



**The Bahamas
Maritime Authority**

THE COMMONWEALTH OF THE BAHAMAS

M.V. Tropical Star

IMO Number: 8408894

Official Number: 8000369



**Report of the marine safety investigation into a
crew fatality on a refrigerated cargo vessel
on 15 June 2019**

M.V. Tropical Star – Marine Safety Investigation Report

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Bahamas Maritime Authority
120 Old Broad Street
LONDON
EC2N 1AR
United Kingdom

The Bahamas Maritime Authority

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1 GLOSSARY OF ABBREVIATIONS AND ACRONYMS

AB	Able Bodied Seaman
BMA	Bahamas Maritime Authority
CCTV	Closed-Circuit Television
No.	Number
OS	Ordinary Seaman
PMS	Planned Maintenance System
SMS	Safety Management System
UTC	Universal Time Coordinated

All times noted in the report are in the style of the standard 24-hour clock without additional annotation and as local time in Davao City, Philippines, which was UTC +8. The CCTV footage was received from the Davao port and the timestamp in the footage is 9 minutes behind the actual time.

2 SUMMARY

- 2.1 On 13 June 2019 the vessel arrived at port Davao, Philippines and commenced the loading operation. The testing of the proximity switches of the cranes was due in June 2019 as per the vessel's Planned Maintenance System (PMS). On 15 June 2019, the Chief Officer tasked the Second Officer to test the proximity switches of the cranes while the Stevedores were on lunch break and the cargo operation was suspended.
- 2.2 The mechanical limit switches on the cranes were replaced with the proximity switches in May 2019. The last test of the mechanical limit switches was carried out in March 2019. The PMS requirement for testing the limit switches was at every 200 running hours of the cranes. Although the mechanical limit switches were replaced with the proximity switches, the PMS records were counting the running hours of the cranes since the last limit switch test (March 2019) and showed the test due date as June 2019.
- 2.3 The Second Officer tasked duty Able-bodied Seaman (AB) and Ordinary Seamen (OS) to test the proximity switches of the cranes. No risk assessment was conducted before commencing the work activity. The duty AB and OS successfully tested the proximity switches of crane no. 1, 2 and 4. Crane no. 3's hook was connected to a spreader¹ attached to a container placed on the deck. The testing of the proximity switch of crane no. 3 required two personnel to disconnect the hook of the crane from the spreader and a third person to operate the crane to test the proximity switch. The AB and OS were tasked to disengage the hook and the Bosun was tasked to operate the crane.
- 2.4 The Bosun accessed the crane cabin using the outside vertical ladder of the crane. The AB and OS used the outside ladder to access the crane mast house and then climbed on to the spreader to access the crane's hook. None of the crew members had any personal fall prevention device and the vertical ladders did not have any fall prevention structure installed to them. The AB and OS disconnected the hook and the Bosun heaved up the crane to test the proximity switch. The switch was successfully tested and the crane hook was lowered and connected back to the spreader.
- 2.5 The AB and OS climbed back to the crane mast house after connecting the crane hook. The Bosun started to descend the outside vertical ladder and while descending the ladder, the Bosun fell from a height of 8.54 meters to the ship's deck.
- 2.6 The Bosun was put on the ship's stretcher and evacuated to the hospital near the port. The Bosun was then transferred to a hospital in Davao city, where he was announced deceased.

¹ A container spreader is a device used for lifting containers.

3 DETAILS OF THE INVOLVED VESSEL(s) AND OTHER MATTERS

3.1 Details of the vessel

3.1.1 M.V. Tropical Star is a refrigerated cargo vessel built in Hanjin Heavy Industry Co. Ltd. Busan, Korea in 1986.

3.1.2 The vessel had the following principal particulars:

Call sign	C6FR8
IMO number	8408894
MMSI number	311 087 000
Built	1986
Length between perpendiculars	141.3 metres
Breadth	24.51 metres
Depth moulded	12.97 metres
Propulsion power	10780 kW
Gross registered tonnage	9749 tonnes
Net registered tonnage	5841 tonnes
Type	Refrigerated Cargo Vessel

3.1.3 At the time of the incident, the vessel was technically managed by Reefership Marine Services Ltd.

3.2 Vessel Certification

3.2.1 M.V. Tropical Star was first registered with the Bahamas Maritime Authority (BMA) on 12 December 2001 and was classed with DNV GL Classification Society. At the time of the incident, the vessel complied with all statutory and international requirements and certification.

3.2.2 The vessel was subjected to a Bahamas Maritime Authority Annual Inspection at the Port of Davao, Philippines on 17 May 2019. No deficiencies or observations were identified.

3.3.3 The vessel had a Port State Control Inspection at the Port of Davao, Philippines on 16 May 2019 with no deficiencies identified.

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GENERAL ARRANGEMENT M. V. "TROPICAL STAR"

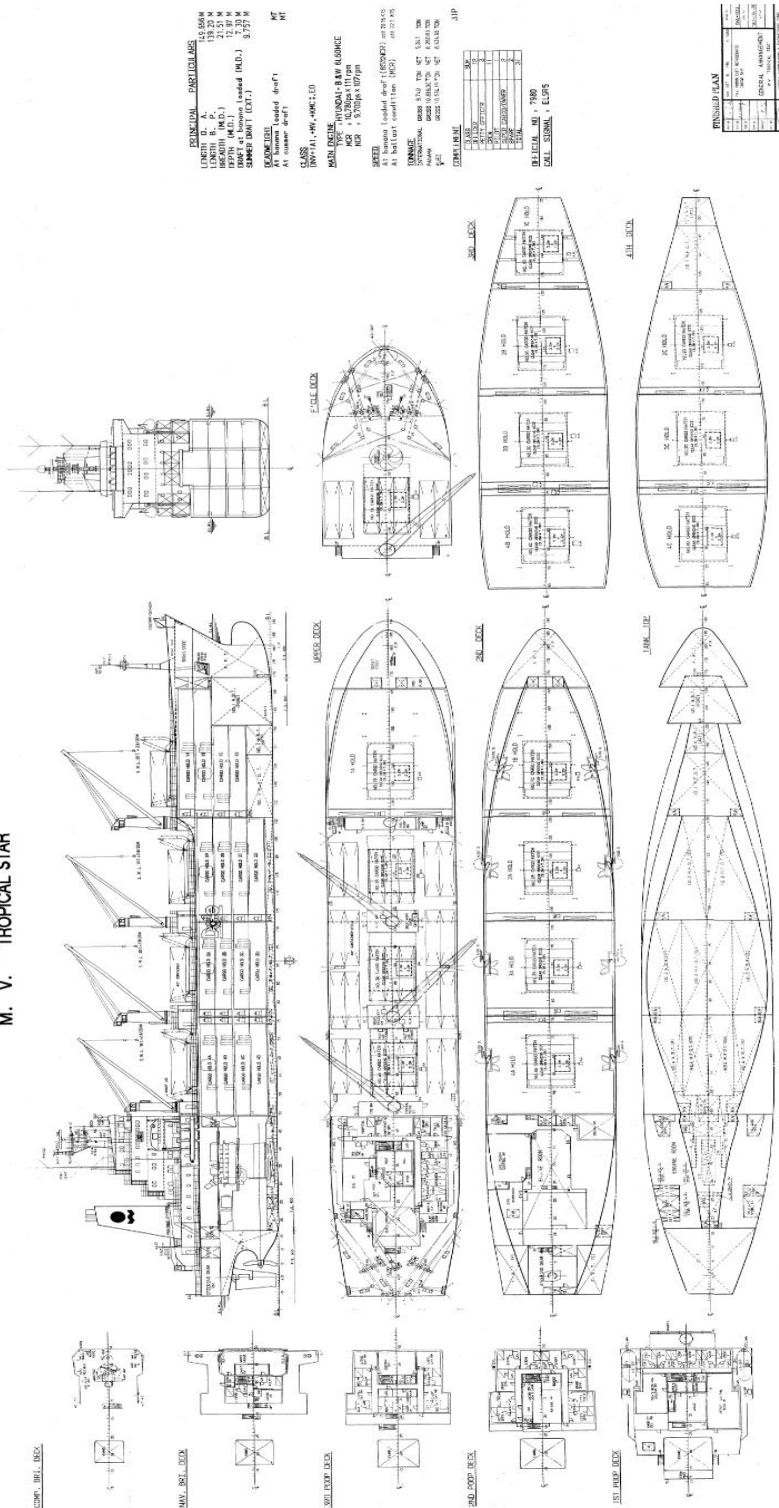


Figure 1: M.V. Tropical Star general arrangement plan

3.3 Crane's mechanical limit switch, proximity switch and testing method

- 3.3.1 The mechanical limit switch and proximity switch on a crane are the safety devices designed to prevent the over-travel of a crane hoist.
- 3.3.2 The mechanical limit switch usually has a mechanical arm with a roller and electromechanical mechanism that activates the switch to interrupt power to the crane motor.



Figure 2: Typical mechanical limit switch

- 3.3.3 The proximity switch sensor detects the crane hoist movement to set limit without any physical contact and stops the hoist movement.



Figure 3: Typical proximity switch

- 3.3.2 To test the working of a mechanical limit switch or a proximity switch, the crane is hoisted up to the set limit and once the crane hoist movement cut off, the test is completed.

4 NARRATIVE OF EVENTS

- 4.1 The morning of 13 June 2019 the vessel arrived at port Davao, Philippines and was all fast at 0812 and commenced loading operation shortly after.
- 4.2 On 15 June 2019 at 0800 hours the Chief Officer tasked the Bosun to remove, clean and install the wire mesh filters of the cargo hold fresh air fans using the high-pressure washing machine on the poop deck.
- 4.3 At 1200 hours, the Chief Officer tasked the Second Officer to test the proximity switches of the cranes as part of the Planned Maintenance System (PMS) requirements.
- 4.4 During that time, the Stevedores were on lunch break and no cargo operation was taking place. The Second Officer instructed the duty AB and OS to test the proximity switch of the cranes.
- 4.5 The duty AB and OS tested the proximity switches of crane 1, 2 and 4.
- 4.6 As the hook of crane no. 3 was connected to a container spreader attached to a container placed on deck, the AB and OS needed the assistance of additional deck personnel to operate the crane to test the switch, while they could unhook the crane from the spreader.



Figure 4: Location of the hook of Crane no. 3

- 4.7 At around 1325 hours, the Second Officer asked the Bosun to assist the AB and OS to test the proximity switch of crane no. 3. The Second Officer asked the Bosun to operate the crane and AB and OS were tasked to unhook the crane no. 3 from the container spreader.
- 4.8 At 1330 hours the Bosun went up the crane cabin using the outside vertical ladder and the OS headed towards the spreader, followed by the AB.

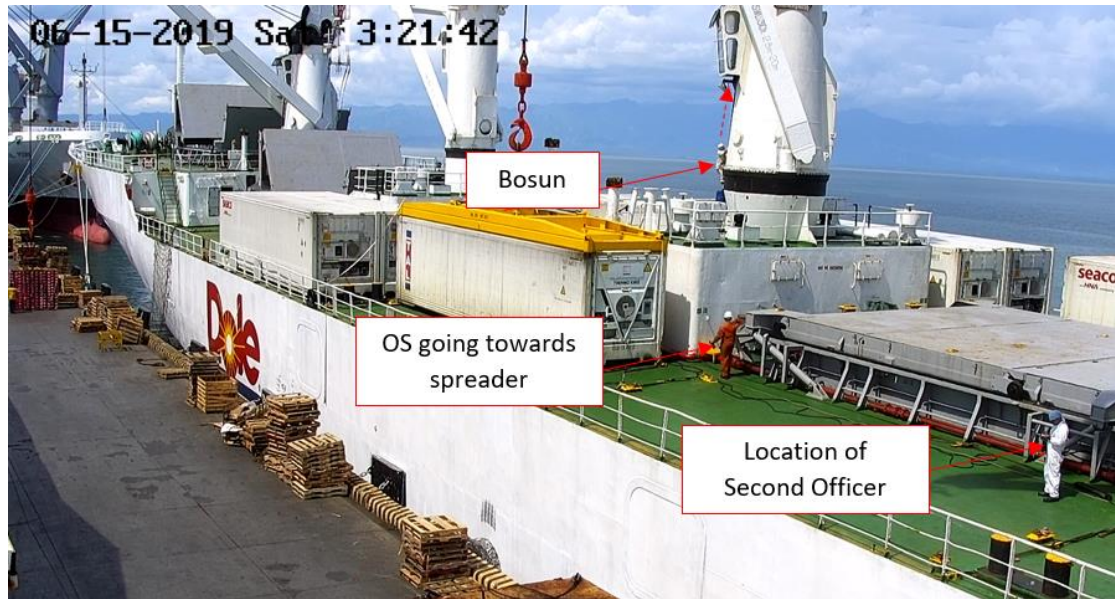


Figure 5: CCTV footage screenshot of Bosun climbing up the outside vertical ladder and OS going towards the spreader



Figure 6: CCTV footage screenshot of AB going towards the spreader

- 4.9 The OS and AB climbed over from the crane mast house to the top of the spreader to access the crane hook.



Figure 7: CCTV screenshot of OS climbing over from the crane mast house to the top of the spreader



Figure 8: CCTV screenshot of AB climbing over from the crane mast house to the top of the spreader

- 4.10 At 1331 hours the Bosun lowered the crane hook and the AB and OS unhooked the crane from the container spreader.



Figure 9: CCTV footage screenshot of AB and OS unhooking the crane no. 3 from the container spreader

- 4.11 The crane was unhooked from the container and the hook was hoisted up to test the proximity switch of the crane. The Second Officer left the vicinity and went towards the gangway.



Figure 10: CCTV footage screenshot of Second Officer leaving the vicinity and going towards the gangway

- 4.12 The proximity switch was checked and was found working satisfactorily. The hook was lowered back again and at around 1335 hours the AB and OS connected the hook back on the container spreader.
- 4.13 The Bosun heaved up the crane back to the stowage position and turned off the crane's motor. The AB and OS climbed back to the crane mast house over the crane mast house railing.



Figure 11: CCTV screenshot of OS climbing on to the crane mast house over the crane mast house railing



Figure 12: CCTV screenshot of AB climbing on to the crane mast house over the crane mast house railing

- 4.14 Moments later the Bosun came out of the crane cabin and climbed upwards for a few steps on the ladder and then commenced to descend the ladder. From the evidence available during the investigation, it could not be determined why the Bosun took a few steps upward on the ladder before he commenced his descent.
- 4.15 While descending the ladder, the Bosun fell from a height of 8.54 meters on to the ship's deck, in between the cargo hold and crane structure.

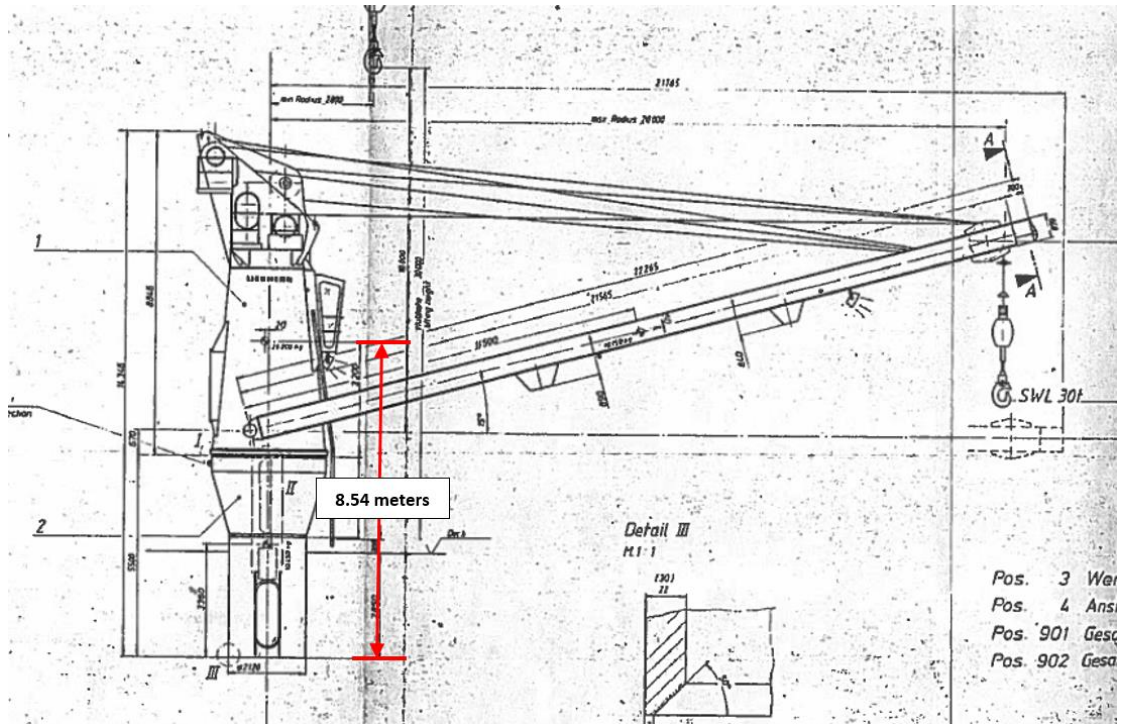


Figure 13: Bosun's fall distance from crane cabin to the ship's deck

- 4.16 At around 1340 the Bosun was put on the ship's stretcher and evacuated to the hospital near the port. Later the Bosun was transferred to another hospital in Davao, where he was announced deceased.

5 ANALYSIS AND DISCUSSION

5.1 Accessing the crane cabin

- 5.1.1 The crane had two access ladders to the crane cabin; one from inside the crane structure and one from outside.

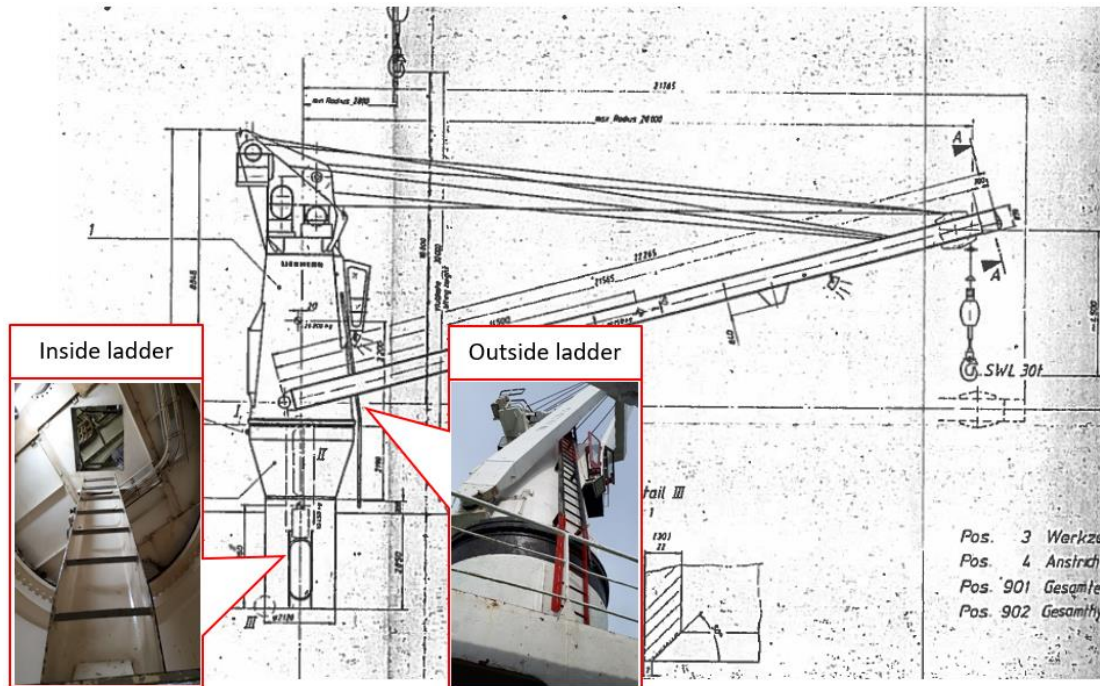


Figure 14: Location of the inside and outside crane access

- 5.1.2 The inside crane access was divided into three platforms with vertical ladders connecting each platform and providing access from ship's deck to the crane cabin.
- 5.1.3 The outside vertical ladder provided access from the crane mast housetop to the crane cabin while the mast house had another vertical ladder providing access from crane mast housetop to the ship's deck.



Figure 15: Crane no. 3's mast house vertical ladder

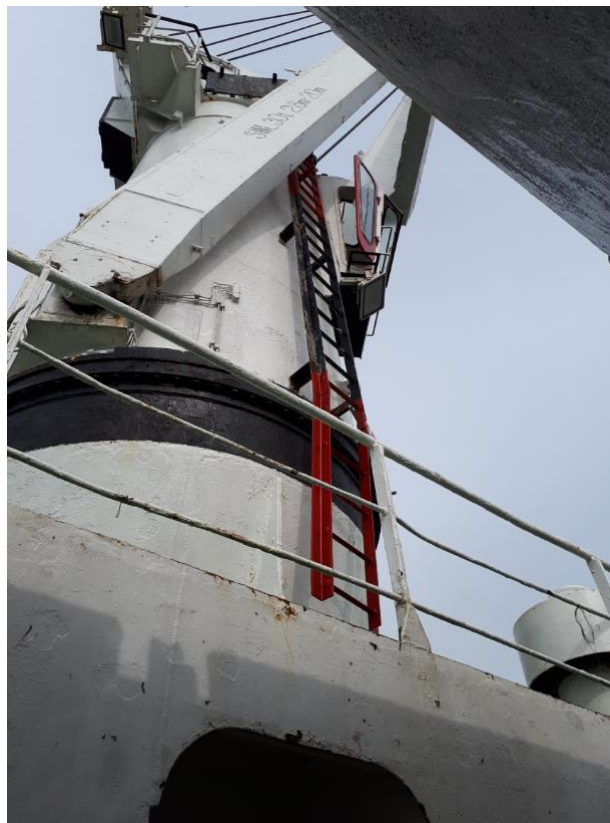


Figure 16: Outside vertical ladder (used by Bosun to access crane cabin)



Figure 17: Inside ladder access to crane cabin

- 5.1.4 As per the crane technical manual the outside vertical ladder is the ladder for emergency descent.

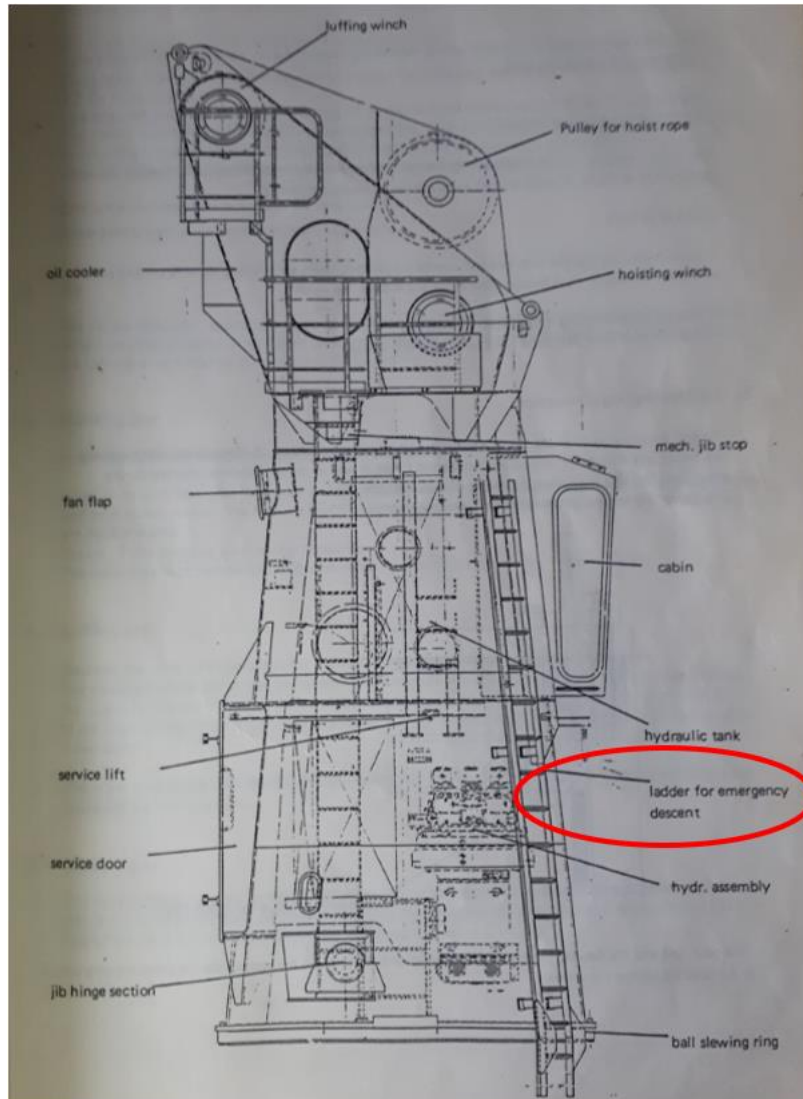


Figure 18: Scan of the crane drawing from the technical manual

- 5.1.5 The ship's crew was aware of both access ladders. However, the outside vertical ladder was usually used to access the crane cabin by the crew and the Stevedores.
- 5.1.6 The outside vertical ladder had a height of 8.54 meters from the ship's deck and 5.39 meters from the crane mast housetop. The vertical ladders onboard did not have any protection structure (such as a safety cage) or any fall prevention mechanism as part of the ladder structure design. Also, no fall prevention device was used by the crew members or Stevedores while using the outside vertical ladder to access the crane cabin. Neither the Flag State regulations nor the Company's² SMS procedure(s) stipulates any requirement to have protection structure incorporated as part of the ladder structure design or the crew members to use any personal fall prevention device.

² As per the ISM code section 1.1.2 "Company" means the Owner of the ship or any other organization or person such as the Manager, or the Bareboat Charterer, who has assumed the responsibility for operation of the ship from the Shipowner and who on assuming such responsibility has agreed to take over all the duties and responsibility imposed by the Code

5.2 Inadequate hazard identification and risk assessment

- 5.2.1 The crane no. 3 was connected to a container spreader attached to a container placed on deck and it required two personnel (AB and OS) to disconnect the crane hook. Hence to test the proximity switch of the crane, the Bosun was tasked to operate the crane while AB and the OS disconnected the crane hook from container spreader.
- 5.2.2 Both AB and OS used the outside vertical ladder of crane mast house to climb up the mast housetop. The height of the crane mast housetop from the deck was 2.85 meters.
- 5.2.3 While accessing the container header the AB and OS climbed over from the crane mast house to the top of the spreader. The Second Officer was on watch at that time and was present on deck when the crew members were climbing on to the spreader from the crane mast house.



Figure 19: CCTV screenshot of OS climbing over from the crane mast house to the top of the spreader



Figure 20: CCTV screenshot of AB climbing over from the crane mast house to the top of the spreader

- 5.2.4 After completion of the test, the AB and the OS connected the hook of the crane back to the spreader and climbed back to crane mast over the crane mast house railing (Figure 11 and Figure 12). The Bosun accessed the crane using the outside vertical ladder and was using the same ladder to descend on completion of the work activity.
- 5.2.5 The OS and AB were exposed to the fall hazard at various instances while climbing on the container top and on the crane mast house ladder without any fall prevention safety measures in place. However, these hazards were not identified and mitigated by the crew members or the Second Officer on deck.
- 5.2.6 The risk assessment and toolbox talks/safety briefs are the tools to identify the hazards and risks to establish appropriate safeguards to eliminate or reduce the potential risk involved in a work activity. The company's SMS procedure for conducting risk assessment states: *'The following tasks and situations will require a Risk Assessment to be undertaken:
Any task that, at immediate appraisal, presents a risk of injury, death, damage to the vessel, other property and/or environment, whether a checklist exists or not.
Routine or non-routine work involving heavy equipment, cranes, loads, polluting or hazardous materials, electrical installations, overside or aloft work, hot work, or maintenance of critical machinery.....'* However, no risk assessment was carried out before commencing the work activity involving operation of the crane to test the proximity switch. Also, no toolbox talk or safety brief was conducted with all three personnel involved in the testing of the proximity switch, before commencing the work activity.
- 5.2.7 The International Safety Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code) section 1.2.2.2 requires *'Safety-management objectives of the Company should, inter alia; assess all identified risks to its ships, personnel and the environment and establish appropriate safeguards.'* The Company's SMS procedure for emergency preparedness states: *'There are many Key Operations on board - on the bridge, in the*

engine room, on deck – which although they are performed day in and day out are still Critical Operations, which have the potential of creating a hazard for the ship and or the crew. Familiarity can lead to contempt, and we have therefore, together with personnel on board, created CHECKLISTS and STANDING INSTRUCTIONS³ covering many routine shipboard procedures. As with the airline business, a Checklist must always be referred to when carrying out a procedure, which it covers, and Standing Instructions must always be complied with.’ The Company’s SMS does include a checklist for ‘working overside/aloft’ which requires the crew members to examine and check equipment such as bosun’s chair, stages, gantlines, safety harnesses⁴, lifelines etc to be in good order for usage. However, the SMS does not provide any procedure or checklist for work activities that may involve risk of fall from height⁵ such as accessing the crane cabin using the outside vertical ladder of 8.54 meters height.

5.3 Lack of training for crane operation

- 5.3.1 The ship’s crew access the crane for conducting routine work activities while at sea and conducting tests such as a limit switch test. While at the port, the cranes are operated by the Stevedores to carry out the cargo operation for loading or discharging the containers.
- 5.3.2 The ship’s crew did not have any formal training in crane operations and relied on the crew member’s experience for operating the crane to conduct any work activity involving the operation of the crane.

5.4 Crane’s proximity switch testing procedure

- 5.4.1 The cranes were fitted with mechanical limit switches, which were replaced with the proximity switches in May 2019.
- 5.4.2 The PMS requirement for limit switch testing was 200 running hours of the crane. The running hours of the crane in May 2019 were not available to the investigation team at the time of the incident.
- 5.4.3 The last mechanical limit switch test was conducted in March 2019 and the running hours of the crane in March 2019 were 30284 hours. Although the new proximity switches were installed in May 2019, the PMS was counting the crane running hours since March 2019 and recorded the total running hours in June 2019 as 30484 hours. As the total running hours as per PMS records were 200 hours since March, it showed the due date for the proximity

³ Standing instructions are the key procedures in the Company’s SMS

⁴ The vessel had 15 full body harnesses onboard at the time of incident.

⁵ As per the United Kingdom Maritime and Coastguard Agency’s Code of Safe Working Practices for Merchant Seafarers 2015 edition section 17.1.1, anyone working in a location where there is a risk of falling may be regarded as working at height. This includes undertaking work inside a tank, near an opening such as a hatch, or on a fixed stairway. Further, as per International Labour Office Code on Accident Prevention on Ships at Sea and in Port section 5.4.7.1 Seafarers working aloft, over the side, or where there is a risk of falling, should wear a safety harness attached to a lifeline.

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switch test for crane no. 3 limit switch⁶ as June 2019 and the Chief Officer decided to test the switches while the vessel was in Davao.

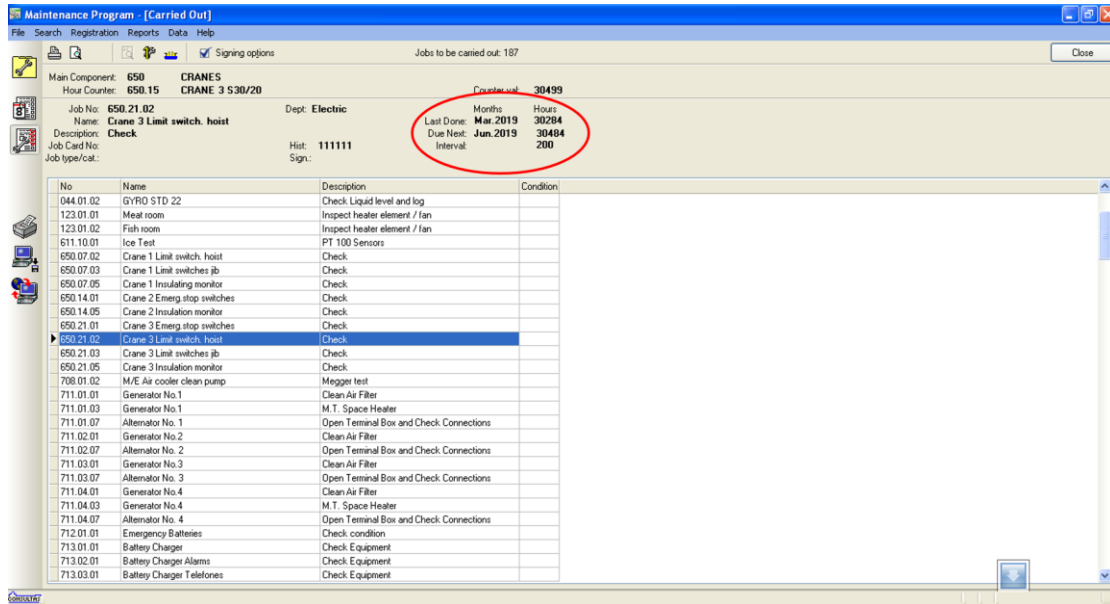


Figure 21: PMS screenshot image for crane no. 3 limit (proximity) switch test

⁶ The mechanical limit switches were changed with proximity switches, however in PMS records it was still recorded as limit switch.

6 CONCLUSIONS

- 6.1 The deceased Bosun fell from a height of 8.54 meters on to the ship deck while descending from the crane cabin using the outside vertical ladder. This vertical ladder was the ladder for emergency descent as per the crane's technical manual.
- 6.2 The Company's SMS did stipulate the requirement for conducting a risk assessment for routine or non-routine work involving cranes. However, no risk assessment was conducted before commencing the work activity. The Company's SMS does include a checklist for 'working overside/aloft' but did not include any specific procedure or checklist for work activity involving risk of fall from height such as accessing the crane cabin using the outside vertical ladder of 8.54 meters in height.
- 6.3 The Company does not have any specific training requirements for crew members operating the crane.
- 6.4 Neither crew member involved in the work activity on the day wore a safety harness or fall prevention device. Further, the crane structure did not have any fall prevention mechanism in place to prevent the fall from height.
- 6.5 Although the new proximity switches were installed in May 2019 replacing the mechanical limit switches, the PMS records calculated running hours of the crane for limit switch test (200 hours) from the last test conducted on the mechanical limit switches in March 2019 and not from the date of the newly installed proximity switch.

7 RECOMMENDATIONS

Recommendation for the operator:

- 7.1 Consider providing training to deck crew focusing on effective risk assessment and appropriate hazard identification such as fall hazards while working on deck and accessing any structures on deck.
- 7.2 It is recommended to update the Company SMS with appropriate procedures and specific checklist(s) ensuring mitigation of the hazards involving risk of fall from height.
- 7.3 Consider providing a physical solution to prevent crew members from falling from height.
- 7.4 Consider reviewing the process of updating the PMS records after installation of any equipment or part thereof.
- 7.5 Consider implementing safety training for crew members focusing on the safe operation of the cranes onboard.

Recommendation for the BMA:

- 7.6 Consider updating the BMA regulations and/or BMA requirements to include specific requirements to ensure that suitable control measures and physical solutions are implemented on all Bahamas registered vessels to mitigate the hazards involving risk of fall from height.
