



SAFETY INVESTIGATION REPORT

202002/033

REPORT NO.: 06/2021

February 2021

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 SICHEM MANILA **Serious injury to a crew member** **during tank cleaning operations,** **at Tarragona anchorage, Spain** **17 February 2020**

SUMMARY

On 17 February 2020, whilst *Sichem Manila* was on anchor, several crew members were engaged in cargo tank cleaning operations. During the process, while one of the crew members was shutting off a valve on the cargo tank cleaning line, the block of the valve burst open, spilling hot water over him.

Tank cleaning operations were immediately suspended, and the injured crew member was transferred to the vessel's hospital where first aid was administered. Eventually, he

was transferred to a local hospital for further treatment.

The Marine Safety Investigation Unit (MSIU) concluded that the cause of the valve block failure was either a high-pressure stream of water or a water hammer effect, acting on the corroded mild steel securing bolts of the valve block.

Considering the safety actions taken by the Company, no recommendations have been issued by the MSIU.



MT Sichem Manila

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FACTUAL INFORMATION

Vessel

Sichem Manila (Figure 1) was an 8,562 gt, double-hulled oil / chemical tanker, owned by Team Tankers City Class Ltd. and managed by V.Ships UK Ltd., United Kingdom. The vessel was built in 2007 by 21st Century Shipbuilding Co. Ltd. in the Republic of Korea and was classed with Det Norske Veritas – Germanischer Lloyd (DNV GL).

The vessel had a length overall of 128.60 m, a moulded breadth of 20.40 m and a moulded depth of 11.50 m. She had a summer draught of 8.71 m, and a designed deadweight of 13,125.657 metric tonnes (mt). At the time of the occurrence, her forward and aft draughts were recorded as 4.50 m and 6.60 m, respectively.

Propulsive power was provided by a six-cylinder, two-stroke, single-acting, low speed, STX – B&W 6S35MC marine diesel engine, which produced 4,440 kW at 173 rpm. This drove a fixed-pitch propeller, enabling *Sichem Manila* to reach an estimated speed of 13 knots.

Crew

Sichem Manila's Minimum Safe Manning Certificate stipulated a crew of 13. At the time of the accident, the vessel was manned by 18 crew members from Peru, Russia, Honduras and Venezuela.

The injured crew member (AB 1) was a 50-year old Honduran national. He had about 22 years of seafaring experience, almost nine of which in the rank of a deck rating with watch keeping certification. He held STCW¹ II/4 qualifications, and his most recent certificate of competency was issued by the Honduran

¹ IMO. (2001). *The International convention on standards of training, certification and watchkeeping for seafarers, 1978, as amended in 1995 and 1997 (STCW Convention)*. London: Author.

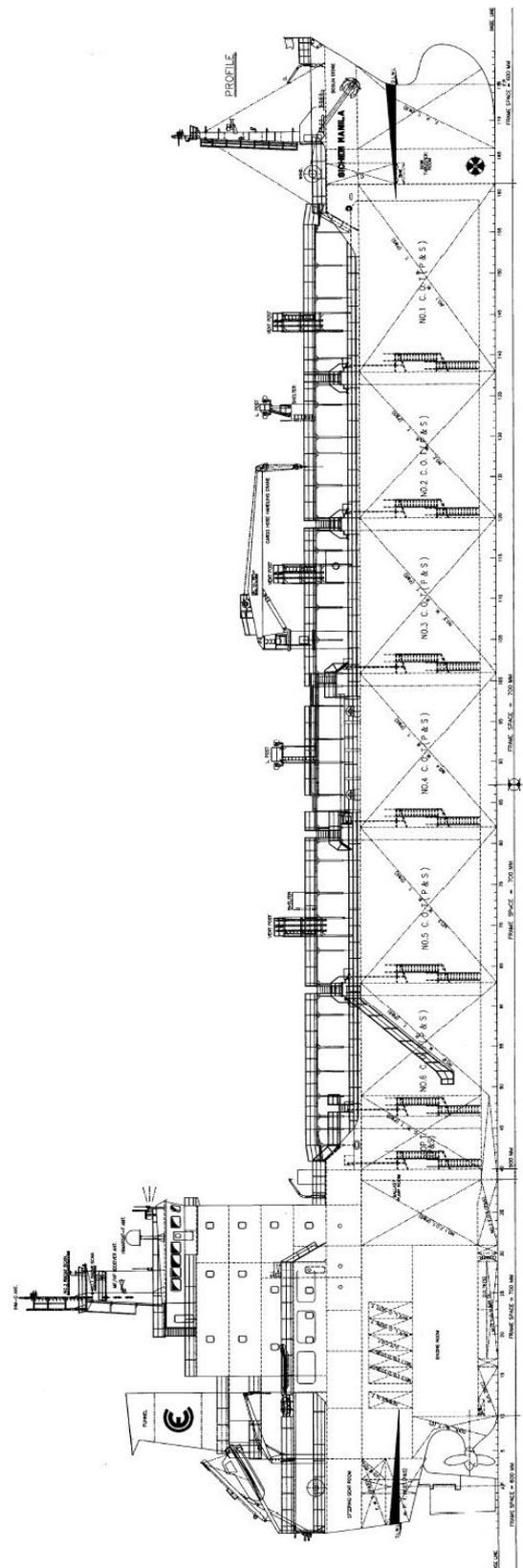


Figure 1: Extract of the General Arrangement Plan – *Sichem Manila*

authorities on 15 March 2017. He had joined the vessel on 31 July 2019 at the port of Algeciras, Spain.

The Peruvian chief officer was 36 years old. He had about 15 years of seafaring experience, 1.5 of which in the rank of a chief officer with STCW II/2 qualifications. His certificate of proficiency was issued by the Peruvian authorities on 24 October 2018. He had joined the vessel on 15 February 2020, at Tarragona anchorage, Spain. The vessel's records indicated that he had been familiarized with cargo tank cleaning operations, by the off-signing chief officer, on 15 February 2020, prior to taking over responsibilities. It was also reported that this was his third consecutive assignment as chief officer on board *Sichem Manila*.

The ordinary seafarer (OS) was a 33-year old Honduran national. He had about three years of seafaring experience, two of which were served in the rank of an OS. He held STCW II/5 qualifications, and his certificate of proficiency was issued by the Honduran authorities, on 23 September 2016. He had joined the vessel on 05 December 2019 at the port of Algeciras, Spain.

The pumpman was also a 33-year old Honduran national. He had about 11 years of seafaring experience, almost one of which in the rank of a pumpman. He held STCW II/4 and III/4 qualifications. His most recent certificate of proficiency was issued by the Honduran authorities on 10 October 2016. In addition, he had undertaken an advanced training course in oil and chemical tanker operations. He had also joined the vessel on 05 December 2019 at Algeciras, Spain.

Environment

Around the time of the accident, the weather was reported to have been clear with a visibility of eight nautical miles (nm). The winds were blowing from a South Southeasterly direction at eight knots. The sea state was reportedly slight with a low,

Southeasterly swell. The air temperature was 14 °C.

Narrative²

Sichem Manila departed from the port of Algeciras, Spain, on 13 February 2020. In ballast condition, the vessel proceeded to Tarragona, Spain, to load her cargo. On arrival, the vessel anchored within the anchorage area of Tarragona, to carry out planned cargo tank cleaning operations prior to berthing and loading operations.

A scheduled change in the vessel's chief officer took place, with the relieving chief officer joining the vessel on 15 February and taking over responsibilities on 16 February. After taking over, the chief officer prepared a tank cleaning plan and conducted a job safety analysis for the tank cleaning operations.

On 16 February, at around noon, the chief officer held a toolbox meeting with the deck crew members. Details of the planned tank cleaning operations, relevant safety precautions and the correct use of personal protective equipment (PPE) were discussed.

The pumpman and two able seafarers (AB) were assigned duty from 0000 to 0600 and from 1200 to 1800; while the bosun, AB 1 and the OS were assigned duty from 0600 to 1200 and from 1800 to 2400.

The planned tank cleaning operations included cold sea water washing of each cargo tank – from nos. 1 port (P) and starboard (S) cargo oil tanks (COT) to nos. 5P and S COTs, using the fixed and portable machines for two hours, followed by a hot sea water wash, again using the fixed and portable machines, for a further 1.5 hours. Thereafter, the plan was to steam each pair of tanks, strip the contents of the tanks, ventilate them and mop them dry.

² Unless otherwise specified, all times mentioned in this safety investigation report are in local time (LT = UTC + 1).

No. 6S COT was designated as a slop tank, into which the wash water had to be transferred from the washed COTs. All COTs had been inerted and it was also planned to have the inert gas generator running continuously during the operations.

At 1300, COT cleaning operations were commenced with the planned cold sea water wash. The operation was completed at about 2100, following which, preparations were made for the hot sea water wash. At around midnight, the hot (75 °C) sea water wash was initiated at the forward tanks. During both cold and hot sea water washes, the tank cleaning pump was set to deliver a pressure of 8.0 bar in the tank cleaning pipeline.

At 0740, on 17 February, the sea water temperature was observed to be low. At the time, washing was undergoing in no. 4P COT. Operations were suspended. At 1000, the hot washing of no. 4P COT was resumed, following which the bosun went to rest and, at around 1100, the pumpman reported on deck.

At around 1128, the chief officer instructed the pumpman to open the tank cleaning machine valves of no. 5S COT. At that time, AB 1 was near the valves of the cargo tank cleaning line to no. 4P COT whilst the OS was beside the tank dome of no. 4P COT, monitoring the tank cleaning hose which was inside it. The pumpman was at the starboard cargo manifold (Figure 2). The chief officer was busy in the cargo control room (CCR), adjusting the no. 4P cargo pump rpm to transfer the wash water from no. 4P COT to no. 6S (slop tank).

When the tank cleaning machine valves of no. 5S COT were opened, the chief officer observed the pressure in the tank cleaning line to drop from 8.0 bar to 6.0 bar. He then instructed AB 1 to shut the portable tank

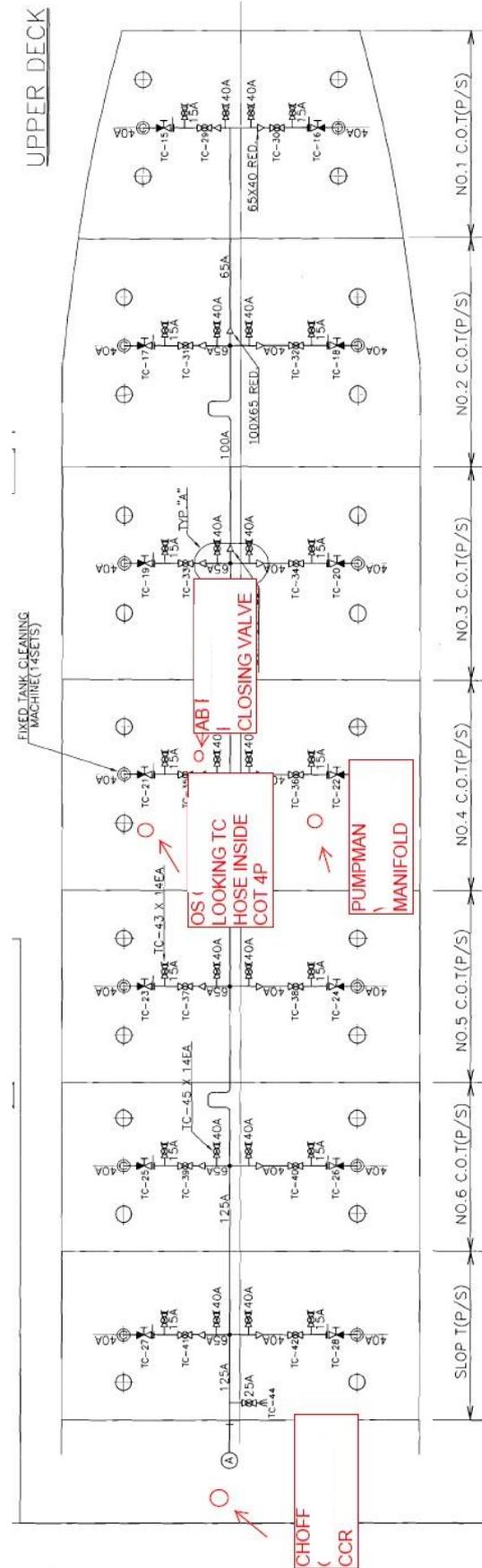


Figure 2: Extract of the Tank Cleaning System Plan, showing the location of the crew members

cleaning machine valves of no. 4P COT.

At about 1130, whilst AB 1 was shutting the valve, the valve block burst open (Figure 3). Consequently, the pressurized, hot wash water sprayed over AB 1's left arm (Figure 4). As he tried to turn away to protect his face, the hot water continued to spray onto the left side of his body (Figure 5).



Figure 3: Valve block which burst open



Figure 4: Simulation of hot water spraying onto AB 1, while shutting the valve



Figure 5: Simulation of AB 1 trying to protect his face from the hot water spray

Post-accident actions

The OS and the pumpman heard the sound of water spraying as well as AB 1's calls for help. The OS immediately reported the matter to the chief officer via the portable radio. Immediately, the chief officer ordered the pumpman to stop the tank cleaning operation. He then informed the master and the second officer of the accident and proceeded down towards the main deck.

In the meantime, the OS assisted AB 1 towards the accommodation, removed AB 1's PPE, and sprayed cold fresh water over him. At around 1135, after the chief officer arrived and assisted AB 1 to the hospital, where the second officer administered first aid. At around 1140, the chief officer instructed the pumpman to remove the damaged valve, blank off that section of the COT cleaning line, and resume the cleaning operation.

At around 1404, after evaluating the situation, the master contacted *International SOS* for medical advice, following which, he notified the Company of the accident. At around 1642, the master contacted the vessel's local agents to arrange for a boat to pick up the injured AB and transfer him to a hospital ashore for further medical treatment.

Injuries suffered by AB 1

At the hospital ashore, it was observed that the AB 1 had suffered second and third degree burns to his left leg, left part of the abdomen and his left hand. The extent of burns was stated to be between 18% and 20%. Following treatment, he was discharged from the hospital on 20 April 2020. Reportedly, he was expected to be fit to resume duty by the beginning of October 2020.

PPE worn by AB 1

It was reported that at the time of the accident, AB 1 was wearing coveralls, a

safety helmet with a face shield, safety gloves and rubber boots (Figure 6).



Figure 6: PPE worn by AB 1

Damaged valve block

The damaged valve block was made of stainless steel. Of the four securing bolts of this block, three were mild steel, while the other was stainless steel. All the three mild steel bolts had ruptured. A closer look at the ruptured bolts indicated heavy corrosion of the bolts.

Reportedly, the stainless steel-valve block and the valve itself, which was a stainless steel-ball valve, were not damaged.

Pressure test of the tank cleaning system

The design pressure of the COT cleaning line was 10 bar. In accordance with the Company's guidelines, the COT cleaning line and associated valves were reportedly pressure tested 1.5 times the design pressure on 16 November 2019. This test was conducted by filling the line with seawater, with the tank cleaning branch valves shut, to build up a pressure of 15 bar in the line. This pressure was maintained for 20 minutes.

The safety investigation was informed that during the test, no leaks were observed in any of the components of the COT cleaning system.

Job safety analysis

In accordance with the Company's procedures, a Job Safety Analysis (JSA) was reportedly performed on 16 February 2020, for the COT cleaning operation. This JSA included a risk assessment, which addressed the hazards associated with the task.

The listed hazards included, amongst others, injury to crew members while working on deck, damage of equipment due to improper operation, in correct operation / unfamiliarity with the operation, and pressurized lines / hoses.

Reportedly, the tank cleaning plan and job safety analysis were discussed among all deck crew members and the engine-room officers.

Records of hours of work / rest

The work / rest hour records of the crew members indicated that their rest periods were in line with the requirements of the STCW Code³ and MLC, 2006⁴. AB 1 had a rest period of six consecutive hours, prior to resuming work on 17 February at 0600.

Consumption of drugs and/or alcohol

Following the accident, an alcohol test conducted on AB 1, the chief officer, the pumpman and the OS. The results of this test were negative for all of them.

³ IMO. (2010). *The Manila amendments to the annex to the International convention on standards of training, certification and watchkeeping for seafarers (STCW)*, 1978. London: Author.

⁴ ILO. (2006). *Maritime Labour Convention*. Genève: Author.

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.

Cause of injuries suffered

The burn injuries suffered by AB 1 were caused by the spray of hot seawater (75 °C) from the COT cleaning line, after the valve block burst open whilst it was being closed.

Failure of the valve block

The three mild steel bolts which were used to secure the valve block had failed. The ruptured bolts were not made available to the safety investigation for further inspections / tests, as they had reportedly been disposed of, following the accident. However, a closer look at photographic information indicated heavy corrosion of the bolts, which would have compromised their strength (Figure 7).



Figure 7: Close-up on the valve block, showing one of the ruptured bolts (circled in yellow)

The safety investigation, therefore, hypothesized that when the stainless steel-ball valve was turned to shut off the flow of the hot wash water, the pressurized stream of water was directed onto the part of the valve block where the strength of the bolts was already compromised by their corrosion. This pressurized stream of water was enough

to cause the corroded bolts to rupture, and the valve block to be pushed open, which resulted in hot water spraying over AB 1.

It was not excluded that a pressure surge towards the valve, or, what is commonly known as a water hammer effect, may have developed when the valve was shut off. This may have caused the valve block to rupture at its weakest points *i.e.*, the corroded mild steel bolts.

Corrosion of the bolts

In all probability, the ruptured bolts had been affected by galvanic corrosion, considering that they were mild steel bolts used to secure the stainless-steel valve block.

Galvanic corrosion⁵ (or dissimilar metal corrosion) occurs when two different metals are coupled together in an electrically conductive electrolyte. This coupling leads to a flow of electrons from the less noble metal (anode) to the more noble metal (cathode), resulting in a deterioration of the anode.

On board vessels, the coupling between stainless steel and mild steel (low carbon steel), when exposed to water (seawater, rainwater, *etc.*), would result in the galvanic corrosion of mild steel.

Galvanic corrosion will not occur when:

- the two dissimilar metals are insulated from each other (using washers / bushes), or
- the point(s) of contact between the two dissimilar metals are not exposed to water / humidity, or
- when the cathode or the cathode and the anode are coated, either near the

⁵ Euro Inox. (2009). *Stainless steel in contact with other metallic materials* (Vol. 10). Retrieved from https://www.worldstainless.org/Files/issf/non-image-files/PDF/Euro_Inox/Contact_with_Other_EN.pdf

point(s) of contact or on large surface areas, or

- when two similar metals are coupled together.

Moreover, although the paint coating on the block and the bolts would have offered a degree of protection to the exposed surfaces, water / moisture could have penetrated through the small gaps, thereby facilitating the corrosion process.

During the safety investigation, it was revealed that extensive works were conducted on the vessel in 2015, whilst she was under the management of a different company. The current ISM Management of the vessel, V.Ships UK Ltd., had taken the vessel under its management on 30 October 2019.

Further checks by the Company revealed another valve on the COT cleaning line, which was fitted with mild steel bolts. It is highly likely that these mild steel bolts were fitted before the change in the vessel's management and slipped past routine checks due to the paint coating.

PPE

AB 1 was reportedly wearing coveralls, a safety helmet with a face shield, safety gloves and rubber boots.

While, in hindsight, it could be stated that additional PPE would have prevented / minimized the extent of the injuries suffered by AB 1, one must bear in mind that cargo tank cleaning operations were routinely performed on board *Sichem Manila*. The cargo tanks were located below the vessel's deck while the crew members were on the deck, where the chances of water spraying over them were extremely minimal. Furthermore, the weather was reportedly clear when the operations were being carried out.

Therefore, in all probability, the crew members would not have felt the need for any additional protective clothing, while the operations were being carried out on the main deck. Then, neither did the vessel's SMS Manual, nor the job safety analysis recommend the use of additional PPE for the cargo tank cleaning operation.

Moreover, the cargo tank cleaning system was reportedly tested to a pressure of 15 bar for about 20 minutes, just a few months prior to the accident. The safety investigation hypothesized that, on account of this recent test, the crew members may have considered the probability of water spraying from a damaged or defective pipe / valve as extremely remote. Therefore, the use of additional protective clothing may have been deemed unnecessary.

Fatigue and drug / alcohol consumption

Work / rest periods of AB 1 complied with the relevant international requirements. The safety investigation, however, could not confirm the quality of his rest hours. Nevertheless, in the absence of any evidence, which could have indicated that his actions or behaviour were symptomatic of fatigue, fatigue was not considered as a contributory factor to this accident.

While the results of an alcohol test, conducted on board after the occurrence, were negative, a drug test was not conducted. Therefore, in the absence of any evidence which could have indicated that the crewmembers' actions or behaviour were influenced by effects of drug consumption, drugs and / or alcohol was not considered a contributory factor to this accident.

CONCLUSIONS

1. AB 1 suffered second and third-degree burns following the failure of the block of a branch valve, which burst open whilst the injured AB was shutting it, causing hot sea water at 75 °C to spray onto him.
2. Neither was the valve block nor the valve damaged due to this occurrence.
3. The mild steel bolts holding the valve block and the valve bridge were heavily corroded, possibly due to a galvanic reaction with a dissimilar metal.
4. The corroded bolts may have ruptured after a pressurized stream of hot water was directed onto the part of the block in the vicinity of these bolts, causing the valve block to burst open.
5. It was not excluded that a water hammer effect may have developed when the valve was shut, resulting in the rupture of the corroded mild steel bolts of the valve block.
6. It is highly likely that the material of the bolts, as well as their corrosion, was not noticed by the crew members due to the paint coating covering them.
7. The PPE worn by the injured AB did not protect him against the hot water spray.

SAFETY ACTIONS TAKEN DURING THE COURSE OF THE SAFETY INVESTIGATION⁶

During the safety investigation, the Company took the following measures to prevent similar accidents on board its vessels:

1. All bolts on the *Sichem Manila*'s cargo tank cleaning line were checked and replaced, as necessary, with stainless steel bolts.
2. All vessels under the Company's management were instructed to check the fittings of their respective cargo tank cleaning lines.
3. All serving masters were instructed to record the pre-operation checks of the cargo tank cleaning system in the deck logbook.
4. The planned maintenance system of the Company's vessels was revised to include the inspection of the tank cleaning line and bolts during the Company's recommended annual pressure test of the tank cleaning line.

RECOMMENDATIONS

Considering the actions taken by the Company, following this accident, no recommendations have been issued.

⁶ Safety actions shall not create a presumption of blame and / or liability.

SHIP PARTICULARS

Vessel Name:	<i>Sichem Manila</i>
Flag:	Malta
Classification Society:	DNV-GL
IMO Number:	9322097
Type:	Oil / chemical tanker
Registered Owner:	Team Tankers City Class Ltd.
Managers:	V.Ships UK Ltd., United Kingdom
Construction:	Steel (double hull)
Length Overall:	128.60 m
Registered Length:	120.85 m
Gross Tonnage:	8,562
Minimum Safe Manning:	13
Authorised Cargo:	Liquid in bulk

VOYAGE PARTICULARS

Port of Departure:	Algeciras, Spain
Port of Arrival:	Tarragona, Spain
Type of Voyage:	Short international
Cargo Information:	In ballast – 4,000 mt
Manning:	18

MARINE OCCURRENCE INFORMATION

Date and Time:	17 February 2020 – 1130 LT
Classification of Occurrence:	Serious marine casualty
Location of Occurrence:	Tarragona anchorage, Spain
Place on Board	Main deck
Injuries / Fatalities:	One serious injury
Damage / Environmental Impact:	Damage to bolts of a valve / None
Ship Operation:	At anchor – Cleaning/washing
Voyage Segment:	Anchored
External & Internal Environment:	Clear weather, with a visibility of 8 nm; South Southeasterly, gentle breeze. Slight seas and low swell.
Persons on board:	18