MARINE SAFETY INVESTIGATION REPORT

Safety investigation into the serious injury on board the Maltese registered product tanker

SANTA MARIA

in position 35° 53.1’ N 014° 46.2’ E

on 24 November 2017

201711/029

MARINE SAFETY INVESTIGATION REPORT NO. 21/2018

FINAL

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Master, crew and managers of *Santa Maria*

Ship’s and Company’s certificates and documents
GLOSSARY OF TERMS AND ABBREVIATIONS

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<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td>Able bodied seafarer</td>
</tr>
<tr>
<td>Backspring</td>
<td>A mooring rope led out from forward towards the stern (forward backspring) or led out from aft towards the bows (aft backspring)</td>
</tr>
<tr>
<td>Bitts</td>
<td>Steel structures on deck around which mooring ropes are turned and secured</td>
</tr>
<tr>
<td>Bosun</td>
<td>A senior able-bodied seafarer in charge of deck ratings</td>
</tr>
<tr>
<td>Bunkers</td>
<td>Fuel used by a vessel for her main propulsion system, electricity generating plant and other machinery</td>
</tr>
<tr>
<td>DWT</td>
<td>Deadweight; the total carrying capacity of a vessel expressed in tonnes</td>
</tr>
<tr>
<td>FO</td>
<td>Fuel oil</td>
</tr>
<tr>
<td>GT</td>
<td>Gross registered tonnage</td>
</tr>
<tr>
<td>Head line</td>
<td>A mooring rope led out from the forward end and leading forward</td>
</tr>
<tr>
<td>ISM</td>
<td>International Safety Management Code</td>
</tr>
<tr>
<td>kW</td>
<td>Kilowatts</td>
</tr>
<tr>
<td>LOA</td>
<td>Length over all</td>
</tr>
<tr>
<td>LR</td>
<td>Lloyd’s Register of Shipping</td>
</tr>
<tr>
<td>m</td>
<td>Metres</td>
</tr>
<tr>
<td>MGO</td>
<td>Marine gas oil</td>
</tr>
<tr>
<td>MSIU</td>
<td>Marine Safety Investigation Unit</td>
</tr>
<tr>
<td>mt</td>
<td>Metric tonne</td>
</tr>
<tr>
<td>nm</td>
<td>Nautical miles</td>
</tr>
<tr>
<td>NT</td>
<td>Net tonnage</td>
</tr>
<tr>
<td>Panama fairlead</td>
<td>Fairlead at extreme forward end of ship on centreline</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal protective equipment</td>
</tr>
<tr>
<td>RPM</td>
<td>Revolutions per minute</td>
</tr>
<tr>
<td>SAR</td>
<td>Search and Rescue</td>
</tr>
<tr>
<td>SMS</td>
<td>Safety Management System</td>
</tr>
<tr>
<td>Spring line</td>
<td>Mooring lines leading in a nearly fore and aft direction, the purpose of which is to prevent surging of the ship while in berth.</td>
</tr>
<tr>
<td>Stern line</td>
<td>A mooring rope led out from the stern and leading aft</td>
</tr>
<tr>
<td>VHF</td>
<td>Very High Frequency (radio communication)</td>
</tr>
<tr>
<td>VTS</td>
<td>Vessel Traffic Services</td>
</tr>
<tr>
<td>Warping drum</td>
<td>Equipment used to haul in mooring ropes</td>
</tr>
</tbody>
</table>
SUMMARY

Santa Maria was alongside a vessel in Bunkering Area 3 West, about 12 nautical miles East by North from Malta’s Grand Harbour. The bosun and another crew member were tasked with the mooring operation on the forecastle deck.

At one point in time, the bosun let go of the windlass control lever and left it in the full heaving position, with the attempt to put a rope stopper on the mooring line once it was brought under full tension.

In reaching for the stopper, the bosun passed over the mooring rope, when he lost his balance, and tripped over the mooring rope, in close proximity of the warping drum. As a result of the fall the bosun’s legs got trapped between the incoming rope as well as the slack rope coming off the warping drum being handled by the deck rating and the rotating warping drum.

The bosun was immediately assisted by other crew members and was eventually air lifted from the vessel and transferred to a local hospital. The immediate cause of the accident was considered to be the crew member’s fall in close proximity to the rotating warping drum.

Taking into consideration the safety actions implemented by the Company, the Marine Safety Investigation Unit has issued no safety recommendations.
1 FACTUAL INFORMATION

1.1 Vessel, Voyage and Marine Casualty Particulars

Name: Santa Maria
Flag: Malta
Classification Society: Lloyd’s Register of Shipping
IMO Number: 7423732
Type: Product tanker
Registered Owner: SL Maria Navigation Ltd
Managers: SL Shipmanagement Co. Ltd
Construction: Steel (Double hull)
Length overall: 92.80 m
Registered Length: 83.76 m
Gross Tonnage: 2813
Minimum Safe Manning: 9
Authorised Cargo: Liquid in bulk
Port of Departure: Valletta, Malta
Port of Arrival: Valletta, Malta
Type of Voyage: Coastal voyage
Cargo Information: 2421.27 mt of MGO and FO
Manning: 14
Date and Time: 24 November 2017 at 18:50
Type of Marine Casualty: Serious Marine Casualty
Place on Board: Forecastle deck
Injuries/Fatalities: One serious injury
Damage/Environmental Impact: None
Ship Operation: Alongside moored
Voyage Segment: Arrival
External & Internal Environment: Night time, Visibility 13 nm, wind Northeasterly Beaufort force 1, low swell (Northeasterly 0.2 m), sea temperature 16 °C
Persons on Board: 14
1.2 Description of Vessel

*Santa Maria*, is a double hull oil tanker, registered in Malta and owned by SL Maria Navigation Ltd. The vessel was built by Fosen Mekaniske Verksteder AS, Norway in 1975 and is classed by Lloyd’s Register of Shipping (LR).

*Santa Maria* has a length overall (LOA) of 92.82 m, a moulded breadth of 14.51 m and a moulded depth of 9.10 m. The vessel has a summer draught of 6.83 m, corresponding to a summer deadweight (DWT) of 4,501 mt.

![Motor Tanker Santa Maria](image.png)

Figure 1: Motor Tanker *Santa Maria*

Propulsive power is provided by an 8-cylinder MaK 8M453AK, medium, speed four stroke diesel engine, producing 3,940 kW at 600 rpm. This drives a single, controllable pitch propeller, reaching a service speed of 13.0 knots.

All Statutory certificates were valid at the time of the accident.
1.3 Crew and Vessel’s Manning

Santa Maria’s Safe Manning Certificate had been issued by the flag State Administration.

Table 1 details the ship’s actual manning in relation to the minimum flag State Administration’s requirements. The Minimum Safe Manning Certificate issued by the flag State Administration required that the ship is manned with at least nine seafarers, including the master. At the time of the accident, the ship was actually manned by a total of 14 seafarers (including the master).

Table 1: Ship's actual manning compared to the Minimum Safe Manning Certificate

<table>
<thead>
<tr>
<th>Minimum Safe Manning</th>
<th>Crew List</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank</td>
<td>Number</td>
</tr>
<tr>
<td>Master</td>
<td>1</td>
</tr>
<tr>
<td>Chief Officer</td>
<td>1</td>
</tr>
<tr>
<td>OOW Navigation</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Chief Engineer</td>
<td>1</td>
</tr>
<tr>
<td>Second Engineer</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine Rating</td>
<td>1</td>
</tr>
<tr>
<td>Deck Rating</td>
<td>1</td>
</tr>
<tr>
<td>Deck Rating</td>
<td>1</td>
</tr>
<tr>
<td>Deck Rating</td>
<td>1</td>
</tr>
<tr>
<td>Deck Rating</td>
<td>1</td>
</tr>
<tr>
<td>Engine Cadet</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
</tr>
</tbody>
</table>
The master was a Maltese national, with the remaining deck officers being Georgian nationals. All the engineers were Egyptians, except for the third engineer, who was a Latvian national. The deck and engine-room ratings were Egyptian, Russian, Georgian and Ukrainian nationals.

1.3.1 The injured crew member
The injured crew member was serving as a bosun on board *Santa Maria*. The bosun, who was 47 years old, had been in the Company’s employment for approximately five years. He was a Russian national and had served several tours of duty on *Santa Maria* as well as on other Company-managed vessels on several occasions.

Documents available on board indicated that his last formal familiarisation training on board had taken place on 04 September 2017, *i.e.* when he had last joined the ship.

1.4 The Forward Mooring Station
The forward mooring station is situated on the forecastle deck. Figure 2 shows the mooring equipment layout.

![Figure 2: Forward mooring station](image_url) (mooring lines are for reference only and are not representative of the actual mooring lay-out at the time of the accident)
The layout is fairly standard and consists of one hydraulically-driven anchor windlass, driving two anchors and two warping drums on either side, which can be engaged and disengaged manually. There is a ‘Panama’ fairlead forward and three additional fairleads on port and starboard sides. There are three mooring bitts on port side and on starboard side and, additionally, two ‘dead man’ roller fairleads mounted low to the deck abaft of, and in line with, the respective warping drums. Overall, the arrangement is symmetrical.

Inspection of the area shortly after the accident had occurred, revealed a generally clean, oil-free deck that was provided with a satisfactory lighting arrangement.

1.4.1 The mooring winch
The mooring winch forward is a standard hydraulic anchor windlass with two warping drums at each end, which can be engaged or disengaged as required. The operating lever is situated behind the winch and is operated from a raised platform. From this position, the operator would have a good all-round visibility of the mooring area.

Pushing the lever forward rotates the drum in a counter-clockwise direction, whilst pulling back on the lever will rotate the drum in a clockwise direction. Once the lever is operated, however, it sticks in that same position and does not fall back to neutral.

The mooring winch start/stop buttons are located below the forecastle deck and there is no easily accessible emergency stop provided on deck.

1.4.2 Typical mooring operations
The forward mooring station is normally manned by a team of either two persons (which would include the bosun as the person in charge and carrying a hand-held radio to communicate with the bridge and an assisting AB), or three persons (consisting of the third officer as person in charge, the bosun and an AB).

When the mooring operation is being done by a team of two persons (as the occurrence in question), the bosun would operate the mooring windlass lever, whilst the assisting AB would handle the mooring ropes directly. A typical mooring operation cycle would see the AB running the mooring rope as per bosun’s instructions and then turning it on the warping drum. The bosun would then operate
the mooring winch, with the AB handling the slack end being recovered and coiling it loosely on deck.

Once the bosun deems that the appropriate tension on the mooring rope has been reached, he would stop heaving by adjusting the control lever into neutral (vertical) position, leave the mooring winch control, proceed to the respective mooring bit and apply a rope stopper to the mooring rope. The AB would then take the mooring rope off the warping drum and lay the rope over the respective mooring bitts. The bosun would then undo the rope stopper. This process is then repeated for all the mooring ropes.

1.5 Environment

The accident happened during night time. Visibility was reported to be 13 nautical miles (nm). The wind was from the Northeast, Beaufort force 1. The Northeasterly swell was low (0.2 m). Sea temperature was recorded at 16 °C, whereas the air temperature was 22.5 °C.

1.6 Narrative

Santa Maria arrived alongside MSC Agadir in Bunkering Area 3 West in position 35° 53.1’ N 014° 46.2’ E, about 12 nm East by North from the Grand Harbour, Valletta. The ship had already run out and secured two headlines and one spring forward. Down aft, she had run out two stern lines and a spring. The ship was settled safely alongside the other vessel.

At about 1845, a third and last headline was run out to the other vessel. This mooring rope was led out through the ship’s ‘Panama’ fairlead. The line was then led on the outside of the forward-most set of bitts on starboard side, through the next set of bitts, and round the starboard side dead man roller fairlead and back again to the starboard warping drum. The mooring rope was run under the drum and turned three times for adequate friction and pull.

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1 Unless otherwise stated, all time are local (UTC +1).
The bosun was in control of the windlass and stood on the windlass platform, in control of the operating lever. The AB was standing further to starboard, behind the bosun’s right shoulder and out of the mooring rope’s bight. He was handling the rope, pulling in the slack end and coiling it loosely out of the way. In order to heave up the rope, the bosun was pushing the operating lever forward, thus getting the warping drum to operate in a counter-clockwise direction (when viewed from starboard side).

At some point, when tension on the incoming rope started to increase, the bosun let go of the operating lever and left it in the heaving position and with the warping drum still rotating and the mooring rope still coming in. He then attempted to cross over the mooring rope in order to get to the bitt, where the rope was planned to be turned and to stop the rope for the AB to turn. However, as he attempted to cross over (Figure 3), he fell across the mooring rope and within instants he got trapped between the mooring rope and the still rotating warping drum (Figure 4).

The MSIU could not determine with certainty whether the bosun actually tripped over the incoming rope, slipped, or fell off the platform on which he was standing. Regardless, he ended up on top of, and across both the incoming rope (bottom of warping drum) as well as the slack rope (coming off the top of the warping drum) which was being handled by the AB. As a result, the bosun’s legs got trapped between the incoming rope as well as the slack rope coming off the warping drum being handled by the deck rating and the rotating warping drum.
Figure 3: Re-construction of the accident (red arrow indicates bosun’s movement and yellow arrows indicate direction of travel of the mooring rope)
It was not clear for the safety investigation as to what happened during the moments that followed. Evidence indicated that the AB quickly pulled the winch operating lever to neutral. However, by this time, the bosun had already been helplessly swung round the warping drum at least once, legs trapped between the mooring rope and drum. Within a very short time of the AB shouting for help, other crew members arrived on the forecastle, to find the bosun trapped and hanging over the top of the warping drum, facing down. The mooring rope was quickly released, the bosun freed and lowered on deck.
At 1853, the accident was reported to the VTS on VHF Channel 12. Emergency assistance was requested. The Company was also notified of the matter. Approximately 18 minutes later, a helicopter arrived on scene in preparation for the evacuation of the injured crew member. In view of the situation with two vessels alongside, the helicopter requested that *Santa Maria* casts off the other vessel prior to the evacuation operation.

Whilst *Santa Maria* made the necessary preparations to cast off, the helicopter returned to base to refuel. By 2125, the helicopter was back on the accident scene and two rescuers were lowered on deck. First aid was administered and the necessary preparations finalised to lift the injured crew member. At 2145, the evacuation was completed and the injured crew member was transported to the hospital for more specialised treatment to his injuries. *Santa Maria* was able to go alongside again and resume the bunkering operation.

1.7 **Injuries Suffered by the Crew Member**

Upon being admitted to hospital, the injured crew member was unable to elicit a clear description of what had occurred. However, he was alert, though exhausted. Injuries to both lower limbs were observed, with a large laceration on the right shin, exposed bone on the left heel and various other abrasions and friction burns on both legs.

Over the course of several days, he was subjected to various tests, treatments and interventions and eventually he was discharged from hospital on 12 December 2017, with a post-hospital treatment plan.
2 ANALYSIS

2.1 Purpose

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

2.2 Hours of Rest

Records held on board indicated that as at the time of the accident, the bosun had had 14.5 hours of rest during the preceding 24-hour period (and 15.5 hours of rest during the preceding 25-hour period). This rest period had been split in three parts; the first period lasted three and a half hours, the second period lasted nine hours and the third period lasted three hours. His total rest period during the preceding seven-day period was 106 hours.

The safety investigation did not come across evidence which suggested that fatigue was a contributing factor to this accident.

2.3 Personal Protective Equipment

Evidence indicated that at the time of the accident, the bosun was wearing the appropriate personal protective equipment that would typically be worn at mooring stations.

2.4 The Number of Seafarers at the Mooring Station and Assessment of Risks

The way the accident dynamics developed would suggest that the crew member had accepted a certain degree of risk during the mooring operation.

Making reference to the Code of Safe Working Practice for Merchant Seafarers, it is stipulated that “during mooring and unmooring operations, a sufficient number of seafarers should always be available...to ensure a safe operation”. It continues that “[w]hen moorings are to be heaved on a drum end, the winch operator must have a full view of the activity.”
Whilst there are no hard and fast rules as to how mooring operations are to be carried out, it is often standard industry practice to have a minimum of three persons at mooring stations. One typical three-man cycle may involve the following processes: person ‘A’ operates the winch, person ‘B’ handles the mooring rope and person ‘C’ assists behind person ‘B’. Once the required tension on the mooring rope is achieved, person ‘A’ stops heaving, person ‘C’ applies the stopper, person ‘A’ gives some slack, person ‘B’ takes the mooring rope of the warping drum and turns the mooring rope on the bitts and finally, person ‘C’ removes the stopper.

As stated elsewhere, the forward mooring operations on Santa Maria were typically carried out either by three persons (the third mate, bosun and an AB) or two persons. On this occasion, there were only two persons; the bosun and an AB. The bosun and the AB involved in the accident had been working together as a team for around 25 days. In this case, the practice on board the ship was to have the bosun operate the windlass, being the senior and the more experienced person of the team. The AB would then handle the end of the mooring rope coming off the warping drum.

At some point, however, a stopper had to be applied and the practice was for the bosun to put the winch operating lever in neutral and to proceed to the respective mooring bitt to put a stopper on the rope, leaving the winch operating lever unattended. The mooring operation had become more or less routine as the mooring configuration was repeated on most occasions, either on port side or starboard side (but, more frequently, on the port side).

Notwithstanding the above, it would have still been challenging for the crew members to achieve safety. The safety investigation believes that the bosun had an excessive workload, which necessitated him to leave the operation of the winch.

It was the MSIU’s concern that the actual number of crew members at the forward mooring station may have been the result of ‘production pressure’ at the cost of safety, albeit not intended. The concern of the safety investigation was that the crew members on board found themselves in a situation where they had to trade thoroughness with efficiency. It would appear that ‘circumstances’ (such as, ensuring that the vessel is made fast alongside in order to start the bunkering operation)
eventually took higher priority over safety. If not, then the bunkering operation would have been delayed.

The MSIU believes that this trade-off may have also been the result of past, similar, successful mooring operations.

2.5 The Bosun’s Actions

Whenever the mooring team consisted of only two persons, the practice was to pick up slack on the mooring rope and, when there was sufficient tension, the winch operating lever would be put in neutral and then left unattended whilst a stopper was being applied to the mooring rope and the rope turned on the respective bitts. On this occasion, not only was the operating lever left unattended, but it was actually left in the heaving position, with the warping drum rotating and the mooring rope still being heaved in.

Moreover, the bosun did not walk all the way around the mooring rope in order to get to the mooring bitt, but attempted to cross over the mooring rope that was being heaved in. This action put him both in the bight of the rope under tension (and the snap-back zone), but also in the direct line of the dead man roller around which the same rope was being led. More crucially, this action put him within a very short distance from the rotating warping drum, which was left unattended. It is very probable that the short cut to cross the mooring rope was chosen because the bosun was aware that the lever was being left in the operating position and therefore he had to attend to the mooring rope without any delays.

Such adaptations are very normal in safety critical domains. Studies have shown that adaptations are normally carried out in a way that would fit the person best and which would not have been necessarily anticipated prior to their happening. The adaptation by the bosun (leaving the lever in the operating position whilst working the rope) was actually an approach to suit his demands and is more commonly known as ‘task tailoring’. In actual fact, rather than circumventing the system, the safety investigation sees this as a coping behaviour related to workload management.
The bosun’s action is suggestive of a local adaptation (on the mooring platform), to ensure global success (execution of the bunkering operation), to bridge (goal) conflicts which he encountered in his work environment.

His was only a coping response to a situation which necessitated him to work in the close proximity of the safety envelope boundary.

2.7 Other Findings

The ship’s Safety Management System addresses mooring operations and also referred to standard industry publications that were to be consulted, including the Code of Safe Working Practices for Merchant Seafarers.

It has to be highlighted that the Code of Safe Working Practices for Merchant Seafarers states that “[o]wing to the design of mooring decks, the entire area should be considered a potential snap-back zone…[t]he painting of snap-back zones on mooring decks should be avoided because they may give a false sense of security.”

It was noticed, however, that the SMS procedure referred to, and gave examples of potential snap-back zones being painted as sectors on the mooring deck. Indeed, a number of potential snap-back zones were noticed, painted on the ship’s mooring deck. No warning signs were posted at the entrance to the mooring station, which is now being considered in the industry as a potential snap-back zone in its entirety.
THE FOLLOWING CONCLUSIONS AND SAFETY ACTIONS SHALL IN NO CASE CREATE A PRESUMPTION OF BLAME OR LIABILITY. NEITHER ARE THEY LISTED IN ANY ORDER OF PRIORITY.
3 CONCLUSIONS

Findings and safety factors are not listed in any order of priority.

3.1 Immediate Safety Factor

.1 The immediate cause of the accident was considered to be the crew member’s fall in close proximity to the rotating warping drum.

3.2 Latent Conditions and other Safety Factors

.1 The crew member had accepted a certain degree of risk during the mooring operation;

.2 The actual number of crew members at the forward mooring station may have been the result of ‘production pressure’ at the cost of safety, albeit not intended;

.3 The crew members on board found themselves in a situation where they had to trade thoroughness with efficiency;

.4 Circumstances’ (such as, ensuring that the vessel is made fast alongside in order to start the bunkering operation) eventually took higher priority over safety;

.5 This trade-off may have also been the result of past, similar, successful mooring operations;

.6 The operating lever was left unattended and in the heaving position, with the warping drum rotating and the mooring rope still being heaved in;

.7 The adaptation by the bosun (leaving the lever in the operating position whilst working the rope) was actually an approach to suit his demands, commonly known as ‘task tailoring’, related to workload management.
3.3 Other Findings

.1 The safety investigation did not come across evidence which suggested that fatigue was a contributing factor to this accident;

.2 The bosun was wearing the appropriate personal protective equipment that would typically be worn at mooring stations.
4 ACTIONS TAKEN

4.1 Safety Actions Taken During the Course of the Safety Investigation

The Company has implemented several safety actions on all its fleet during the course of the safety investigation:

- Organising further training to crew designated for mooring operations and reporting of equipment problems;
- Revision in the number of crew members on the forward and aft mooring stations;
- Assigning of a deck officer in charge of each mooring team;
- Enhanced means of communication to each mooring team;
- Application of anti-slip paint at each mooring station;
- Enhanced maintenance regime with respect to the mooring equipment; and
- Distribution of a Fleet Circular to compliment the Mooring Operations Procedure within the Company’s SMS.

5 RECOMMENDATIONS

In view of the safety actions taken by the Company, no recommendations have been made.