[MSI Report 2024-000]

Marine Safety Investigation Report

on Oil/Chemical Tanker *New Bright*

- Explosion -

Date of Accident: 21 December 2023

Date of Publication: Day Month 2024

Korea Maritime Safety Tribunal

Marine Safety Investigation Team

Note

This marine safety investigation report aims to identify the cause of the marine accident and prevent similar marine accidents or incidents in the future under Article 18.3 of the Act on the Investigation of and Inquiry into Marine Accidents. It is therefore advised that this report not be used for assigning blame or determining liability.

This report quotes the names of the relevant acts and agencies that were in place at the time of writing.

Contents

1. Executive Summary ····· **2**

2. Findings of Fact ····· **6**

2.1 Ship particulars ····· 6

2.2 Shipowner and operation ····· 9

2.3 Crew composition ····· 10

2.4 Properties of cargo (Benzene) ····· 12

2.5 Cargo tank cleaning procedures ····· 14

3. Development of the Accident ····· **18**

3.1 Arrival, cargo discharge, and departure from China ····· 18

3.2 Cargo tank explosion ····· 19

3.3 Ship abandonment, rescue operation and damage ····· 23

3.4 Korea-China joint on-site investigation ····· 26

4. Analysis ····· **29**

4.1 Analysis on the direct cause of the tank explosion ····· 29

4.2 The C/O's failure to implement the master's orders ····· 30

4.3 Non-compliance with safety rules, including tank cleaning procedures ····· 32

4.4 Lack of awareness on flammable and static accumulator cargoes ····· 33

4.5 Communication issues among the crew with different nationalities ····· 34

4.6 Communication errors caused by fatigue of the crew ····· 36

5. Conclusions ····· **40**

6. Recommendations ····· **43**

6.1 Strictly carrying out the master's instructions ····· 43

6.2 Complying with the Cargo Tank Cleaning Instruction and the relevant regulations ····· 43

6.3 Strengthening management of flammable and static electricity accumulator cargoes ··· 44

6.4 Enhancing communication skills of the crew with different nationalities ····· 44

6.5 Developing measures to manage the crew's fatigue during cargo operations ····· 44

section

1

Executive Summary

1. Executive Summary

1.1 New Bright is an Oil and Chemical Tanker (hereinafter referred to as "the tanker") delivered at the Samho shipyard in Korea on 3 December 2007 and registered at Jeju Port with a gross tonnage of 8,504 tons, length of 119.45 meters, breadth of 20.40 meters, and depth of 11.50 meters; she was equipped with one 4,400-kilowatt diesel engine.

1.2 The tanker was berthed at Changshu Port, in China's Jiangsu Province, at 21:05 (local Chinese time, GMT+8) on 19 December 2023. At 02:00 on 20 December, she commenced to discharge approximately 11,410 tons of benzene that had been loaded at Daesan Port in Korea. The unloading operation was completed at approximately 09:30 on 21 December, and the next day the tanker departed from Changshu Port on the Yangtze River at around 10:20, bound for the port of Incheon in Korea. She was scheduled to take on about 12,000 tons of benzene at Incheon Port and was scheduled to arrive there at around 13:00 on 23 December.

1.3 At around 12:45 on 21 December while still sailing along the river, the New Bright bosun and two ordinary seamen (OS) went onto the forward anchor station for emergency standby and performed operations, including opening the pressure and vacuum (P/V) valve and the hatch cover of the cargo tanks, as instructed by the chief officer (C/O).

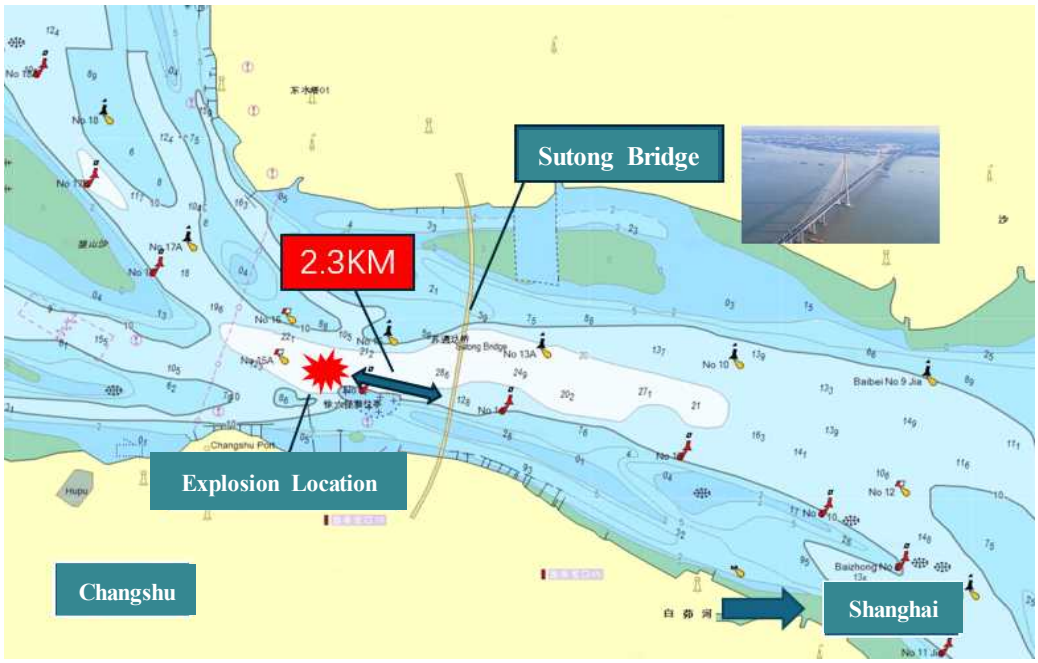
1.4 At around 14:45 on the same day, the bosun and two OS on the deck as per the tanker's direction to be positioned at emergency anchoring station for passing through the Sutong Yangtze River Bridge, connected a compressed air line to the cargo common line of the center manifold. Then, after putting a portable rubber hose into the drain pipe of this common line, they put the other side of the hose into the hatch of Cargo Tank (CT) No. 3 on starboard and started to supply compressed air.

1.5 While watching the cargo residue flow out from the cargo pipeline through the hose, the bosun went to the bow temporarily and informed of this air blowing operation the two OS on standby for emergency anchoring. After that, he returned to the site and checked on the air blowing, and the cargo

tank exploded.

1.6 The explosion occurred at 15:06 on 21 December 2023 about 2.3 kilometers west of the Sutong Yangtze River Bridge (31-45-36N, 121-01-35E). The accident location on board is adjacent to CT No. 3, where the flame first ignited; explosions occurred two to three times consecutively; and then, the hull rapidly listed to starboard.

1.7 The accident occurred at around 15:06 on 21 December 2023, and the New Bright master who was adjacent to the bridge wing gave the order to abandon ship, pressed the distress button, and directed the crew to lower the life rafts. At around 15:40 on the same day, a total of 22 persons, including 19 crewmembers and three pilots, were safely rescued by a boat from the China Maritime Safety Administration (MSA). The fire was extinguished at around 20:00.



<Figure 1> The explosion location of New Bright (quoted from the Chinese MSA documents)

1.8 The accident occurred just 2.3 kilometers from the Sutong Bridge. Four shipping service routes intersect at this location, making it susceptible to major losses should a ship sink, or marine pollution occur in the area. The Chinese MSA actively and swiftly responded to the situation at the early stage, rescuing all the people and preventing additional damage.

1.9 At around 22:23 on the same day, the tanker was towed to shallow water and temporarily beached

southeast of the accident location. She was taken to a floating dock on 1 January 2024. This accident severely damaged the tanker's cargo tank, deck, bulkhead, and cargo pipes, and the tanker suffered partial damage to the accommodation area. There were no fatalities, but three crewmembers suffered burns or other injuries.

1.9 The weather was overcast at the time of the accident, with wind blowing out of the northwest at 8 to 10 meters per second; waves about 0.3 meters high; and visibility of some 7 nautical miles. The temperature was 4 degrees below zero and the sea temperature was about 10 degrees.

section

2

Findings of Fact

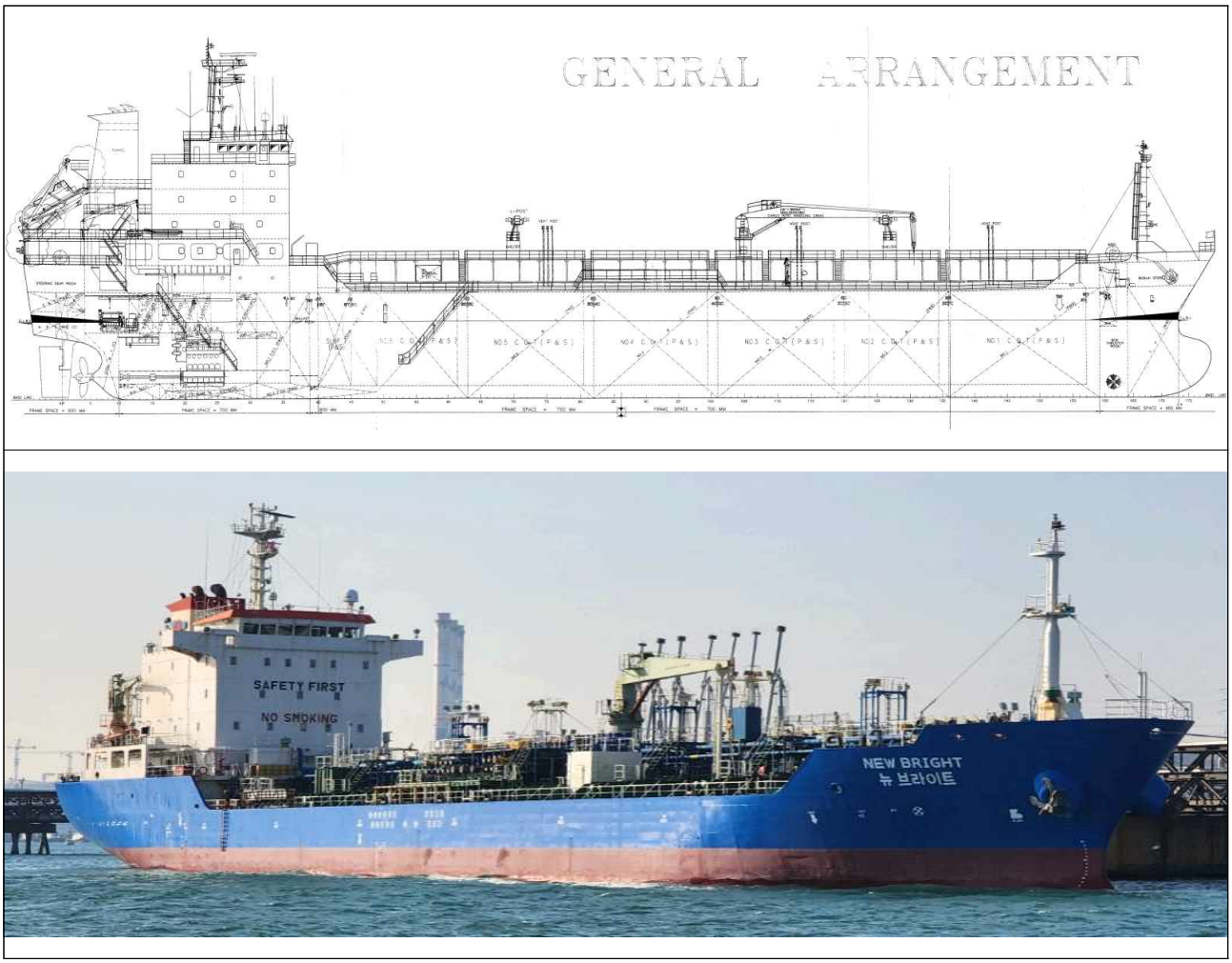
2. Findings of Fact

2.1 Ship particulars

2.1.1 Principal particulars of New Bright

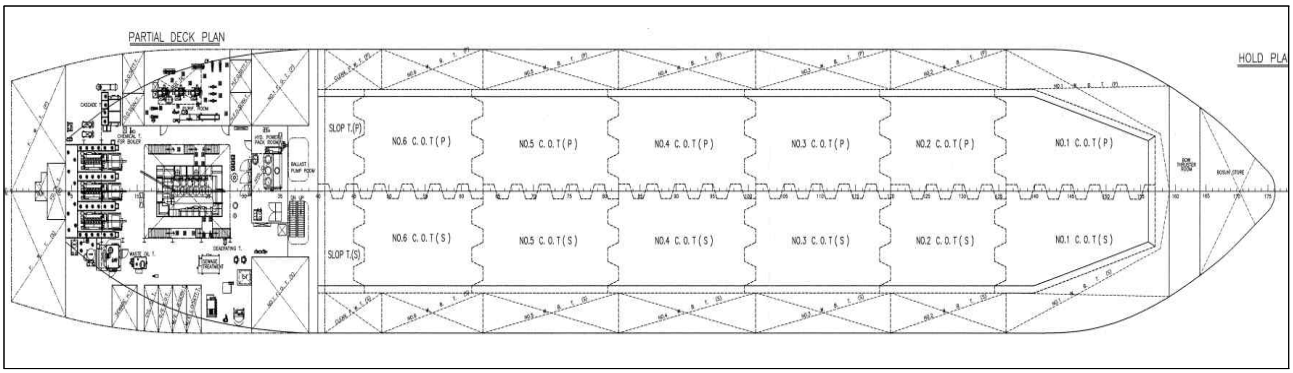
Ship Name	NEW BRIGHT
Flag State	Republic of Korea (ROK)
Port of Registry	Jeju
IMO No. / Official No.	9332432 / JJR-161029
Ship Type	Oil & Chemical Tanker
Owner	Seongho Shipping Co., Ltd.
Safety Management Company	Seongho Shipping Co., Ltd.
Builder	Samho Shipyard
Date of Launch	3 Dec. 2007
Classification Society	Korean Register of Shipping (KR)
Gross Tonnage (t) / DWT (mt)	8,504 / 12,898
Length (m)	119.45
Breadth (m)	20.40
Depth (m)	11.50
Main Engine	Diesel
Max. Output (kW)	4,400
Propeller	1 (screw-type)

2.1.2 New Bright is an oil/bulk liquid chemical product carrier launched from the Samho shipyard in Korea on 3 December 2007 and registered at Jeju Port with a gross tonnage of 8,504 tons, length of 119.45 meters, breadth of 20.40 meters, and depth of 11.50 meters; she was equipped with one 4,400-kilowatt diesel engine.



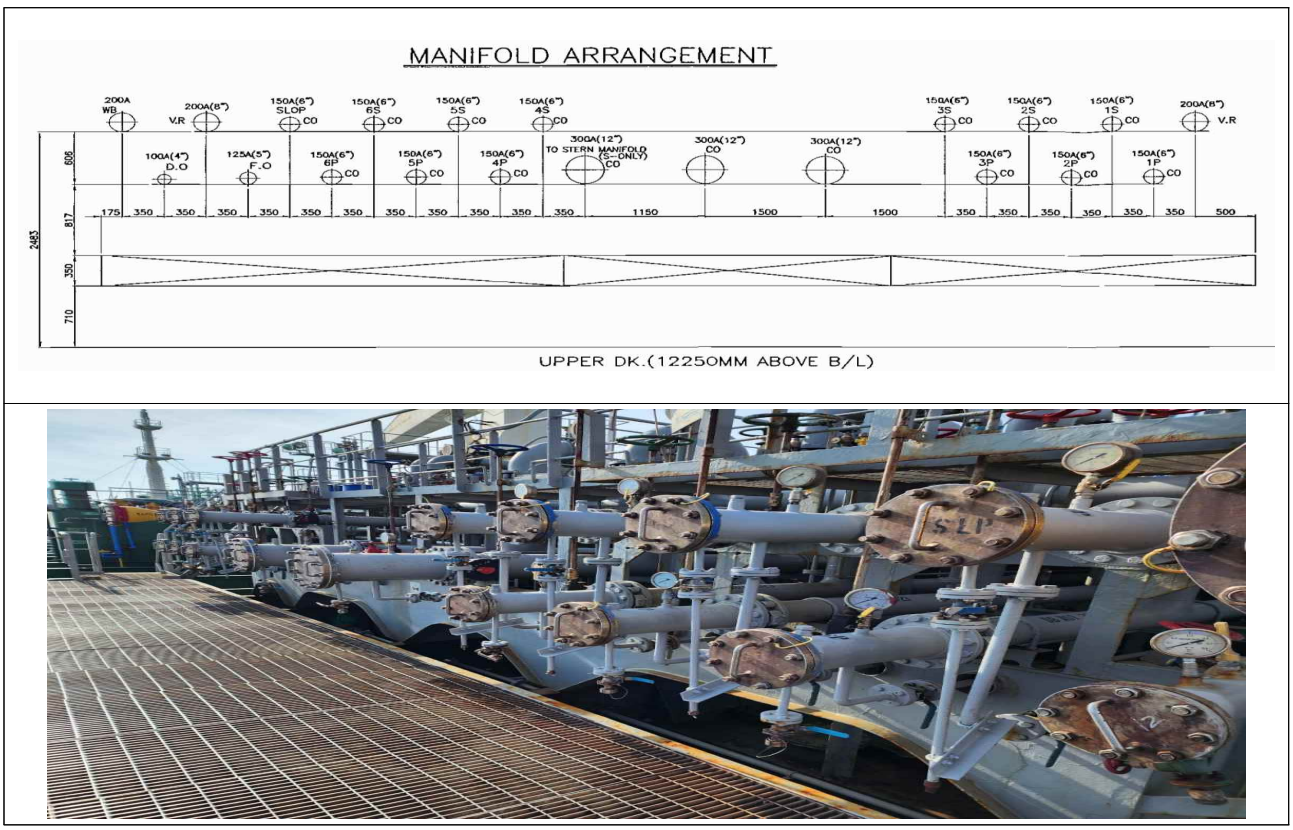
<Figure 2> General arrangement (up) and photo (down) of New Bright (sourced by the company)

2.1.3 New Bright has a total of twelve cargo tanks, with six each on the port and starboard sides. They are numbered from one to six. A slop tank is arranged behind Cargo Tank No. 6 on each side. A ballast tank is on the outside of each of the twelve cargo tanks, and they are designated as Nos. 1 to 6 on each side. Each cargo tank is equipped with an independent cargo pump, and a ballast pump room is behind the slop tanks.



<Figure 3> Layout of cargo tanks and ballast tanks of New Bright

2.1.4 At the center of New Bright's upper deck is the manifold where cargo pipelines are located and arranged identically on both port and starboard sides. The pipelines are structured to process thirteen different types of cargoes. Moreover, individual cargo and slop tanks (P&S) can be loaded with different cargoes.



<Figure 4> Manifold arrangement of New Bright (up) and the photo of the manifold (down, the same type ship, New Star)

2.1.5 New Bright completed a periodic survey from the Korean Register of Shipping (KR) in Mokpo,

Korea, on 7 December 2022 and held a certificate[1] valid until 21 February 2028. The International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk[2], necessary for international shipping of liquid chemical in bulk, was also issued in Mokpo on 7 December 2022 and it is valid until 21 February 2028.

2.1.6 New Bright received the Safety Management Certificate (SMC)[3] from the KR, which has been valid from 9 October 2021 to 8 October 2026.

2.2 Shipowner and operation

2.2.1 The owner of New Bright is Seongho Shipping Co. Ltd. ("Seongho Shipping"), which has specialized in transporting oil and liquid chemical for about sixty years since its establishment in November 1965.

2.2.2 Seongho Shipping directly manages the tanker's safety, and as of the end of May 2024, the shipowner is directly managing and operating nine oil and chemical tankers (except New Bright[4]). Its Marine Operation Team, with a designated person (DP), is responsible for crew management, the technical team for providing stores and ship repairs, while the Safety Management Team oversees ship survey and certification audits.

1) Cargo Ship Safety Construction Certificate (SC); Cargo Ship Safety Equipment Certificate (SE); and Cargo Ship Safety Radio Certificate (SR), etc.

2) New Bright is capable of transporting chemical cargoes listed on Appendix 1 of the certification (for benzene) pursuant to the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulks (IBC Code)

3) Safety Management Certificate (SMC) certifies that the tanker was audited and identified as appropriate by the KR on 21 Sep. 2021.

4) Sold on 1 Feb. 2024 after the accident occurred on 21 Dec. 2023

Name of Vessel	DWT	Built Year	Coating	Cargo pump	Tk no.	Laden Speed	Trading route	ECDIS	Phenol handling
NEW GLOBAL	5,646	Feb. 2009	Epoxy	Framo 200m3/h	10+2	11	NE ASIA	TRANSAS	X
NEW HARMONY	5,646	Apr. 2009	Epoxy	Framo 200m3/h	10+2	11	NE ASIA	TRANSAS	X
SEONGHO GALAXY	5,538	Oct. 2007	Epoxy	Marflex 200m3/h	10+2	11	NE ASIA	TRANSAS	X
SEONGHO PIOCE	5,555	Oct. 2008	Epoxy	Marflex 200m3/h	10+2	11	NE ASIA	TRANSAS	X
NEW BRIGHT	12,865	Dec. 2007	Epoxy	Framo 350m3/h	12+2	12	SE/NE ASIA	MECYS	X
NEW SILVER	12,865	Jan. 2008	Epoxy	Framo 350m3/h	12+2	12	SE/NE ASIA	MECYS	X
NEW STAR	12,900	Sep. 2006	Epoxy	Framo 350m3/h	12+2	12	SE/NE ASIA	TRANSAS	X
SEONGHO ACE	13,140	Jun. 2009	Epoxy	Framo 350m3/h	12+2	12	SE/NE ASIA	TRANSAS	X
SH VENUS	6,894	Jun. 2022	SUS(NSSC2120)	Framo 200m3/h	10+2	12	SE/NE ASIA	FURUNO	O
SH OLIVIA	6,871	July. 2022	SUS(NSSC2120)	Framo 200m3/h	10+2	12	SE/NE ASIA	FURUNO	O

All vessels' Kind, Type, Class & Flag : Oil/Chemical Tanker(IMO Type II), 'KR' (Korea Register) & Korean Flag, 'KR' (Korea Register) & Panama Flag
All vessels' has a Heating coil & 2 ECDIS

<Figure 5> Particulars of the Seongho Shipping fleet (Nine in total as of May 2024; New Bright was scraped)

2.2.3 New Bright transported oil and chemical products in bulk, such as benzene and gasoline, mostly loaded at Daesan and Ulsan Ports in Korea. These cargoes were discharged in Asian ports, including those in China, Cambodia, Myanmar, Malaysia, and Singapore.

2.2.4 New Bright had transported 10,000 tons of paraxylene from Daesan Port during her voyage prior to the accident and discharged it at Jiangyin Port in China. In the following voyage, 12,000 tons of benzene was loaded at Daesan Port in Korea and discharged at Changzhou Port, in Jiangsu Province, China. The tanker was then scheduled to load about 12,000 tons of benzene at Incheon Port in Korea for the next voyage.

2.3 Crew composition

2.3.1 A total of nineteen persons were on board New Bright at the time of the accident. Four among them, the master, the C/E, C/O, and 2/E were from Korea; and of the remaining crewmembers, ten were from Indonesia and five were from Myanmar.

2.3.2 The New Bright master held a first-class deck officer license and became the master in May 2017. He has worked on five oil/chemical tankers owned by Seongho Shipping in that capacity, and his service as master spans about six years. He boarded New Bright for the first time on 22 October 2023, about two months before the accident occurred.

2.3.3 The C/O held a second-class deck officer license. He was promoted as C/O in January 2021, and since then, he has worked on three oil/chemical tankers owned by a different company in that capacity. His service as C/O spans close to two years. New Bright was his first tanker to board since he joined Seongho Shipping on 14 June 2023, about six months before the accident occurred.

2.3.4 The bosun who was assigned to the operation by the C/O is a Burmese who has served aboard for a total of five years. He boarded New Bright on 7 June 2023, about six months before the accident occurred, and in early December (two weeks before the accident), he had been promoted from the AB to the bosun.

2.3.5 A total of nineteen crewmembers, including Indonesians, Burmese, and the Korean master, communicated with one another in the working language, English. The master stated that it had not been significantly difficult to give work instructions and get them to perform their duties, while the C/O stated he had difficulty in communicating with the Burmese bosun.[5)]

2.3.6 The officers' navigational watch system on New Bright was as follows: the 3/O kept watch from 08:00 to 12:00 and from 20:00 to 24:00; 2/O "A" from 00:00 to 04:00 and from 12:00 to 16:00; and 2/O "B" from 04:00 to 08:00 and from 16:00 to 20:00. The three officers were assigned to three different watchkeeping shifts by turns. The C/O was in full charge of cargo management and not engaged in the watchkeeping duties.

2.3.7 2/O "A" held a third-class deck officer license, and he was assigned to New Bright on 10 April 2023, which was his second ship of Seongho Shipping. 2/O "B" held a second-class deck officer license with service experience of seven years in total. On 15 June 2023 New Bright became his fifth ship to which he had been assigned in that capacity. The 3/O held a third-class deck officer license and boarded New Bright as the second ship of Seongho Shipping on 25 August 2023.

5) The statements given by the master and the C/O on 27 Jan. 2024

운항 업무 절차 Shipboard Operation Procedure | Doc No : PR-08 Page : 2/17

5. 항해 당직 Navigational Duty

Master should be handwritten and display night order in night navigation (every day if possible) by free form and all officers/ engineer shall be observed it.

2) 항해 당직의 편성
Assignment of Navigational Duties

(1) 편성
Assignment

① 당직 타수의 교대도 당직 사관과 같은 시간대에 한다.
Watch officer and crew should be relieved at same time.

당직시간 Time	당직 항해사 Duty Officer	
0000-0400 1200-1600	2/O A	2/O
0400-0800 1600-2000	2/O B	3/O A
0800-1200 2000-2400	3/O	3/O B

<Figure 6> Assignment of navigational duties quoted from the Shipboard Operation Procedures

2.4 Properties of cargo (benzene)

2.4.1 Benzene, which caused the explosion on New Bright, is a colorless liquid with a unique odor. The material safety data sheet (MSDS) states that benzene has the following specific hazards: (1) it is a highly flammable liquid and vapor; (2) its fierce polymerization can lead to fire and explosion; (3) it can create an explosive mixture at its flash point or higher; (4) it is highly flammable as it can be easily ignited by heat and sparks; (5) benzene vapor may cause dizziness or asphyxiation unwittingly; (6) if a person inhales and touches benzene, it may irritate or burn the skin and eyes; and (7) benzene may be toxic if it is inhaled and absorbed through the skin.

2.4.2 The melting point of benzene is 5.5° below which it remains as a solid. Also, its flash point sits at -11°. Thus, external ignition sources can cause it to burn even at -11°. Also, benzene has very low electric conductivity, classifying it as a non-conductor, and it can store up static electricity[6].

2.4.3 The International Maritime Organization (IMO) has long been aware of the aforementioned benzene risks, and on 18 June 2003, it has set out the "MSC/Circ.1095 - Revised Minimum Safety Standards for ships carrying liquids in bulk containing Benzene[7]" and circulated it to its member states. Importantly, these amended standards focused on the scenario in which a ship is exposed to benzene when onloading cargo and gas freeing is performed. The related precautions were added accordingly.

6) ISGOTT (International Safety Guide for Oil Tankers and Terminals) 6th Edition 3.1.4.3 Conductivity

7) MSC/Circ.1095 - Revised Minimum Safety Standards for ships carrying liquids in bulk containing Benzene, 18 Jun. 2003

2.4.4 The substance of the annex has a total of fourteen measures, including cargo information to the master; cargo information to the crew; air quality monitoring; personal protection; maintenance of equipment for personal protection; entering into enclosed spaces; training; medical monitoring; precautions during cargo operations; a controlled tank venting system; cargo measurements and sampling; and contaminated clothes. It also describes precautions tailored to each case when treating benzene.

2.4.5 Importantly, the appendix listed precautions to be given to the crew with examples in connection with loading and gas-freeing operations. For instance, the ventilation to the accommodation area shall be stopped/re-circulated and the fire flaps kept closed; vapor concentrations on the deck shall be measured prior to any work being undertaken; the crew working on the deck shall wear appropriate protective equipment; and only work related to cargo handling is allowed on the deck.

Product Name	Benzene	Proper Shipping Name	Benzene and mixtures having 10% benzene or more
Exposure Limit	TWA 0.5ppm, STEL 2.5ppm	Odor	Unique aromatic odor
Flash Point	-11°C (C.C)	Range of Explosion Limit	1.2% to 8.0%
Melting Point	5.5°C (C.C)	Vapor Pressure	94.8mmHg
Classification of Hazards & Risks	• Flammable liquid: Category 2 • Skin corrosion/irritation: Category 2 • Serious eye damage/irritation: Category 2 (2A/2B) • Germ cell mutagenicity: Category 1A • Carcinogenicity: Category 1A • Specific target organ toxicity (Repeated exposure): Category 1 • Aspiration hazard: Category 1 • Chronic aquatic toxicity: Category 2	Stability & Reactivity	• Highly flammable liquid and vapour • May cause fire/explosion if fiercely polymerized • May form explosive mixtures at the flash point or above • High flammability: it may be easily ignited by heat, spark, or flame • Vapors may form explosive mixtures with air • Vapors may move to ignition sources and cause a flashback • Vapors may cause dizziness or asphyxiation unwittingly • Causes skin or eye irritation or burn if inhaled and contacted

<Table 1> Properties of benzene (quoted from the MSDS)

2.5 Cargo tank cleaning procedures

2.5.1 Cargo tank cleaning should be always planned and documented, and its potential risk is to be identified and assessed.[8] The Procedures and Arrangement Manual of New Bright to identify procedures and facilities of discharging noxious liquid substances was approved by the KR on 4 July 2016.

2.5.2 The tanker developed the cargo tank cleaning plan and conducted the cleaning operation pursuant

8) ISGOTT (International Safety Guide for Oil Tankers and Terminals) 6th Edition 12.3.2. Tank Washing Risk Management

to the Cargo Tank Cleaning Instruction given by the company.

2.5.3 Chapter 3 of the instruction stipulates as part of general precautions that all of the crew on board should be aware that tank cleaning and gas freeing have been scheduled, and those engaged in the cleaning operation are required to wear the appropriate protective equipment.

2.5.4 Chapter 4 (Cargo Tank Cleaning Preparation) of the instruction states that a ship must hold a toolbox meeting with those engaged in the operation prior to cleaning, and the C/O is to supervise the overall operation and ensure the cleaning operation can be conducted safely in each case by reflecting clear procedures into the cargo tank cleaning plan based on the specific cargo properties.

2.5.5 Chapter 11 (Gas Freeing) of the instruction states that the crew must check the flammable gas level inside the tank before initiating the cleaning operation if machine cleaning or steaming is scheduled after cargo discharging. Moreover, if the low explosion level (LEL)[9] of the cargo exceeds 10%, the crew is obligated to free the gas in the tank to decrease the level.

2.5.6 Also, gas freeing is to be carried out while leaving the main hatch closed and the P/V valve fully opened for sufficient air pressure. Once the flammable gas level inside the tank declined to 10% or lower of the LEL, the crew completes the gas freeing and starts cleaning the tank.

2.5.7 Pre-cleaning is generally referred to as an operation to clean a cargo tank with either seawater or fresh water after cargo discharge, while chemical cleaning is to re-clean the cargo tank after pre-cleaning with seawater or fresh water mixed with detergent.

2.5.8 Rinsing is to clean a cargo tank with seawater and fresh water to remove residual chemical components and odor inside after the tank has been cleaned with chemicals. Steaming cannot be carried out next to a tank loaded with self-reactive or flammable chemicals because of the static electricity risk.

2.5.9 The final step of tank cleaning is draining, which is to remove the residual liquid on the bottom, in the valves, or in the pipes of the cargo tank. After that, the crewmembers perform mopping: they go directly inside the tank and wipe away any remaining traces of water with cotton rags. At the same

9) LEL (Low Explosion Limit) is referred to as the lowest explosion limit needed for a flammable gas or vapor to burn in air (or the lowest gas concentration that will explode in air, *Occupational Safety Dictionary*)

time, they conduct drying by using a fan.

section

3 Development of the Accident

3. Development of the Accident

3.1 Arrival, cargo discharge, and departure from China

3.1.1 New Bright was berthed alongside at Changshu Port, in Jiangsu Province, China at 21:05 on 19 December 2023 (local time in China; UTC+8). At 02:00 on 20 December, she commenced to discharge approximately 11,410 tons of benzene that had been loaded at Daesan Port in Korea.

3.1.2 She completed unloading at around 09:30 on 21 December, the following day. The tanker departed from Changshu Port with 19 crewmembers on board, including the master, at around 10:20 and proceeded along the Yangtze River while being maneuvered with three pilots[10)], on her way toward Incheon Port in Korea.

3.1.3 When the tanker left Changshu Port, she had 241.58 tons of heavy fuel oil, 32.50 tons of diesel oil, and 174 tons of fresh water. Her drafts forward and aft were 3.50 and 5.30 meters, respectively, meaning that her trim by stern was 1.80 meters.

3.1.4 New Bright was scheduled to load about 12,000 tons of benzene at her next destination, Incheon Port. The distance from the pilot station to the inner anchorage of Incheon Port was about 440 miles (a voyage of approximately 36 hours), so the tanker was expected to arrive at Incheon Port at around 13:00 on 23 December (local time in Korea; UTC+9).

10) The Yangtze River is a compulsory pilotage area where a ship is required to sail about 145 miles with a pilot on board (ab. 14 to 14.5 hours).

REMARK: ETA TO INCHEON, KOREA (INNER ANCHORAGE) IS 1300LT ON 23RD DEC' 2023

DEP' CONDITION

A. VLSFO/241.58 MT (248.31 K/L) MGO/32.50 MT (36.64 K/L) ME SYS/ 8400 LTR, ME CYL/9125 LTR, GE SYS/8185 LTR, FW/174 MT

B. DRAFT F: 3.50 M / A: 5.30 M

<Figure 7> Full text quoted from the departure report sent to the company by the master (11:49 on 21 December 2023)

3.2 Cargo tank explosion

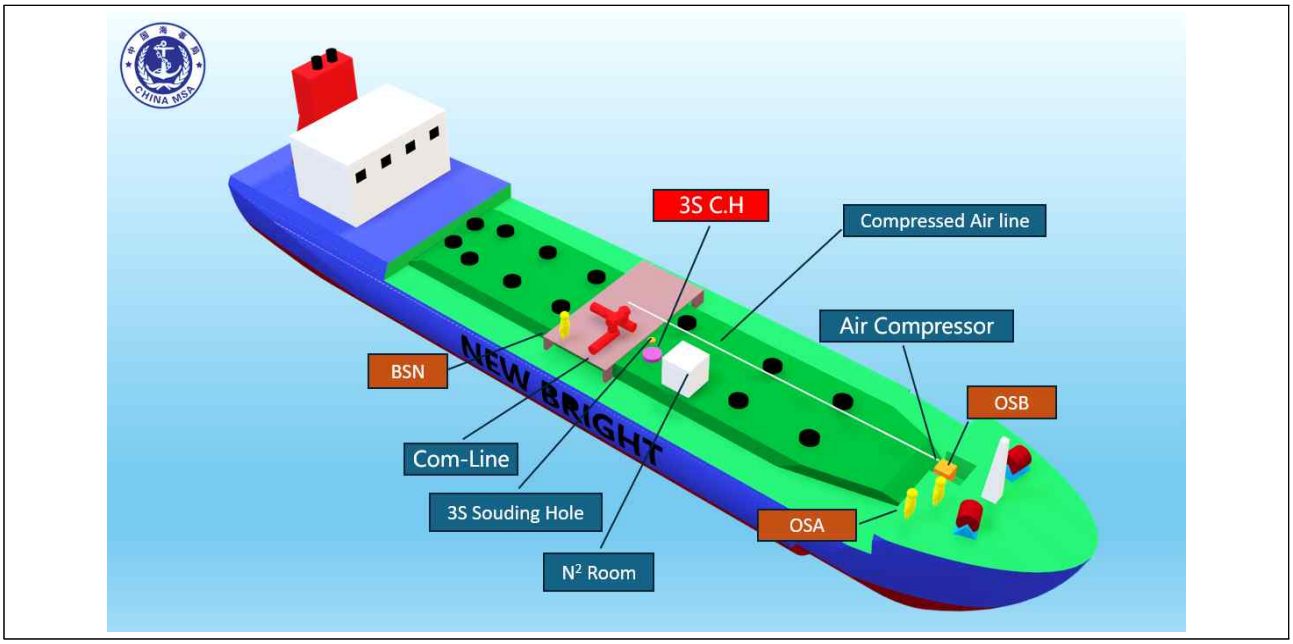
3.2.1 The C/O completed departure preparation with the bosun and other deck ratings at around 11:00 on 21 December 2023, the day of the accident. While returning to the accommodation area, the C/O pointed toward a cargo pipeline and directed the bosun to open its valves. He stated this was a normal procedure to prevent the valves from freezing from the benzene residue in the cargo pipeline after cargo discharge.

3.2.2 Then, the C/O cleared documents at the cargo control room (CCR), wrote up additional necessary instructions, delivered them to the bosun who was in the crew mess room, and went to his room to rest at around 12:00. The written instructions consisted of the following five operations: (1) purging the cofferdam[11)] to remove the cargo residue inside the cargo pump; (2) opening the P/V valve of each cargo tank after checking their condition; (3) lashing equipment on the deck; (4) checking if the steam valves of each cargo tank are closed; and (5) cracking open the cargo tank hatches.

3.2.3 At around 12:45 on the same day, the bosun and the OS, who were on the deck as requested by the pilots to be standby at the forward anchor station, completed the operations the C/O instructed, including opening the P/V valve and cracking open the cargo tank hatches. An hour later, at around

11) Cofferdam purging: connecting a purging hose to check leakage of hydraulic oil of cargo pumps and cargo; supplying compressed air into the cofferdam; and releasing gas and residues inside. (the crew should wear PPE due to potential risk of gas and residues)

13:45, they returned to the mess room and rested.



<Figure 8> Major arrangement of pipelines related to the accident (quoted from the Chinese MSA's documents)

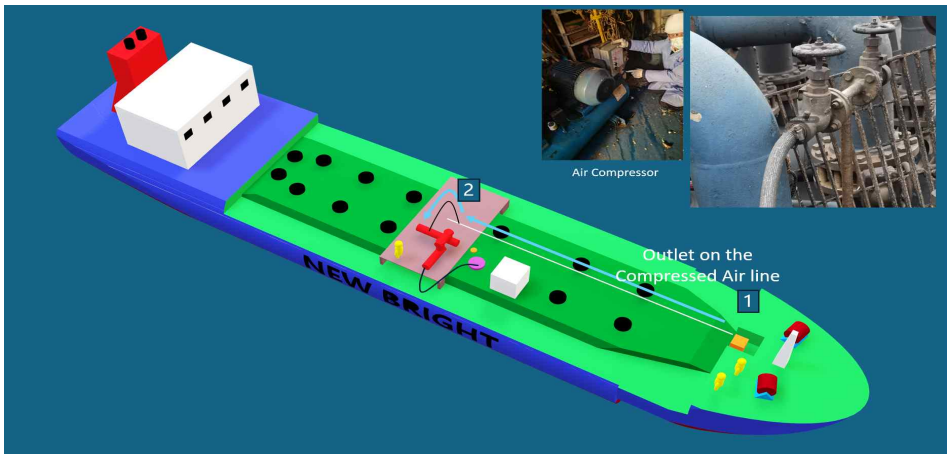
3.2.4 At around 14:45 on the same day, the bosun and two OS, who were standby at the forward anchor station for passing under the Sutong Bridge, returned to the deck, connected the compressed air line to the common line of the center manifold, put a portable rubber hose into the drain pipe of this common line as well as the other side of the hose into the hatch of CT No. 3 (S), and started to pump compressed air into the cargo tank (air blowing).

<Figure 9> Recreating the operation of connecting hoses for air blowing on board New Global (which belongs to Seongho Shipping; and the photos were quoted from the company's documents)

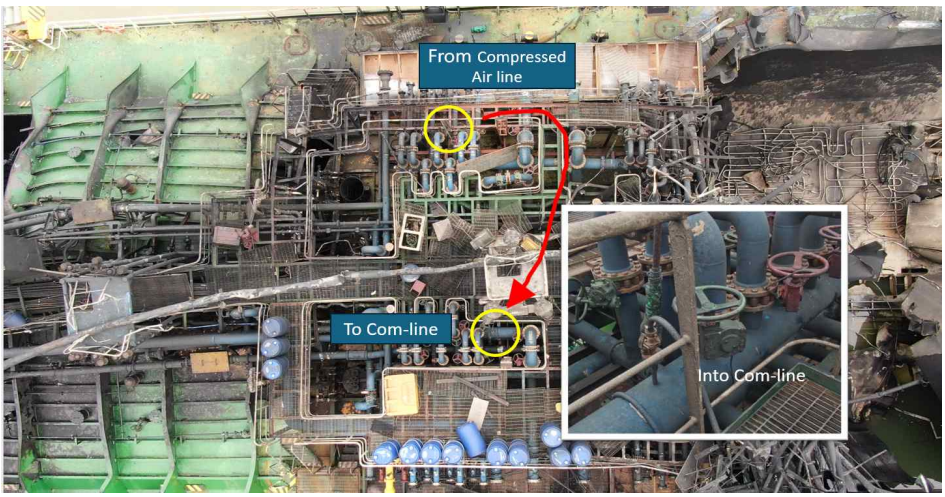
3.2.5 This air blowing operation was not among the five instructions written by the C/O. He stated, "I never directed this work (air blowing)." According to the written statement given by the bosun, however, he conducted such a task after the C/O had instructed that the "tank cleaning should be set up in advance."

3.2.6 In other words, the C/O argued that he had neither intended the tank cleaning operation nor instructed the above-mentioned task, while the bosun believed the C/O's written and oral instructions were part of preparation for tank cleaning, and thus, on his own he carried out air blowing to remove the residue from inside the cargo pipeline. Both stated differently, and as for now, it is not possible to identify who told the truth. However, it is true that the C/O wrote five instructions and that the bosun followed the instructions with other crewmembers without any objection.

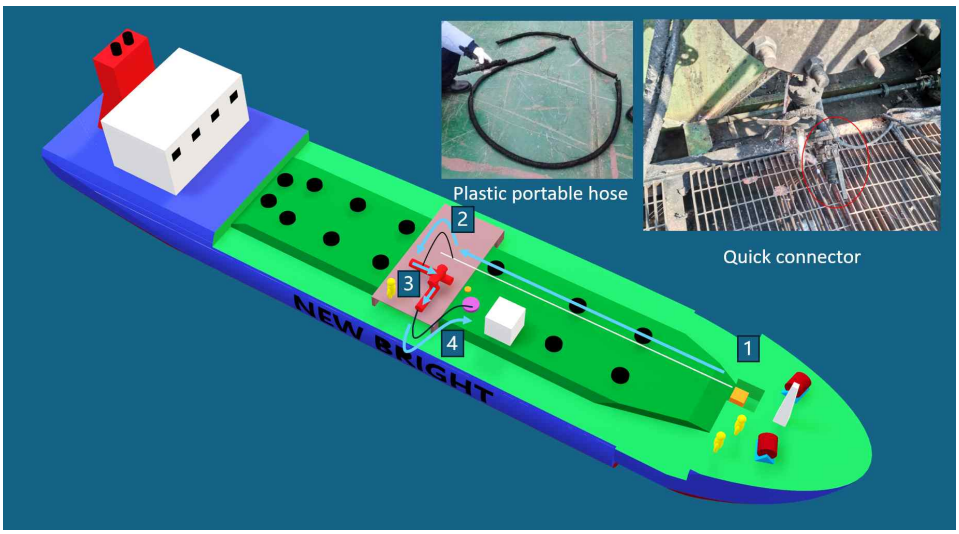
3.2.7 While watching the cargo residue flow out from the cargo pipeline through the hose, the bosun went to the bow for a while and informed of this air blowing operation the two OS who were on standby for emergency anchoring. After that, he came back to the site and checked the status of air blowing, when the cargo tank exploded.



① Operating the air compressor at the bosun store → ② Connecting it to the compressed air line



② Connecting the compressed air line to the common line (after explosion of New Bright)



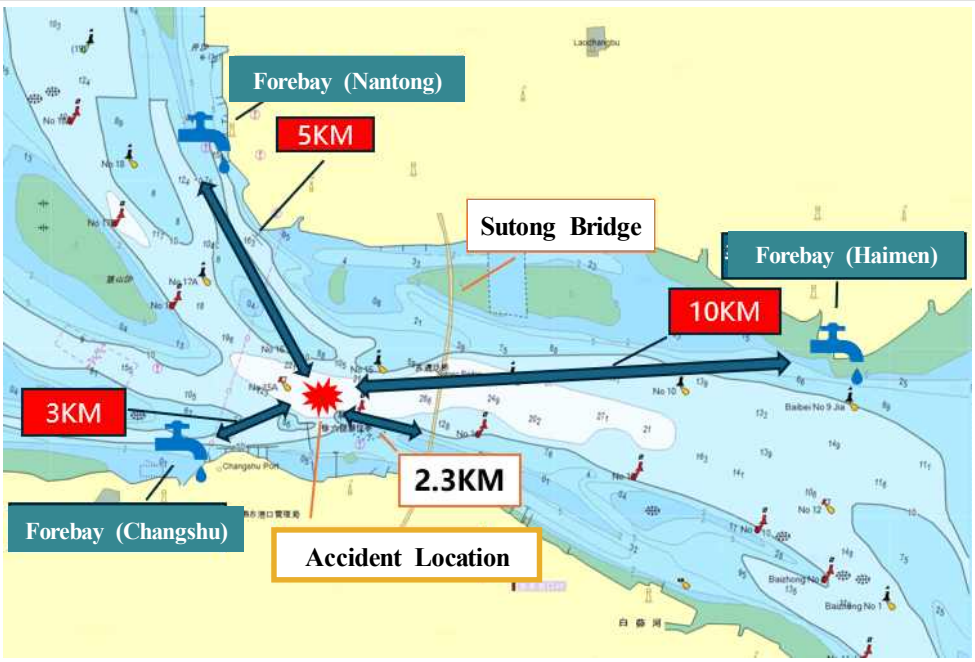
③ Connecting a rubber hose to the quick connector of the drain line, which is to release residues from the common line

④ Putting the rubber hose into the hatch of CT No. 3 (S) and supplying the compressed air

<Figure 10> Process of connecting pipes related to the accident on board New Bright (quoted from the Chinese MSA's documents)

3.2.8 The explosion occurred at 15:06 on 21 December 2023 about 2.3 kilometers west of the Sutong Yangtze River Bridge (31-45-36N, 121-01-35E). The accident location on board is adjacent to CT No. 3 where the flame first ignited; explosions occurred two to three times consecutively; and then, the hull rapidly listed to starboard.

3.2.9 At the time of the accident, it was overcast with a wind blowing from the northwest at 8 to 10 meters per second; the waves were about 0.3 meters high; and visibility was about 7 nautical miles. The temperature was about 4 degrees below zero.



<Figure 11> Explosion location and the adjacent forebays (quoted from the Chinese MSA's documents)

3.3 Ship abandonment, rescue operation and damage

3.3.1 At around 15:06 on 21 December 2023, the day of the accident, the master adjacent to the bridge

wing ordered ship abandonment and pressed the distress alarm button. Soon after the third explosion, the tanker drastically listed to starboard, which the master determined would interfere with the evacuation to lifeboats and abandon the ship. Instead, he ordered the crew to release the life rafts on both sides.

3.3.2 OS "A" and "B," who were on standby at the forward muster station, jumped into the river and one pilot evacuated to the life raft and abandoned the ship. At around 15:40 on the same day, a total of 22 crewmembers, including 19 crewmembers and three pilots, were safely rescued by the boat of the Chinese MSA. The fire was completely extinguished by around 20:00.

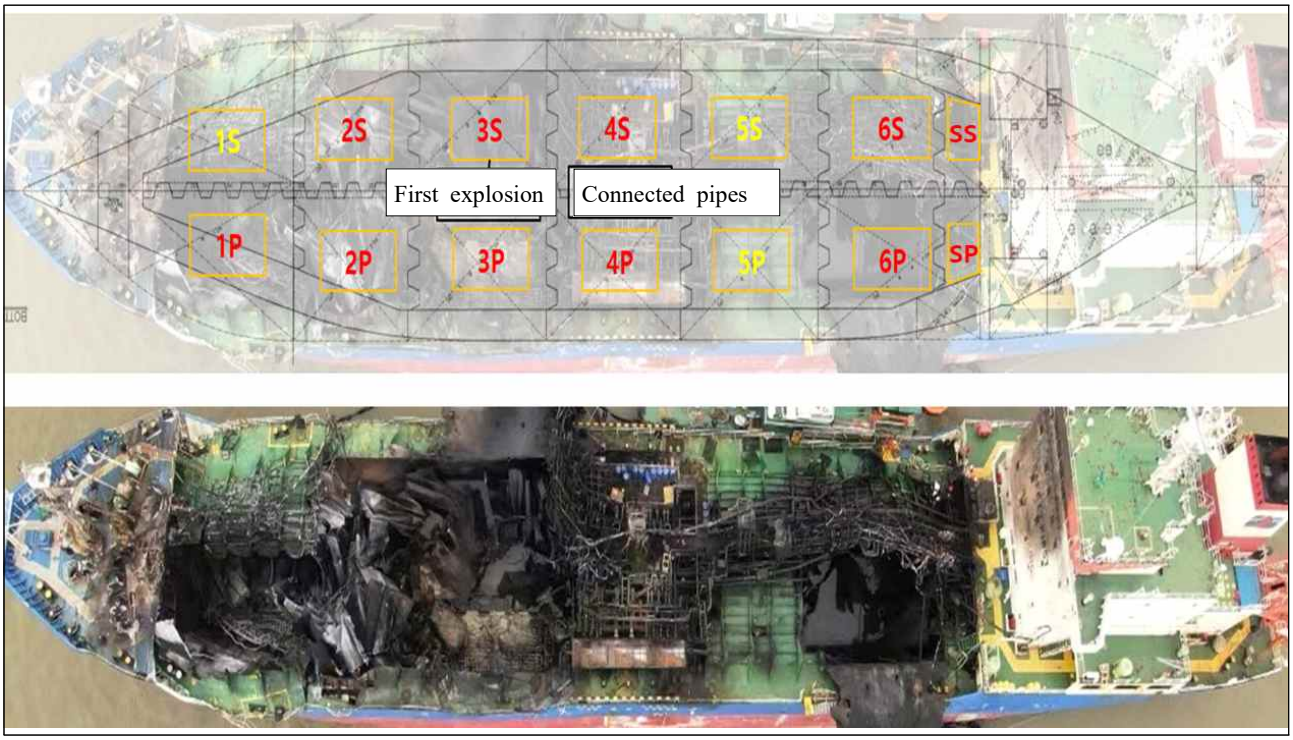
<Figure 12> Rescue operation and evacuation of the New Bright crew (left) and fire extinguishment (right; quoted from the Chinese MSA's documents)

3.3.3 The accident took place just 2.3 kilometers away from Sutong Bridge. It is a place adjacent to three forebays, which provide domestic water for about 10 million residents of three nearby metropolitan areas, and the intersection of four shipping routes. Therefore, massive losses can be suffered should a ship sink, or marine pollution occur at this location. The Chinese MSA actively and swiftly responded to the accident in the early stage, rescued all personnel, and prevented additional damage.

3.3.4 At around 22:33 on the same day, New Bright was towed and beached in shallow water southeast of the accident site. She was taken to the floating dock on 1 January 2024.

3.3.5 The accident caused the tanker to suffer severe damage to her cargo tank, deck, bulkhead, and cargo

pipes as well as partial damage to the accommodation area. There were no fatalities, but three crewmembers suffered burns or other injuries.



<Figure 13> Comparison of the photo of New Bright after hull explosion and cargo tank layout (quoted from the Chinese MSA's documents)

<Figure 14> Photo of New Bright on the floating dock after explosion (quoted from the Chinese MSA's documents)

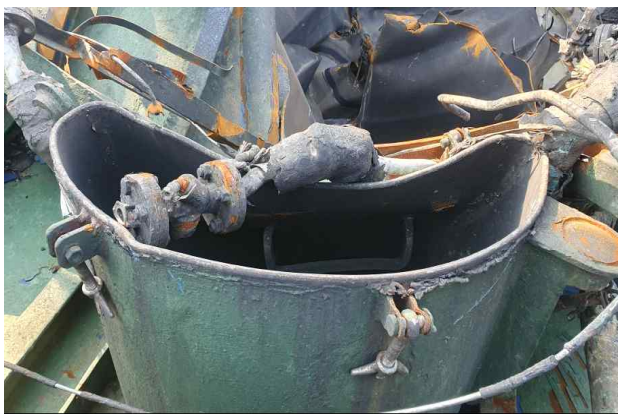
3.4 Korea-China joint on-site investigation

3.4.1 The Korea Maritime Safety Tribunal (KMST) of the Republic of Korea has visited the accident location and investigated the lifted hull for two nights and three days, from 25 to 27 January 2024, under the proactive support and cooperation of the Chinese MSA.

3.4.2 This on-site investigation enabled the KMST to identify the first explosion location (CT No. 3 (S)) and the damaged hull condition. However, the bulkheads of all cargo tanks were damaged, and the upper deck was massively impaired, making it dangerous for investigators simply to access the CCR and certain other areas. Thus, their investigation was limited.

3.4.3 The KMST held the ROK-China Marine Safety Investigation Meeting on 27 January 2024, where the KMST and the Chinese MSA shared their investigation progress and discussed areas of future cooperation. In addition, a Q&A session[12)] was held with the master, the C/O, and the bosun to get a clear picture of how the accident had unfolded.

12) (1) General information (work experience & communication); (2) Cargo loading/discharging plan & procedures of benzene; (3) Cargo tank cleaning procedures; and (4) Operation instructions and implementation after departure

Damaged cargo tanks (Nos. 2 & 3)	Bridge & accommodation area
Deck area viewed from the port bow	Deck area viewed from the starboard bow
	
Starboard manifold	Opening of the cargo tank

<Figure 15> Photo of New Bright damaged from explosion (The photos were taken during the on-site investigation in China)

section

4 Analysis

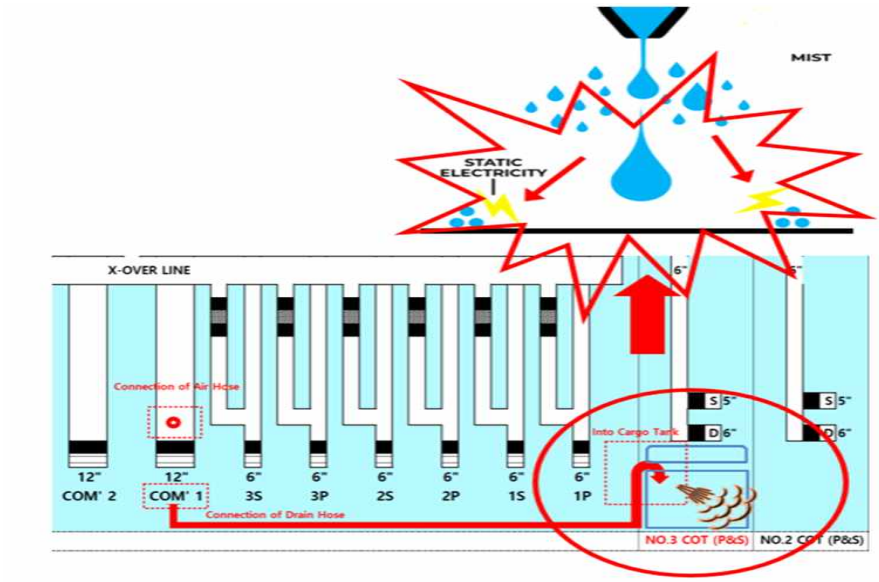
4. Analysis

4.1 Analysis on the direct cause of the tank explosion

4.1.1 The bosun opened the cargo tank a crack as instructed by the C/O. This action most likely allowed outside air to enter the cargo tank while flammable vapor inside the cargo tank was let outside. Moreover, a flammable gas mixture was presumably created inside the tank or on the deck.

4.1.2 At around 14:45 on 21 December 2023, the bosun and two OS, who went out on the forward anchor station for emergency standby for passing under the Sutong Bridge, connected the compressed air line to the common line of the center manifold, put one side of the portable rubber hose into the drain pipe of this common line and the other side into the hatch of CT No. 3 (S), and started to pump compressed air into the cargo tank (air blowing).

4.1.3 Presumably the bosun understood the C/O's directions as preparation for tank cleaning and decided to carry out them on his own initiative, removing the residue from inside the cargo pipeline.



* The rubber hose was lowered about one meter down from the top of the hatch cover of CT No. 3. (Total height of CT No. 3 is about 10 meters)

<Figure 16> Cargo residue ejection from the rubber hose connected to CT No. 3 and the explosion (quoted from the company's document)

4.1.4 Once the air blowing was initiated, air and cargo residue rushed, probably adding high pressure to the end of the rubber hose. When liquid pours from a pipe with a small cross-section area, its friction may cause a surge in static electricity (electrostatic discharge[13)]), which is assumed to be a major cause of the explosion. If not, the exposed metal wire at the end of the hose may have generated sparks while contacting the inner side of the cargo tank. Or, bits of residue may have free-fallen from the top of the cargo tank to the bottom, collided against one another and generated static electricity[14)].

4.2 The C/O's failure to implement the master's orders

4.2.1 At around 09:40 on 21 December 2023, the day of the accident, the tanker was heading along the Yangtze River on her way to Incheon Port in Korea, after discharging the cargo and departing from Changshu Port, in Jiangsu Province, China. The Yangtze River is an area of compulsory pilotage,

13) It is a phenomenon when liquid spurts from a pipe with a small sectional area. When the liquid is sprayed out, the pure gas itself does not create electrification. However, when the gas is mixed with foreign substance, including dust, the liquid generates static electricity when spurting out (Safety Education Manual of the Korea Occupational Safety and Health Agency), KISA-Electricity-03)

14) ISGOTT (International Safety Guide for Oil Tankers and Terminals) 6th Edition 3.2.6. Free fall in tanks

and thus, a pilot boards a ship at a pier and sails about 145 nm with the crew (ab. 14 hours to 14.5 hours).

4.2.2 The distance between the pilot station in the Yangtze River and the port of Incheon is about 440 nm, taking about 36 hours for a tanker to sail traverse. New Bright was originally planned to load benzene at Incheon Port, just as she had done on her previous voyage. To ensure continued compliance with cargo quality specifications, however, the cargo tanks had to be cleaned.

4.2.3 At around 09:00 on 21 December, the master ordered the C/O, "keep the cargo tank hatches tightly locked until the tanker moves away from the river, and beyond being on standby at the forward anchor station, do not conduct any operations on the deck, including tank cleaning, until the morning of 22 December."

4.2.4 The master believed that the crewmembers needed time to rest just in case they would have to respond to an emergency, given the Yangtze River had such congested vessel traffic. Moreover, it generally takes 24 hours to clean cargo tanks and about 36 hours to arrive at Incheon Port. Therefore, the master determined that the crew still had enough time even if they started operations in the open waters, after the pilots had disembarked the tanker.

4.2.5 As mentioned above, however, the C/O wrote up the following five instructions, delivered them to the bosun, and went back to his room to rest: (1) purge the cofferdam to remove cargo residue inside the cargo pump; (2) open the P/V valve of each cargo tank after checking their condition; (3) lash equipment on the deck; (4) check whether the steam valves of each cargo tank are closed; and (5) crack open the cargo tank hatches.

4.2.6 Among those instructions, opening the cargo tank a crack, which is for gas freeing at the middle stage of tank cleaning, was not necessary at that time. In addition, the tanker crew was not in a hurry; ample time remained for tank cleaning as well. The C/O stated that he himself did not know why he had directed the bosun to carry out these tasks, which went against those of the master.

4.2.7 Meanwhile, the International Safety Management (ISM) Code[15)] stipulates that the company should establish in the SMS that the master has the overriding authority and the responsibility to make decisions with respect to safety and pollution prevention. Therefore, the company's Safety

15) International Safety Management (ISM) Code: 5. Responsibilities & Authority of the Master

Quality Environment and Health Manual (SQEHM)[16] specifies 21 items as the master's authority, among which item No. 19 prescribes that the responsibility and authority to make the final decisions with respect to safety operation and pollution prevention lies with the master of the ship.

4.2.8 The C/O should have rightly followed the instructions that the master had given based on his rational decision, and the possibility exists that the C/O's not following them without a reason could have been one of the causes of this accident.

4.3 Non-compliance with safety rules, including tank cleaning procedures

4.3.1 The tank cleaning operation comes with a significantly high risk of explosion and asphyxia. Therefore, significant steps are taken to prepare and check prior to the operation, while those engaged in the cleaning are required to have a thorough understanding of the operation and comply with the safety guidelines.

4.3.2 In order to ensure safety, the crewmembers are to undertake several precautionary measures when preparing for the cleaning operation. These include holding a toolbox meeting, identifying the cargo properties, including flammability and risk of explosion, and checking the atmospheric level before entering the cargo tank.

4.3.3 In this case, no toolbox meeting or plan took place related to the tank cleaning operation prior to the accident. That is because the New Bright master instructed the C/O not to carry out any operation on the deck until the morning of 22 December, as described in the paragraph 4.1.3. As a result, the tanker had neither any preparation nor plan for tank cleaning as well as risk assessment for flammable cargo.

4.3.4 In the end, the cargo tank hatch was cracked open without taking any preparatory steps, and air blowing was carried out. This procedure pumped in compressed air by putting the one side of the rubber hose connected to the drain pipe of the common line into the hatch of CT No. 3 (S).

4.3.5 As for cargo management aborad New Bright, the C/O is responsible for the on-site command of cargo loading/discharging as well as tank cleaning and gas freeing. The company's Cargo Tank Cleaning Instruction stipulates that the C/O is to plan and supervise all gas freeing operations and

16) Safety Quality Environment and Health Manual (SQEHM): 9) Master of 4. Responsibility & Authority

notify the procedures to then entire crew on board.[17] However, such provisions were not complied with in this case.

4.3.6 Meanwhile, opening the hatch a crack immediately after departure differs from the general tank cleaning procedures or the company instructions. Thus, the bosun and the ratings could have refused such an unauthorized order.

4.3.7 The Safety Management Instruction[18] of the company states that the crew engaged in the shipboard operation should use the Stop Work card and present their opinion to their supervisor when they determine the operation process is not safe, and that they should resume the operation only after a clear measure has been taken or explanation has been given to the crew. Such useful rules to prevent accidents were already established, but not followed on site.

4.4 Lack of awareness on flammable and static accumulator cargoes

4.4.1 The task at hand involved a highly explosive and flammable cargo of benzene. Yet, the C/O directed the bosun and ratings to simply crack open the hatch cover without giving any specific explanation on the properties of benzene, checking the gas level inside the cargo tank, or preparing them to wear personal protective equipment (PPE) with precautions.

4.4.2 The gas concentration was not measured, so confirming the air conditions inside the cargo tank is impossible. However, from the moment the hatch cover was opened a crack, outside air flowed into the tank, and benzene vapors diffused over the deck, exposing the crew to them.

4.4.3 While performing operations as instructed, the bosun and the ratings did not have PPE with them, including a portable gas detector. The bosun stated that he was waiting to check to see whether the rubber hose connected to CT No. 3 released benzene vapor. His very statement indicates the likelihood that he was not able to clearly recognize the hazards of benzene.

4.4.4 Meanwhile, the bosun and two OS carried out the air blowing task with the compressed air to remove the cargo residue inside the common line. The regulations prohibit this process when dealing with static electricity accumulators such as benzene[19]. It is because such cargoes may

17) Ch. 11 (Gas freeing) of the Cargo Tank Cleaning Instruction (Doc No : IN-09-02)

18) Ch. 27 (Safety Management Culture) of the Safety Management Instruction (Doc No: IN-08-03)

generate static electricity due to friction and risk explosion if any flammable gas mixture exists inside the cargo tank.

4.4.5 Even in the Cargo Management Procedures[20)] of the company, compressed air cannot be used for cleaning a pipeline of flammable cargo or one that accumulates static electricity. However, the crew on the tanker did not follow the provisions.

4.4.6 In addition, the rubber hose used for air blowing had to be checked for its proper connection and performance. In this case, however, it is not possible to identify when this rubber hose was provided, and even its manufacturer and product specifications are not available as it was damaged in the explosion. The company mentioned that there was no separate book to record the maintenance of the hose, as it was used for multiple purposes on board.

4.4.7 The master stated that he had never seen an air blowing operation that shifted residue directly into a cargo tank with a hose. Rather, he added, it was generally used to blow residue from one side, either onshore or on a tanker, to the other side during the discharging operation. Thus, he stated he could not understand why the bosun had carried out the operation in this manner.

4.4.8 The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) requires[21)] the crew, including the bosun, to fully understand the shipboard cargo operation procedures, which include tank cleaning and gas freeing, as well as safety management. However, they presumably failed to fully understand the properties of benzene and did not take all available means to ensure safety in the operation process.

4.5 Communication issues among the crew with different nationalities

4.5.1 The C/O is a Korean national, while the bosun is from Myanmar. When on board, they communicated with each other in the working language, English. The C/O stated[22)] that he had

19) ISGOTT (International Safety Guide for Oil Tankers and Terminals) 6th Edition 3.2.1. General precautions against electrostatic hazards

20) Cargo Management Procedures (Doc No : PR-09) 10. Cargo Transfer Operation

21) STCW A-V/1-1-1: Mandatory minimum requirements for the training and qualification of masters, officers, and ratings on tanker

22) The statement by the C/O on 22 Feb. 2024

sometimes experienced difficulties in communicating with the Burmese bosun.

4.5.2 Also, the preceding bosun was expected to reboard the tanker after two months of vacation, so the company promoted the most diligent person among three ABs to the bosun position. It was state d[23] that his performance had been lacking.

4.5.3 At around 11:00 on 21 December 2023, the day of the accident, the C/O returned to the accommodation area after completing departure operations with the bosun and ratings. While doing so, he pointed at the cargo pipeline, giving a verbal direction[24] to the bosun to open up its valves.

4.5.4 Next, the C/O directed in writing the bosun, who was in the crew mess room, to conduct the following five operations: (1) purge the cofferdam to remove the cargo residue inside the cargo pump; (2) open the P/V valve of each cargo tank after checking its condition; (3) lash equipment on the deck; (4) check to ensure the steam valves of each cargo tank are closed; and (5) crack open the hatch of cargo tanks. The C/O stated that he had not thought of tank cleaning when giving such verbal and written instructions.

4.5.5 However, the C/O approached the bosun when he was having his meal in the mess room after completing the unloading operation, telling him to get ready for tank cleaning. Then, the bosun stated that the C/O had instructed air blowing for the common line, followed by five operations instructed in writing for tank cleaning.

4.5.6 As described above, the C/O and the bosun gave different statements. As for now, it is not possible to identify whose statement is true. The fact remains, however, that they did not have clear communication regarding air blowing and tank cleaning. Such communication errors eventually made the bosun crack open the hatch of CT No. 3, insert the rubber hose, and carry out air blowing, which resulted in an explosion.

4.5.7 As for crew training, the bosun scored 53 points in tank cleaning from the shipboard work proficiency evaluation conducted on 28 November 2023, which is less than the minimum score set by the regulations. Also, eight crewmembers, including the bosun, have scored less than 60 points

23) The statement by the C/O on 6 Mar. 2024

24) The statement by the master and the C/O on 27 Jan. 2024

from the cargo management and fire fighting training.

4.5.8 Still, the company did not offer familiarization training to those promoted while being on board or retraining to those who received less than 60 points from the on-the-job training, as required in its education and training instructions. The familiarization and on-the-job training can support seamless communication among the crewmembers by helping them better understand shipboard operations.

4.5.9 The STCW requires the master and the C/O, who are at the management level, to be capable of organizing and managing the crew in order to control the operation of the ship and safety of life at sea.[25] Such human resource management demands effective communication skills. Since the C/O himself stated there had been difficulties in communicating with the bosun, he should have proactively communicated with him and double checked whether the directions had been clearly delivered to the bosun.

4.6 Communication errors caused by fatigue of the crew

4.6.1 The C/O forgot the master's order not to perform operations related to tank cleaning until the tanker passed out of the Yangtze River and gave a written direction to the bosun to carry out five operations, including opening the cargo tank a crack. The C/O stated[26] that he had no idea why he had given such direction to the bosun, saying that he may have made a mistake out of extreme fatigue.

4.6.2 Among those five operations directed by the C/O, opening the pressure and vacuum relief valve involves working at height, which requires the crew to write up a checklist and share precautions in advance. However, the C/O stated that he had not written up the checklist as it had been a routine task and the crew had been engaged in other jobs, and he again mentioned extreme fatigue for the reason why he had given inappropriate direction.

4.6.3 According to a circulated guideline of the IMO, the "Guidelines on Fatigue[27]," fatigue is a "state

25) STCW A-II/2: Mandatory requirements for certification of master and chief mates on ship's of 500 gross tonnage or more

26) The statement by the C/O on 22 Feb. 2024

27) The IMO's circular on Guidelines on Fatigue, MSC.1/Circ.1595 (24 Jan. 2019) supersedes MSC.1/Circ.1014 on Guidance on fatigue mitigation and management (12 Jun. 2001).

of physical and/or mental impairment resulting from factors such as inadequate sleep; staying awake for long periods; work/rest requirements out of sync with circadian rhythms; and physical, mental or emotional exertion that can impair alertness and the ability to safely operate a ship or perform safety-related duties."

4.6.4 In addition, the Maritime Labor Convention (MLC) prescribes[28)] the minimum hours of rest for all seafarers as fatigue of the crew affects safe operation of a ship and the company is obliged to provide the crew with sufficient hours of rest.

4.6.5 Therefore, the company assigned one more officer to the tanker so that the C/O could be excluded from the navigational and anchor watch (see 2.3.4) and focus only on cargo operations. Also, it posted the table of shipboard working arrangement during the cargo watch where the crew could record and manage their hours of rest systemically. By doing so, the company checked whether the crew complied with the required number of rest hours.

4.6.6 The C/O's record of hours of rest for the previous three months from September to November 2023 before the accident confirms that he rested and worked about 15.4 hours and 8.6 hours a day on average, respectively. The log also shows that he worked for about 11 hours and rested for about 13 hours during cargo discharge. These satisfy the MLC's "hours of rest" regulation, prescribing 10 hours of rest per 24 hours (one day) and 77 hours of rest over seven days. The record identifies that the C/O took sufficient hours of rest for the previous three months before the accident.

4.6.7 According to the record of actual operations done by the C/O in the departure report as well as the statement, when the accident occurred, he started berthing operations at 20:50; finished them at 21:05 on 19 December 2023; and started to discharge the benzene cargo at 02:00 on 20 December. The cargo discharging continued for 31 hours and 30 minutes and completed at 09:30 on 21 December. Later, the C/O inspected the cargo tanks with a surveyor, and on the same day, the tanker departed at 10:20. He did the paperwork until 11:00. After having lunch and giving orders to the bosun, the C/O went back to his room for rest at around 12:00.

4.6.8 It took a total of 39 hours and 10 minutes from the moment he conducted berthing operations to the time he went to his room for rest after departure. Since it is practically difficult to rest during

28) Maritime Labour Convention, 2006 Regulation 2.3 Hours of work and hours of rest

berthing and departure operations (which take about 7 hours 40 minutes), the crew usually take turns for watch and rest during the cargo discharging operation (31 hours 30 minutes). In this case, however, the C/O stated that he had slept only for three to four hours during cargo discharging as the shore office had requested him to raise and lower the cargo pump pressure repeatedly.

4.6.9 If his statement is true, the C/O must have rested only for about four hours out of about 39 hours, including hours taken for berthing and departure operations. Moreover, he may very well have made a mistake if he had indeed had an extremely high level of fatigue.

section

5

Conclusions

5. Conclusions

5.1 The New Bright bosun cracked open the hatch of CT No. 3 as instructed by the C/O, probably resulting to the creation of a flammable gas mixture inside the tank. The bosun regarded the crack opening as a preparation work for tank cleaning, and thus he connected a portable rubber hose to the hatch of CT No. 3 (S) and pumped in the compressed air (air blowing) so that the residue could be removed from the cargo pipe. In this process, it is presumed that static electricity was generated inside the cargo tank and it ignited an explosion after meeting with a flammable gas mixture.

5.2 The master reasonably determined that he had sufficient time to clean the cargo tanks as it took about 36 hours from the pilot station on the Yangtze River to Incheon Port and that the crew must be rested in case of an emergency response. Therefore, he ordered the C/O not to carry out any operation on the deck till the tanker passed out of the river. However, the C/O did not follow the master's order but gave a written instruction of five deck operations to the crew.

5.3 The tank cleaning operation carries a significantly high risk of explosion and asphyxia. Therefore, significant tasks must be taken to prepare and check prior to the operation and those who engage in the cleaning are required to have a thorough understanding of the operation and comply with the safety rules. In this instance of New Bright, however, no preparations were done or plans made for the tank cleaning as required in the Cargo Tank Cleaning Instruction. Moreover, they neither conducted a risk assessment on flammable cargoes nor checked the gas level inside the cargo tank. Also, procedures were in place allowing the crew to refuse the instruction of unsafe operations. However, such procedures were not followed.

5.4 While handling benzene, a highly explosive and toxic cargo, the tanker management did not share the properties and precautions regarding this cargo with those engaged in operations. Blowing residue out of the cargo pipe with compressed air may generate static electricity as a result of friction. Thus, if a flammable gas mixture exists in the cargo tank, so does the risk of explosion. The company's Cargo Management Procedures also prescribe that the compressed air cannot be used for cleaning a line for of flammable or static accumulator cargoes, but this provision was not followed.

5.5 The C/O and the bosun failed to communicate clearly with each other on work instructions and the tank cleaning confirmation. As a result, the crew performed the operation in a manner that differed from the provisions, and eventually an explosion resulted. Also, the company's education and training instruction requires the tanker to offer on-the-job training to those who fail to satisfy the threshold of the work proficiency evaluation and those promoted while on board. However, these provisions were not implemented.

5.6 The company was satisfying the hours-of-rest standards set by the MLC by assigning additional officers to the tanker and easing the fatigue of the C/O. Still, the C/O stated that he had made a mistake out of fatigue when giving operation instructions at the time of the accident. It cannot be ruled out that he may have made a mistake if he had indeed had an extremely high level of fatigue.

section

6 Recommendations

6. Recommendations

6.1 Strictly carrying out the master's instructions

6.1.1 It is documented in the ISM Code and the SQEHM of the company that the responsibility and final decision-making authority with respect to safety operation and pollution prevention rests with the master of the ship, and the master holds an overriding authority to take any measures if it is deemed the best decision for the crew, the ship, and marine environments, in an emergency.

6.1.2 Therefore, the crewmembers are obliged to comply with the master's instructions as long as they are not against the provisions or unfair. If the C/O receives direction from the master, the C/O should immediately share it with the whole crew to ensure the direction can be implemented.

6.1.3 The company must establish a system for following onboard commands by providing the crew with regular training on the regulations covering the master's responsibilities and authority so that the master's instructions can be properly carried out.

6.2 Complying with the Cargo Tank Cleaning Instruction and the relevant regulations

6.2.1 As a responsible safety officer of the tank cleaning and gas freeing operations, the C/O or the duty officer is to thoroughly prepare for the operations, including setting up a plan for tank cleaning, while ensuring that those who engage in the operations, including the bosun, clearly understand the plan and procedures and regularly check whether they conduct the operations as instructed and comply with the safety precautions.

6.2.2 Those who engage in tank cleaning, including the bosun, need to be aware of the cleaning procedures. Should the C/O give an inappropriate order that may threaten their safety, they are to present their opinion to the C/O pursuant to the SMS Procedures. They are allowed to resume the operation only after they clearly understand the situation.

6.2.3 The company is obligated to regularly train all crewmembers and verify whether they comply with the tank cleaning procedures on board. Meanwhile, the company must ensure that they are allowed to refuse instruction of unsecured operations in accordance with the instruction.

6.3 Strengthening management of flammable and static accumulator cargoes

6.3.1 When the C/O prepares for tank cleaning, he is to precisely identify the risk factors, including cargo flammability and toxicity; come up with safety precautions; and describe the risks associated with the cargoes to those who engage in the operation, including the bosun, so that they can safely carry out the work.

6.3.2 The company is obligated to develop a separate management instruction for cargoes with high risk, including benzene, and distribute it to the crew as a reference. Checks are to be conducted to verify safety precautions for dangerous cargoes are well practiced during the shipboard operations.

6.4 Enhancing communication skills of the crew with different nationalities

6.4.1 On a ship, the crewmembers are of various nationalities. Therefore, in order to prevent accidents, they should be able to have clear communication with one another. Given that, the company needs to establish procedures to ensure the crew clearly understood the given instructions and to support their understanding.

6.4.2 Also, in order to boost the crew' understanding on safety precautions and work procedures, the company may consider distributing safety guidelines or leaflets written in their mother tongue languages. Additionally, the company needs to conduct evaluations on crewmembers' work proficiency as stated in the instructions to help them build their work capabilities.

6.5 Developing measures to manage the crew's fatigue during cargo operations

6.5.1 The crew, including the master, should be aware that their fatigue may cause marine accidents as it undermines their ability to make decision and concentration, resulting in mistakes. Therefore, the crewmembers need to ease their fatigue and proactive manage their physical condition while

satisfying the hours of rest as required in the MLC.

6.5.2 The company must be sure the crew is allowed to take sufficient rest as prescribed in the regulations. In particular, it should establish procedures to check whether the crewmembers are on duty without any issues while a tanker is at berth. Thus, the company should ensure fatigue-driven human error does not occur onboard a tanker. Over the mid- and long term, the company needs to strive to avoid accidents from human error by coming up with measures to manage fatigue.

Korea Maritime Safety Tribunal

Republic of Korea