



# REPUBLIC OF THE MARSHALL ISLANDS

## Maritime Administrator

### AP DUBRAVA CASUALTY INVESTIGATION REPORT

Fatalities During Enclosed Space Entry

South Atlantic Ocean | 17 July 2019

Official Number: 6174

IMO Number: 9694684





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## **AUTHORITY**

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



*Maritime Administrator*



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## PART 1: EXECUTIVE SUMMARY

On 17 July 2019, the Republic of the Marshall Islands-registered bulk carrier AP DUBRAVA, managed by Atlantska plovdba d.d. (the “Company”), was underway in the South Atlantic Ocean.

It was planned that Tank No. 801, a slop and greywater<sup>1</sup> storage tank, would be emptied and rinsed by using a fire hose to spray saltwater into the tank through a manhole from the Main Deck. The Chief Officer (C/O), the Bosun, and an Able Seafarer Deck (ASD) 1 were conducting this task. The C/O directed the ASD1 to enter the tank with him to rinse the tank from the inside, while the Bosun remained on deck. While rinsing a bulkhead from the second platform down inside the tank, the C/O and the ASD1 collapsed. The Bosun observed the two crewmembers, through the open manhole, laying on the second platform motionless. He immediately notified the Officer of the Watch (OOW) of the incident, who then sounded the general alarm. The Bosun then proceeded to the Accommodation to retrieve a self-contained breathing apparatus (SCBA). While the Bosun was retrieving the SCBA, the Second Engineer (2/E) and ASD2 entered the tank without wearing SCBAs. They also collapsed on the second platform near the C/O and the ASD1. The remaining crewmembers mustered and carried out the enclosed space rescue of all four crewmembers without further incident. First aid was provided to the injured crewmembers, however, the C/O and the ASD2 stopped breathing and were subsequently determined to be deceased. The 2/E and the ASD1 were evacuated by helicopter to a shoreside hospital where they recovered.

The Republic of the Marshall Islands Maritime Administrator’s (the “Administrator’s”) marine safety investigation identified the following:

1. Causal factors that contributed to this very serious marine casualty include:
  - (a) failure of the C/O to ensure that enclosed space entry procedures were followed prior to entering Tank No. 801, which likely contained an oxygen deficient atmosphere.

<sup>1</sup> Greywater refers to wastewater from streams which do not contain fecal matter; such as sinks, showers, and laundry washing machines.

- (b) inadequate onboard implementation of the Company's Stop Work Authority;
  - (c) inappropriate response to the enclosed space emergency when the 2/E and ASD2 entered Tank No. 801 without wearing SCBA's and without waiting for adequate personnel;
  - (d) failure of the Master to ensure that the C/O implemented the enclosed space entry procedures prior to starting work on Tank No. 801; and
  - (e) failure to wear safety harnesses with lifelines, as required by the SMS, which delayed the removal of the crewmembers from the tank.
2. Additional causal factors that may have contributed to this very serious marine casualty include:
- (a) onboard use of standing risk assessments which are generic in nature and not adequate for identifying the hazards associated with a specific space;
  - (b) selection of a generic enclosed space rescue drill scenario, which did not stress the importance of properly implementing the enclosed space rescue procedures nor the dangers of immediately entering the space to attempt rescue;
  - (c) ineffective onboard training with regards to the identification of enclosed spaces and the procedures to be followed prior to entry; and
  - (d) delay in fitting of SCBAs to the incapacitated crewmembers inside the tank.

## **PART 2: FINDINGS OF FACT**

The following Findings of Fact are based on the information obtained during the Administrator's marine safety investigation.

1. Ship particulars: see chart to right.
2. On 7 July 2019, AP DUBRAVA departed San Lorenzo, Argentina on a loaded voyage to Las Palmas, Canary Islands. The ship was carrying 36,348.7 metric tons of corn in bulk.
3. On the morning of 17 July 2019, AP DUBRAVA was underway in the South Atlantic Ocean about 170 nautical miles (NM) northeast of Vitoria, Brazil. Planned work for the day included rinsing Tank No. 801 with saltwater through a manhole from the Main Deck.

### **SHIP PARTICULARS**

**Ship Name**  
AP DUBRAVA

**Registered Owner**  
AP Shipping Company Limited

**ISM Ship Management**  
Atlantska plovidba d.d.

**Flag State**  
Republic of the Marshall Islands

IMO No.	Official No.	Call Sign
9694684	6174	V7KM5

Year of Build	Gross Tonnage
2015	25,494

Net Tonnage	Deadweight Tonnage
13,068	38,700

**Length x Breadth x Depth**  
177.0 x 32.0 x 15.0 meters

**Ship Type**  
Bulk Carrier

**Document of Compliance  
Recognized Organization**  
Bureau Veritas

**Safety Management Certificate  
Recognized Organization**  
Bureau Veritas

**Classification Society**  
Bureau Veritas

**Persons on Board**  
18

- The weather on 17 July 2019 was reported to be clear skies, Beaufort Force 6-7 winds, and swells of 2-3 meters (m).

**Tank No. 801**

- Tank No. 801 is a designated slop and greywater storage tank located between the No. 5 Water Ballast Tank and the Engine Room forward bulkhead, immediately forward of the Accommodation (see Figure 1).

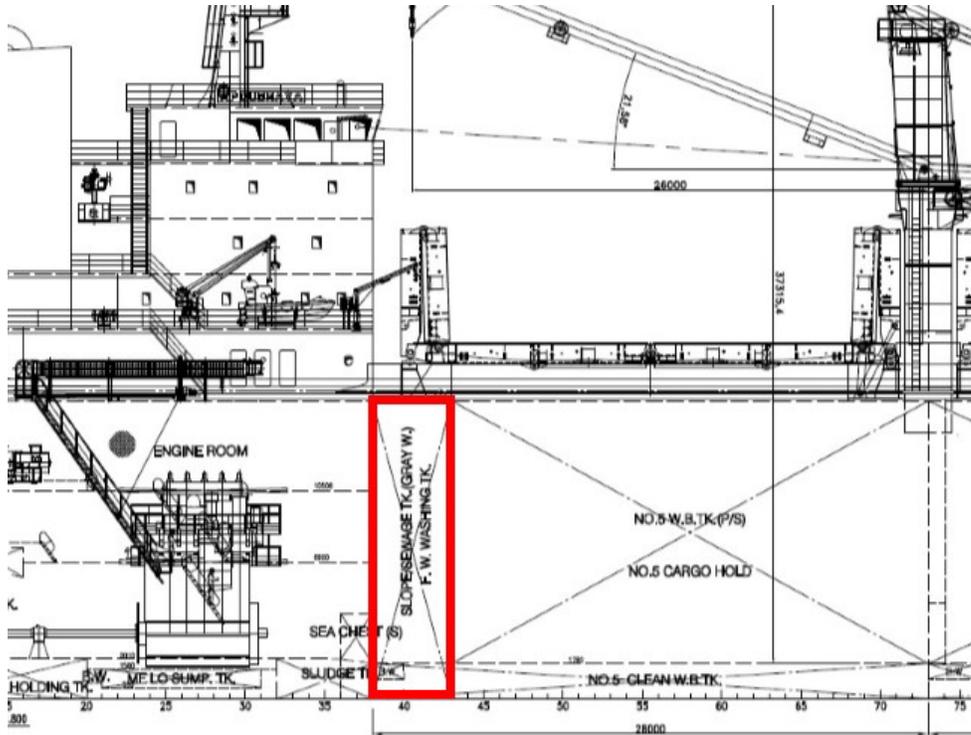


Figure 1: Location of Tank No. 801.

- The tank is accessed through a watertight manhole cover on the port side Main Deck near the aft end of the Cargo Hold No. 5 hatch cover. The manhole cover is marked with “SLOP” and secured with nuts around its perimeter (see Figure 2).

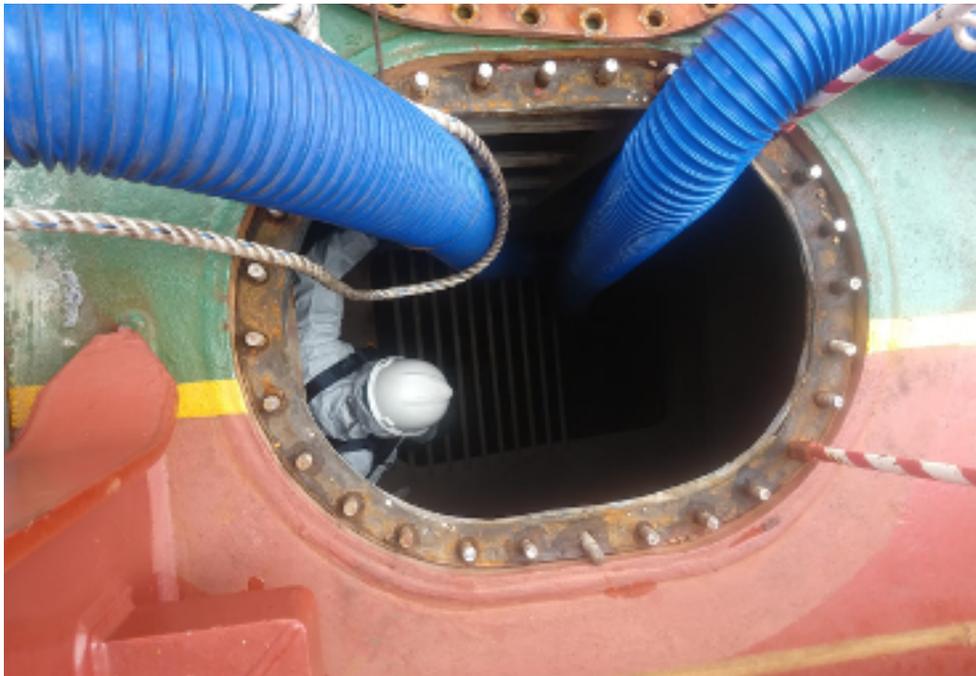


Figure 2: Tank No. 801 access hatch and first platform.

7. There are several platform levels connected by straight ladders within Tank No. 801, extending from the Main Deck to the bottom of the tank (see Figure 3).



Figure 3: View towards Upper Deck from mid-level of Tank No. 801 (left). View towards bottom of Tank No. 801 from mid-level (right).

8. All internal structures of Tank No. 801 were reported to be epoxy coated to prevent corrosion. Photographs of the internal structure of the tank following the incident showed small, isolated areas of corrosion, however, the surface coating was largely intact and in good condition.
9. At the time of the incident, Tank No. 801 contained about 20 cubic meters of greywater and cargo hold washing residuals. The last cargo which was carried prior to hold washing was bulk sulphur.

**Incident**

10. On the morning of 17 July 2019, the contents of Tank No. 801 were to be pumped overboard, and the tank rinsed with saltwater. It was planned that a fire hose would be used to spray saltwater into the tank, through the manhole from the Main Deck.<sup>2</sup>
11. At 0930,<sup>3</sup> the manhole cover of Tank No. 801 was removed to allow for natural ventilation of the tank.
12. At about 1000, the 2/E asked the C/O what the plan was for emptying of Tank No. 801. The C/O informed the 2/E that the manhole cover had been removed for ventilation of the tank and that the emptying was scheduled for 1300 to 1330 that day.
13. As discussed with the C/O, the 2/E began pumping the contents of Tank No. 801 overboard at 1300 on 17 July 2019.
14. After the contents of Tank No. 801 were pumped overboard, the C/O assigned the ASD1 to assist him with the rinsing of Tank No. 801 from the inside, while the Bosun was assisting with opening and closing the salt water supply valve from the Main Deck.
15. The ASD1 entered the tank with the hose and was followed by the C/O.<sup>4</sup> The ASD1 was spraying areas of the tank, as directed by the C/O. SCBAs were not being worn by the C/O or the ASD1 and a Permit to Work was not issued. Atmospheric testing was likely not conducted prior to entry as the gas detector was not found in or near the tank.
16. While on the second platform inside Tank No. 801, the C/O directed the ASD1 to spray a black colored mass off a bulkhead.<sup>5</sup> The mass was reported to be about 30 centimeters (cm) in diameter and about 5 cm thick.
17. The ASD1 reported that he began to feel unwell (tightness of his throat, weakness in his legs, and dizziness) within 10 seconds of spraying saltwater onto the black colored mass.<sup>6</sup> At that time, the C/O was standing behind him. The ASD1 quickly lost consciousness, as did the C/O at some point after the ASD1.
18. At about 1335, the Bosun looked through the open manhole and saw the C/O and the ASD1 lying unconscious on the platform. He immediately notified the OOW, who was the Second Officer (2/O) and on the Bridge at the time of the incident. The 2/O then notified the Master and sounded the general alarm. After notifying the 2/O, the Bosun went to the Accommodation to get an SCBA and spare air cylinders.

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2 The Master reported that he was aware of the plan to spray saltwater through the open manhole but was not aware that crewmembers would be entering the tank.

3 Unless otherwise stated, all times are ship's local time (UTC -2).

4 The exact time of entry into Tank No. 801 was not recorded on board and is not known.

5 The type of substance or the composition of the black colored mass is unknown.

6 As stated by the ASD1 following the incident.

19. The Master proceeded to the Bridge to relieve the 2/O as the OOW.
20. When the general alarm was sounded, the 2/E was walking forward from the Accommodation to Deck Crane No. 4. He proceeded to the manhole of Tank No. 801. Looking through the opening, he saw the C/O lying motionless on the second platform. He immediately climbed into the tank and down to the C/O's location. He found the C/O to be unconscious. He then attempted to exit the tank but was also rendered unconscious while climbing the ladder. He was not wearing an SCBA when he entered the tank.
21. At some point prior to the arrival of other crewmembers, the ASD2 also entered Tank No. 801 without an SCBA and was rendered unconscious. The location of the ASD2 prior to entering the tank, and the events that occurred once he entered the tank, are not known.
22. At about 1340, the crew were mustered at the manhole with the necessary rescue equipment. At about 1348, the Chief Engineer (C/E) and the ASD3 entered the tank, wearing SCBAs. They located the four crewmembers and assessed their condition; all were found to be unconscious. It was noted that the 2/E and the ASD1 were breathing, the C/O appeared to be having difficulty breathing, and the ASD2 did not appear to be breathing. The C/E and ASD3 then exited the tank.
23. The 2/O, ASD4, and an Ordinary Seafarer entered the tank, wearing SCBAs, in order to remove the crewmembers. They immediately fitted SCBAs to the injured crewmembers. Due to the small space, a stretcher could not be used to lift them. Therefore, a rope was tied around each of the crewmembers' chests and they were hauled up to the deck, while the rescuers in the tank guided the injured crewmembers as they were being lifted.
24. At 1356, the 2/E and the ASD1 were removed from the tank and at 1406, the C/O and the ASD2 were removed. Cardiopulmonary resuscitation (CPR) was started on the ASD2 and medical oxygen was provided to all injured crewmembers.
25. All four unconscious crewmembers were transferred to the ship's Hospital for continued treatment and monitoring. Eventually, the 2/E and the ASD1 regained consciousness. The C/O and ASD2 remained unconscious. CPR was continued on the C/O and the ASD2.
26. The Brazilian Navy was notified of the incident by the Master and the Company. The Brazilian Navy informed the Master that a helicopter could not reach the ship until the next morning due to darkness and the poor weather conditions.
27. The Master then diverted the ship towards the nearest port, Vitoria, Brazil. However, the ship was only able to make speed of about 8 knots due to the rough sea state.
28. Despite the efforts of the crew, the ASD2 did not respond to life saving efforts and appeared to be deceased on the evening of 17 July 2019. The C/O stopped breathing and appeared to be deceased on the morning of 18 July 2019.

29. At about 0605 on 18 July 2019, a Brazilian Navy helicopter arrived at the location of AP DUBRAVA and hoisted the 2/E, the ASD1, and the Steward aboard for transport to a shoreside hospital.<sup>7</sup> The C/O and ASD2 were not taken by the helicopter as they were deceased. The helicopter departed AP DUBRAVA at 0734.
30. The 2/E and the ASD1 were treated at a hospital in Vitoria, Brazil and eventually recovered from their injuries.
31. Postmortem examinations of the C/O and ASD2 were conducted in Brazil and it was determined that the cause of death was asphyxia for both crewmembers.

**Crew Experience**

32. AP DUBRAVA had a complement of 18 crewmembers, more than what was required by the Minimum Safe Manning Certificate issued by the Administrator.
33. The Master joined the ship on 12 April 2019. He had a total of 37 years of shipboard experience, all of which had been with the Company. He had served in the capacity of Master for 15 years.
34. The C/O joined the ship on 12 April 2019. He had been sailing for eight years, all of which had been with the Company. He had two years of experience as a C/O.
35. The 2/E joined the ship on 1 April 2019. He had been sailing for 17 years, 10 of which had been as a 2/E. This was his first contract with the Company.
36. The Bosun joined the ship on 7 May 2019. He had been sailing for 37 years, all of which had been with the Company. He had held the rank of Bosun for 14 years.
37. The ASD1 joined the ship on 25 March 2019. He had been employed by the Company for 13 years, all of which had been as an ASD.
38. The ASD2 joined the ship on 11 April 2019. He had been employed by the Company for 13 years, all of which had been as an ASD.
39. All involved seafarers held the appropriate Republic of the Marshall Islands seafarer documentation for their positions.
40. All involved seafarers held current medical certificates and were reported to be fit for duty without restrictions.
41. The Administrator did not find any indication that any crewmembers involved with this incident did not to get the amount of rest mandated by the International Maritime Organization's (IMO's) Seafarers Training, Certification and Watchkeeping (STCW) Code, Section A-VIII/1, paragraphs 2 and 3 and the International Labour Organization's Maritime Labour Convention, 2006 (MLC, 2006), Regulation 2.3.

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<sup>7</sup> The Steward had collapsed earlier in the day, reportedly due to the stress of the situation. He regained consciousness and shoreside medical authorities recommended that he be transferred ashore as well.

**SMS**

42. As required by the IMO's International Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management (ISM) Code), the Company's SMS provided procedures for shipboard tasks. These included requirements for using personal protective equipment (PPE), conducting pre-task hazard assessments, pre-task briefings (also known as Toolbox Talks), and issuance of a Permit to Work when entering enclosed spaces.
43. The Company's SMS stipulates that no person open or enter an enclosed space unless authorized by the Master or Safety Officer, and after having ensured that appropriate safety procedures have been followed.<sup>8</sup> The safety procedures specific to certain tasks are detailed in the Company's Permit to Work system.
44. The Permit to Work system includes a permit specific to entering enclosed spaces. An Entering Enclosed Space Permit can only be approved by the Master or the Safety Officer. The system requires that an enclosed space checklist be completed prior to issuance of the Entering Enclosed Space Permit. The person approving the permit is required to ensure that a risk assessment has been completed, the space has been properly ventilated, the atmosphere of the space has been checked at all levels for oxygen and harmful vapors, and that the enclosed space entry checklist has been completed.
45. On 16 July 2019, the Master, C/O, and C/E conducted a review of a standing risk assessment for entry into enclosed spaces. The risk assessment is a generic listing of the hazards which may be encountered during an enclosed space entry and is listed as covering all enclosed spaces on board. The risk assessment identified several hazards, consequences, and existing control measures (*see Figure 4*).

Hazard(s):		Consequence(s)
1	Lack of oxygen, presence of toxic gasses	> personal injury, loss of life
2	Hard accessible and/or slippery area	> personal injury, loss of life
3	Poor light and visibility	> personal injury, loss of life
4	Safety equipment failure	> personal injury, loss of life
5	Access area not marked and/or protected properly	> personal injury, loss of life
Existing control measures or other factors to reduce risk:		
1	Ventilation well in advance of planned entrance. Regular checking with calibrated equipment.	
2	Practical use of PPE and necessary equipment. Adequate assistance prepared and arranged.	
3	Additional portable lights (safety lamps) for use in enclosed and/or hazardous areas to be placed/used.	
4	AMS Procedures: SAF/SEC 004 (check lists used: SAF10, SAF 12) – work order issued.	
5	Access surrounding area properly protected/marked – warning placed.	

Figure 4: Hazards, consequences, and control measures captured on the standing risk assessment.

46. The SMS includes a reminder that it should never be assumed that a hold or tank is safe for entry and a requirement that an SCBA be worn by entrants if the adequacy of ventilation or atmospheric testing is in doubt. Prior to entering an enclosed space, the SMS requires that the space be ventilated for a minimum of 24 hours if natural ventilation is utilized or four hours if mechanical ventilation is provided. Atmospheric testing of the enclosed space is required to be carried out prior to entry, and at regular intervals until all work is completed. This testing should be conducted at as many different levels as is necessary to obtain a representative sample of the atmosphere in the enclosed space.

<sup>8</sup> The C/O is designated as the Safety Officer on board AP DUBRAVA.

47. The SMS states that the person responsible for overseeing a specific task is required to ensure that the appropriate PPE is being worn by the crewmembers performing the work. They are also responsible to ensure that the PPE is in good condition. The SMS states that the C/O is directly responsible for ensuring that appropriate PPE is used on board and that the Master is ultimately responsible for the implementation of the procedure. In addition, the SMS section which discusses PPE includes a warning that air purifying respirators do not provide protection in oxygen deficient atmospheres and that they should not be used if the atmosphere of a space is known or suspected to be oxygen deficient. Further, the SMS requires that crewmembers entering an enclosed space wear a rescue harness with lifelines attached, unless impractical.
48. The Company's SMS includes the authority for any crewmember, regardless of rank, to question any order/instruction if they believe that following such instruction will place them in a position of peril, without the fear of reprisals. This Stop Work Authority includes the ability to supersede an issued Permit to Work if a crewmember judges the procedure to be unsafe. The policy requires that the crewmember bring the issue to the attention of the Safety Officer, who is then responsible for investigating the circumstances of the potential unsafe order/instruction. According to the policy, the Master has ultimate onboard authority for determining if a planned action is safe.
49. The Company's SMS also details the actions to be taken when carrying out an enclosed space rescue. These procedures provide a warning that under no circumstances should crewmembers enter an enclosed space in the event of an emergency before help has arrived and rescue procedures have been implemented. The SMS also requires that all crewmembers entering an enclosed space to conduct a rescue wear an SCBA.

#### ***Training and Drills***

50. The last enclosed space entry drill was conducted on 15 June 2019 in the Engine Room Workshop. The Master, C/O, 2/E, ASD1, and ASD2 were all recorded as having participated in the drill, which simulated entry into a space following fire extinguishment. It was held immediately following a fire drill in the same space and was reported to have lasted 20 minutes.
51. Upon joining the ship, all crewmembers are required to complete a ship safety familiarization training checklist within 24 hours or prior to commencing their duties. This checklist requires that all crewmembers be trained in the actions to take if a person is overcome in an enclosed space. In addition, the checklist requires that crewmembers understand the requirements relating to the use of PPE during enclosed space entry. Records indicate that the Master, C/O, 2/E, ASD1, and ASD2 completed this training.

#### ***Gas Detection Equipment***

52. An "ALTAIR 4XR" multi-gas detector, manufactured by MSA Safety Incorporated, was available on board AP DUBRAVA. This portable meter measures combustible/explosive gases, oxygen, carbon monoxide, and hydrogen sulfide. The meter does not have an internal pump and requires an external pump if used to sample remote areas with a hose.
53. The gas detector was last calibrated by a shore technician on 7 December 2018, with all parameters passed.

## PART 3: ANALYSIS

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

### *Enclosed Space Entry Procedures*

The Company's SMS contains detailed procedures for entry into enclosed spaces, including a specialized Permit to Work. The SMS places responsibility on the Master and Safety Officer to ensure that these procedures are fully implemented and complied with. However, these procedures were not followed by the Safety Officer (who was the C/O) prior to entry into Tank No. 801 and no safety precautions were taken. This includes the failure to conduct a pre-task risk assessment, to provide adequate ventilation, to conduct atmospheric testing, to ensure the use of proper PPE, and to complete an Entering Enclosed Spaces Permit.

### *Pre-task Risk Assessment*

A pre-task risk assessment, required by the Company's SMS, was not completed prior to beginning the rinsing of Tank No. 801. As such, it is not known if any hazards associated with entry into the tank were identified or discussed with the assigned crewmembers.

On 16 July 2019, the day prior to this incident, the C/O was involved in a periodic review of a standing risk assessment pertaining to enclosed space entry. The risk assessment was generic in nature and was listed as covering all enclosed spaces on the ship. Although this risk assessment was in place prior to the incident, it was not adequate since it did not address the hazards specific to the enclosed space being entered (such as cargo residues being present in the tank) or the work being conducted, nor were the identified existing control measures in place.

### *Ventilation*

The C/O had the manhole cover of Tank No. 801 removed about four hours prior to the scheduled time that rinsing was to begin. The intention of opening the manhole was reportedly to provide natural ventilation to the tank. The Company's SMS requires that an enclosed space be provided with natural ventilation for at least 24 hours prior to entry, or four hours if mechanical ventilation is used. The ventilation of the tank was not in compliance with the requirements of the SMS.

In addition, the design of the space would limit the effectiveness of natural ventilation. Tank No. 801 extended from the Main Deck to the bottom of the hull. Natural ventilation through the open manhole would provide little, if any, air exchange at the lower levels of the tank. The C/O and the ASD1 were not rendered unconscious until they descended to the second platform. This may be an indication that the natural ventilation was effective at the top of the tank but not lower levels.

### *Atmospheric Testing*

The SMS also requires that atmospheric testing be conducted at as many levels as possible within an enclosed space to determine if the atmosphere is safe for entry. Further, the SMS also requires that testing be conducted periodically while work is being carried out. There is no record of atmospheric testing being

conducted prior to entry or periodically while working in the enclosed space since the multigas meter was not found to be in possession of the C/O or the ASD1.

#### ***Entry Into Tank No. 801***

It was reported that it was planned to supply saltwater to Tank No. 801 by spraying a fire hose through the open manhole. It is not known why the C/O decided to order the ASD1 to enter the tank, and then followed him, without following the procedures contained in the SMS and without taking any precautions. The C/O received initial training when he joined the ship relating to enclosed space entry and participated in the most recent enclosed space rescue drill. In addition, he is reported to have participated in a routine review of the standing enclosed space entry risk assessment along with the Master and C/E on the day prior to this incident. These factors, combined with the C/O's shipboard experience, indicates that he should have been familiar with the identification of enclosed spaces, the hazards of enclosed space entry, as well as the proper procedures to follow for entry.

#### ***Atmosphere of Tank No. 801***

Postmortem examinations of the deceased C/O and the ASD2 determined that the cause of death was asphyxia. The oxygen concentration within the tank at the time of the incident is not known, however, it is presumed that an oxygen deficient atmosphere existed when the crewmembers were working in the tank.

Tank No. 801 was used to store cargo hold washing water prior to discharge overboard. The last cargo carried by AP DUBRAVA was bulk sulphur. When in contact with water, sulphur can form highly corrosive sulphurous acid, which is extremely corrosive to steel.<sup>9</sup> The corrosion of steel consumes oxygen, which could contribute to an oxygen deficient atmosphere existing in an enclosed space. Tank No. 801 was epoxy coated, limiting the exposure of unprotected steel to the corrosive effects of sulphurous acid to small, isolated areas.

Following the incident, ASD1 stated that he began to feel unwell at around the same time that he sprayed saltwater onto the black mass which was on the bulkhead. While the composition of the black mass could not be confirmed, the disruption of the mass from the bulkhead may have contributed to the irritation and eventual incapacitation of the crewmembers inside the tank.

#### ***PPE***

The PPE required by the Company's SMS was not worn by the C/O or the ASD1 while working inside the tank. Since there is no record that the atmosphere of the tank was tested, it is not known if the tank was safe for entry. As such, the SMS required that SCBAs be worn. In addition, the SMS required that safety harnesses with lifelines be worn when entering enclosed spaces. The C/O and the ASD1 did not wear SCBAs or safety harnesses.

The configuration of the platforms within the tank prevented the use of a stretcher when removing the incapacitated crewmembers from the tank. Therefore, improvised harnesses were tied around their chests with

<sup>9</sup> International Maritime Solid Bulk Cargoes Code (Resolution MSC.268(85)) Appendix 1 - Individual Schedule of Solid Bulk Cargoes – Sulphur UN 1350.

rope. The rescuers would have been able to more quickly remove the crewmembers from the tank had they been wearing a harness with lifeline, negating the need to fasten ropes while they remained in the tank.

### ***Stop Work Authority***

The Bosun and the ASD1 also received initial familiarization training upon joining AP DUBRAVA, which included a requirement to become familiarized with enclosed space entry procedures and the Company's Stop Work Authority. In addition, they both participated in the last enclosed space rescue drill with the C/O. However, neither individual took action to prevent the entry into an enclosed space. While the Stop Work Authority is well detailed in the Company's SMS, the failure to take action to stop entry into the enclosed space may indicate insufficient onboard implementation of this policy.

### ***Response to Enclosed Space Rescue***

The Bosun was the first crewmember to recognize that the C/O and the ASD1 were incapacitated due to lack of oxygen inside the tank. He immediately notified the OOW of the incident and proceeded to retrieve an SCBA from the Accommodation. When the OOW sounded the general alarm, other crewmembers proceeded to the port side manhole of Tank No. 801.

The 2/E arrived at the tank first, shortly after the Bosun went aft to the Accommodation. Seeing the C/O and the ASD1 lying on the second platform, he immediately climbed into the tank and down to their location. He was not wearing an SCBA and became unconscious shortly after reaching the C/O. At some point after the 2/E became incapacitated, the ASD2 entered the tank, also without an SCBA. He was unable to exit from the tank and became unconscious. The remaining crewmembers brought the necessary equipment to the tank entrance and carried out the enclosed space rescue in accordance with the procedures contained in the SMS and without further incident.

The 2/E and the ASD2 had both participated in enclosed space rescue drills aboard AP DUBRAVA in the past, yet in an attempt to assist a fellow crewmember in distress, both entered the enclosed space without taking necessary precautions, resulting in the death of the ASD2.

### ***Effectiveness of Onboard Training***

While an enclosed space rescue drill had been conducted about a month prior to the incident, it is likely that the scenario used was not effective. The drill simulated the rescue of a crewmember from an enclosed space following a fire drill. In this scenario, the crew were already mustered and wearing the necessary PPE prior to conducting the rescue. However, many enclosed space rescue incidents often occur during the normal course of routine work, without any other emergency occurring such as the case with this incident. A drill scenario which is initiated by the observation of a crewmember who appears to be incapacitated within an enclosed space would stress the importance of properly implementing the enclosed space rescue procedures and the dangers of immediately entering the space to attempt rescue.

### *Supervision by the Master*

The SMS requires that enclosed space entry procedures be followed prior to the opening of an enclosed space. On the morning of the incident, the Master was aware that Tank No. 801 would be rinsed with saltwater through an open manhole from the Main Deck. However, he did not take any action to ensure that the enclosed space entry procedures were properly implemented by the C/O prior to work starting. It is also reported that he was not aware that crewmembers would be entering Tank No. 801.

## **PART 4: CONCLUSIONS**

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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. Causal factors that contributed to this very serious marine casualty include:
  - (a) failure of the C/O to ensure that enclosed space entry procedures were followed prior to entering Tank No. 801, which likely contained an oxygen deficient atmosphere.
  - (b) inadequate onboard implementation of the Company's Stop Work Authority;
  - (c) inappropriate response to the enclosed space emergency when the 2/E and ASD2 entered Tank No. 801 without wearing SCBA's and without waiting for adequate personnel;
  - (d) failure of the Master to ensure that the C/O implemented the enclosed space entry procedures prior to starting work on Tank No. 801; and
  - (e) failure to wear safety harnesses with lifelines, as required by the SMS, which delayed the removal of the crewmembers from the tank.
  
2. Additional causal factors that may have contributed to this very serious marine casualty include:
  - (a) onboard use of standing risk assessments which are generic in nature and not adequate for identifying the hazards associated with a specific space;
  - (b) selection of a generic enclosed space rescue drill scenario, which did not stress the importance of properly implementing the enclosed space rescue procedures nor the dangers of immediately entering the space to attempt rescue;
  - (c) ineffective onboard training with regards to the identification of enclosed spaces and the procedures to be followed prior to entry; and
  - (d) delay in fitting of SCBAs to the incapacitated crewmembers inside the tank.

## **PART 5: PREVENTIVE ACTIONS**

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In response to this very serious marine casualty, the Company has taken the following Preventive Actions. The lessons learned from this incident have been circulated to all ships within the Company's managed fleet.

1. An additional multi-gas meter will be provided to all the Company's managed ships to ensure that two are always available for use on board.
2. The Master, C/O, C/E, and 2/E aboard all Company managed ships will be specially briefed on enclosed space entry and rescue procedures prior to joining.
3. Additional enclosed space rescue training will be provided to crewmembers of all ships within the Company's managed fleet.
4. Additional training on the Company's Permit to Work system will be provided to all crewmembers.
5. The Stop Work Authority will be reaffirmed on board all ships in the Company's managed fleet.

## **PART 6: RECOMMENDATIONS**

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

1. It is recommended that the Company provide training to all crew serving on ships in the Company's managed fleet which details the importance of conducting thorough risk assessments prior to conducting work, with specific emphasis on the importance of viewing the actual work area and the dangers of relying on generic risk assessments.
2. It is recommended that the Administrator consider developing training guidelines for use during enclosed space rescue drills on Republic of the Marshall Islands-registered ships, focusing on a seafarer's natural desire to assist a fellow crewmember in distress, possibly disregarding necessary safety precautions and the dangers posed by this action.

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