BSAFE

INCIDENT CASE STUDY

No.29 | NOVEMBER 2025

BENZENE VAPOUR FATALITY FOLLOWING UNAUTHORISED TANK ENTRY

ON 20 JANUARY 2024, WHILE A SHIP WAS UNDERWAY AFTER DISCHARGING BENZENE, A CREW MEMBER ENTERED A CARGO TANK BEFORE ENCLOSED-SPACE ENTRY PROCEDURES HAD BEEN AUTHORISED AND BEFORE CONFIRMING THE ATMOSPHERE WAS SAFE. HE WAS LATER FOUND COLLAPSED AT THE BOTTOM OF THE TANK AND, DESPITE RESCUE EFFORTS, DID NOT SURVIVE. THE INVESTIGATION REPORT CONCLUDED WITH THE PRESUMPTION THAT RESIDUAL BENZENE VAPOURS AND OXYGEN-DEFICIENT ATMOSPHERE WITHIN THE TANK WERE THE PRIMARY FACTORS LEADING TO HIS RAPID INCAPACITATION AND SUBSEQUENT FATALITY.

FIGURE 1 PHOTO OF SHIP
SOURCE KMST MSI REPORT 2024-002

INCIDENT OVERVIEW

BACKGROUND OF SHIP AND VOYAGE DETAILS

An 8,270 gt oil/chemical tanker had discharged benzene on its previous voyage and was proceeding in ballast towards Korea to load its next nominated cargo. The ship had completed discharge at Jiangyin, China and departed for Yeosu, Korea. The planned sequence between voyages included a full cycle of gas freeing and cleaning of cargo tanks in preparation for the next chemical cargo.

The final part of the cleaning process required physical tank entry to conduct manual wiping or "mopping", of any residual wash water. As is standard, tank entry required an enclosed space entry permit to be issued by the master. This company's policy was to mark the hatch cover of the space to show that a permit had been issued, and it was now safe for entry.

Some of the cargo tanks had previously carried benzene. Although the tanks had been rinsed and ventilated for gas freeing, residue benzene vapours remained a serious hazard. Benzene is highly volatile and toxic; in a confined or poorly ventilated environment, inhalation can rapidly cause dizziness, incapacitation, collapse, respiratory failure or fatal exposure.

The ship had a multinational crew, with personnel from Korea, Indonesia, and Myanmar.

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WHAT HAPPENED

On the morning of the incident, the ship was several hours into the passage. Preparations were underway for the "mopping" stage of tank cleaning. This stage typically occurs only after gas freeing has progressed sufficiently and the tank atmosphere has been gas tested and verified safe.

At around 1010 hrs the chief officer (C/O) instructed four deck ratings (bosun, able seaman, and two ordinary seamen) to bring mops and rags to the main deck in preparation for mopping operations which were planned to take place inside the washed cargo tanks. At this point, the "enclosed space entry permit" process had not yet been initiated, and no confirmation had been made that the tank atmosphere was safe. It is understood that the C/O had noted a strong smell of cargo residue from within the cargo tanks at deck level, and had therefore felt it unnecessary to test the atmosphere as it was clearly still unsafe.

Shortly afterwards, one of the ordinary seamen (OS) appears to have acted ahead of the authorised sequence. They entered the cargo tank through an open hatch, before the atmosphere had been tested and confirmed safe. It was later discovered that they were not carrying a portable multi-gas detector and was instead wearing a filter-type mask, presumably as "protection". The filter-type mask worn offered no protection in an oxygen-deficient space and could not protect against residual benzene or other toxic vapours that might still linger inside the tank.

Around 1035 hrs, the bosun, who was walking across the deck, looked down into cargo tank 10 Port. Seeing the OS lying collapsed on the tank bottom, the bosun immediately raised the alarm. The bridge informed the master, and shipboard emergency response commenced.

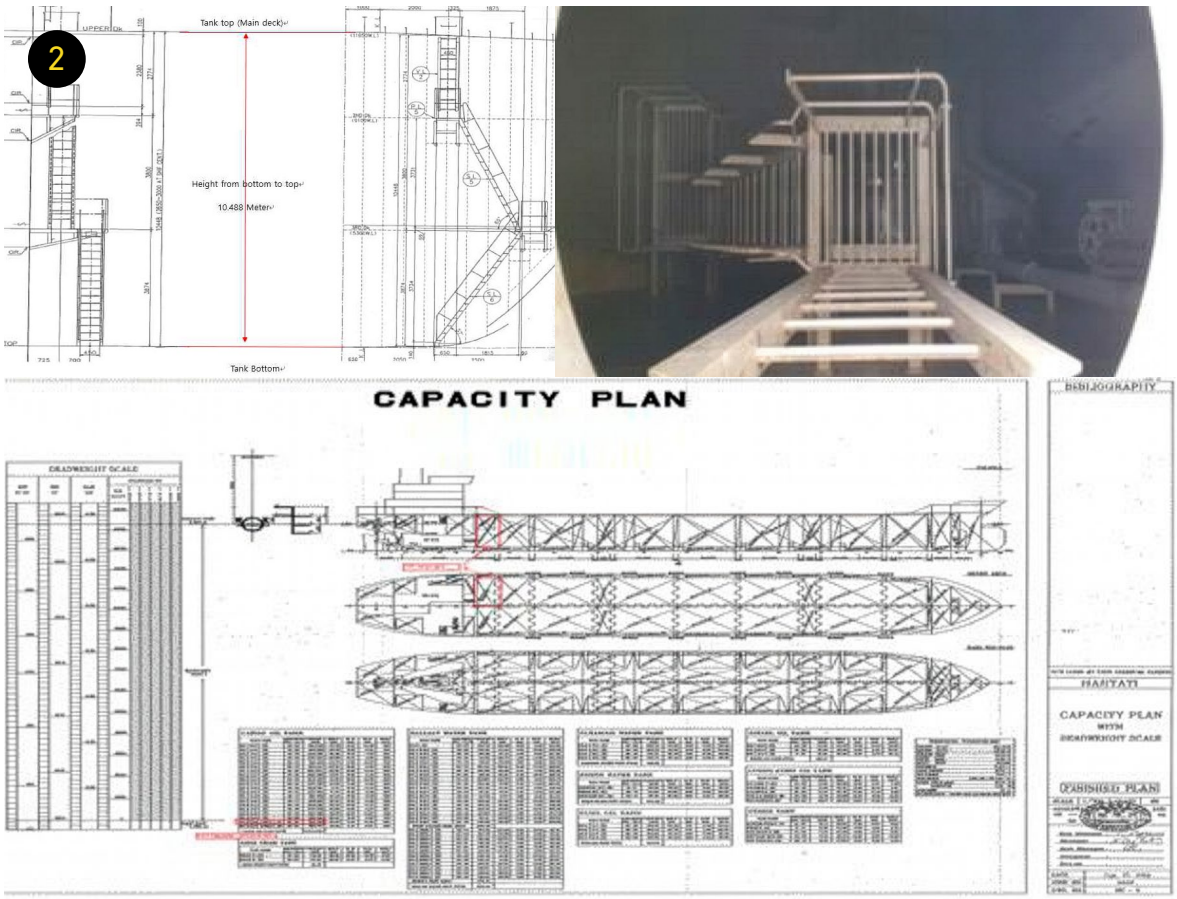

FIGURE 2 HATCH AND LOCATION OF CARGO TANK
SOURCE KMST MSI REPORT 2024-002

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The C/O and second officer donned Self Contained Breathing Apparatus (SCBA) and entered the tank to recover the OS. They fitted the OS with an Emergency Escape Breathing Device (EEBD) but he remained unresponsive. The OS was brought up to deck level on a stretcher and CPR was initiated, with medical support sought from the shore rescue authorities. Despite prolonged resuscitation efforts, the OS did not regain consciousness and was later declared deceased upon hand-over ashore.

The subsequent autopsy identified traumatic injury consistent with a fall onto a hard surface, including cervical spinal fracture – meaning the atmosphere incapacitated the OS before they had reached the bottom. Benzene was detected in the OS's cardiovascular system. Based on this, and the fact that the tank bottom was only accessible by ladder, it was determined that the OS had entered the tank of their own volition, inhaled residual benzene vapours, collapsed inside the tank and fell, sustaining fatal injury. The tank atmosphere had not been tested and confirmed safe prior to entry, and the filter-type mask worn by the OS was not suitable or approved for protection against benzene vapours or oxygen-deficient atmospheres.

This event developed rapidly and at a point where the tank had not yet been formally cleared for entry. Until an enclosed space permit is issued, a cargo tank must be treated as hazardous, regardless of whether the hatch is open, a fan is running, or the tank has been recently washed.

FIGURE 3 TYPICAL CARGO TANK ENTRANCE HATCH OF TANKER

The purpose of the permit process is to confirm, through measured data and recorded gas testing, that it is safe to proceed. Tanks may look harmless from above yet can still harbour atmospheres that can quickly incapacitate or kill without warning. Therefore, visual appearance from the deck level cannot be relied upon; the atmosphere within a tank can remain dangerous even when it seems inactive or benign.

CONTACT

For more information on this incident email losprevention@tindallriley.com

THIS CASE STUDY IS DRAWN FROM KOREA MARITIME SAFETY TRIBUNAL MARINE SAFETY INVESTIGATION REPORT - OIL/CHEMICAL TANKER *KOREA CHEMI* - FATALITY OF A CREWMEMBER. MSI REPORT 2024-002: https://www.kmst.go.kr/eng/board.do?menuIdx=229&bbsIdx=100538

BRITANNIA COMMENTARY ON INCIDENT ON NEXT PAGE

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BRITANNIA COMMENTARY ON INCIDENT

ORGANISATIONAL CONTROLS - ENCLOSED SPACE PERMIT

In this case, a fundamental control barrier was bypassed: tank entry commenced before the enclosed space entry permit system had been formally initiated.

The entire protective architecture and other layers (gas measurement, authorisation, PPE verification, standby watch, continuous communication, SCBA presence, rescue readiness) only becomes active and accountable once the enclosed space entry permit has been opened.

There was no intent to circumvent procedure; rather, there appears to have been an assumption that conditions were already suitable to proceed. However, assumption is not a control measure. Procedural discipline and correct sequencing remain critical safeguards.

The OS did not wait for the formal authorisation sequence, and the C/O had not yet transitioned the operation from "preparing equipment on deck" to "safe to enter". Between those two phases lies the single most consequential barrier in enclosed space safety.

The OS had been onboard for approximately eight months – long enough to be familiar with the ship's routines, layout and operations. However, extended familiarity can sometimes introduce a cognitive "normalisation" risk, where hazards appear less threatening over time because they are encountered frequently.

Also, the C/O had identified that the odour remained strong and had already decided that entry was not yet safe but did not report this to the Master, nor did he halt the forward momentum of preparations, potentially further creating ambiguity around "readiness status".

As an additional layer of protection, physical barriers or temporary guards over hatches may be considered to prevent premature access to spaces that have not yet been declared safe for entry. This simple measure reinforces the procedural status of the space, reduces ambiguity, and provides an immediate physical reminder that the tank remains "closed", and reduces the likelihood of someone stepping into a tank "just to check" or to prepare equipment before controls are fully in place.

GAS TESTING DISCIPLINE – BY EQUIPMENT, NOT BY NOSE

In the hours leading up to the incident, a "strong" odour was reported. Reliance on smell is fundamentally unreliable; the human nose desensitises quickly to certain smells, and many dangerous vapours are either odourless or only detectable by smell at concentrations already above hazardous limits.

Atmospheric acceptance criteria are quantitative and instrument-based for a reason. "Smells strong" or "smells acceptable" are not tests.

Tank atmospheres cannot be safely assessed by intuition, visual checks, open hatches, or ventilation alone. Even recently washed tanks may still contain vapour pockets or oxygen-deficient zones. Entry conditions must therefore be verified using calibrated instruments, with readings recorded and compared against defined tolerances, before anyone enters the space.

Also, reagent tubes or type-specific gas detectors should be used where applicable. It is important that tests are conducted for the specific hazards present – in this case, benzene – so that the analysis reflects the actual risk rather than a general hydrocarbon test. Selecting the right detection method is part of ensuring atmosphere testing is meaningful, not merely procedural.

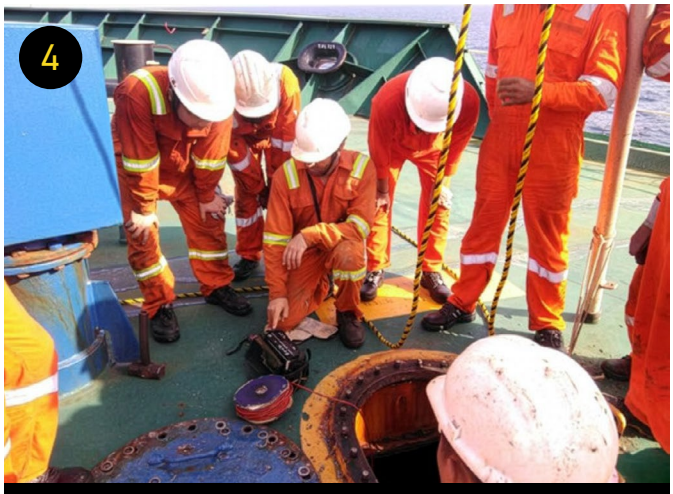

FIGURE 4 REGULAR TRAINING IN TANK ATMOSPHERE TESTING IS RECOMMENDED

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BRITANNIA COMMENTARY ON INCIDENT

PPE LIMITATIONS

Filter-type masks, regardless of branding, are not appropriate respiratory protection for cargo tank entry. They cannot supply oxygen, nor can they reliably protect against unknown or mixed toxic vapours that may be present in an enclosed space.

On many tankers, there can sometimes be a cultural tendency to treat filter masks as an "extra layer" of protection. In practice, this creates risk because the user may believe they are protected when they are not.

For enclosed space entry into cargo tanks, respiratory protection must be SCBA, or equivalent approved breathing apparatus as specified in the ship's SMS. However, PPE cannot replace or compensate for, the formal enclosed space entry process.

EMERGENCY RESPONSE & RESCUE READINESS

It is positive that no crew member attempted an immediate rescue without respiratory protection — a common cause of secondary casualties during enclosed-space incidents. The C/O and 2/O correctly donned SCBAs before entering the space which demonstrated adherence to training and an understanding of the risks involved.

However, the OS was fitted with an EEBD, which is designed for self-escape rather than rescuing an unconscious casualty. This reflects a common misunderstanding on many ships and highlights the need for periodic refresher drills on the correct sequence and selection of rescue equipment during enclosed-space and other emergencies.

Shore notification also appears to have been initiated promptly once the casualty was brought on deck, and the ship subsequently deviated to port upon the coast guard's instruction.

CLARITY OF SMS & MULTILINGUAL UNDERSTANDING

The official investigation recommended that the company provide translated versions of the SMS and P&A Manual so that all crewmembers – especially those for whom English is not a first language – can fully understand the requirements. For high-risk tasks such as enclosed space entry, clear and easy-to-understand language is an essential safety control measure.

If procedures are misunderstood or only partly understood, this can weaken compliance, particularly during handovers or when work deviates from the usual routine. Providing key SMS sections in languages familiar to the crew helps reduce the risk of errors and supports safer operations on board.

SAFETY CULTURE – SUPERVISION AND COMMAND

Informal "go-ahead" assumptions often develop in repeat tasks. However, enclosed space status only changes when the C/O and Master authorise it.

Fatigue, routine familiarity, or the desire to "prepare work early" can push seafarers across a boundary they rationally know should not be crossed. Crucially, personal experience does not take the place of procedural discipline and should never be used as justification to bypass it.

Supervisors must actively manage the critical transition between preparing equipment on deck and authorising entry from the moment a task moves from preparation to execution. This is where safety culture is visible in real time: in the decision on when it becomes formally safe to enter.

Especially in a high-risk environment, proactive supervision should not be viewed negatively as micro-management but rather recognised and embraced as an important layer of protection. It is the mechanism that keeps critical authorisation barriers intact and safeguards the crew. A strong safety culture should empower every individual to speak up confidently whenever there are concerns about their own safety or that of others.

REFLECTIVE LEARNING MATERIAL ON NEXT PAGE

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REFLECTIVE LEARNING MATERIAL - BENZENE VAPOUR FATALITY FOLLOWING UNAUTHORISED TANK ENTRY

THE QUESTIONS BELOW WILL HELP YOU TO REVIEW THE INCIDENT CASE STUDY EITHER INDIVIDUALLY OR IN SMALL GROUPS. IF POSSIBLE, DISCUSS YOUR CONCLUSIONS WITH OTHERS, AS THIS IS AN EFFECTIVE WAY OF THINKING ABOUT THE ISSUES IN MORE DEPTH.

PLEASE USE THE INFORMATION PROVIDED IN THE CASE STUDY TOGETHER WITH YOUR OWN EXPERIENCES AND THOUGHTS, TO REFLECT ON THE INCIDENT AND HOW THE ISSUES IDENTIFIED MIGHT RELATE TO YOUR OWN SITUATION.

WHAT DO YOU BELIEVE WAS THE IMMEDIATE CAUSE OF THE INCIDENT?

WHAT OTHER FACTORS DO YOU THINK CONTRIBUTED TO THE INCIDENT?

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WHAT DO YOU BELIEVE WERE THE BARRIERS THAT SHOULD HAVE PREVENTED THE INCIDENT FROM OCCURRING?

WHY DO YOU THINK THESE BARRIERS MIGHT NOT HAVE BEEN EFFECTIVE ON THIS OCCASION?

HOW OFTEN DO YOU PERSONALLY VALIDATE THAT GAS TEST RESULTS ARE RECORDED BEFORE ENTRY IS PERMITTED?

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WAS THE DISTINCTION CLEAR BETWEEN "PREPARING EQUIPMENT ON DECK" AND "ENTERING A TANK TO BEGIN WORK"?

WHAT WOULD YOU HAVE DONE DIFFERENTLY AS C/O WHEN YOU FIRST SMELLED THE STRONG ODOUR DURING GAS FREEING?

HOW DOES YOUR SHIP REINFORCE THAT "PERMIT TO WORK" IS NOT A PAPER FORM — BUT A SAFETY BARRIER?

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ARE YOU FAMILIAR WITH YOUR COMPANY'S SMS PROCEDURES FOR ENCLOSED SPACE ENTRY?

NOTES