REPUBLIC OF THE MARSHALL ISLANDS

Maritime Administrator

ALTHEA CASUALTY INVESTIGATION REPORT

Fatal Accommodation Space Fire

South Atlantic Ocean | 22 November 2021

Official Number: 3546

IMO Number: 9396309

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DISCLAIMER

In accordance with national and international requirements, the Republic of the Marshall Islands Maritime Administrator (the "Administrator") conducts marine safety investigations of marine casualties and incidents to promote the safety of life and property at sea and to promote the prevention of pollution. Marine safety investigations conducted by the Administrator do not seek to apportion blame or determine liability. While every effort has been made to ensure the accuracy of the information contained in this Report, the Administrator and its representatives, agents, employees, or affiliates accept no liability for any findings or determinations contained herein, or for any error or omission, alleged to be contained herein.

AUTHORITY

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

Maritime Administrator

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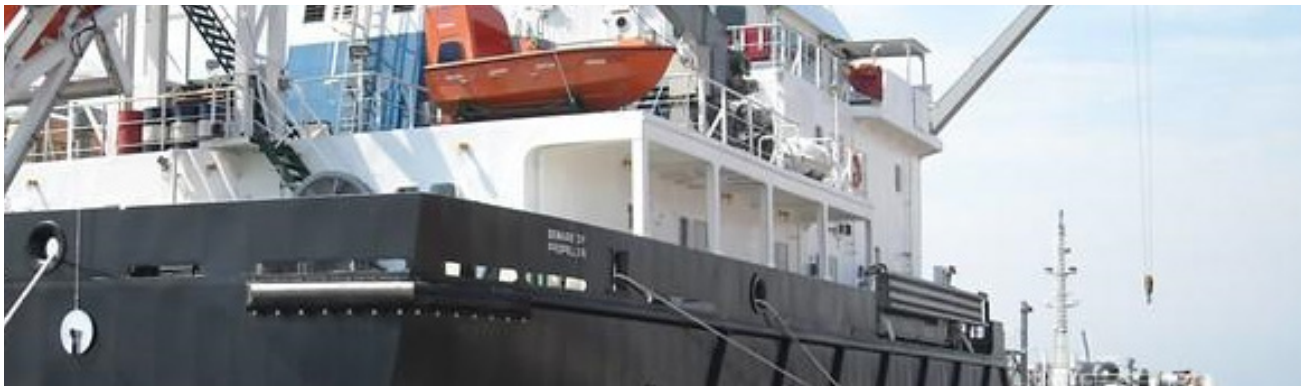
LIST OF ABBREVIATIONS AND ACRONYMS

2/O	Second Officer
ASD	Able Seafarer Deck
C	Celsius
C/O	Chief Officer
cm	Centimeter
COVID-19	Coronavirus Disease
CPR	Cardiopulmonary Resuscitation
EEBD	Emergency Escape Breathing Apparatus
FSS Code	Fire Safety Systems Code
IMCO	International Marine Contractors Association
ISM Code	International Safety Management Code
kg	Kilogram
L	liter
m	Meter
MLC, 2006	Maritime Labour Convention, 2006
MSF	Marine Safety Forum
nm	Nautical Mile
OOW	Officer on Watch
OSV	Offshore Support Vessel
PA	Public Address
SCBA	Self-Contained Breathing Apparatus
SMS	Safety Management System
SOLAS	International Convention for the Safety of Life at Sea
STCW Code	Seafarers' Training, Certification, & Watchkeeping Code
UTC	Coordinated Universal Time



PART 1: EXECUTIVE SUMMARY

On 21 November 2021, the Republic of the Marshall Islands-registered oil and chemical tanker ALTHEA, managed by Medtankers Management Ltd. (the "Company"), departed Cabinda, Republic of Angola (hereinafter, "Angola") on a ballast voyage to Luanda, Angola.

At 2012[1] on 22 November 2021, the ship's fire alarm system sounded. The C/O, who was the OOW on the Bridge, determined that smoke detectors on the starboard side of the upper deck passageway had been activated. The C/O then made an announcement using the ship's PA system to have all crewmembers report to the muster station. Personnel accountability was taken while the crewmembers prepared for firefighting operations. It was determined that two crewmembers were unaccounted for, the Oiler1 and the ASD1. Both of their cabins were on the starboard side of the upper deck. A short time later, the Oiler1 was accounted for as he was able to escape his cabin and evacuate to the main deck.

The Master was eventually able to contact the ASD1 by calling the phone in his cabin. He reported that he was unable to escape due to heavy fire and smoke in the upper deck passageway outside his cabin. Meanwhile, fire parties began accessing the upper deck through an internal stairway. They were met with heavy fire, smoke, and high temperatures which prevented them from reaching the ASD1's cabin. At 2100, crewmembers were able to lower an EEBD to the ASD1 through the open porthole to his cabin; however, the porthole was not large enough to allow and SCBA to be passed into the cabin. Contact with the ASD1 was subsequently lost at 2110. Crewmembers continued to fight the fire, which was mostly extinguished by 0025 on 23 November 2022. They were then able to access the ASD1's cabin, where he was found unresponsive below the porthole. The ASD1 was determined to be deceased and a postmortem examination determined that he died due to carboxyhemoglobinemia, resulting from carbon monoxide inhalation.

It was determined that the fire originated in a crew cabin on the starboard side of the upper deck. The cabin of origin had been unoccupied for over four hours prior to the fire alarm sounding. The door to the cabin of origin was likely closed when the fire started, allowing it to grow in size until a smoke detector in the passageway was activated. The extent of damage in the cabin of origin hindered a specific determination of cause. However, a possible cause of the fire is an electrical defect of a personal electronic device or its power cord.

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

The marine safety investigation conducted by the Republic of the Marshall Islands Maritime Administrator (the "Administrator") identified the following:

1. The cause of the fire, which originated in an unoccupied crew cabin on the upper deck, could not be definitively determined. It is possible that the cause was electrical and the source of ignition was potentially a personal electronic device or its power cord.

2. Causal factors that contributed to this very serious marine casualty include:

   (a) the door to the cabin of origin was closed at the time of ignition, as the occupying crewmember was on duty and not in the cabin, which allowed the fire to grow without detection until the nearest smoke detector in the passageway was activated;

   (b) the intensity of the fire and smoke in the upper deck passageway between the ASD1's cabin and the nearest egress route which prevented the ASD1 from escaping and the fire parties from rescuing him;

   (c) the porthole of the ASD1's cabin was not large enough to allow the ASD1 to exit through nor to allow an SCBA to be passed into the cabin;

   (d) the fire parties were unable to access the ASD1's cabin from the exterior of the ship.

3. An additional causal factor that may have contributed to this very serious marine casualty includes:

   (a) the Company's SMS did not address charging of personal electronic devices or inspection of devices and their associated power cords.

PART 2: FINDINGS OF FACT

The following Findings of Fact are based on the information obtained during the Administrator's marine safety investigation. Due to travel restrictions imposed in response to the COVID-19 pandemic, the Administrator was not able to arrange for onboard attendance as part of its marine safety investigation of this very serious marine casualty. All related information available to the Administrator was obtained remotely.

SHIP PARTICULARS

Vessel Name
ALTHEA

Registered Owner
Africa Maritime Ltd.

ISM Ship Management
Medtankers Management Ltd.

Flag State
Republic of the Marshall Islands

IMO No.	Official No.	Call Sign
9396309	3546	V7RN7

Year of Build	Gross Tonnage
2009	5,046

Net Tonnage	Deadweight Tonnage
1,686	6,333

Length x Breadth x Depth
94.9 x 18 x 9.6 m

Ship Type
Oil and Chemical Tanker

Document of Compliance Recognized Organization
DNV

Safety Management Certificate Recognized Organization
DNV

Classification Society
DNV

Persons on Board
19

1. Ship particulars: *see* chart on page 9.

2. ALTHEA is an oil and chemical tanker built in 2009 *(see Figure 1)*.

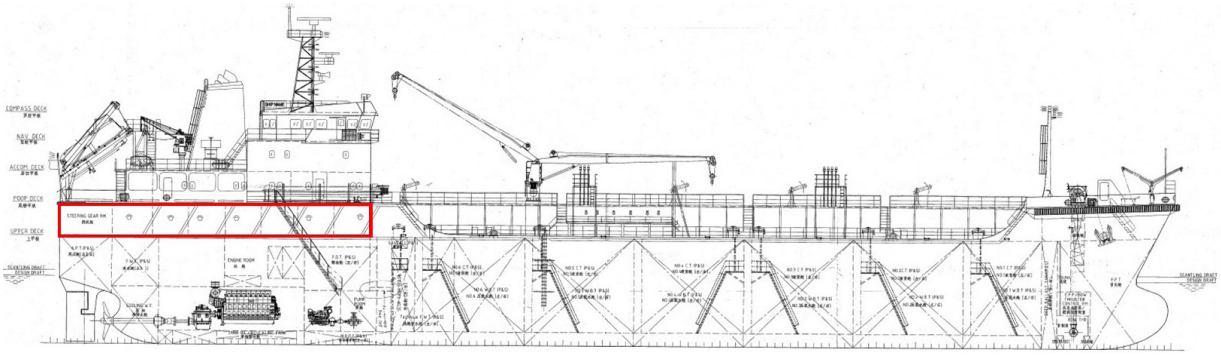


Figure 1: General Arrangement Plan of ALTHEA, with the upper deck indicated in red.

3. Crew cabins are located on the upper deck, along with several storerooms, mechanical spaces, and public spaces. The upper deck cannot be directly accessed from the exterior of the ship.

4. The primary means of access is an enclosed staircase located on the forward end of the deck *(see Figure 2)*. This staircase extends the height of the Accommodation. A secondary staircase is at the aft end of the upper deck.

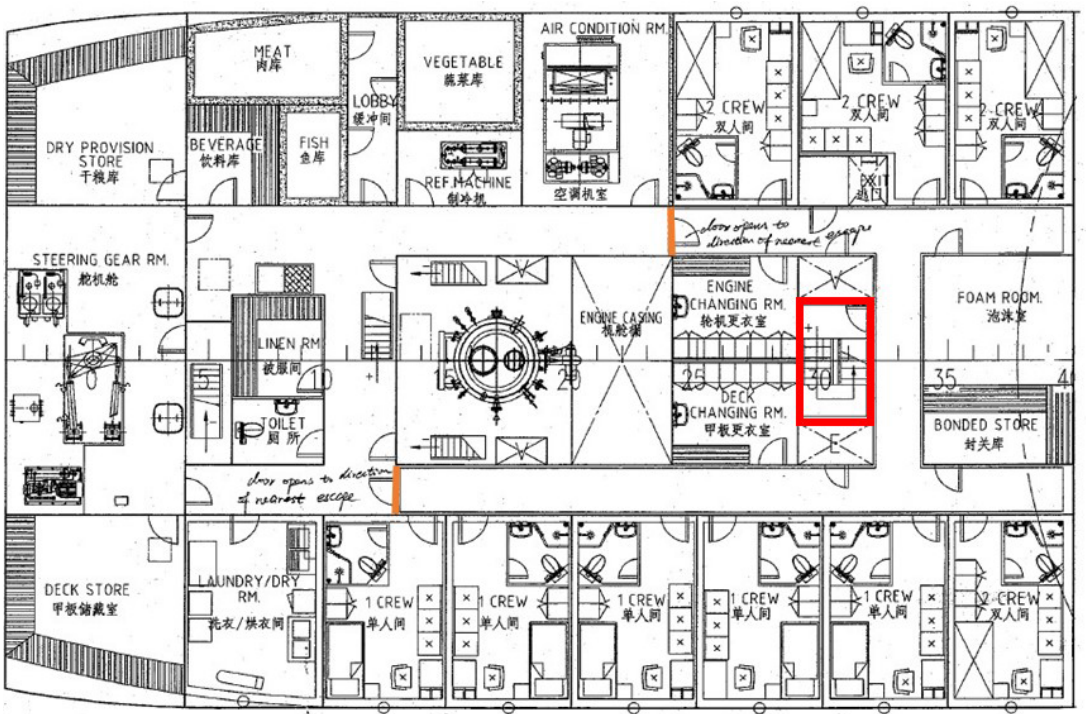


Figure 2: ALTHEA's upper deck arrangement. The main staircase is highlighted in red and two self-closing Class "C" fire doors are highlighted in orange.

5. The upper deck is divided by two self-closing Class "C" fire doors *(see Figure 2)*.

ALTHEA Fire Control Plan

6. ALTHEA's fire control plan was approved by DNV and details the fire protection arrangements provided on board *(see Figure 3)*.

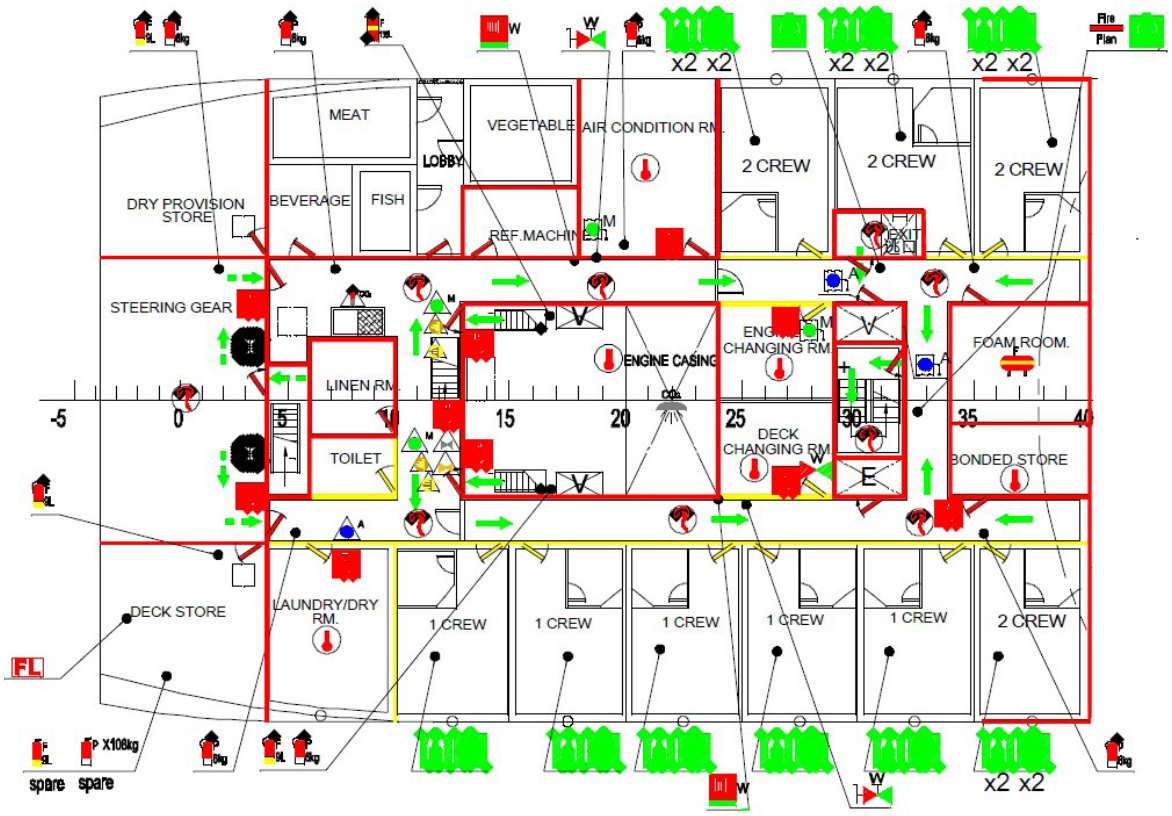


Figure 3: Fire control plan for ATLHEA's upper deck.

7. The bulkheads between the crew cabins and the passageway are "B-0" class divisions.[2] The doors for each of the crew cabins are "B-0" class self-closing doors.

8. The bulkheads encasing the forward stairway are "A-0" class.[3] The door between the stairway and the upper deck passageway is an "A-0" class self-closing door.

9. The bulkheads between the crew cabins are "C" class divisions.[4]

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2 SOLAS Chapter II-2 regulation 3/4 defines "B" class divisions as those constructed of non-combustible materials (with the exception of veneers), insulated with non-combustible materials that prevent the average temperature of the unexposed side from rising more than 140° C above the original temperature or any single point from rising more than 225° C above the original temperature for less than one minute, and constructed to prevent the passage of flame for at least one hour.

3 SOLAS Chapter II-2 regulation 3/2 defines "A" class divisions as those constructed of steel or other equivalent material, suitably stiffened, insulated with non-combustible materials that prevent the average temperature of the unexposed side from rising more than 140° C above the original temperature or any single point from rising more than 180° C above the original temperature for less than one minute, and constructed to prevent the passage of smoke and flame for at least one hour.

4 SOLAS Chapter II-2 regulation 3/2 defines "C" class divisions as those which are constructed of non-combustible materials but are not required to be rated for the prevention of heat transfer nor passage of smoke or flames.

10. Smoke detectors are fitted in six locations throughout the upper deck passageway. The crew cabins are not fitted with any fire or smoke detectors.[5] The fire alarm system provides audible and visual warning throughout the upper deck when the fire detection system is activated.

11. There are six portable fire extinguishers mounted in various locations throughout the upper deck passageway.[6] Five of these are 6 kg dry powder extinguishers and one is a 9 L foam extinguisher.

12. Two fire hydrants, with fire hoses of sufficient length to reach all areas with two jets of water, are provided in the upper deck passageway.[7] One is on the port side and the other is on the starboard side.

13. Two EEBDs are mounted on bulkheads of the upper deck passageway, near the crew cabins.[8]

Incident

14. On 21 November 2021, ALTHEA departed Cabinda, Angola and was bound for Luanda, Angola. The ship was in ballast and proceeding to the next loading port.

15. At 2012 on 22 November, the ship's fire alarm sounded. At the time, ALTHEA was about 20 nm offshore of Barra do Dande, Angola.

16. The C/O, who was the OOW on the Bridge, determined that smoke detectors on the starboard side of the upper deck passageway had been activated. The C/O then made an announcement using the ship's PA system to have all crewmembers report to the muster station. The Master proceeded to the Bridge.

17. At the time, the Bosun was in his cabin on the port side of the upper deck. He reported seeing heavy smoke towards the starboard side of the upper deck passageway as he was exiting. Additionally, the 2/O, two ASDs, and a Motorman reported the smell of "burnt electrical cables" while in the Smoking Room just prior to the fire alarm sounding.[9]

18. At about 2020, it was determined that the Oiler1 and ASD1 had not reported to the muster station. The Master immediately used the PA system to direct the Oiler1 and ASD1 to report to the muster station. Both of the unaccounted crewmembers' cabins were next to each other on the starboard side of the upper deck *(see Figure 4)*.

5 SOLAS Chapter II-2 regulation 7/5.1 requires a fixed fire detection and fire alarm system be installed in all corridors, stairways, and escape routes within accommodation spaces. Smoke detectors are not required to be fitted in crew cabins.

6 SOLAS Chapter II-2 Regulation 10/3 requires accommodation spaces to be provided with portable fire extinguishers of appropriate types and numbers. These fire extinguishers must be ready for use, easily visible, and able to be reached quickly.

7 SOLAS Chapter II-2 regulation 10/2.1.5.1 requires that fire hydrants be installed to allow any part of the ship normally accessible to be reached by two separate jets of water. Fire hoses of a sufficient length to reach any area within the space are also required to be provided.

8 SOLAS Chapter II-2 regulation 13/3.4.2 requires that at least two EEBDs be carried within the accommodation spaces.

9 The Smoking Room is on the starboard side of the poop deck, immediately above the location of the activated smoke detectors.

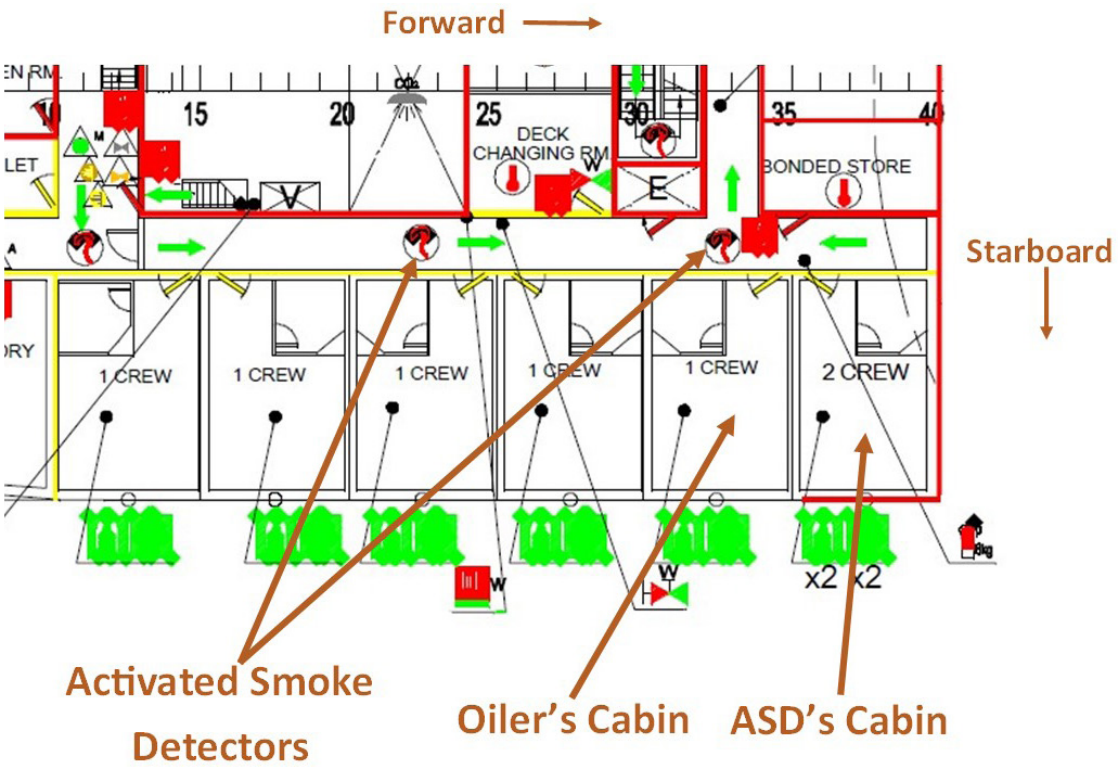

Figure 4: Locations of the unaccounted crewmembers' cabins and the activated smoke detectors on the starboard side of the upper deck.

19. At about 2025, two of ALTHEA's crewmembers entered the upper deck passageway, through the center stairs, wearing firefighting ensembles with SCBAs and carrying a fire hose from the poop deck. They reported encountering heavy fire, high temperatures, and thick smoke in the forward, starboard side of the upper deck passageway. They also reported that the fire appeared to be originating from a crew cabin on the starboard side.

20. At the same time, other crewmembers used fire hoses to conduct boundary cooling of the forward, starboard, and aft sides of the poop deck.

21. At about 2030, Oiler1 safely exited the upper deck using the main staircase. He had been sleeping in his cabin at the time the fire alarm activated.

22. At about 2040, the Master established contact with the unaccounted for ASD1 using the ship's phone system. The Master informed the ASD1 that he needed to evacuate his cabin immediately. The ASD1 advised the Master that he doubted that he would be able to leave due to heavy smoke and flames in the passageway outside his cabin door. He also stated that he had already attempted to exit but quickly returned to his cabin.

23. At about 2045, the two crews conducting fire extinguishment in the upper deck had to leave the space due to low air pressure in their SCBA cylinders. They were unable to reach the ASD1's cabin due to the flames and dense smoke. They were immediately relieved by two additional crewmembers who were already wearing firefighter ensembles and SCBAs. They continued the efforts to extinguish the fire and rescue the ASD1.

24. At about 2100, crewmembers used a rope to lower an EEBD through the open porthole to the ASD1's cabin. There is no direct access to this porthole from the exterior of the ship *(see Figure 5)*. The ASD1 reported that he was still unable to leave his cabin due to the flames and heat in the passageway. Additionally, the 39 cm porthole was too small for the ASD1 to exit through or to allow an SCBA to be passed into the cabin.

Figure 5: Photo of the starboard side of ALTHEA, with the porthole to the ASD1's cabin circled in orange (left). Photo of the EEBD that was lowered to the ASD1, taken following extinguishment of the fire (right).

25. At about 2110, communication with the ASD1 by phone and through the porthole had been lost.

26. At 2147, the Master issued a distress call. Four vessels in the vicinity of ALTHEA responded to the call and offered to assist.

27. At about 2335, the OSV BOURBON EXPLORER 519[10] arrived at ALTHEA and maneuvered alongside the ship. Two SCBAs, along with spare cylinders, were provided to ALTHEA's crewmembers by BOURBON EXPLORER 519.

28. Crewmembers wearing firefighting ensembles and SCBAs continued to try to extinguish the fire and rescue the ASD1, having to rotate teams to replace SCBA cylinders four more times.

29. By about 0025 on 23 November 2021, the fire had been knocked down and crewmembers were able to reach the ASD1's cabin. The ASD1 was found unresponsive on the deck below the open porthole. He was immediately removed from the cabin and brought to the main deck. He did not have a pulse and CPR was immediately started. It is reported that the ASD1 did not have any visible injuries or burns.

30. Shortly thereafter, the fire was fully extinguished. Crewmembers continued monitoring the fire affected area for re-flash.

10 BOURBON EXPLORER 519 is a 78.25 m OSV registered in the French Republic.

31. Ten of the ship's 12 spare SCBA cylinders were used during the firefighting and rescue operations. An additional four that were provided by the BOURBON EXPLORER 519 were also used.

32. At about 0103, the ASD1 was transferred to BOURBON EXPLORER 519 for urgent transport to Luanda, which was the nearest port.

33. BOURBON EXPLORER 519's Master subsequently informed ALTHEA's Master that, at about 0130, lifesaving efforts were stopped. BOURBON EXPLORER 519's crew had determined that the ASD1 was deceased.

34. The ASD1's body was disembarked by BOURBON EXPLORER 519 at Luanda. An autopsy conducted by the local medical authority determined that the ASD1 died due to carboxyhemoglobinemia resulting from carbon monoxide inhalation.

Post-fire Condition of the Upper Deck

35. The heaviest fire damage was located on the forward, starboard side of the upper deck *(see Figure 6)*. The port side had smoke damage but no signs of direct flame impingement. The self-closing fire doors on the port and starboard sides of the upper deck passageway largely prevented smoke and flame from spreading into the aft portion of the passageway.

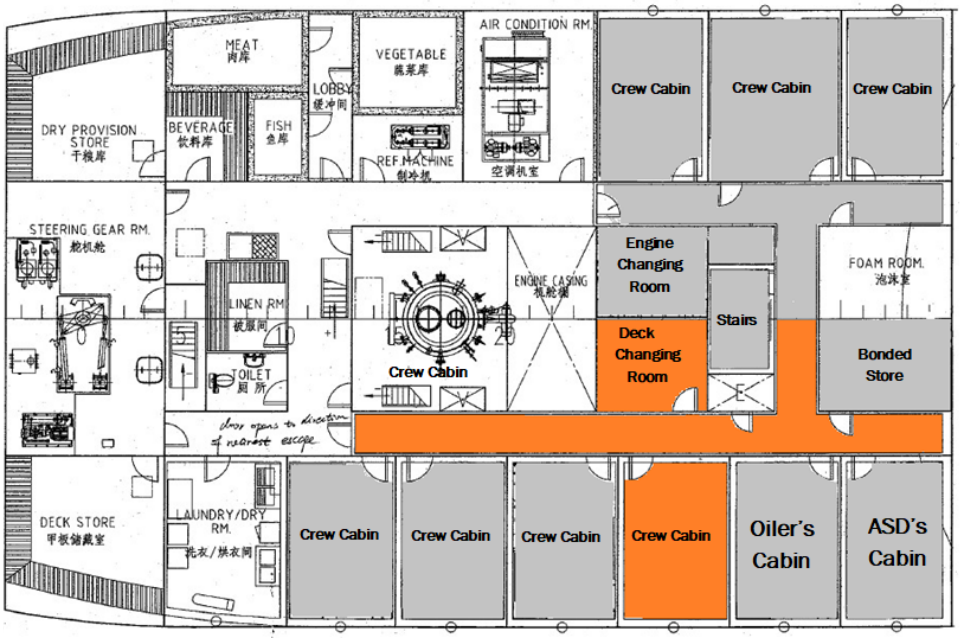

Figure 6: Diagram of the impact on the upper deck, with fire damage indicated in orange and smoke damage indicated in grey.

36. One crew cabin on the starboard side had significant fire damage, with all surfaces showing evidence of direct flame exposure. Most contents were completely burned *(see Figure 7)*. This cabin was aft of the ASD1's cabin. The heaviest fire damage was observed on the interior side (towards the cabin) of the bulkhead and overhead paneling. Burn patterns indicate that the door to this cabin was closed when the fire started. The crewmember assigned to this cabin was not occupying it when the fire started as he was on duty. It is customary for crewmembers to keep their cabin doors closed when they are not occupying the space.

37. The crewmember assigned to this cabin left around 1600 for duty. This was the last time he was in the cabin prior to the fire. The crewmember was unable to recall if any of his personal electronic devices were left plugged in when he left. After his watch ended at 2000, the crewmember assigned to this cabin went to the designated smoking room and remained there until the fire alarm sounded.

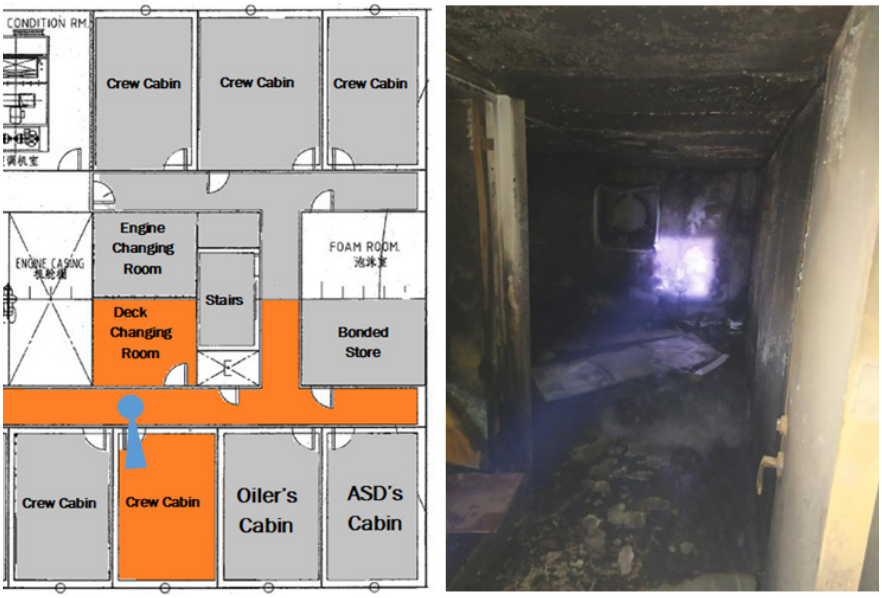

Figure 7: Photo of the crew cabin with the heaviest fire damage. Orientation of view is indicated in blue. The bathroom inside this cabin can be seen to the left of the photo.

38. The starboard passageway had significant fire damage *(see Figure 8)*. Fire damage decreased with distance from the seat of the fire within the crew cabin.

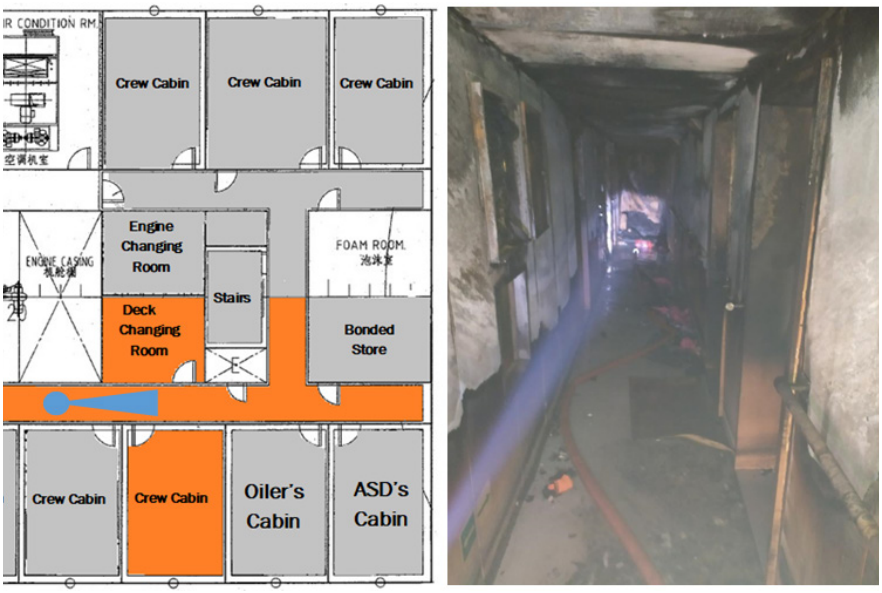

Figure 8: Photo of the forward, starboard side passageway of the upper deck. Orientation of view is indicated in blue.

39. The passageway directly outside the ASD1's cabin had significant fire damage which extended from near deck level up to the overhead *(see Figure 9)*. The overhead and bulkhead paneling were deformed due to heat. A large pile of fire debris had collected at the end of the dead end corridor adjacent to the ASD1's cabin.

Figure 9: Photo of the passageway outside the ASD1's cabin. Orientation of view is indicated in blue.

40. The door to the ASD1's cabin was closed when the fire started and was found closed when he was removed by crewmembers. Fire damage was present on the exterior of the door *(see Figure 10)*.

Figure 10: Photo of the exterior of the door to the ASD1's cabin.

41. The upper half of the inside of the door to the ASD1's cabin shows signs of exposure to high temperatures, as evidenced by the melted veneer *(see Figure 11)*. No evidence of direct flame contact was observed on the inside of the door, frame, or surrounding areas.

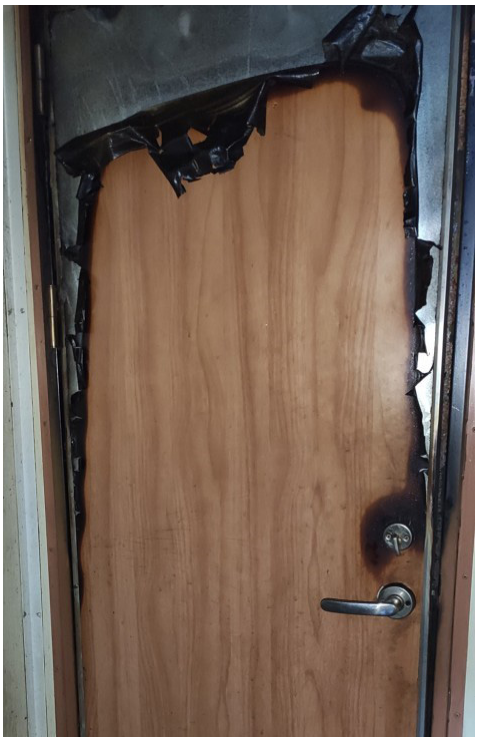

Figure 11: Photo of the inside of the door to the ASD1's cabin.

42. Soot had collected on the bulkheads, overhead, and furniture in the ASD1's cabin *(see Figure 12)*. There was no fire damage, aside from the peeling veneer on the inside of the door.

Figure 12: Photos of the ASD1's cabin, taken after firefighting water had been removed.

43. All damage was confined to the upper deck, with no extension to other decks reported.

ALTHEA's Crew

44. ALTHEA had a complement of 19 crewmembers, five more than required by the Minimum Safe Manning Certificate issued by the Administrator.

45. All involved seafarers held the appropriate Republic of the Marshall Islands-issued seafarer documentation for their positions.

46. Experience of ALTHEA's crewmembers:

RANK	TIME ON BOARD ALTHEA	TIME IN RANK	TIME WITH COMPANY	TOTAL TIME AT SEA
Master	2 months, 30 days	5 years	15 years	15 years
C/O	30 days	9 years	12 years	16 years
2/O	7 months, 18 days	2 years	7 years	10 years
3/O	4 months, 25 days	1 year, 4 months	10 years	14 years
C/E	7 months, 18 days	27 years	23 years	38 years
2/E	4 months, 25 days	7 years	5 years	36 years
3/E	4 months, 25 days	1 year	4 years	10 years
Electrician	7 months, 18 days	21 years	16 years	21 years
Bosun	7 months, 18 days	13 years	13 years	18 years
ASD1 (Deceased)	30 days	4 years	30 days	5 years
ASD2	3 months, 12 days	1 year, 6 months	1 year, 6 months	2 years, 6 months
ASD3	7 months, 18 days	2 years	5 years	5 years
Pumpman	7 months, 18 days	1 month	22 years	22 years
Oiler1	7 months, 18 days	11 years	10 years	11 years
Oiler2	7 months, 18 days	15 years	18 days	15 years
Oiler3	30 days	12 years	5 years, 7 months	12 years
Cook	7 months, 18 days	17 years	19 years	20 years
Engine Cadet	7 months, 18 days	1 year, 6 months	7 months, 18 days	1 year, 6 months
Relief Master	2 days	3 years	9 years	38 years

47. The Administrator found no indication that crewmembers involved with this incident failed to receive the amount of rest mandated by the STCW Code, Section A-VIII/1, paragraphs 2 and 3, and MLC, 2006, regulation 2.3.

48. The ASD1's most recent physical examination certificate was issued on 22 September 2021. He was found fit for duty without any restrictions.

SMS

49. As required by the ISM Code, the Company maintained an SMS on board ALTHEA. The last audit of the SMS had been conducted by DNV on 3 November 2020. The attending auditor determined that the SMS was well implemented.

50. The SMS states that smoking is only allowed in designated spaces inside the Accommodation. During navigation, smoking is allowed in the following compartments:

    (a) Smoking Room;

    (b) Bridge;

    (c) Ship's Office;

    (d) Cargo Control Room; and

    (e) Engine Control Room.

51. The use of personal electronic devices is allowed in crew cabins. The Company's SMS does not address the inspection, use, or charging of personal electronic devices. The Company's SMS does include restrictions on the use of mobile telephones on board depending on the operational status of the ship (loaded, underway, at terminal, etc.).

52. The SMS includes a requirement that all new crewmembers complete initial familiarization training upon joining ALTHEA. Among other items, this training includes the requirement that crewmembers be familiarized with:

    (a) the Company's SMS;

    (b) the Company's quality, health, safety, environmental protection, and drug and alcohol policies;

    (c) the duties and responsibilities for their position on board;

    (d) the location of fire-fighting appliances;

    (e) the location of breathing apparatus;

    (f) the designated escape routes; and

    (g) the fire and abandon ship procedures.

53. Records indicate that all crewmembers on board ALTHEA had completed this initial familiarization training as required by the SMS.

54. The Company's SMS requires that all crewmembers participate in a fire drill at least once per month. Additionally, all crewmembers are required to participate in fire or abandon ship training once per week. Records indicate that the last fire drill was conducted on 12 November 2021. This drill was unannounced and simulated a fire in the paint locker at the forecastle. With the exception of the Master, Chief Engineer, and Cook, all crewmembers participated in this drill.

PART 3: ANALYSIS

The following Analysis is based on the above Findings of Fact.

Cause and Origin

Fire and intensity patterns indicate the fire originated in a crew cabin on the upper deck, starboard side *(see Figure 7)*. Less damage was observed on the upper deck as distance from the cabin of origin increased. The exact origination location within the cabin of origin could not be determined due to the extent of damage, combined with the impact from firefighting. However, fire patterns indicate that the fire likely originated within the livable space of the cabin and not within the bulkhead or overhead paneling.

The determination of the cause of the fire was also hindered by the extent of damage in the cabin of origin. It is not believed that the fire was attributed to smoking in the cabin. The crewmember assigned to this cabin had left the space over four hours prior to the fire alarm sounding. Additionally, this crewmember went directly to the designated smoking room once relieved from watch and remained there until the fire alarm activated.

A possible cause of the fire was an electrical fault which provided the source of ignition. This could have involved a portable electronic device or its power cable in the cabin of origin. Following the incident, the crewmember assigned to the cabin of origin could not recall if any personal electronic devices were left plugged in when he left the cabin. Personal electronic devices and their associated chargers left unattended while plugged in have the potential to be a source of ignition, having been identified as the probable cause of recent shipboard fires.[11]

The Company's SMS includes restrictions regarding the use of cellular telephones on board. It specifies where on board cellular telephones may be used based on the status of the ship (in port, underway, loaded, etc.). The SMS does not address the use, charging, or inspection of other personal electronic devices within the Accommodation. It is likely that personal electronic devices were frequently left plugged in while crewmembers were not in their cabins.

Exit Path from the ASD1's Cabin

The ASD1's cabin was located all the way forward, on the starboard side of the upper deck *(see Figure 4)*. This cabin had one means of egress through the cabin door. It is reported that the porthole in his cabin was not large enough to allow him to pass through. In order to exit the upper deck, the ASD1 would have had to turn aft after exiting through his cabin door. He would then have had to turn inboard into the forward, athwartships passageway. The main staircase would then be on his left, a short distance down the passageway.

Evidence suggests that the door to the cabin of origin was closed when the fire started. The incipient fire continued to grow undetected until enough smoke was emitted into the passageway to activate the nearest smoke detector. The time elapsed between inception and fire alarm activation is not known. However, it is reported that the fire had already spread into the passageway from the fire affected cabin, along with large quantities of smoke, when crewmembers began

11 *See* Ireland Marine Casualty Investigation Board "Report of Investigation into the Fire and Loss of "FV HORIZON" off the Old Head of Kinsale, Co. Cork;" IMCO Safety Flash 27/17 "Laptop Battery Fire," 24/16 "Overheating Notebook Computer," and 16/16 "Mobile Phone Charger Failure;" and MSF Safety Alert 16-09 "Cabin Fire."

evacuating the upper deck. The ASD1 would have had to move down the fire affected passageway, directly towards the heaviest fire, in order to evacuate from his cabin.

The timing of the ASD1's first attempt to evacuate from his cabin and the conditions in the passageway at the time are not known. It is reported that it occurred sometime between the fire alarm activating at 2012 and the Master speaking with him on the phone at 2040. It is known that fire was present in the passageway near the ASD1's cabin very shortly after the fire alarm activated. The heat and smoke from the fire would have continued to increase exponentially as time elapsed, until water was applied, further inhibiting his evacuation.

The Oiler1, who was initially unaccounted for, was able to escape from his cabin without injury at about 2030. The Oiler1's cabin was in between the cabin of origin and the ASD1's cabin *(see Figure 6)*. Both of their cabin doors were immediately next to each other. It is not known why the Oiler1 was able to escape the upper deck while the ASD1 was not.

ASD1's Cause of Death

The ASD1's death was attributed to carboxyhemoglobinemia as the result of carbon monoxide inhalation. Carbon monoxide is produced as a byproduct of incomplete combustion. The fire in the cabin of origin likely became oxygen limited at some point, causing significant quantities of carbon monoxide to be produced. The carbon monoxide, along with the smoke from the fire, eventually passed from the cabin of origin, into the passageway, and subsequently into the ASD1's cabin. This is evidenced by the soot observed on most surfaces in his cabin. Once inhaled, carbon monoxide displaces oxygen in the blood and deprives vital organs (such as the brain and heart) of sufficient oxygen. There is no indication that significant heat or fire was present in the ASD1's cabin.

Firefighting and Rescue Operation

Following activation of the fire alarm system, ALTHEA's crewmembers quickly mustered and began preparing to fight the fire. This includes fire parties donning protective equipment and commencing boundary cooling. The size of the fire precluded the use of fire extinguishers. Fire parties quickly deployed a fire hose from the deck above and advanced it down the stairwell. However, they were met with heavy fire and very high temperatures in the upper deck passageway as they approached the cabin of origin. This prevented the rescue teams from reaching the ASD1's cabin until the bulk of the fire was knocked down.

The ASD1 was not able to exit through the upper deck passageway nor was the porthole in his cabin large enough for him to fit through. With heavy fire preventing the fire party from reaching the ASD1, an EEBD was lowered to him through the open porthole to his cabin using a rope from the deck above. However, this was not sufficient to support the ASD1 until rescue teams could reach him. The ASD1 presumably removed the EEBD once it was expended and continued to breathe the smoke contaminated air in the cabin. He would have been able to stick his head out of the porthole, but this would likely not have prevented him from inhaling carbon monoxide as the smoke was exiting his cabin through the single porthole.

The FSS Code defines an EEBD as "a supplied air or oxygen device only used for escape from a compartment that has a hazardous atmosphere" which is required to have a serviceable duration of at least 10 minutes. The FSS Code further states that SCBAs are required to be capable of functioning for at least 30 minutes. The crew were able to pass an EEBD to the ASD1; however, the porthole to his cabin was not large enough to fit an SCBA through.

PART 4: CONCLUSIONS

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

1. The cause of the fire, which originated in an unoccupied crew cabin on the upper deck, could not be definitively determined. It is possible that the cause was electrical and the source of ignition was potentially a personal electronic device, its power cord, or an extension cord.

2. Causal factors that contributed to this very serious marine casualty include:

   (a) the door to the cabin of origin was closed at the time of ignition, as the occupying crewmember was on duty and not in the cabin, which allowed the fire to grow without detection until the nearest smoke detector in the passageway was activated;

   (b) the intensity of the fire and smoke in the upper deck passageway between the ASD1's cabin and the nearest egress route which prevented the ASD1 from escaping and the fire parties from rescuing him;

   (c) the porthole of the ASD1's cabin was not large enough to allow the ASD1 to exit through nor to allow an SCBA to be passed into the cabin;

   (d) the fire parties were unable to access the ASD1's cabin from the exterior of the ship.

3. An additional causal factor that may have contributed to this very serious marine casualty include:

   (a) the Company's SMS did not address charging of personal electronic devices or inspection of devices and their associated power cords.

PART 5: PREVENTIVE ACTIONS

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

1. The Company's SMS will be amended to include a policy regarding the inspection and use of personal electronic devices on board. The policy will prohibit personal electronic devices from being left unattended while plugged in or charging.

2. The Company's updated SMS policy regarding personal electronic devices will be included in initial familiarization training and to the Company's scheduled training program. Additionally, the newly implemented policy will be communicated on board using posters.

3. The Company will review and update, as necessary, the training checklist relating to the conduct of fire drills to emphasize evacuation of accommodation spaces.

4. The Company's training schedule will be amended to include specific training on evacuating from accommodation spaces and the actions to be taken when the primary exit route is blocked.

PART 6: RECOMMENDATIONS

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

1. Based on the above Conclusions and in consideration of the Preventive Actions taken, it is recommended that the Company:
   (a) review the number and placement of EEBDs within the Accommodation to ensure they are readily available to crewmembers when exiting their cabins; and
   (b) conduct additional training during routinely scheduled fire drills regarding the rescue of crewmembers from spaces with no exterior access (such as the cabins on the upper deck) and the use of SCBAs to extend survivability.

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