Marine Safety Investigation Unit

Transport Malta

SAFETY INVESTIGATION REPORT

202103/022 REPORT NO.: 05/2022 March 2022

MT SEASCOUT

Explosion leading to equipment and structural damages in position 21° 07.1' N 059° 31.9' E 18 March 2021

SUMMARY

Seascout was in transit to Al Duqm, Oman, for her scheduled dry-docking, with a riding team of technicians assisting the crew in the preparations of the vessel.

As part of these preparations, the walkway ramps on the main deck were being dismantled to check on their condition and that of the piping passing underneath.

Two of the bolts on the last ramp were particularly hard to undo and the assigned technician opted to use an angle grinder to facilitate the work.

Sparks emitted from the grinding disk flew towards the vent head of fuel oil tank no. 2 port. Subsequently, an explosion rocked the vessel, causing damages to her steel structure, and port side lifeboat and liferafts.

Taking into consideration the safety actions adopted by the Company, the MSIU has issued no recommendations.

MV *Seascout*

FACTUAL INFORMATION

The vessel

Seascout (Figure 1) was a 57,301 gt, double-hull oil tanker, owned by Valiant Sailor Marine Inc. and managed by Thenamaris Ships Management, Greece (the Company). *Seascout* was built in 2004, by Hyundai Samho Heavy Industry Co. Ltd. in the Republic of Korea and was classed with Lloyd's Register of Shipping (LR).

The vessel had a length overall of 243.96 m, a moulded breadth of 42.00 m and a moulded depth of 21.00 m. She had a summer draught of 14.92 m, which corresponded to a summer deadweight of 105,330 metric tonnes (mt). At the time of the occurrence, her forward and aft draughts were recorded at 6.2 m, and 8.2 m, respectively.

Propulsive power was provided by a 6-cylinder, two-stroke, single-acting, direct reversible, HYUNDAI-MAN B&W 6S60MC MK6 slow speed marine diesel engine, which produced 11,324 kW at 97 rpm. This drove a fixed-pitch propeller, enabling *Seascout* to reach an estimated speed of 15 knots.

Crew and riding team

The Minimum Safe Manning Certificate of *Seascout* stipulated a crew of 15. At the time of the occurrence, the vessel was manned by a crew of 26 Filipinos. Additionally, six Bulgarian technicians were on board to assist in the preparation for the vessel's scheduled dry-docking.

The pumpman had embarked on *Seascout* in Singapore, on 05 November 2020. He had 35 years of experience at sea and a total of 11 years of experience in his present rank. He was also certified under STCW[1] II/5 as an able seafarer deck. He had been sailing as a

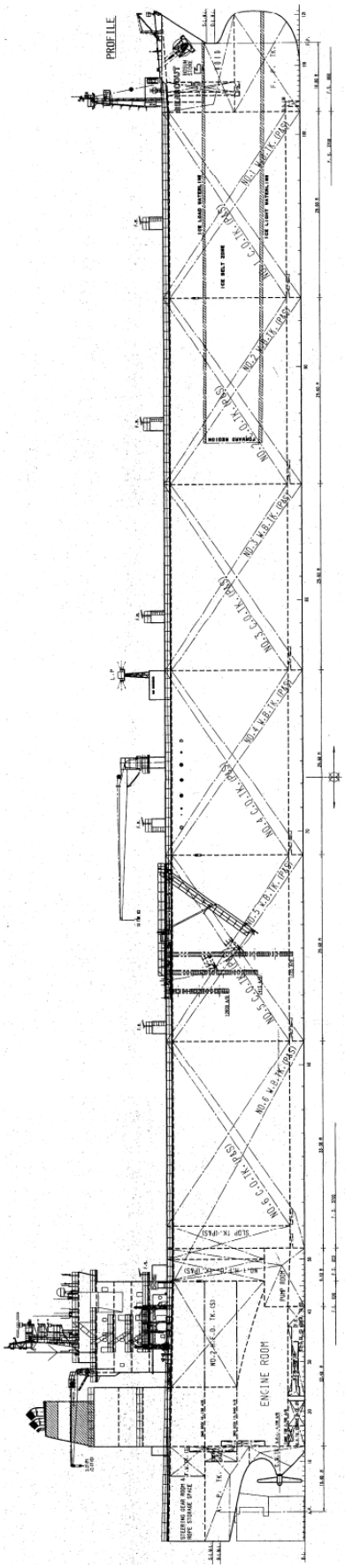

Figure 1: An extract from the vessel's general arrangement plan

[1] IMO. (2001). The International convention on standards of training, certification and watchkeeping for seafarers, 1978, as amended in 1995 and 1997 (STCW Convention). London: Author.

pumpman with the Company for about six years. The pumpman kept watches neither in port nor at sea. His working hours were from 0800 to1700.

The able seafarer deck (AB), who was working with the pumpman at the time of occurrence, had embarked on *Seascout* at Fujairah, U.A.E., on 22 February 2021. He had 11 years of experience at sea, of which, six were served on tankers. Three months prior to the occurrence, he was promoted to the rank of an AB. He had an STCW II/5 certificate issued by the maritime authorities of the Philippines. At sea, the AB's watch hours were the 0400 – 0800 and 1600 – 2000.

The technician, who was on deck at the time of the occurrence, had started his career in 1987 and had been working with the Company as a technician for 24 years. He had joined the vessel on 17 March 2021, at Fujairah, U.A.E., along with five other technicians. He was the designated foreman of the riding team of technicians. The technician had undergone basic safety training on tankers.

Environment

Information submitted by the vessel reported clear weather, with a visibility of about 12 nautical miles. A moderate breeze was blowing from the South. The sea was moderate, with a 1.5-metre-high swell approaching the vessel abeam. The air and sea temperatures were recorded at 31 °C and 27 °C, respectively.

Fuel oil tank (FOT) no. 2 port (P)

The vessel had bunkered 596.5 mt of VLSFO[2] on 22 February 2021, which were stored in FOT no. 2P. According to the fuel oil analysis (FOA) report and the certificate of quality (COQ) of the bunkers, the fuel met the relevant ISO standards. Additionally, these reports included the test results, which were conducted on a fuel sample collected during bunkering.

Of importance to this safety investigation were the following results:

- Flash Point[3]: 60°C (FOA) / 63°C (COQ); and
- Pour point[4]: 24°C (FOA) / 21°C (COQ).

Furthermore, the FOA report contained a cautionary note on the pour point, which stated that if the fuel was stored below the pour point, it would become unpumpable. It further stated that the fuel had to be stored at a minimum of 10°C above the pour point temperature.

The FOA report was issued on 27 February, following which, the engineers maintained the FOT no. 2P at a temperature of 36°C. The gas concentration readings from the sounding pipe were around 25% of the LEL[5] at that time.

On 17 March 2021, the chief engineer decided to gradually increase the temperature of FOT no. 2P to a set point of 48°C. He had done so to maintain the pumpability of the fuel, since the vessel would be idle, and heating would have to be stopped in the upcoming scheduled dry dock.

[2] Very low Sulphur fuel oil (VLSO) – with a maximum Sulphur content of 0.5 %.

[3] Flash point: the lowest temperature at which a liquid gives off sufficient gas to form a flammable gas mixture near the surface of the liquid.

[4] The lowest temperature at which a petroleum oil will remain fluid.

[5] Lower Explosive Limit: the lowest concentration (%) of a gas or vapor in air, that can produce a flash of fire in presence of an ignition source (*e.g.*: a spark).

Narrative[6]

Seascout departed from Khor Fakkan, U.A.E., in ballast and gas-free conditions, on 17 March 2021. It was bound for Al Duqm, Oman, for the scheduled dry-docking. The arrival date was 19 March 2021, with docking on arrival.

On 18 March 2021, at 0800, a toolbox meeting was carried out. The task to remove the deck ramps for inspection and maintenance was assigned to the riding team. A cold work permit and a risk assessment for the removal of deck ramps had been prepared by the chief officer. The former document was also countersigned by the master and the technician foreman.

By 1700, the crew and technicians left for dinner. Only two more bolts on the ramp, near the accommodation block, had to be undone. After dinner, one of the assigned technicians set off to complete his task. Having already tried to use other means to undo the last two heavily corroded bolts, he decided to use an angle grinder to facilitate the job.

The pumpman and the AB, who were close-by on deck (Figure 2), were installing a new isolation valve on the fire line, when they heard the angle grinder running.

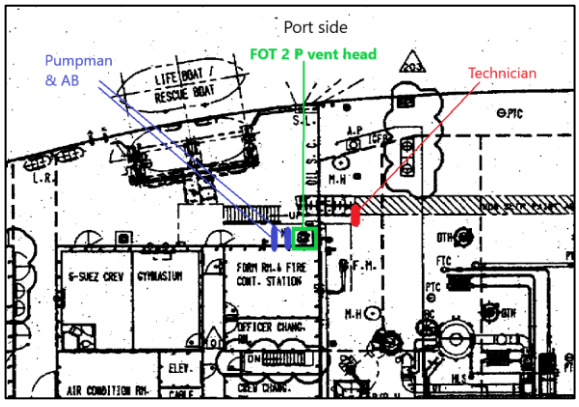

Figure 2: Extract from the General Arrangement plan indicating the location of the crew members and the technician prior to occurrence

The pumpman requested the AB to inform the technician not to use it. The AB called out to the technician, and the technician immediately ceased his work.

However, by the time the pumpman and the AB arrived at the technician's position, they observed smoke coming out of the vent of FOT no. 2P (Figure 3). The pumpman directed everyone to move away and clear the area. At around 1833, while the pumpman, AB and the technician were running towards the midship store to get fire-fighting equipment, the pumpman and AB saw a flash and flames from the air vent, followed by a loud explosion.

Figure 3: The location of occurrence

Hearing the explosion, the master activated the nearest manual call point which set off the fire alarm. Soon after, all hands were accounted for and the fire squads assembled.

[6] Unless otherwise specified, all times refer to ship's time (UTC + 4).

Fire hoses were deployed, and boundary cooling of the affected deck area was commenced, although there were no visible fire / flames.

Inspection of the deck area during the boundary cooling, revealed that the port side liferaft had fallen overboard but was still attached to the vessel. Moreover, the port lifeboat had been displaced and suspended from its davit. By 1910, whilst the vessel's engine was stopped, the crew managed to retrieve the liferaft on board.

Cooling down continued until past midnight, when the temperature in FOT no. 2P was observed to drop. An inert gas connection was made and FOT no. 2P was flooded with inert gas. By 0400 of 19 March 2021, the crew managed to secure the suspended lifeboat and the vessel resumed her voyage.

Sustained damages

During the damage assessment carried out by the crew and Class thereafter, the following were reported:

- deck deformation between frames 28 and 46 (Figure 4);
- buckling of the side shell and internals between frames 28 and 46, in way of the main deck to the second deck;
- buckling of the forward bulkhead inside FOT no. 2P;
- buckling of the aft bulkhead inside FOT no. 2P;
- misalignment of the port side lifeboat davit;
- damage to the foundation of no. 1 liferaft; and
- damage to the stairs leading to the lifeboat platform.

Figure 4: Bulging of the open deck, directly above FOT no. 2P

ANALYSIS

Aim

The purpose of a marine safety investigation is to determine the circumstances and safety factors of the accident as a basis for making recommendations, and to prevent further marine casualties or incidents from occurring in the future.

Immediate cause of the explosion

Residual fuel oils are known to produce light hydrocarbons inside their storage tank, even when they are kept at temperatures lower than their flashpoint. Vapour composition may also reach an explosive atmosphere, even when the fuel is unheated.

The heating of the fuel inside FOT no. 2P had been gradually increased, albeit kept at a lower temperature than the flashpoint of the fuel. It was not excluded that gas concentration may have increased inside the tank and the vent pipe during this time, some of which would have vented out and accumulated around the vent head of the tank.

The grinding wheel in use was of the conventional type, rather than, say, of the ceramic-type, which would have generated a lower cutting temperature. Moreover, given

that the angle grinder was operated near the vent head of FOT no. 2P, without a protective screen, spark(s) and high temperature particles emitted from the angle grinder must have reached the position of the vent head.

The safety investigation considered that spark(s) and high temperature particles[7] either passed through the mesh of the flame arrestor, or landed inside the save-all of the tank head, leading to the explosion. Oily / waxy residues on the flame arrestor (Figure 5), found after the accident may have contributed to the flame propagation at the tank's vent head and into the tank.

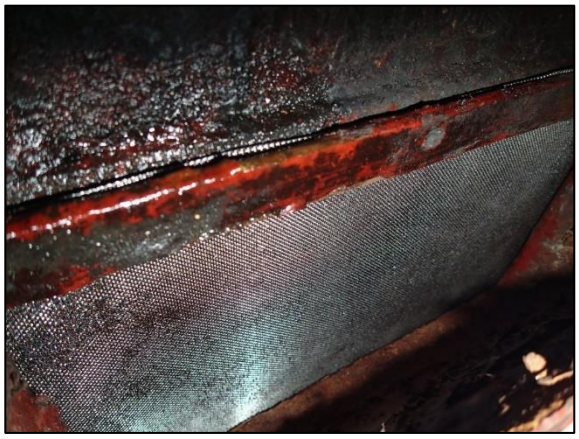

Figure 5: The flame arrestor of the vent head of FOT no. 2P after the occurrence, indicating oily / waxy residues

What followed gave clear indications to the safety investigation that an explosive atmosphere was present inside and potentially around the vent head. The subsequent flash and the ejection of flames from the vent head were signs that the gases generated by the fuel within the tank were within the flammable range. However, since a fire or subsequent explosions did not occur, it was hypothesized that not enough oxygen was present within the tank to sustain combustibility.

[7] Literature suggests that particles from the grinding wheel and the material being cut may reach a temperature of 1,100°C.

Explosive atmosphere

Fuel sample analysis reports received for the VLSFO in FOT no. 2P indicated that it had to be kept at 10°C above its pour point temperature. This prompted the chief engineer to increase the heating within the tank to 36°C (*i.e.*, 2°C higher than required).

Two days prior to arrival at the dry-docks, heating of the FOT was gradually increased to 48°C, which was well beyond the recommended storage temperature. The rationale behind this increase was that tank heating would have to be stopped during the vessel's stay in the dry-dock, although the fuel would still need to be kept at the recommended temperature; otherwise, the crew would risk the fuel becoming unpumpable.

Heating up of the fuel closer to its flashpoint must have resulted in an increased generation of gases, which would ultimately be vented to the atmosphere via the tank's vent head. It so happened that for most of 18 March 2021, the vessel was heading on a course of 204° (T), at a speed of about 12 knots. Wind was blowing from the South at a speed of 11 knots (Figure 6). This would have created an apparent wind of around 22 knots approaching the vessel at a close angle on its port side (Figure 7).

Figure 6: Wind direction relative to the vessel's heading

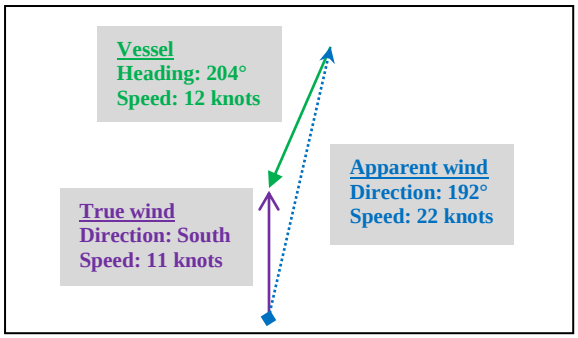

Figure 7: Sketch indicating the approximate apparent wind experienced by the vessel at the time of occurrence.

Considering that FOT no. 2P vent head was in a somewhat protected location, *i.e.*, against the port side bulkhead of the accommodation block (Figure 8), the safety investigation hypothesized that the direction of the apparent wind would have not been effective to disperse the vapours emanating from, and around the vent. One must also bear in mind that due to the motions of a vessel at sea, and the variable characteristics of the true wind itself, the direction and speed of the apparent wind would not be constant but would tend to fluctuate.

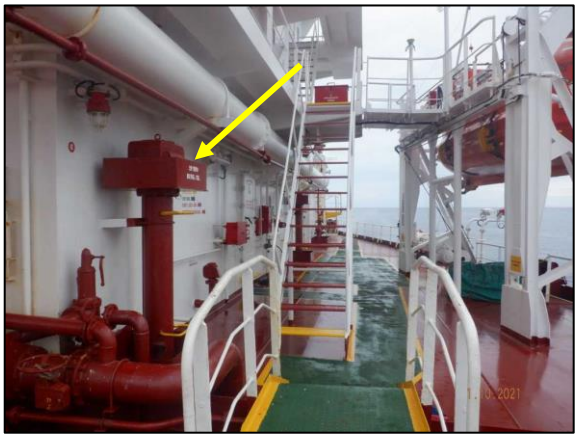

Figure 8: The vent head of FOT no. 2P against the accommodation block on port side

The safety investigation also considered the semi-protected location of the vent head, which may have led to the formation of eddies in its vicinity (Figure 9). This would have increased the risk of ignition of the vapours due to their concentration in one area. The ISGOTT[8] cautions on how eddies formed by turbulence (produced by obstructions to the wind flow), would adversely affect the effective dispersion of emitted vapours.

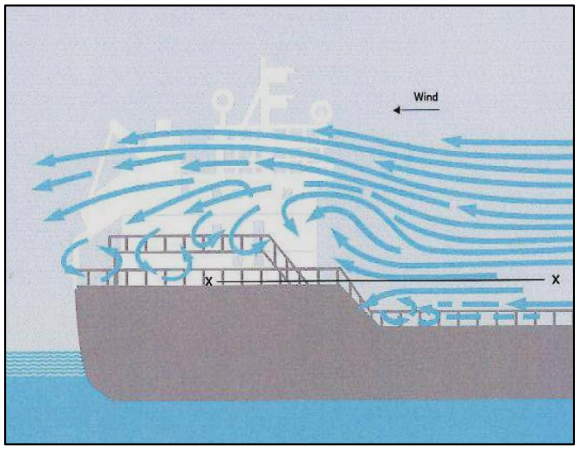

Figure 9: Typical pattern of airflow around the accommodation block

Source: Oil Companies International Marine Forum (OCIMF) (2020). *International safety guide for oil tankers and terminals (ISGOTT)* (6th ed.). London: Author.

Acceptance of risk

The vessel was due to arrive at the dry-dock facility on the morning of 19 March 2021. The riding team was given the task to remove the deck ramps for inspection and maintenance at 0800 of 18 March 2021. Prior to breaking for dinner, the foreman technician had one last ramp to remove, which remained secured by two, heavily corroded bolts.

The technician resumed his task around 1800. Having tried with an impact wrench, smaller sized spanners, and a chisel, he was unable to remove the last two bolts. Eventually, their hexagonal shape was rounded, making it even more difficult to undo them.

The technician, aware that the next day the vessel would be busy in the dry-dock, wanted to expedite the job's completion. Therefore,

[8] OCIMF (2020). *International Safety Guide for Oil Tankers and Terminals (ISGOTT)* (6th ed.). London: Author.

he took an angle grinder from one of the workshops, with the intention of cutting off the two remaining bolts (Figure 10).

At the vessel's location, the sun was setting on the horizon at around 1815 and daylight would have been reducing considerably. This might have also prompted the technician to find a quick solution to the issue at hand prior to sunset.

Figure 10: One nut had been successfully cut by the angle grinder, before the explosion occurred

The safety investigation was informed that the technician had used the angle grinder on previous occasions, on other vessels, as a last resort and when necessary, without any consequences. The decision to use the angle grinder may have been influenced by this, and all the above factors. The technician was aware that the vessel was not carrying any cargo and the cargo tanks were gas free. This may have prompted the technician to make use of the angle grinder.

Performance variability - work as imagined *vs* work as done

Procedures would dictate that, having encountered an issue (the stuck bolts) during his work, the technician would relay the same to the chief officer. Then, a hot work permit would be drawn up, which would include the preparation of the area where the hot work would be carried out (*i.e.*, cleaning of the area, taking worksite atmosphere checks, installing forced ventilation, preparing fire-fighting equipment in the vicinity, conducting a risk assessment, *etc.*). All these (time-consuming) tasks would have to be carried out while night-time was approaching.

To make it in time, before the vessel reached the dry-dock the next day and before the last few minutes of sunlight faded, the technician had no other option but to act otherwise. Banking on his experience, he took the initiative to proceed, not only because he was motivated to complete the task expected of him, but because the solution to the issue seemed to be a simple one. The cutting of corroded nuts and bolts using an angle grinder would have speeded up the process.

By using the angle grinder, the technician expected (and rightly so) that the assigned task would be executed quickly and in time. The safety investigation believes that, although the technician was aware that sparks would be generated by cutting the bolts with the angle grinder, he was unaware of the flammable gases accumulating around the vent head of the bunker tank in the vicinity.

CONCLUSIONS

1. Sparks emitted from the angle grinder reached the vent head of FOT no. 2P and an explosion occurred.
2. The VLSFO in FOT 2 P was heated up to 48°C, to maintain pumpability of the fuel during the vessel's stay in the dry dock, which resulted in an increase in the generated volume of flammable gas.
3. The safety investigation considered that spark(s) and high temperature particles either passed through the mesh of the flame arrestor, or landed inside the save-all of the tank head, leading to the explosion.

4. Oily / waxy residues on the flame arrestor (Figure 5), found after the accident may have contributed to the flame propagation at the tank's vent head and into the tank.
5. No protective screen had been erected prior to the commencement of the task.
6. The grinding wheel in use was of the conventional type, rather than, say, of the ceramic-type, which would ensure a lower cutting temperature
7. The vessel was experiencing an apparent wind of 22 knots from her port bow. This wind did not assist in the dispersion of the concentration of the flammable gas at the vent head. This suggested that the vent head was somewhat protected from this wind and/or the formation of eddies affected the dispersion of flammable gas.
8. The last two bolts on the deck ramp were heavily corroded and could not be removed with conventional hand tools.
9. The technician's decision to use the angle grinder was influenced by his willingness to finish the task in time, prior hours of darkness and the vessel's arrival in dry dock.

SAFETY ACTIONS TAKEN DURING THE COURSE OF THE SAFETY INVESTIGATION[9]

The Company had carried out the following preventative actions, following this occurrence:

- Refresher webinars were organised to emphasise the 'stop work authority' and the handling of riding teams for vessels and crew.
- A safety officer will be on board the vessel(s) whenever riding teams are employed for pre-dry-docking preparations.
- When a riding team is employed on board, the planning of jobs will be done daily, authorized by the master, and submitted to the Company for review and approval.
- Riding teams will be accompanied by the vessel's assigned safety officer who will constantly monitor the jobs.
- Safety related training material is presented to riding teams prior to their embarkation.
- A webinar on bunkering operations was delivered to relevant office and seagoing personnel.
- All superintendent engineers and relevant sea going personnel completed a refresher training on fuel handling and storage safety with particular focus on the new VLSFO properties and characteristics.
- The Fuel Management Plan was updated to include precautions on the storage and handling of VLSFO.
- The risk assessment for bunker heating was updated.
- New buildings will be equipped with closed-type vapour locks over the bunker tanks to facilitate the measurement of tank atmosphere.
- The frequency of bunker tanks' atmosphere checks was set to be carried out daily.
- The planned maintenance schedule was updated to include bimonthly inspections of the vent heads, for the removal of any accumulated oily and waxy residues.

[9] **Safety actions shall not create a presumption of blame and / or liability.**

SHIP PARTICULARS

Vessel Name:	MV *Seascout*
Flag:	Malta
Classification Society:	Lloyd's Register of Shipping (LR)
IMO Number:	9255660
Type:	Oil Tanker
Registered Owner:	Valiant Sailor Marine Inc., Liberia
Managers:	Thenamaris Ships Management Inc., Greece
Construction:	Steel
Length Overall:	243.96 m
Registered Length:	235.82 m
Gross Tonnage:	57,301
Minimum Safe Manning:	15
Authorised Cargo:	Oil in bulk

VOYAGE PARTICULARS

Port of Departure:	Khor Fakkan, U.A.E.
Port of Arrival:	Al Duqm, Oman
Type of Voyage:	Short international voyage
Cargo Information:	In ballast
Manning:	26

MARINE OCCURRENCE INFORMATION

Date and Time:	18th March 2021, at 18:33 (LT)
Classification of Occurrence:	Serious Marine Casualty
Location of Occurrence:	21° 07.14' N 059° 31.9' E
Place on Board	Main Deck
Injuries / Fatalities:	None
Damage / Environmental Impact:	Material damage – affecting structural integrity
Ship Operation:	In passage / Maintenance
Voyage Segment:	Transit
External & Internal Environment:	Southerly moderate breeze with moderate sea and a 1.5 m swell. Air temperature was 31°C and sea temperature was 27°C.
Persons on board:	32