

Fatalities resulting from enclosed space entry



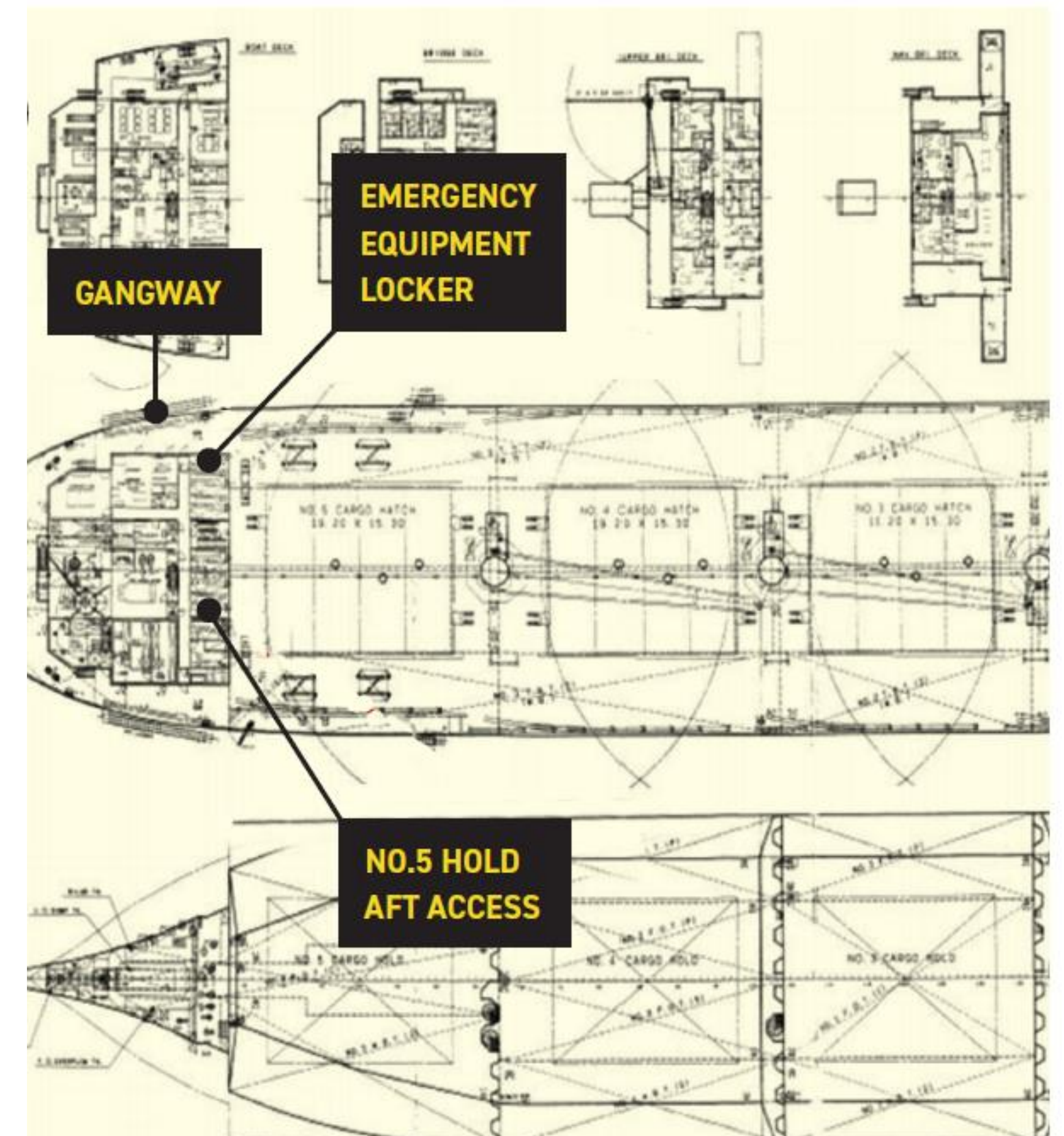
Fatalities resulting from enclosed space entry**BACKGROUND**

- A bulk carrier was loading logs in Port Marsden, New Zealand.
- Before Port Marsden It had loaded logs in its holds at various ports in New Zealand.
- At some of the load ports showers of rain had been observed.
- Hold No. 5 had been loaded full in previous port – two days before.
- Upon loading in Port Marsden the logs were to be fumigated on passage to China.
- Two fumigation officials embarked to carry out a pre-inspection to ensure the ship was compliant for the fumigation.
- They reported to the master that:
 - Hatches 1F to 4F had excessive amounts of water visible, this needed to be removed prior fumigation
 - The rubber seal on hold No. 5 aft access door needed replacing.
- The master discussed the matter with the C/O, after which the C/O went out on deck.

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THE INCIDENT

- On deck the C/O asked the bosun to follow him to hold No. 5
- On their way to the hold, the C/O told the bosun that he wanted to go down into the hold as there was water in it.
- The bosun asked him twice not to go down due to an unpleasant smell
- At the hold entrance they opened the access hatch and the C/O climbed onto the access ladder and descended
- The bosun tried to follow, but after the C/O had descended only 5 or 6 steps down the ladder, he suddenly fell onto the logs below.
- The bosun alerted the crew at the gangway, then made his way to the aft mooring station to get a rope to retrieve the C/O.



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THE INCIDENT (continued)

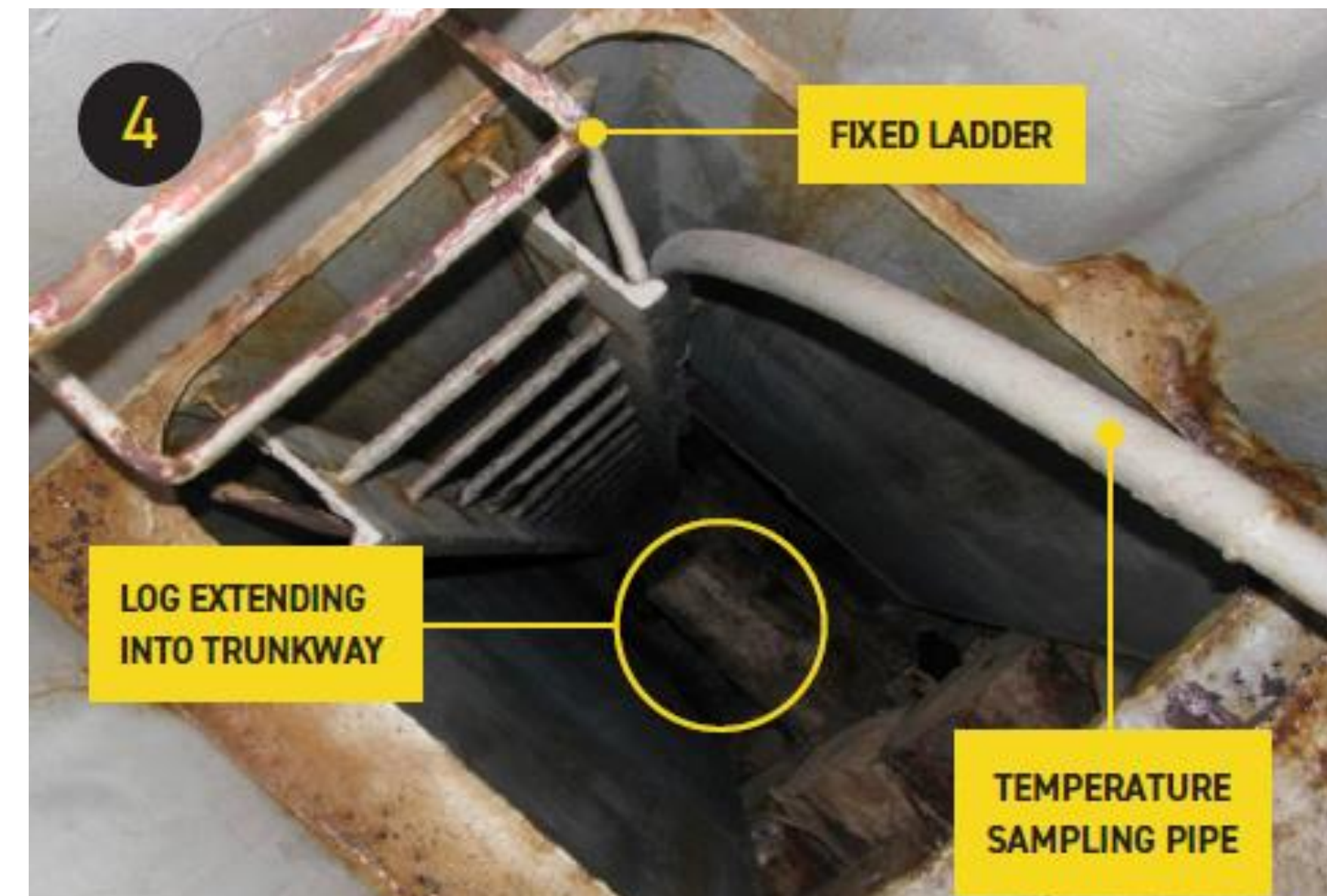
- The second officer (2/O) was at the gangway and alerted the master by radio.
- Afterwards the 2/O fetched a breathing apparatus (BA) set from the emergency equipment locker and oxygen from the ship's hospital.
- An able seaman (AB) ran into the accommodation to alert the third officer (3/O) in the ship's office. The 3/O tried to follow the AB to the incident site, but the AB disappeared from view.
- The 3/O instead went to hold No.4, where he met the master. Both unsure of where the incident had occurred, but then heard on the radio that it was at hold No.5 aft access and proceeded there
- As the bosun returned to the access, he found the AB who had alerted the 3/O, climbing down into the hold with another crew member about to follow.
- The bosun managed to prevent the last crew member from entering, but heard the AB fall. Looking down he noticed him lying, apparently unconscious, on top of the C/O.



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THE INCIDENT (continued)

- The master arrived at the scene and instructed the 3/O to fetch a BA set and instructed the bosun and a crew member to raise the alarm.
- The master then went to the wheelhouse to activate the general alarm.
- On his way he informed the fumigation officials, who called the local emergency services to request an ambulance.
- The 3/O returned and put on the BA set, tied the rescue rope around his waist and entered the hold.
- He was able to tie the rope around the C/O, who was then hauled onto deck.
- The 3/O was too exhausted to attempt to rescue the AB, instead the first engineer (1/E) put on the other BA set and entered the access hatch.
- However, the BA set prevented him manoeuvring past a protruding log so he exited the hold and instead put on an emergency escape breathing device (EEBD) then re-entered.



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THE INCIDENT (continued)

- When he got to the AB, he noticed what he thought were signs of life.
- He took off his EEBD mask and placed it momentarily on the AB to try to revive him.
- He then replaced his mask and attached the rescue rope to the AB, who was hauled onto deck.
- As the 1/E was nearing the top of the access ladder his EEBD ran low on compressed air, and he had to be hauled out. When reaching the upper deck, he was suffering from asphyxia.
- Ambulance staff tried to resuscitate the C/O and the AB, but both were pronounced dead at the scene.
- They also administered oxygen to the 1/E, and he was airlifted to the nearest hospital. However, he was discharged later that day and returned to the ship.



EEBD used during the rescue

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REFLECTIVE LEARNING

The questions below are intended to be used to help review the incident case study either individually or in small groups:

- **What do you think was the immediate cause of the incident?**
- **What other factors do you think contributed to the incident?**
- **What do you think were the barriers that should have prevented this incident from occurring?**
- **Why do you think these barriers might not have been effective on this occasion?**
- **How do your company's procedures define an enclosed space? And what are the minimum precautions to be taken before entering such a space?**
- **What training have you received in entering enclosed spaces? When did you last participate in a drill/training simulating a rescue from an enclosed space?**
- **What is your company's procedure if witnessing a person collapsing while inside an enclosed space?**
- **Is an Emergency Escape Breathing Device (EEBD) appropriate to use for a rescue operation within an enclosed space and why?**

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LESSONS LEARNED

The following lessons learned have been identified based on the available information in the investigation report and are not intended to apportion blame on the individuals or company involved:

- **Testing of the hold atmosphere** – The oxygen level 3 metres down the ladder was revealed to be as low as 3%. This would have only supported useful consciousness for 9 to 12 seconds, rapidly followed by total unconsciousness and death within 5 minutes .
- **Cause of death** – The C/O and the AB died from asphyxia due to oxygen deprivation, which was consistent with the depleted level of oxygen in the cargo hold.
- **Oxygen levels in the cargo hold** – This would have been depleted by organic decomposition of the logs, while toxic gases such as CO, CO₂ and H₂S may also have been present.
- **Safety Management Manual** – This referred to the dangers associated with the cargo and the procedures to be taken if entering an enclosed space but these were not adhered to.
- **Training** – No evidence could be found of any drill or training being performed during the previous 3 months. Regular and effective enclosed space drills and training are key to ensuring awareness and preparedness.

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LESSONS LEARNED

The following lessons learned have been identified based on the available information in the investigation report and are not intended to apportion blame on the individuals or company involved:

- **Human response** – It could not be established what enclosed space training the deceased AB had received, but it is possible that he did not realise that the C/O had lost consciousness due to the atmosphere, as the entrance had been left unattended after the initial incident.
- **Stop Work Authority** – The reason why the experienced C/O ignored the bosun's warnings and entered the hold could not be established, an effective Stop Work Authority program would have supported the bosun.
- **The rescue response** – This was not well coordinated or practised, taking 15 to 20 minutes to remove the bodies from the hold and attempt resuscitation. Given the survival time in the atmosphere, any rescue attempt would have had to have been immediate and efficient.
- **Use of EEBD** – EEBD's are designed only to be used while escaping a hazardous atmosphere and should not be used to enter an oxygen deficient space

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HIERARCHY OF BARRIER CONTROLS

EXAMPLES OF POSSIBLE RISK MITIGATION CONTROL MEASURES RELATED TO THE CASE STUDY

MOST EFFECTIVE	ELIMINATE THE HAZARD		<p>DESIGN allows for remote operation limiting the need to access enclosed space?</p> <p>ADEQUATE NATURAL VENTILATION to ensure the inside atmosphere is safe for entrance at all times.</p>
	SUBSTITUTE THE HAZARD		<p>TESTING ATMOSPHERE to ensure oxygen and gas levels are within the required parameters before entrance.</p>
	ISOLATE THE HAZARD	PHYSICAL CONTROLS/BARRIERS	<p>MECHANICAL VENTILATION to ensure the space can be ventilated before entrance.</p> <p>ATTENDANT at entrance.</p> <p>CONTROLLED ACCESS to space with locked hatches, key control.</p>
	INFLUENCE BEHAVIOURS	ADMINISTRATIVE CONTROLS/BARRIERS	<p>PERMIT TO WORK/PESE, including Job Hazard Analysis, Toolbox Talk. WARNING SIGN on enclosed space entrance. COMMUNICATION system for all parties in place.</p>
	PROTECT	BEHAVIOURAL/SKILL CONTROLS/BARRIERS	<p>TRAINING/DRILLS in enclosed space hazards and rescue.</p> <p>STOP WORK AUTHORITY programme.</p>
LEAST EFFECTIVE		PPE CONTROLS	<p>USE of appropriate PPE (eg. footwear, carry personal multi-gas detector, rescue harness, fall protection, EEBD (for escape), BA set (for rescue operations)).</p>

The suggested barriers/controls above are provided to help generate reflective discussions, and should not be considered as conclusive/definitive or comprehensive for the provided case study. The risk and control measures relating to any similar scenario or activity must always be appropriately assessed based on the specific onboard arrangement and circumstances.

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CONCLUSIONS

This incident appears to be the result of a collective failure of a number of safety processes and barriers, which should have been fully implemented as part of the onboard Safety Management System (SMS).

The apparent disregard of the well-known risks associated with the carriage of logs may point to an ineffective onboard safety culture. Tragically, the scenario where a rescuer succumbs to the same fate as the person being assisted in an enclosed space is all too familiar in the maritime industry.

Both the C/O and AB were experienced seafarers. Why the C/O decided to enter an enclosed space without taking the necessary precautions will remain unanswered. It may be that a delay in the ship's departure (caused by the fumigation officials raising certain problems) may have affected his decision making. However, commercial or operational pressures should never lead to the bypassing of safety critical procedures.

The incidents also highlights the importance of clear communication as there were actually no need for the C/O to go down into the hold No. 5, as this was not one of holds identified by the fumigating officials to have water removed.

Furthermore, drills and training are essential so all crew are familiar with their assigned tasks and responsibilities in case of an emergency. Given the short survival time in an oxygen deficient atmosphere, any rescue attempt need to be started immediately and carried out efficiently – but most important safely!!

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QUESTIONS