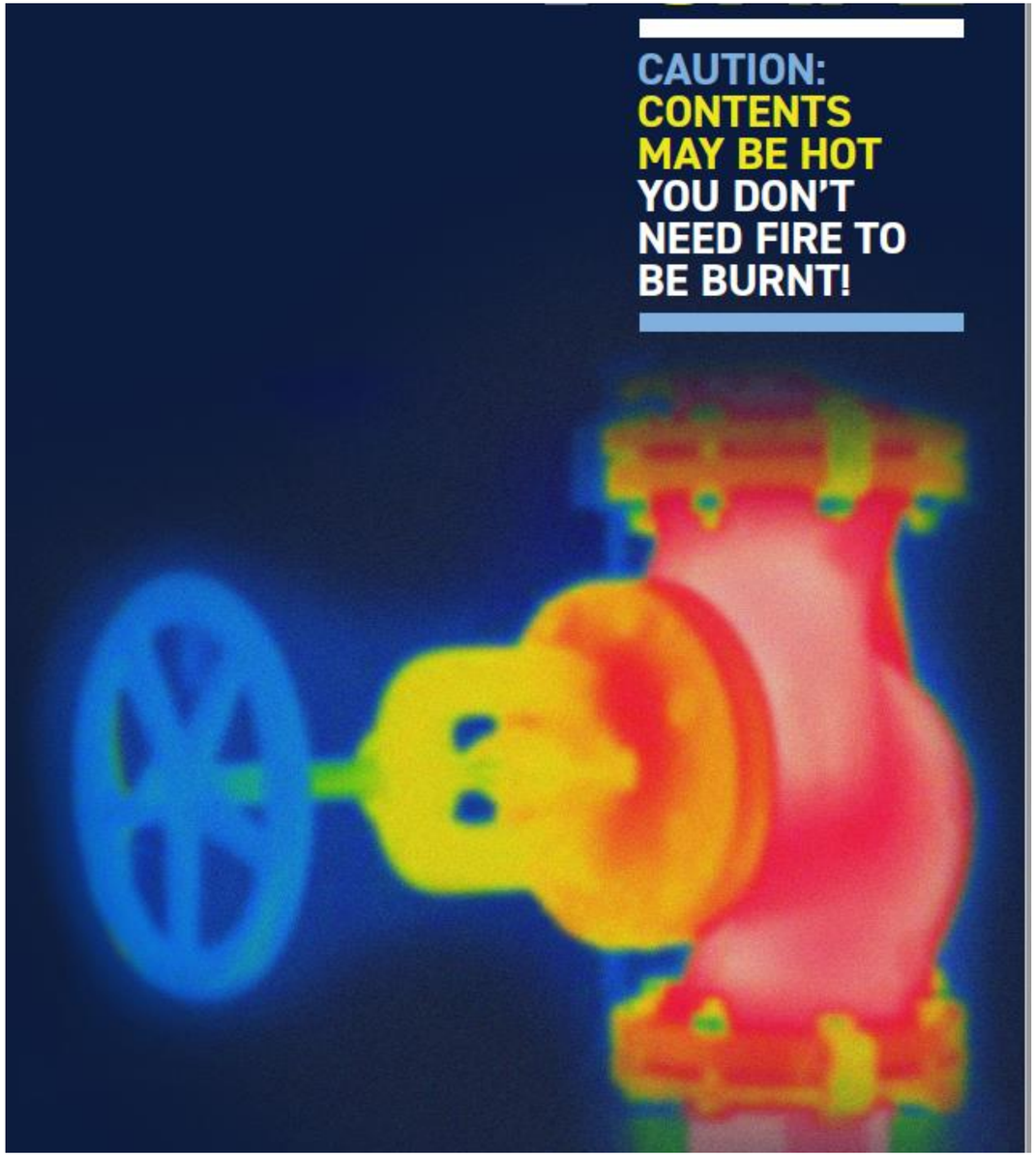
Death of Third Engineer due to burn injuries

BSAFE CASE STUDY



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BACKGROUND

- During transfer of sludge to No. 2 “Waste Oil Settling Tank” (WOS) it was observed that the level gauge of the tank was malfunctioning

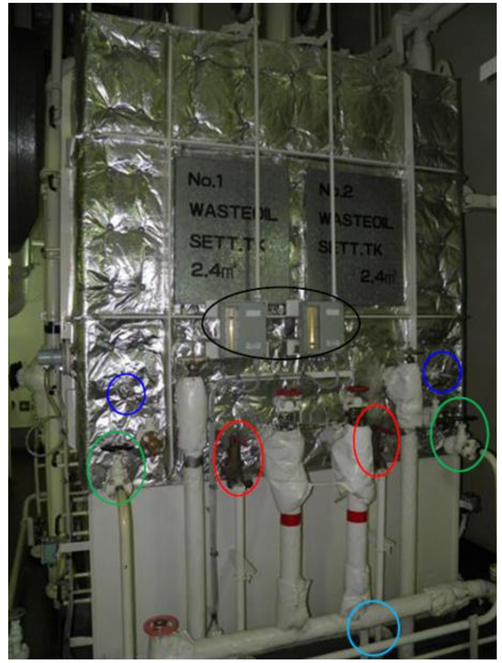
The malfunctioning level gauge
Source: HBMCI

- The Chief Engineer (C/E) decided that the WOS should be cleaned the next day and the level indicator to be repaired

- The C/E prepared a “Job Hazard Analysis” (JHA) for the tank cleaning operation in accordance with the ship’s Safety Management System Manual, and the 2/E, assisted by the 3/E was assigned to the job

DRAINING THE TANK

- The 2/E opened the WOS drain valve to drain off the sludge by gravity to the “Bilge Separator Oil Tank” (BSO tank) for about 10 minutes
- To confirm it was empty, the 3/E tried to turn the wire wheel of the scale reduction device on the top of the WOS and reported it was working
- Lastly, the 2/E opened the self-closing water drain valve, where Only a small quantity was observed before stopping
- Based on above the 2/E concluded that the WOS was empty



Blue: thermometer
Green: drain to BSO Tank
Red: self-closing valves
Light Blue: scupper
Black: level gauges
Source: HBMCI

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THE ACCIDENT

- Using a small folding ladder the 3/E started removing the manhole cover which was located about two metres above the floorplates
- Using an air impact wrench he removed most of the nuts from the manhole apart from four
- He loosened the last 4 bolts by a half turn. As no oil leakage from the was observed, he loosened the remaining nuts further
- Without removing the nuts, he pulled the cover which detached from the seat
- This resulted in hot oil of approx. 86°C splashing from the manhole bottom onto the 3/E

The manhole located two meters from the floor
Source: HBMCI

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BSAFE CASE STUDY

THE ACCIDENT

- The 2/E, managed to pull away the 3/E and remove his coverall which was soaked with the hot oil
- The 3/E was brought the ship's hospital where it was observed that he had sustained serious burns to various areas of his body and applicable first aid was initiated
- The Master reported the incident to the company and the local agent to request a medevac of the 3/E
- Two hours after the incident a helicopter arrived to bring the 3/E to the hospital
- Though appearing fine and able to board the helicopter himself the 3/E died 12 days later at the hospital due to septic shock

REFLECTIVE LEARNING

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

- **What do you believe was the immediate cause of the accident?**
- **What other factors do you think contributed to the accident?**
- **What do you believe were the barriers that should have prevented this accident from occurring?**
- **Why do you think these barriers might not have been effective on this occasion?**

REFLECTIVE LEARNING

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

- **How do you ensure that these barriers are effective on your ship?**
- **Does your company require you to conduct a toolbox talk, or another short meeting to talk through the job instructions and risk assessments. If so, when does the talk take place?**
- **Does your Company have a Stop Work Authority program, or a similar requirement to stop work in case of an unsafe condition or behaviour? If so, who has this authority?**
- **What precautionary measures are included in your company's procedure for draining and opening tanks to ensure that it is conducted safely?**

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:

- **Lack of proper Job Hazard Analysis (JHA) –** Not identifying the potential hazards related to the unknown quantity of hot sludge remaining in the tank due to the malfunctioning level gauge
- **Making assumptions –** Despite the experience and professional knowledge of the involved they assumed the tank was empty which lead to an unexpected hazard exposure and injury
- **Confirmation bias –** Meaning to favour information that confirms one's previously existing beliefs. This can be avoided by personally challenging oneself to take a minute and think about the job at hand – to consider what can go wrong and how, and what steps one can personally take to minimize the risk
- **Taking shortcuts –** Though this may be appealing, it can lead to undesirable outcomes. Measuring the quantity of the BSO Tank could have helped identify that it was not safe to open the manhole cover of the WOS

LESSONS LEARNED (Continued)

- **Planned Maintenance System (PMS) –** This did not address the foreseeable jamming of the level gauges with sludge oil. The provision of an appropriate and regular regime for cleaning the tank would have helped avoid the need for this unplanned and hazardous task

- **Sounding pipe –** The tank was not fitted with a sounding pipe as an alternative means when the level gauge malfunctioned. Although not a requirement, this would have allowed the two engineers to verify the contents of the tank

- **Protective clothing –** The 3/E was wearing a common cotton coverall. This provides only limited protection against the penetration of hot liquid and transfer of heat to the skin. The investigation identified that an ISO 11612 compliant coverall could have possibly provided better protection to the 3/E

- **Toolbox talk** – A short meeting with the involved personnel discussing the findings of the JHA prior to opening the manhole could have further helped to identify the hazards and necessary precautions to prevent the accident from occurring

- **Temperature of the sludge oil** – Although the heating of the tank had been closed, the adjacent tank was continually heated. As a result, the content were indirectly heated to about 86˚C through conduction

LESSONS LEARNED (Continued)

- **Stop Work –** A successful Stop Work Authority (SWA) program could enable the crew to use their authority to stop work in case of an apparent unsafe condition or behaviour and prevented this accident

- **Safe practices for the opening of the manhole –** The common practice identified in the investigation report to safely remove this type of manhole cover is to:
  - -Remove all nuts except four crosswise;
  - -Slightly loosen the four nuts by no more than ½ turn;
  - -Tighten the jackscrews to detach the cover from the seat;

If a leakage is observed, the cover may be easily secured back by loosening the jackscrews and re- tightening the nuts

If no leakage is observed, loosen the nuts another ½ turn and tighten the jackscrews

If there is still no leakage, continue to loosen the four crosswise nuts and remove the cover

The manhole cover of the tank and the two jackscrews fitted on the top and bottom side.
Source: HBMCI

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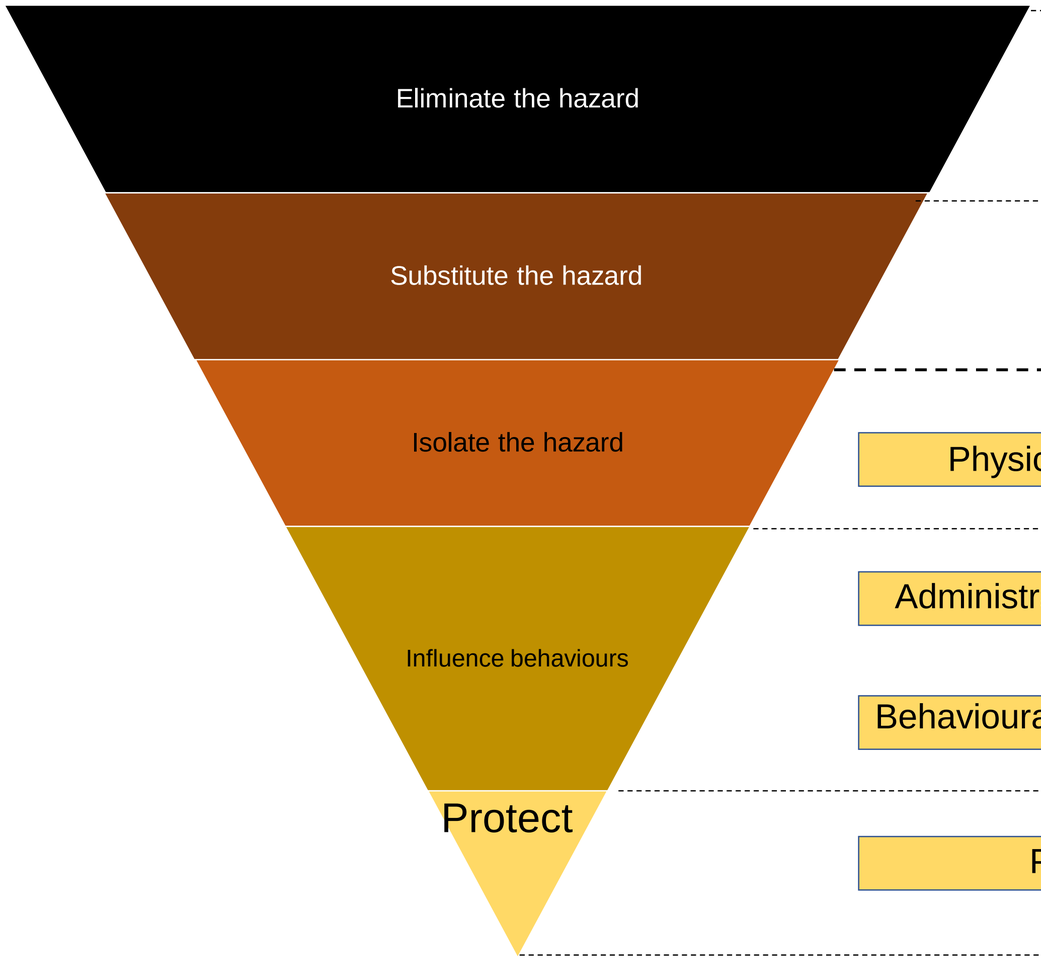
BSAFE CASE STUDY

Hierarchy of Barrier Controls

Most effective



Least effective

Physical controls/barriers

Administrative controls/barriers

Behavioural/Skill controls/barriers

PPE controls

Examples of possible risk mitigation control measures related to the case study

Investigate the correct temperature to avoid excessive heating of the sludge?

Implement a PMS requirement for periodic cleaning of the WOS tanks to avoid the jamming of level gauges

Provision of a sounding pipe to provide a safer means of verifying the tank contents?

Possible provision of insulation between the two tanks to reduce the heating of the sludge through conduction?

SMS/structured pre-work assessment of system safety

Effective Manhole opening procedures

Job Hazard Analysis (JHA)

Toolbox Talk

Means of avoiding confirmation bias, complacency?

Implementation of a Stop Work system?

Use of heat/flame protective clothing during operations with burn injury hazards

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.

CONCLUSION

This fatality is a tragic example of how a chain of contributory factors in combination can lead to an accident.

If the hazards had been correctly identified and the appropriate risk controls had been in place, the tragic death of the 3/E could have been prevented.

It is worth mentioning that a lack of experience was not a factor: all of the Engineers involved were experienced marine professionals. However this did not prevent them from making assumptions with regard to the safety of the work environment.

Assumptions that turned out to be fatal.

QUESTIONS?