REPUBLIC OF THE MARSHALL ISLANDS

Maritime Administrator

TRF KASHIMA MARINE SAFETY INVESTIGATION REPORT

Fatal Enclosed Space Entry

South China Sea | 14 July 2024

Official Number: 6611

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DISCLAIMER

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AUTHORITY

An investigation, under the authority of the Republic of the Marshall Islands laws and regulations, including all international instruments to which the Republic of the Marshall Islands is a Party, was conducted to determine the cause of the casualty.

Maritime Administrator

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LIST OF ABBREVIATIONS AND ACRONYMS

2/O. . . . . Second Officer

C/O . . . . . Chief Officer

ASD. . . . . Able Seafarer Deck

CCR. . . . . Cargo Control Room

Circ.. . . . . Circular

CPR. . . . . Cardiopulmonary Resuscitation

CT or Cargo Tank . . . . . Cargo Tank

DWT . . . . . Deadweight Tonnage

EEBD . . . . . Emergency Escape Breathing Device

FW. . . . . Fresh Water

ILO . . . . . International Labour Organization

IMO. . . . . International Maritime Organization

JWKO . . . . . Junior Watchkeeping Officer

LAYCAN . . . . . Laydays / Canceling

m . . . . . Meter

MRCC. . . . . Maritime Rescue Coordination Center

MSC . . . . . Maritime Safety Committee

MT. . . . . Metric Tons

No. . . . . Number

OICNW. . . . . Officer in Charge of a Navigational Watch

OOW. . . . . Officer on Watch

OS . . . . . Ordinary Seafarer

P or Port . . . . . Port

PPE . . . . . Personal Protective Equipment

ppm . . . . . Parts per Million

QHSE . . . . . Quality, Health, Safety, and Environment

RO. . . . . Recognized Organization

RSC. . . . . Rescue Sub-center

S or Starboard . . . . . Starboard

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

SAR . . . . . Search and Rescue

SCBA . . . . . Self-contained Breathing Apparatus

SMC . . . . . Safety Management Certificate

SMS . . . . . Safety Management System

STEL . . . . . Short-term Exposure Limit

US NIOSH . . . . . United States National Institute for Occupational Safety and Health

UTC . . . . . Coordinated Universal Time

WMA . . . . . Warsash Maritime Academy

WMU . . . . . World Maritime University

DOCUMENTS CITED

ISM Code . . . . . International Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management Code)

MLC, 2006 . . . . . Maritime Labour Convention, 2006

STCW Code . . . . . Seafarers Training, Certification and Watchkeeping Code

MARPOL . . . . . International Convention for the Prevention of Pollution from Ships

STCW . . . . . International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978

IMO Resolution MSC.1/Circ.1598 . . . . . Guidelines on Fatigue

Modelling the Hours of Work and Rest . . . . . Modelling the Hours of Work and Rest of Merchant Navy Watch Keepers and Tug Crews

A Culture of Adjustment . . . . . Evaluating the Implementation of the Current Maritime Regulatory Framework on Rest and Work Hours

PART 1: EXECUTIVE SUMMARY

On 14 July 2024, the Republic of the Marshall Islands-registered oil/chemical tanker TRF KASHIMA, managed by Anglo Eastern Shipmanagement (Singapore) PTE. LTD. (the "Company"), was underway in the South China Sea en route to the Republic of Singapore (hereinafter "Singapore"), where the ship was due to arrive on the morning of 16 July 2024. Work being done on board included cleaning of the ship's cargo tanks.

At 1646,[1] either the Pumpman or OS2 reported by radio that the C/O had collapsed inside No. 6 S CT. The Master immediately directed the OOW to sound the general alarm and to make an announcement for crewmembers to proceed to No. 6 S CT for an enclosed space rescue.

The Master and other crewmembers arrived at the No. 6 S CT dome at 1649. They found the access hatch open and saw the C/O lying on the upper platform and the Pumpman lying on the second platform inside the cargo tank. The OS2 could not be seen.

A rescue was conducted in accordance with the ship's enclosed space rescue plan. By 1705, the C/O, Pumpman, and OS2, who had been found lying under the Pumpman on the second platform, had been removed from the cargo tank. When they were each removed from the cargo tank, all three were unconscious but were breathing and had a pulse, however the OS2's pulse was weak. Crewmembers started administering CPR and medical oxygen to the OS2 before moving him to the ship's Hospital, where crewmembers continued to administer CPR and medical oxygen. The C/O regained consciousness within a few minutes after being administered medical oxygen before being taken to the ship's Hospital. The Pumpman remained unconscious after being administered medical oxygen and was also moved to the ship's Hospital where crewmembers continued administering medical oxygen.

The Master sought shoreside medical advice and then diverted the ship toward the nearest port so that the C/O, Pumpman, and OS2 could be disembarked for medical treatment. By 1750, the Pumpman had regained consciousness but was continuing to have difficulty breathing and, by 1755, the C/O was determined to be in stable condition. The OS2 remained unresponsive and at 2000, crewmembers stopped administering CPR after the shoreside medical doctors determined he was deceased.

TRF KASHIMA rendezvoused with a SAR vessel shortly before 0300 on 15 July 2024. A rescue team, which included a medical doctor and a police officer embarked the ship. The rescue team members examined the C/O, Pumpman, and

1 Unless stated otherwise, all times are ship's local time (UTC +8).

OS2 and at 0322 confirmed that the OS2 was deceased. The rescue team, along with the C/O and Pumpman, safely disembarked to the SAR vessel, which immediately proceeded to shore, where the Pumpman was admitted to the hospital for medical treatment.[2]

The marine safety investigation conducted by the Republic of the Marshall Islands Maritime Administrator (the "Administrator") determined the C/O had entered the No. 6 S CT to take pictures required by the Charterer and that the OS2 and Pumpman entered the cargo tank to aid the C/O after they saw him lying on the upper platform. The entry into the cargo tank by the three crewmembers was not conducted in accordance with the ship's enclosed space entry procedures and without taking any required precautions. It was also determined that the C/O had previously made multiple entries into the ship's cargo tanks, also to take pictures required by the Charterer, while cargo tank cleaning operations were conducted on 9–11 and 13–14 July 2024. Evidence of a lack of oversight by the Master, crewmember fatigue, and that records of work and rest hours were not being accurately maintained were also identified.

The following lessons learned were identified.

- Enclosed spaces should never be entered for any reason, including to assist a fellow crewmember, without implementing established shipboard procedures.
- Masters and other senior officers must place safety above all else, and through both their words and actions, provide a positive example for junior officers and ratings.
- Deviations from established procedures increase the risk of accidents.

PART 2: FACTUAL INFORMATION

The following Factual Information is based on the information obtained during the Administrator's marine safety investigation.

Ship particulars at the time of the incident: *see* chart to right.

SHIP PARTICULARS

Vessel Name
TRF KASHIMA

Registered Owner
WLR/TRF KZ Holding I LLC

ISM Ship Management
Anglo Eastern Shipmanagement (Singapore) PTE. LTD.

Flag State
Republic of the Marshall Islands

IMO No.	Official No.	Call Sign
9733349	6611	V7PA8

Year of Build	Gross Tonnage
2015	12,225

Net Tonnage	Deadweight Tonnage
6,255	19,950

Length x Breadth x Depth
139.3 x 24.2 x 13.2 m

Ship Type
Oil/Chemical Tanker

Document of Compliance Recognized Organization
DNV GL

Safety Management Certificate Recognized Organization
DNV GL

Classification Society
DNV GL

Persons on Board
22

2 As of the date of publication of this report, the Pumpman remains in a minimally conscious state requiring long term domestic medical care.

TRF KASHIMA was built with ten pairs of cargo tanks *(see Figure 1)*. Each cargo tank had a separate cargo line and vent.

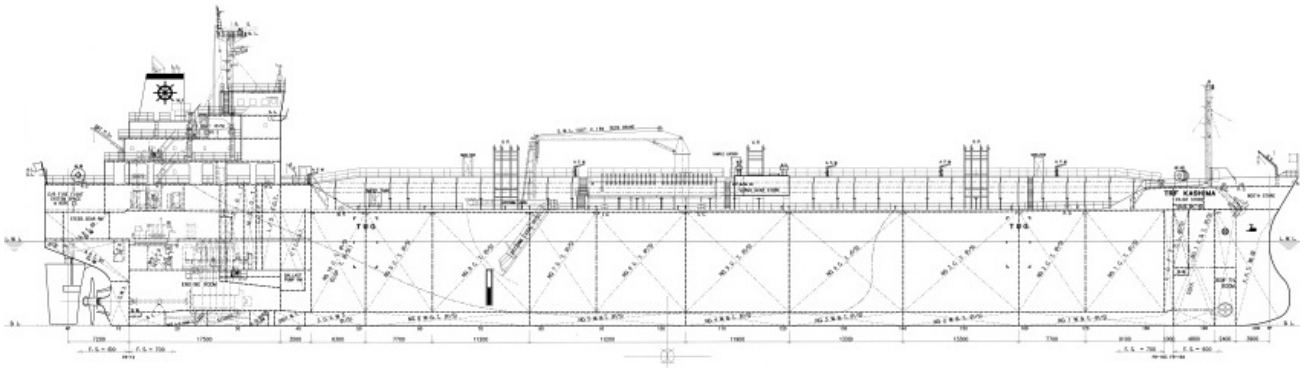

Figure 1: TRF KASHIMA General Arrangement.

Narrative

TRF KASHIMA departed Al Jubail, Kingdom of Saudi Arabia on 16 June 2024 after loading parcels of Di Ethylene Glycol, Methanol, Methyl Metha Acrylate, and Mono Ethylene Glycol in 17 of the ship's 20 cargo tanks. No. 1 P CT contained MARPOL Annex I slops from a prior voyage. Nos. 5 P and 10 S CTs were both empty. The ship's loading was as shown in the following table:

No. 1 P CT MARPOL Annex I Slops	No. 1 S CT Di Ethylene Glycol
No. 2 P CT Mono Ethylene Glycol	No. 2 S CT Mono Ethylene Glycol
No. 3 P CT Mono Ethylene Glycol	No. 3 S CT Mono Ethylene Glycol
No. 4 P CT Methanol	No. 4 S CT Methanol
No. 5 P CT Empty	No. 5 S CT Methyl Metha Acrylate
No. 6 P CT Mono Ethylene Glycol	No. 6 S CT Mono Ethylene Glycol
No. 7 P CT Mono Ethylene Glycol	No. 7 S CT Mono Ethylene Glycol
No. 8 P CT Mono Ethylene Glycol	No. 8 S CT Mono Ethylene Glycol
No. 9 P CT Methanol	No. 9 S CT Methanol
No. 10 P CT Methanol	No. 10 S CT Empty

The cargo tanks loaded with Mono Ethylene Glycol were padded with nitrogen[3] supplied from shore during cargo loading to ensure the quality of the cargo by maintaining the oxygen level inside these cargo tanks was less than 3%. The cargo tanks loaded with Di Ethylene Glycol, Methanol, Methyl Metha Acrylate, and MARPOL Annex 1 slops had not been inerted. The two empty cargo tanks were both gas-free.

The ship was scheduled to discharge cargo at Singapore; Kuantan, Malaysia; and Dong Nai, Socialist Republic of Vietnam.

On 25 June 2024, the Company informed TRF KASHIMA's Master that after the current cargo was discharged, the ship should proceed to Pelintung, Republic of Indonesia to load a cargo of cooking oil. The LAYCAN[4] for loading was 12–18 July 2024.

Two days later, on 27 June 2024, the Company informed the Master that to comply with the Charterer's instructions it was necessary to passivate[5] all the cargo tanks except for No. 5 S CT and that all cargo tanks had to be Kosher washed (e.g., steamed) before loading cargo at Pelintung since the last three cargoes carried in each of the cargo tanks had included used cooking oil. The Company also provided the Master with the Charterer's instructions for passivating and Kosher washing the cargo tanks.[6] Lastly, the Company advised the Master that arrangements were being made for a third-party surveyor to remotely issue a passivation certificate and for a Rabbi to remotely approve the Kosher wash. The Master acknowledged the instructions regarding the need to passivate and Kosher wash the cargo tanks. He also advised the Company that it would not be possible to passivate and Kosher wash the cargo tanks until after the ship departed Dong Nai.

TRF KASHIMA anchored off Singapore for attendance by a cargo surveyor and to await berthing instructions at 1606 on 4 July 2024. During the port call at Singapore, it was planned to discharge cargo at three different berths.

The ship was underway from the anchorage by 0700 on 5 July 2024 and was moored at the first discharging terminal at 0836. After finishing discharge operations at the first terminal, the ship shifted to the second terminal, where it was moored at 0818 on 6 July 2024. Upon completing the planned discharge at the second terminal, the ship shifted to the third terminal and was moored at 2300. Cargo discharge operations were completed at the third terminal at 1230 on 7 July 2024 after which TRF KASHIMA departed Singapore for the voyage to Kuantan.

While in Singapore from 5–7 July 2024, the ship was engaged in cargo-related activities for just over 49 hours. During this time, the entire contents of Nos. 4 P, 4 S, 9 P, 9 S, and 10 P CTs were discharged in air at the first two terminals.[7] The entire contents of No. 3 P CT and all but 29 MT of the contents of No. 6 S CT were discharged at the third terminal. The discharge from No. 3 P CT was an open discharge. Nitrogen was supplied from shore during the discharge of No. 6 S CT to pad the 29 MT of Mono Ethylene Glycol that remained in the cargo tank by keeping the oxygen level at less than 3%. Additionally, the MARPOL slops in No. 1 P CT were also discharged ashore in air.

3 Nitrogen is a colorless, odorless gas. It has a vapor density of 0.967 and is lighter than air. The recommended STEL established by US NIOSH is 1 ppm. Nitrogen is immediately dangerous to life at concentrations of 13 ppm and above. *See US NIOSH Pocket Guide to Chemical Hazards* (https://www.cdc.gov/niosh/npg/npgd0454.html).

4 LAYCAN when used in a Charter Party establishes a range of dates when the ship is expected to arrive at the loading port ready to load cargo. The Charterer can cancel the Charter Party if the ship does not arrive at the load port ready to load cargo within the stated period.

5 Passivation is conducted on board ship by spraying the cargo tanks with either a nitric acid or citric solution after they are washed. The purpose for passivation is to form a thin, protective oxide layer on the interior of the cargo tank that both protects the cargo tank against corrosion and cargo from being contaminated.

6 The Charterer's instructions and the Company's review of the cargo tank cleaning plan prepared by TRF KASHIMA's C/O is discussed later in the report.

7 During an "in air" or open discharge, air enters the cargo tank through the cargo tank venting system as the contents of the cargo tank are discharged. Any nitrogen or inert gas that might be in the cargo tank is not replaced.

On 8 July 2024, while TRF KASHIMA was en route to Kuantan, the Master issued risk assessments for gas freeing, cleaning, and mopping the ship's cargo tanks. Some of the hazards and associated controls identified on these risk assessments are shown in the following table.

HAZARDS	EXISTING CONTROLS
Fatigue	• STCW work/rest periods • Planning of tank cleaning operations • Master to ensure that jobs are planned in a manner to ensure sufficient rest for crewmembers
Access hatch opened while tank atmosphere is unsafe	• Tank access hatch is not to be opened until the tank is gas- freed and tested safe for entry • Tank cleaning chemicals, fresh water, etc. to be added through tank cleaning hatch or ullage ports • Same to be briefed to staff before tank cleaning operations and to be ensured throughout the operation
Handling nitrogen or working near nitrogen atmosphere	• A breath of nitrogen can be fatal • SMS mandated warning signs must be posted • All staff must be familiarized with nitrogen hazards, especially in enclosed spaces or areas near tank vents, and follow safety precautions

The C/O conducted a Toolbox Talk that was attended by the Pumpman, deck ratings, and Deck Cadet during which the cargo tank cleaning plan and risk assessments were reviewed.

Following the Toolbox Talk, the C/O, Pumpman, deck ratings, and Deck Cadet[8] cleaned and ventilated Nos. 3 P, 4 P, 4 S, 9 P, 9 S, and 10 P CTs. The atmosphere in each of these cargo tanks contained 20.9% oxygen and had no detectable hydrocarbons after they were ventilated. None of these cargo tanks were passivated or steamed since they were adjacent to cargo tanks containing Mono Ethylene Glycol. They also started cleaning No. 1 P CT. Cargo tank cleaning operations were conducted from approximately 0130 until about 1400.

At 2248, a pilot embarked and by midnight on 9 July 2024, TRF KASHIMA was moored at Kuantan. Cargo discharge operations commenced at 0100 and were completed by 1800, after which the ship got underway and proceeded en route to Dong Nai. At Kuantan, the contents of Nos. 1 S and 5 S CTs were discharged. The discharge from both tanks was an in air discharge.

After the ship was at sea en route to Dong Nai, the C/O, Pumpman, deck ratings, and Deck Cadet resumed cargo tank cleaning operations at 2230 and continued working until about 0600 on 10 July 2024. Cargo tank cleaning operations were also conducted between about 1430–1730 on 10 July 2024 and 0900–1330 on 11 July 2024.[9] During this time, the

8 The working arrangements of the C/O, Pumpman, deck ratings, and Deck Cadet are discussed later in the report.

9 On 11 July 2024, the ship's clocks were set ahead one hour to conform with local time in Dong Nai (UTC +7). All times for 11 July 2024 and onward are UTC +7.

ship's crewmembers finished cleaning No. 1 P CT and while also cleaning the two cargo tanks that had been emptied at Kuantan, Nos. 4 P, 10 P, and 10 S CTs were also passivated and steamed. The other empty cargo tanks were not passivated or steamed since the adjacent cargo tanks contained Mono Ethylene Glycol.

It was not necessary for crewmembers to enter the cargo tanks to clean or passivate them. Entry into the cargo tanks was necessary to take the pictures required by the Charterer after they were passivated and to mop them dry.

The C/O entered Nos. 4 P, 10 P, and 10 S CTs after they were passivated to take photographs required by the Charterer of the inside of each cargo tank from the top platform. There is no record that an enclosed space entry permit was issued before the C/O entered these cargo tanks to take the pictures. It could also not be confirmed if any crewmember had seen the C/O entering or exiting any of these cargo tanks.

TRF KASHIMA anchored offshore Dong Nai at approximately 1900 on 11 July 2024. After weighing anchor and embarking a pilot, the ship proceeded inbound to Dong Nai just after 2300. The ship was moored at 0348 on 12 July 2024 and shortly thereafter started discharging all the cargo that remained on board from Nos. 2 P, 3 S, 6 P, 6 S, 7 P, 7 S, 8 P, and 8 S CTs by in air discharge. By 0500 on 13 July 2024, all cargo had been discharged.

A pilot embarked TRF KASHIMA at 0854 and the ship got underway a short time later. The outbound passage to sea was completed by approximately 1330 and the ship commenced the sea passage to Singapore, where the ship was scheduled to conduct a crew change and to receive bunkers and stores, before proceeding to Pelintung to load cargo.[10] The sea passage from Dong Nai to Singapore was estimated to require 54 hours, which placed the ship's estimated arrival time at approximately 1700 on 15 July 2024. However, based on an agreement between the Company and the Charterer, the Master declared the ship's estimated arrival as 0800 on 16 July 2024.

After the ship was at sea, the C/O conducted a Toolbox Talk with the Pumpman, deck ratings, and Deck Cadet to review the plan for cleaning the ship's cargo tanks and the risk assessments that had been approved by the Master on 8 July 2024. The C/O, Pumpman, deck ratings, and Deck Cadet resumed cargo tank cleaning operations. Between 1600–1800 they cleaned all the cargo tanks that had been emptied at Dong Nai. By 2000, they started to passivate and Kosher wash all the cargo tanks except for Nos. 4 P, 10 P, and 10 S CTs, which had been passivated and Kosher washed after the ship departed from Kuantan.

The citric acid solution used for passivation was introduced into the cargo tanks by opening the access hatch and then pouring the solution into the cargo tank. The access hatch was closed while the citric acid solution was circulated inside the cargo tank.

After a cargo tank was passivated, the C/O, who was wearing a personal gas detector, opened the access hatch and entered the cargo tank to take photographs from the top platform. There is no record that an enclosed space entry permit was issued or that the atmosphere inside the cargo tank was tested for these entries. It could not be determined if any crewmembers had seen the C/O entering or exiting a cargo tank.

10 The passage from Singapore to Pelintung was approximately 8–10 hours.

Passivation and steaming of the remaining 17 cargo tanks continued without stopping until approximately 1600 on 14 July 2024 when passivation of all the cargo tanks had been completed. By this time, all the cargo tanks except for Nos. 6 P and 6 S CTs had also been photographed by the C/O and then steamed. It was planned to ventilate the cargo tanks overnight and for the crewmembers to mop them during the day on 15 July 2024.

At approximately 1620, the Master had the OOW call the C/O, who was on deck, to the Bridge. The C/O arrived on the Bridge a few minutes later after stopping in the CCR, where he left his flashlight, radio, and personal gas detector. After the C/O reached the Bridge, he and the Master discussed the Charterer's cargo tank cleaning instructions and the stowage plan for the cargo that would be loaded at Pelintung. The Master also asked the C/O to prepare a time log for the cargo tank passivation and to transfer the videos required by the Charterer of each step of the Kosher wash to a shared folder on the ship's computer. The C/O left the Bridge at 1633 and went back out on deck without stopping in the CCR to collect his flashlight, radio, and personal gas detector.

At 1642, the Pumpman called the Deck Cadet, who was in the CCR, by radio and asked him to bring the C/O's flashlight to the C/O. The Deck Cadet took the flashlight to the C/O, who was standing next to the cargo tank dome for No. 6 S CT *(see Figure 2)*. The Deck Cadet returned to the CCR after giving the flashlight to the C/O. The Pumpman and OS2 were near the cargo pumps for Nos. 6 P and 6 S CTs completing preparations to steam these two cargo tanks. The ASD1 and ASD2 were at the forward end of the port side cargo manifold preparing to ventilate the cargo tanks so that they would be ready for entry on the morning of 15 July 2024. The OS1 was on deck at the cargo pump for No. 8 P CT for stripping any remaining wash water from that cargo tank.

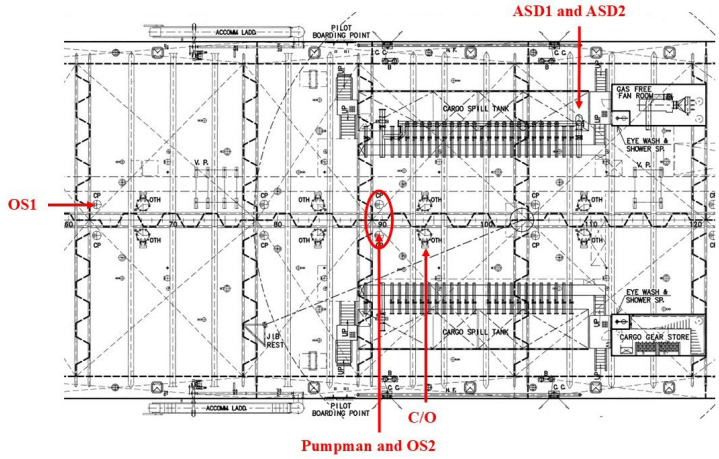

Figure 2: Locations of the crewmembers working on deck when the Deck Cadet brought the C/O's flashlight to the C/O. Both the port and starboard side manifolds were about 3 m above the main deck. The area between the port and starboard side manifolds was covered with grating on which drums were stored.

The C/O entered No. 6 S CT to take photographs of the cargo tank from the upper platform after the Deck Cadet gave his flashlight to him. His entry into the cargo tank was not witnessed by any of the ship's crewmembers. The C/O was not wearing a personal gas detector, the atmosphere inside the cargo tank had not been tested, nor had an enclosed space entry permit been issued for this entry.

Except for the Pumpman and OS2, none of the other crewmembers who were on deck, nor the OOW on the Bridge, had a direct line of sight to the cargo tank dome for No. 6 S CT due to the external frames and the grating and cargo pipelines that were located above the main deck between the port and starboard side manifolds *(see Figure 3)*.

Figure 3: Grating and cargo pipelines above the cargo tank dome for No. 6 S CT.

At 1646, either the Pumpman or the OS2 reported by radio that the C/O had collapsed inside No. 6 S CT.[11] The Master immediately directed the OOW to sound the general alarm and to make an announcement for crewmembers to proceed to No. 6 S CT for an enclosed space rescue.

By 1649, the Master, the 2/O, and other crewmembers had arrived at the cargo tank dome for No. 6 S CT with SCBAs, extra air bottles, gas detectors, EEBDs, and rescue harnesses with lines. Through the open access hatch they observed that the C/O was lying on the top platform, and that the Pumpman was lying on the second platform *(see Figure 4)*. They could not see the OS2.

Figure 4: No. 6 S CT access ladder. The vertical ladder from the cargo tank dome to the upper platform is shown in the photograph on the left. The inclined ladder between the upper platform and the second platform is shown in the photograph on the right. The locations where the C/O and Pumpman were found are circled in red. The OS2 was found lying under the Pumpman.

11 Some crewmembers reported that the crewmember who made this report sounded like the Pumpman.

The atmosphere inside No. 6 S CT was checked as the 2/O and ASD1 donned SCBAs. The atmosphere contained 4.0% oxygen and no detectable carbon monoxide, hydrogen sulfide, or hydrocarbons.[12]

The 2/O and ASD1 entered No. 6 S CT. They observed that the C/O was unconscious but had a pulse and was gasping for breath. An EEBD was placed over his head. They were not able to put a rescue harness on the C/O because of how he was lying on the platform, so they tied a line around his torso. Crewmembers on deck then hoisted the C/O out of the cargo tank at 1653. The C/O was laid on the deck and administered medical oxygen. He regained consciousness a short time later.

The 2/O and ASD1 exited No. 6 S CT and at 1654 a second rescue team consisting of the ASD3 and an Oiler, both of whom were wearing SCBAs, entered No. 6 S CT. They observed that the Pumpman was lying unconscious on top of the OS2 on the second platform *(see Figure 4)*. The second rescue team tried to put a rescue harness on the Pumpman but, due to limited space, they were unsuccessful. After the rescue team tied a line around the Pumpman's torso, he was hoisted out of the cargo tank by crewmembers and placed on the main deck at 1701.

The 2/O examined the Pumpman and confirmed that the Pumpman was unconscious. The 2/O also determined that the Pumpman had a pulse and was breathing weakly. The Pumpman was administered medical oxygen. His breathing improved and he was moved to the ship's Hospital where he continued to be administered medical oxygen.

A third rescue team, which was made up of the JWKO and OS1, wearing SCBAs then entered No. 6 S CT. They placed an EEBD over the OS2's head before attempting to put a rescue harness on him. They were unable to put a rescue harness on him and tied a line around his torso. By 1705, the OS2 had been hoisted out of the cargo tank and was laid on the main deck.

The OS2 was unconscious, had a weak pulse, and was not breathing when he was removed from the cargo tank. Under the direction of the Master and 2/O, crewmembers immediately started CPR and administered oxygen before moving him to the ship's Hospital where crewmembers continued to administer medical oxygen and CPR. Simultaneously, the Master sought medical advice from a shoreside doctor.

The C/E informed the Company by telephone of the emergency on board. The Company instructed that the ship should divert and proceed at full speed to Kuantan. At the same time, the Master and the Company began contacting regional MRCCs to arrange for the medical evacuation of the C/O, Pumpman, and OS2.

The ship's crewmembers continued to provide medical care to the C/O, Pumpman, and OS2 in accordance with recommendations that were received from shoreside medical doctors. This included administering CPR to the OS2. By 1750, the Pumpman had regained consciousness but was continuing to have difficulty breathing and, by 1755, the C/O was determined to be in stable condition.

12 As previously stated, No. 6 S CT was partially discharged at Singapore so it was necessary to add additional nitrogen to the tank to maintain the oxygen level at less than 3%. Although the remaining contents of the tank (29 MT) were discharged in air at Dong Nai, the volume of air that would have entered No. 6 S CT during discharge would not have been sufficient to significantly increase the volume of oxygen inside the cargo tank. When tested on the afternoon of 16 July 2024, just before the ship's arrival at Singapore, the atmosphere inside No. 6 S CT contained 4.2% oxygen, 6 ppm carbon monoxide, and no detectable hydrogen sulfide or hydrocarbons. The atmosphere inside each of the other cargo tanks contained 20.9% oxygen, and no detectable carbon monoxide, hydrogen sulfide, or hydrocarbons .

The ship's Master was informed by MRCC Singapore at 1835 and by MRCC Malaysia at 1843 that the ship was outside of the range of either Singapore or Malaysia based SAR helicopters. The Company then contacted MRCC Jakarta to arrange for the medical evacuation of the C/O, Pumpman, and OS2. At 1951, RSC Natuna contacted TRF KASHIMA to coordinate the medical evacuation of the three crewmembers.

The OS2 remained unresponsive. At 2000, the shoreside medical doctors determined the OS2 was deceased after which the crewmembers stopped administering CPR.

At 2014, the TRF KASHIMA's Master confirmed with RSC Natuna the position where the ship would rendezvous with a SAR vessel. The Master then directed the OOW to proceed to the designated position, which was approximately 60 NM south southwest of the ship's position.

TRF KASHIMA arrived at the designated rendezvous position at 0135 on 15 July 2024. The ship was contacted by the SAR vessel and was provided an updated rendezvous position that was approximately 10 NM to the east. TRF KASHIMA arrived at the revised rendezvous position at 0225.

The SAR vessel rendezvoused with TRF KASHIMA and by 0300, a rescue team, which included a medical doctor and a police officer, had embarked the ship. The rescue team members examined the C/O and Pumpman. They also confirmed that the OS2 was deceased.

By 0410, the Pumpman and C/O had both been safely disembarked to the SAR vessel, which immediately proceeded to shore. Once to shore, the Pumpman was admitted to the hospital for medical treatment. Although the C/O was stable, at the request of the rescue team he was also disembarked and transported to the hospital for a medical examination. After the SAR vessel had proceeded to shore, TRF KASHIMA resumed its passage to Singapore, where the ship arrived at approximately 1600 on 16 July 2024.

Crew

TRF KASHIMA had a complement of 22 crewmembers, six more than what was required by the Minimum Safe Manning Certificate issued by the Administrator. Crewmembers assigned to the deck department who were on board in excess of the required minimum safe manning included a JWKO, Deck Cadet, and Pumpman. The duties of the JWKO included standing duty as OOW. The other crewmembers who were in excess of the required minimum safe manning included a Fitter assigned to the Engine Department, a Chief Cook, and a Messman.

Each crewmember held the appropriate Republic of the Marshall Islands-issued seafarer documentation for their position on board TRF KASHIMA. The required qualifications included certification for service on board oil and chemical tankers verifying completion of the training required by STCW, regulation V/1-1.[13]

The experience of the Master, C/O, and other crewmembers who were working on deck on the afternoon of 14 July 2024 is shown in the following table.

13 This regulation requires that Masters, C/Os, C/Es, and 2/Es hold a certificate in advanced training and that junior officers and ratings hold a certificate in basic training. The mandatory minimum requirements for basic and advanced training requirements are stated in the STCW Code, Section A-V/1-1, Tables A-V/1-1-1, 1-1-2, and 1-1-3. Both the basic and advanced training requirements include demonstrating knowledge and understanding of the precautions to be taken when entering enclosed spaces.

RANK	TIME ON BOARD TRF KASHIMA	TIME IN RANK	TIME WITH COMPANY	TOTAL TIME ON BOARD TANKERS
Master	2.6 months	7.7 years	19.8 years	15 years
C/O	4.5 months	1.7 years	4.5 months	8.4 years
Pumpman	2.8 months	1 year	8.9 years	4.8 years
ASD1	7.6 months	6 years	7 years	1.5 years
ASD2	4.5 months	1.1 years	8.9 years	3 years
OS1	4.5 months	0.8 years	1.5 years	1 year
OS2	9.9 months	1.1 years	1.5 years	0.8 years

Prior to signing on board TRF KASHIMA for his first contract with the Company, the C/O had completed two contracts as C/O on board oil/chemical tankers under the management of another company. He also completed the Company's induction and pre-boarding process, which included the completion of both classroom and web-based training at the Company's training center. This training addressed the Company's safe work procedures, which included the Company's Golden Rules for Personal Safety[14] and the dangers associated with the normalization of deviation from established procedures. He had also completed an enclosed space entry course for senior officers and the Company's SMS familiarization training.

Because the C/O was new to the Company, he was assigned to a ship with a senior Master. After signing on board TRF KASHIMA, he sailed for two weeks with the off-going C/O before assuming his duties as the ship's C/O. The C/O was scheduled to sign off following TRF KASHIMA's arrival at Singapore on 16 July 2024.

The Pumpman, who was on his second contract in his current rank, had previously completed five contracts as an ASD on board Company-managed oil/chemical tankers. He completed advanced training for oil tanker operations in February 2023 and advanced training for chemical tanker cargo operations one month later. He also completed a 10-day pumpman skill enhancement training course.[15]

The OS2 was completing his third contract on board a Company-managed ship. TRF KASHIMA was the first oil/chemical tanker on which he sailed. His two previous contracts had been on board a bulk carrier and a product tanker. He had previously completed a basic oil and chemical tanker familiarization course in 2020[16] and crew safety course in July 2021.

The C/O, Pumpman, and OS2 had each completed the Company required safety familiarization training within a day after signing on board TRF KASHIMA. The safety familiarization training included a review of both the Company's requirements for enclosed space entry and Golden Rules for Personal Safety.

The C/O, Pumpman, and OS2 were not assigned duty as a watch stander.

14 The Company's Golden Rules for Personal Safety are discussed later in the report.

15 The content of the advanced oil and chemical tanker cargo operations courses met the requirements of the *STCW Code*, Tables A-V/1-1-2 and 1-1-3, and the content of the pumpman skill enhancement course included the requirements of the *STCW Code*, Table A-V/1-1-1.

16 The content of the basic oil and chemical tanker familiarization course met the requirements of the *STCW Code*, Table A-V/1-1-1.

Work Rest Hours of Crew

The C/O, Pumpman, deck ratings, and Deck Cadet had been engaged in cargo tank cleaning operations for almost 22 of the 24 hours immediately prior to the C/O's entry into No. 6 S CT. The crewmembers recorded work/rest hours during this period are shown in the following table.

CREWMEMBER	WORK HOURS	REST HOURS	NUMBER OF REST PERIODS
C/O	No Record		
Pumpman	Record Incomplete		
ASD1	17.5	6.5	2
ASD2	12	12	2
ASD3	12	12	2
OS1	12	12	2
OS2	Record Incomplete		

The C/O's hours of work and rest had not been recorded since 4 July 2024. When interviewed as part of the Administrator's investigation he stated that he had not had any significant rest between when the ship arrived at Dong Nai shortly before 0400 on 12 July 2024 and when he entered No. 6 S CT at 1646 on 14 July 2024. During this time, the C/O had been responsible for coordinating cargo operations, which required approximately 25 hours from start to finish, supervising cargo tank cleaning operations, and preparing documentation required by the Charterers.[17] The C/O said he did not receive any significant rest when the ship was discharging cargo at Singapore and Kuantan or when cargo tank cleaning operations were being conducted before and after the port call at Kuantan.

The C/O stated he felt some pressure since all the cargo tanks had to be clean and ready to load cargo before TRF KASHIMA arrived at Singapore because of the short transit to Pelintung. He also stated he had not had any of the ship's OICNWs assist with the cargo tank cleaning operation because the Charterer required videos to be taken of each step of the steaming process.

The C/O said he did not remember what happened after he entered No. 6 S CT. He also said he must have forgotten about the hazards of nitrogen when he entered the cargo tank.

The Pumpman's work and rest hours on 14 July 2024 were not recorded. Based on interviews of the C/O and other crewmembers, the Pumpman had been working for most of the 24-hour period before he entered No. 6 S CT shortly before 1700 on 14 July 2024. The record of his work and rest hours, which was complete through 2400 on 13 July 2024, indicated he had received at least 10 hours of rest and had not worked more than 14 hours on each of the preceding days, including while TRF KASHIMA was in Singapore on 5–7 July 2024. His hours of rest were broken into three periods on 6–8 July 2024 and into four periods on 9 July 2024.

17 Documentation required by the Charterers is discussed later in the report.

In anticipation of TRF KASHIMA's planned cargo operations in Singapore, Kuantan, and Dong Nai and the need to have all cargo tanks clean and ready to load cargo before returning to Singapore, the C/O had adjusted the deck ratings and Deck Cadet's work schedules. From 5 July 2024 onward they were working six-hour shifts with six hours of rest between each shift *(see Figure 5)*. The working hours for the ASDs included when they were on duty as part of the ship's navigational watch.

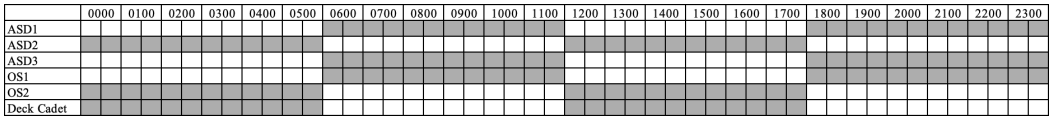

Figure 5: Work schedule for deck ratings and Deck Cadet from 5 July 2024 onward.

When interviewed as part of the Administrator's marine safety investigation, some of the deck ratings and Deck Cadet acknowledged they had worked more hours than shown on the record of their work and rest hours during the seven-day period before the C/O entered No. 6 S CT. Based on the records of work/rest hours and crewmember interviews, the ASD1 had worked 17.5 hours and the OS2 had worked at least 12 hours during the 24-hour period before the C/O entered No. 6 S CT on 14 July 2024. Each of the other deck ratings and the Deck Cadet had not worked for more than 12 hours during this 24-hour period and had received at least 77 hours of rest during the seven-day period before the C/O entered No. 6 S CT. On some of those days, the rest hours of some of the deck ratings had been divided into three periods.

The C/O provided the Master updates regarding the progress of the cargo tank cleaning operations following the ship's departure from Dong Nai. There is no indication the Master attempted to verify that the C/O, Pumpman, and other crewmembers who were engaged in this operation were receiving sufficient rest.

Charterer's Instructions

Based on the ship's prior cargoes, the Charterer required that, in addition to a standard water wash and, as applicable, the circulation of degreaser, each cargo tank had to also be passivated and then Kosher washed before loading cooking oil at Pelintung. The instructions issued by the Charterer for Kosher washing the cargo tanks included the following requirements:

1. take photographs of each cargo tank immediately after it was passivated;
2. leave each cargo tank empty 24 hours after being passivated;
3. steam each cargo until the condensate return reaches 90°C; and
4. provide short videos for each cargo tank of the different steps of the steaming process (i.e., turning on the steam, the number of the cargo tanks being steamed, and the condensate return reaching 90°C).

The photographs and videos were supposed to be sent to the Orthodox Union office where they would be reviewed by a Rabbi so the cargo tanks could be certified as having been Kosher washed.

Neither the Charterer's instructions nor the emails from the Company to the Master or from the Master to the Company made any reference to ensuring the cargo tanks were safe for entry before a crewmember entered them to take the photographs required by the Charterer.

Cargo Tank Cleaning Plan and Operations

The plan for cleaning the cargo tanks after the cargo loaded at Al Jubail had been discharged was developed by the C/O, approved by the Master, and forwarded to the Company prior to TRF KASHIMA's arrival at Singapore. The plan identified five different cleaning methods based on the last three cargoes loaded in each cargo tank. Each of the cleaning methods included most of the same steps but there were differences in how long each step would require. The method for cleaning cargo tanks that had been loaded with oil (e.g., MARPOL Annex I slops, etc.) also included an additional step for the use of a degreaser. To comply with the Charterer's requirements, all five cleaning methods required that each cargo tank be gas freed, mopped dry, and left empty for 24 hours after it was passivated and again after Kosher washing.

Depending on which of the five cleaning methods identified on the cargo tank cleaning plan was used, between 35.5–42.5 hours was required to clean any one of the ship's cargo tanks. Because multiple pairs of cargo tanks could be cleaned at the same time, the Master and C/O estimated that approximately 60 hours was required to clean all the ship's cargo tanks.[18]

TRF KASHIMA's crewmembers had actively engaged in cargo tank cleaning operations for approximately 22.3 hours before the ship arrived at Dong Nai. During this time, they had washed Nos. 5 P and 10 S CTs, which had been empty during the voyage from Al Jubail to Singapore, and Nos. 1 P, 1 S, 3 P, 4 P, 4 S, 9 P, 9 S, and 10 P CTs, which had been emptied during discharge operations at Singapore and Kuantan. They had also passivated and Kosher washed Nos. 4 P, 10 P, and 10 S CTs.

In addition to needing to passivate and Kosher wash the eight cargo tanks that had been cleaned but not passivated and Kosher washed prior to TRF KASHIMA's arrival at Dong Nai, the ship's crewmembers also needed to clean, passivate, and Kosher wash the nine cargo tanks that were emptied at Dong Nai while TRF KASHIMA was en route to Singapore.

By the time the C/O entered No. 6 S CT at approximately 1646 on 14 July 2024, the ship's crewmembers had finished washing, passivating, and Kosher washing all the cargo tanks except for Nos. 6 P and 6 S CTs, which still needed to be Kosher washed *(see Figure 6)*. It was planned that after these two cargo tanks were Kosher washed, all the cargo tanks would be ventilated overnight and then mopped and dried during the day on 15 July 2024.

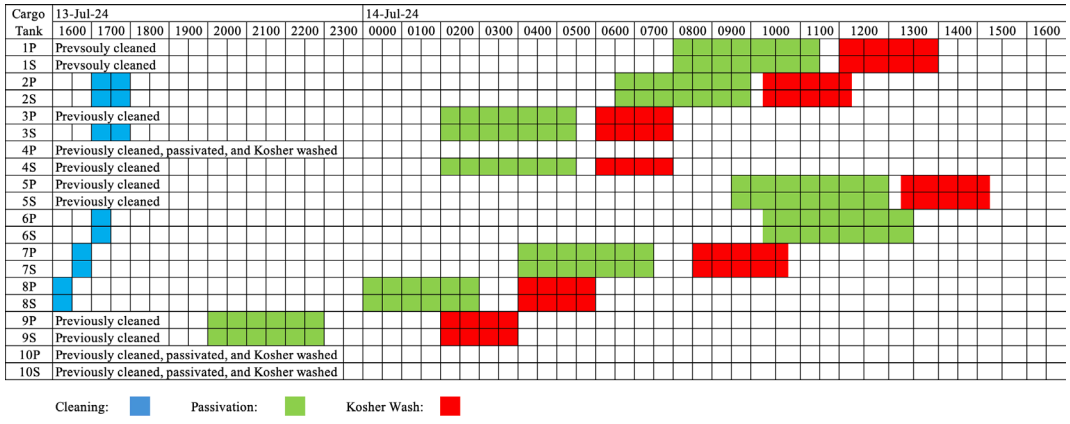

Figure 6: Tank cleaning operations completed on 13–14 July 2024 following TRF KASHIMA's departure from Dong Nai based on records maintained by the C/O.

18 It is noted that only two or three cargo tanks could be Kosher washed at the same time.

Company Procedures

As required by the ISM Code, the Company's SMS procedures intended to ensure shipboard tasks, including enclosed space entry and cargo tank entry and cleaning, were conducted safely. The Company's SMS also included more general guidance intended to promote a positive safety culture on board Company-managed ships.

The portion of the Company's SMS addressing a positive safety culture included the statement that: "Symptoms of a poor safety culture included widespread and routine procedural violations, failure to comply with the Company's safety rules and poor decisions that prioritise cost over safety." This section highlighted, among other things, the importance of leadership by senior crewmembers, good planning, and risk awareness.

The Company also required all seafarers working on board Company-managed ships to know and always follow the Company's Golden Rules for Personal Safety. These golden rules included wearing proper PPE and obtaining a Permit-to-Work before entering an enclosed space.

Additionally, the Company's SMS addressed the need to identify and eliminate workarounds, which were defined as "a temporary solution to circumvent a problem without eliminating it." Identified examples of problems included difficult procedures and challenging timelines. This section of the Company's SMS included the following statement: "When repeated over time, a workaround becomes accepted as 'normal', which is also known as 'normalisation of deviance'." It also cautioned that workarounds "may benefit the individual and the organisation to get the 'job done' but it also increases the risk of accidents."

The Company's SMS included a section addressing safety leadership that identified several leadership qualities. These included leading by example, recognizing crewmembers' limitations, and placing safety above everything. This section included the observation that while these leadership qualities are important for crewmembers of all ranks, they are particularly important for ships' Masters.

All crewmembers, regardless of rank, working on board Company-managed ships had the "right and responsibility to stop unsafe acts and conditions." The Company's SMS included a reminder for senior officers to "encourage, support, and recognize" the exercise of stop-work authority by crewmembers. It also stated that the exercise of this authority would not result in disciplinary action or discrimination against the seafarer. Crewmembers who were engaged in cargo tank cleaning operations on 9–11 and 13–14 July 2024 were aware that they had this authority. There is no indication any of them had either exercised or attempted to exercise their stop work authority at any time while cargo tank cleaning operations were being conducted during this period.

The Company's general safe work procedures included PPE requirements for different tasks, including cargo tank cleaning and enclosed space entry. Safety helmets, safety boots, overalls, gloves, and eye protection were required for both cargo tank cleaning and enclosed space entry. Whereas it was recommended that the use of a personal gas monitor be considered when engaged in cargo tank cleaning operations, it was required when entering a cargo tank or other enclosed space.

In accordance with the Company's cargo tank cleaning procedures, the C/O was responsible for planning, supervising, and conducting cargo tank cleaning operations. The ship's Master was responsible for ensuring that cargo tank cleaning operations were "carried out safely" and was required to review and approve the cargo tank cleaning plan developed by

the C/O. The Master was also required, after approving the plan, to send it to the Company for review before sending it to the vessel's owners and Charterer.

The Company's cargo tank cleaning procedures included guidance for planning and conducting cargo tank cleaning operations. They also included cautions intended to ensure such operations were conducted safely. These cautions included the below statements.

1. "Do not open tank hatch access until the tank is verified gas-free."

2. "Do not use tank access hatch for adding chemicals/FW during tank cleaning. Use other tank openings."

Entry into an enclosed space, which included entering a cargo tank, on board Company-managed ships was defined as a controlled task that required implementation of the relevant Permit-to-Work system procedures. The Company had also adopted a zero-tolerance policy for non-compliance with their enclosed space entry procedures, which required among other things that:

1. all entrances to enclosed spaces be marked "DO NOT ENTER WITHOUT PERMIT" *(see Figure 7)*;

2. no person was to enter an enclosed space without permission from the ship's Master;

3. ventilation be started well before entry and continued while the space was occupied and that if only natural ventilation was possible that the space be allowed to "breathe" for at least 24 hours; and

4. the atmosphere inside the space be checked before entry at several levels before an entry permit was issued, immediately before entry, and re-checked at pre-determined intervals not to exceed 30 minutes.

Figure 7: No. 6 S CT access hatch. Every cargo tank access hatch on board TRF KASHIMA was marked with "N2 KILLS" in addition to the warning required by the Company's enclosed space entry procedures.

The Company's procedures for cargo tank entry permitted the use of a Multiple Tank Entry Permit on board Company-managed chemical tankers provided the Company's enclosed space entry procedures were met. The cargo tank entry

procedures also included a tagging system to indicate whether a cargo tank was safe for entry and if a crewmember was in a cargo tank *(see Figure 8)*.

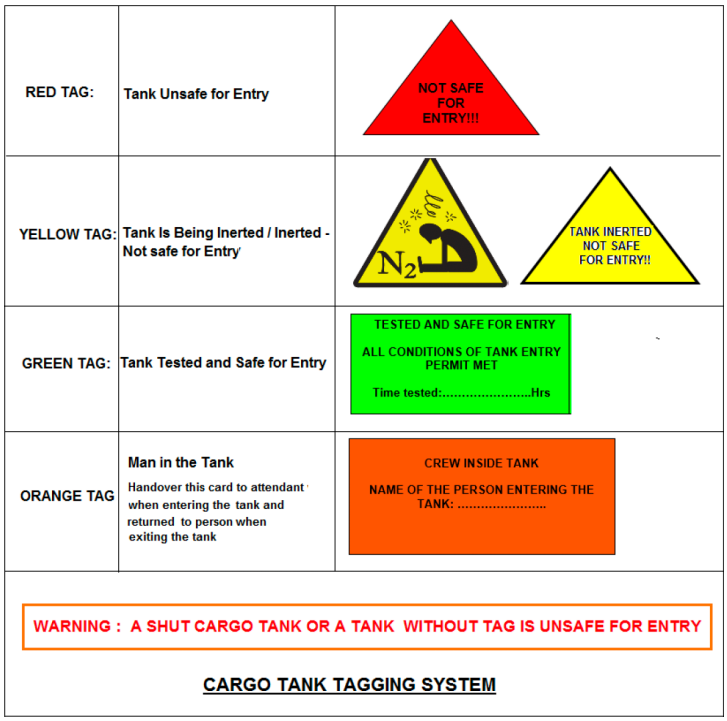

Figure 8: Company's cargo tank tagging system.

There is no indication the Company's cargo tank tagging system was implemented while cargo tank cleaning operations were being conducted on 9–11 July 2024 before TRF KASHIMA's arrival at Dong Nai or on 13–14 July 2024 following the ship's departure from Dong Nai.

An external audit of onboard compliance with the Company's SMS was conducted by the RO that issued the ship's SMC as required by the ISM Code on 25 April 2024. This audit, which included compliance with the Company's enclosed space entry procedures, was completed with no observations or non-conformities being issued.

Prior Cargo Tank Entries

Crewmembers had most recently entered TRF KASHIMA's cargo tanks on 12–13 May 2024 and 7–9 June 2024 to mop and dry them after they were cleaned. Crewmembers, including the C/O, Pumpman, and OS2, also entered the cargo tanks on 17 May 2024 and 16–17 June 2024 to mop and dry them prior to loading cargo. Enclosed space entry permits were issued for each of these entries.

The C/O said it was his standard practice to enter cargo tanks after they were cleaned to take photographs. It could not be established with certainty how often he may have entered cargo tanks on board TRF KASHIMA or while on board other oil and chemical tankers without complying with the ship manager's enclosed space entry procedures.

Enclosed Space Entry and Rescue Training and Drills

Enclosed space entry and rescue drills were required to be conducted once every two months in accordance with the Company's training matrix. The dates the three most recent drills were conducted and the scenario they were based on were:

1. 1 June 2024 – rescue of Pumpman from the No. 10 P CT after falling while entering the cargo tank;
2. 13 April 2024 – rescue of 2/E from the No. 9 S CT after slipping and falling while entering cargo tank to repair cargo pump; and
3. 7 February 2024 – rescue of Cadet from the Ballast Water Pumproom.

Following each of these drills, the ship's C/O conducted enclosed space entry training for all crewmembers. This training included a review of what an enclosed space is, the hazards associated with enclosed spaces, and the Company's enclosed space entry procedures.

The C/O and OS2, who had both signed on board TRF KASHIMA in late February 2024, participated in the enclosed space rescue drill and training that was conducted on 13 April 2024 and 1 June 2024. The Pumpman, who signed on board on 20 April 2024, participated in the enclosed space rescue drill and training conducted on 1 June 2024. The C/O, Pumpman, and OS2 had also participated in enclosed space rescue drills and training while working on board other oil and chemical tankers.

Training addressing the Company's enclosed space entry procedures was conducted for all crewmembers on board TRF KASHIMA on 10 May 2024 as part of a routine shipboard visit by the Company's QHSE Manager and Operations Manager. As part of their attendance on board, the QHSE Manager and Operations Manager also interviewed the ship's crewmembers to assess their awareness of, among other things, the Company's safe work requirements and enclosed space entry procedures. No observations related to crewmember awareness of the Company's safe work and enclosed space entry procedures were raised.

Gas Detection Equipment

The gas detection equipment on board TRF KASHIMA included five personal gas detectors capable of detecting hydrogen sulfide, oxygen, methane, and nitrogen. Each of the personal gas detectors had last been tested and calibrated by a certified third-party on 29 October 2023. Each had most recently been tested on board against a span gas and determined to be operating properly on 30 June 2024.

Prior Fatal Enclosed Space Entry on Board TRF MANDAL

A fatal enclosed space entry occurred on board the Company-managed TRF MANDAL on 23 July 2022 when the ship's C/O made an unplanned entry into a cargo tank during cargo tank cleaning operations after discharging a cargo that had been padded with nitrogen.[19] The cargo tank had been washed with sea water but not yet gas freed. Casual factors identified by the Administrator's marine safety investigation that contributed to that very serious marine casualty included:

19 Full details are included in the Administrator's TRF MANDAL Marine Safety Investigation Report, which was issued on 8 April 2024.

1. the entry into the cargo tank was made without taking any precautions and without complying with the enclosed space entry procedures contained in the Company's SMS;
2. the C/O disregarded a warning from a Deck Cadet, who had intervened and requested that the C/O check the atmosphere inside the cargo tank with a personal gas detector;
3. the risk assessment and Toolbox Talk completed prior to starting cargo tank cleaning did not include the hazards posed by working in or around inerted cargo tanks; and
4. non-adherence to the Company's stop work policy.

Potential complacency regarding the danger of entering enclosed spaces or working around inerted cargo tanks may also have contributed to that very serious marine casualty.

It was also determined that the potential consequences of that very serious marine casualty were reduced because other crewmembers recognized the dangers of entering an enclosed space and did not immediately enter the cargo tank to attempt to rescue the C/O but instead conducted the rescue in accordance with the established shipboard procedures.

Preventive actions taken by the Company following the death of the C/O on board TRF MANDAL on 23 July 2022 included:

1. assessing the effectiveness of enclosed space entry training on board Company-managed ships;
2. undertaking a fleet-wide safety campaign to reaffirm the authority of all crewmembers to stop unsafe acts and to raise awareness of the hazards posed by nitrogen;
3. conducting a thorough review of the Company's cargo tank cleaning and entry procedures to prohibit opening cargo tank access hatches until the respective cargo tank was gas free;
4. updating the risk assessments for cleaning and gas freeing cargo tanks; and
5. producing a video that was provided to all ships in the Company-managed fleet based on the lessons learned from this incident.

PART 3: ANALYSIS

The following Analysis is based on the above Factual Information.

Company's Enclosed Space Entry and Cargo Tank Entry Procedures

The Company had procedures in place to ensure that cargo tanks and enclosed spaces on board Company-managed ships could be entered safely. These procedures, which incorporated lessons learned from the fatal enclosed space entry that had previously occurred on board the Company-managed TRF MANDAL, required that certain conditions be met (e.g., that the space be ventilated, atmosphere tested and determined safe for entry, cargo tank access hatches not be opened until the atmosphere was tested, etc.) and that certain safeguards be in place (e.g., that no person was permitted

to enter an enclosed space without permission from the ship's Master) before anyone entered a cargo tank or enclosed space. The Company's procedures additionally included a tagging system to indicate whether a cargo tank was safe for entry *(see Figure 8)*.

The Company also established policies and issued guidance addressing the Company's expectations regarding safe work. These policies and guidance highlighted the importance of leadership by senior crewmembers, good planning, and risk awareness. The Company also empowered all crewmembers, regardless of rank, to stop unsafe acts and conditions.

The Company's procedures for entering a cargo hold or enclosed space are examples of administrative controls. Such controls lower risk by reducing exposure to a hazard while a particular task or activity is being conducted by providing written instructions for the task or activity.[20] Administrative controls do not establish physical barriers and are only effective if they are implemented consistently, a point that is emphasized in the Company's guidance addressing safe work and the dangers of the normalization of deviation.

The C/O had entered 15 cargo tanks during the day on 14 July 2024 before he entered No. 6 S CT. He had also previously entered Nos. 4 P, 10 P, and 10 S CTs while TRF KASHIMA was en route to Dong Nai. Although he had been wearing a personal gas detector, none of these entries were made in accordance with the Company's enclosed space entry procedures.

There was also no indication that the Master, who was aware that the Charterer required pictures be taken inside the cargo tanks after they were Kosher washed, had reminded the C/O about the need to comply with the Company's enclosed space entry procedures when entering the cargo tank to take the required pictures either when he approved the cargo tank cleaning plan or at any time before or while cargo tank cleaning operations were being conducted both prior to the ship's arrival or departure from Dong Nai. There is also no indication the Company had reminded the Master to ensure that entries into the cargo tanks to take the pictures required by the Charterer were done in accordance with their established enclosed space entry procedures. Neither the Master nor the C/O needed to be reminded that the Company required any entry into an enclosed space be conducted in accordance with established procedures. Both were aware of that requirement. However, reminders can contribute to safety by reinforcing the importance of established procedures, such as the Company's enclosed space entry procedures, and the need to comply with them.

In addition to the multiple entries into cargo tanks without complying with the Company's enclosed space entry procedures, there were multiple deviations from the Company's cargo tank cleaning and entry procedures during the cargo tank cleaning operations that were conducted on 9–11 July 2024 before TRF KASHIMA arrived at Dong Nai, and on 13–14 July 2024 after the ship's departure. These deviations included:

1. the cargo tank access hatches being opened without the cargo tanks having been gas freed;
2. using cargo tank access hatches to add the citric acid solution to the cargo tanks while they were being passivated; and
3. not implementing the Company's cargo tank tagging system during the cargo tank cleaning operations that were conducted on 9–11 July 2024 before TRF KASHIMA's arrival at Dong Nai or on 13–14 July 2024 following the ship's departure from Dong Nai.

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20 Administrative controls are lower-level means of reducing risk. Higher-level means of reducing risk are those that either eliminate the hazard, substitute the hazard with one that is less hazardous, or isolate the hazard. US NIOSH, Hierarchy of Controls (https://www.cdc.gov/niosh/hierarchy-of-controls/about/index.html).

Training and Awareness

The C/O, Pumpman, and OS2 had completed enclosed space entry training as part of the formal training required by STCW regulation V/1-1 for service on board oil and chemical tankers. They had also participated in enclosed space rescue drills and training conducted on board TRF KASHIMA and the other oil and chemical tankers on which they had previously each served. Based on this, they all should have been very much aware of the dangers of enclosed spaces and that any entry into an enclosed space must be made in accordance with established procedures.

They were also familiar with the Company's enclosed space entry procedures. Evidence of this is that the C/O, Pumpman, and OS2 all had previously entered cargo tanks on board TRF KASHIMA on 16 May 2024 and 2 June 2024 in accordance with enclosed space entry permits issued per the Company's enclosed space entry procedures.

Given that the C/O, Pumpman, and OS2 had all previously worked on board chemical tankers, they all would have had at least some awareness of the hazards associated with nitrogen. This is particularly true for the C/O.

Cargo Tank Cleaning Plan and Operations on 13–14 July 2024

Following TRF KASHIMA's departure from Dong Nai, the Master declared that the ship's estimated time of arrival at Singapore was 0800 on 16 July 2024. Based on the estimated time of arrival declared by the Master, there was sufficient time for the ship's crewmembers to clean the cargo tanks in accordance with the plan that had been developed by the C/O, approved by the Master, and reviewed by the Company. It is estimated that if the cargo tank cleaning operations had been conducted in accordance with the approved cargo tank cleaning plan, which included gas freeing and leaving each cargo tank empty for 24 hours before being Kosher washed as required by the Charterer, the cargo tank cleaning operation could have been completed by early evening on 15 July 2024.

Based on the record of cargo tank cleaning operations conducted on 13–14 July 2024, the cargo tanks that were cleaned following the ship's departure from Dong Nai were not left empty for 24 hours between when they were passivated and when they were Kosher washed *(see Figure 6)*. Rather, they were left empty for between 0.25–3 hours. The C/O explained the deviation from the approved cargo tank cleaning plan by saying he felt rushed since all the cargo tanks had to be ready for loading before the ship arrived at Singapore, where he was scheduled to sign off, and that he wanted to finish Kosher washing the cargo tanks on 14 July 2024 so that they could be ventilated overnight and then dried during the day on 15 July 2024.

C/O's Entry into No. 6 S CT and Response

The C/O, who was not wearing a personal gas detector, entered No. 6 S CT after it was passivated without checking the atmosphere inside the cargo tank to take pictures required by the Charterer while the Pumpman and OS2 were completing preparations to Kosher wash the cargo tank. The C/O said that he did not have any memory of what happened after he started climbing down the vertical ladder leading from the cargo tank dome to the upper platform. He also acknowledged either forgetting or not considering the dangers of nitrogen exposure.

After either the Pumpman or OS2 reported by radio at 1649 that the C/O had collapsed inside of No. 6 S CT, they both entered the cargo tank. Based on how they were found lying on the second platform inside of No. 6 S CT, the OS2 entered the cargo tank first and was followed by the Pumpman. It is likely they entered the cargo tank to try to assist the C/O.

Although both the Pumpman and OS2 had received training regarding the dangers associated with enclosed spaces and were aware they should only be entered in accordance with established shipboard procedures, their immediate response to assist a fellow crewmember overcame their professional training. Their response was also not unique. In five of the eight enclosed space entry incidents that were reported to have occurred on board Republic of the Marshall Islands-registered ships between 2020–2024, one or more of the ship's crewmembers entered the enclosed space to assist a fellow crewmember without taking any precautions. This resulted in four additional rescues and two fatalities of crewmembers who responded without complying with established rescue procedures. It also delayed the response in four of the cases because the crewmembers who entered the enclosed space did not first raise the alarm that another crewmember had entered an enclosed space.

The atmosphere inside of No. 6 S CT contained 4.0% oxygen and no carbon monoxide, hydrogen sulfide, or hydrocarbons were detected when it was checked just before the first rescue team entered the cargo tank approximately less than 10 minutes after the C/O was reported to have entered it. The fact that the C/O did not have any memory of what happened after he started climbing down the vertical ladder from the cargo tank dome into the cargo tank and that the C/O, Pumpman, and OS2 were all unconscious when they were removed from No. 6 S CT is consistent with exposure to a low oxygen environment. It is also consistent with exposure to concentrations of nitrogen that exceed the STEL.

The Master, 2/O, and other crewmembers arrived at the cargo tank dome for No. 6 S CT with equipment required to conduct an enclosed space rescue within minutes after the C/O was reported to have collapsed inside the cargo tank. Although the rescue teams were not able to put a rescue harness on the C/O, Pumpman, or OS2 due to the limited space on the cargo tank access ladder and platforms, they were able to tie lines around their chests so they could be lifted through the cargo tank dome access hatch. The rescue operation was otherwise conducted without incident, and all three were removed from the cargo tank within 20 minutes of the initial report.

Fatigue

Fatigue can affect a seafarer's ability to work safely and effectively by, among other things, causing lapses of memory and by impairing a person's ability to assess a situation and anticipate or recognize potential hazards. A primary cause of fatigue is lack of sleep. Other causes of fatigue include prolonged periods of work and stress.

Based on TRF KASHIMA's records of cargo and cargo tank cleaning operations during the seven-day period prior to when the C/O entered No. 6 S CT at approximately 1646 on 14 July 2024, the ship's crewmembers had conducted approximately:

1. 22 hours of cargo tank cleaning operations in the 24 hours immediately preceding the C/O's entry into No. 6 S CT;
2. 25 hours of cargo operations at Dong Nai on 12–13 July 2024;
3. 4–5 hours of cargo tank cleaning operations on 11 July 2024;
4. 9 hours of cargo tank cleaning operations on 10 July 2024;
5. 17 hours of cargo operations at Kuantan on 9 July 2024; and
6. 12–13 hours of cargo tank cleaning operations on 8 July 2024.

This seven-day period followed immediately after the ship's crewmembers had conducted approximately 45 hours of cargo operations at three different terminals at Singapore between 5–7 July 2024.

The C/O had not received any significant rest between when TRF KASHIMA arrived at Dong Nai shortly before 0400 on 12 July 2024 and when he entered No. 6 S CT on 14 July 2024. He also had not received any significant rest while the cargo operations were conducted at Singapore and Kuantan. Although the ship's records of cargo tank cleaning operations indicate there were times while the ship was en route to and after departure from Kuantan when the C/O may have been able to receive 10 hours of rest in any one 24-hour period, he likely had developed a sleep debt[21] and became fatigued between when the ship arrived at Singapore on 5 July 2024 and when he entered No. 6 S CT on 14 July 2024.

Sleep debt can affect a person's level of alertness and performance. Persons with a sleep debt may also lose awareness of how fatigued they are and become unable to judge their own level of performance. Other factors that would have contributed to the C/O being fatigued included multiple, extended periods of continuous or near-continuous work and the pressure (e.g., stress) he said that he felt since all of the cargo tanks had to be ready to load cargo when TRF KASHIMA arrived at Singapore on the morning of 16 July 2024.

Indications that the C/O was fatigued included leaving his personal gas detector and flashlight in the CCR when he went back out on deck after meeting with the Master on the Bridge and forgetting, or not considering, the hazards of nitrogen exposure.

The Pumpman's record of work and rest hours indicates he had received at least 10 hours of rest and had not worked for more than 14 hours during any 24-hour period on 13 July 2024 and the subsequent days preceding. This record also indicates that the time of day when he worked and rested had varied based on when cargo operations or cargo tank cleaning operations were being conducted and that his periods of rest had been divided into three or four periods on several days. The implication is that the Pumpman may have been sleeping at irregular intervals and that his sleep may have been subject to work related interruptions, which can contribute to fatigue. Additionally, the Pumpman had worked for most of the 24-hour period immediately before he entered No. 6 S CT to assist the C/O and OS2. Working for extended periods can also contribute to fatigue.

The STCW Code, Section A-VIII/1 establishes minimum hours of rest and MLC, 2006, standard A.2.3 establishes maximum hours of work for seafarers which are intended to reduce the potential for seafarers to become fatigued. Both also prohibit a seafarer's hours of rest in any 24-hour period being divided into more than two periods, one of which cannot be less than six hours in length. Whereas the STCW Code requirements are applicable to seafarers assigned duty as an officer in charge of a watch or as a rating forming part of a watch, the MLC, 2006 requirements are applicable to all seafarers.

There is no indication the C/O, who was not required to stand any navigational watches, had established a work schedule for himself and the Pumpman to ensure their work hours during the cargo discharges that were planned for Singapore, Kuantan, and Dong Nai and while the ship's cargo tanks were cleaned did not exceed the requirements established by the MLC, 2006.

21 Sleep debt is generally defined as "insufficient accumulated sleep over multiple consecutive 24-hour periods." *See* IMO MSC.1/Circ.1, Module 1.

The C/O had adjusted the deck ratings and Deck Cadet's schedules from 5 July 2024 onward so that three of them would be working at any time *(see Figure 5)*. This schedule of six hours on followed by six hours of rest complies with the minimum requirements of both the STCW Code and MLC, 2006 and is a common watch system within some sectors of the maritime industry. It is also the watch system where seafarers typically receive the least amount of sleep in any 24-hour period and can contribute to seafarers becoming fatigued.[22]

Some of the deck ratings and the Deck Cadet acknowledged having worked more hours during the seven-day period before the C/O entered No. 6 S CT than shown on their record of work and rest hours.[23] It was not established with certainty whether they had been instructed to underreport their work hours during this period of time or if it was the result of normalized behavior.

Stop-work Authority

Crewmembers who had been engaged in the cargo tank cleaning operations that were conducted on board TRF KASHIMA on 9–11 and 13–14 July 2024 were aware that they had stop-work authority. There is no indication that any crewmember who might have seen the C/O entering or exiting a cargo tank while cargo tank cleaning operations were being conducted before TRF KASHIMA's arrival at, or departure from, Kuantan or Dong Nai had either asked him why he was entering the cargo tanks or attempted to exercise their stop-work authority.

Oversight by Master

The risk assessments the Master issued for cleaning, gas freeing, and mopping the ship's cargo tanks identified fatigue as a hazard. The associated controls for managing this hazard included the ship's Master ensuring that jobs were planned in a manner to ensure sufficient rest for crewmembers. Although the C/O had kept the Master aware of the status of the ongoing cargo tank cleaning operations, there was no indication the Master had ensured that the C/O or any of the other crewmembers who were engaged in cargo tank cleaning were in fact receiving sufficient rest or that the cargo tank cleaning was being conducted in accordance with the plan that he (i.e., the Master) had approved.

The Master was aware that a crewmember would need to enter each cargo tank to fulfill the Charterer's requirement to take photographs of the inside of each cargo tank before it was passivated. He was also aware he had not approved any enclosed space entry permits while cargo tank cleaning operations were being conducted prior to or after departure from either Kuantan or Dong Nai. There is also no indication that he had discussed this with the C/O.

Consistent with the ISM Code, the Company's SMS included a clear statement that the Master had overriding authority and responsibility for safety. This responsibility was restated in the Company's cargo tank cleaning procedures, which required the Master to ensure that cargo tank cleaning operations were carried out safely. The Master's lack of oversight of the cargo tank cleaning operations that were being conducted on board TRF KASHIMA was not consistent with the exercise of this responsibility.

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22 *See* WMA report, *Modeling the Hours of Work and Rest*, for a discussion of hours of sleep for different watch schedules.

23 It is noted that the WMU has identified underreporting or misreporting of work/rest hours to be a widespread practice throughout the worldwide fleet. *See* WMU Report, *A Culture of Adjustment*, pages 5–6.

Onboard Safety Culture

There are several indications that there was not a positive safety culture on board TRF KASHIMA when this very serious marine casualty occurred. These included:

1. onboard normalization of deviation from the Company's enclosed space entry and cargo tank cleaning procedures during the:
   (a) cargo tank cleaning operations that were conducted on board on 9–11 and 13–14 July 2024; and
   (b) C/O's entry into the cargo tanks to take pictures after the cargo tanks were passivated but not ventilated;
2. crewmembers' records of work and rest hours which did not accurately reflect the number of hours worked or rest received during the seven-day period before the C/O entered No. 6 S CT;
3. insufficient oversight of the cargo tank cleaning operations conducted on 9–11 and 13–14 July 2024 by the Master and Company; and,
4. neither the Master nor the C/O placed safety above all else or set a positive example for the ship's junior officers and ratings.

PART 4: CONCLUSIONS

The following Conclusions are based on the above Factual Information and Analysis and shall in no way create a presumption of blame or apportion liability.

1. Causal factors that contributed to this very serious marine casualty included:
   (a) the C/O's entry of No. 6 S CT and subsequent entry by the OS2 and Pumpman without implementing the Company's enclosed space entry procedures or otherwise taking necessary precautions;
   (b) the lack of oversight by the Master and Company of the cargo tank cleaning operations that were conducted on the ship on 9–11 and 13–14 July 2024;
   (c) onboard normalization of deviation from established procedures and requirements during the cargo tank cleaning operations that were conducted on board on 9–11 and 13–14 July 2024 as evidenced by:
      (i) the C/O making multiple entries into the ship's cargo tanks to take pictures without implementing the Company's enclosed space entry procedures;
      (ii) opening cargo tank access hatches without cargo tanks being gas freed, using cargo tank access to add the citric acid solution to the cargo tanks, and the cargo tank tagging system which was not implemented; and
      (iii) the deviation from the Company-approved plan for cleaning the cargo tanks.
2. Additional causal factors that may have contributed to this very serious marine casualty included the:
   (a) need to enter the cargo tanks to take pictures required by the Charterer while cargo tank cleaning operations were being conducted was not identified on the cargo tank cleaning plan developed by the C/O, reviewed by the Master, and approved by the Company; and
   (b) C/O and possibly the Pumpman being fatigued.

3. Additional issues that were identified but did not contribute to this very serious marine casualty included:
   (a) crewmembers' records of work and rest hours did not accurately reflect the number of hours worked or rest received during the seven-day period before the C/O entered No. 6 S CT; and
   (b) the inability of the rescue teams to put rescue harnesses on the C/O, Pumpman, and OS2 due to the limited space on the cargo tank access ladder and platforms.

PART 5: PREVENTIVE ACTIONS

In response to this very serious marine casualty, the Company has taken the following Preventive Actions.

1. A safety flash was sent to all ships in the Company-managed fleet sharing preliminary information regarding the incident that had occurred on board TRF KASHIMA and that required Masters to conduct an immediate safety briefing with all officers and ratings to review the Company's enclosed space entry procedures and risk assessment.

2. A senior Company-QHSE Superintendent conducted training for the ship's crewmembers that included a review of the:
   (a) content of the Company's safety flash;
   (b) safe work practices and relevant Company procedures for enclosed space entry, cargo tank cleaning, and gas freeing;
   (c) Company procedures for conducting risk assessments; and
   (d) Company's stop work authority policy and process for implementing it.

3. Mandated a fleetwide safety standdown during which no enclosed space entry operations were to be conducted until the ship's Master:
   (a) verbally confirmed with the Company that all crewmembers had been briefed regarding the Company's enclosed space entry procedures and, if applicable, hazards of nitrogen; and
   (b) obtained permission from the Company.

4. The Company's Chief Operating Officer conducted a safety meeting with all officers who were currently on leave to review the incident that had occurred on board TRF KASHIMA and to remind them of their responsibility to speak up and challenge, without risk of retribution, any unsafe acts or conditions.

5. The Company's Managing Director spoke with crewmembers who were currently serving on all Company-managed ships to reinforce the Company's expectations for seafarers to exercise their stop-work authority and compliance with the Company's enclosed space entry procedures.

6. All crewmembers, both those who were currently serving on board a Company-managed ship and those who were shore side, were required to recomplete portions of the Company's e-learning program addressing enclosed space entry and nitrogen hazards.

7. Revised the agenda for the Company's 2024 tanker safety seminar, focusing on compliance with enclosed space entry procedures, held discussions with officers and ratings to understand issues they face complying with the Company's enclosed space entry procedures, and sought suggestions for improvement.

8. Updated the Company's "Speak-Up" program to enable anonymous reporting using an app.

9. Prepared a two-part video series addressing preparations for and proper entry into an enclosed space and hazards associated with inert gas, nitrogen, and hydrocarbons.

10. Updated the onboard training requirements for Company-managed chemical tankers to mandate that Company training videos addressing nitrogen hazards and enclosed space entry fatalities be viewed monthly during an onboard safety meeting.

11. Revised the Company's cargo tank tagging system to require that red tags be placed on all cargo tank hatches during cargo tank cleaning operations, whether or not entry into the cargo tanks is planned, and that the red tag be replaced with a green tag after the atmosphere inside the cargo tank is determined safe for entry and an enclosed space entry permit has been issued.

12. Painted nitrogen warnings on cargo tank hatches were replaced with yellow triangular nitrogen hazard tags, which were placed on cargo tank hatches only when the applicable cargo tank contained nitrogen.

13. Established a requirement for the Company's Operations Department and ship's Master to discuss with a Charterer:

    (a) the necessity of and hazards associated with (e.g., enclosed space entry) any Charterer-specific instructions that exceed industry standards (e.g., taking photographs of the inside of cargo tanks, taking video, and providing narration of one or more steps in the cleaning process, etc.); and

    (b) additional time required to fulfill any Charterer-specific instructions.

14. Revised the Company's cargo tank cleaning procedures to require:

    (a) that cargo tank cleaning plans include the work schedules for officers and ratings who will be engaged in the planned cargo tank cleaning operations;

    (b) Charterer-specific instructions that exceed industry standards and the time required for completion on the cargo tank cleaning plan prepared by a ship's C/O; and

    (c) an expansion of the Company's review of cargo tank cleaning plans to include an assessment of the planned work schedule to ensure all involved crewmembers will be adequately rested.

15. The Company's senior management conducted one-on-one meetings with all Masters focused on Company expectations for Masters to demonstrate visible leadership and to participate in the pre-operation briefing and risk assessment process for all critical operations, including cargo tank cleaning and enclosed space entry.

16. Updated the agenda for pre-joining briefings for Masters and other senior officers to reinforce Company expectations from them regarding their responsibility for providing onboard leadership and promoting a positive safety culture.

17. Initiated an online pre-joining briefing program for all ratings that includes participation by senior Company management to address the Company's expectations for a positive safety culture on board Company-managed ships,

the exercise of stop-work authority by crewmembers, and to reinforce Company expectations regarding compliance with established enclosed space entry procedures.

18. Updated the Company's recruitment process to better assess how a candidate meets the Company's expectations regarding promotion of a positive onboard safety culture, etc.

19. Revised the Company's cultural fitness check for seafarers to include a 360-degree cultural fitness check within 30 days of joining a Company-managed ship for new or recently promoted senior officers.

PART 6: RECOMMENDATIONS

The following Recommendations are based on the above Conclusions and in consideration of the Preventive Actions taken.

1. It is recommended that the Company undertake a fleet-wide safety campaign focused on promoting:
   (a) awareness of the potentially negative effects of fatigue on safety;
   (b) awareness of the factors that can contribute to fatigue;
   (c) accurate reporting of work and rest hours; and,
   (d) obtaining feedback from crewmembers working on board Company-managed ships who may be pressured or encouraged to underreport their work hours.

The Administrator's marine safety investigation is closed. It will be reopened if additional information is received that warrants further review.