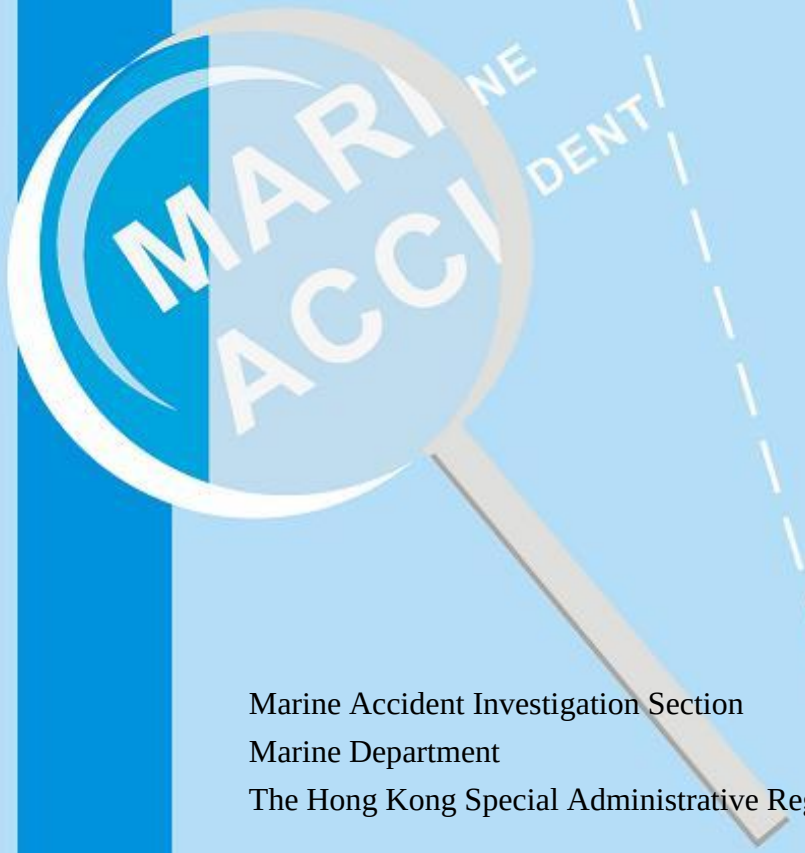
Report of Investigation into the fatal accident on board Hong Kong Registered Ship "*Sainty Vanguard*" at sea 30nm west off Hadera of Israel on 19 December 2013.



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

9 February 2015

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 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.

Table of Contents **Page**

1. Summary

1.1 On 17 December 2013, when the Hong Kong registered bulk carrier "Sainty Vanguard" (hereinafter referred to as the *Vessel*) was drifting at about 30 nautical miles west off Hadera of Israel waiting to berth at Port Hadera of Israel for discharging cargo "Coal", the hydraulic remote control system for the ballast valves of the *Vessel* was found malfunctioning. On the next day, a team of crewmembers tried to repair the system by entering the Valve Box Compartments in the double bottom though the No.1 to No.4 cargo holds in which coal had been loaded.

1.2 On 19 December 2013, the Bosun entered alone No.7 cargo hold forward access space without the permission or knowledge of any senior shipboard staffs. The Bosun lost his conscious and was found lying on the spiral ladder in No.7 cargo hold forward access space. Thereafter both the Chief Officer and the Ordinary Seaman1 (OS1) tried to rescue and entered the same space consecutively without following the enclosed space entry procedure. Fortunately, the OS1 was not affected and the Chief Officer was rescued by other crew, and they did not lose their lives in the incident. The Bosun was sent ashore by a helicopter and then transferred to a hospital for rescue. But he was certified death by the hospital on the same date.

1.3 Investigation into the accident revealed that cargo hold access space in No.7 cargo hold was not safe for entry when the cargo holds were loaded with hazardous cargoes. The Bosun was overcome by high concentration of carbon monoxide and oxygen depletion inside the space that was lethal to him.

1.4 The investigation had also identified the following contributory factors leading to this accident:

- The *Vessel* failed to follow strictly the enclosed space entry procedure stipulated in shipboard Safety Management Manual (SMM) in particular the gas free procedures prior to entry of enclosed space;
- The crew who entered the space with high risk of oxygen depletion and existence of toxic gas did not wear breathing apparatus sets;
- The person supervising the entry into the enclosed space for the rescue (i.e. the Chief Officer) entered the enclosed space alone without following enclosed space entry procedures to evaluate entry safety and to spare an attendant at the space entrance to monitor; and
- Cargo spaces loaded with coal might become oxygen depletion, toxic and flammable. No warning sign/poster was posted at cargo space entrances.

2. Description of the Vessel

2.1 Particulars of "Sainty Vanguard"

Port of Registry	:	Hong Kong
IMO Number	:	9660578
Official Number	:	HK-3683
Call Sign	:	VRLJ5
Classification Society	:	Bureau Veritas
Type of Ship	:	Bulk Carrier
Keel Laid	:	20 December 2011
Built At	:	Sainty Shipbuilding (Yangzhou) Corp Ltd, Yizheng JS Yard, China.
Ship Owner	:	Sainty Marine Corp Ltd, China.
DOC Company	:	Graig Ship Management Ltd, United Kingdom
Length	:	229 metres
Breadth	:	32.3 metres
Depth	:	20.05 metres
Gross Tonnage	:	43,974
Net Tonnage	:	27,688
Deadweight	:	82,000
Main Engine	:	one set of Doosan Engine (South Korea) MAN-B&W 5S60MC-C8
Engine Power	:	11,900 kW
No. of Crew	:	20

Fig 1: M.V. "*Sainty Vanguard"*

2.2. **“Sainty Vanguard”**, a seven-hold bulk carrier built by Sainty Shipbuilding (Yangzhou) Corp Ltd, Yizheng JS Yard, China in 2011. She was powered by a five-cylinder marine diesel engine, Doosan Engine (South Korea) MAN-B&W 5S60MC-C8, capable of developing engine power of 11,900 kW. The *Vessel* was owned by Sainty Marine Corp Ltd, China and managed by Graig Ship Management Ltd, United Kingdom (hereinafter referred to as the Company).

3. Sources of Evidence

a) The statements of the Master, and Officers of "Sainty Vanguard*";* and

b) Information provided by the Ship Management of "Sainty Vanguard*"*.

4. Outline of Events

(All time shown in this report is local time, GMT+2 hours)

4.1 On 17 December 2013, the *Vessel* was drifting at about 30 nautical miles west off Hadera of Israel waiting to berth at Port Hadera of Israel for discharging cargo "Coal" (about 81,500 metric tons) in bulk loaded in Ust Luga, Russia.

4.2 The Chief Officer informed the Chief Engineer that the hydraulic driven remote control of some ballast valves were not functioning. Those ballast valves with faulty remote control were then reset at "Close" position due to the "fail safe" feature. The ballast valves needed to be operative during the cargo discharging at the berth, as the *Vessel* had to pump in ballast water during the cargo discharging to meet the stability requirements. In order to operate the ballast valves locally or to repair the valve control transmitters, the crew had to reach the valve control transmitters through the cargo holds with emergency hydraulic hand pump and the accessories.

4.3 As the shipboard Safety Management Manual (SMM) stipulated that the entry of enclosed spaces required authorization from the Management Company, the Master had followed the procedure and applied for the enclosed space entry permit from the Company. The superintendent of the Company had then granted the entry permission only on 17 December 2013.

4.4 On 18 December 2013, a toolbox meeting was held by the Chief Officer and the Chief Engineer. No.1 to No.4 cargo hold access hatches including the corresponding cargo hold hatches began to be opened in the morning when the day-work started at 0800. In the afternoon the testing to the atmosphere inside the cargo hold access spaces were carried out by the Chief Officer. The atmosphere testing was done by lowering down the personal multi-gas meter with rope. When the atmosphere was found normal, the crew entered the spaces and repaired the faulty valve control transmitters. The repair works were considered satisfactory. All the hatches were then closed before they called off the work.

4.5 On 19 December 2013, another toolbox meeting was held by the Chief Engineer. At 0800, the ship crew began to open all the cargo hold access hatches including all the cargo hold hatches. It was noticed that the valve control transmitters inside No.1 and No.4 cargo holds were still faulty. Before attempting to reach the faulty valve control transmitters, the Chief Officer tested the atmosphere inside No.1 and No.4 cargo hold access spaces and all found normal.

4.6 The Chief Officer instructed all the crew members not to enter No.5, 6 and 7 cargo hold access spaces. The Chief Officer accompanied with the Chief Engineer, the OS1 and the Deck Cadet entered No.1 cargo hold access space at about 0845. After the repair work inside the space, the Chief Engineer asked the Chief Officer to test the valve control from the deck office.

4.7 On his way back to the deck office, the Chief Officer noticed a tool box laid beside No.7 cargo hold forward access hatch which was abnormal as the Valve Box Compartment was not underneath. When he looked through the access hatch, he noticed a sign of person trapped inside No.7 cargo hold forward access space. He then called the OS1 through the portable radiotelephone to come to No.7 cargo hold forward access hatch. Before the arrival of the OS1, the Chief Officer entered the space without following enclosed space entry procedures, in particular, ventilation and gas free.

4.8 After a while the OS1 arrived No.7 cargo hold forward access hatch, when he found out nobody there, he also entered No.7 cargo hold forward access space to find out what had happened. To his surprise he noticed both the Chief Officer and the Bosun were lying inside the space, he quickly escaped from the space and alerted the Master through the portable radiotelephone at about 0905.

4.9 The Master summoned the search and rescue team (SAR). The SAR team was compose of two able seamen and equipped with breathing apparatus sets and air supply hose from the deck air line. This air supply hose was connected up with the deck service air system mainly for miscellaneous routine services. The crew also brought along the emergency escape breathing device (EEBD) as a kind of supportive equipment to the scene. When the SAR team reached the victims inside the space, the Chief Officer was waken up by the supplied air from the hose. The Chief Officer was even able to assist the rescue operation when the SAR team secured the Bosun with rope and lifted him out of the space. When the Bosun was removed out of the space, the crew applied cardiopumonary resuscitation treatment to the Bosun lying on the deck.

4.10 At 0908, the Master informed the Company and sought for helicopter to transport the Bosun to shore for medical treatment.

4.11 At 0952, the *Vessel* proceeded toward the port Hadera to shorten the travelling time of the helicopter from shore to the *Vessel*. At 1045 the helicopter arrived and lifted the Bosun away from the *Vessel* at about 25 minutes after the arrival.

4.12 The Chief Officer was later send to a hospital by a pilot boat when the *Vessel* arrived No.1 Anchorage of the port at 1405. Eventually, the *Vessel* dropped her anchor at No.1 Anchorage at 1415 to wait for berthing.

4.13 Thereafter, the Bosun was certified death by the doctor in the hospital while the Chief Officer was found normal and was then dispatched home.

5. Analysis of Evidence

Working experience & training

5.1 The Master of the *Vessel* had more than 10 years of seagoing experience, and about two years of which were in the capacity of a ship master. He took over as the Master of the *Vessel* for about two months before the accident. He held a Class 1 Certificate of Competency issued by the People's Republic of China on 1 February 2012 valid until 1 February 2015.

5.2 The Chief Officer had more than seven years of seagoing experience and about one and a half of years of which were in the capacity of a chief officer. He took over as the Chief Officer of the *Vessel* for about eight months before the accident. He held a Class 2 Certificate of Competency issued by the People's Republic of China on 11 July 2011 valid until 11 July 2016.

5.3 The OS1, joined the *Vessel* on 02 May 2013. He had about two years of working experience as an ordinary seaman. When the accident happened, he had been working on board for about seven months.

5.4 The Bosun held a "Certificate of Competency" to support navigation issued by the People's Republic of China on 11 July 2011 valid until 11 July 2016. He had more than 16 years of seagoing experience. He joined the *Vessel* on 02 May 2013 as the Bosun and he had more than one year working experience as a Bosun when the accident happened.

Working hours

5.5 There was no evidence to show any staffs had deviation on rest hours prior to the accident. Fatigue of crew members was not considered as a factor leading to the accident.

Alcohol Abuse

5.6 There were no indications or evidence of alcohol abuse of the crew and the officers involved.

Location of the Valve Box Compartments

5.7 The ballast water valve control transmitters were located inside the valve box compartments in double bottom under the respective cargo hold lower stools. The access cover of each valve box compartment was adjacent to the bottom end of the spiral ladder in each cargo hold (Fig.2).

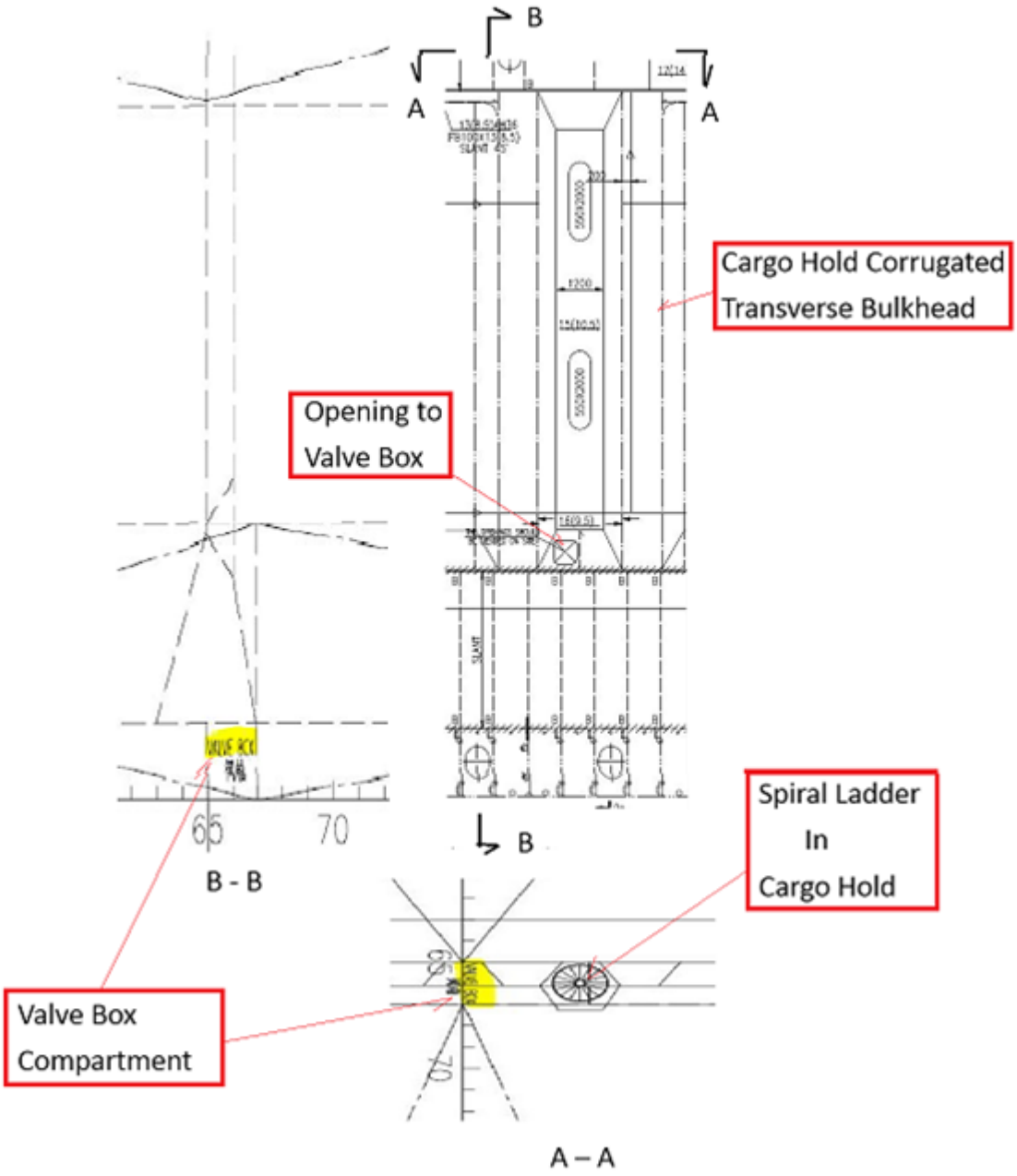


Fig. 2: No.6 Cargo Hold, Aft Section

Coal - hazardous cargo in bulk quantity.

5.8 According to International Maritime Solid Bulk Cargoes Code, the Coal (bituminous and anthracite) is a natural, solid, combustible material consisting of amorphous carbon and hydrocarbons.

5.9 Coal is categorized as Group "B" (classed MHB) due to its potential chemical hazardous when in bulk quantity. Coal may create flammable atmosphere, may heat spontaneously, may deplete the oxygen concentration, may corrode metal structures.

5.10 Coal may emit methane, a flammable gas. A methane/air mixture in certain degree is explosive and can be ignited by sparks or naked flame, e.g., electrical or frictional

sparks, a match or lighted cigarette. Methane is lighter than air and may, therefore, accumulate in the upper region of the enclosed space. Therefore all the electrical equipment (for example: the multi-gas meter, torch, electrical ventilation fan at the hold entrance) brought into the cargo hold spaces loaded with coal should be the safe type suitable for explosive atmosphere.

5.11 Coal may be subject to oxidation, leading to depletion of oxygen and an increase in carbon dioxide (CO_2) or carbon monoxide (CO) concentrations in the cargo hold. CO gas is toxic and odorless.

5.12 Some coals may be liable to react with rain water and produce acids which may produce hydrogen gas which is also odorless, flammable and toxic. Hydrogen is much lighter than air.

The atmosphere of the cargo hold access space around the spiral ladder

5.13 To reach the access cover of each Valve Box Compartment, the crew must climb down from the cargo hold access hatch through the spiral ladder except for the access cover of the Valve Box Compartment for No.7 cargo hold which was located in the Engine Room. The spiral ladder was fixed in the corrugated cargo hold transverse bulkhead and was protected from any potential mechanical damage during the cargo operations by one steel face plate at the front of the ladder and two steel web plates at either sides of the ladder throughout the depth. The face plate had two big holes (Fig.3) allowing natural air flow between the cargo hold and the cargo hold access space.

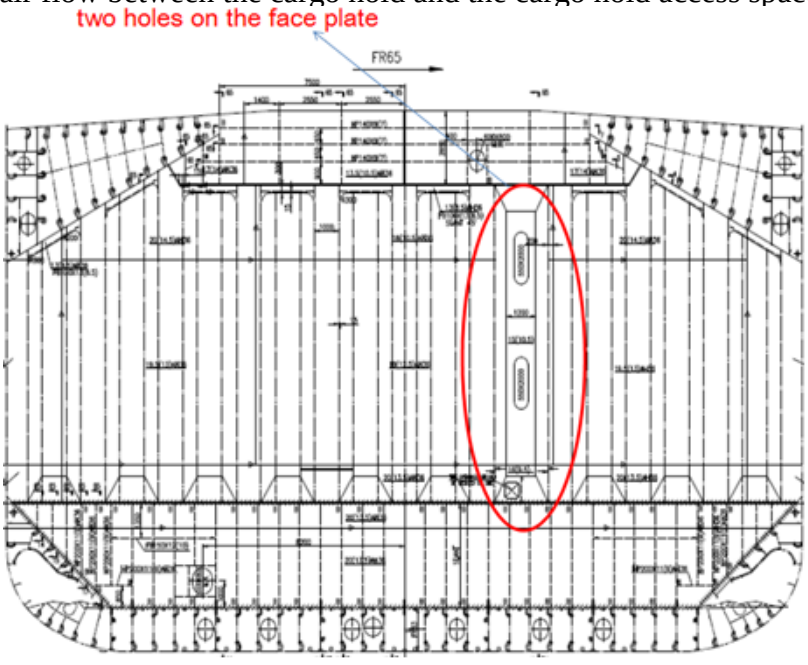


Fig. 3: The two holes on the face plate of the cargo hold access space

5.14 Toxic gases such as carbon monoxide were odorless in nature. It could be emitted from the cargo "Coal" and accumulated amply in the cargo holds during the voyage from the loading port Ust-Luga, Russia to the discharge port Hadera, Israel.

5.15 Although all the cargo hold hatches were opened (Fig.4) when the fatal accident happened on 19 December 2013, the air pockets within the cargo holds including the cargo hold access spaces could be trapped with toxic and flammable gases.

Fig. 4: All the cargo hold hatches and the access hatches were opened

5.16 Regarding the incident in No.7 cargo hold, the lower hole on the face plate had been shielded by the cargo "Coal". The cargo hold access space was then intermittently contaminated by toxic and flammable gases emitted from the cargo "Coal", the atmosphere was therefore unstable and was subject to change under natural ventilation. The cargo hold access space could not be considered as safe for entry.

5.17 The entry to the cargo hold access space in No.7 cargo hold should therefore not be permitted. However, in case any entry that is absolutely necessary, for example: for emergency/ rescue purpose, only properly trained and experienced crew equipped with breathing apparatus (Fig.5) may consider entry for the purpose.

Fig. 5: The Breathing Apparatus used on board.

5.18 The Chief Officer tested the atmosphere and safely entered the cargo hold access spaces in No.1 and No.4 cargo holds on 18 December 2013 and again in No.1 cargo hold on 19 December 2013. This might give a wrong impression to all the crew including the Bosun that the enclosed space entry procedure was merely a routine and the cargo hold access spaces were safe for entry. The crew failed to recognized the below effects and symptoms of the oxygen depletion and high carbon monoxide concentration:

- Oxygen is essential to life; the normal atmosphere has an oxygen content of 20.8 percent by volume. In general, oxygen deficiency leads to a loss of mental alertness and a distortion of judgment and performance. It cannot be determined through an individual's senses. This happens within a relatively short time without the person's knowledge and without prior warning. For oxygen content 8 - 6%, fainting within a few minutes, resuscitation possible if carried out immediately. For oxygen content less than 6%, fainting almost immediate, death or severe brain damage.
- A carbon monoxide concentration of 0.05 percent (500 ppm) may produce unconsciousness in a little more than an hour, and may prove fatal in four hours. However, higher concentrations may cause almost immediate unconsciousness and death within a few minutes.

Safety Management Manual

5.19 The shipboard Safety Management Manual (SMM) stipulated the requirements on the entry of enclosed spaces. The following procedures stated in the manual had not been complied with by the crew during the accident:

- Permit to Work to be completed;
- Risk Assessment to be reviewed and modified as required;
- The entry instruction to be fully reviewed;
- Email confirmation from office for entry is to be obtained;

- Potential hazards identified are to be isolated or made safe; and
- Toolbox Talk prior to entry to be conducted, entry procedure to be discussed and understood by entry team.

Entry of Enclosed Space without following the Company Procedures

5.20 As per the enclosed space entry procedure in the SMM permission of the entry on the specific day from the Company was required. The Company permitted the entry only on 17 December 2013. No permission was granted from the Company on the following days when the entry was made on 18th and 19th of December 2013.

5.21 The Bosun entered alone No.7 cargo hold forward access space without the permission or knowledge of senior shipboard staffs, in contravention of the Code of Safe Working Practices for Merchant Seamen and in breach of Company procedure for enclosed space entry.

5.22 The atmosphere of No.7 cargo hold access space was unsafe for entry. The lack of oxygen at that moment in the space caused the Bosun to collapse within a few minutes and to fall down from the spiral ladder with the head going first (Fig.6), since it was reported that the Bosun sustained additional head injury before his death.

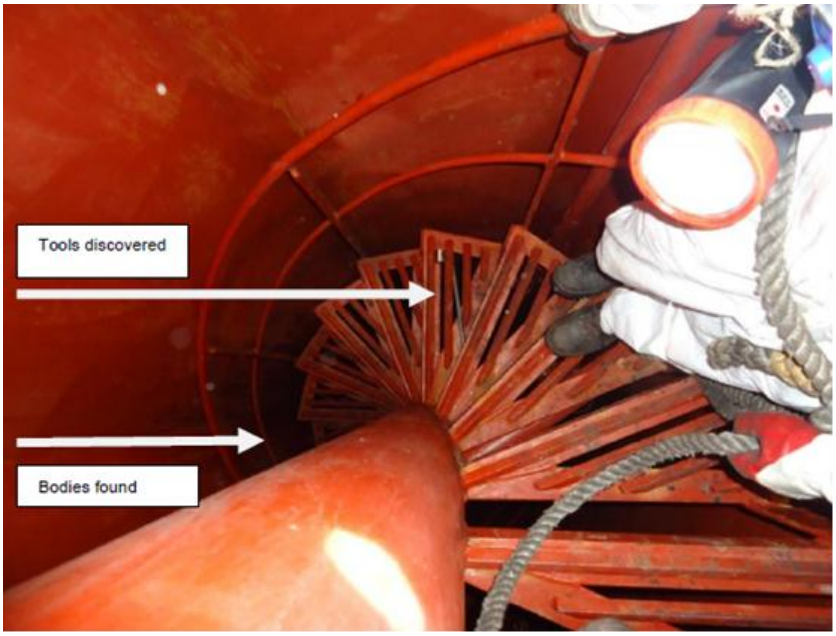


Fig. 6: No.7 cargo hold forward access space where the Bosun was found

Inappropriate Type of Gas Detector was used

5.23 The Chief Officer used the multi-gas meter (Maker: BW Technologies, Type: Max XT II) (Fig.7) as a primary source to check the enclosed spaces prior to the entries. This multi-gas meter was only a back- up/second protection equipment for the hazardous atmosphere, to allow the crew to identify a sudden change of condition (when alarm was on) and to leave the space immediately.

Fig. 7: The personal multi-gas meter

5.24 The crew should enter the cargo hold access space with breathing apparatus. For risk assessment, the internal atmosphere should also be tested, with a calibrated direct-reading instrument, for the following conditions in the order given: (1) oxygen content, (2) flammable gases and vapours, and (3) potential toxic air contaminants at various levels of the space.

5.25 It is popular to use a gas monitor meter with either an internal or external pump capable of properly drawing the air sample back to the fresh air monitoring point during initial testing of the space. Such type of gas monitor meter was one of the requirements by the International Maritime Solid Bulk Cargoes (IMSBC) Code for ships carrying coal.

Communication failure between the working crew and the person in charge.

5.26 On 18th and 19th December 2013, the Chief Officer as a person in charge of the work had entered the enclosed space with all the working crew and left the space entrance unattended by any competent person. As a result the supervision to every entries lost. This also caused the communication failure between the crew inside the space and the supervision outside.

5.27 When the Chief Officer noticed a sign of person trapped inside a space later in the morning on 19th December 2013, he failed to spare at least one trained attendant with effective communication means to remain at the entrance to the space whilst it was occupied. Those unoccupied enclosed space entrances were unsafe for the entry of personnel.

5.28 There was no evidence to show that an agreed and tested system of communication had been established between the crew inside the space, the attendant at the entrance, the officer on watch and the officer in charge who was the Chief Officer.

No warning poster at cargo spaces entrances.

5.29 Cargo spaces loaded with coal might become oxygen depleted, toxic and flammable. Precaution should be warned prior to entry. The enclosed space hazardous warning poster should be prominently displayed in the cargo space entrances as per the paragraph 6.2 of the IMO Resolution A.1050(27) "Recommendations for Entering Enclosed Spaces aboard ships".

Toolbox Meeting required by the Company Safety Management System was conducted unsatisfactorily.

5.30 SMM required that the Toolbox Meeting should be conducted prior to the enclosed space entry. The entry procedure should be discussed and understood by all the crew involved to the task.

5.31 It was noticed that the Toolbox Meetings did not involve all the crew who would involve in the task. On 18 December 2013, both the Chief Engineer and the Chief Officer hold the meeting. However, on 19 December 2013, only the Chief Engineer hold the meeting.

5.32 The crew were not fully briefed on the dangers associated with the cargo "Coal". This seemed to make the Bosun to enter No.7 cargo hold access space on his own by mistake on 19 December 2013.

6. Conclusions

6.1 On 17 December 2013, when the Hong Kong registered bulk carrier "Sainty Vanguard" was drifting at about 30 nautical miles west off Hadera of Israel waiting to berth at Port Hadera of Israel for discharging cargo "Coal", the hydraulic remote control system for the ballast valves of the *Vessel* was found malfunctioning. On the next day, a team of crewmembers tried to repair the system by entering the Valve Box Compartments in the double bottom though the No.1 to No.4 cargo holds in which coal had been loaded.

6.2 On 19 December 2013, the Bosun entered alone No.7 cargo hold forward access space without the permission or knowledge of any senior shipboard staffs. The Bosun lost his conscious and was found lying on the spiral ladder in No.7 cargo hold forward access space. Thereafter both the Chief Officer and the Ordinary Seaman1 (OS1) tried to rescue and entered the same space consecutively without following the enclosed space entry procedure. Fortunately, the OS1 was not affected and the Chief Officer was rescued by other crew, and they did not lose their lives in the incident. The Bosun was sent ashore by a helicopter and then transferred to a hospital for rescue. But he was certified death by the hospital on the same date.

6.3 Investigation into the accident revealed that cargo hold access space in No.7 cargo hold was not safe for entry when the cargo holds were loaded with hazardous cargoes. The Bosun was overcome by high concentration of carbon monoxide and oxygen depletion inside the space that was lethal to him.

6.4 The investigation had also identified the following contributory factors leading to this accident:

- The *Vessel* failed to follow strictly the enclosed space entry procedure stipulated in shipboard Safety Management Manual (SMM) in particular the gas free procedures prior to entry of enclosed space;
- The crew who entered the space with high risk of oxygen depletion and existence of toxic gas did not wear breathing apparatus sets;
- The person supervising the entry into the enclosed space for the rescue (i.e. the Chief Officer) entered the enclosed space alone without following enclosed space entry procedures to evaluate entry safety and to spare an attendant at the space entrance to monitor; and
- Cargo spaces loaded with coal might become oxygen depletion, toxic and flammable. No warning sign/poster was posted at cargo space entrances.

7. Recommendations

7.1 A copy of this report should be sent to the Master and the Company of the *Vessel*, advising them the findings of this incident. The Company should issue circulars to remind all masters, officers and crew on board ships the lessons learnt from the incident.

7.2 The Company should ensure the Master and all crewmembers to strictly follow the Company's procedures to enter enclosed spaces and to carry out training/drills, in particular:

i) to enter suspected or unsafe space for safety of life must have breathing apparatus donned at all times;

ii) to establish direct communication between crewmembers and person in charge of the enclosed space entry for monitoring the operation; and

iii) to conduct at least once every two months the enclosed space entry and rescue drill as per SOLAS Chapter III, Part B, Regulation 19.3 (MSC.350(92)). The drills should be planned and conducted using the required equipment and should take into account IMO Resolution A.1050(27) for entering enclosed spaces.

7.3 The Company should inform the Marine Accident Investigation Section of the Hong Kong Marine Department of the above corrective actions taken upon completion.

7.4 A Merchant Shipping Information Note (MSIN) should be issued to promulgate the lessons learnt from this accident.

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 Marine Department to send a copy of draft report to that person or organization for their comments.

8.2 The draft report was sent to the Manager of the *Vessel* of *Graig Ship Management Ltd, Shanghai, China* for the comments.

8.3 During the consultation period, comments from the Manager of the *Vessel* were received and had been properly considered and the report has been amended accordingly.