



Report of investigation
into the incident on
the electrocution of crew on board
the locally licensed split hopper barge
"Geoworks SB-4"
at the waters near Port Island
on 26 May 2005



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



1. Summary

- 1.1 An accident happened onboard the split hopper barge "Geoworks SB-4" on 26 May 2005. While the Vessel was being towed to the marine worksite for loading dredged sea mud, water ingress was found at the port forward void space of the Vessel. The Crewmen used a portable submersible bilge pump to pump the water out of the void space. In the course of the work, one of the Crewmen was electrocuted while handling the pump.
- 1.2 Contributing to the accident was the 3-wire cable in one of the multi-gang electrical connectors for which the 'earth' terminal had been wrongly connected to the 'live' wire. The wrong connection caused the enclosure of the pump subject to the live terminal of 130V line voltage. Furthermore, the ELCB system which provided earth fault protection was not in a working condition. As a result, the circuit breaker of the ELCB system was not triggered resulting in the electrocution of the deceased.

2. Description of Vessel

2.1 "*Geoworks SB-4*" (hereinafter referred as *the Vessel*), is a single hold split hopper barge with local license No. 21637V. The Vessel was not equipped with any propulsion engine. A three phase diesel generator was fitted in the machinery space in the deck house to supply electricity to the vessel.

2.2 Particulars of "*Geoworks SB-4*"

Licence Number:	21637V
Type of Ship:	Non-mechanised Split Hopper Barge
Year of First License:	1993
Name of Builder:	Soochow Shipyard, Jiangsu, China.
Owner of Vessel:	Hua Ning Industries Ltd
Length:	49.81 metres
Breadth:	12.41 metres
Moulded Depth:	4.56 metres
Gross Tonnage:	1083
Net Tonnage :	758
Main Engine	N.A.
No. of Crew	2



Fig. 1: Photo of split hopper barge "*Geoworks SB-4*"

3. Sources of Evidence

- a) The Crewman of "*Geoworks SB-4*" (Crewman B)
- b) The Electrical Contractor
- c) The Hong Kong Police Force
- d) Ship's drawings
- e) Autopsy report

4. Outline of events

- 4.1 At about 0000 on 26 May 2005, the Vessel was towed by a tugboat "Tsui Ho 9" (Licence No. 3934) from the waters of Ninepin Group to the marine work site at north of Port Island for loading dredged sea mud. There were two crewmen on board the Vessel, Crewman A and Crewman B. On arrival of the marine work site, it was found that the Vessel had listed to its port side.



Fig. 2: The location of the Accident

- 4.2 The Crewmen suspected that seawater had got into the void space of the Vessel causing the Vessel to list. Therefore, Crewman A made a phone call informing the company that the Vessel could not be loaded until the listing had been rectified. At about 0250, they dropped anchor and opened the manhole of the void space for inspection.
- 4.3 Since seawater was found inside the port forward void space of the Vessel. Crewman A arranged a portable submersible bilge pump using external power via extension power cables to pump out the seawater. He also prepared a ventilation fan to supply fresh air into the void space during the pumping operation.
- 4.4 At about 0400, Crewman A found that most of the seawater had been pumped out, he therefore entered the void space for inspection. At the bottom shell plate of the Vessel, two tiny holes were found. He used two wooden plugs to

stop the leakage of seawater.

- 4.5 Crewman A attempted to continue to pump out all the water from the void space. Due to the void space was divided into sections by its structural members, he needed to move the portable submersible bilge pump from section to section inside the void space. Around that time, Crewman B heard a scream for help and saw Crewman A had fallen down to the bottom shell plate with the face down. Crewman B immediately disconnected the electrical power from the extension power cable of the portable submersible bilge pump and sought help from the crew of adjacent tugboats. A few minutes later, the Crewman A was taken out from the void space.
- 4.6 Shortly afterward, a police launch arrived at scene and sent Crewman A to the Prince of Wales Hospital. However, he was certified dead later in the hospital.

5. Findings and Analysis

- 5.1 At the time of the accident, the Vessel was engaged in the dredging work at west of Mirs Bay Dangerous Goods Anchorage. Such work involved some grab dredgers, tugs and split hopper barges. The Vessel was one of the split hopper barges to transport the dredged sea mud for dumping at a designated dumping area near Ninepin Islands.
- 5.2 It was stated that the deceased had been working onboard the local vessels for more than ten years. He had been employed on board this Vessel for some years. Apparently, he was familiar with the work on board the Vessel.
- 5.3 The electric power of the Vessel was provided by a 3-phase, 3-line 220V diesel generator which was fitted in the machinery room at the port aft of the Vessel. During investigation, a running test was conducted and the line voltage of the generator was found to be about 225V. The diesel generator was equipped with an earth leakage circuit breaker (ELCB) system which provided earth fault protection for the supply of electricity. However, the ELCB system was found inoperable. After the incident, an electrician was employed by the owner of the Vessel to carry out an inspection. He found that a solenoid of the ELCB system was damaged causing the malfunction of the earth-fault protection device. Had the ELCB system functioned properly, the electricity supply would be tripped off if there was an electric fault.
- 5.4 The electrician was the owner of an electrical engineering company. He was the contractor employed by the Vessel's owner to install the diesel generator and the electrical distribution system to the Vessel in 2002. He was also employed to carry out maintenance on the electrical installations of the Vessel. He stated that the earth-fault protection device was functioning properly during last inspection by his company in April 2005.
- 5.5 The schematic diagram of the ELCB system of the diesel generator of the Vessel is shown in Fig. 3. The ELCB is a device to detect the leakage current of the loads of the Vessel. When the leakage current reached the level of 30mA, the ELCB would be activated to energise the solenoid to open the magnetic circuit breaker and cut off the electric supply.

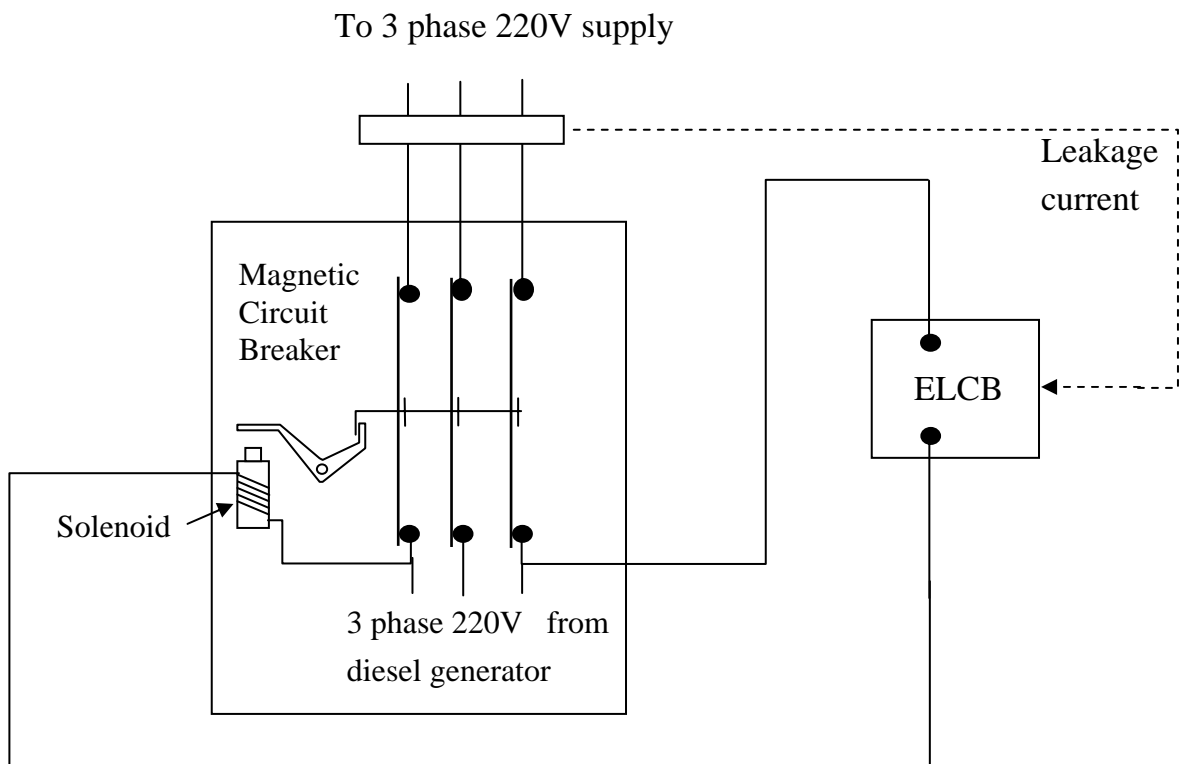


Fig. 3 ELCB System

5.6 The diesel generator supplied electrical power to the lightings and various power sockets of the Vessel. The portable submersible bilge pump took the electrical power from one multi-gang electrical connector in the machinery space via two long extension power cables (Sections B and C) as shown in fig. 4.

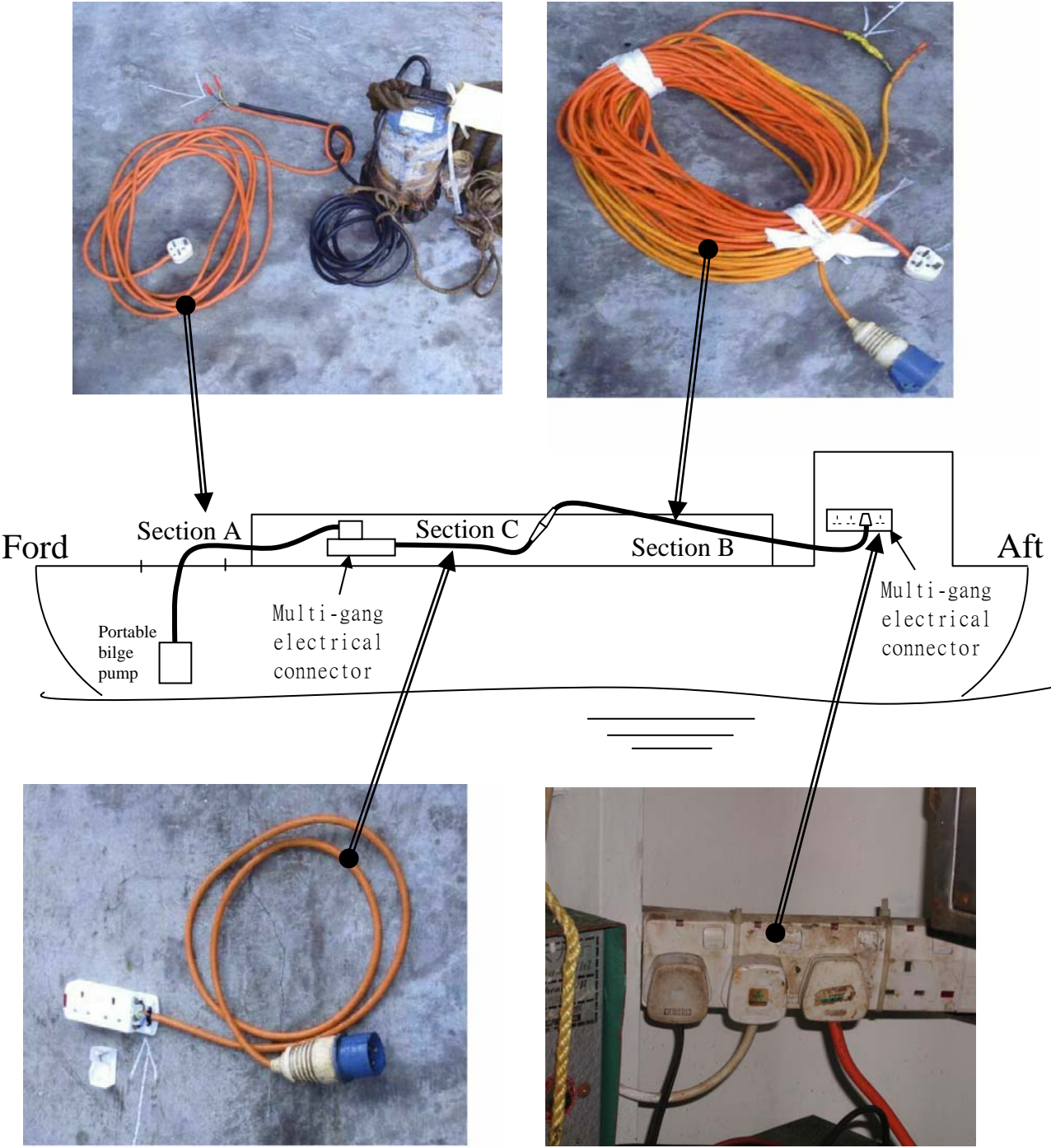


Fig. 4: Cable connections of the portable bilge pump.

5.7 Section A were cables connected to the submersible bilge pump. Section B was a long extension power cable connected to the Vessel's power socket in the machinery space. Section C was a short extension power cable connecting Section A and Section B.

a) The submersible bilge pump and the power cable Section A:

The portable submersible bilge pump was a single compact unit which comprises of a rotary water pump and a single phase motor. The enclosure of the pump and the motor was watertight and made of metal. It was connected with an earthing connection for earth fault protection and the integrity of the pump was found in good working order. The electric cable was a 3-wire rubber shielded cable, namely live, neutral and earth. One end of the 3-wire cable was connected to the electrical terminal of the pump, the other end of the cable was connected to a 13A plug with correct polarity connections.

b) The long extension power cable Section B:

The long extension power cable was a 3-wire rubber shielded cable of about 51.3 m in length. The ends of the cable were connected to a 13A plug and a weather proof socket connector in correct polarity. The 13A plug was plugged to the 13A multi-gang electrical connector in the machinery space while the weather proof socket was connected to weather proof plug connection of the short extension power cable Section C.

c) The short extension power cable Section C:

The short extension power cable was a 3-wire rubber shielded cable of about 1.9 m in length. The ends were connected to a 13A plug and a 13A multi-gang electrical connector. The polarity of the wiring connection at the 13A plug was correct. However, the polarity of the wiring connection at the multi-gang electrical connector was wrong. It was found that the 'Live' and 'Earth' poles were swapped (See fig. 5). Apparently, someone had mistakenly connected the wiring at the multi-gang electrical connector. As such, the enclosure of the submersible bilge pump would become "live" during the operation.

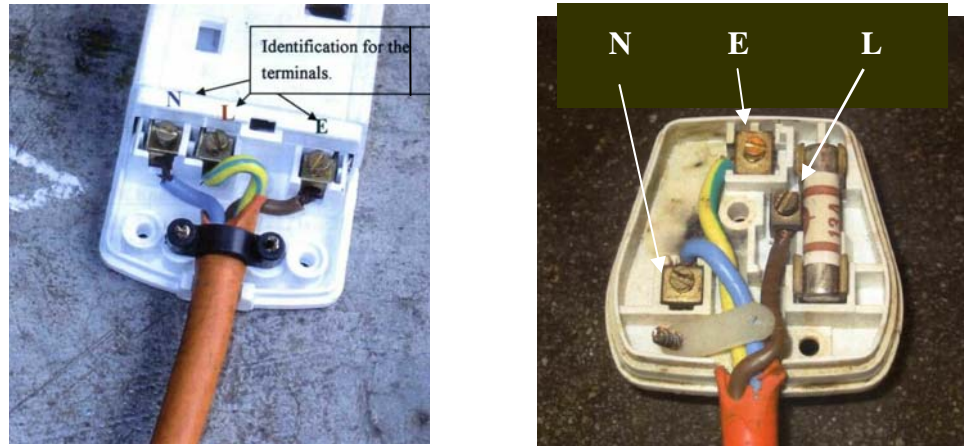
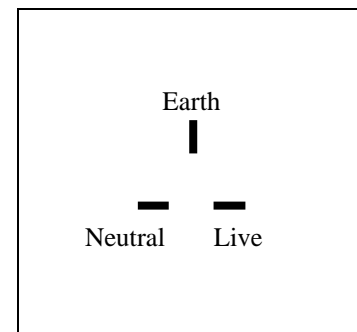


Fig. 5: The wrongly connected extension power cable section C

A trial run was conducted with the above arrangement and the voltage readings at the multi-gang electrical connector of the cable Section C were recorded as follows:

<u>Polarities</u>	<u>Voltage / Volts</u>
Live-Earth	130
Earth-Neutral	225
Neutral-Live	130



The electrical distribution of the Vessel was a 3-phase, three wire 220V system. The system provided 220V phase to phase voltage and 127 V line voltage. Obviously, the Earth and the Neutral connections were connected to the phase voltages source of the diesel generator, while the Live connection was connected to the Earth point of the hull of the Vessel.

- 5.8 Although the submersible bilge pump was provided with a reduced voltage of 130 V, the pump was still able to pump out seawater from the void space. While the Crewman A shifted the submersible bilge pump from section to section inside the void space by his hands, it was possible that he was electrocuted when touching the live pump casing at a voltage of 130V.
- 5.9 Apart from the defects which caused the accident, the extension power cables had not been properly maintained. Following defects were found:

- a) Each wiring of the cables Section A and Section B was connected by twisting individual wire together with the junctions covered by insulation tape. The connections were not sheathed properly and would easily be pulled apart during operations.
- b) Non-weather proof type of 13A plug and multi-gang electrical connector were used. It was unsafe to use them in the open deck areas of the Vessel, as water may get into the equipment.

5.10 The autopsy report of the deceased was compatible with a diagnosis that the cause of the death was appeared to be electrocution.

6. Conclusion

- 6.1 An accident happened onboard the split hopper barge "Geoworks SB-4" on 26 May 2005. While the Vessel was being towed to the marine worksite for loading dredged sea mud, water ingress was found at the port forward void space of the Vessel. The deceased used a portable submersible bilge pump to pump the water out of the void space. In the course of the work, the deceased was electrocuted while handling the pump.
- 6.2 Contributing to the accident was the 3-wire cable in one of the multi-gang electrical connectors for which the 'earth' terminal had been wrongly connected to the 'live' wire. This mistake caused the enclosure of the pump without earthing protection and subject to the live terminal of 130V line voltage. Furthermore, the ELCB system which provided earth fault protection was not in a working condition. As a result, the circuit breaker of the ELCB system was not triggered resulting in the electrocution of the deceased.

7. Recommendations

- 7.1 A copy of this report should be sent to the owner/operator of the Vessel advising them the findings of this incident.
- 7.2 The owner/operator of the Vessel are reminded that:
 - a) Internal connections of extension power cable should be connected in correct polarity. Such work should be done by a competent person.
 - b) Inspection of the electric circuit protection devices such as ELCB system should be conducted periodically by a competent person.
- 7.3 A Marine Department Notice (MDN) should be issued to draw the attentions to all concerned parties the lessons learnt in the incident.

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 the draft report to that person or organization for their comments.
- 8.2 The Chinese translation of the draft report was sent to the Crewman of the Vessel for requesting him to revert with their comments. No submission was received.