



SAFETY INVESTIGATION REPORT

202401/035

REPORT NO.: 02/2025

January 2025

The Merchant Shipping (Accident and Incident Safety Investigation) Regulations, 2011 prescribe that the sole objective of marine safety investigations carried out in accordance with the regulations, including analysis, conclusions, and recommendations, which either result from them or are part of the process thereof, shall be the prevention of future marine accidents and incidents through the ascertainment of causes, contributing factors and circumstances.

Moreover, it is not the purpose of marine safety investigations carried out in accordance with these regulations to apportion blame or determine civil and criminal liabilities.

NOTE

This report is not written with litigation in mind and pursuant to Regulation 13(7) of the Merchant Shipping (Accident and Incident Safety Investigation) Regulations, 2011, shall be inadmissible in any judicial proceedings whose purpose or one of whose purposes is to attribute or apportion liability or blame, unless, under prescribed conditions, a Court determines otherwise.

The report may therefore be misleading if used for purposes other than the promulgation of safety lessons.

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MT Chemical Hunter **Fatal injuries to a crew member in the ballast pump-room,** **in position 22° 42' N 097° 11' W** **on 28 January 2024**

SUMMARY

On 28 January 2024, an able bodied seafarer (AB) on board *Chemical Hunter* was severely scalded by steam. The accident happened during cargo tank washing and steaming operations. *Chemical Hunter* had just left the port of Altamira, Mexico when the accident occurred. The vessel returned to port where the injured crew member was transferred to a hospital. Despite the first aid given on board, and the more specialised treatment in hospital, the injured crew member succumbed to his injuries about two weeks after the accident.

The safety investigation determined that the failure mechanism of the steam inlet valve to the cargo tank cleaning

water heater was most likely to have been fatigue and that no sudden event precipitated the failure.

When the steam valve failed, the AB was engulfed in a dense cloud of hot steam and consequently, suffered severe burn injuries. He also suffered damage to his lungs due to hot steam inhalation.

The Marine Safety Investigation Unit (MSIU) has recommended the Company to verify the integrity of all the steam valves using NDT techniques and replace any valves, as necessary. Furthermore, the Company has been recommended to circulate the findings of the safety investigation within its fleet.



FACTUAL INFORMATION

The vessel

Chemical Hunter was a Maltese-registered oil tanker of 9,155 gt. It was built in 2015 at Asakawa Shipbuilding Yard, Japan. The vessel's registered owners were Chemical Hunter Shipping BV and was managed by Fleet Management Ltd., based in Hong Kong. *Chemical Hunter* was classed by Nippon Kaiji Kyokai, which also acted as the Recognised Organisation for the compliance of the International Safety Management (ISM) Code.

The vessel had an overall length of 134.03 m, a breadth of 21.60 m, and a summer deadweight of 16,081 tonnes. Propulsion power was provided by a Hitachi MAN B&W 6S35MC marine diesel engine, capable of producing 4,440 kW power at 167 rpm. The vessel was also fitted with a 695 kW bow thruster.

Chemical Hunter was fitted with 20 cargo tanks, with a total capacity of 17,586.32 m³. To assist with the cargo tank cleaning, the vessel was fitted with two Framo hydraulically driven, horizontal centrifugal pumps, rated at 100 m³hr⁻¹.

Manning

The Minimum Safe Manning Certificate of *Chemical Hunter* stipulated a crew of 15. At the time of the occurrence, there were 22 crew members on board, all Indian nationals.

At the time of the accident, the vessel was at sea with the bridge manned by the third mate and the engine-room was being attended by the third engineer, as the duty engineer.

The able bodied seafarer

The able bodied seafarer (AB) was 35 years old. He qualified for his Certificate of Proficiency as Able Seafarer, issued under the authority of Government of India in 2017, which allowed him to sail as an AB.

He first went to sea in 2010 and had been in the current rank since 2017.

He was certified medically fit on 08 June 2023 and joined the vessel on 09 June 2023 in Gebze, Türkiye. He completed his Safety Familiarisation Card on the same day, under the instruction of the chief mate.

The AB had been assigned the 1200 to 1800 watch and had just come on duty, when the accident happened. At the time of the accident, he was wearing a safety coverall, shoes, goggles, and leather gloves. He carried a walkie talkie and a personal gas detector.

Events leading up to the accident¹

Chemical Hunter departed the port of Altamira, Mexico at 0818 on 28 January 2024, after discharging a cargo of Alkyl Benzene. At 0912, the master set the engine to full away on sea passage, bound for New Orleans, USA.

At about 1000, the chief mate conducted a toolbox meeting with the pumpman, the deck cadet and one of the ordinary seafarers (OS) who were on duty, in preparation for the cleaning and steaming of the empty cargo tanks. The cleaning and steaming were necessary for the next cargo, which the vessel was expected to load in New Orleans. Soon afterwards, cargo tank cleaning was commenced using live steam.

At about 1130, the chief mate instructed the pumpman to line up ambient water through the cargo tank cleaning water heater.

At about 1200, the AB reported for duty to the chief mate in the cargo control room (CCR). The chief mate explained the scope of work being undertaken and assigned him duties. He also instructed him to relieve the pumpman, so that the latter could have his

¹ Unless otherwise stated, all times are local (UTC -6).

lunch. By 1210, the handover between the AB and the pumpman was completed. The pumpman, along with the OS, proceeded for lunch, but remained on standby on the UHF radios. At that stage, the plan was to carry out a hot water wash of the cargo holds.

At 1216, the AB entered the ballast pump-room, following the instructions from the chief mate to line up the steam line to the water heater (**Figure 1**). The chief mate asked the duty engineer to reduce the steam to 50% as the cargo tanks live steaming was being concluded.

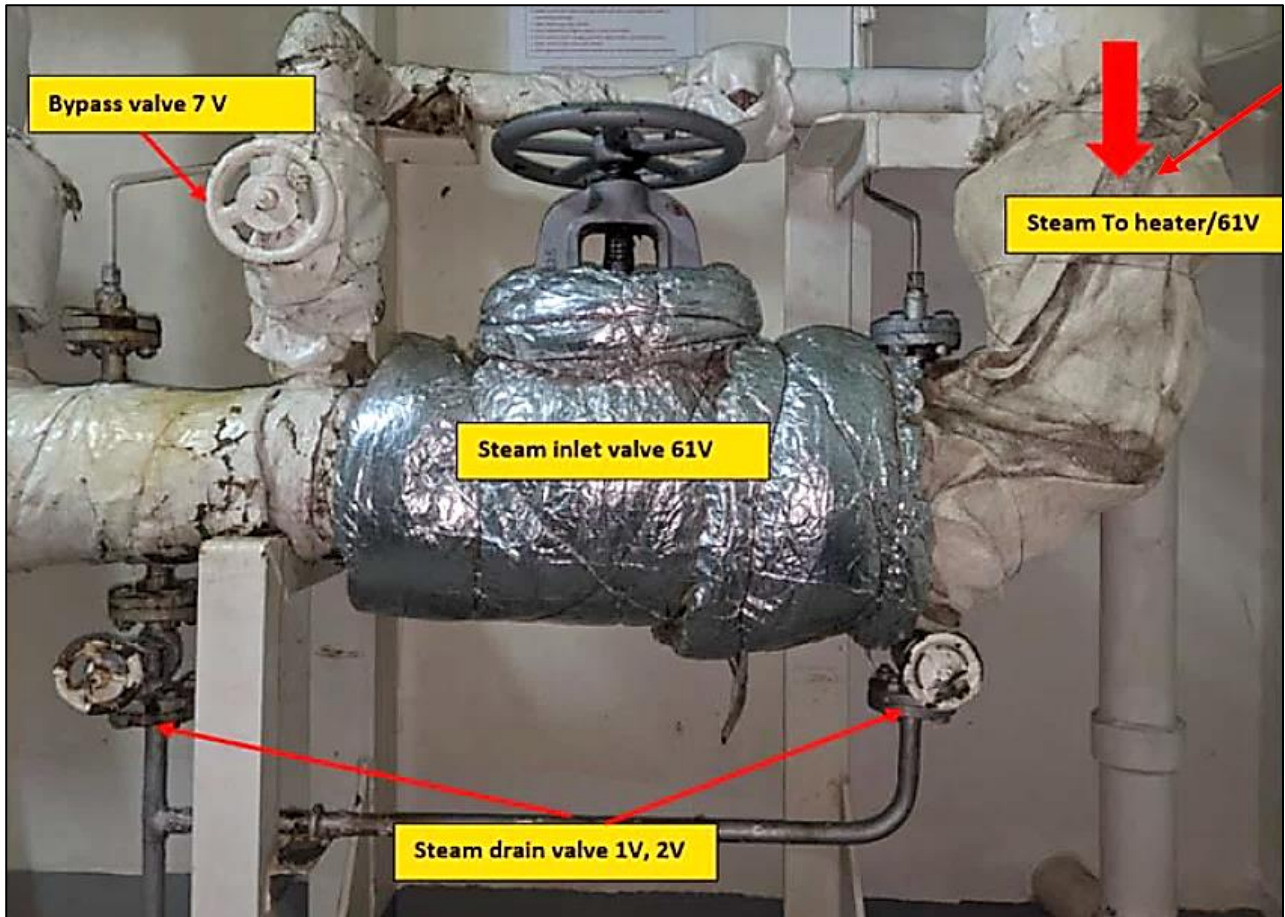


Figure 1: Steam inlet line

Source: Company

The AB eventually received instructions on UHF radio to line up the steam through the cargo tank cleaning heater. At around 1225, a loud explosion occurred in the ballast pump-room, engulfing the AB in a cloud of steam. The chief mate, who was in the CCR at the time, rushed to the ballast pump-room as the AB was not responding on the radio. He also informed the bridge. The duty engineer was asked to stop the steam supply.

The safety investigation received conflicting information as to the amount by which the cargo tank cleaning water heater steam inlet valve was found open, varying from being cracked open to one turn open (**Figure 2**). There was also conflicting information regarding the entry time of the AB into the pump-room².



Figure 2: Ruptured steam inlet valve

Post-accident events

In the meantime, the AB managed to exit the compartment unaided, and headed to the nearest washrooms. He was met by two crew members who assisted him to remove his safety coverall and have a cold-water shower.

Soon afterwards, the master, who was informed of the accident, arrived on scene, to find that the AB was seriously injured and

had burn injuries covering extensive parts of his hands, legs and back.

The master immediately informed the vessel's managers at 1232 and at 1245, he instructed the bridge team to contact MRCC Tampico for assistance and immediate evacuation of the injured crew member.

At about 1305, the chief mate, along with the pumpman, entered the ballast pump-room and established that the escape of live steam was the result of the steam inlet valve, which had ruptured (**Figure 2**).

As MRCC Tampico was not responding to the vessel, the master contacted the vessel's managers, explained the severity of the injuries, and the need to return to Altamira, being the closest port. The Company agreed with this proposal and the vessel deviated to Altamira at 1320. Meanwhile, the AB was provided with medication on the advice of the Company's appointed medical doctor.

At 1336, the Company appointed agents to assist in the landing of the injured AB. The vessel's ETA to the port limits was 1700 and at 1510, the agents confirmed that a boat had been arranged to transfer the AB ashore, where he would be met by an ambulance.

At 1700, the vessel arrived at the rendezvous position and at 1718 the transfer launch was alongside. The injured AB transferred to the launch and at 1737, the launch departed the vessel. The AB was able to transfer without any assistance. At 1800, the vessel was on full away, resuming its passage to New Orleans.

On 14 February, the AB passed away, while still in the hospital at Altamira.

² The timing from the pump-room entry log was used for the purpose of this safety investigation report.

Cargo tank cleaning water heater

The cargo tank cleaning water heater was located at the far end of the ballast pump-room (**Figure 3**). The heater was a U-tube stack, with seawater passing through the coils and steam around it in its shell. Steam was generated by an oil-fired vertical water tube boiler, with a working pressure between 6 bars to 8 bars, and an evaporation rate of 15,000 kg hr^{-1} at 7 bars.

The heater (**Figure 4**) was capable of heating about 100 m $^3\text{hr}^{-1}$ of wash water from about 20 °C to 80 °C. This allowed simultaneous operation of six tank washing machines.



Figure 3: View of heater when entering

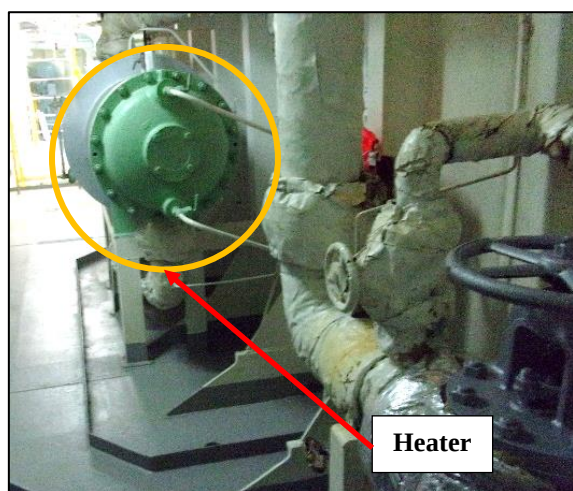


Figure 4: View of the heater looking outside

The steam inlet line had two drain valves, one before and one after the valve. A smaller diameter bypass line was fitted for preheating

the water heater (**Figure 1**). The ruptured steam inlet valve was a globe valve of cast steel construction, with a nominal diameter of 125 mm and working pressure of 10 kPa.

The last external inspection of the heater and valves was carried out on 09 September 2023 and at the same time pressure tested to 14.7 bar and found in good order.

The heater and its fittings were also subject to monthly and quarterly visual inspections and were found to be satisfactory during the last inspection. The last monthly inspection was carried out on 15 January 2024, about 13 days before the accident.

Cargo tank cleaning preparation

In accordance with the cargo tank cleaning process, a 'Tank Cleaning Checklist' was completed by the chief mate. The checklist considered the risk assessment of the activity, and a review of the cargo tank cleaning plan.

Environment

Chemical Hunter's records indicated that at the time of this occurrence, the sky was partly cloudy. The wind was blowing from the North, measuring Force 4 on the Beaufort Scale, with a swell of about 1 m from the Northwest. The air temperature was 20 °C.

Cause of death

The safety investigation was informed that no post-mortem was carried out. Moreover, citing legal restrictions, the cause of death was not communicated to the MSIU. It was understood, however, that the AB had second degree burns on 30 % of his body. In hospital, he developed serious breathing complications, where it also became known that he had inhaled steam at the time of the accident.

ANALYSIS

Aim

The purpose of a marine safety investigation is to determine the circumstances and safety factors of the accident as a basis for making recommendations, and to prevent further marine casualties or incidents from occurring in the future.

Records of hours of work / rest

The AB's work / rest hours records for the month of January 2024 indicated that his hours were compliant with the STCW requirements. He had stood the 0000 to 0400 watch on 28 January 2024 and then had 7.5 hours of rest before commencing work again at 1130 on the same day. Although no details on his hour of rest were available, the safety investigation did not come across any factors, which would have suggested that fatigue was a contributing factor to this accident.

Drug and alcohol testing

The company operated a zero-tolerance policy towards the consumption of alcohol and illegal drugs while on duty. Following the accident, in accordance with the Company's policy, alcohol tests were undertaken by all the crew, including the injured AB. All the tests returned negative results.

Metallurgical examination

The metallurgical examination conducted on the failed valve body and fragments concluded that the mechanism of failure was most likely to have been fatigue. The steam valve exhibited signs of corrosion and delamination of the protective paint. The examination revealed signs of pre-existing multiple developing cracks on the body (**Figures 7 and 8**). Although the material composition of the valve body was within specification, there was a wide variation of wall thickness (up to 7 mm) in the valve

casing. This variation was thought not to have been caused by corrosion; rather it was attributed to the manufacturing process.

The metallurgical examination further revealed that exacerbation of crack growth could have been aided by the stencil marks on the valve and the uneven geometry.

The detached fragment from the valve casing was examined under a microscope at 10 arbitrary, but evenly spaced locations. Despite cleaning with a de-rusting agent, it was observed that some of the rust adhered more tenaciously to the fracture surface, suggesting that the rusting was of a longer standing nature and therefore, the failure was progressive instead of instantaneous.



Figure 7: Continuing crack with further existing cracks bifurcating from it



Figure 8: Close up of crack

The metallurgical test report concluded that:

- the material properties of the steam valve were consistent with those that would be expected for a component manufactured from grey cast-iron;
- no apparent, significant defects were found in the cast material in way of the fracture locations and while the wall thickness was measured to be variable, it was not evident from the investigation that this was owing to corrosion; the absence of significant graphitisation suggested that this was not the case;
- the failure mechanism was mostly likely fatigue, and this appeared to have initiated in way of the cast stencilling to the outer surface of the steam valve body;
- in the absence of any other exacerbating material anomalies, the failure appeared to have been of a progressive nature and the cause of failure appeared to have been owing to the parameters of operation, and likely exacerbated by the presence of stencilling and/or the variable wall thickness. Whether or not the operating parameters of the steam valve were as expected, or in any way unusual, was beyond the scope of the metallurgical investigation.

Actions of the AB

As the AB entered the pump-room alone, there were no witnesses to his actions inside. However, according to the pump-room entry log records, he had been inside the space for approximately 10 minutes. He went there specifically to carry out the chief mate's instructions to line up the steam to the heater.

Considering that he spent about 10 minutes in the pump-room, the safety investigation hypothesised that it was more likely that he opened the steam valve after first draining the condensate, using the fitted drain valves.

It was only after he was satisfied that it was safe to open the steam valve that he shut the drain valves and finally opened the steam inlet valve to the heater.

Had the AB opened the steam inlet valve one full turn immediately after entering the space, the failure would have happened within seconds (had it been water hammering that caused the failure), rather than 10 minutes later. Therefore, it was also considered highly likely, that he had followed the correct procedures, and the likely cause of failure was incipient weakness in the steam valve, rather than water hammering.

Valve failure

The metallurgical analysis concluded that the failure mechanism was fatigue. The cyclic loading required for fatigue failure was thermal in the case of the steam valve because of the heating and cooling of the valve during the periods when the tank cleaning heater was used.

In addition to the cracked surface, crack fronts progressing through the valve casing were observed. This suggested that more than one crack front was growing progressively with time and therefore, a single rapid failure event was less likely. This was congruent with the fact that slow cracks can develop segmented crack fronts, each segment subsequently propagating along separate fracture planes.

Figure 2 revealed heavy rust stains on the inside of the valve lagging. This further corroborated the metallurgist's findings. The valve casing had most probably developed cracks over time, and steam and water were seeping through. The delaminating protective paint was also further evidence of pre-existing cracks.

The Company has been requested s to provide the maximum boiler pressure and the steam temperatures to the safety

investigation, to better understand the failure mechanism of the steam valve. The MSIU was informed that the maximum boiler pressure was 0.98 MPa, whereas the steam temperature was 164.9 °C.

Material fatigue is considered to be a complex phenomenon since relatively small stresses over a long period of time can be very consequential. In this particular case, the steam temperature was rather low and assuming that a hot-to-cold relatively frequent transition across the constrained regions of the valve even existed and considering the coefficient of thermal expansion of grey cast iron, the resultant strain and consequent stress would not be large. It was also concluded that as such, this could only have played a role in the failure of the valve, in the presence of other synergistic effects, such as corrosion, external damage (*e.g.*, crack initiation), *etc.*

Emergency response

The vessel's crew responded to their best ability after the AB suffered severe burns. The consultation with a medical person and administration of medication based on the advice received may have helped to stabilise the condition of the injured AB. The master's decision to return to Altamira to land him ashore, in agreement with the Company, was also considered appropriate.

Although the AB was able to leave the vessel and enter the launch without being physically carried, the severity of his medical condition was not underestimated. He had suffered injuries to his lungs due to steam inhalation and had 30% second degree burns to his body. He was in the hospital for more than two weeks before he died.

The absence of a detailed chronology of his treatment and a post-mortem examination was of concern to the MSIU and reflected a regretted situation where critical information, requested for the purpose of a safety investigation, was withheld, citing legal

restrictions. It was also of concern because the MSIU remained convinced that this information would have not been withheld, had it been requested by a judicial investigation.

CONCLUSIONS

1. The AB suffered from fatal steam scalding, following the structural failure of a steam valve.
2. The metallurgical examination conducted on the failed valve body and fragments concluded that the mechanism of failure was most likely to have been fatigue.
3. The steam valve exhibited signs of corrosion and delamination of the protective paint. The examination revealed signs of pre-existing multiple developing cracks on the body.
4. The metallurgical examination further revealed that exacerbation of crack growth could have been aided by the stencil marks on the valve and the uneven geometry.
5. The master's decision to return to Altamira to land him ashore, in agreement with the Company, was also considered appropriate.

SAFETY ACTIONS TAKEN DURING THE COURSE OF THE SAFETY INVESTIGATION³

Fleet Management Limited took a number of safety actions including:

- Initiated its own internal investigation into the accident on board the vessel.

³ Safety actions and recommendations shall not create a presumption of blame and / or liability.

- Issued a Circular Fleet Alert to all its managed vessels.
- Mandatory requirement was imposed on all deck and engine room staff to complete a training module on steam handling operations.
- A QHSE alert on the outcome of the Company's investigation has been shared across the fleet.
- All vessels were required to prepare ship-specific instructions for lining up the steam system for heating or steaming.
- The Cargo Operation Manual and Job Hazard Analysis have been reviewed, and guidance has been included to consider the findings of the internal investigation.
- A critical safety task analysis process has been drafted to be incorporated into the SMS, during its next revision.

RECOMMENDATIONS

Fleet Management Ltd is recommended to:

02/2025_R1 – examine all steam valves and mountings in their fleet, using NDT techniques, if necessary, to verify their integrity.

02/2025_R2 – circulate the finding of the safety investigation within its fleet.

SHIP PARTICULARS

Vessel Name:	<i>Chemical Hunter</i>
Flag:	Malta
Classification Society:	Nippon Kaiji Kyokai
IMO Number:	97588789
Type:	Oil / Chemical Tanker, Type II & III
Registered Owner:	Chemical Hunter Shipping BV
Managers:	Fleet Management Ltd
Construction:	Steel
Length Overall:	134.03m
Registered Length:	n/a
Gross Tonnage:	9,155
Minimum Safe Manning:	11
Authorised Cargo:	Liquids in bulk

VOYAGE PARTICULARS

Port of Departure:	Altamira, Mexico
Port of Arrival:	New Orleans, USA
Type of Voyage:	International
Cargo Information:	Ballast
Manning:	22

MARINE OCCURRENCE INFORMATION

Date and Time:	28 January 2024 at about 18:24 (UTC)
Classification of Occurrence:	Serious Marine Casualty
Location of Occurrence:	In approximate position 22° 42'N and 097° 11'W
Place on Board	Ballast pump-room
Injuries / Fatalities:	One fatality
Damage / Environmental Impact:	None reported
Ship Operation:	Ballast – Tank Cleaning
Voyage Segment:	Transit
External & Internal Environment:	Wind ENE, Beaufort force 4, Overcast
Persons on board:	22