Marine Safety Investigation Unit

Transport Malta

SAFETY INVESTIGATION REPORT

201901/023 REPORT NO.: 02/2020 January 2020

MT *SICHEM RUBY*

Serious injury to crew member
in position 41° 21.5' N 010° 11.0' W
20 January 2019

SUMMARY

On 20 January 2019, *Sichem Ruby* was in transit to Castellon, Spain, with a cargo of sulphuric acid that was loaded, in Aviles, Spain.

During the previous cargo operations, the pumpman had noticed that one of the stripping line valves of no. 2 port (2P) was leaking slightly and on 20 January, he decided to attend to it.

The pumpman removed the valve and replaced it with an overhauled one. However, as he was tightening the first bolt on the flange to his right, sulphuric acid sprayed into his face and body. He immediately proceeded to the decontamination showers and called for help.

The pumpman was eventually airlifted to the nearest hospital, where he stayed for several days to receive treatment.

Taking into consideration the safety actions taken by the Company, no safety recommendations have been made.

MT *Sichem Ruby*

FACTUAL INFORMATION

The vessel

Sichem Ruby was a Maltese-registered oil/chemical tanker of 5,303 GT. She was built in Japan in 2006 by Murakami Hide Shipbuilding. The vessel's registered owners were Team Tankers Regional Ltd.; she was managed by V.Ships France SAS, and classed by Det Norske Veritas–Germanischer Lloyd (DNV-GL). The vessel had a length overall of 114.99 m, a breadth of 18.22m, and a deadweight of 8,824 tonnes.

The configuration of the vessel's cargo system enabled the carriage of twelve different grades of cargo, with each cargo tank having a dedicated, centrifugal type, submerged pump.

Sichem Ruby was powered by one HITACHI MAN B&W 6L36MC, 6-cylinder diesel engine, which produced 3,900 kW at 210 rpm. This drove a single fixed-pitch propeller, to reach a service speed of 14 knots.

Crew

Sichem Ruby's Minimum Safe Manning Certificate required a crew of 15. There were 19 crew members at the time of the accident. The crew members were from Latvia, Lithuania, Russia, France, Georgia and the Philippines.

The chief officer was from Lithuania. He had embarked *Sichem Ruby* two days prior to the occurrence. This was his second consecutive contract on board this vessel, as he had served as a chief officer for two months in the previous year. He had served 11 years at sea and had been working as a chief officer for six months with V.Ships France SAS. He had obtained his STCW II/2 Certificate of Competence in 2016.

The injured pumpman was a Filipino national and, at the time of the accident, he was 42 years old. He had been working at sea for 22 years with V. Ships France SAS, of which, nine years were as a pumpman. In 2007, he started sailing on chemical tankers. He had obtained his deck rating certificate, which was issued by the Republic of Philippines, in 2006. He had joined *Sichem Ruby* in Montoir, France, on 14 November 2018.

Environment

At the time of the accident, the weather was reported to be clear. Winds were blowing from the North with a recorded speed of 19 knots. The air temperature was 14 °C.

Stripping system

According to the vessel's approved Procedures and Arrangements (P&A) Manual[1], the vessel had no special stripping line. A compressed air blowing system was provided on each cargo pump for stripping the cargo tank (Figure 1).

However, Figure 1 also shows pipelines of a 25 mm diameter, passing from the pump stack to the manifold, identified as '25A STR P TO MANFOLD' (highlighted in blue). Moreover, the P & A Manual also mentioned that a stripping system was available to strip the cargo tanks and lines, following unloading. Furthermore, the P & A Manual also indicated that the stripping system may also be used to drain the deck lines into the appropriate cargo tanks, upon completion of loading.

For stripping the cargo tanks, the ideal stern trim had to be 1.89 m and no list. The P & A Manual indicated that cargo operations did not have to be stopped to strip the cargo tank following bulk unloading.

[1] The P & A Manual is a requirement of MARPOL 73/78, Annex II, for ships certified to carry Noxious Liquid Substances in bulk. It identifies all operational procedures with respect to cargo handling, residue discharging, ballasting and deballasting. This Manual is not intended as a safety guide.

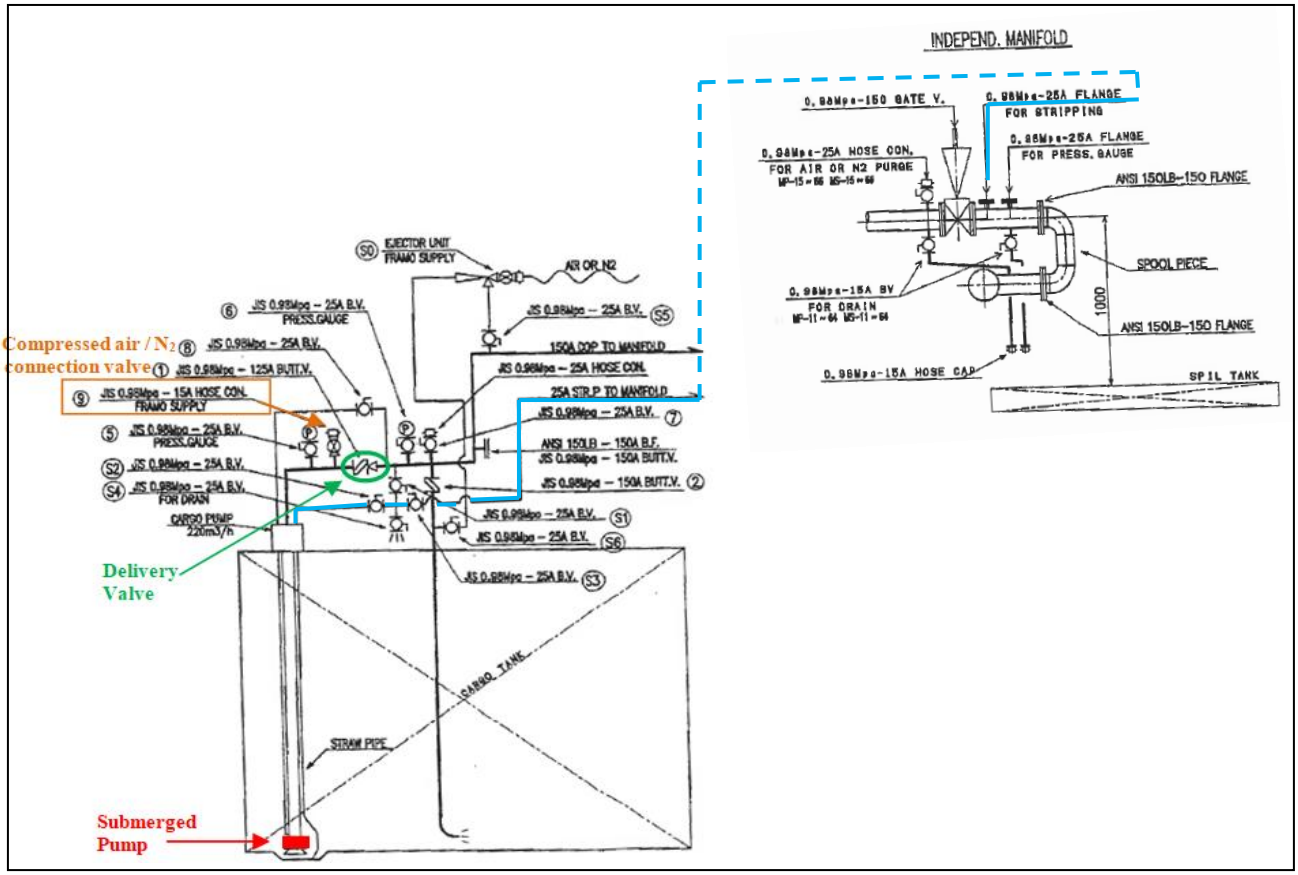

Figure 1: Piping arrangements for cargo tanks

Reduction of the pump's speed would reduce the unloading capacity; however, the pump would steadily continue to strip the cargo tank. To completely unload the cargo tank, the P & A Manual provided the following procedure:

(1) Discharge by cargo pumps

- *Cargo tanks are stripped to the most possible extent by submerged pumps.*

(2) Vacuum stripping after discharge by cargo pumps

- *Connect an ejector unit to the compressed air or N_2 gas supply line;*
- *Trigger the ejector unit*;
- *Make sure pressure of the inside pipe is decreased*;
- *The vacuumed air is sucked up the residual cargo*;
- *Check the status from a sight glass fixed to a cargo hatch.* [sic]

Furthermore, the P & A Manual provided the following operational procedure for stripping the cargo deck lines of cargo tanks numbers one and two:

- *Unloaded a cargo by a submerged pump until it's impossible to unload the residual cargo*;
- *Make sure a delivery valve and connection valve is shut*;
- *Connect the compressed air or N_2 line to an air connection valve at the pump side*;
- *Open the air connection valve until the inside pressure of pipe is increased to 5 kg/cm^2*;
- *After the pressure is increased to 5 kg/cm^2, shut the air connection valve*;
- *Open a connection valve at the manifold side, the residual cargo in the pipe is unloaded*;

- *When the inside pressure of pipe becomes 0 kg/cm^2, shut the connection valve.* [sic]

A second set of operational procedures for stripping the cargo deck lines of tanks three to six, were also provided. The difference was the connection of the compressed air / N_2 being at the manifold side, rather than the pump side.

Stripping method used on board

The adopted method for stripping the cargo tanks and lines, by-passed a major part of the 25 mm stripping line and was as follows:

- Connect air or N_2 hose (depending of cargo) to the dedicated connection on discharge line above the Framo pump;
- Close the discharge valve ⊗;
- Flush through the main cargo line directly to the manifold.

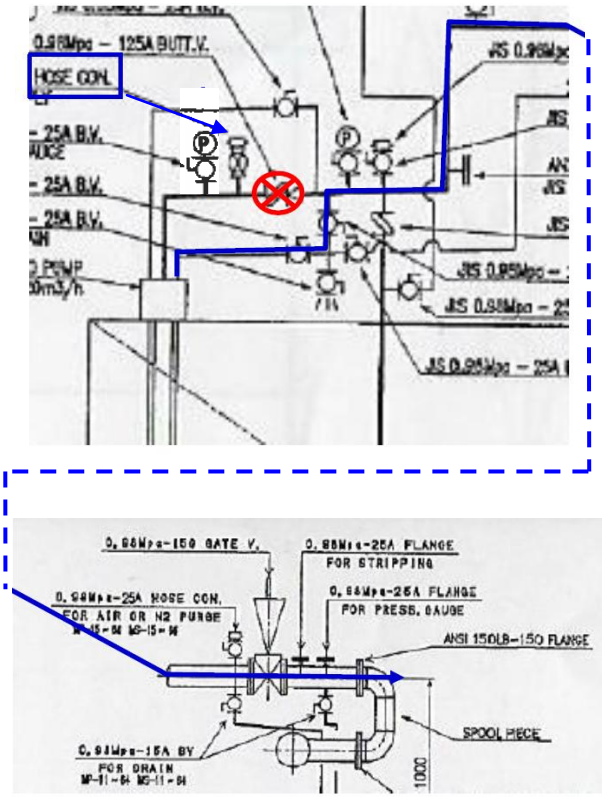

Figure 2: Pipeline diagram showing the method adopted on board of stripping cargo tanks and lines

Besides the aforementioned method, no other procedures were applied for cargo tank and line stripping.

Narrative[2]

On 09 January 2019, the vessel loaded sulphuric acid in cargo tank no. 2 port, at the port of Assemini, Italy. This cargo tank was later completely unloaded at Castellon, Spain, on 14 January 2019.

On the next day, cargo tank no. 2 port and its associated cargo and stripping lines were reported to have been washed by sea and fresh water. The cargo lines were drained on the main deck, where it was visibly clear that no more traces of cargo were left in the lines. These lines were then completely isolated from the other cargo tanks and piping.

On 20 January 2019, the pumpman commenced work at 0800. At 1300, the pumpman attended a work related meeting with the chief officer where he was assigned to measure the manifold valve and to change the oil of the cargo tank cleaning machines.

Later that afternoon, in preparation to overhaul a leaking valve on the stripping line of cargo tank no. 2 port, the pumpman opened the leaking valve and the drain valve (Figure 3), to confirm that the line was empty. Seeing no indication of any liquids inside the pipeline, the pumpman proceeded to dismantle the leaking valve from the stripping line of cargo tank no. 2 port.

[2] Unless otherwise stated, all times are Ship's time (UTC + 1).

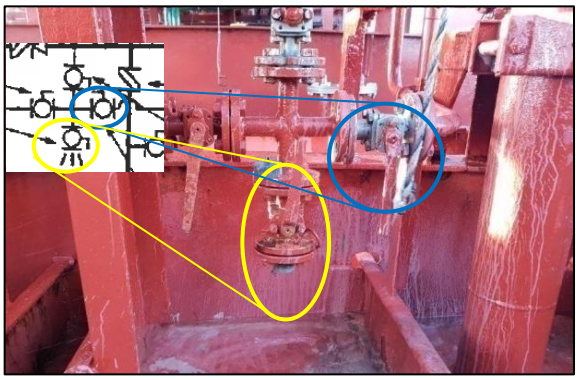

Figure 3: Position of the leaking valve (blue) & position of drain valve (yellow)

At that time, the pumpman was wearing an overall and a pair of safety shoes, as part of his personal protective equipment.

After removing the leaking valve, the pumpman noticed a Teflon blank installed on the right flange (Figure 4).

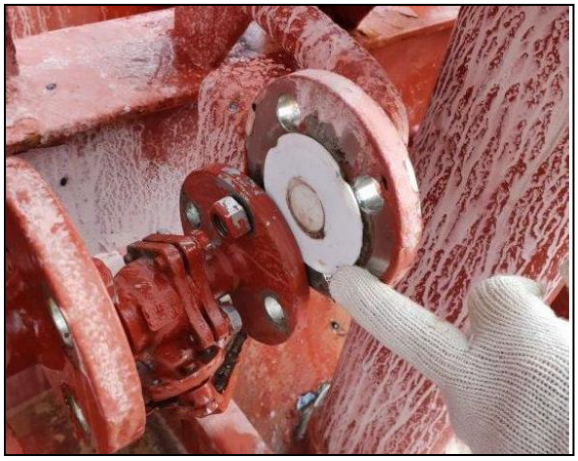

Figure 4: Teflon blank in way of the stripping line

After removing the valve, the pumpman placed a reconditioned valve into position. Suddenly, sulphuric acid sprayed onto his face and body, as soon as he started tightening the first bolt on the right flange (Figure 5).

The pumpman started shouting and immediately ran to the decontamination shower on the port side, but found no water. He went over to the starboard side, by which time, one ordinary seafarer (OS) noticed him running. The OS went directly to help him and opened the fresh water supply line for the pumpman to flush his face and body with fresh water.

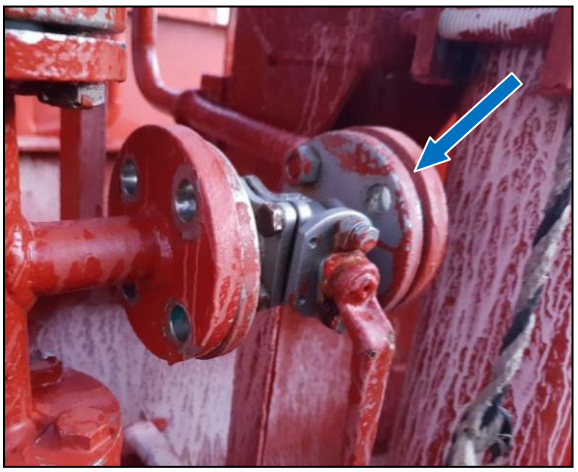

Figure 5: Right flange: location where sulphuric acid allegedly sprayed out from (blue arrow)

At around 1635, the chief officer, who was at that time the officer on duty on the bridge, was notified of the accident. After alerting the master and the second officer, the chief officer went on deck to assess the situation.

In the meantime, more crew arrived to help the pumpman. As a first aid measure, the crew members removed his contaminated clothes and continued to shower him with fresh water. Later, he was transferred to the accommodation where they continued washing him with fresh water.

The master had contacted CIRM[3] for medical advice and was informed to transfer the injured to a hospital. A medical evacuation via a helicopter was arranged and, approximately four hours after the occurrence, the pumpman was airlifted to hospital.

Sustained injuries

The pumpman had suffered from chemical burns affecting his face, neck, both upper

[3] Centro Internazionale Radio Medico (International center for radio medical advice.)

extremities and right thigh. His right eye was injured and consequently, his vision deteriorated after this accident.

Following repatriation, he continued receiving medical treatment at a local hospital.

Sulphuric acid

Sulphuric acid is a colourless, odourless and syrupy liquid that is soluble in water, in a reaction that is highly exothermic. Sulphuric acid is used in many industries such as in the agricultural industry, the electrical/electronic engineering industry, the polymers industry, *etc*.

The Material Safety Data Sheet (MSDS) for sulphuric acid, provided on board, listed the following precautionary statements:

- Wear protective gloves/ protective clothing/ eye protection/ face protection;
- IF EXPOSED: immediately call a POISON CENTER or doctor/physician;
- IF SWALLOWED: rinse mouth. Do NOT induce vomiting;
- IF IN EYES: Rinse cautiously with water for several minutes.

In addition, it clearly indicated the hazards related to this substance as: causing severe skin burns and eye damage.

Teflon blanks

Teflon is a type of hard plastic (polytetrafluoroethylene) consisting of two simple elements; carbon and fluorine. It is non-reactive and resistant to chemicals. Due to its versatile properties, it has many industrial uses. On board *Sichem Ruby*, this was manually cut to size from a Teflon sheet and used as a means to blank off pipelines.

During the pumpman's tenure on board, it was confirmed that he had overhauled 10 different valves with similar Teflon blanks installed.

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.

Immediate cause of the accident

Sulphuric acid sprayed from between the Teflon blank and the pipeline flange which was to the pumpman's right side, while the pumpman was securing the first bolt on the reconditioned valve. It is the view of this safety investigation, that while tightening the bolt, the Teflon blank dislodged and gave way under the pressurised sulphuric acid, which remained trapped in the pipeline.

Leaking valves

There were no records available on board as to when these Teflon blanks had been installed.

Reportedly, none of the officers and crew on board were made aware of their presence - except for the pumpman who, after the accident, claimed to have seen Teflon blanks elsewhere while dismantling valves on other stripping lines. Moreover, when the pumpman had joined *Sichem Ruby*, the previous pumpman had informed him of the presence of Teflon blanks located on all drain valves.

After the accident, the crew found that Teflon blanks had been placed on both ends of the stripping line on no. 2P. The blank that was nearest to the manifold was found cracked, allowing liquid to seep through (Figure 6).

The safety investigation could not establish the cause of the Teflon blank failure.

Figure 6: Cracked Teflon blank on the stripping line at the manifold's side

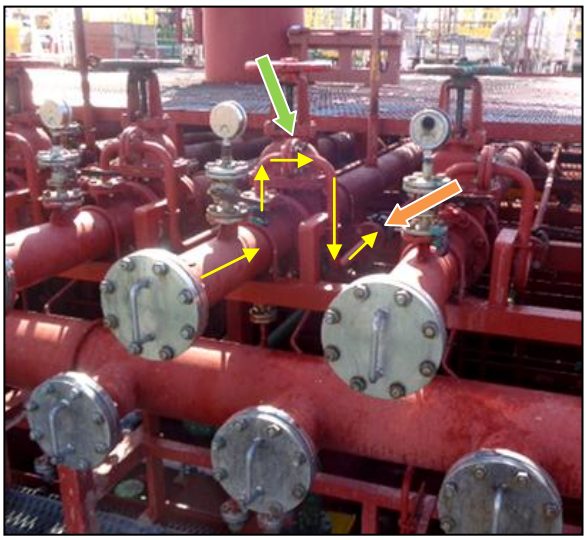

Figure 7: Location of the cracked Teflon blank, in between the flanges (green arrow) and location of the ball valve (orange arrow), on the stripping line

After further investigation by the Company, it was discovered that the chief officer, who was on board *Sichem Ruby* in the summer months of the previous year, had instructed the pumpman on board at that time, to install these blanks. The rationale behind these fittings was to eliminate potential issues with leaking valves on the drain lines.

Stripping system procedure

The stripping procedure that was reportedly being applied on board did not make use of the stripping line available on deck. Instead, compressed air / N_2 were being used to empty the pump and cargo line while by-passing the stripping line (Figure 2). This would explain why the Teflon blanks did not obstruct the stripping operations adopted on board.

Following the stripping line piping, from the manifold side back to the cargo tank, it was observed that after the cracked Teflon blank, a ball valve was installed (Figure 7).

Taking into consideration that most of the stripping line was being bypassed, most of the valves leading to/from the stripping line were understood to have remained closed during cargo operations. Furthermore, the stripping valve at the manifold was confirmed to have been working properly. Thus, sulphuric acid should not have been present in the stripping line to.

However, it was later reported that during deck line washing and draining, all the stripping line valves were kept open. This would have allowed sulphuric acid, which was accumulated in between the cracked Teflon blank and the ball valve, at the manifold, to pass through the rest of the stripping line unnoticed, until it reached the other Teflon blank.

The P & A Manual's procedure for stripping the cargo did not appear clear. For instance, identified valves (such as connection valve), did not give a clear identification o which valves they were referring to. It was not excluded that this could have been the reason why the crew on board adopted their own procedures for stripping the tanks and lines.

Although the P & A Manual initially indicated that there was no special stripping line on board, it later goes on to refer to a stripping system for cargo tanks and lines. During the course of this safety investigation, it was noticed that the vessel was, in fact, fitted with stripping lines of 25 mm diameter for each cargo tank.

Moreover, the piping arrangements were identical for all cargo tanks, but the P & A Manual specified two sets of deck line stripping procedures – one for cargo tank nos. 1 and 2 and another for cargo tank nos. 3 to 6. The reason for these different procedures remained unclear to the safety investigation.

Acceptance of Risk

It would have been very remote for the pumpman to envisage that sulphuric acid was trapped between the leaking valve he was meant to replace and the ball valve at the manifold. Nor could, in the opinion of this safety investigation, this have been identified during the filling up of a permit-to-work on pipelines.

The available MSDS for the sulphuric acid cautioned on the use of occupational exposure controls. These included the use of acid resistance gloves, chemical safety goggles or a full face shield, and acid resistant clothing.

Nonetheless, when no cargo operations are being carried out, the Company's PPE matrix required that as a minimum, crew working on deck should wear long sleeved clothing, boiler suits, safety shoes and a safety helmet.

The pumpman was wearing an overall and safety shoes for the task. Before proceeding to remove the leaking valve from the pipeline, the pumpman opened the drain valve for that line and confirmed that the line was empty, affirming to himself in the process that it was safe to carry out the work with the PPE he was wearing.

Considering that no cargo operation was being carried out, the pumpman was not expected to wear the required full PPE. In this case, the lack of safety helmet was not considered to have exacerbated his burn injuries, although this was not in line with the Company's PPE matrix.

The chief officer had joined just two days prior to this occurrence. He was unaware of the presence of leaking valves, and of the pumpman's intention to replace these valves; consequently, a permit-to-work on pipelines was not completed. As mentioned elsewhere in this safety investigation report, a permit-to-work would have been unlikely to identify the sulphuric acid trapped in the pipeline. However, a toolbox talk, which discussed the replacement of the leaking valves, might have brought to light the presence of the Teflon blanks to the newly embarked chief officer.

It would seem that, whenever a leak was discovered, the crew were instructed to report it to the officers, and the officers would then inform the pumpman. The pumpman would assess the valve's condition and rectify the issue at the next available opportunity. In the past, the pumpman had already overhauled and replaced similar valves, where Teflon blanks were present. It later transpired that the pumpman had previously carried out these works without being issued with a permit-to-work on pipelines. This indicated that the practise of replacing valves without the issuance of a permit had become a norm on board.

The reason behind the pumpman's motivation to attend to the leaking valves remained unclear to the safety investigation. It does seem to be more of a proactive positive approach as in any case, he would have been instructed to do the job after informing the chief officer about it.

It was also noticed that a certain degree of precaution was taken (the pumpman had opened the drain valve to reassure that no

liquid remained in the pipeline, before carrying out his works). However, the safety investigation is of the view that the pumpman had overhauled the leaking valves without a permit to work in place, since he had successfully overhauled such valves in the past. It might be fit to suggest that the pumpman was overcome by an outcome bias; whereby his decision was based on past uneventful outcomes.

Decontamination showers

The IBC Code[4] required suitably marked decontamination showers and eyewash to be available on deck at convenient locations. The showers and eyewash were to be operable in all ambient conditions.

Sichem Ruby had decontamination showers located on the main deck on both port and starboard, forward of the manifolds. However, since the vessel was underway and no cargo operations were being carried out, the fresh water supply to these showers was closed, in accordance with the Company's SMS procedures.

Given that the showers were no opened before work was initiated on the system, this delayed immediate access to fresh water for the pumpman who, at that time, seemed unaware that the fresh water supply to the decontamination showers was closed. This prompted him to run to the other shower, located on starboard side, when another crew member went to his aid and opened the fresh water supply line for him.

CONCLUSIONS

1. Sulphuric acid splashed on the pumpman during maintenance work on the stripping line;
2. The crew adopted different cargo stripping procedures because the P & A Manual seemed unclear;
3. Teflon blanks were installed on all stripping lines, for each cargo tank, possibly to eliminate potential issues with leaking valves on draining lines;
4. The pumpman was the only person on board aware of these Teflon blanks;
5. The Teflon blank, which was installed on the manifold side of the stripping line of no. 2P, was found cracked;
6. Sulphuric acid had entered no. 2P stripping line pipeline through the cracked Teflon blank and the ball valve that was being kept open while draining the lines;
7. The pumpman could not have envisaged that sulphuric acid was trapped in the pipeline;
8. The safety equipment and clothing worn by the pumpman were not adequate to protect him from chemical injuries;
9. Outcome bias of the task in hand, could have led the pumpman to carry out the task without the necessary permit;
10. The decontamination showers were not immediately available – supply of fresh water to these showers was only opened by another crew member.

[4] IBC Code -International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk

SAFETY ACTIONS TAKEN DURING THE COURSE OF THE SAFETY INVESTIGATION[5]

During the course of the safety investigation, the Company took the following actions:

1. Removal of all Teflon blanks from all pipelines and checks on sister vessel for any similar blanks;
2. Reinforcing of PPE campaign for routine maintenance jobs for the whole fleet;
3. A reporting and communication campaign was launched for the whole fleet to highlight problems with lack of reporting to line officer or to the Company, accordingly;
4. A campaign to reinforce the use of toolbox talk meetings and relevant work permits for the whole fleet was launched;
5. A campaign to reinforcing the reporting and recording of any isolated/blanked equipment/piping was initiated;
6. Sharing of the case's findings with all group vessels as a learning engagement tool;
7. The SMS Manual has been amended to ensure that whenever the vessel is carrying corrosive cargoes and slops, emergency showers are kept ready for immediate use and supplied with water even if no cargo operations are in progress;
8. The lessons learned have been distributed to all vessels within the Fleet and are being highlighted during crew seminars and senior officials' briefings.

[5] **Safety actions shall not create a presumption of blame and / or liability.**

SHIP PARTICULARS

Vessel Name:	*Sichem Ruby*
Flag:	Malta
Classification Society:	DNV-GL
IMO Number:	9344174
Type:	Oil/Chemical Tanker
Registered Owner:	Team Tankers Regional Ltd.
Managers:	V. Ships France SAS
Construction:	Steel
Length Overall:	114.99 m
Registered Length:	108.53 m
Gross Tonnage:	5,303
Minimum Safe Manning:	15
Authorised Cargo:	Oil / Chemical

VOYAGE PARTICULARS

Port of Departure:	Aviles, Spain
Port of Arrival:	Castellon, Spain
Type of Voyage:	International Voyage
Cargo Information:	7,599.95 mt of Sulphuric Acid
Manning:	19

MARINE OCCURRENCE INFORMATION

Date and Time:	20 January 2019 at 16:30 (LT)
Classification of Occurrence:	Serious Marine Casualty
Location of Occurrence:	41° 21.5’ N 010° 11.0’ W
Place on Board	Main Deck
Injuries / Fatalities:	One serious injury
Damage / Environmental Impact:	None
Ship Operation:	In passage
Voyage Segment:	Transit
External & Internal Environment:	Wind and swell were coming from the North with a wind speed of 19 knots. Visibility was good, recorded as 10 nm.
Persons on board:	19