Marine Safety Investigation Unit

Transport Malta

MARINE SAFETY INVESTIGATION REPORT

Safety investigation into the fatal occupational accident on board the Maltese registered bulk carrier

ELENI M

in position 45° 10.5' N 012° 32.7' E

on 18 November 2017

201711/026

MARINE SAFETY INVESTIGATION REPORT NO. 20/2018

FINAL

Investigations into marine casualties are conducted under the provisions of the Merchant Shipping (Accident and Incident Safety Investigation) Regulations, 2011 and therefore in accordance with Regulation XI-I/6 of the International Convention for the Safety of Life at Sea (SOLAS), and Directive 2009/18/EC of the European Parliament and of the Council of 23 April 2009, establishing the fundamental principles governing the investigation of accidents in the maritime transport sector and amending Council Directive 1999/35/EC and Directive 2002/59/EC of the European Parliament and of the Council.

This safety investigation report is not written, in terms of content and style, with litigation in mind and pursuant to Regulation 13(7) of the Merchant Shipping (Accident and Incident Safety Investigation) Regulations, 2011, shall be inadmissible in any judicial proceedings whose purpose or one of whose purposes is to attribute or apportion liability or blame, unless, under prescribed conditions, a Court determines otherwise.

The objective of this safety investigation report is precautionary and seeks to avoid a repeat occurrence through an understanding of the events of 18 November 2017. Its sole purpose is confined to the promulgation of safety lessons and therefore may be misleading if used for other purposes.

The findings of the safety investigation are not binding on any party and the conclusions reached and recommendations made shall in no case create a presumption of liability (criminal and/or civil) or blame. It should be therefore noted that the content of this safety investigation report does not constitute legal advice in any way and should not be construed as such.

MARINE SAFETY INVESTIGATION UNIT
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Malta

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Master and crew members MV *Eleni M*

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GLOSSARY OF TERMS AND ABBREVIATIONS

AB	Able Seafarer
kW	Kilowatt
m	Metres
mm	Millimetre
MSIU	Marine Safety Investigation Unit
Mt	Metric tonnes
RINA	Registro Italiano Navale
Rpm	Revolutions per minute
SMS	Safety Management System

SUMMARY

In the evening of 18 November 2017, the Maltese registered bulk carrier *Eleni M* departed Porto Marghera in Italy, bound for Alexandria in Egypt with a cargo consisting of iron. After departure, the crew members on deck began to tidy up in preparation for sea passage. On the aft deck, the mooring lines that had been used while the ship was in port were being secured on the two mooring winches. During the final stage of the securing process, the last mooring line on the port side winch, the AB who arranged the mooring line on the winch drum assisted by one deck cadet, was caught in the winch and dragged into the limited clearance between the reeled-in mooring rope on the winch drum and the deck underneath.

This happened within only a few seconds, while the assisting cadet had approached the AB who was operating the winch to convey the message to stop reeling in. The AB got crushed between the deck and the mooring rope and consequently he was severely injured. He was later pronounced dead by a medical doctor on board a Coast Guard vessel, which had come to assist and evacuate the casualty.

The safety investigation of the fatal accident revealed that in order to perform the task of stowing the mooring ropes on the winch drum, the crew members had to engage physically with the ropes while the winch was rotating, to stow it properly and make room for all of the rope. The close proximity to the rotating winch and physical interaction made it possible to get caught. Furthermore, communication among the crew members easily became ineffective due to the setup of the mooring arrangement and loud noises on the aft mooring deck.

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

1 FACTUAL INFORMATION

1.1 Vessel, Voyage and Marine Casualty Particulars

Name	*Eleni M*
Flag	Malta
Classification Society	RINA
IMO Number	9228033
Type	Bulk Carrier
Registered Owner	Aegean Navigators Company Ltd.
Managers	Eastern Mediterranean Maritime Ltd.
Construction	Steel
Length overall	189.99 m
Registered Length	182.98 m
Gross Tonnage	28718
Minimum Safe Manning	12
Authorised Cargo	Dry Bulk
Port of Departure	Porto Marghera, Italy
Port of Arrival	Alexandria, Egypt
Type of Voyage	International
Cargo Information	Dry bulk cargo (21548,11 mt)
Manning	23
Date and Time	18 November 2017 at 20:00
Type of Marine Casualty	Very Serious Marine Casualty
Place on Board	Poop deck
Injuries/Fatalities	One fatality
Damage/Environmental Impact	None
Ship Operation	Normal Service – On passage
Voyage Segment	Transit
External & Internal Environment	Accident happened during night time. Visibility was 12 nautical miles and a North Northeasterly gentle breeze. There was slight North Northeasterly swell (0.5 m). Sea and air temperatures were recorded at 12 ^{0}C.
Persons on Board	24

1.2 Description of Vessel

Eleni M (Figure 1) is a Maltese registered geared bulk carrier, fitted with five cargo holds. The vessel was built in 2001 at the Oshima Shipbuilding Co. Ltd., in Japan and is classed by Registro Navale Italiano (RINA). *Eleni M* is owned by Aegean Navigators Company Ltd. and her management is undertaken by Eastern Mediterranean Maritime Ltd.

The vessel has a length overall of 189.90 m, a moulded breadth of 32.36 m and a moulded depth of 16.67 m. She has a summer draught of 11.92 m, corresponding to a summer deadweight of 50,992 tonnes. Propulsive power is provided by a 6-cylinder B&W 6S50MC-C, two-stroke, slow speed, direct drive diesel engine, producing 7,650 kW at 107 rpm. This drives a single fixed pitch propeller to reach a service speed of 14.50 knots.

Eleni M was operating in tramp service on the spot market with no fixed routes or schedules. However, the Mediterranean waters were not unfamiliar to the ship's crew.

Figure 1: MV *Eleni M*

1.3 Aft deck layout and mooring equipment

The aft deck on *Eleni M* was open, with two mooring winches installed as well as several mooring bits and fairleads (Figures 4 and 5). Although the accident happened at night time, the crew members found the mooring deck to be sufficiently illuminated.

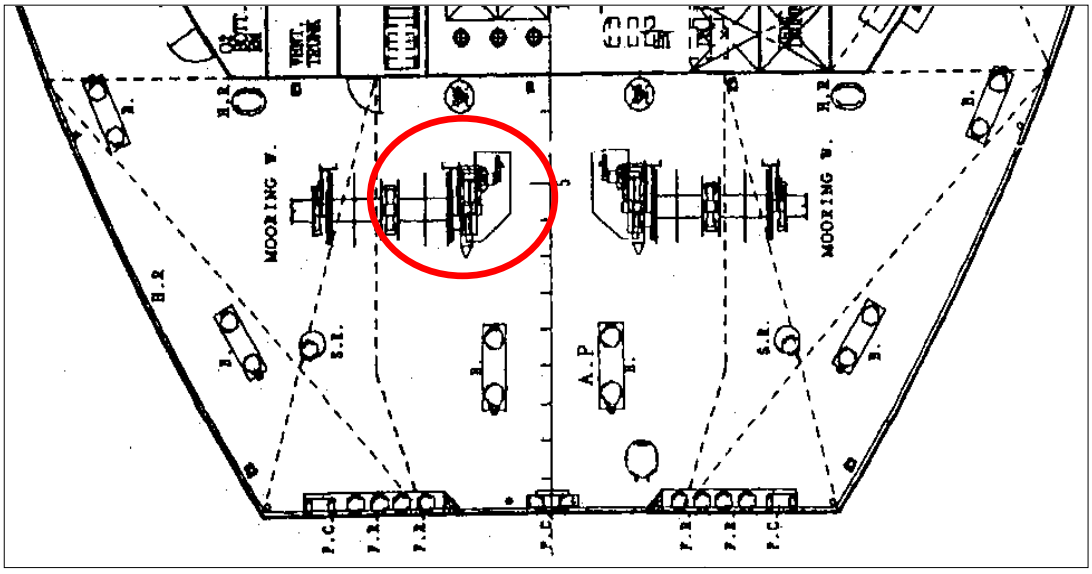

Figure 4: Aft deck layout on *Eleni M*, showing the winch where the accident happened

Figure 5: Aft deck layout on *Eleni M* at night, where the accident happened

Each of the mooring winches had two working / storage drums and a warping drum at the one end. Each drum had a storage capacity to hold 200 m of mooring rope with a diameter of 70 mm (**Annex 1**). The mooring rope in use on the winch drum during the course of the accident had, according to its certificate, a length of 220 m and a diameter of 72 mm (Figure 6 / **Annex 2**).

Figure 6: Mooring winch drum with mooring rope fully reeled in

The discrepancy between the nominal holding capacity of the winch drum and the actual dimensions of the mooring rope in use, reduced the clearance underneath the drum when the mooring rope was fully reeled in on the drum. Furthermore, it was normal practice to reel two mooring ropes onto one winch drum, which effectively reduced the clearance even further and necessitated even more careful stowage to ensure that the rope fitted on the drum. The clearance between the mooring ropes and the deck underneath on the day of the accident was between 150 mm and 200 mm (Figure 7).

Figure 7: Clearance underneath the winch drum

1.4 Procedures for tidying up after mooring operations

Whenever *Eleni M* left port, it was normal procedure to tidy up the deck spaces in preparation for the sea passage. The ship's Deck and Cargo Manual offered general advice on how to carry mooring operations in a safe manner; for instance, it stated that the winch operator had to be experienced, and that any trainees involved should be carefully supervised by experienced seamen. The procedures did not specify in great detail how tidying up of the deck (following departure) should be done (**Annex 3**). However, this was considered a standard and rather simple routine that the experienced ABs were fully capable of carrying out by themselves.

The securing of mooring ropes on the winches was normally done by reeling in all the mooring ropes on the drums on the two winches. There was one experienced AB stationed by the winch controls on the side of the winch, while a second AB would be arranging the mooring rope on the drum during the reel in, positioned immediately behind the winch drum. At the very final stage of the reel in, when all of the mooring rope would have been reeled onto the drum (except the eye, which was the only part left on deck), the winch operator would operate the winch at a very slow speed. The AB working with arranging the rope would then secure this by means of a piece of thin rope tied to the end of the eye, tying the other end of the thin rope to the winch

foundation. The winch operator would then tighten up on the winch to secure the mooring ropes.

Communication was normally done by hand signals to the winch operator, either by the AB, or a supervisor working by the winch drum; verbal communication was hampered due to the high noise levels on the aft deck. During the course of the accident, the normal procedure was followed and a deck cadet assisted with the operation from a position behind the AB, as shown in Figure 8.

Figure 8: Securing the mooring line on the winch drum (*reconstruction*)

1.5 Information about Key Crew Members

1.5.1 Vessel's manning

At the time of the accident, the crew compliment was in accordance with the Minimum Safe Manning Document issued by the Maltese authorities on 13 November 2015 and valid until 08 January 2020. According to the ship's hours of rest and work records, the crew members involved in the accident had sufficient time to rest during the period prior to the accident.

At the time of the accident, *Eleni M* had a crew compliment of 23 and additionally, one passenger was on board. All of the crew members were Filipino nationals.

The bridge team consisted of the master, the chief mate, two navigational officers, as well as two deck cadets. On deck, the bosun was assisted by four ABs. According to the ship's SMS, the ABs were designated the task of assisting the chief and deck officers (but reporting to the bosun), with mooring and unmooring operations, while the master had the overall responsible for all operations on board. The deck cadets were consistently assigned to help on deck during mooring and unmooring operations, under the supervision of either the experienced ABs or the responsible officers.

This was also the situation on the day of the accident, where one cadet assisted the other deck crew members during unmooring, pilot disembarkation, and the subsequent tidying up and making ready for sea passage. During the time of the accident, the chief officer had just left the aft mooring station to go and check the work progress on the forward deck. Present on the aft deck were two highly experienced ABs[1], assisted by a deck cadet.

1.5.2 The crew members

The master, who was 33 years old, had been working for the Company for 14 years, from cadet to a master. He had served as a master on board *Eleni M* for the six months prior to the accident. His certificate of competence as a master was issued on 16 February 2016.

The chief officer, who was 33 years old, had been working for the Company for 14 years as well, with the last three years serving in the capacity of a chief officer with six months of service on board *Eleni M*. He held a certificate of competence as a master mariner, which was issued on 09 May 2017.

AB 1 (the casualty), who was 41 years old, had been working for the Company for 13 years, six of them as an able seafarer. He had served in this capacity on board *Eleni M* for seven months prior to the accident. He held a certificate as an able seafarer deck, issued on 11 April 2014.

AB 2, who was 42 years old, had been working for the Company for 15 years, 11 of which as an able seafarer. He had served in this position for five months before the

[1] Referred to as AB 1 and 2 in this safety investigation report.

accident happened. He held a certificate as an able seafarer deck, issued on 06 March 2014.

The deck cadet, who was 20 years old, had been engaged with the Company for two months, and had only served on *Eleni M*. He held an STCW basic safety training certificate, issued on 09 September 2016. It was the third time that the deck cadet had participated in mooring and unmooring operations.

1.6 Narrative

On 18 November 2017 at 1700, *Eleni M* departed Porto Marghera Italy, loaded with iron, bound for Alexandria, Egypt. The two pilots, who had assisted the ship during departure, disembarked at 1855. The crew members on deck started making the vessel ready for the sea passage, as per normal routine, thus retrieving and securing the pilot ladder, securing the anchors, and the mooring lines on the winch drums.

The weather was calm with only slight seas. On the aft deck, two experienced ABs worked to secure all of the mooring rope lines on the two winches, together with the chief and second mates. Just before 2000, when the first three ropes had been duly secured, the officers left the aft deck to attend to other business on deck. A deck cadet went aft to assist the two ABs with the securing of the last mooring line.

One of the ABs was operating the winch from the control lever, while the other AB guided the rope onto the winch drum so that it would stow neatly. The cadet assisted the AB with the stowing from a position behind the AB. During the final stage of the reeling in, the AB who did the stowing, knelt down very close to the winch drum, in order to be able to make the last part of the mooring rope fit on the winch and prevent chafing from the deck. Chafing was a potential problem because of the very little clearance between the fully loaded winch drum and the deck surface underneath.

The AB operating the winch had no awareness of the activities behind the winch drum as this itself prevented him from visually observing the AB who did the stowing. Then, the loud noises on the aft deck, coming from the engine-room, the steering gear below and the engine-room ventilation fan, prevented verbal communication on the aft deck. Therefore, the cadet, who was situated further aft and within visibility of the

winch operator, acted as a communication link between the two ABs. Figure 2 shows positions of the crew members prior to the accident occurrence.

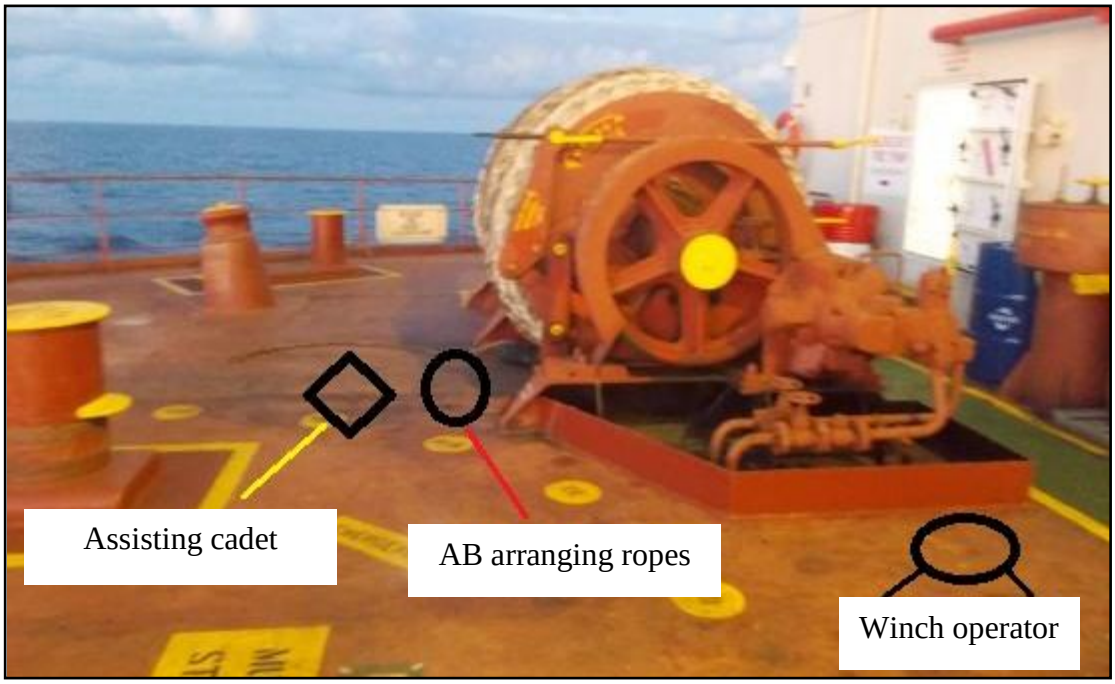

Figure 2: Positions of crew members prior to the accident (source: ELENI M)

When the mooring line was almost completely stowed on the winch, with only the rope eye left on deck, the AB working with the stowing told the cadet to go to the winch operator and to ask him to stop reeling in, in order to be able to secure the rope eye with a small piece of thin rope on the winch foundation.

The cadet got up from his position and walked for approximately three metres to the winch operator's position and told the winch operator to stop the winch, which he immediately did. It was only about two to three seconds later, when the cadet turned around towards the aft part of the winch drum again and noticed that the AB was no longer behind the winch. He also noticed that almost all of his body was now underneath the winch drum, despite the limited clearance between the stowed rope lines and the deck, with only his legs visible. The cadet shouted to the AB operating the winch, who immediately realised that a serious accident had just occurred. Figure 3 shows the locations of the crew members after the accident.

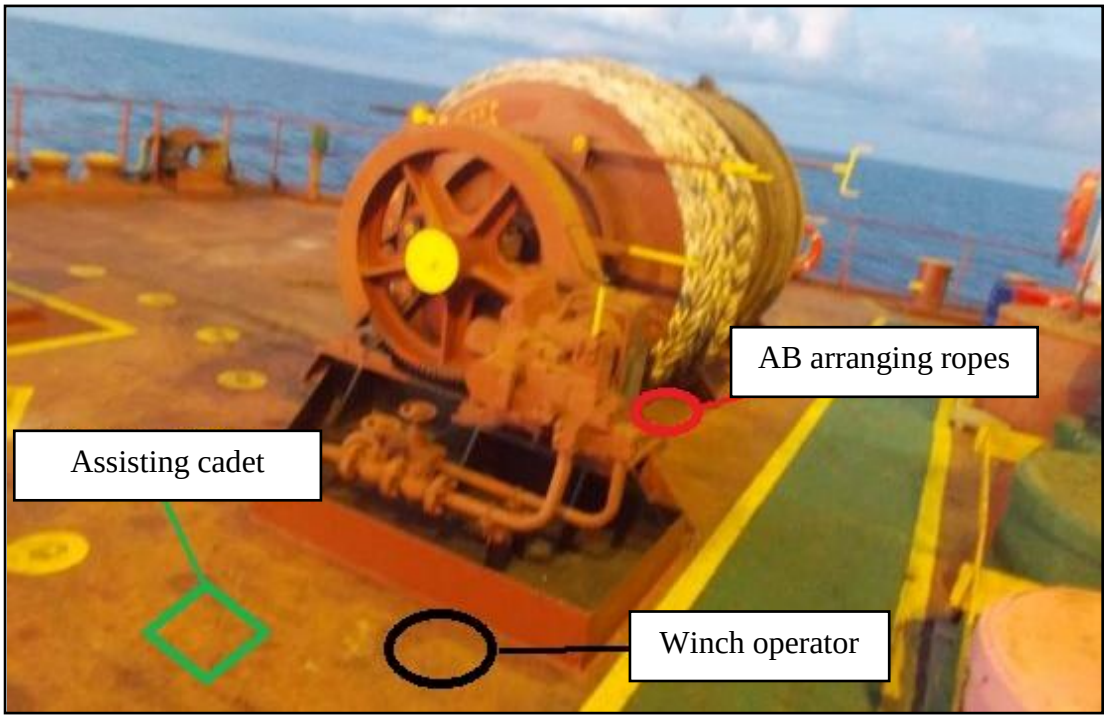

Figure 3: Positions of crew members after the accident

1.6.1 Rescue operation

The two crew members made their way rapidly towards the bridge to get help. On their way up, they met the master, who was on his way down from the bridge to the officer's messroom just after having being relieved by the officer of the watch. The master immediately instructed the bridge to sound the general alarm, which was followed up by an announcement on the public address system, instructing all crew members to proceed to the aft deck, to assist the casualty.

Coming from the forward deck, the chief mate was the first crew member to arrive on the casualty site. From a rapid evaluation of how the injured AB was positioned under the winch drum, the chief mate could immediately determine that it would not be possible to manually free the casualty by dragging him out from underneath the winch drum, as he appeared to be severely stuck. The chief mate noted that the only way to get the AB out, was to reel in further on the winch, in order to have the entire body pass under the winch drum and come out on the forward side of this.

1.6.2 Shore assistance

When the casualty was pulled out from underneath the winch drum, he was unconscious and with no vital signs. The officers immediately started providing first

aid by means of CPR and resuscitation. The master went to the bridge and at about 2015, he called up Malamocco Port on the VHF to seek medical advice. The duty officer at Malamocco Port instructed the master to call the Harbour Master in Venice, to whom the master explained the situation on board; how they were in urgent need of evacuation of the casualty due to his very poor condition, and that he intended to return to the anchorage off Malamocco for this purpose. This was eventually acknowledged by the Harbour Master.

Just after 2100, a Coast Guard vessel arrived alongside *Eleni M*, with a medical doctor on board. The crew members started preparing the injured AB for evacuation, by securing him onto a stretcher. At 2210, the stretcher was lowered down onto the Coast Guard vessel, but not long after the doctor informed the master of *Eleni M* that the AB had been pronounced dead. The Port Control instructed the vessel to proceed to Chioggia Anchorage where the anchor was dropped just before midnight. The following day, during the morning of 19 November, local officials and police representatives boarded the ship. At 1842, the anchor was aweigh and the ship proceeded on her journey towards Alexandria, Egypt, where it safely arrived on 24 November at 1400.

1.7 Formal Risk Assessment

A generic risk assessment form, addressing mooring operations, had been completed prior to the accident. However, while this was to some extent concerned with the correct operation of the winch and communication between the parties involved with mooring operations, there were no identified risks in relation to the actual securing of the mooring lines on the winches after mooring operations had been completed. Specifically, the risk of being caught by the winch while reeling up the mooring lines was not addressed by the formal risk assessment, nor was the risk associated with reeling an excessive mass of mooring rope onto the winch drums (**Annex 4**).

1.8 Environmental Conditions

Accident happened during night time. Visibility was 12 nautical miles and a North Northeasterly gentle breeze. There was slight North Northeasterly swell (0.5 m). Sea and air temperatures were recorded at 12 ^{0}C.

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 The Execution of the Mooring Winch Operations

The accident on board *Eleni M* happened when one of the ABs worked to arrange the mooring rope on the winch drum, in order to secure this as part of the preparation for sea passage. The accident happened at the very instance, in a matter of about 2.5 seconds, and when he was not being watched by a fellow crew member (a deck cadet). Thus, the exact details of how the crew member got caught by the mooring rope and was subsequently dragged into the winch remain unknown to the safety investigation. However, several conditions have been identified, which allowed the situation to arise and the accident to materialise.

When the mooring ropes were secured on the four winch drums, it was customary to stow more than four ropes because additional ones were used for mooring operations and because it was the most convenient way to stow these for sea passage. Thus, it can be said that stowing the additional ropes on the winches was a trade-off between efficiency and thoroughness. This was motivated by a drive towards optimising processes in terms of workload and time consumption as well as practicalities related to stowing space, and the fact that there was an insufficient number of winch drums available to hold every mooring rope individually.

This approach had proven efficient on numerous instances. The procedure of stowing two mooring lines on one winch drum, however, also made the arrangement of the mooring ropes on the winch drums bulkier and making them almost touch the deck. Because this was excessive in relation to the nominal holding capacity of the winch drums, it required careful stowage by means of the manual handling of the ropes, particularly during the latter stage of the securing process. Furthermore, the clearance underneath the drum with the excessive mass of mooring rope stowed was severely

limited, which made it possible to get caught between the remaining rope (the last part of the rope with the eye) that was placed on deck and the next layer already reeled onto the winch drum, and to create a squeeze effect on a caught object.

With the mooring winch continuously rotating, the squeezing forces would be strong enough to drag a caught object underneath the winch drum. Once the mooring rope end would have passed underneath the winch drum and come out on the forward facing side of the winch, the squeezing forces would again diminish and a caught object would be released.

Although the physical distance between the winch operator and the crew member working closely behind the winch was only about three metres, the bulk of rope on the winch drum, the physical design of the winch, with the operating lever further forward (and located on the side of the winch), would have made it impossible to visually observe from the control station what was actually going on, on the aft part of the winch, where the casualty was working at the time of the accident.

Thus, the operation relied on a third crew member to act as the intermediate link between the winch operator and the AB arranging the mooring lines, to maintain effective control of the operation. During the course of the accident, this link was broken, briefly, when the cadet went to tell the winch operator to stop heaving in. This brief 'control interruption' lasted no more than three seconds; but that was enough to allow for the accident to materialise.

2.3 The Position of the Injured Crew Member

When the injured crew member was discovered by the deck cadet underneath the winch, he was still stuck. When the chief officer subsequently operated the winch controls, the casualty continued to be dragged in a forward direction until the mooring rope stopped squeezing on the body of the casualty. The eye-end of the mooring rope had at this point travelled half way up on the winch drum. The casualty was found face-down and with one arm stretched out in front of his head.

Although nobody witnessed what had actually happened behind the winch during the crucial seconds when the accident happened, the final position of the casualty

indicated that during the end of the arranging of the mooring ropes, he had stretched out his arm most likely to sort out the rope in the space between the layer of mooring ropes on the winch drum and the remaining part of the rope (the eye-end), which was still located on deck at this time. During the few seconds when the deck cadet walked from his position behind the casualty to the winch operator, during which time the winch was also still rotating, the crew member was caught from his arm between the layer of rope on the winch drum and the eye-part on deck, creating sufficient squeezing force to drag the casualty.

The second or two that passed before the deck cadet conveyed the message to stop reeling in on the winch, provided enough time for the upper part of the casualty's body to be dragged underneath the winch drum, despite the low rotation speed, because of the very close proximity to the winch at which the arranging of the mooring ropes had to be done. The noise levels on the aft deck made it impossible for the winch operator and the deck cadet to acknowledge any cries for help or other such indications that something had gone wrong.

2.4 Risk Assessment and Formal Procedures

The accident happened when several factors coincided in a way that had not been foreseen or described formally. The risks involved with the operation of securing the mooring ropes on the winches were not obvious to either the crew or the writers of the Formal Risk Assessment, and the procedures had been carried out in the same way numerous times with no history of accidents.

The Formal Risk Assessment format relied on the ability to foresee events that were dangerous, based largely on either imagination of the writers, or experience from previous instances where processes have presented a danger. When a process would have not been previously identified as dangerous (as with this case of securing a mooring rope) and crew members would not imagine it as being dangerous (because of the past success in carrying out the process), the procedures and Formal Risk Assessment may be an ineffective barrier against accidents in a dynamic and complex environment which, the MSIU believes was the case on board *Eleni M*.

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

The immediate cause of the fatal injury was the crew member being trapped between the mooring rope on the winch drum and the deck on the poop deck.

3.2 Latent Conditions and other Safety Factors

.1 With a situation that required careful stowage of the mooring ropes on the winches, in order to fit the excessive mass of ropes onto the winch drums, it was necessary to intervene physically, at a close proximity and with ropes on the winch while this was rotating. This granted the opportunity to get caught during the final stage of the stowage procedure, because of the limited clearance between the ropes and the deck.

.2 It was customary to stow more than four ropes because additional ones were used for mooring operations and because it was the most convenient way to stow these for sea passage.

.3 There was an insufficient number of winch drums available to hold every mooring rope individually.

.4 The clearance underneath the drum with the excessive mass of mooring rope stowed was severely limited, which made it possible to get caught between the remaining rope.

.5 The margins between success and failure was very narrow during the final stage of the mooring rope stowing procedure, with only a few seconds of inattention from the cadet, while he approached the winch operator to tell him to stop, being enough to allow the accident to materialise.

.6 The design of the work flow of securing the mooring lines and the physical setup of the mooring arrangement hampered good communication on the aft deck, because of the missing visual contact and the impossible verbal communication due to the noise levels.

3.3 Other Findings

.1 The task of stowing mooring lines to make ready for sea passage was a routine task that had been carried out successfully numerous times prior to the accident.

.2 Small variations in the everyday work performance may coincide in combinations and convert otherwise seemingly simple and routine operations, into serious accidents. In this case, intersecting circumstances related to timing, close human proximity to kinetic energy, design, and poor communication, were both difficult to predict and address in a Formal Risk Assessment.

4 ACTIONS TAKEN

4.1 Safety Actions Taken During the Course of the Safety Investigation

During the course of the safety investigation, the Company has adopted the following actions:

- An official notification was issued to the fleet soon after the accident, cautioning crew members on the risks related to mooring operations and highlighting the importance of communication at the mooring stations;
- An official notification was issued to the fleet requesting the completion of Company approved training on mooring operations and for the refreshing training on the subject matter for all crew members who had already completed the training;
- A Fleet Circular was issued by the Company, providing details of the accident and lessons learnt, for discussion during safety meetings on board;
- An on board training session carried out by the master on the proper handling and securing of mooring ropes, evaluation of risk while using mooring winches, communication procedures and supervision;
- An on board training session carried out by the Marine Superintendent on mooring arrangements and operations.

ANNEXES

Annex 1: Specification of the hydraulic driven deck machinery

	SPECIFICATION OF HYDRAULIC DRIVEN DECK MACHINERY	NIPPON PUSNES CO., LTD.

3. Mooring winch

1) Particular		DM No.	
Quantity per ship	right type	DM 4	1 set(s)
	left type	DM 3	1 set(s)

Type		NS16HW
Hauling load (1st. layer)	t(kN)	15(147)
Nominal hauling speed (1st. layer)	m/min.	15
Hydraulic motor		HMC200
Speed ratio of hydr. motor (high/low)		3.14
Gear ratio		4.818
Required differential pressure	kgf/cm² (MPa)	211 (20.7)
Required oil flow	L/min.	131
Drum size (dia. × length)	mm	φ508×1100L
No. of drum		2
Storage capa. of drum (rope dia.×length)	mm×m	φ70 × 200L (within 7 layers)
Slack rope speed (1st. layer)	m/min.	45
Brake holding power (1st. layer)	t(kN)	45(441)
Warping drum pull load	kN	15(147)
Warping drum size (dia. × length)	mm×mm	φ500×500L
No. of warping drum		1
Weight	t	4.3

2) Gear list		Pinion	Gear
Module	mm	10	10
No. of teeth	mm	22	106
Pressure angle		20°	20°
Addendum modification coefficient		0	0
Pitch circle dia.	mm	220	1060
Width of teeth	mm	146	140

— 5 —

Annex 2: Mooring rope test certificate

MK # 14

GL Industrial Services GmbH.

Certificate No. 120/6-07

Test Certificate

This is to certify that, at the request of **BUYER**, the undersigned surveyor to this society attended their Approved works, on 13.04.2010 for the purpose of inspection of the below mentioned items.

GLIS order No. : 0580-09-11023-202

Place of inspection : At Approved Works.

Materials / Items : **OCEANMOORFLEX 8 – STRANDS POLYPROPYLENE MIXED FIBRE ROPE IN ORANGE COLOUR WITH RED & BLACK TRACER YARN IN THREE STRAND WITH 2-MTRS CANVAS COVERED EYES SPLICED AT BOTH ENDS.AS PER BSEN ISO 1346 – 2004 STANDARD.**

P.O. No. : **002250**

Items Inspected:

Size	No. of Coils	Coil Bale No	Length (as confirmed by manufacturer)	Minimum required Breaking Strength (in Kgf)	Breaking strength of samples (in Kgf)
DIA 72MM	01	2134	220 Mtrs	93900	94962

Inspection / Verification Performed: Selection of random samples, Witnessing Breaking Load Testing.

Identification : By Name of the B. No. / Size / Colour / Length / MBL / M. Code and has been hard stamped on Lead seal As " GL ".

Results : The test gave no reason for objection, it is confirmed that the ropes comply with the Minimum Guaranteed breaking strength requirement of **BUYER**

Note : Testing performed as per BSEN ISO 1346 - 2004. Certificate issued based on test results of randomly drawn sample no.**2132** from Coil Bale no.**2128 TO 2137.**

The inspection performed and certificate issued without prejudice to whomsoever it may concern.

Attending Surveyor: Mr. Pushilal

[redacted]

Date:
13.04.2010

INDUSTRIAL SERVICES 20617

For Germanischer Lloyd
Industrial Services GmbH

Subject to the latest general terms of the business of Germanischer Lloyd Industrial Services GmbH
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M/V ELENI M

[redacted]

FOR MOORING ROPE & TUGLINE USE
RCVD AT FUJAIRAH
16 MAY 2010

Annex 3: SMS extracts on mooring ropes and wires

CHAPTER 3 – MOORING ROPES AND WIRES

1.1 GENERAL SAFETY PRECAUTIONS

1.1.1 Seamen shall not, in any circumstances, stand in a bight of rope or wire, whenever practicable, in the bight formed between the mooring winch and the coiled rope. In no circumstances must they stand across a rope or wire which is under strain or being worked.

1.1.2 When ropes and wires are subject to exceptional strain, as in towing, all persons shall remain in a position of safety whenever possible. The safest method of heaving by means of turns on a drum end is for one man to be employed on the drum end with a second man backing and coiling down the slack as it is taken in. **An experienced seaman shall remain at the winch controls at all times throughout the mooring procedure.** When wires are used for mooring to buoys or dolphins, the eyes of the wires shall be seized to prevent them catching on obstructions when they are let go. Always make sure that drum ends are kept free from grease and paint and that rollers and fair leads turn smoothly.

1.1.3 Examine a rope frequently throughout its length both for external wear and for wear between the strands in order to assess its residual strength. Always access the strength in the worst worn or damaged parts of the rope.

1.1.4 Unqualified crew members shall not be involved in mooring operations. In case trainee is involved, he shall be carefully supervised by an experienced seaman.

1.2 WIRE ROPES AND REELS

Wire ropes shall never be used directly from a reel because in the event of the wire fouling the reel both the reel and the frame might be torn from the deck and cause injuries. Sufficient slack shall be taken off the reel to cover all contingencies and flaked out on the deck in a safe manner. If there is any doubt as to the amount of slack required the complete wire shall be removed from the reel. When cargo winches are used for handling springs on the main deck suitable leads shall be provided. If a snatch block is used, the block and its attachment shall have a proof load at least equal to that of the breaking strain of the wire.
Avoid passing wires through sharp edge constructions or using sharp angles.

1.3 SAFETY PRECAUTIONS IN HANDLING SYNTHETIC AND NATURAL FIBER ROPES

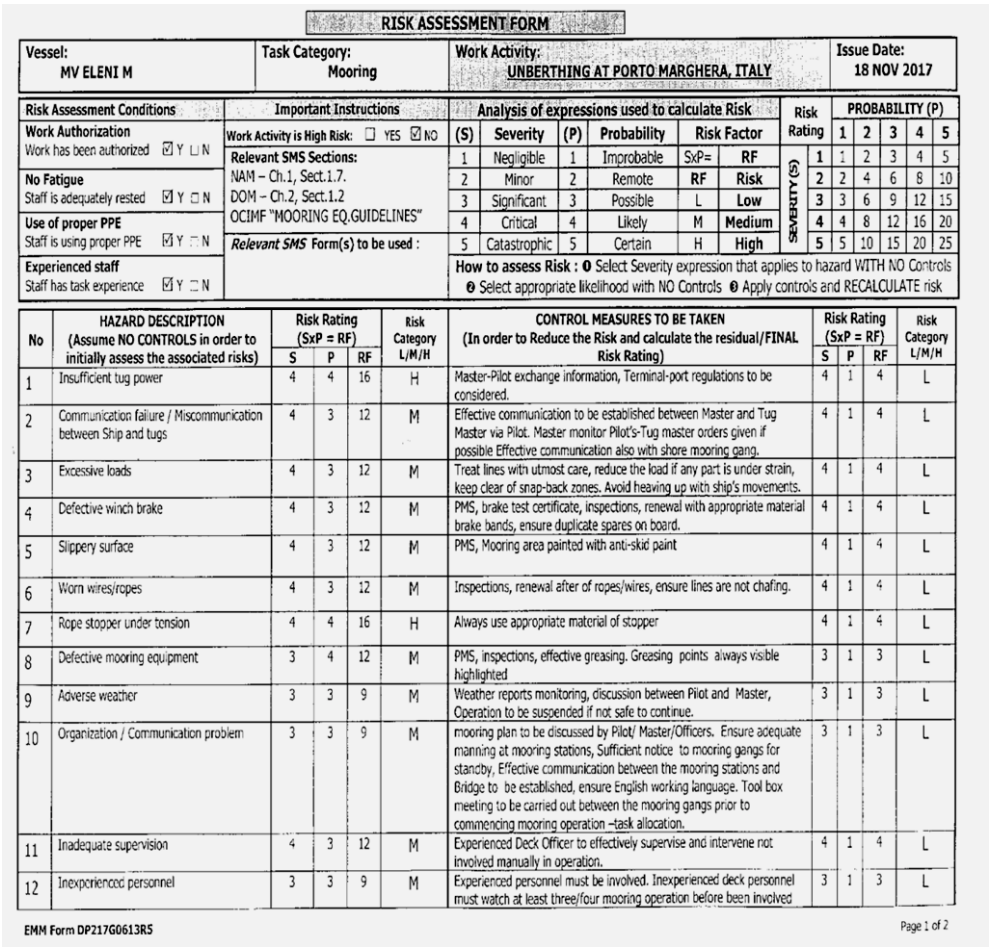
New rope shall always be taken out of a coil in an anti-clockwise direction to avoid disturbing the lay of the rope. If the coil can be suspended on a swivel, rotated, and the rope taken from outside the coil, kinks in the rope will be avoided. Sharp angles in the rope shall be avoided. It is important when wire is being joined to any natural or synthetic fibre rope that a thimble be inserted in the eye of the fibre portion and that both wire and rope shall have the same direction of lay. Ensure that all splices are intact and never allow a wire to cross a fibre rope on a bollard, and try to keep wires and ropes in different fairleads and bitts.

1.4 HANDLING, INSPECTION AND REMOVAL FROM SERVICE OF WIRE MOORING LINES

1.4.1 Prevent kinking of lines. When unreeling, the reel shall be mounted on a spindle and the line pulled directly off the reel, not over the end. If a loop forms, it shall be thrown out immediately, before any load is placed on the line.

1.4.2 Wire lines shall be lubricated periodically. Proper lubrication reduces the abrasive effect of individual wires sliding against one another and helps to prevent corrosion. Wire lines are lubricated during manufacture, but his initial treatment is lost during use, particularly in marine applications. Ideally, the line shall be lubricated every two or three months. Several patent varieties of wire line oil are available and the lubricant may be brushed on or a box lubricator used. Mooring line manufacturer's recommendations shall be followed.

Annex 4: Risk assessment form



RISK ASSESSMENT FORM

Vessel:	Task Category:	Work Activity:	Issue Date:
MV ELENI M	Mooring	UNBERTHING AT PORTO MARGHERA, ITALY	18 NOV 2017

Risk Assessment Conditions

- **Work Authorization** — Work has been authorized ☑ Y ☐ N
- **No Fatigue** — Staff is adequately rested ☑ Y ☐ N
- **Use of proper PPE** — Staff is using proper PPE ☑ Y ☐ N
- **Experienced staff** — Staff has task experience ☑ Y ☐ N

Important Instructions

Work Activity is High Risk: ☐ YES ☑ NO

Relevant SMS Sections:
NAM – Ch.1, Sect.1.7.
DOM – Ch.2, Sect.1.2
OCIMF "MOORING EQ.GUIDELINES"

Relevant SMS **Form(s) to be used :**

Analysis of expressions used to calculate Risk

(S)	Severity	(P)	Probability	Risk Factor	
1	Negligible	1	Improbable	SxP=	RF
2	Minor	2	Remote	RF	Risk
3	Significant	3	Possible	L	Low
4	Critical	4	Likely	M	Medium
5	Catastrophic	5	Certain	H	High

How to assess Risk : ❶ Select Severity expression that applies to hazard WITH NO Controls ❷ Select appropriate likelihood with NO Controls ❸ Apply controls and RECALCULATE risk

Risk Rating	PROBABILITY (P) 1	2	3	4	5
SEVERITY (S) 1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

No	HAZARD DESCRIPTION (Assume NO CONTROLS in order to initially assess the associated risks)	Risk Rating (SxP = RF) S	P	RF	Risk Category L/M/H	CONTROL MEASURES TO BE TAKEN (In order to Reduce the Risk and calculate the residual/FINAL Risk Rating)	Risk Rating (SxP = RF) S	P	RF	Risk Category L/M/H
1	Insufficient tug power	4	4	16	H	Master-Pilot exchange information, Terminal-port regulations to be considered.	4	1	4	L
2	Communication failure / Miscommunication between Ship and tugs	4	3	12	M	Effective communication to be established between Master and Tug Master via Pilot. Master monitor Pilot's-Tug master orders given if possible Effective communication also with shore mooring gang.	4	1	4	L
3	Excessive loads	4	3	12	M	Treat lines with utmost care, reduce the load if any part is under strain, keep clear of snap-back zones. Avoid heaving up with ship's movements.	4	1	4	L
4	Defective winch brake	4	3	12	M	PMS, brake test certificate, inspections, renewal with appropriate material brake bands, ensure duplicate spares on board.	4	1	4	L
5	Slippery surface	4	3	12	M	PMS, Mooring area painted with anti-skid paint	4	1	4	L
6	Worn wires/ropes	4	3	12	M	Inspections, renewal after of ropes/wires, ensure lines are not chafing.	4	1	4	L
7	Rope stopper under tension	4	4	16	H	Always use appropriate material of stopper	4	1	4	L
8	Defective mooring equipment	3	4	12	M	PMS, inspections, effective greasing. Greasing points always visible highlighted	3	1	3	L
9	Adverse weather	3	3	9	M	Weather reports monitoring, discussion between Pilot and Master, Operation to be suspended if not safe to continue.	3	1	3	L
10	Organization / Communication problem	3	3	9	M	mooring plan to be discussed by Pilot/ Master/Officers. Ensure adequate manning at mooring stations, Sufficient notice to mooring gangs for standby, Effective communication between the mooring stations and Bridge to be established, ensure English working language. Tool box meeting to be carried out between the mooring gangs prior to commencing mooring operation –task allocation.	3	1	3	L
11	Inadequate supervision	4	3	12	M	Experienced Deck Officer to effectively supervise and intervene not involved manually in operation.	4	1	4	L
12	Inexperienced personnel	3	3	9	M	Experienced personnel must be involved. Inexperienced deck personnel must watch at least three/four mooring operation before been involved	3	1	3	L

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RISK ASSESSMENT FORM

						under close supervision by the responsible Officer. Frequent training on mooring operation procedures.				
13	Winch motor oil leaks	3	4	12	M	PMS, mooring area kept oil free, scuppers closed.	3	1	3	L
14	Inappropriate mooring arrangements	4	3	12	M	Mooring arrangement to be as per deck operational manual ch 3 section 1.11 and chapter 3.	4	1	4	L
15	Wrong operation of winch	3	3	9	M	Mooring winches to be operated by experienced persons/ heave/pay out direction to be stenciled on the winch, appropriate signals for winch operator, continuous eye-sight between Officer in charge and winch operator. Winch operator shall never move off the operating handle.	3	1	3	L
16	Mixed mooring lines (synthetic fiber/wire)	3	3	9	M	Mixing ropes/wires not to be used where applicable.	3	1	3	L
17	Darkness	3	3	9	M	Mooring stations to be adequately illuminated, intrinsically safe flash lights to be used.	3	1	3	L
18	Incorrect reeling on the drum	3	4	12	M	If split drum winch on board ensure split drum is used with one layer only, ensure straight reeling on drums.	3	1	3	L
19	Inappropriate mooring layout	3	3	9	M	Effective mooring to be attained.	3	1	3	L
20	Rope caught on the jetty while unmooring	4	4	16	H	Avoid vessel movement before all lines are in, keep always clear from the bight of a rope.	4	1	4	L
21	Rope caught by propeller	4	4	16	H	Proper communication between the Officer in charge aft and the Bridge check that the propeller is clear before any movement, lines not to be slackened uncontrollable and below the sea surface.	4	1	4	L

Alternative methods of task completion: