Danish Maritime Accident Investigation Board

MARINE ACCIDENT REPORT
February 2013

NICOLAI MAERSK
Fatal accident to seafarer on 26 April 2012

The Danish Maritime Accident Investigation Board
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Front page: The fuel oil hose handling and Suez boat davit.
Photo: The Danish Maritime Accident Investigation Board.

The marine accident report is available from the website of the Danish Maritime Accident Investigation Board www.dmaib.com

The Danish Maritime Accident Investigation Board

The Danish Maritime Accident Investigation Board is an independent unit under the Ministry of Business and Growth that carries out investigations with a view to preventing accidents and promoting initiatives that will enhance safety at sea.

The Danish Maritime Accident Investigation Board is an impartial unit which is, organizationally and legally, independent of other parties

Purpose

The purpose of the Danish Maritime Accident Investigation Board is to investigate maritime accidents and to make recommendations for improving safety, and it forms part of collaboration with similar investigation bodies in other countries. The Danish Maritime Accident Investigation Board investigates maritime accidents and occupational accidents on board Danish merchant and fishing vessels as well as accidents on foreign ships in Danish territorial waters.

The investigations of the Danish Maritime Accident Investigation Board procure information about the actual circumstances of accidents and clarify the sequence of events and reasons leading to these accidents.

The investigations are carried out separate from the criminal investigation. The criminal and/or liability aspects of accidents are not considered.

Marine accident reports and summary reports

The Danish Maritime Accident Investigation Board investigates about 140 accidents annually. In case of very serious accidents, such as deaths and losses, or in case of other special circumstances, either a marine accident report or a summary report is published depending on the extent and complexity of the accident.

Contents

1. SUMMARY

On 26 April 2012, NICOLAI MAERSK arrived at Jebel Ali, Dubai, United Arab Emirates. Shortly after arrival at 1515 hours the ship began loading and unloading containers.

During the stay in Jebel Ali, the ship was to receive lubricating oil both in bulk and in drums. The drums were to be hoisted on board by means of the aft stores crane. The lubricating oil in bulk was to arrive by truck and be pumped on board at the bunker station on the upper deck close to the gangway.

In order to receive the oil, preparations were made to hoist on board the bunkering hose for lubricating oil. The intention was to use the fuel oil hose and Suez boat handling davit for hoisting the hose for the lubricating oil. While preparing the crane, the 2nd engineer for some reason mounted the emergency operation crank fitted on a shaft that is directly connected to the electric motor powering the crane.

When mounting the emergency operation crank, he activated the lowering function on the remote control switch box whereby the crank started rotating at very high revolutions. The crank was hurled off and hit the engineer causing fatal injuries.

This report does not contain any recommendation. After this incident, the shipping company has initiated a number of preventive measures.

2. FACTUAL INFORMATION

2.1 Photo of the ship

Figure 1: NICOLAI MAERSK in Dubai
Source: Viktor/Shipspotting.com

2.2 Ship particulars

Name of vessel:	NICOLAI MAERSK
Type of vessel:	Container Ship (fully cellular)
Nationality/flag:	Danish (DIS)
Port of registry:	Bogense
IMO number:	9192454
Call sign:	OVZB2
DOC company:	Moller-Maersk A/S
IMO company no. (DOC):	0309317
Year built:	2000
Shipyard/yard number:	China Shipbuilding Corp (CSBC) – Kaohsiung. Yard No.: 743
Classification society:	Lloyd's Register of Shipping
Length overall:	198.62 m
Breadth overall:	30.25 m
Gross tonnage:	27,733
Deadweight:	30,420 t
Draught max.:	11.15 m
Engine rating:	28,348 kW
Service speed:	21.8 kts
Hull material:	Steel

2.3 Voyage particulars

Port of departure:	Tanjung Pelepas, Malaysia
Port of call:	Jebel Ali, Dubai, United Arab Emirates
Type of voyage:	Merchant shipping, international
Cargo information:	General cargo in containers
Manning:	20
Number of passengers:	0

2.4 Weather data

Visibility:	Good
Light/dark:	Daylight

2.5 Marine casualty or incident information

Type of marine casualty/incident:	Occupational accident
IMO classification:	Very serious casualty
Date, time:	26 April 2012 at 1645 LMT
Location:	Jebel Ali, Dubai
Position:	24°59.1’ N – 055°04.3’ E
Ship’s operation, voyage segment:	Alongside
Place on board:	Boat deck
Human factor data:	Yes
Consequences:	Fatal injury to a seafarer

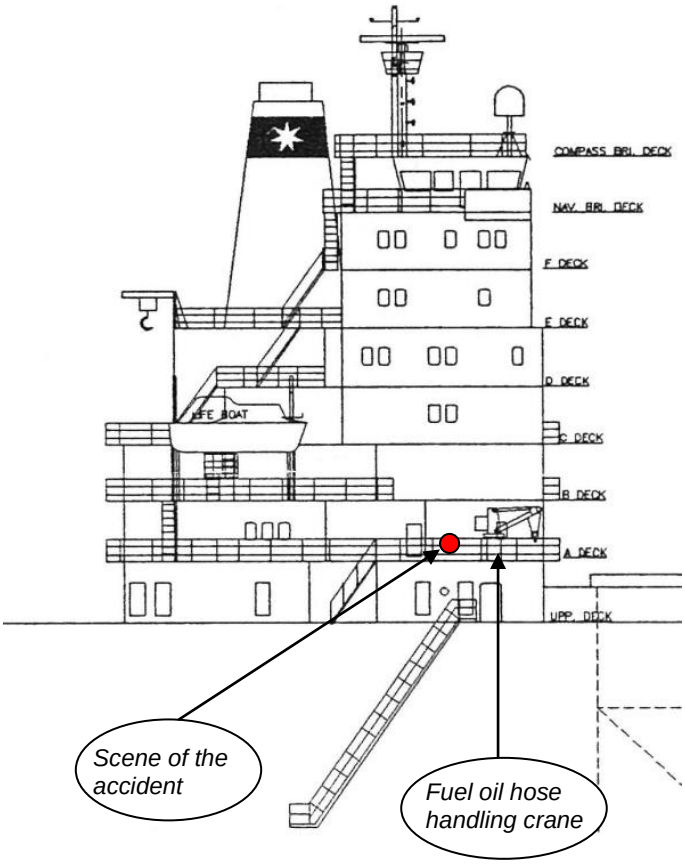
Figure 2: Scene of the accident. Jebel Ali, Dubai
Source: Google Earth

2.6 The ship's crew

Master:	46 years of age. Employed by the company in 2001. Appointed a master in December 2011. Took over the command of NICOLAI MAERSK on 1 April 2012.
2nd engineer :	30 years of age. Employed by the company in October 2010. Was on his third signing on as a second engineer on board NICOLAI MAERSK. Signed on 17 April 2012. Total time of service on board NICOLAI MAERSK: 4 months and 9 days.
Chief engineer:	55 years of age. Employed by the company for almost 38 years, hereof 22 years as a chief engineer. Assigned to NICOLAI MAERSK as a chief engineer when it was built 12 years ago.

3. NARRATIVE

3.1 The fuel oil hose handling and Suez boat davit (crane)



NICOLAI MAERSK is equipped with two cranes intended for hoisting fuel oil bunkering hoses and lifting Suez boats. The cranes are placed on the A deck just above the gangway on each side of the ship. Figure 3 to the left shows the location of the crane and the scene of the accident.

The manifold for bunker oil, lubricating oil and other liquids necessary for the operation of the ship is placed on the upper deck just below the cranes.

The crane is primarily used to handle the fuel oil bunkering hose that is very heavy and cannot be handled manually.

The crane is not used for lifting stores and provisions on board as it is not possible to land goods on the upper deck and the A deck.

Thus the crane is only used for bunkering primarily fuel oil and for hoisting Suez boats.

Figure 3: Location of the fuel oil hose handling crane and scene of the accident

3.1.1 Technical specifications

PARTICULARS

Hoisting capacity:	5,000 kg
Hoisting/lowering operation:	By 19 kW electric motor and winch with automatic mechanical safe brake or by emergency handle (crank)
Height from deck to upper position of crane:	2.40 m
Working radius:	2.50 m
Type of arm:	Fixed
Slewing:	200 degrees
Safety devices:	- Overload protection switch - Hoisting limit switch - Automatic mechanical safe brake - Interlock limit switch for emergency operations[1]

[1] Although an interlock limit switch is mentioned in the technical specifications, there was no such switch on the crane.

WINCH & ELECTRIC MOTOR

Hoisting speed:	15 metres/minute at full load
Emergency operation of hoisting:	In case of electrical power failure, the hoisting winch can be operated manually by a crank
Slewing gear:	Composed of a geared turntable and a worm reduction gear with a manual operation crank
Revolutions/minute on the shaft:	1,770 rpm

The remote push button switch box (control box) for operating the winch on the crane included a cable with a length of 15 metres.

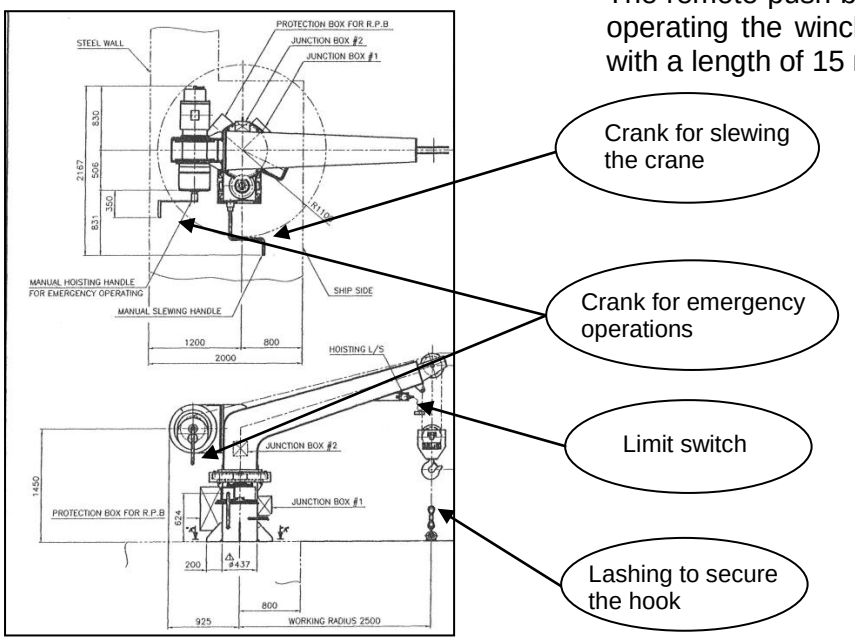


Figure 4: The fuel oil hose handling crane
Source: Danish Maritime Authority

3.1.2 Operation of the crane

To enable normal operation of the crane, electrical power has to be switched on. This is done by activating a switch on a starter panel placed in the air-conditioning room on deck A, see figure 5. The starter panel is mounted on the wall in a cabinet. Each crane has its own starter panel.

When the power is turned on in the air-conditioning room, it is possible to operate the crane electrically. A control box is used for operating the crane. When not in use, the control box is stored in a cabinet on the crane. The control box is connected to the crane by a cable with a length of 15 metres.

The slewing function can be operated manually only by using a crank.

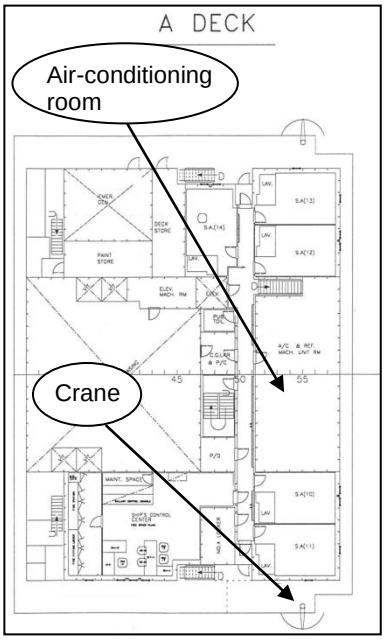


Figure 5: The air-conditioning room
Source: Danish Maritime Authority

3.1.3 Functionality of the push buttons

Figure 6: The control box
Source: Danish Maritime Accident Investigation board

In figure 6 to the left, the control box is shown.

<u>EMERGENCY STOP</u>

When the emergency stop is activated, the electrical power to the crane is off. To regain the power, it is nesescary to activate a switch on the starter panel in the air-conditioning room.

<u>SOURCE</u>

Source is an indicator showing whether the power is switched on or off.

<u>OFF/ON</u>

Switch activating/deactivating the hoisting and lowering buttons on the switch box.

<u>HOISTING</u>

Activates the hoisting function.

<u>LOWERING</u>

Activates the lowering function.

When the crane had been used, it was common practice to activate the emergency stop in order to make sure that the power was off when the crane was not supposed to be used.

3.1.4 Emergency operation of the crane

Figure 7 shows the crank used for emergency operation mounted on the rotor shaft.

In case of power failure or if otherwise needed, it is possible to operate the crane manually. This is done by mounting a crank on the rotor shaft of the electric motor. The shaft is without gear and driven by the electric motor.

Figure 7: The emergency crank mounted on the rotor shaft
Source: Danish Maritime Accident Investigation board

Before the accident, the emergency operation crank was placed in a holder on the crane.

The crane is fitted with an automatic mechanical safe brake. The hand wheel for the brake is shown in figure 8. The brake declutches when power is connected and the hoisting or lowering function is activated. When the power is off, it is necessary to loosen the brake manually by turning a handwheel on the crane.

When the automatic mechanical safe brake has been loosened, it is possible to lower and hoist by hand.

Figure 8: Hand wheel for manual operation of the brake
Source: Danish Maritime Accident Investigation board

3.1.5 Interlock limit switch

According to the crane's technical specification, the crane should have been equipped with an "Interlock limit switch for emergency operation". The switch is also listed under safety features in the ship's deck operation manual. In the documentation, the functioning of the switch has not been detailed. According to the control circuit drawing for the crane, the limit switch was not installed upon delivery and has not been retro-fitted on the crane installation either. The two first ships in a series of a total of six sister ships, of which NICOLAI MAERSK was the second, were not equipped with an interlock limit switch on the cranes.

3.2 The use of the crane

When the crane has been used, the hook has to be lashed to an eye in the deck. This is done by hoisting the hook by means of the control box. Before the block reaches the jib of the crane, it activates a limit switch stopping the hoist function. When the limit switch is activated, it is not possible to hoist the crane any longer using the control box, but it is possible to lower the hook.

In order to tighten the lashing, it was common practice to deactivate the limit switch manually and then carefully hoist the hook with small jerks until the lashing was tight.

Figure 9 shows the hook and the lashing. In the figure, the lashing is not tightened, but has a little slack caused by the lowering of the hook at the time of the accident.

When preparing the crane for normal use, the hook is lowered by means of the control box after the power has been turned on in the air-conditioning room. When the hook has been lowered a little, the lashing can be removed.

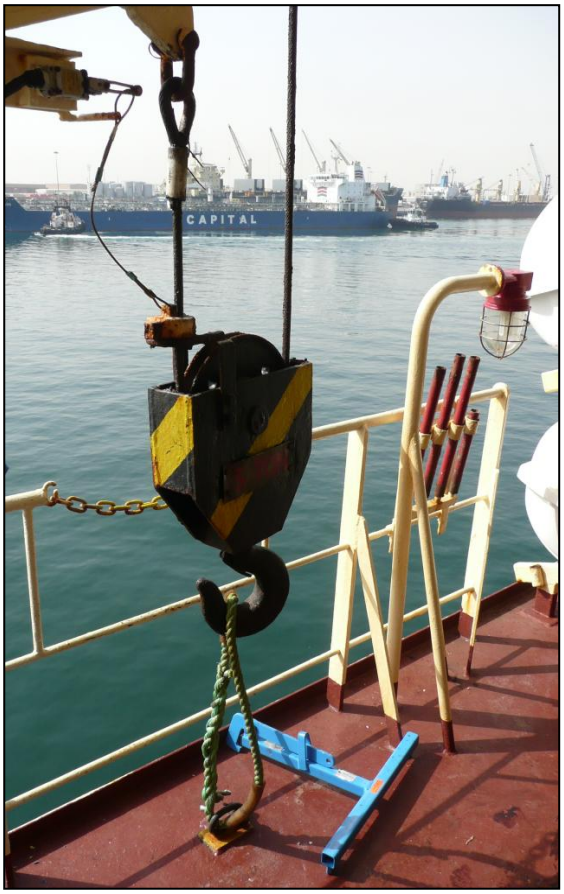


Figure 9: The hook, its lashing and the drum lifter
Source: Danish Maritime Accident Investigation board

Normally all work on deck is carried out by the deck crew, the AB's. This includes the operation of the bunker crane. When bunkering, the crane is therefore normally operated by one of the deck crew, while other ratings assist in connecting the hose to the bunker station. On the day of the accident, the deck crew were busy elsewhere when the lubricating oil hose was to be lifted and connected to the bunker station.

None of the three crew members who had been called for assistance had operated the crane before. The 2nd engineer had not been seen operation the crane on any occasion on board NICOLAI MAERSK.

3.3 Maintenance, survey and check of the crane

The crane is manufactured by Sekwang Marine Machineries Co. Ltd. and was installed on the ship upon delivery from the ship yard.

In July 1999, the crane was inspected and tested by Lloyd's Register of Shipping. The inspection was carried out in accordance with the approved drawings and LR's Code for Lifting Appliances in a Marine Environment and found satisfactory. After the inspection and tests, a certificate was issued.

The crane was tested and examined at the shipyard in Dubai on 19 March 2010, and subsequently a certificate of test and examination was issued. The test was performed by a dock master from Drydocks World, Dubai. The test was a dynamic test with a proof load of 6.25 tonnes applied. The crane was found to be free from any permanent deformation visual to the eye. This test and examination is carried out every fifth year.

NICOLAI MAESK has a Repair Design Requisition and Maintenance system (RDRM system) to manage maintenance, including maintenance of the crane.

According to the RDRM system, regular checks have to be made. On NICOLAI MAERSK, these regular checks are made by the chief engineer who inspects the external appearance of the crane as well as the functionality by activating the buttons on the control box as well as the switch panel in the air-conditioning room. The emergency hoisting/lowering operation is also tested. These checks are made every quarter. Once a year, the inspection is more thorough and includes greasing, an inspection of the wires, hooks and brakes, etc. This is documented in the RDRM system. The crane had its last thorough annual inspection on 15 November 2011. The interlock limit switch was not mentioned in the RDRM system.

There has not been any problem with the functionality of the crane since delivery besides normal adjustment of the brakes. The brakes were last adjusted in early April 2012.

3.4 Familiarization and instruction

Prior to departure or within 24 hours of signing on, any crewmember must have knowledge of a number of items mostly related to safety. One of these items is the use of onboard cranes, including an explanation of the use of the emergency stops.

Familiarization of the on board cranes is part of the initial familiarization routine. The form of familiarization and the order it should be conducted is for the company's discretion.

There are no regulatory requirements regarding knowledge or operation of on board cranes.
Before commencing any work, all participants in the work must have received supervision about the work from the officer responsible for the operation.

3.5 Bunkering

The bunker stations for different types of oil are placed on the upper deck just below the cranes placed on the A deck.

When fuel oil is being bunkered, it is necessary to use a crane to hoist the fuel oil hose to the bunker station. For this either the ship's own crane or a crane on the bunker boat is used because the fuel oil bunkering hose is too heavy to handle manually. The lubricating oil hose is normally hoisted by means of a heaving line as normally it is not heavy.

When the chief engineer has approved the type and amount of oil, the bunkering is normally carried out by the chief officer assisted by AB's. This does not apply to the bunkering of lubricating oil for which the 2nd engineer is responsible.

3.6 Preparations for receiving lubricating oil

NICOLAI MAERSK arrived at Jebel Ali at 1515 hours on 26 April 2012, where it berthed with the starboard side alongside. Shortly after arrival, loading and unloading of containers commenced.

On the day of the accident, the ship was to receive 12,000 litres of lubricating oil for the auxiliary engines. This oil was to be delivered by truck. In addition 2,000 litres of similar lubricating oil were to be delivered in drums. The drums were to be hoisted on board by means of the monorail crane on the upper deck aft and thereafter stored in the steering gear room. The bunker crane is not used for loading drums as it is impossible to land the drums on deck.

Two crew members were told to fetch the drum lifter in the steering gear room and bring it to the A deck and prepare it. The drums were to be lifted to the A deck and later stored in the steering gear room. A third crew member was told to go to the bunker crane to assist with the bunkering of lubricating oil.

The 2nd engineer had decided to use the fuel oil hose handling crane to hoist the hose used for lubricating oil. While two crew members were repairing/preparing the drum lifter and the third crew member was on standby, the 2nd engineer started to prepare the bunker crane in order to lift the lubricating oil hose on arrival of the truck.

3.7 The accident

Besides the two crew members preparing the drum lifter, a repairman was also called to the A deck to assist with the bunkering operation at the crane.

Figure 10 illustrates the positions of the three crew members and the 2nd engineer immediately before the accident.

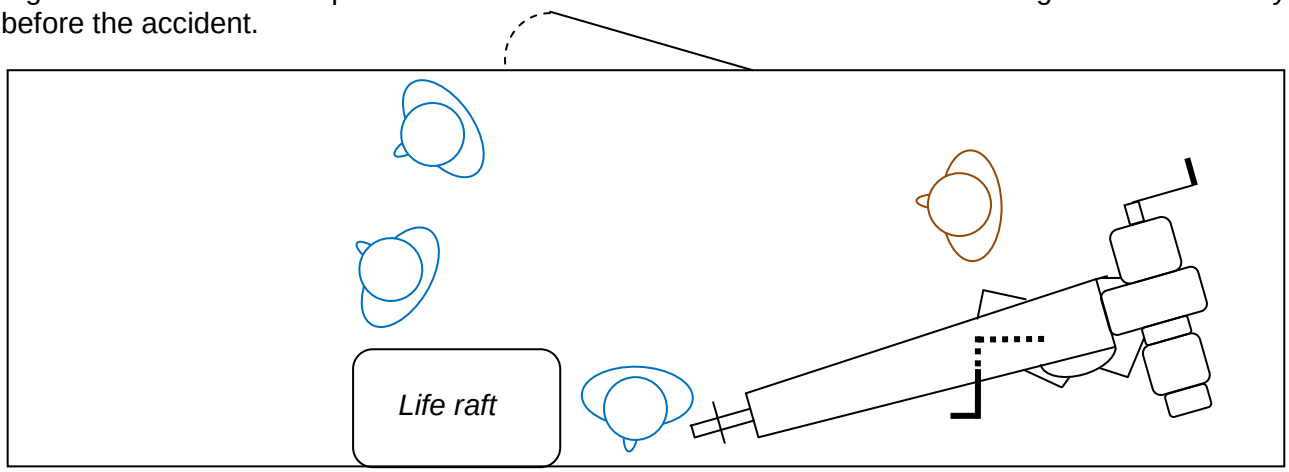


Figure 10: The scene of the accident before the accident
Source: Danish Maritime Accident Investigation board

The repairman was standing at the railing on the A deck close to the bunker crane. He had been told by the 2nd engineer to be ready to assist with the bunkering operation and lifting of the drums with the stores crane when they arrived. In the meantime, he should assist with the lubricating oil hose. He arrived on the A deck approximately three minutes before the accident.

When the repairman came to the A deck, he observed that the 2nd engineer was working with the crane and that the two crew members from the engine were busy preparing the drum lifter.

At some point in time, the repairman observed that the 2nd engineer was holding the control box in one hand and the crank for the emergency operation in the other hand.

Prior to the accident, there had been no communication between the three crew members and the 2nd engineer. At the time of the accident, they all had their backs to the 2nd engineer.

Suddenly the three crew members heard a sound as if the crane was running for a short moment followed by a loud noise. As they turned around, they saw the 2nd engineer lying on the deck with very severe wounds to the head leaving no doubt that he was dead.

At the time of the accident, the 2nd engineer was wearing ear protection but no safety helmet. The 2nd engineer had been working on the A deck for approximately ten minutes before the accident.

Figure 11: The crank on the buggy of the container crane
Source: Moller – Maersk A/S

The crank and debris from the 2nd engineer's hearing aid were found on the quay aft of crane. The crank was found at a horizontal distance from the scene of the accident of about 50 metres. It was initially found by a stevedore on the rails used by the container cranes and thereafter placed on the buggy of one of the container cranes. Figure 11 shows the crank on the buggy where it was found later approximately one hour after the accident by a crew member who brought it on board. Based on knowledge of the speed of the rotation and the dimension of the handle is it possible to calculate the speed of the handle in the rotation. The speed was 158 km/h. There were no traces of blood on the crank.

3.8 Test of the crane after the accident

After the accident, the crane was tested in the presence of the Danish Maritime Accident Investigation Board.

The switches in the air-conditioning room turning on and off the power to the crane were tested and found in good order.

The functionality of the control box was tested and found in good order.

The hoist limit switch was also tested and found in good order.

The automatic mechanical safe brake preventing the crane from hoisting/lowering when disconnected from the electrical power was tested and found functioning as intended.

The emergency crank was mounted on the end of the rotor shaft and it was possible to lower and hoist the hook by means of the crank only when the automatic mechanical safe brake was loosened. It was observed that it was possible to wriggle the crank when mounted and pressed against the shaft as much as possible. When mounted, the crank could hold its position on the rotor shaft.

4. ANALYSIS

At the time of the accident, the electrical power to the crane was switched on in the air-conditioning room and the ON/OFF switch on the control box was set to ON. The automatic mechanical safe brake was engaged. It was possible to lower the hook by means of the control box as the automatic mechanical safe brake declutches when the hoisting and lowering buttons are activated. An attempt to lower the hook by means of the emergency crank was impossible when the automatic brake was engaged. At the time of the accident, the brake was engaged.

Shortly before the accident, the 2nd engineer was seen with the control box in one hand and the crank for emergency operation of the crane in the other. Based on these facts, the 2nd engineer must have mounted the crank on the rotor shaft and thereafter activated the lowering button on the control box.

There are no indications that the 2nd engineer had been given instructions in operating the fuel oil hose handling and Suez boat crane except what was contained in the familiarization 24 hours of signing on. One of the items in this familiarization was an explanation of the use of the emergency stop. This familiarization can not oppose the elements of danger relating to the operation of the crane. Combined with the mounting of the crank without loosening the automatic brake first, indicates limited knowledge in the operation of this crane.

When the emergency crank is mounted and the lowering function on the control box is activated, the crank will instantly start rotating at a speed of 1,770 revolutions per minute. The crank handle will then move at a speed of approximately 186 km/hour based on a radius of 28 cm from the crank shaft to the handle. The crank has a weight of 3.2 kg. As the crank does not fit tight on the shaft end, but is able to wriggle, it could be hurled off within a very short moment after activating the lowering function, thus hitting and causing fatal injury to the 2nd engineer.

After the accident, it was found that the hook was lowered approximately 10 centimetres. This shows that the crane had been activated for lowering for less than half a second, during which time the crank had rotated about 15 times.

Figure 12 below shows the position of the three crewmembers and the 2nd engineer immediately after the accident. The dotted line indicates the estimated trajectory of the crank.

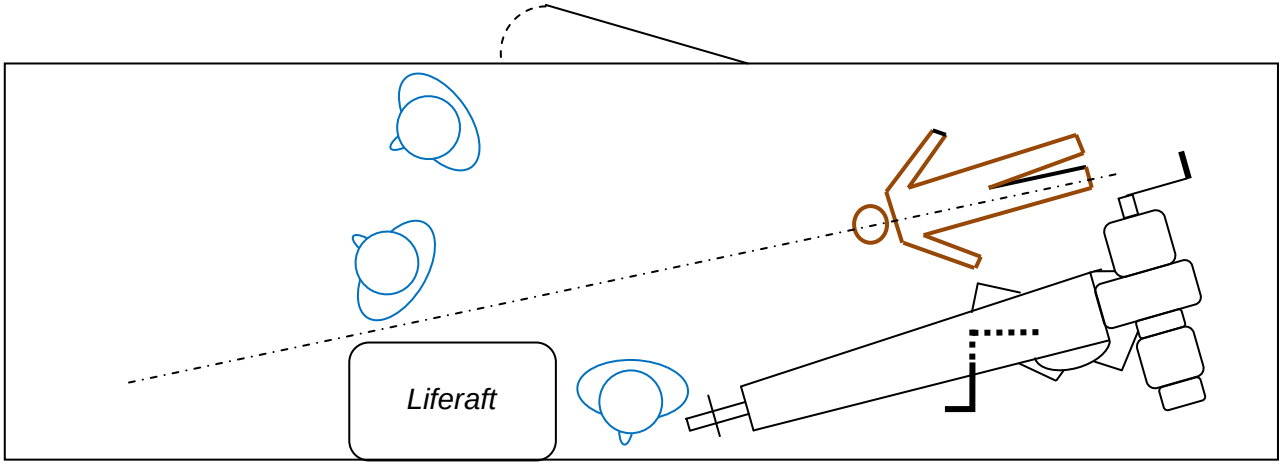


Figure 12: The scene of the accident after the accident
Source: Danish Maritime Accident Investigation Board

The crank and debris from the 2nd engineer's hearing aid were found on the quay aft of crane. The crank was found at a horizontal distance from the scene of the accident of about 50 metres.

Blood stains in different places on the crane and in adjacent areas on the A deck prove that the 2nd engineer was standing at a short distance aft of where the emergency operation crank was mounted on the crane, but not close enough to be hit by the crank if it was mounted on the shaft. When he was struck by the heavy crank, his feet were pushed backwards giving the position shown in figure 12.

According to the crane's technical specification, the crane should have been equipped with an "interlock limit switch for emergency operation. This switch is also listed under safety features in the ship's deck operation manual. According to the control circuit drawing for the crane, the limit switch was not installed at delivery and has not been retro-fitted on the crane installation either. During the investigation it has not been possible to determine the cause of why the absence of this safety device was not acknowledged during inspections and maintenance.

5. CONCLUSIONS

It is the assessment of the Investigation Board that the 2nd engineer mounted the emergency crank on the shaft end of the electrical rotor and thereafter activated the lowering function on the control box. The emergency crank was hurled off and hit the engineer in the head causing fatal injuries

The investigation has indicated that the 2nd engineer had limited knowledge and experience in operating the fuel oil hose handling and Suez boat crane. This was a contributing condition to the accidental event.

The interlock limit switch that should have cut off the power to the crane in case the emergency operation crank was mounted on the crane was mentioned both in the crane specifications and in the ship's deck operation manual. However, the absence of this safety feature was not acknowledged by the manufacturer, the classification society or during regular external and internal inspections and maintenance. The absence of the interlock safety switch was thus never recognized and this latent risk became active when the emergency crank was used in an uncommon way by a

crew member with limited experience and knowledge in operation the fuel oil hose handling and Suez boat crane.

6. CORRECTIVE ACTIONS

After the accident, the company sent a Technical Flash to the fleet with the following corrective actions to be taken:

- Fleet wide crane survey to be carried out and assessed for further required actions.
- Interlocks to be built in on fuel oil hose handling and Suez boat cranes not equipped with such to secure that the crane cannot be operated electrically if the manual hoisting crank is used. Installation of interlock switches has been completed on the company's N-class series.
- Cranks and handles to be duly marked in order to avoid similar incidents.
- Review introduction / familiarization procedures and check lists.
- Review procedures / work instructions in the RDRM-system (Repair design requisition and maintenance system) and GSMS (Global Ship Management System).