Report of investigation into the oil spill accident on board Taiwan registered container ship "TS TAICHUNG" at Kwai Chung Container Terminals, Hong Kong on 1 April 2022

The Hong Kong Special Administrative Region
Marine Department
Marine Accident Investigation Section

21 February 2023

Purpose of Investigation

The purpose of this investigation, conducted by the Marine Accident Investigation Branch (MAIB) of Marine Department, is to determine the circumstances and the causes of the incident with the aim of enhancing the safety of life at sea and avoiding similar incidents in future.

It is not intended to apportion blame or liability towards any particular organization or individual except so far as necessary to achieve the said purpose.

The MAIB has no involvement in any prosecution or disciplinary action that may be taken by the Marine Department resulting from this incident.

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Summary

At 0518 hours on 1 April 2022, the Taiwan registered container ship "TS TAICHUNG" (*the vessel*) berthed at the No.7E, Kwai Chung Container Terminals (KCCT), Hong Kong on her starboard side. A total of 300 tonnes of low sulphur fuel oil (LSFO) was ordered to be supplied to *the vessel* from the locally licensed bunker barge "COLOANE" (*the barge*).

At 1410 hours, *the barge*'s starboard side was secured to *the vessel*'s port side for the bunkering operation. At 1514 hours, the Fourth Engineer No.1 of *the vessel* (*the 4/E-1*) found that LSFO spilled out from the air vent heads of No.3 (S[1]) LSFO tank on the starboard side upper deck of *the vessel*. The overflowed LSFO further spilled into the sea over the deck side gutter bar near Bay 34 and Bay 35. He immediately informed the Chief Engineer of *the vessel* (*the C/E*) of the oil spill accident and stopped the bunkering operation. After that, the emergency alarm was activated onboard to muster all crew in response to the oil spill incident.

The investigation revealed that the contributory factor leading to the accident was that the crew failed to isolate the LSFO transfer line of the No.3 (S) LSFO tank before bunkering operation, resulting in an unexpected amount of LSFO being flowed from No.3 (P[2]) LSFO tank into the No.3 (S) LSFO tank which was not discovered by the crew until oil spill accident happened.

The investigation also identified that *the vessel* did not follow the approved drawings of *the vessel's* Classification Society to fit the stop-check valve of the No.3 (S) LSFO tank with non-return function when retrofitting the fuel oil transfer piping system in July 2020; and the crew failed to follow the bunkering procedures of the shipboard Safety Management System (SMS) to monitor the bunker loading process in respect of the rate and quantity with timely remedial action taken including giving ample warning to *the barge* at the final bunkering stage, and communicate with *the barge* on the bunkering operation effectively.

[1] S: Starboard side

[2] P: Port side

1. Description of the vessels

1.1 *The vessel*

Ship name	:	TS TAICHUNG (Figure 1)
Flag	:	Taiwan
Port of registry	:	Keelung
IMO number	:	9359727
Ship Type	:	Container Ship
Year built, shipyard	:	2007, Naikai Zosen Cooperation Innoshima Shipyard, Japan
Gross tonnage	:	27,356
Net tonnage	:	11,856
Summer deadweight	:	33,549
Length overall	:	199.93 meters
Breadth	:	32.2 meters
Engine output, type	:	21735 kw, Hitachi Man – B & W, 7S70MC-C
Classification society	:	CR Classification Society/ Nippon Kaiji Kyokai
Registered owner	:	T.S. Lines Co., Ltd.
Management company	:	T.S. Lines Co., Ltd.

Figure 1 *The vessel*

1.2 *The barge*

Ship name	:	COLOANE (Figure 2)
Type, class of vessel	:	Oil Carrier, II
Certificate of Ownership number	:	B138959
Length overall	:	69.98 meters
Extreme Breadth	:	12 meters
Gross tonnage	:	998
Net tonnage	:	344
Main engine power	:	1213 kw
Material of hull	:	Steel
Number of persons permitted to carry	:	10

Figure 2 *The barge*

2. Sources of evidence

2.1 The crew of *the vessel*.

2.2 The coxswain of *the barge*

2.3 The management company of *the vessel* (*the company*).

2.4 The weather report provided by the Hong Kong Observatory (HKO)

2.5 The Harbour Patrol Section and Pollution Control Unit of the Marine Department

3. Outline of events

(All times were local time UTC + 8 hours.)

3.1 On the night of 28 March 2022, *the vessel* departed Qingdao, China and sailed to Hong Kong. After *the vessel* leaving Qingdao, the No.3 (S) tank was found to have about 12 m^3 of LSFO left as checked by *the 4/E-1*.

3.2 At about 2300 hours on 31 March 2022, *the 4/E-1* went to the Engine Room (E/R) to prepare for fuel changeover for the main and auxiliary engines from heavy fuel oil (HFO) to LSFO before *the vessel* entered Hong Kong waters. At about 2342 hours, the *C/E* started the fuel changeover procedures in the E/R with the LSFO transfer pump suction connected to No. 3 (P) LSFO tank.

3.3 *The vessel* was planned to load 300 tonnes (about 315 m^3) of LSFO into the No.3 (S) LSFO tank upon arrival in Hong Kong. At about 0000 hours on 1 April 2022, *the 4/E-1* manually re-sounded the No.3 (S) LSFO tank and confirmed the oil quantity remained unchanged, i.e., 12 m^3. For the forthcoming meeting and the bunkering, *the 4/E-1* then prepared a bunkering pre-loading plan and relevant documents and submitted them for vetting by *the C/E*.

3.4 At 0042 hours, *the 4/E-1* and *the C/E* left the E/R to take a rest after the completion of the fuel changeover.

3.5 At 0230 hours, the duty engine crew of *the vessel* were on standby in the E/R while *the vessel* was entering the Hong Kong waters. Thereafter, additional engine crew, including *the C/E* and *the 4/E-1,* were stationed in the E/R for preparing the berthing in Hong Kong. *The C/E* held a pre-bunkering meeting and briefed the involved engine crew (*duty bunkering crew*) on their duties related to the bunkering and its preparation.

3.6 At 0518 hours, *the vessel* berthed the No.7E of the KCCT on her starboard side.

3.7 At 1410 hours, *the barge*'s starboard side was secured to *the vessel*'s port side. The engine crew connected the bunker hose of *the barge* to the manifold of the portside side bunker station on the 'A' deck of *the vessel*. *The C/E* held a meeting with the representative of the bunker supplier (*the bunker officer*) before commencing bunkering and agreed on the maximum bunkering rate and its pressure were 300 m^3 per hour and 3 kg/cm^2 respectively.

3.8 At 1430 hours, *the vessel* commenced bunkering of LSFO into the No.3 (S) LSFO tank. *The C/E* stayed in the engine control room to oversee the bunkering operation. Four *duty bunkering crew* stayed at the port side bunker station to maintain the bunker watch. The other *duty bunkering crew*, including *the 4/E-1,* who acted as a coordinator to communicate with each party using of two-way walkie-talkie, was stationed with the Fourth Engineer No.2 on the starboard upper deck near the sounding pipe of the No.3 (S) LSFO tank to monitor the quantity of fuel oil being received. During the bunkering operation, the bunkering pressure and the temperature of fuel oil observed at the bunker manifold were about 2 to 3 kg/cm^2 and 31°C respectively.

3.9 At about 1500 hours, the *duty bunkering crew* at the bunker station reported through walkie-talkie to *the C/E* that an abnormal noise was heard from the bunker hose, and the fuel oil sample bag connected to the sampling device on the bunker manifold was expanded. *The C/E* then informed *the barge* to suspend bunkering after receiving the report and enquired *the bunker officer* whether *the barge* was blowing the bunker line by air.

3.10 At 1512 hours, *the vessel* resumed the bunkering operation after *the C/E* confirmed that the oil quantity in the No.3 (S) LSFO tank was about 305 m^3.

3.11 At 1514 hours, *the 4/E-1* reported to *the C/E* through a walkie-talkie that fuel oil spilled out from the air vent heads of No.3 (S) LSFO tank on the starboard side upper deck of *the vessel* (Figure 3) and immediately ran to the port side bunker station to inform *the barge* to

stop pumping. The bunkering operation was stopped at 1515 hours. The emergency alarm was activated on board to muster all crew in response to the oil spill incident.

Figure 3 Oil spilled from the air vent heads of No.3 (S) LSFO tank

3.12 At 1518 hours, the master of *the vessel (the Master)* called the local agent for assistance and reported the oil spill incident to Marine Department via the agent.

3.13 *The vessel* crew cleaned up the overflowed fuel oil on the starboard side upper deck. As the scuppers on the upper deck were plugged, some overflowed fuel oil accumulated on the deck and spilled into the sea over the deck side gutter bar near Bay 34 and Bay 35 (Figure 4).

Figure 4 Oil flowed into the sea near Bay 34 and Bay 35

3.14 At 1620 hours, *the C/E* confirmed that the oil quantity in the No.3 (S) LSFO tank was about 372 m^3. He also estimated that the overflowed fuel oil was about 1000 liters, of which 800 liters were collected on board and 200 liters were spilled into the sea.

4. Analysis

Certification and manning

4.1 The statutory certificates of *the vessel* were valid and in order. *The vessel* was manned by 21 crew members, including the Master. The Minimum Safe Manning Certificate of *the vessel* was issued by the Government of Taiwan on 14 August 2020, and the manning of *the vessel* fulfilled the requirements.

4.2 *The Master* possessed a Master Certificate of Competency issued by the Government of Taiwan with validity period until 25 October 2025. He had about 4 years of experience as a master.

4.3 *The C/E* possessed a Chief Engineer Certificate of Competency issued by the Government of Taiwan with validity period until 21 January 2026. He had about 17 years of experience as a chief engineer.

4.4 *The 4/E-1* possessed an Engineer Certificate of Competency issued by the Government of Taiwan with validity period until 2 December 2024. He had about 14 months of experience as a fourth engineer.

4.5 There was no abnormality noted with regard to the certification and qualification of the crew concerned.

Fatigue and alcohol or drug abuse

4.6 There was no evidence to show that any *duty bunkering crew*, including *the C/E* and *the 4/E-1*, suffered from fatigue at work or abuse of alcohol and drugs.

Weather conditions

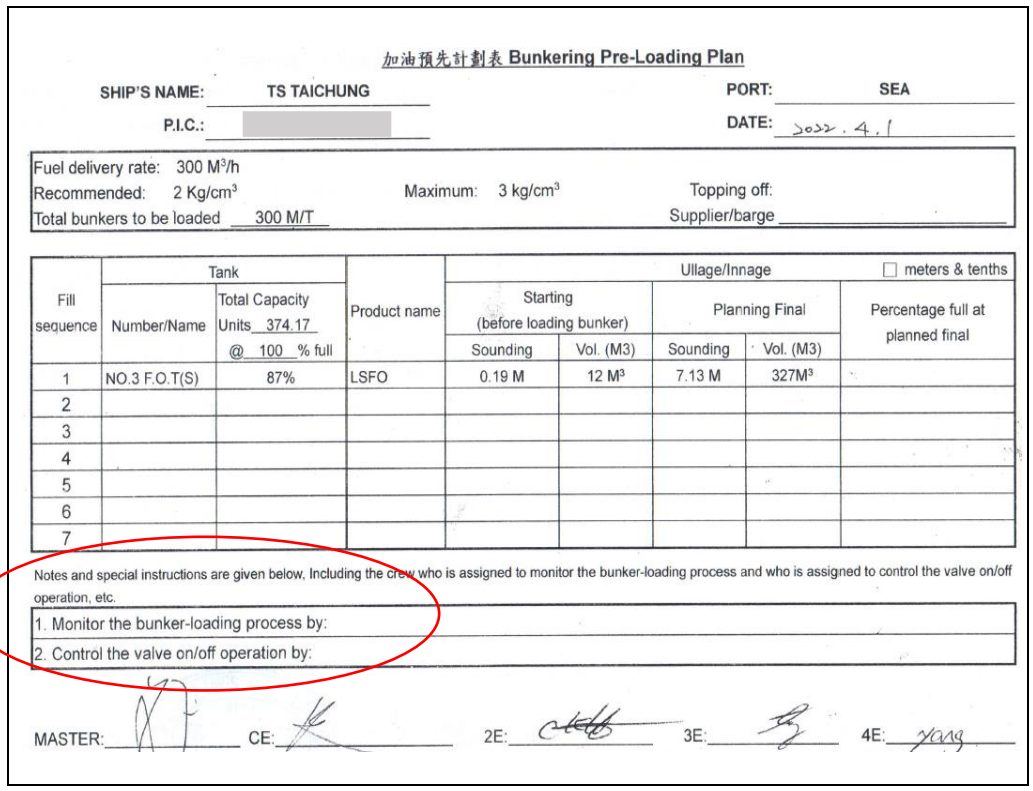
4.7 At the time of the incident, the weather was cloudy and rainy with southwesterly wind of Beaufort wind scale Force between 1 to 2. The sea had small wavelets. The weather and sea were not considered to be the contributory factors to the accident.

Bunkering preparation

4.8 According to the bunkering preparation procedures of the shipboard SMS of *the vessel* (i.e., Document No. PR-0808) (*bunkering procedure*), three sets of checklists including a checklist for bunkering meeting (FM-0808-01), a checklist for bunker operation plan (FM-0808-02) and checklist for bunkering (FM-0808-03) shall be completed before/during/after the bunkering operation.

4.9 *The C/E* held the bunkering meeting with the *duty bunkering crew* on 1 April 2022. The related information, such as fuel oil tank condition, bunkering data, the responsibility of duty personnel, emergency procedures, communication, etc., were briefed in the meeting. The relevant checklists, such as FM-0808-01, FM-0808-02, and FM-0808-03, were completed and signed by the C/E to follow the requirements of the shipboard *bunkering procedure*.

4.10 A bunkering pre-loading plan (FM-0705-05) prepared by *the 4/E-1,* was signed by the Second and the Third Engineers on board and vetted by *the C/E* and *the Master* (Figure 5) before the bunkering operation. The maximum capacity of the fuel tank was 374 m^3, and the planned final oil quantity of the fuel tank would be 327 m^3 which was about 87% full by volume.



加油預先計劃表 Bunkering Pre-Loading Plan

SHIP'S NAME: TS TAICHUNG PORT: SEA

P.I.C.: DATE: 2022.4.1

Fuel delivery rate: 300 M^3/h
Recommended: 2 Kg/cm^3 Maximum: 3 kg/cm^3 Topping off:
Total bunkers to be loaded 300 M/T Supplier/barge

Fill sequence	Tank Number/Name	Tank Total Capacity Units 374.17 @ 100 % full	Product name	Ullage/Innage ☐ meters & tenths: Starting (before loading bunker) Sounding	Starting (before loading bunker) Vol. (M3)	Planning Final Sounding	Planning Final Vol. (M3)	Percentage full at planned final
1	NO.3 F.O.T(S)	87%	LSFO	0.19 M	12 M^3	7.13 M	327M^3	
2								
3								
4								
5								
6								
7								

Notes and special instructions are given below, Including the crew who is assigned to monitor the bunker-loading process and who is assigned to control the valve on/off operation, etc.

1. Monitor the bunker-loading process by:
2. Control the valve on/off operation by:

MASTER: CE: 2E: 3E: 4E:

Figure 5 Bunkering pre-loading plan

4.11 According to the bunkering pre-loading plan, there was no special instruction provided, and nobody was assigned to monitor the bunker loading process.

4.12 The estimated completion time of the bunkering operation would be 63 minutes (Table 1), as calculated by the maximum bunkering rate of 300 m^3 per hour provided in the bunkering pre-loading plan.

Minute	Capacity of No.3 (S) LSFO tank	
	m^3	**%**
0 (Start)	12	3
15	87	23
30	162	43
45	237	63
60	312	83
63 (End)	327	87

Table 1 Bunkering loading plan calculated by maximum bunkering rate of 300 m^3 per hour

Bunkering rate and bunker quantity verification (Table 2 refers)

4.13 According to paragraphs 3.8 to 3.11, the bunkering operation started at 1430 hours and finally stopped at 1515 hours. The duration of the bunker pumping by *the barge* was 33 minutes, excluding the suspended time of 12 minutes from 1500 hours to 1512 hours for checking abnormal noise during the bunkering operation.

4.14 According to the Bunker Delivery Note provided by *the barge*, about 267 m^3 of LSFO was loaded to *the vessel* in 33 minutes. The average bunkering rate was about 485 m^3 per hour. It exceeded the maximum bunkering rate of 300 m^3 per hour as agreed between *the bunker officer* and *the C/E* set in the bunkering pre-loading plan (FM-0705-05).

4.15 The bunker operation was temporarily suspended at 1500 hours. Afterward, the *duty bunkering crew* manually checked that the quantity of the fuel oil inside the No.3 (S) LSFO tank was allegedly to be about 305 m^3. There was 12 m^3 of LSFO remained inside the fuel tank before bunkering, the actual quantity of bunker being received was about 293 m^3 in the first 30 minutes. Based on the information provided above, by calculation, the bunkering rate might reach 586 m^3 per hour.

Quantity and capacity of No.3 (S) LSFO tank and bunkering rate (during bunkering operation) Planned final quantity of the filling tank: 327 m^3 (87% full) Maximum agreed bunkering rate (as planned): 300 m^3/ hour										
Time	Duration of bunkering (Min)	Measured by crew			Calculated by Bunker Delivery Note			Calculated by bunkering pre-loading plan		
		m^3	%	m^3/h	m^3	%	m^3/h	m^3	%	m^3/h
1430 (start)	0	12	3	--	12	3	--	12	3	--
1500	30	305	82	586	255	68	485	162	43	300
1500 - 1512	Suspension of bunkering operation									
1514 (oil spill)	32	374	100	679	271	72	485	172	46	300
1515 (end)	33	374	100	--	279	75	485	177	47	300
1620	--	372	99	--	--	--	--	--	--	--

Table 2 Analysis table of bunker quantity and bunkering rate

4.16 According to paragraphs 4.14, 4.15 and Table 2, the investigation found that *the C/E* and the *duty bunkering crew* did not realize the abnormal bunkering rate, and did not communicate effectively with *the barge* to verify the bunkering rate or bunker quantity received during the bunker loading process.

4.17 As mentioned in paragraph 4.15, the quantity of the fuel oil inside the No.3 (S) LSFO tank was allegedly to be about 305 m^3 (82% full) when t*he vessel* temporarily suspended bunkering operation at 1500 hours. The bunker loading process came to the final bunkering stage for receiving the remaining bunker of 22 m^3 to add up to 327 m^3 (87% full) of the planned final volume. However, the oil spill happened on board *the vessel* just 2 minutes after resuming the bunkering operation. According to the average bunkering rate mentioned in paragraph 4.14 (i.e. about 485 m^3 per hour), about 16

m^3 LSFO was loaded onto the No.3 (S) LSFO tank in 2 minutes. Considering that the capacity of the fuel tank was 374 m^3, there would be about 69 m^3 of available space for receiving such an amount which should not cause the overflow of the LSFO. It could be deduced that the reported figure of 305 m^3 of fuel oil inside the No.3 (S) LSFO tank at 1500 hours was deemed to be inaccurate. It was also deduced that a certain amount of fuel oil might possibly be entered into the No.3 (S) LSFO tank from the other fuel tanks onboard.

4.18 Sections 3.3.1 and 3.3.2 of the *bunkering procedure* state that ample warning is to be given to *the barge* at the final bunkering stage and the exact quantity of the bunker received in the fuel tank is to be monitored during bunkering. However, *the duty bunkering crew,* including *the C/E,* failed to follow the requirements of *the bunkering procedure* of the shipboard SMS to monitor the bunker loading process to give an ample warning to *the barge* at the final bunkering stage as mentioned in paragraph 4.17 and did not take timely verification of the quantity of the bunker received and remedial action.

LSFO transfer system

4.19 *The vessel* modified the existing fuel oil transfer system. It retrofitted a newly installed LSFO transfer line connecting to both No.3 (P & S) LSFO tanks and the inlet of the LSFO transfer pump (*the LSFO line*) in a shipyard in July 2020. The relevant drawings of the amended fuel oil transfer system were approved by the CR Classification Society on 5 August 2020.

4.20 According to the approved drawing of the fuel oil transfer system (Figure 6), *the LSFO line* should have quick closing outlet valves (OV-201 and OV-202) installed on both No.3 (P & S) LSFO tanks. Additionally, two stop-check valves[3] (NQV-24 and NQV-25) should have installed on *the LSFO line* just after both quick closing outlet valves.

[3] They are non-return valves, i.e. only allow the oil to flow from the fuel oil tank to the pipeline directing to the fuel oil transfer pump suction.

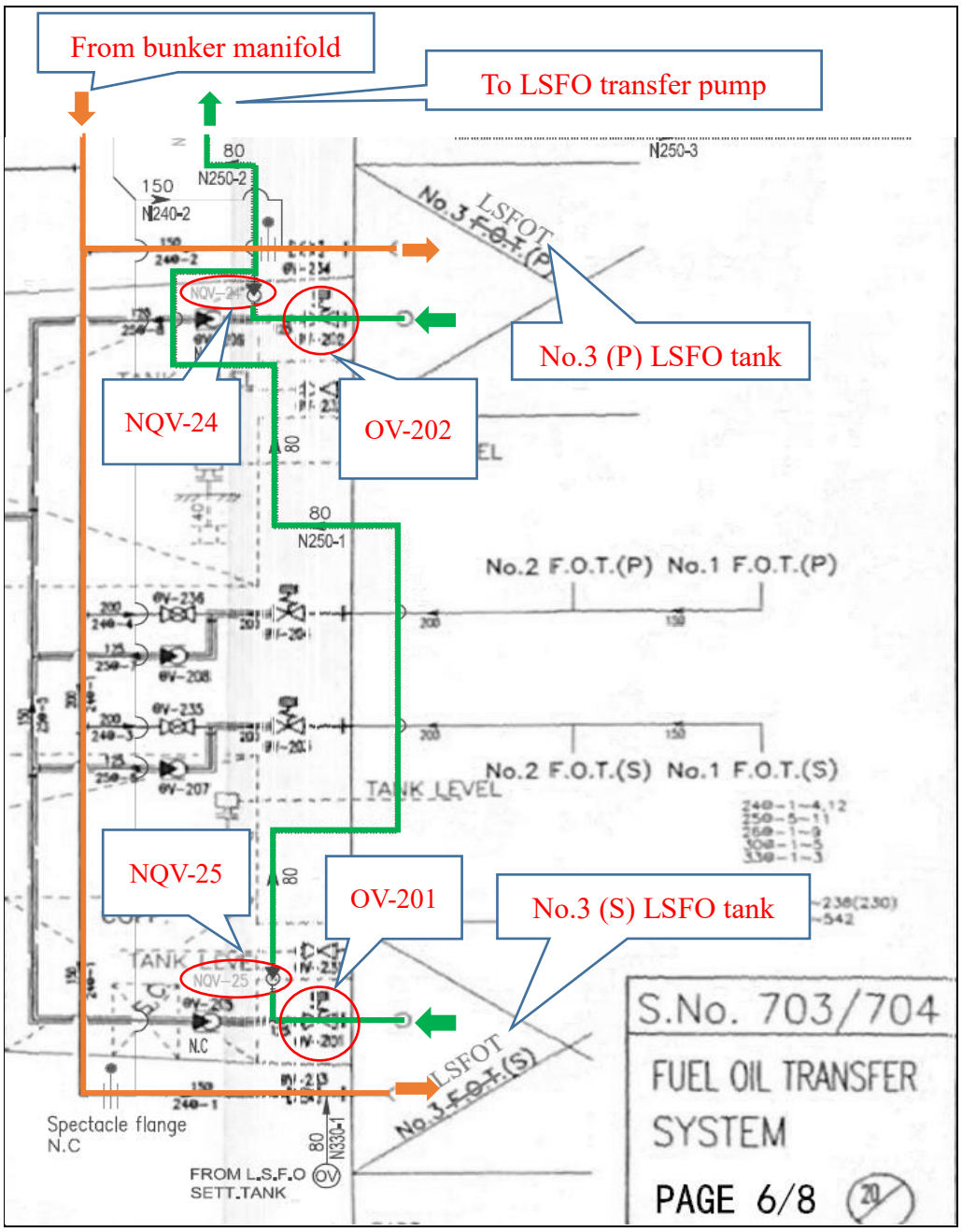


Figure 6 LSFO transfer system

Post-investigation

4.21 As *the vessel* was using LSFO for the main and auxiliary engines during her stay in Hong Kong, the quick closing outlet valve (OV-202) and the stop check valve (NQV-24) of the No.3 (P) LSFO tank to the LSFO fuel oil transfer pump were kept open.

4.22 The post-investigation estimated that about 90 m^3 of fuel oil deficiency in the No.3 (P) LSFO tank was lost. It also found that the quick closing outlet valve (OV-201) of the No.3 (S) LSFO tank was kept open[4], and the stop check valve (NQV-25) (*the valve*) was not fully closed during the fuel changeover. The preliminary finding showed that the oil loss might flow into the No.3 (S) LSFO tank by gravity before the bunkering operation. The non-return function of *the valve* was suspected to be defective. It was also found that the crew failed to isolate *the LSFO line* of the No.3 (S) LSFO tank before bunkering operation, resulting in about 90m^3 of LSFO being flowed from the No.3 (P) LSFO tank into the No.3 (S) LSFO tank which was not discovered by *duty bunkering crew* until oil spill accident happened.

4.23 On 9 August 2022, *the valve* was dismantled for inspection while *the vessel* underwent a special survey in the dry dock. The attended surveyor of the Classification Society found that *the valve* was not a stop check valve as required under the approved drawing but a globe valve without a non-return function which could not prevent the backflow of liquid (Figure 7). It indicated from the post-investigation that the fuel oil transfer system was fitted with an incorrect type of valve and did not follow the approved drawings by the Classification Society in installing the stop-check valve with a non-return function during its retrofitting.

[4] The quick closing outlet valve of the fuel tank connected to the suction of the fuel oil transfer pump should be kept closed when not in use.

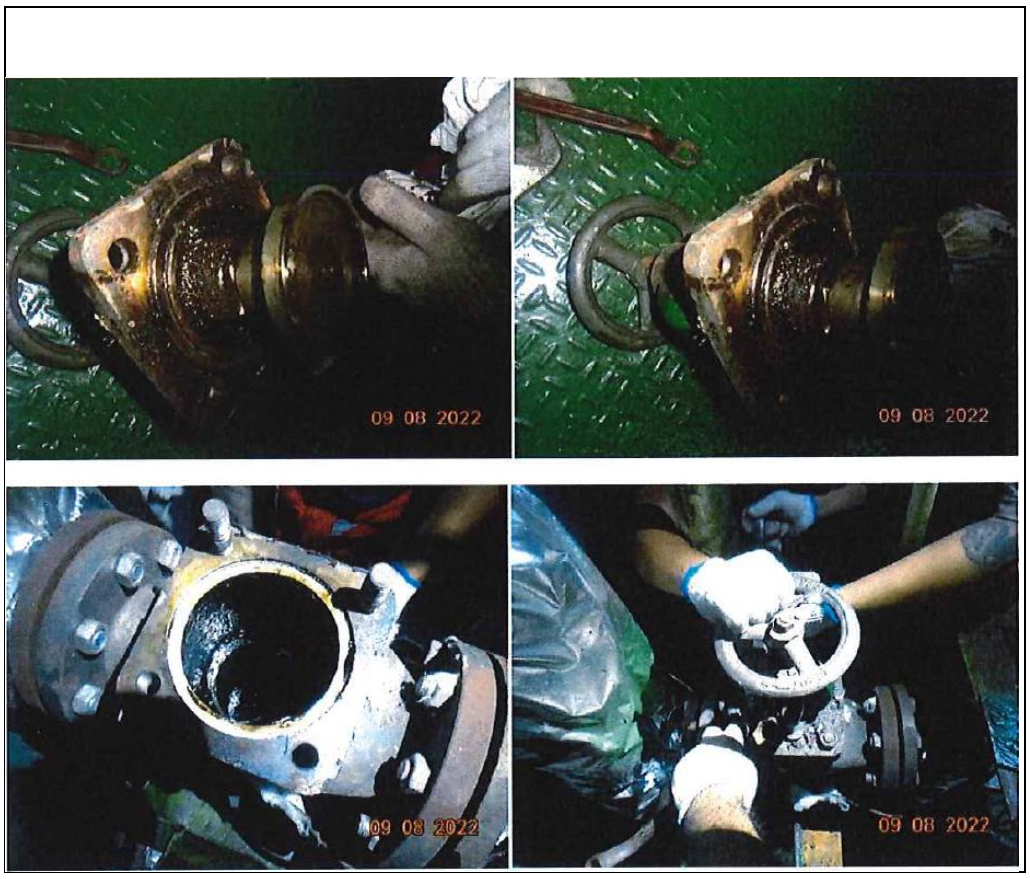


Figure 7 Inspection of *the valve* (NQV-25) showed that the type of *the valve* was not according to the approved drawing

4.24 The discovery of the incorrect globe valve fitted, as mentioned in paragraph 4.23 above, can help to support the preliminary finding in paragraph 4.22 and explain the spillage scenario[5] with details as follows:- (Figure 8)

(i) Before the commencement of the bunkering at 1430 hours, the content of the No. 3 (S) LSFO tank had gradually increased from its initial content of 12 m^3 to approximately 102 m^3 due to about 90 m^3 of fuel oil flowed from the No. 3 (P) LSFO tank by gravity.

(ii) Since it was reported that the fuel oil started spilling at 1514 hours, when the tank content was up to its maximum of 374 m^3, the total amount of bunker loaded would be 272 m^3 (the max.). As this happened in a total of 32 minutes, the average bunker pumping rate of the barge would be 510 m^3 per hour. Hence, when the bunkering was suspended at 1500 hours due to the abnormal noise, the bunker loaded was estimated to be 255 m^3

[5] The spillage scenario used to simulate the events of the oil spill accident on board based on the available and estimated bunkering data.

as per the bunkering delivery note (Table 2) and the tank content at that time might be 357 m^3 as calculated.

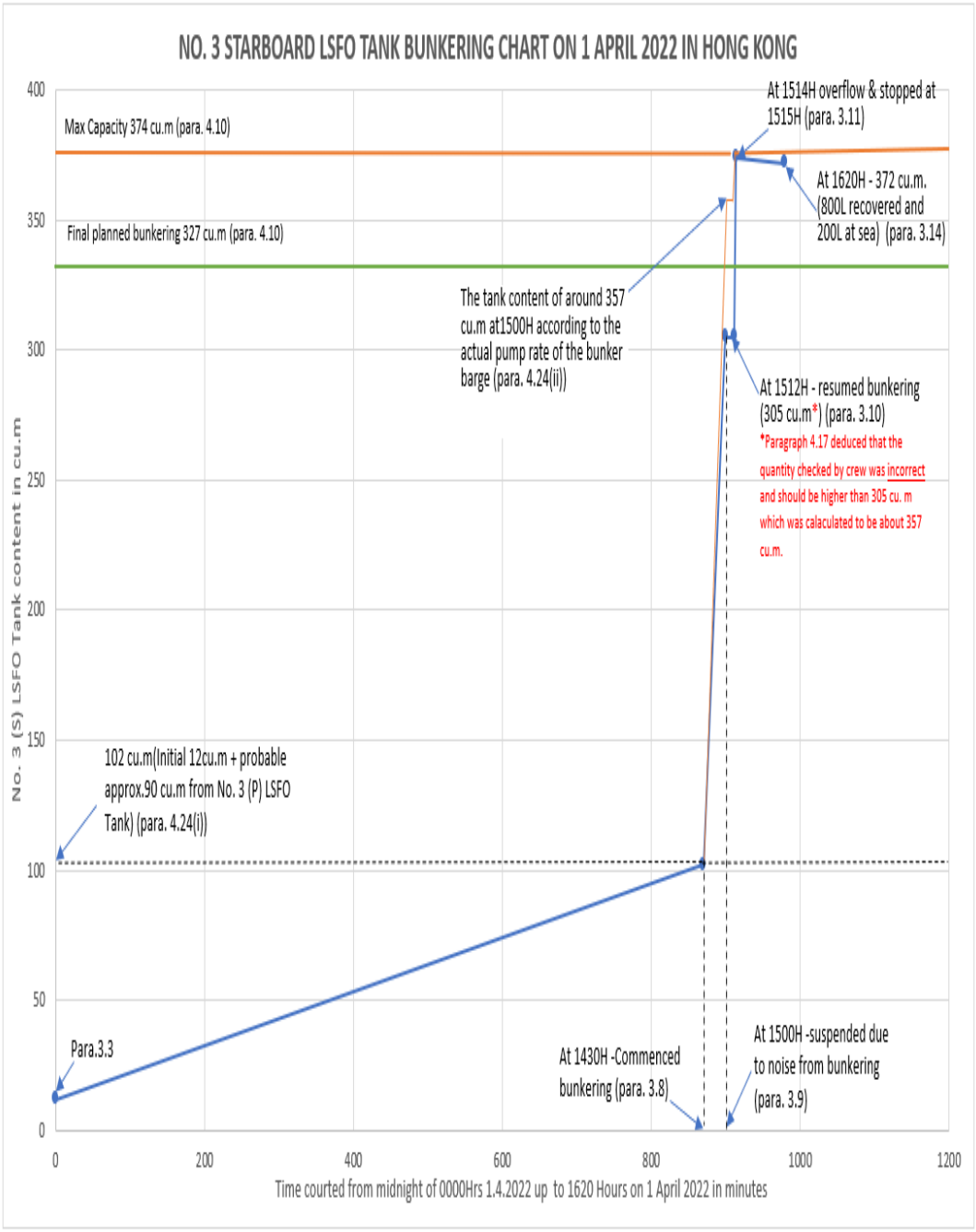


Figure 8 Bunkering Chart on 1.4.2022

(iii) Assuming the bunker pump of *the barge* could achieve the pumping rate of 510 m^3 per hour upon starting, an amount of 17 m^3 should have been pumped into the tank in only 2 minutes leading to the overflow at the time of 1514 hours.

(iv) At 1620 hours, the final content of the No. 3 (S) LSFO was measured to be 372 m^3 probably the fuel oil inside the tank had been settled down as from 1515 hours.

5. Conclusions

5.1 At 0518 hours on 1 April 2022, *the vessel* berthed at the No. 7E, KCCT, Hong Kong on her starboard side. A total of 300 tonnes of LSFO was ordered to be supplied to *the vessel* from *the barge*.

5.2 At 1410 hours, *the barge*'s starboard side was secured to *the vessel*'s port side for the bunkering operation. At 1514 hours, *the 4/E-1* found that LSFO spilled out from the air vent heads of the No.3 (S) LSFO tank on the starboard side upper deck of *the vessel*. The overflowed LSFO further spilled into the sea over the deck side gutter bar near Bay 34 and Bay 35. He immediately informed *the C/E* of the oil spill accident and stopped the bunkering operation. After that, the emergency alarm was activated on board to muster all crew in response to the oil spill incident.

5.3 The investigation revealed that the contributory factor leading to the accident was that the crew failed to isolate *the LSFO line* of the No.3 (S) LSFO tank before bunkering operation, resulting in an unexpected amount of LSFO being flowed from the No.3 (P) LSFO tank into the No.3 (S) LSFO tank which was not discovered by *duty bunkering crew* until oil spill accident happened.

5.4 The investigation also revealed that *the vessel* did not follow approved drawings of the vessel's Classification Society to fit the valve with non-return function when retrofitting the fuel oil piping system in July 2020; and the crew failed to follow the bunkering procedures according to the shipboard SMS:

(a) to monitor the bunker loading process in respect of the rate and quantity with timely remedial action taken including giving ample warning to *the barge* at the final bunkering stage; and

(b) to communicate with *the barge* on the bunkering operation effectively.

6. Recommendations

6.1 The management company of *the vessel* should issue a circular informing all masters, officers, and crew members of its fleet of the investigation findings and lessons learnt from this accident and instruct them to:

(a) isolate fuel oil transfer system connecting to respective fuel tanks when they are not in use before bunkering operation.

(b) strictly follow the requirements of the Classification Society approved drawings to fit the stop-check valve while retrofitting the fuel oil transfer system; and

(c) strictly follow the requirements of the shipboard SMS during the bunkering operation:

(1) to monitor the bunker loading process effectively in respect of the rate and quantity with timely remedial action taken;

(2) to give ample warning to the bunker barge at the final bunkering stage; and

(3) to communicate with the bunker barge on the bunkering operation effectively.

6.2 A Marine Department Notice should be issued to promulgate the lessons learnt from this accident.

7. Submission

7.1 A copy of the draft investigation report, in its entirety, was sent to the following parties for comments:

(a) *the company* and *the Master* of *the vessel*;

(b) the shipowner and the coxswain of *the barge*;

(c) the Harbour Patrol Section and the Pollution Control Unit of the Marine Department.

7.2 By the end of consultation period, comment from the Harbour Patrol Section was received and the report had been amended as appropriate.