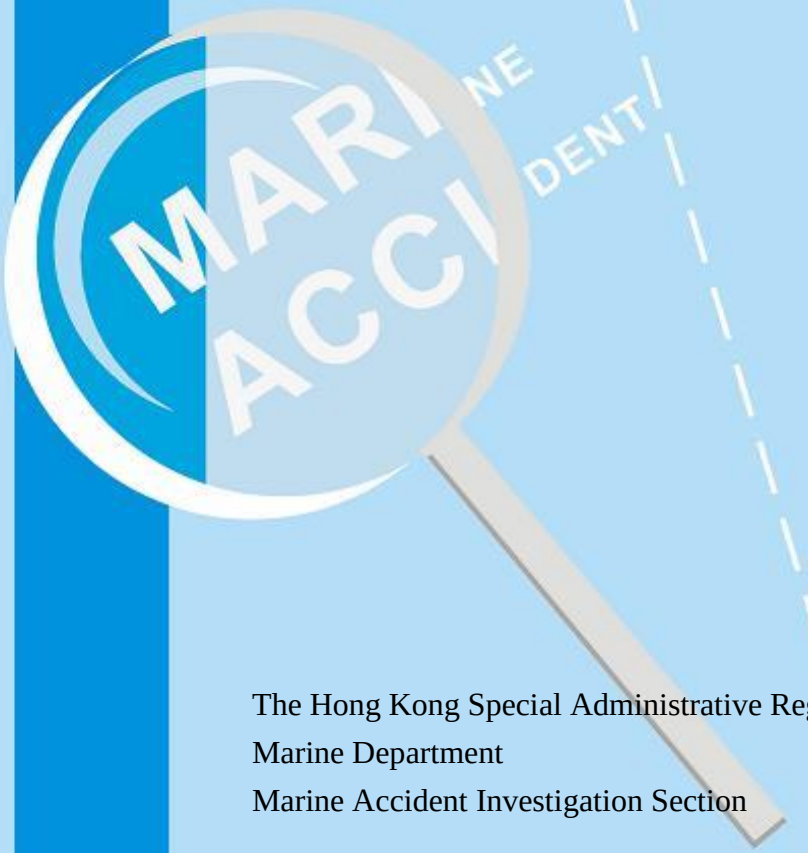
Report of investigation into the explosion accident on board the Hong Kong registered bulk carrier "*CSSC Cape Town*" at Gibraltar on 19 February 2021



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

8 February 2022

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 about 2110 hours on 19 February 2021, the Hong Kong registered bulk carrier "*CSSC Cape Town*" (*the vessel*), fully loaded with coal cargo, was proceeding to Gibraltar anchorage. While the crew members were preparing for anchoring, an explosion happened on board *the vessel*. The chief officer (C/O) and deck cadet (D/C) suffered severe burn injuries in this accident.

At about 2107 hours on 19 February 2021, after picking up the pilot, the C/O and D/C entered the windlass control room to start the hydraulic pump motors of the windlass system (the hydraulic pump motor) to prepare for anchoring at the Gibraltar anchorage. While pressing the power switch of the No.2 hydraulic pump motor located in the windlass control room, an explosion happened and followed by smoke rising. Eventually, the C/O and D/C suffered severe burn injuries in the accident and were evacuated to a local hospital for medical treatment.

The investigation had identified that the contributory factors leading to this accident were that the crew members failed to follow the general requirements and special precaution of Appendix 1 of the International Maritime Solid Bulk Cargoes Code (*IMSBC Code*)[1]; the shipboard Safety Management System (SMS) failed to identify the windlass control room as an enclosed/dangerous space causing the crew members to underestimate the inherent risk of explosion or fatality hazards of the windlass control room when carrying coal cargo; and the crew members were lack of safety awareness on the carriage of the coal cargo and not familiar with the SMS.

[1] *IMSBC Code*: The International Maritime Solid Bulk Cargoes Code entered into force on 1 January 2011 under the SOLAS Convention. The *IMSBC Code* as annexed to IMO Resolution MSC. 268(85) facilitates the safe stowage and shipment of solid bulk cargoes by providing information on the dangers associated and instructions on the procedures to be adopted when the shipment of solid bulk cargoes is contemplated.

1. Description of the vessel

Ship name	:	*CSSC Cape Town* (Figure 1)
Flag	:	Hong Kong, China
Port of registry	:	Hong Kong
IMO number	:	9853888
Type	:	Bulk carrier
Year built, shipyard	:	2020, CSSC Huangpu Wenchong Shipbuilding Company Limited
Gross tonnage	:	66,786
Net tonnage	:	37,647
Summer deadweight	:	120,582.4 tonnes
Length overall	:	254.95 metres
Breadth	:	43 metres
Engine power, type	:	11,600 kW, MAN B&W 6G60ME-C9.4-TII
Classification society	:	DNV GL[2]
Registered owner	:	Fortune Central Shipping Limited
Management company	:	Wah Kwong Ship Management (HK) Ltd

Figure 1 *The vessel*

[2] On 1 March 2021 DNV GL became DNV

2. Sources of evidence

2.1 Information provided by the Master, the crew members and the management company (*the Company*) of *the vessel*.

3. Outline of events

(All times were local time UTC + 01:00 hours)

3.1 On 5 February 2021, *the vessel* departed from Baltimore, USA, fully laden with coal cargo, to India via Gibraltar for discharging.

3.2 At about 1030 hours on 19 February 2021, the bosun proceeded to the ship forward to test the anchor and windlass systems. He opened the weathertight door of the windlass control room for ventilation for about 5 minutes. The bosun then entered the windlass control room to switch on the power of the hydraulic pump motors to test the port and starboard anchors. The port and starboard anchors were tested and no abnormality was found. The bosun noticed an abnormal sound coming from the starter and control cabinet of the No.2 hydraulic pump motor when switching off the No.2 hydraulic pump motor. He informed the second engineer (2/E) about the abnormality and asked him to inspect the windlass system.

3.3 At about 1125 hours, the 2/E, third engineer, and fourth engineer inspected the No.1 and No. 2 hydraulic pump motors with their starter and control cabinet in the windlass control room and carried out running test of both hydraulic pump motors, but no abnormality was observed. At about 1145 hours, they stopped both of the hydraulic pump motors and left the windlass control room.

3.4 At about 1930 hours, the bosun led an able seafarer deck and the D/C to prepare the port side pilot ladder for picking up a pilot. The port side pilot ladder was prepared at about 2005 hours.

3.5 At about 2050 hours, the master instructed the anchor party, consisting of the C/O, bosun, D/C, and able seafarer deck (AB1), to prepare anchoring after picking up the pilot.

3.6 At about 2107 hours, the pilot embarked on *the vessel.* The anchor party proceeded to the ship forward to prepare the anchoring. The AB1 was assigned to get the anchor ball in the bosun storeroom. The bosun proceeded to the forecastle deck to standby. The C/O and D/C proceeded to the windlass control room to switch on the

hydraulic pump motors. The second officer (2/O) also arrived at the port side forecastle ladder to familiarize the anchoring operation (Figure 2).

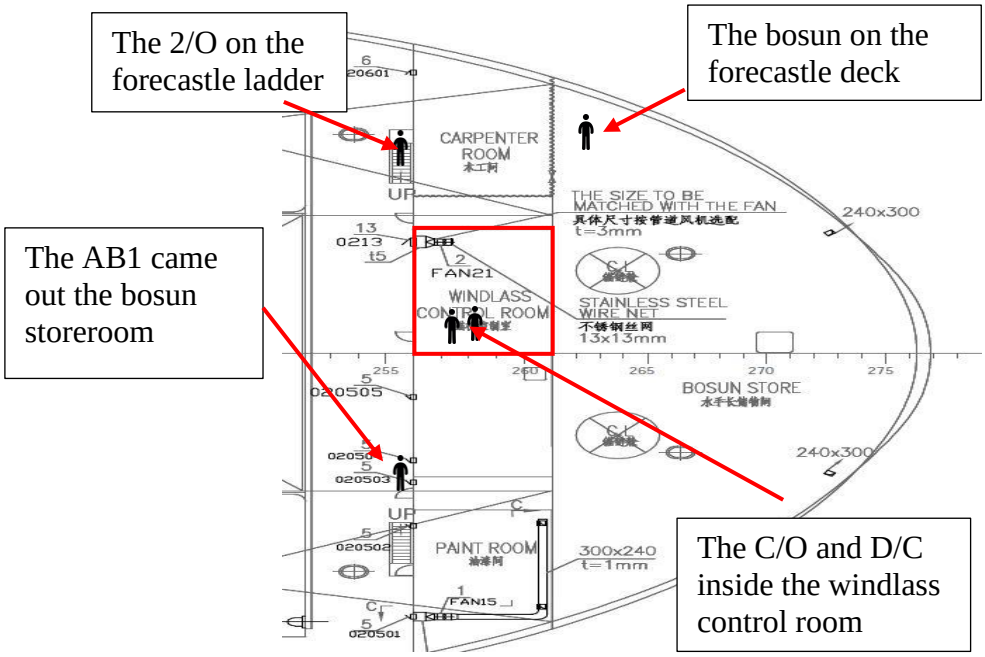

Figure 2 The location of the crew when the accident happened

3.7 At about 2110 hours, the AB1 came out the bosun storeroom and intended to proceed to the forecastle deck. The C/O and D/C entered the windlass control room to switch on the hydraulic pump motors. While the D/C was pressing the power switch of the hydraulic pump motor located at the starter and control cabinet, an explosion happened and followed by smoke rising.

3.8 The AB1 saw the D/C coming out of the windlass control room by himself and suffered burns on his face. The AB1 ran to the windlass control room immediately and saw the C/O with his boiler suit on fire, suffering a severe burn and trying to crawl out of the windlass control room. Soon after, the bosun and 2/O arrived at the scene and assisted the C/O in getting out of the windlass control room.

3.9 The 2/O informed the master that the C/O and D/C suffered severe burn injuries and required emergency shore medical assistance via his portable radio. As instructed by the 2/O, the AB1 took care of the D/C and assisted the D/C in cutting the burnt boiler suit outside

the accommodation.

3.10 At about 2111 hours, the Master broadcasted the incident via the public address system and mustered the crew members for the emergency recuse operation. The pilot informed Gibraltar's Vessel Traffic Services (VTS) about the explosion incident onboard and requested emergency medical assistance.

3.11 About 2212 hours, the paramedics from ashore embarked and provided the first aid treatment to the C/O and D/C. The C/O and D/C were evacuated ashore for further medical treatment at about 2317 hours.

3.12 The C/O and D/C were repatriated to their homeport, China, on 21 August 2021 and 18 April 2021 for further medical treatment respectively.

4. Analysis

The vessel's certificates and manning

4.1 The statutory trading certificates of *the vessel* were valid and in order. *The vessel* was manned by 19 crew members, including the master.

4.2 The master had worked in *the Company* for about 14 years and joined *the vessel* on 29 May 2020. He was newly promoted on board to the rank of master about 1 month's ago before the accident. He possessed a Class I Certificate of Competency issued by China valid until 27 December 2021.

4.3 The C/O had worked in *the Company* for about 1 month and joined *the vessel* on 9 January 2021. He had about one and a half years of experience as a chief officer. He possessed a Class II Certificate of Competency issued by China valid until 2 November 2025.

4.4 The 2/O had worked in *the Company* for about 9 years and joined *the vessel* on 29 May 2020. He had about two and a half years of experience as a second officer. He possessed a Class III Certificate of Competency issued by China valid until 28 February 2022.

4.5 The D/C had worked in *the Company* for about 1 month and joined *the vessel* on 9 January 2021. He had about 1 month of experience as a deck cadet.

4.6 The bosun had worked in *the Company* for about 11 years and joined *the vessel* on 29 May 2020. He had about 10 years of experience as a bosun.

4.7 The AB1 had worked in *the Company* for about one and a half years and joined *the vessel* on 29 May 2020. He had about one and a half years of experience as an able seafarer deck.

4.8 There was no abnormality noted with regard to the certification and experience of the crew concerned.

Fatigue, alcohol, and drugs abuse

4.9 There was no evidence to show that any crew on board suffered from either fatigue at work or abuse of alcohol and drugs.

Weather and sea conditions

4.10 On the day of the accident, the weather was fine with southerly wind of Beaufort Wind Scale force 3. The weather and the sea conditions were not considered contributory factors to the accident.

Properties of Coal in bulk, general requirements and special precautions

4.11 In accordance with Appendix 1, Individual Schedules of Solid Bulk Cargoes, of the *IMSBC Code* (the appendix), coal[3] is classified as "materials hazardous only in bulk (MHB)", which means it may possess chemical hazards when carried in bulk and require special precautions. Coals may emit a flammable gas of methane. When a methane/air mixture is between 5% and 16% methane, it can be ignited by sparks or naked flame. If the cargo space boundaries are not tight, methane can seep through into spaces adjacent to the cargo space[4].

4.12 Paragraphs "General requirements of all types of these cargoes" (General Requirements) and "Special Precautions" of the coal cargo in the appendix [5] require that cables and electrical components situated in cargo spaces and adjacent enclosed spaces are safe in an explosive atmosphere or positively isolated, the atmosphere in the cargo spaces shall be monitored daily. As far as practicable, that any gases which may be emitted from this cargo do not accumulate in the above-mentioned areas. Such areas shall be adequately ventilated and are regularly monitored for the presence of methane.

4.13 The cargo safety information provided to the master by the shipper before loading the coal cargo in Baltimore, USA stated that the coal cargo might emit methane and/or may self-heat. However, the

[3] P.122 of the Annex to MSC.268(85)

[4] P.124 of the Annex to MSC. 268(85)

[5] P.124 - P.127 of the Annex to MSC. 268(85)

investigation revealed that the General Requirements and Special Precautions of the appendix were not strictly followed as below:

(a) the crew members had not confirmed the electrical components in the windlass control room were safe for the carriage of coal cargo which might emit methane;

(b) the crew members failed to monitor the atmosphere in the cargo spaces daily during the laden voyage;

(c) the crew members failed to take control measures, such as ventilation, to avoid flammable gas accumulated inside the windlass control room; and

(d) there was no evidence to show that the enclosed working spaces had regularly monitored for the presence of methane.

The windlass control room

4.14 The windlass control room located in the ship forward was designated for storing the hydraulic tank, hydraulic pumps with their motors of the windlass system, and their starter and control cabinet. The No.1 cargo hold access was located within the windlass control room and isolated by the access hatch cover. The windlass control room was provided a ventilation flap for natural ventilation and a motor driven-fan for mechanical ventilation (Figure 3).

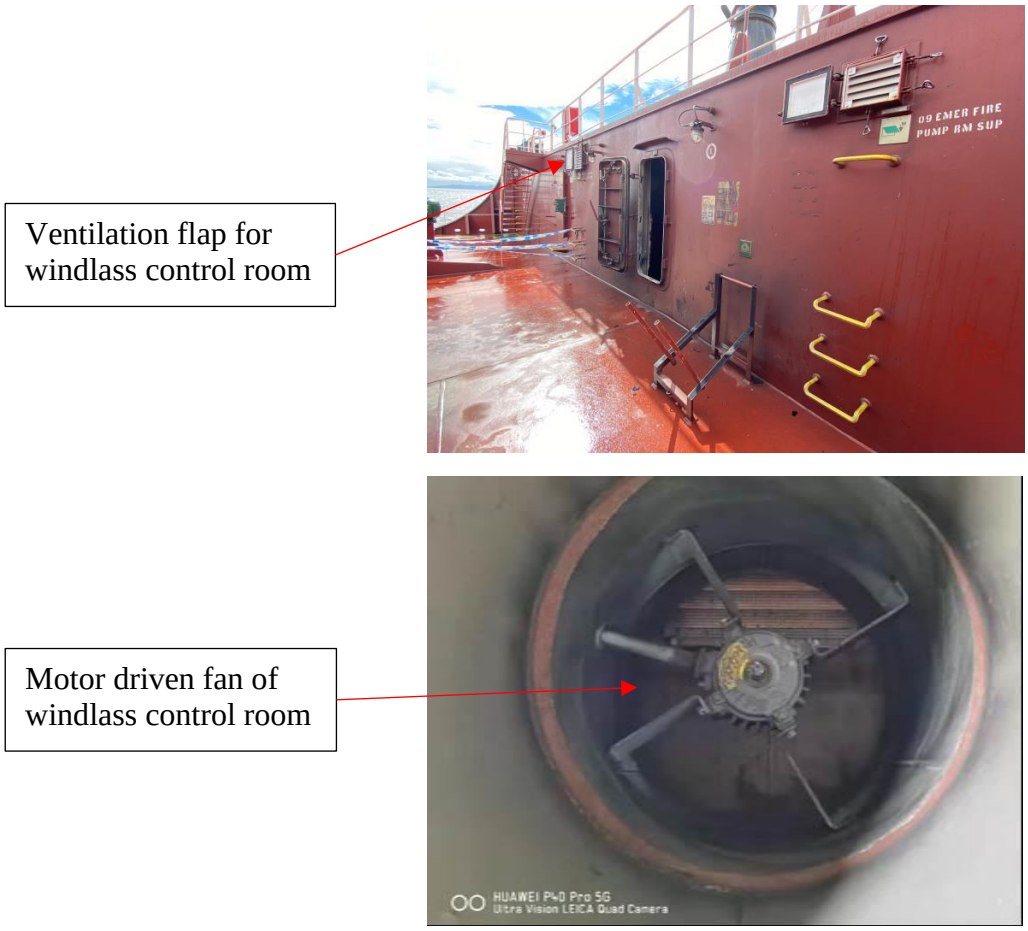

Figure 3 Ventilation flap and motor driven fan of windlass control room

4.15 As a result of the explosion, the starboard bulkhead and port bulkhead of the windlass room were buckled, and the flat bars of these bulkheads were deformed. The starter and control cabinet and the ventilation were damaged (Figure 4). The windlass system was out of order.

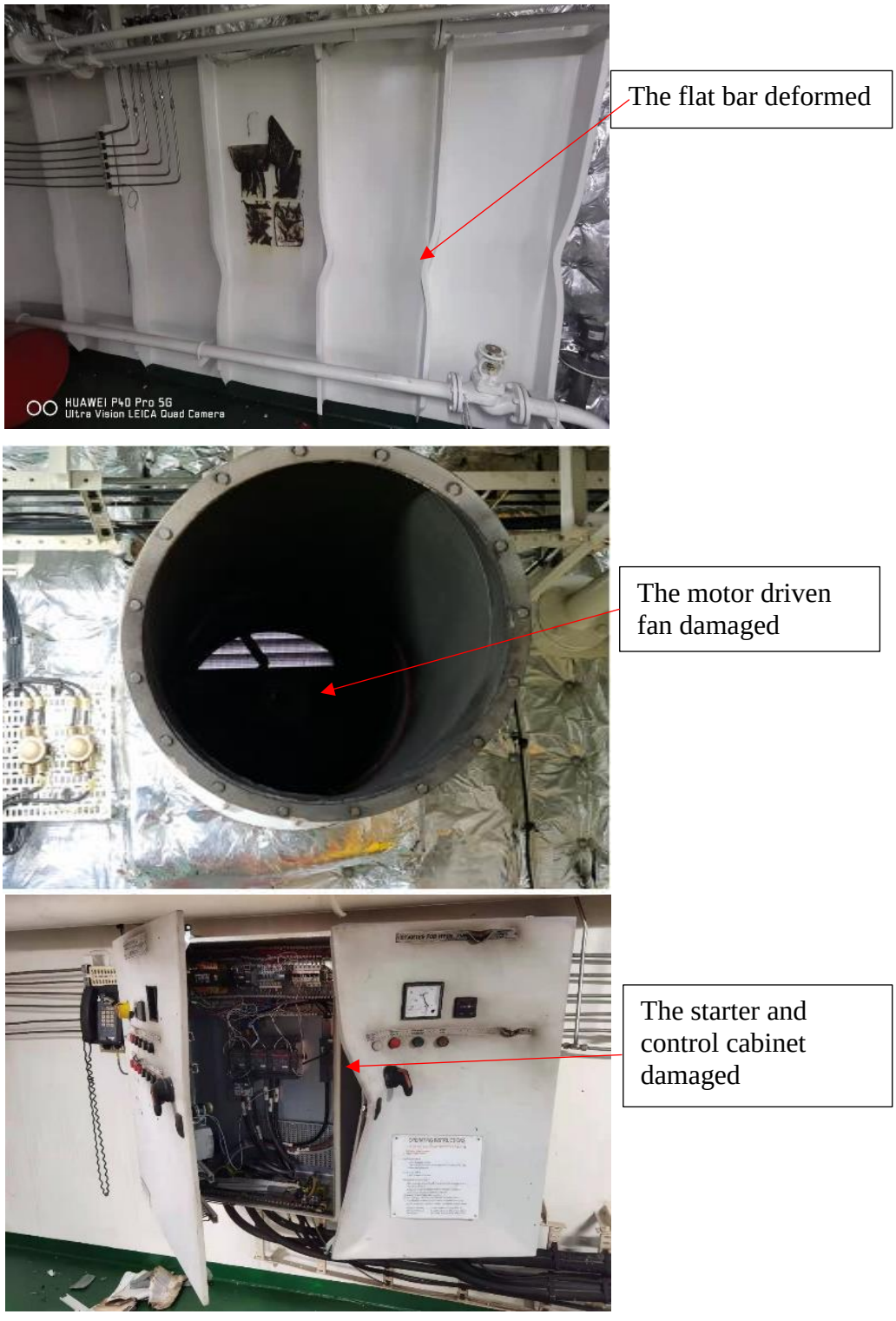

Figure 4 Photos showing the damaged after the explosion

Probable cause of explosion

4.16 *The vessel* was fully loaded with coal cargo, including the No.1 cargo hold (*the hold*). Flammable methane gas emitted from coal would accumulate at the bottom of the hatch cover and the access hatch cover of *the hold*. The methane gas can seep into the windlass control room through the access hatch when the access hatch cover is not gastight.

4.17 The protection class of the starter and control cabinet was IP54 which means that the ingress protection rating of the cabinet is protected against quantity of dust that could interfere with the normal operation of the product but is it not fully dust tight. The product is completely protected against solid objects and water splashing from any angle. However, it was not gastight or explosive proof.

4.18 After the accident, *the Company* had investigated the condition of the access hatch cover of *the hold* at the port of Gangavaram, India. It was found that the access hatch cover of *the hold* was slightly leaking through the ultrasonic test. It was deduced that the methane gas emitted from the coal cargo seeped into the windlass control room and accumulated inside the starter and control cabinet through the access hatch (Figure 5).

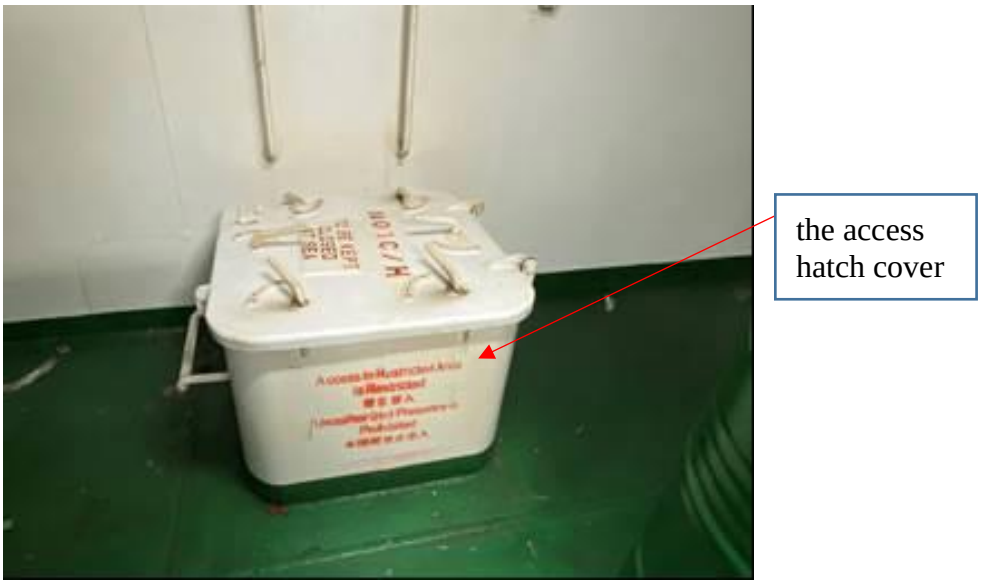

Figure 5 The access hatch of the No.1 cargo hold was located in the windlass control room

4.19 Although there was no evidence to ascertain the level of flammable methane/air mixture accumulated inside the starter and control cabinet and the windlass control room, the ventilation flap of the windlass control room was closed, and the mechanical ventilation also had not been switched on since departure. It was deduced that the methane gas had reached its flammable limits which could be ignited by a spark. Upon the D/C switched on the hydraulic pump motor, the spark generated inside the starter and control cabinet could ignite the methane gas resulting in the explosion.

Enclosed/Dangerous space entry

4.20 Sections 15.1.5 and 15.1.6 of the Code of Safe Working Practices for Merchant Seafarers (*the Code*)[6] state that a dangerous space may not necessarily be enclosed on all sides, such places are not usually considered to be dangerous spaces, but the atmosphere may become dangerous because of a change in the condition inside which may occur intermittently, e.g., adjacent connected spaces of cargo space access ways. It also states that any dangerous spaces on board ship should be identified using risk assessment and kept under review. It recommends to record the characteristics of the space, the likely hazard and measures to prevent entry unless safety procedures are followed.

4.21 Appendix E of the "Bulk Carrier Manual" of the shipboard SMS of *the vessel* stated that the atmosphere measurement of each cargo hold should be taken daily. Its adjacent working spaces, e.g., storerooms, carpenter's shop, passageway, tunnels, etc., should be regularly monitored for the presence of methane, oxygen, and carbon monoxide when loaded with coal cargo.

4.22 In accordance with Regulation 7, "Atmosphere testing instrument for enclosed spaces" of Chapter XI-I of the International Convention for the Safety of Life at Sea (SOLAS), every ship shall carry an appropriate portable atmosphere testing instrument capable of measuring the concentration of oxygen, flammable gas or vapours, hydrogen sulphide, and carbon monoxide prior to entry

[6] Section 4 of Cap.478M "Merchant Shipping (Seafarers) (Code of Safe Working Practices) Regulation" refers.

into enclosed spaces.

4.23 The bosun realized that the windlass control room might be unsafe to enter. Hence, he opened the weathertight door for about 5 minutes before entering the windlass control room for ventilating purpose. Despite the gas detectors being equipped on the vessel, there was no evidence to show that the crew members had used the gas detectors to ensure the safety of the windlass control room prior to their entry. The crew members did not take any gas reading for the cargo holds and their adjacent working spaces since the departure from the loading port. It indicated that the crew members did not strictly follow *the Code* and the shipboard SMS requirements.

4.24 Chapter 5.5 (Dangerous Areas) of the shipboard "Health, Safety and Environment Manual" (HSE Manual) listed the dangerous areas of *the vessel*. However, the windlass control room was not identified as a dangerous area. Considering that *the hold* was loaded with coal cargo, its access hatch was located within the windlass control room, and the methane gas might emit from the coal cargo and seep into the windlass control room through the access hatch, the windlass control room should be considered as a dangerous space according to *the Code*. If *the Company* had identified the windlass control room as a dangerous space, the crew members might follow the requirements of "Dangerous Areas" of the shipboard HSE Manual before entering the windlass control room. The accident might have been avoided.

Safety awareness and safety training on carrying the coal cargo

4.25 On the morning of the accident, the bosun noticed an abnormal sound coming from the starter and control cabinet after switching off the power of the No.2 hydraulic pump motor and informed the engineer officers to check. However, the crew members, including the engineer officers, could not associate the abnormal sound with the possibility of explosion caused by the methane/air mixture from *the hold* ignited by a spark inside the starter and control cabinet. It was revealed that the crew members were lack of safety awareness on the carriage of the coal cargo by *the vessel*.

4.26 Appendix E of the "Bulk Carrier Manual" of the shipboard SMS stated that the hazards of carrying coal cargo and safety control measures should be taken to mitigate the risk. However, there was no evidence to show that the relevant safety training had provided to the crew members to alert them to the inherent risk of explosion or fatality hazards of carrying coal cargo, including the potential hazards mentioned in the cargo safety information provided to the master from the shipper before loading.

4.27 The investigation revealed that the crew members were not familiar with the "Bulk Carrier Manual" of the shipboard SMS.

5. Conclusions

5.1 On 19 February 2021, *the vessel* fully loaded with the coal cargo proceeded to the Gibraltar anchorage. The C/O and D/C entered the windlass control room in the ship forward to start the hydraulic pump motors of the windlass system preparing for anchoring. While the D/C was pressing the power switch of the hydraulic pump motor, an explosion happened and followed by smoke rising. The accident resulted in the C/O and D/C suffering severe burn injuries. Both of them were evacuated to a local hospital for medical treatment.

5.2 The investigation had identified the contributory factors leading to this accident:

(a) the crew members failed to strictly follow the General Requirements and Special Precautions stated in Appendix 1 of the *IMSBC Code*;

(b) the shipboard SMS failed to identify the windlass control room as an enclosed/dangerous space resulting in the crew members underestimating the inherent risk of explosion or fatality hazards of the windlass control room when carrying coal cargo; and

(c) the crew members were lack of safety training on the potential hazards regarding carriage of *the coal cargo* and were not familiar with the shipboard SMS.

6. Recommendations

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

(a) strictly follow the General Requirements and Special Precautions of Appendix 1, the *IMSBC Code* when loading coal cargo; and

(b) enhance the safety awareness and training onboard and the alertness of the risk of explosion and fatality hazards of carrying MHB cargo in particular when carrying coal cargo.

6.2 The management company should consider revising the shipboard SMS to identify additional dangerous spaces on board and conduct an internal audit on *the vessel* to ensure that the crew members strictly follow the safety requirements when carrying coal cargo.

6.3 A Hong Kong Merchant Shipping Information Note is to be issued to promulgate the lessons learnt from this accident.

7. Submission

7.1 The draft investigation report, in its entirety, was sent to the management company and the Master of the vessel for comments.

7.2 By the end of consultation period, comments from the management company were received and handled with no change of the content of the report.