
Working on energised systems (steam injuries)

1. Purpose

- 1.1. This Safety Alert is issued by the Bahamas Maritime Authority to raise awareness of the hazards associated with work on or near hot water and steam systems. It aims to highlight the importance of understanding the properties of heated water and steam and that even when the systems are isolated, stored energy can cause injury.

2. Introduction

- 2.1. The Bahamas Fleet recently experienced two steam related casualties including one where a member of the crew required hospitalisation. Both cases highlight learning opportunities to be shared across the wider fleet.

3. CASE 1 – The engine room day team were tasked to rectify a leak on the #1 Exhaust Gas Boiler circulation pump. The plan was to replace the circulation pump entirely with a spare pump and repair it in a controlled environment.

- 3.1. In preparation for the task, the second engineer completed the 'works requiring lockout and tagout' checklist which included a preparation and risk analysis as per the company's safety management system. The second engineer stopped the EGB circulation pump, switched off the main breaker, and closed the suction and delivery valves for the pump. The staff chief engineer countersigned the checklist at 09:50, authorising the work to begin.
- 3.2. Around 10:30, a 1st repairman removed insulation from the delivery side flange and began slackening the bolts. Another 1st repairman began slackening bolts on the suction side flange. There was no water or steam draining so they continued slackening the bolts simultaneously until the flange faces were unsealed, which effectively vented the system.
- 3.3. There was a quick release of hot water and steam from the delivery side flange, coming into contact with the 1st repairman. He quickly vacated the area and proceeded to receive treatment. He experienced ruptured blisters and areas of redness on his right upper arm/hand along with other areas of redness and tenderness across his right leg and chest.

4. **CASE 2** – Whilst in port, weld repairs were to be completed to an Exhaust Gas Economiser (EGE) tube by an external contractor. The EGE was isolated from the boiler steam system, seven days prior to repairs. Details were recorded in the 'Lockout and Tagout' records. During the period of isolation, the vessel maintained steam generation using oil fired boilers and EGE connected to the common steam and water circulating system. There was a requirement to install two steel bolted blanking plate to facilitate isolation of EGE as the outlet stop valve and non-return was passing. The EGE pressure gauge indicated no residual pressure and no discharge from the drain valve when opened.
- 4.1. On completion of the repairs, an engineer and fitter were required to reinstall the outlet and a non-return valve to the EGE for connection to steam generating system. This required removal of the blanking plates. To complete the work, the engineer was required to work at an elevated height and in a constrained position.
- 4.2. While the engineer was slackening bolts, he observed steam/water emitting from sealing face between blanking plate and system pipework. He retightened the bolts, checked isolation valve and opened the drain valve. There was no evidence of steam or water from the drain valve, and isolating valve handwheel was checked for closure using a handwheel spanner.
- 4.3. He returned to elevated position and started to unbolt the blanking plate when there was a rapid release of steam. Due to the constraints of the working position, the engineer unable to move away. The engineer sustained severe scalding injuries, blistering to upper torso, shoulders, buttocks, and legs and was airlifted to hospital.

5. General Guidance

- 5.1. Stored heat or specific heat capacity is the energy required to raise a given quantity of a substance by one degree. Water (H₂O) has a high specific heat capacity, so it heats and cools slowly and can retain substantial thermal energy.
- 5.2. Mechanical or electrical isolation does not remove stored heat from hot-water or steam systems. Cooling time varies and may require longer work windows or alternative maintenance methods.
- 5.3. These systems are usually fitted with methods of draining, isolation, and venting. Each method performed alone may not make the system safe to work on.
- 5.4. Valves can indicate they are closed but may have internal leaks allowing passage, drains can initially appear to be working as intended but later become blocked, giving a false impression the system section has completed draining. Venting is only as effective as the location in the system where the venting takes place.

- 5.5. Operators and managers should consider which combination of factors may be required to best protect personnel who are required to complete work on systems while still technically energised.
- 5.6. In Case 1, pressure gauges read zero, a drain at a lower point in the system was opened, valves to the pump were closed but the system was not vented until the delivery side flanges were released, hence the release.
- 5.7. In Case 2, the system had been isolated for seven days, and it was unknown that the drain valve associated with the isolated pipework section leading to the blanking flange was restricted, preventing a reliable means to confirm a non-hazardous condition was present.

6. Precautions on opening systems

- 6.1. When preparing to work on a pressurised water and steam system, precautions need to be taken into consideration.
- Hot water and steam systems can remain hazardous long after isolation. They should be considered live and energised, until proven otherwise.
 - Isolated condensed steam will have stored energy which can remain at an elevated temperature to flash back into steam when released to atmospheric pressure. At its boiling point, 1 litre of water expands to about 1,600 litres of steam.
 - Steam can remain trapped in dead-end sections of pipes, between closed valves or blank flanges and etc. Do not accept that pipework, pressure vessels, and equipment connected to a steam generation system is non-hazardous as result of it being switched off, even when valves are closed and vents are open.
 - When working on pipework, equipment, or pressure vessels, double valve isolation is the best protection. The isolated section needs to have the capability to be drained, vented and purged.
 - Where double valve isolation is not possible, incorporate blanking flanges. Before removing blanking flanges, verify that worker will not be exposed to hazards during disassembly.
 - Pressure gauges reading zero does not mean the system is completely empty.
 - Lockout tagout/drainage/mechanical and physical barriers should be verified before starting of work. Confirm that changing conditions or prolonged isolation have not made the system hazardous.
 - When planning the work, consider constraints for access, including obstruction and working at height. Ensure personnel have an effective means of escape if changing conditions expose them to a hazard.

7. Further reading

- 7.1. There are numerous marine safety investigation reports addressing steam-system work and related injuries. The following is a non-exhaustive list.

Wisdom Venture (2025) Hong Kong (ATSB Report)

The engineering team on board an oil tanker began maintenance on the main deck steam valve for the cargo heating system which was leaking from the bonnet joint gasket. The system was isolated and during removal of the valve bonnet residual hot condensate was released injuring three crew members.

See: www.atsb.gov.au/sites/default/files/2025-09/Final%20report%20MO-2025-004.pdf

Nieuw Amsterdam (2024) Netherlands

A third engineer and motorman were conducting routine maintenance on the sewage system when an expansion joint located in the compartment ruptured and filled the space with steam. The rate at which the room filled with steam prevented the two crew members from escaping. They did not survive their injuries.

See: <https://onderzoeksraad.nl/wp-content/uploads/2025/10/Fatal-accident-after-rupture-of-expansion-joint-in-steam-pipe.pdf>

Constellation (2024) Bahamas

On board an LPG tanker, a fitter, motorman, and wiper were assigned the task of removing the furnace drainpipe on an auxiliary boiler. While carrying out the work, the fitter opened an adjacent handhole cover believing it was connected to the furnace drainpipe, but it instead accessed the water side of the boiler. This exposed the fitter to steam and hot water resulting in him suffering fatal burns.

See: www.bahamasmaritime.com/wp-content/uploads/2025/01/MSI-Report-Constellation-Steam-release.pdf

MT Chemical Tanker (2024) Malta

On board an oil tanker, the crew were preparing to clean and steam the empty cargo tanks. While a crew member was in the ballast pumproom, a steam inlet valve ruptured engulfing him in steam. He suffered second degree burns and died two weeks after the casualty.

See: https://msiu.gov.mt/wp-content/uploads/2025/01/MT-Chemical-Hunter_Final-Safety-Investigation-Report.pdf

Navigator of the Seas (2020) Bahamas

Crew onboard a passenger ship prepared to inspect and carry out maintenance on a feedwater tank. While three crew members were inside the tank, there was a sudden release of steam. Two crew members received significant burns and one died.

See: www.bahamasmaritime.com/wp-content/uploads/2022/09/Navigator-of-the-Seas-MSI-Report-final.pdf

8. Validity

- 8.1. This Safety Alert is valid until further notice.