



Report of Investigation
into the Explosion on Board
the Dangerous Goods Carrying
Barge “Cheung Kam Shui No. 2”
on 22 August 2005



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

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 0930 on 22 August 2005, an explosion and subsequently a fire occurred inside the cargo hold of the dangerous goods carrying barge "*Cheung Kam Shui No. 2*" while it was loaded with Pyrotechnic Special Effects Materials (PSEM) and moored alongside another vessel inside the Western District Public Cargo Working Area. The accident resulted in the death of the Coxswain and serious injuries to three other crewmembers of the vessel.
- 1.2 The explosion was probably caused by the heat and spark generated when a circular saw bench was used for cutting the cardboard cylinders of the PSEM inside the cargo hold of the vessel.

2. Description of the Vessel

- 2.1 "Cheung Kam Shui No. 2" (hereafter referred as *the Vessel*), local license No. M21429Y, is a cargo vessel designed to carry the category 1¹ dangerous goods (DG) - explosives and blasting agents within the Hong Kong waters. It is equipped with a crane at the forward of *the Vessel* to facilitate cargo handling operations. *The Vessel* is propelled by two diesel engines. One diesel generator is fitted in the engine room for supplying electricity to auxiliary services of *the Vessel*.



Fig. 1: Photo of dangerous goods barge "Cheung Kam Shui No. 2"

¹ Cap. 295A Dangerous Goods (Application and Exemption) Regulations. Reg. 3 "Classification of dangerous good"

2.2 Particulars of *the Vessel*

Licence Number	: M21429Y
Type of Ship	: DG carrying barge
Year of Built	: 1986
Name of Builder	: Cheung Yau Lam Marine & Engineering Co.
No. of Cargo Hold	: One
Where built	: Yiu Lian Dockyards Limited.
Length	: 23.77 metres
Breadth	: 7.33 metres
Depth	: 2.75 metres
Gross Tonnage	: 165.68
Net Tonnage	: 115.98
Engine Power	: Total 220 B.H.P.

3. Sources of Evidences

3.1 Information was provided by following persons

- a) Owner of *the Vessel*
- b) Assistant Coxswain of *the Vessel*
- c) Engineer of *the Vessel*
- d) Sailor of *the Vessel*
- e) Person in charge of Pyromagic Production Ltd.
- f) Wife of the deceased
- g) Special Effects Operators and Special Effects Assistants participated in the pyrotechnic display
- h) The vehicle drivers
- i) A pilot witnessed the explosion

3.2 The Hong Kong Police Force

3.3 The Television and Entertainment Licensing Authority

3.4 Vessel Traffic Centre

4. Outline of Events

- 4.1 At about 2105 on 21 August 2005, *the Vessel* departed from the Western District Public Cargo Working Area (WDPCWA) to Watson Road Landing (WRL) at North Point for loading the unused, misfired² and residues of the pyrotechnic special effects materials (PSEM). At about 2130, *the Vessel* berthed at WRL.
- 4.2 The PSEM were used for the pyrotechnic display show of "A Symphony of Lights", which was conducted at the rooftops of twelve commercial buildings earlier on that evening. Due to unfavorable weather condition, the estate management of two commercial buildings refused to allow the PSEM to be fired at their rooftops. Therefore, substantial amount of unused, together with those misfired and residues of the PSEM were loaded back to *the Vessel* for storage. The residues of the PSEM consisted mainly of cartons and cardboard tubes left behind after the display.
- 4.3 The unused and the misfired PSEM were loaded into the cargo hold while the residues were loaded on top of the hatch cover boards. *The Vessel* departed from WRL at about 2218 and arrived at the WDPCWA at about 2245. The crewmembers of *the Vessel* then transferred the residues to the shore for dumping as domestic waste while the unused and misfired PSEM retained inside the cargo hold of *the Vessel* for storage. The crewmembers had moored *the Vessel* alongside another vessel "*Cheung Kam Shui I*" at the WDPCWA before they left *the Vessel*.
- 4.4 In the morning of 22 August 2005, the crewmembers of *the Vessel* returned on board. The Assistant Coxswain, the Engineer and the Sailor were preoccupied with repairing work in the engine room and nobody knew the Coxswain whereabouts.
- 4.5 At about 0930, the crewmembers went out of the engine room after they had completed the repair work. They found that some smoke was emitting from the cargo hold. The Engineer and the Sailor immediately went into the cargo hold with fire extinguishers to see what had happened. They found that the cargo hold was engulfed with smoke. While they tried to operate the fire extinguishers, the PSEM exploded.
- 4.6 The Engineer and the Sailor were able to escape from the cargo hold.

² Misfired - The PSEM that could not work properly during the pyrotechnic display.

Later, the fire was extinguished by shore fire brigade and the body of the Coxswain was found inside the cargo hold. The Assistance Coxswain, the Engineer and the Sailor were sent to hospital by ambulances for medical treatment.

5. Findings and Analysis

The owner and the crewmembers of the vessels

- 5.1 The owner of *the Vessel* had been running the conveyance of category 1 DG for more than forty years, he owned two sister vessels for carrying DG, namely, "*Cheung Kam Shui 1*" and "*Cheung Kam Shui No.2*". The vessels were normally operated and maintained by four family crewmembers consisting of the owner's two younger brothers and two sons. All the four crewmembers were on board *the Vessel* at time of the accident.
- 5.2 The deceased had more than twenty years working experience onboard vessels and he was experienced in shipboard DG operations. He obtained his "Local Certificate of Competency for Master of 300 tons and under" in 1986 and he was the only competent person out of the four crewmembers to take charge of *the Vessel* as Coxswain. However, on the evening of 21 August 2005, he did not sail on board *the Vessel*, which was under the command of the Assistant Coxswain with a "Local Certificate of Competency for Master of 60 tons and under". The Assistant Coxswain was not qualified to command *the Vessel* of 115.98 tons.
- 5.3 The Engineer obtained his "Local Certificate of Competency for Engineer of over 150 B.H.P" in 2001, he was qualified to take charge of *the Vessel* of 220 B.H.P.

The DG carrying vessel "*Cheung Kam Shui No.2*"

- 5.4 *The Vessel* is a single hold cargo vessel designed for carrying category 1 DG. A "Declaration of Fitness" was issued by Marine Department for conveyance of the category 1 DG. *The Vessel* had been hired by Pyromagic Productions Ltd. to convey the PSEM for the pyrotechnic display shows on every weekends since 25 June 2005. As the PSEM is a category 1 DG, a "Conveyance Permit"³ was issued by the Entertainment Special Effects Licensing Authority (ESELA) for the PSEM display show.

Conveyance of PSEM after the display show

³ Cap. 560 Entertainment Special Effects Ordinance, Sec.21 Permits required for conveyance of pyrotechnic special effects materials

- 5.5 On departing from the WRL on 21 August 2005, *the Vessel* was loaded with 28 cartons of unused and an unknown amount of misfired PSEM. According to the conditions specified in the Conveyance Permit, *the Vessel* should be supervised by a Special Effects Operator (SEO)⁴ and sailed to the Western Dangerous Goods Anchorage (WDGA) as destination. However, there was no SEO on board to supervise the conveyance during the voyage and *the Vessel* had not sailed to WDGA. *The Vessel* was later moored alongside to its sister vessel "*Cheung Kam Shui 1*" at berth WD 24 of the WDPCWA, it stayed there overnight until next morning.
- 5.6 The Assistant Coxswain stated that the gearbox cooler of *the Vessel* was found defective during the voyage. It would be unsafe to carry out repair in the anchorage area. Therefore he changed the route and took *the Vessel* to the WDPCWA for the repairing work. However, the change of the route had contravened the Conveyance Permit conditions without prior approval from the relevant Departments.

Route monitoring

- 5.7 Currently, the requirement on the participation in the Vessel Traffic Service⁵ (VTS) is generally applicable to ocean going ships and river trade vessels of over 1000 gross tonnage. Therefore, the locally licensed vessel at size of *Cheung Kam Shui No. 2* was not a VTS participating vessel. Thus the movements of *the Vessel* within the harbour could not be supervised and monitored by the Vessel Traffic Centre. As accidents happened on DG carrying vessels may lead to serious consequences, measures may need to be set up to monitor more closely the movements of DG carrying vessels.

The position of the deceased at the time of the accident

- 5.8 At about 0930 on 22 August 2005, the Assistant Coxswain, the Engineer and the Sailor noted that a few pieces of the hatch cover boards at the starboard forward end had been removed with part of the tarpaulin cover sheet opened. Apparently the Coxswain had entered the cargo hold through the stairway there.

⁴ Special effects operator as stipulated in Cap. 560 Entertainment Special Effects Ordinance, Sec. 5.

⁵ Requirement for vessels to report the navigational information to Vessel Traffic Centre with aims at control, supervise and monitor vessel's movements.

The extension power cable

- 5.9 The diesel generator was running to facilitate the repair work inside the engine room at the time of the accident. An extension power cable (see fig. 2) was found to have been rigged from the aft of *the vessel* to the cargo hold. Although the extension power cable was not connected and the plug end was left inside the toilet close to the galley, the cover of the socket was opened at the time of the investigation. It was believed that someone had unplugged the cable during the fire. Apparently, a crewmember had connected the electric power from the electric power socket at the galley to an electrical appliance in the cargo hold in the morning of 22 August 2005. To operate any electrical appliance inside the cargo hold loaded with DG was extremely dangerous as heat and sparks would be generated to ignite the PSEM.

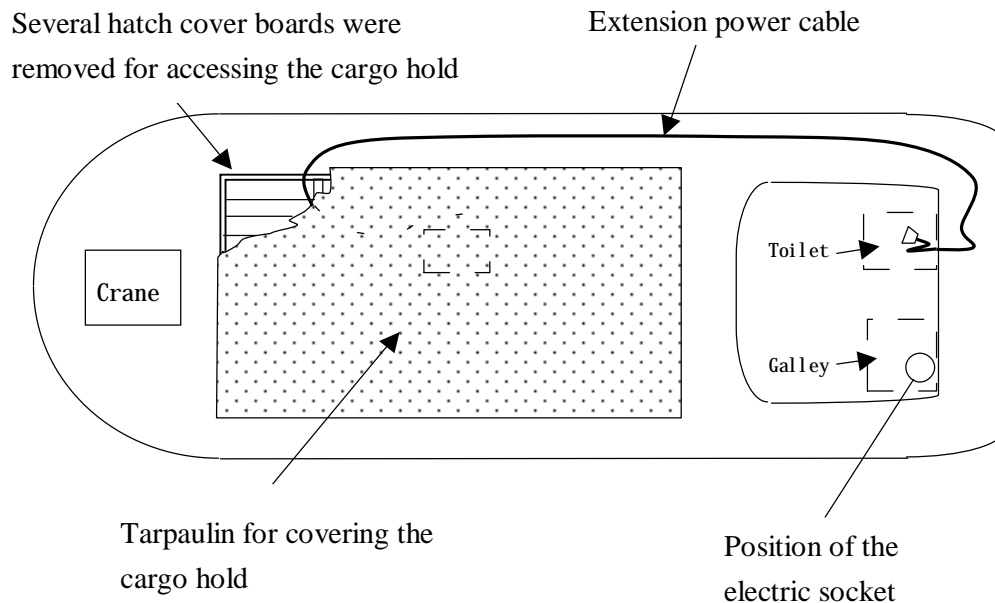


Fig. 2: The rigging of the extension power cable

Stowage of PSEM

5.10 The cargo hold of *the Vessel* was loaded with 28 cartons (482 pieces) of unused and misfired PSEM. Apart from the PSEM, lots of equipment were stowed inside. The stowage arrangement of the PSEM and various equipment is shown in fig. 3.

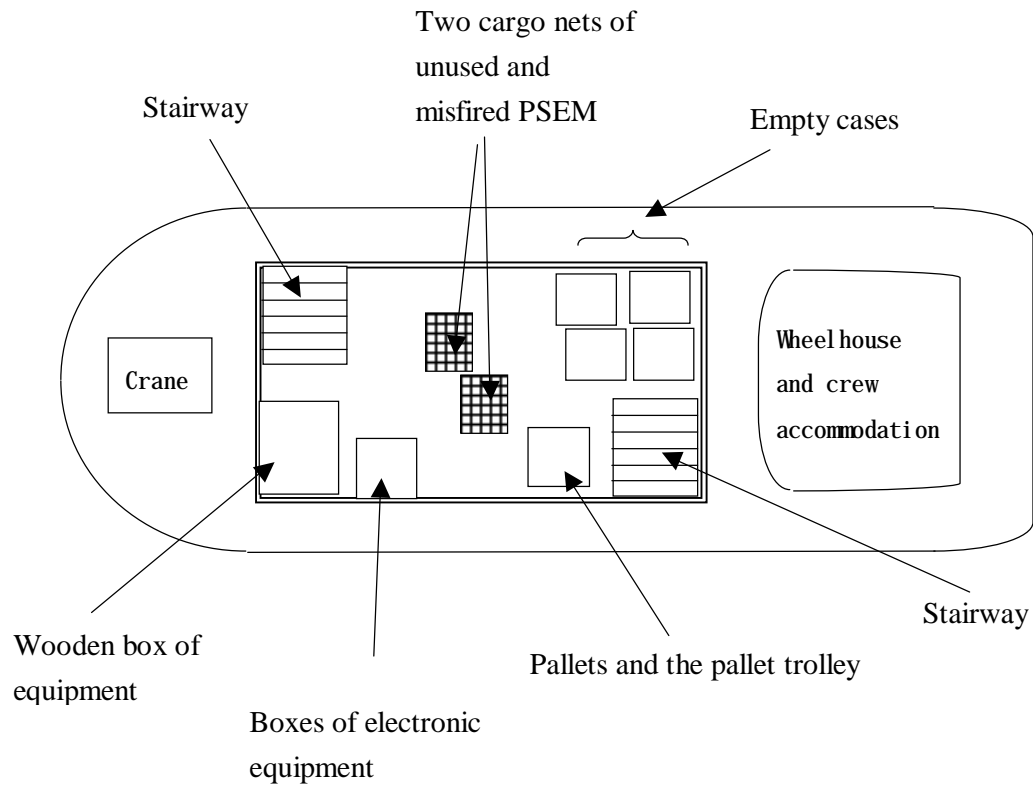


Fig. 3: Stowage arrangement of the PSEM and various equipment in the cargo hold of *the Vessel*. (Based on the description of the witnesses and site investigation)

5.11 The unused PSEM were packed in cartons and the misfired PSEM were put in plastic bags. The cartons and plastic bags were stowed in two cargo nets and placed near the centre of the cargo hold. However, some other boxes of equipment were also placed adjacent to the PSEM. There were no securing arrangement to prevent the movement of cargoes during voyage.

The particulars of the PSEM

5.12 The PSEM (see fig. 4) were manufactured in Mainland China by "廣東惠州土產進出口公司" and consisted of a number of cylindrical cardboard tubes of sizes 30mm and 50mm in diameters. The tubes were sealed at the base by plugs that made of wood or sand clay. Inside the tubes, there were lift charge and pyrotechnic materials which were explosive and inflammable materials. Electric matches and fuses were placed inside the cardboard tubes for activating the lift charge during the PSEM displays.

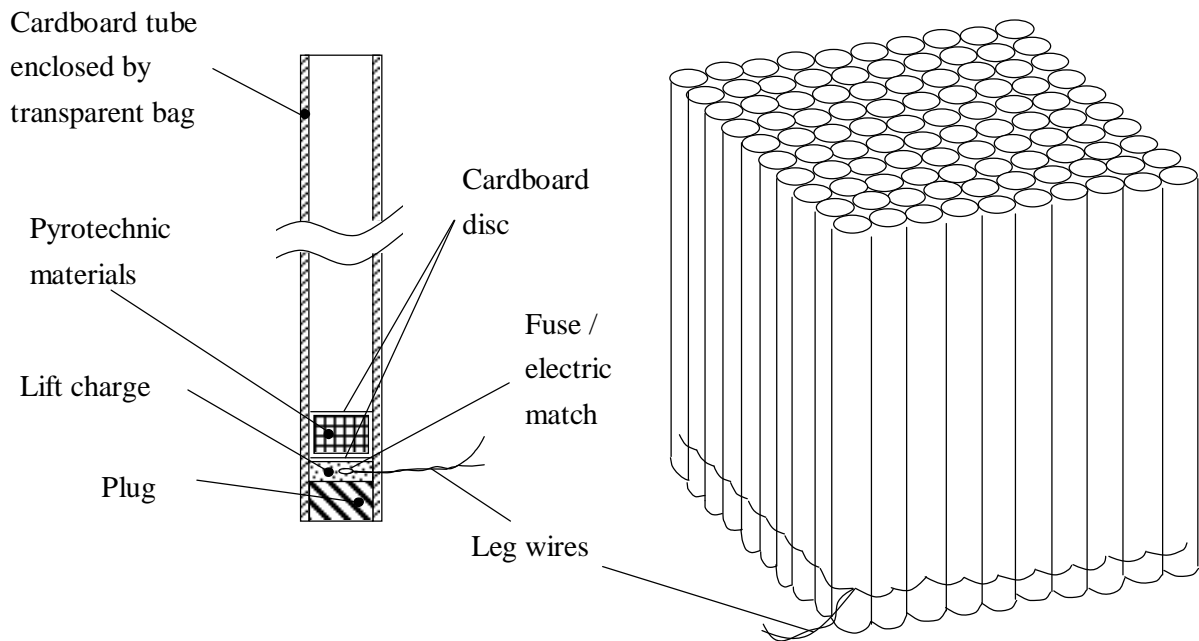


Fig. 4: Sketch of the PSEM in the cargo hold.

5.13 The explosion caused almost all hatch cover boards fell into the cargo hold (see figs. 5a & 5b). The tarpaulin sheet was burnt with a large hole near the centre position. The stacking of the PSEMs was collapsed, part of them were burnt and darkened by the fire. The Coxswain was found dead inside the cargo hold. A circular saw bench and the socket end of the extension power cable were found near the deceased. Some transparent plastic bag (see fig. 5b) used for covering the PSEM were found stripped off and scattered on the floor. It was also noticed that a knife cutter (see fig. 5b) was found on top of a box of the PSEM. It is believed the knife cutter had been used by the deceased for cutting off plastic bags of the PSEM.



Fig. 5a: Condition of the cargo hold after the fire and the explosion



Fig. 5b: Condition of the cargo hold after the fire and the explosion

The circular saw bench

5.14 The circular saw bench (see fig. 6) was found at the starboard side of the cargo hold. A circular saw was mounted underneath the wooden bench in such a way that the circular saw cutter protruding up to the table surface through a slot. The switch of the circular saw bench was set at "ON" position and the extension power cable was rigged for obtaining electrical power from the electric mains of *the Vessel*. The bench was badly burnt and the circular saw disc was tangled with the legwires of the PSEM via the slot (see fig. 7).



Fig. 6: The burnt saw bench



Fig. 7: Legwires were tangled at the circular saw cutter

5.15 The circular saw bench was normally used for cutting wooden dunnage and hatch cover boards. The crewmembers stated that the circular saw bench was in working order and it was not stowed inside the cargo hold prior to the accident.

The cut cylindrical cardboard tubes

5.16 A number of cut cylindrical cardboard tubes (see fig. 8) were found scattered on the floor of the cargo hold. It appeared that, for an unknown reason, the deceased had been cutting the misfired PSEM cylindrical tubes with the circular saw bench inside the cargo hold. Such cutting process

was extremely dangerous, as a large amount of heat could be generated during the cutting of cardboard tube. Explosive powder contained in the lift charge and pyrotechnic materials might also spread in form of dust in the cutting operation. It is believed that the explosion was caused by the heated up saw blade which ignited the explosive powder. The unused PSEM were subsequently ignited by the heat and fire generated in the explosion.



Fig. 8: The cut away PSEM cardboard cylinder found inside the cargo hold.

Disposal of PSEM

5.17 There was no clear instructions for the crewmembers to dispose of the PSEM. In the past, the crewmembers disposed of the residues of the PSEM as domestic waste. The misfired PSEM were first immersed into water by personnel from Pyromagic Productions Ltd., the soaked PSEM were later disposed of as domestic waste by the crewmembers. However, the misfired PSEM in the incident had not been so treated. They were unsafely handled by the deceased.

VHF radio installation

- 5.18 There was complaint about the difficulty to make telephone call to relevant departments for help. Under the current legislation, locally licensed vessels did not require a VHF radio installation. There was no VHF radio onboard *the Vessel*. The crewmembers of *the Vessel* relied on mobile telephones for outside communications. Due to the limited coverage of mobile telephone networks in the waters of Hong Kong, the reliability of the communication was in question. Emergency assistance, if required would be delayed when *the Vessel* is in an area outside the network coverage.

6. Conclusions

- 6.1 An explosion and subsequently a fire occurred inside the cargo hold of *the Vessel* on 22 August 2005 while it was loaded with PSEM and moored alongside another vessel inside the WDPCWA. The accident resulted in the death of the Coxswain and serious injuries to three other crewmembers.
- 6.2 Due to the absence of witness, the exact cause of the accident could not be established. However, based on the findings and analysis, the fire and explosion were probably caused by the heat and spark generated when a circular saw bench was used for cutting the cardboard cylinders of the PSEM inside the cargo hold of *the vessel*.
- 6.3 The investigation has also revealed following findings:
- a) *the Vessel* was not under command of a qualified coxswain during the voyage in the night before the incident;
 - b) *the Vessel* did not operate in accordance with the conditions as stipulated in the Conveyance Permit;
 - c) *the Vessel* did not sail to the designated dangerous goods anchorage while carrying the PSEM;
 - d) *the Vessel* was not supervised by a Special Effects Operator while conveying the PSEM;
 - e) the PSEM was not properly segregated with other goods in the cargo hold. Both the PSEM and other goods were not properly secured;
 - f) Crewmember did not properly handle and dispose of the misfired PSEM;
 - g) *the Vessel* was not a VTS participating vessel, its movements could not be monitored by the Vessel Traffic Centre; and
 - h) *the Vessel* was not equipped with VHF radio installation, reliable communication to shore stations could not be established.

7. Recommendations

- 7.1 A copy of this report should be sent to the owner and the operator of *the Vessel* advising them the findings of this incident and instructing them to follow proper safety precautions, e.g.
- a) no electrical machinery should be used in cargo hold when carrying DG;
 - b) *the Vessel* must be under command of a competent Coxswain;
 - c) all DG and other goods should be properly segregated and secured;
and
 - d) conditions as stipulated in the Conveyance Permit should be strictly followed, such as the designated routing for *the Vessel* and under supervision of a Special Effects Operator.
- 7.2 Instructions and procedures for the disposal of unused and misfired PSEM should be established and made known to all crewmembers.
- 7.3 The Marine Department may consider appropriate measures to monitor more closely the movements of DG carrying vessels.
- 7.4 The Marine Department may consider that all locally licensed vessels carrying DG should be equipped with VHF radio installations to enable reliable communication between the vessels and shore stations.

8. Submissions

- 8.1 In the event that the conduct of any person or organization is criticized in a casualty investigation report, it is the policy of the Hong Kong Marine Department that a copy of the relevant parts of the draft report are 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 relevant parts of the draft report were forwarded to the following parties:
 - a) Owner of *the Vessel*.
 - b) Person in charge of Pyromagic Production Ltd.
- 8.3 Submission on the report was received for the Owner of *the Vessel*. The Investigation Officer has taken into account to the views for the submission and the draft report has been suitably amended.