



**HELLENIC REPUBLIC
HELLENIC BUREAU FOR MARINE CASUALTIES INVESTIGATION
MARINE CASUALTY SAFETY INVESTIGATION REPORT**

07/2014

**FATAL FALL OF BOSUN
FROM THE DECK CRANE OF B/C «PANORIA»**



January 2017

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Foreword

The Hellenic Bureau for Marine Casualties Investigations was established by Law 4033/2011 (Government Gazette 264/22.12.2011), in the context of implementing EU Directive 2009/18/EC. HBMCI conducts technical investigations into marine casualties or marine incidents with the sole objective to identify and ascertain the circumstances and contributing factors that caused it through analysis and to draw useful conclusions and lessons learned that may lead, if necessary, to safety recommendations addressed to parties involved or stakeholders interested in the marine casualty, aiming to prevent or avoid similar future marine accidents.

The conduct of Safety Investigations into marine casualties or incidents is independent from criminal, discipline, administrative or civil proceedings whose purpose is to apportion blame or determine liability. This investigation report has been produced without taking under consideration any administrative, disciplinary, judicial (civil or criminal) proceedings and with no litigation in mind. It does not constitute legal advice in any way and should not be construed as such. It seeks to understand the sequence of events occurred on the 01st of December 2014 and resulted to the examined very serious marine casualty. Fragmentary or partial disposal of the contents of this report, for other purposes than those produced may lead to misleading conclusions. The investigation report has been prepared in accordance with the format of Annex I of respective Law (Directive 2009/18/EC) and all times quoted are Local Time (LT= GMT-6) unless otherwise stated.

Under the above framework, HBMCI has been examining the Bosun's fatal fall from the cargo crane of B/C "Panoria", occurred on the 1st of December 2014 at Brownsville Texas, USA. This report is mainly based on information and evidence that have been derived from the interview process and information collected from those individuals involved in the marine casualty. Commission Regulation (EU) No 1286/2011/Annex/paragraphs 4.2 & 4.31 have been applied also in order to properly identify casual and contributing factors which led to the marine accident.

¹ **Abstract from Commission Regulation 1286/2011.**

4.2 *Proper identification of causal factors requires timely and methodical investigation, going beyond the immediate evidence and looking for underlying conditions, which may be remote from the site of the marine casualty or incident, and which may cause other future marine casualties and marine incidents. Marine safety investigations should therefore in principle serve as a means of identifying not only immediate causal factors but also conditions that may be present in the whole operational process. To achieve this, the analysis of the evidence collected shall be thorough and iterative.*

4.3 *If a gap of information cannot be resolved and is filled in by logical extrapolation and reasonable assumptions, such extrapolation and assumptions shall be made clear in the wording of the report. A useful tool in this process can be the identification of all options and their analytical reduction to reach the most likely hypotheses.*

Glossary of abbreviations and acronyms

1.	AB	Able seaman
2.	B/C	Bulk Carrier
3.	bfrs	Force of wind in beauford scale
4.	BHP	Brake Horse Power
5.	CoC	Certificate of Competency
6.	CBP	Customs and Border Protection
7.	C/O	Chief Officer
8.	DOC	Document of Compliance
9.	GMT	Greenwich Mean Time
10.	gt	Gross Tonnage
11.	IMO	International Maritime Organization
12.	ILO	International Labor Organization
13.	ISM	International Management Code for the safe operation of ships and for pollution prevention
14.	kN	KiloNewton
15.	Kn(s)	Knot(s), measuring unit of speed equal to one nautical mile (1.852 km) per hour
16.	LT	Local time
17.	m	Meters
18.	MT	Metric Tones
19.	nm	nautical miles
20.	O(s)OW	Officer(s) on the watch
21.	OS	Ordinary Seaman
22.	P.D.	Presidential Decree. Rule of law issued by the Head of State
23.	PMS	Planned Maintenance System
24.	PPE	Personal Protective Equipment such as helmet, gloves, suitable shoes, ear plugs, etc.
25.	RPM	Revolutions Per Minute
26.	SMC	Safety Management Certificate
27.	SMS	Safety Management System
28.	SOLAS	Convention for the Safety of Life at Sea 1974, as amended
29.	STCW	International Convention on Standards of Training, Certification and Watch keeping for seafarers
30.	UMS	Unmanned Machinery Space
31.	USCG	United States Coast Guard
32.	°	degrees (of angle)

1. Executive Summary

On 30 November 2014, at approximately 22:30, the Greek flagged B/C "*Panoria*" berthed at Brownsville Texas, USA laden with steel slabs from Novorossiysk, Russia. The cargo discharge operations were scheduled for the following day morning hours using *Panoria*'s deck cranes.

Early morning hours, on 01 December 2014, the stevedores' superintendent, and shore safety personnel boarded on the vessel to review *Panoria*'s cargo gear condition and documentation and permit the deck crane operation. During said cargo gear inspection some broken wires were observed at the load hoist wire of No.2 deck crane and operation permit could not be granted unless the hoist wire was replaced.

Vessel's crew started the preparation for the replacement of the crane wire at around 10:30. They had one hour lunch break at 12:00 and continued with the replacement of the wire at 13:00. At approximately 15:25, the one end of the old wire was connected with the new wire and the crew started winding the old wire rope at low speed. However, the connecting piece of the two wires got snagged on a transverse (cross section) of the crane's jib. The Bosun who was standing at the crane's platform directly below the control cabin, walked out onto the crane's boom wearing a safety harness and moved towards the cross section to un snag the connecting piece. When he reached to the cross section he attached his safety harness to the old wire that was being replaced. While he was standing on the jib's cross section he lost his balance and fell from a height of 9.5 meters on the cargo hold's hatch cover. The safety harness did not prevent his fall as the old wire rope was not secured to any fixed point and was hanging free.

No one saw the exact movements of the Bosun while attempting to release the wire apart from one AB standing on the main deck, at the top of the cargo hold hatch cover No.3 who was the only crew member that witnessed the Bosun's fall from the crane boom. The AB reported immediately the accident to the Chief Officer who was inside the control cabin. The C/O reported immediately to the master and headed to the hospital room to bring the stretcher and the oxygen respirator. At the same time a port policeman noticed the incident from the shore and got on board. He instructed the crew not to move the Bosun until the arrival of the emergency services which already had being informed.

Brownsville medical service team members got on board approximately after 20 minutes, however Bosun's condition was very serious and their efforts to keep him alive were unsuccessful. Shortly after the medical team's arrival on site the Bosun was pronounced dead. According to the post mortem report Bosun's death was caused by severe injuries on his head and his back.

At 17:55 the local authorities transferred the Bosun's body ashore. Cargo operations had stopped earlier and all stevedores disembarked from the vessel at approximately 16:12. The following days the vessel completed the cargo discharging operations and sailed for China where HBMCI investigation team boarded.

2. Factual Information

2.1 Vessel's Particulars

Name of vessel	PANORIA
Type of vessel	Bulk Carrier
Nationality/flag	Greece
Port of registry	Piraeus
IMO number	9480930
Call sign	SVAA9
Managing company	MAGNA MARINE INC.
Year built	02/2008
Shipyard	IWAGI ZOSEN CO LTD -JAPAN
Hull material	Steel
Hull design	Single hull
Length (overall)	189,94 m
Breadth (moulded)	32,26 m
Gross tonnage	30004
Deadweight (summer)	53514 metric tones
Draft (summer)	12.303 m
Main Engine power	MITSUI MAN B&W 6S50MC-C (MARK VII), 12,893 bhp X 127 rpm – 10,962 bhp X 120 rpm
Service speed	14.50 knots - Ballast condition 14.00 knots - Laden condition
Holds/Hatches(Type - Dimensions)	5/5 (Folding type- Weather tight steel hatch cover- 21.12 X 17.60 m. each)
Cranes/Makers/Dimensions	4 sets X 30,5 MT / MITSUBISHI Electro Hydraulic X 26 m each - Outreach: about 10 m
Classification society	Lloyd's Register
SMC (issued by)	Lloyds Register
Minimum Safe Manning	11



Figure 1: Vessel’s berthing position at Brownsville, Texas, USA (Source: MARICOT INC)

2.2 Environmental conditions

Wind – direction	West - 3 knots
Sea State	Calm
Visibility	Good
Light/dark	Light
Current	N/A
Temperature	21° C

2.3 Voyage particulars

Port of origin	Novorossiysk, Russia
Port of call	Brownsville, Texas USA
Type of voyage	International
Cargo information	Steel slabs
Crew on board	20

2.4 Marine casualty information

Type of marine incident	Very Serious Marine Casualty
Date, time	01 December 2014, at 15:35 LT
Location	Brownsville, Texas USA
Voyage segment	Berthed alongside Dock No.15
Ship's operation	Replacement of deck crane's hoist wire
Place on board	Cargo Crane No.2
Consequences to individuals, environment and property	Death of Bosun

3. Narrative

3.1 Arrival at Brownsville

Bulk Carrier "Panoria", loaded with 44,000 MT cargo of steel slabs from Novorossiysk, Russia approached to the port of Brownsville, Texas, USA, early evening hours on Sunday 30 November 2014. At approximately 19:00 crew was on ST/BY and the vessel arrived at the canal entrance. The port pilot boarded Panoria and the vessel proceeded to the berthing position under the escort of two tugs. She was safely berthed at around 22:30.

Upon arrival a team of five inspectors from "Customs and Border Protection Service" boarded the vessel at 22:37. Prior to any discharge operation, the vessel had to be inspected for Asian Gypsy Moth² also, in terms of the standard arrival formalities. The Asian Gypsy Moth inspection was completed at approximately 09:00 of the following day and the vessel was cleared to proceed with cargo unloading operations, which were arranged to commence using the vessel's deck cranes operated by shore side crane operators.

At approximately 10:00 on the 1st of December 2014, a stevedore's safety inspector along with two other shore side personnel boarded the vessel to inspect the cargo gear and its documentation in order to permit the deck crane operation. During the cargo gear documentation review it was observed that the last annual inspection was carried out on 05 October 2013, almost one year and 2 months ago. Moreover, the next annual inspection's due date was not recorded to the dedicated field of the vessel's cargo gear book. Panoria's crew clarified that under the respective Greek legislation a ± 3 month time period is applied to the

² Asian Gypsy Moth (AGM) is a serious pest that can be carried on the superstructure of ships and cargo. AGM populations are prevalent in some seaport areas in Far East Russia, Japan, Korea, and Northern China. If introduced, AGM would pose a significant risk to the North American plant resource base, businesses that rely on plant resources, and to market access. Vessels must arrive to North American ports with required pre-departure certification and free of AGM (Notice 03/2013 by US Department of Agriculture and Canadian Food Inspection Agency).

annual inspection due date and the inspection team proceeded with the inspection of deck cranes according to the stevedore's safety guidelines.

During the aforementioned crane inspection some broken wires of a strand of the hoist wire rope of No 2 crane were found broken. It was reported that the number of the broken wires were not more than 3. Said broken wires were located at the hoist drum inside the crane tower at the bottom winding part of the cable. The stevedore's requested the replacement of the hoist cable in order to permit the crane operation, while Panoria's crew claimed that considering the wire type, 2 or 3 broken wires of a strand do not stand as clear ground for the cable's replacement. After a short discussion between the master and the stevedore's representatives, at around 10:30 the replacement of the hoist wire of No.2 deck crane was agreed. The crew prepared the crane by lowering the jib to its rest stand, over the closed hatch cover of No. 3 cargo hold.

According to information derived from the interview process, the hoist cable replacement would not affect the vessel's discharging operation as the use of the other three cranes, for unloading cargo holds 1,2,4,5 in sequence respectively was scheduled according to the unloading plan.

3.2 Hoist wire replacement

The working team for the replacement of No 2 deck crane hoist wire comprised the C/O, Bosun, four AB's and the electrician. Before starting any operation, the C/O prepared a risk assessment, according to the vessel's SMS provisions and the relevant permit for working aloft was signed by C/O and the Master. The wire replacement procedure started at approximately 11:00 and comprised three stages.

First stage involved the preparation and checking of the safety equipment and tools required for the task and the proper arrangement of the new wire on main deck. The crew brought the new wire from the vessel's storage compartment in the forecastle and laid it down carefully avoiding any torsions or damage.

Second stage involved working aloft operations. A team consisting by C/O, Bosun and one AB, disconnected the thimble of the old wire from its fixed point on top of the crane house. The old wire was lowered down on deck and was cut near the thimble so as the old wire would be connected with the new wire and reeved through the sheaves on the crane. At 12:00 the crew had a lunch break and started again at 13:00.

The last stage of the process involved the connection of the two wires and the winding of the old wire, until it was taken out from the crane and the new wire reached the hoist drum inside the crane house. The position and task of the involved crew members is projected at Table 1.

Table 1

Crew Member	Position	Task
1 C/O	Inside control cabin	Operating the controls (heaving or slacking the wire)
2 Bosun	Crane platform below the control cabin	Monitoring the winding process and report the progress to the C/O
3 Two AB's	At the hoist drum inside the crane tower	Paying out the old wire and arranging the new wire's winding on the drum
4 One AB	On top of No.3 cargo hold hatch cover	Handling and greasing the new wire coming in
5 One O/S, one Cadet	On top of No.2 cargo hold hatch cover	Reeling the old wire coming from the crane tower back door

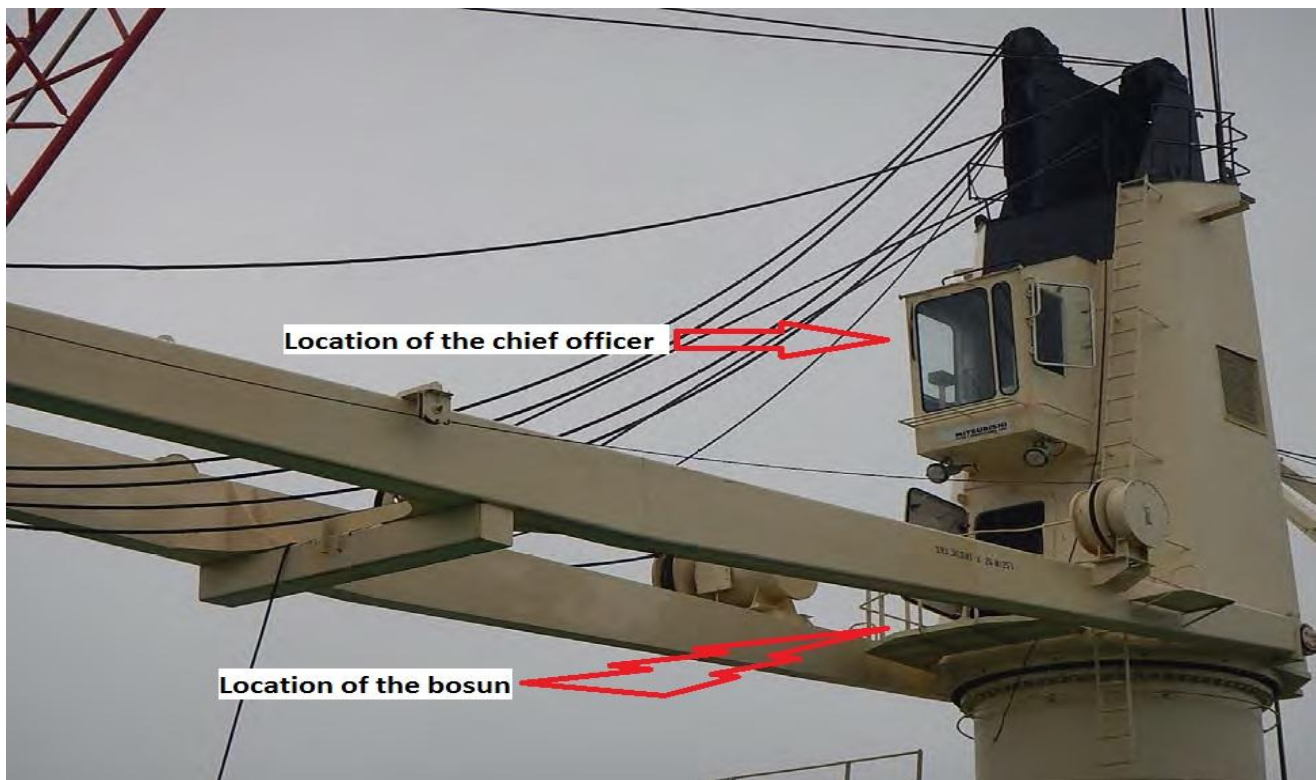


Figure 2: The location of the Chief Officer and the Bosun during the wire replacement procedure.

At approximately 15:25, the new wire was connected with the old wire using a connecting sleeve and the crew started winding the old wire at low speed. At that time the Bosun who was at the crane's platform monitoring the process told the C/O to stop the operation of the hoist winch due to a problem at the hoist drum. C/O stopped the operation of the crane and looked into the crane tower where the two ABs and the Bosun were arranging the cable on the hoist drum.

However, at the same time the connecting sleeve got snagged while passing the corner of the horizontal cross section member of the jib (figure 3). C/O didn't notice that the connection sleeve got snagged at the jib's cross section, while Bosun did not reported it to him.



Figure 3: The point where the wire sleeve got snagged.

Without notifying the C/O, Bosun jumped over the crane's platform railing, walked onto the left side of the crane's jib and crawled towards the cross section to release the connection sleeve (Figure 4). His attempt to release the wire was noticed only by the AB stationed at the top of No.3 cargo hold hatch cover (Figure 5).

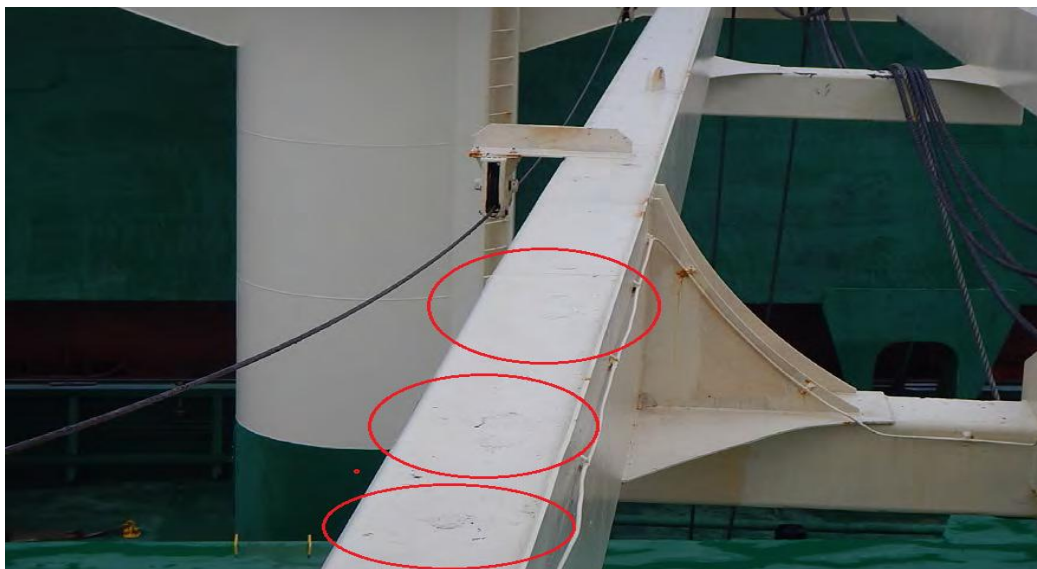


Figure 4: Bosun's footprints after walking out on the left hand side of the crane boom as viewed from the crane platform (source: MARICOT INC)



Figure 5: View of the inner and outer crane area from the position of the C/O.

When Bosun reached the jib's cross section he hooked his fall arrester to the old wire that was being replaced. When he managed to release the wire rope he lost his balance and fell from a height of 9.5 meters on the hatch cover (Figure 6). His safety harness which was secured on the old wire could not restrain his fall.



Figure 6 : The location where the Bosun fell on top of cargo hatch cover No.3 (source: MARICOT INC)

3.3 Accident response

The AB who was on No.3 hatch cover was the only crew member to see the Bosun's fall. He immediately reported the accident to the C/O and run towards the Bosun who was still conscious and asked the AB to remove his safety belt. The C/O immediately informed the

Master and run to the vessel's hospital to take the stretcher and first aid medical equipment. Consequently, approximately at 15:35 an attending port policeman boarded and advised the crew not to move the casualty until the arrival of paramedics who already had been notified from the Master and the shore personnel. At approximately 16:00 a fully equipped ambulance arrived on scene and medical personnel came on board to provide medical assistance. Unfortunately by that time Bosun's condition was critical and he died after a few minutes.

Bosun's body was transferred to shore at 17:55 and the area remained secured by the local authorities until the following day. Alcohol breathing tests were performed to the involved crew members by the local authorities with negative results³.

Cargo discharging operations were suspended immediately after the accident at about 15:40, and the stevedores left from the vessel at approximately 16:12. On the 3rd of December No.2 crane was inspected and entered into service for the unloading operations.

4. Analysis

The analysis of the examined marine casualty aims to identify the causes and factors that contributed to the marine casualty, taking into account the sequence of events and the collection of investigation information in order to draw useful conclusions leading to safety recommendations. HBMCI's Investigation Team boarded Panoria at China by the end of January 2015 so as to examine the scene of the casualty, interview the involved crew members and collect necessary information for the casualty analysis.

4.1 Panoria's deck cranes

Panoria is a standard design bulk carrier with 5 cargo holds located forward of the accommodation superstructure. She is equipped with four 30MT electro-hydraulic deck cranes manufactured by Mitsubishi Heavy Industries LTD, and four grabs of adjustable capacity 6m³-12m³ (Figure 7).

³ According to the USCG Report of Required Chemical Drug and Alcohol testing following a serious marine incident Ref. no. OMB 1625-0001.

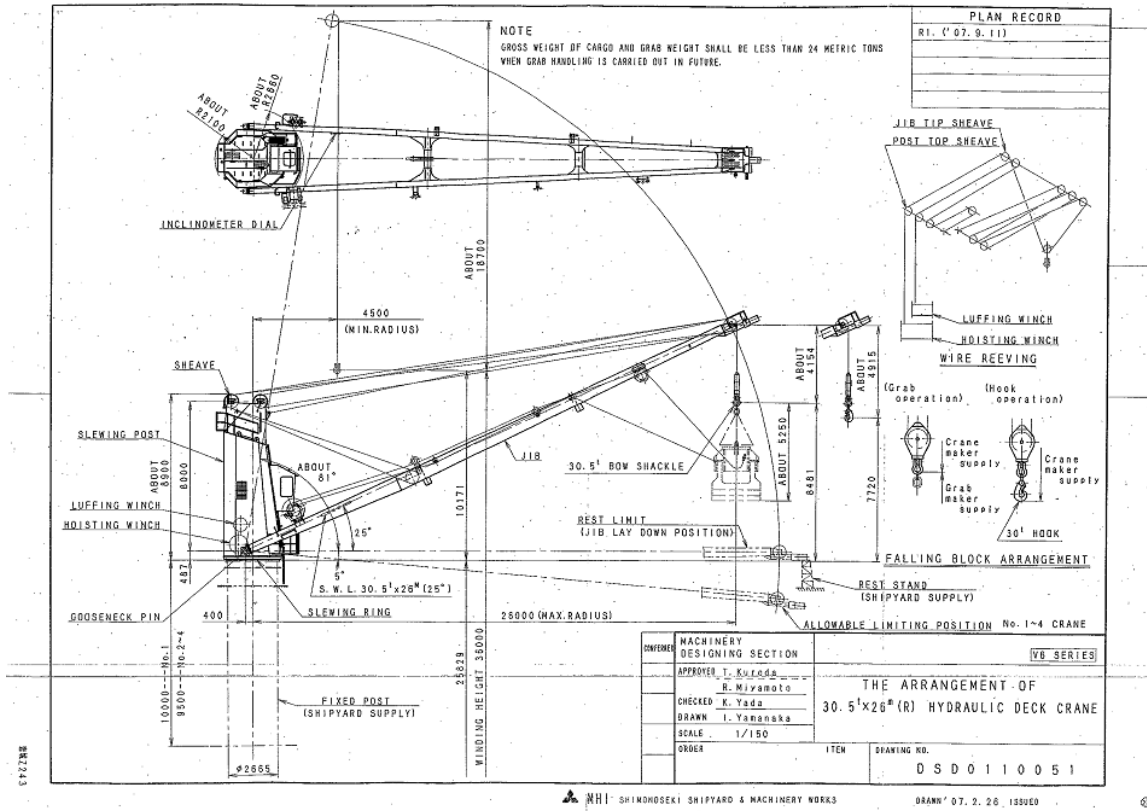


Figure 7 : General Arrangement of Panoria’s Deck Crane.

4.2 Hoisting wire rope

The wire rope that was to be replaced was part of four similar cables delivered in four reels on board on 13th January 2010 and stowed for the replacement of the old hoist wires of Panoria’s deck cranes. According to the vessel’s records the hoisting wire of the No.2 crane had been replaced on 28 October 2011. Since then and until the day of the casualty No.2 deck crane operated for 870 hours. The technical specifications of the wire rope are presented in Table 2 below. A sample of the hoisting wires had been tested, and a test certificate had been issued on 23 July 2009. Based on the said Certificate the sample wire broke at 908.55kN.

Table 2

Hoist wire rope technical specifications	
Manufacturer	KISWIRE LTD
Material	Galvanized steel
Lenght	2000m
Diameter	33,5mm
No. of strands	4
No. of wires per strand	39
Core type	Fiber core

Lay direction	Right hand regular lay ⁴
Lay length	249,3mm
Specified breaking load	778,00kN

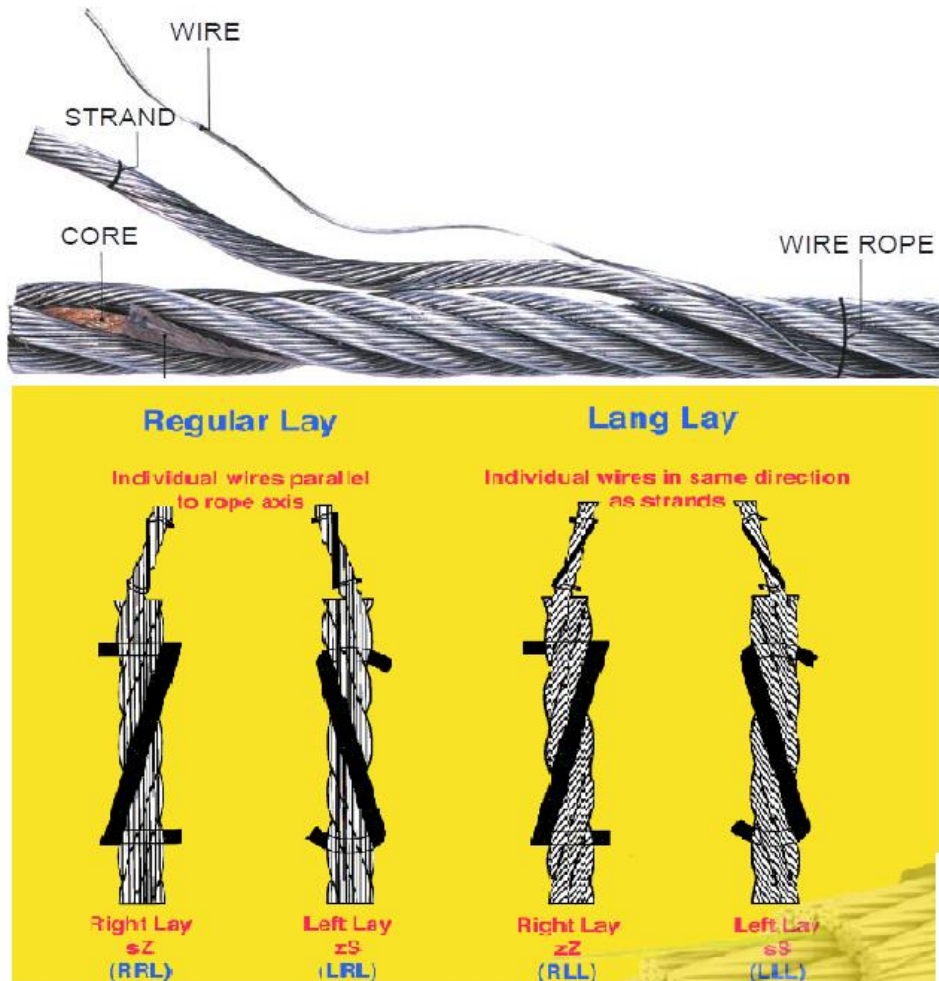


Figure 9: Wire rope composed of different strands of wound steel wires and the rope lay directions.

4.3 Decision making for wire replacement

4.3.1 Panoria’s deck crane documentation

.1 Certification: Under the general provisions of art. 4 of ILO Convention No. 134, vessel’s cargo gear is regulated by national legislative framework. On Greek registered vessels Cargo Gear safe operation is regulated by P.D. No. 316/2001 “Inspection Regulation for vessels’ lifting appliances” (Official Government Gazette No. A’ 212/2001) which, inter alia, sets the requirements for the inspection of lifting appliances in order to certify that they can operate

⁴ The lay direction of the strands in a rope can be right (symbol Z) or left (symbol S) and the lay direction of the wires can be right (symbol z) or left (symbol s). A rope is called “regular lay rope” when the lay direction of the wires in the outer strands is in the opposite direction to the lay of the outer strands themselves. If both the wires in the outer strands and the outer strands themselves have the same lay direction, the rope is called “lang lay rope” (formerly Albert’s lay or Lang’s lay).

without danger to the crew, the crane operators and the workers in general. According to aforementioned regulation, Panoria was carrying a Certificate of Fitness for her Cargo Gear issued by Lloyds Register (LR) on 06/10/2012, valid until 05/10/2017 and subject to periodical annual surveys. Said certificate recorded the deck cranes' safe working load to be 30,5 MT and that they had been tested under a proof load of 35,5 MT, with an angle of 25° to the horizontal, over a length of 26 meters of the crane's boom. The last annual inspection recorded on the aforementioned Certificate was on 05 October 2013 carried out at Singapore.

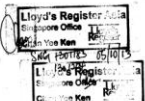
According to aforementioned legislative framework, the mandatory annual inspections of the lifting appliances may be carried out within a time period of ± 3 months from the anniversary date of expiration of the Certificate of Fitness of Cargo Gear. Conclusively, the annual inspection of the Panoria's deck cranes was at the time of the casualty, within the applicable timeframe period for the year 2014, since it could be carried out from 5th July 2014 until 5th January 2015.

.2 Cargo Gear book: According to the P.D. 316/2001, Panoria was carrying a Cargo Gear Book issued by the vessel's Classification Society (LR) on 12/06/2008. All carried out inspections of the vessel's cargo gear are recorded to the aforementioned Book, including initial inspections for the issuance of the Certificate of Fitness, annual surveys, as well as inspections after damages and repairs. Apart from the above, the Cargo Gear Book provides a separate field where the next periodical survey's due date is recorded. The recent recordings of Panoria's Cargo Gear Book, previous to the examined marine casualty, included an after repair inspection of deck crane No.1 carried out in Singapore on 05/10/2013 and an annual survey carried out on the same date in Singapore as well. It is noted that for said recordings on Panoria's Cargo Gear Book, the due date of the next inspection was not recorded to the Book's appropriate field (Figure 8). Furthermore, the post to the examined marine casualty annual survey which was carried out on 11/12/2014 in New Orleans was recorded to the Certificate of Fitness of Cargo gear but wasn't recorded to the Cargo Gear Book as well. Said survey was recorded to the Cargo Gear Book by the Classification Society's Office in China later on; however the next inspection's due date was missing. It is noted that an examination of Panoria's Cargo Gear Book past recordings revealed that the initial inspection carried out on 12/06/2008 by the Classification Society's Piraeus Office had been recorded to the Cargo Gear Book properly whereas the next inspection's due date stating also the applied ± 3 month time period was also recorded (Figure 9).

ΒΙΒΛΙΟ ΕΠΙΘΕΩΡΗΣΗΣ ΑΝΥΨΗΤΙΚΩΝ ΜΕΣΩΝ
ΦΟΡΤΙΝ ΣΤΑΘΩΝ ΑΝΩ ΤΩΝ 100 ΚΤΩ
CARGO GEAR BOOK OF CARGO SHIPS OVER 100 G.T.

ΣΗΜΕΙΩΣΗ
Οι επιθεωρήσεις που θα αναγράφονται στην στήλη 3 παραλαμβάνουν:
- Αρχική
- Ετήσια
- Πενταετής (ανά 5 έτη)
- Επισκευτή / Ζημιά
- Άλλη

Note
The thorough examinations to be indicated in column 3 include:
- Initial
- 12-monthly
- Five-yearly
- Repair / Damage
- Other thorough examinations

1. Περιγραφή του αναψυκτικού αλυσού που επιθεωρήθηκε (Αριθμός ή ορισμός αν υπάρχει). Situation and description of Loose Gear (with distinguishing numbers or marks, if any) which have been thoroughly examined.	2. Αριθμός πιστοποιητικών παραλαβών. Certificate Nos.	3. Διεγερθήκε επιθεώρηση (βλ. Σημείωση 1) Examination performed (see Note)	4. Βεβαιώνω ότι κατά την παραπάνω περιγραφή, το αναψυκτικό αλυσό στην στήλη 1 επιθεωρήθηκε και δε βρέθηκαν ελλείψεις ή ανωμαλίες που να επηρεάζουν την ασφαλή λειτουργία του, εκτός από αυτά που αναγράφονται στην στήλη 5. (Ημερομηνία, υπογραφή και σφραγίδα) I certify that on the date to which I have appended by signature, the Loose Gear shown in column 1 were thoroughly examined and no defects affecting its safe working condition were found other than those shown in column 5 (Date, stamp and signature)	5. Παρατηρήσεις (Ημερομηνία, υπογραφή) Remarks (to be dated and signed)	6. Ημερομηνία επόμενης ασφαλιστικής επιθεώρησης. Next examination due date
DECK CRANE NO 1 DECK CRANE NO 2 DECK CRANE NO 3 DECK CRANE NO 4 GENERAL USE CRANE P-SIDE GENERAL USE CRANE STBD CR CRANE CRANE		12-MONTHLY			

ΒΙΒΛΙΟ ΕΠΙΘΕΩΡΗΣΗΣ ΑΝΥΨΗΤΙΚΩΝ ΜΕΣΩΝ
ΦΟΡΤΙΝ ΣΤΑΘΩΝ ΑΝΩ ΤΩΝ 100 ΚΤΩ
CARGO GEAR BOOK OF CARGO SHIPS OVER 100 G.T.

ΣΗΜΕΙΩΣΗ
Οι επιθεωρήσεις που θα αναγράφονται στην στήλη 3 παραλαμβάνουν:
- Αρχική
- Ετήσια
- Πενταετής (ανά 5 έτη)
- Επισκευτή / Ζημιά
- Άλλη

Note
The thorough examinations to be indicated in column 3 include:
- Initial
- 12-monthly
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- Other thorough examinations

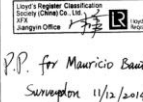
1. Περιγραφή του αναψυκτικού αλυσού που επιθεωρήθηκε (Αριθμός ή ορισμός αν υπάρχει). Situation and description of Loose Gear (with distinguishing numbers or marks, if any) which have been thoroughly examined.	2. Αριθμός πιστοποιητικών παραλαβών. Certificate Nos.	3. Διεγερθήκε επιθεώρηση (βλ. Σημείωση 1) Examination performed (see Note)	4. Βεβαιώνω ότι κατά την παραπάνω περιγραφή, το αναψυκτικό αλυσό στην στήλη 1 επιθεωρήθηκε και δε βρέθηκαν ελλείψεις ή ανωμαλίες που να επηρεάζουν την ασφαλή λειτουργία του, εκτός από αυτά που αναγράφονται στην στήλη 5. (Ημερομηνία, υπογραφή και σφραγίδα) I certify that on the date to which I have appended by signature, the Loose Gear shown in column 1 were thoroughly examined and no defects affecting its safe working condition were found other than those shown in column 5 (Date, stamp and signature)	5. Παρατηρήσεις (Ημερομηνία, υπογραφή) Remarks (to be dated and signed)	6. Ημερομηνία επόμενης ασφαλιστικής επιθεώρησης. Next examination due date
ALL LIFTING APPLIANCE	NOS 1400338	12-MONTHLY	 P.P. for Mauricio Baezista Savannah 11/2/2014		

Figure 8: Abstract from Panoria’s Cargo Gear Book showing the recording of the annual surveys carried out on 05/10/2013 and 11/12/2013. The last field indicating the next inspection’s due date is not filled.

ΒΙΒΛΙΟ ΕΠΙΘΕΩΡΗΣΗΣ ΑΝΥΨΗΤΙΚΩΝ ΜΕΣΩΝ
ΦΟΡΤΙΝ ΣΤΑΘΩΝ ΑΝΩ ΤΩΝ 100 ΚΤΩ
CARGO GEAR BOOK OF CARGO SHIPS OVER 100 G.T.

ΣΗΜΕΙΩΣΗ
Οι επιθεωρήσεις που θα αναγράφονται στην στήλη 3 παραλαμβάνουν:
- Αρχική
- Ετήσια
- Πενταετής (ανά 5 έτη)
- Επισκευτή / Ζημιά
- Άλλη

Note
The thorough examinations to be indicated in column 3 include:
- Initial
- 12-monthly
- Five-yearly
- Repair / Damage
- Other thorough examinations

1. Περιγραφή του αναψυκτικού αλυσού που επιθεωρήθηκε (Αριθμός ή ορισμός αν υπάρχει). Situation and description of Loose Gear (with distinguishing numbers or marks, if any) which have been thoroughly examined.	2. Αριθμός πιστοποιητικών παραλαβών. Certificate Nos.	3. Διεγερθήκε επιθεώρηση (βλ. Σημείωση 1) Examination performed (see Note)	4. Βεβαιώνω ότι κατά την παραπάνω περιγραφή, το αναψυκτικό αλυσό στην στήλη 1 επιθεωρήθηκε και δε βρέθηκαν ελλείψεις ή ανωμαλίες που να επηρεάζουν την ασφαλή λειτουργία του, εκτός από αυτά που αναγράφονται στην στήλη 5. (Ημερομηνία, υπογραφή και σφραγίδα) I certify that on the date to which I have appended by signature, the Loose Gear shown in column 1 were thoroughly examined and no defects affecting its safe working condition were found other than those shown in column 5 (Date, stamp and signature)	5. Παρατηρήσεις (Ημερομηνία, υπογραφή) Remarks (to be dated and signed)	6. Ημερομηνία επόμενης ασφαλιστικής επιθεώρησης. Next examination due date
DECK CRANE AT FORWARD NO. 14 (C) 2-A-1-1-2013 DECK CRANE AT FORWARD NO. 133 (C) 2-A-1-1-2013 DECK CRANE AT FORWARD NO. 202 (C) 2-A-1-1-2013 DECK CRANE AT FORWARD NO. 62 (C) 2-A-1-1-2013 GENERAL USE CRANE AT FORWARD NO. 14 (C) 2-A-1-1-2013 GENERAL USE CRANE AT FORWARD NO. 23 (C) 2-A-1-1-2013		INITIAL	ACCEPTED BY LR ON BEHALF OF HELLERIC PLAC. ADMINISTRATION AND BY PREVIOUS CLASS SOCIETY TESTING CERTIFICATE NO. 808-00002 NO CI - TEST DATED 23 FEB 2008	NOTE	23 FEB 2009 (± 3 MONTHS)

Figure 9: The recording of the initial inspection indicating the next inspection due date at the last field.

4.3.2 Panoria’s deck crane documentation review

According to the information collected during the interview process Panoria’s crew was not expecting an in situ inspection of the vessel’s deck cranes and their cable wires by the stevedore’s personnel as they hadn’t experienced similar request during previous cargo discharging operations in other USA ports. It was stated that the inspections they had experienced before discharging operations were focused only on reviewing the vessel’s cargo gear proper and valid documentation.

In the examined marine casualty the stevedore’s inspection team initially reviewed the cargo gear’s documentation and observed that the last annual inspection was performed more than one year before. Furthermore it was observed that the next annual inspection due date was not recorded to the vessel’s Cargo Gear Book. It was reported that the aforementioned findings challenged the credibility of the cargo gear documentation and initiated a discussion in the course of which Panoria’s crew attempted to clarify to the stevedore’s inspection team that the vessel’s flag legislation applies a ±3 month period to the annual inspection due dates.

According to available information, crew's clarifications was accepted by the stevedore's inspection team, however the missing recordings of the next annual survey due dates in Panoria's Cargo Gear Book provided clear grounds to the stevedore's inspection team for a more thorough inspection of Panoria's cargo gear equipment, including a detailed inspection of the deck crane wires.

4.3.3 Wire rope inspection

4.3.3.1 Crew's inspection

During the period of the examined marine casualty, Panoria was carrying a valid Safety Management Certificate issued by her classification Society, which confirmed that the vessel's Safety Management System complied with the requirements of the ISM code. The inspection and maintenance of Panoria's deck cranes falls within the relevant provisions of the International Safety Management Code stating:

Ch. 10.1: *"the owning or managing Company of a ship should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company."*

Ch.10.2:*"in meeting the inspection and maintenance requirements the Company should ensure that: 1, inspections are held at appropriate intervals, 2. any non conformity is reported, with its possible cause, if known, 3. Appropriate corrective action is taken, 4. Records of these activities are maintained."*

Ch.10.3:*"The Company should identify equipment and technical systems the sudden operational failure of which may result in hazardous situations. The safety management system should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of stand-by arrangements and equipment or technical systems that are not in continuous use."*

Ch. 10.4: *"The inspections mentioned in 10.2 as well as the measures referred to in 10.3 should be integrated into the ship's operational maintenance routine."*

Further to the above, the applicable national regulation of P.D. 316/2001 provides a 3month periodical inspection of the lifting appliances performed by the vessel's crew.

With regard to the deck cranes, the aforementioned provisions were incorporated in Chapter 10 of Panoria's SMS by means of form DSA 10-002 "GUIDELINES FOR THE OPERATION AND MAINTENANCE OF CARGO CRANES AND DERRICKS". Said guidelines implemented, inter alia, a 4month periodic inspection and a checklist prior to the operation of the deck cranes carried out by the crew, while a specific reference provided that manufacturer's instruction should be included as well. Nonetheless, it is noted that vessel's SMS did not include reference

to the 3month periodical inspection, provided by the aforementioned P.D. 316/2001 and did not incorporate any specific guidelines to the crew for said inspection.

Both the 4month periodic inspection and the prior to operation checklist provided a wire inspection. However, no further or more detailed guidelines were provided by the vessel's SMS or the crane manufacturer's instructions. It is noted that when the crane's jib rests on the stand (parked) most parts of the hoist and luffing wires are not accessible by the crew as they are positioned between the winch drums and the sheaves on the crane tower as well as between the crane tower sheaves and the sheaves at the jib's tip. An effective wire inspection process would require visual inspection of all the wire sections including the sections between the sheaves. Resultantly it would require a similar to the wire greasing process where a crew member is accessing all the sections of the wires.

Every 4month inspection was recorded to the dedicated form DSA 10-002c and was submitted to the managing company. The last 4month inspection of Panoria's deck cranes was carried out by her crew on 29/11/2014, two days before the casualty and one day prior to the arrival at Brownsville. According to the filled DSA 10-002c form for said inspection, no remarks were recorded that could infer that the broken wires of the No.2 deck crane runner were observed. Therefore it is suggested that Panoria's crew did not observe them during the 29/11/2014 inspection or any other previous inspection.

Considering the above it is inferred that a more detailed instruction to the crew for the wire rope inspection focused on the non-accessible parts of the wires, could ensure that broken wires or any other kind of abnormalities would be observed by the crew during routine inspections and reported to the vessel's managing company.

4.3.3.2 Stevedores inspection

Following the review of Panoria's cargo gear documentation and the discussion between the stevedore's inspection team and the crew it was decided to proceed with an inspection of the vessel's cargo gear in order to permit the operation. As stated in par. 4.3.2 Panoria's crew was not expecting an inspection of the cranes by shore side personnel as they hadn't experienced such an inspection at their previous discharging operations in other USA ports, however they permitted the inspection in order to proceed with the discharging operations.

Considering the above, it is suggested that stevedores followed their routine procedures applied to marine terminals, according Safety regulations of the Occupational Safety and Health Administration (OSHA) of the U.S Department of Labor. Said provisions require, amongst others,

a visual inspection of each crane and derrick on each day of use for defects in functional operating components⁵.

It was reported that during said inspection one stevedore put his hand at the bottom of the No.2 hoist winch drum and felt the broken wires of the hoist cable. A more thorough examination revealed that 2-3 broken wires of one strand were broken. The stevedores reported to the crew that the number of the broken wires indicated that the hoist wire was not in good condition and that it should be replaced. However, Panoria's crew considered that the hoist wire rope remained fit for use, since the number of the broken wires found was not considered significant. Apart from the above, no other distortion or corrosion was observed as all wire ropes were well maintained and sufficiently greased. It is noted that during the interview process it was reported that the wire rope should be replaced if the wear down of the rope diameter reached the limit of 8% to 10% of the nominal diameter.

Considering the above it is suggested that stevedores applied their local procedures for the wire rope replacement criteria. Such procedure is referred in OSHA standard no. 1926.1413 "*Cranes and derricks in construction/Wire rope inspection*"⁶. According to par. 1926.1413(a)(2)(ii)(A), the observed wire rope broken wires are considered as "*Category II*" deficiencies, as this category includes, inter alia, visible broken wires as follows:

"1926.1413(a)(2)(ii)(A)(1): In running wire ropes: Six randomly distributed broken wires in one rope lay or three broken wires in one strand in one rope lay, where a rope lay is the length along the rope in which one strand makes a complete revolution around the rope."

Moreover, par. 1926.1413(a)(4)(ii), describes the appropriate actions when "Category II" deficiencies are observed as it states:

"If a deficiency in Category II (see paragraph (a)(2)(ii) of this section) is identified, operations involving use of the wire rope in question must be prohibited until:

1926.1413(a)(4)(ii)(A): The employer complies with the wire rope manufacturer's established criterion for removal from service or a different criterion that the wire rope manufacturer has approved in writing for that specific wire rope (see § 1926.1417),

1926.1413(a)(4)(ii)(B): The wire rope is replaced (see § 1926.1417), or

1926.1413(a)(4)(ii)(C): If the deficiency is localized, the problem is corrected by severing the wire rope in two; the undamaged portion may continue to be used. Joining lengths of wire rope

⁵, OSHA standard no:1917.45(k), "Marine terminals/Cargo Handling Gear and equipment/Cranes and derricks" (source:https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10382&p_table=STANDARDS)

⁶ https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=34

by splicing is prohibited. If a rope is shortened under this paragraph, the employer must ensure that the drum will still have two wraps of wire when the load and/or boom is in its lowest position.”

It was reported that at the time of the casualty Panoria did not carry any wire rope's manufacturer documentation or any other valid document stating the removal criteria, which could be provided to the stevedores inspection team and objectively prove that the number of the broken wires observed did not stand as a reason for the hoist cable replacement. On this ground the aforementioned par.1926.1413(a)(4)(ii)(B) was applied and stevedores refused the crane operation until the replacement of the hoist wire.

In light of the above it is derived that the absence of valid documentation stating the wire rope's removal criteria contributed to the decision making for the replacement of the wire, following the request of stevedores inspection team.

4.3.4 Wire rope discard criteria

4.3.4.1 Regulatory framework

The International regulatory framework does not provide any specific reference for wire rope inspection or other guidance for applied discard criteria. On this basis, the IMO Maritime Safety Committee, at its 95th meeting, which was held in London from 3 to 12 June 2015, agreed that IMO guidelines should be developed to cover design, fabrication and construction for new installations; onboard procedures for routine inspection, maintenance and operation of lifting appliances and winches; and familiarization of ship's crew and shore-based personnel. The matter had being referred to the Sub Committee on Ships Systems and Equipment (SSE) and it is being discussed by the respective Correspondence Group⁷.

In addition, the applicable national legislative framework, as provided by P.D. 316/2001, does not include any specific reference or instructions with regard to wire rope inspection, deficiencies or discard criteria as well. Moreover, it does not set any mandatory requirement to carry on board the wire rope manufacturer's discard criteria.

Considering the above, it derives that the appraisal of the wire rope condition is not efficiently regulated. Consequently, when clear discard criteria are not promptly instructed by the manufacturer or the managing company as well, the responsible crew members tend to apply their personal judgment according to their levels of knowledge and expertise.

⁷ IMO Docs: SSE 4/8, SSE 4/8/1, SSE 4/8/2.

Nonetheless, the subject falls under the applicable Rules of the vessel's Classification Society. Said Rules incorporate the Lloyds Register "*Code for Lifting appliances in a marine environment*" applied for the periodical thorough examination of the cargo gear equipment, which defines the corresponding criteria for the replacement of the wire ropes. According to the provisions of Table 12.3.3⁸, wire ropes may become unfit for service for a number of factors such as:

- visible broken wires,
- change in diameter,
- strand fracture,
- deformation,
- damage and corrosion both external and internal.
- The discard criteria will vary according the type of construction and rope size. In the absence of any criteria used by the rope manufacturer, International standard ISO 4309:2010 "*Cranes-Wire ropes –Code of Practice for examination and discard*", is referred where further discard criteria are provided.

Apart from the above, at the "*Annual Survey Requirements*" section of the aforementioned Code it is stated: "*In general, the rope is to be replaced immediately if any of the discard criteria in ISO 4309:2010 are exceeded*".

Considering the above in relation to par. 4.3.3.1 it derives that the Panoria Classification Society's Rules for the wire rope discard criteria were not incorporated into the vessel's SMS.

4.3.4.2 ISO 4309:2010 discard criteria

ISO 4309:2010 "*Cranes-Wire ropes –Code of Practice for examination and discard*" establishes general principles for the care and maintenance, and inspection and discard of steel wire ropes used on cranes and hoists. Section 6 and the relative Annexes of said Standard sets the individual discard criteria. It is underlined that the described criteria are applied in the absence of instructions provided by the manufacturer of the crane or by the supplier or manufacturer of the rope.

In terms of examining if the observed broken wires justified the wire's replacement and in the absence of Panoria's No.2 hoist cable manufacturer's discard criteria relevant provisions of the ISO Standard's provisions are applied. According to said provisions and taking into account the rotating-resistant specification of the wire rope, Table 4 of par. 6.5 of the Standard, for rotation-resistant ropes is applied. Taking into consideration the following wire rope's technical specifications:

⁸ Chapter 12, section 3 of Lloyds Register "*Code for Lifting appliances in a marine environment*".

- No of outer strands: 4,
- Total No of loadbearing wires in the outer layer of strands: 156,
- The broken wires were observed on a length less than “6d” (d=rope’s nominal diameter) on a rope’s section spooling on a single layer drum,

it derives that the observed broken wires justified the wire rope’s replacement, in the absence of wire rope’s manufacturer instructions. More specifically, according to the Table, the wire rope should be discarded if two broken wires were observed over a length of “6d”.

4.3.5 Wire rope inspection guidelines

Apart from the aforementioned ISO Standard, ILO has developed Codes of practical guidance⁹ published for the safe operation and use of the lifting appliances. Although not binding, the codes aim to raise the level of safety and health in all port operations around the world as well as on the ship. In these codes wire ropes discard criteria include indicatively the following:

- *“the number of broken wires or needles in any length of ten diameters exceeds 5 per cent of the total number of wires in the rope;*
- *broken wires appear in one strand only;*
- *broken wires are concentrated in a shorter length of rope than ten diameters;*
- *Its statutory life or service life as recommended by the manufacturer has expired, although the wire may outwardly look good.*
- *there is any tendency towards “bird caging”¹⁰.*
- *they show signs of excessive wear indicated by flats on individual wires”*

The codes stipulate in turn that further guidance is provided by the international standard ISO 4309 “Cranes-Wire ropes –Code of Practice for examination and discard”, and that the reasons for any defects should be investigated and remedial action taken.

Furthermore, the International Marine Contractors Association (IMCA), developed and published a “Guidance on Wire Rope Integrity Management for Vessels in the Offshore Industry”. Said publication provides guidelines on wire rope inspection, maintenance, thorough examination, discard, record keeping, causes of deterioration etc.

⁹ Section 5.2.1.2 of ILO’s Code of Practice for the Safety and health in Ports Edition 2005 –Section 18.2.4 of ILO’s Code of Practice for Accident prevention on board ship at sea and in Port 2nd Edition 1996.

¹⁰ Separation of the strands of the wires.

4.4 Wire Rope Replacement Procedure

C/O and six crew members started the hoist wire replacement procedure according to the manufacturer’s instructions provided by the crane’s operating manual. Said procedure included the following steps:

1. Lowering of the crane jib on its rest stand and the securing of the crane hook block.
2. Setting the crane limit switch to “by pass”.
3. Disengaging of the hoisting clutch, by loosening the hex-bolt and shifting the clutch (plate) from the limit switch box as shown in Figure 10. After complete disengaging of the clutch, the plate was re-fixed using the same hex bolt.

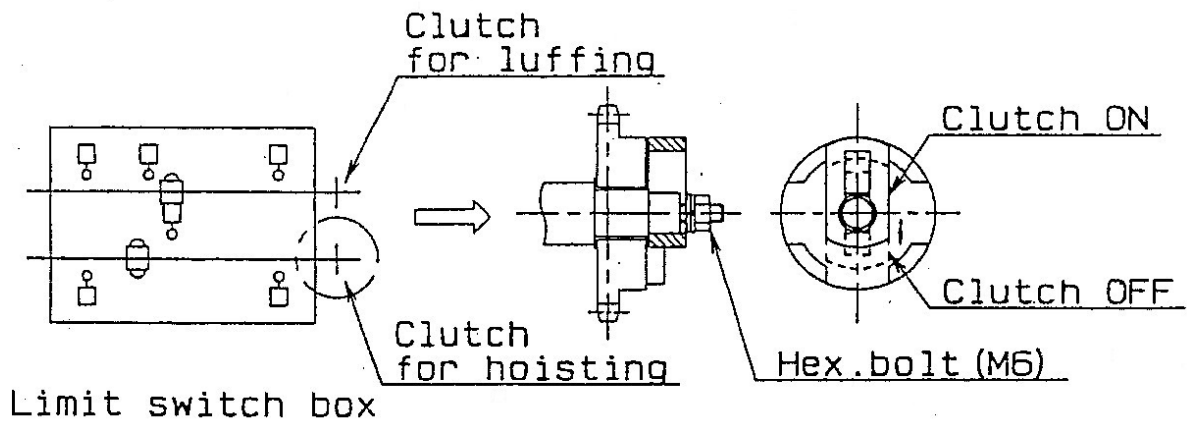


Figure 10: Disengaging the hoist limit switch clutch

4. Disconnecting the end of the old wire from the top of the crane house (at the thimble side) and lowering it on the main deck (Figure 11).

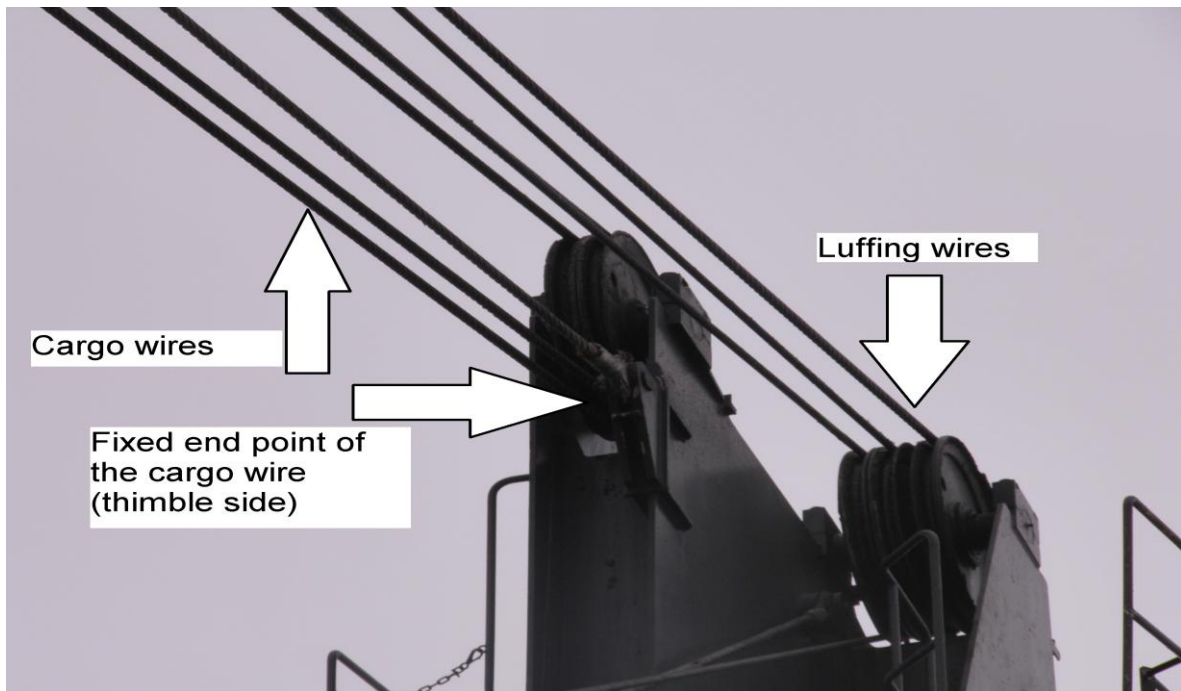


Figure 11: Cargo (hoist) and luffing wires on top of the crane house.

- Whipping (seizing) the end of the old wire, approximately 0,5-1m from the thimble and cutting the thimble off (see Figure 12).



Figure 12: Seizing and cutting off the end of the crane cargo (hoist) old wire.

- Connecting the old wire with the new wire using a «wire sleeve». The wire sleeve is a tube made of braided strands, which is pulled over the rope ends, fastening them together using wire mesh grips (see Figure 13).

Special attention should be given when the wire sleeve passes through structural parts of the crane, like wire guards, falling blocks and sheaves.



Figure 13: The wire sleeve that was used to connect the old with the new hoist wire on board “Panoria”

7. Removing the end set pin at the hoisting drum side.
8. Winding the old wire rope at low speed and paying it out from the crane’s back door. Simultaneously the new wire, connected to the other end of the old wire was directed towards the winch drum. The winding would stop when the end of the new wire would come to the end set point at the hoisting drum.
9. Holding in the new wire inside the crane tower using a stopper, disconnecting it from the old wire and connecting it to the drum with the end set pin.
10. Heaving the other end of the wire at the thimble side, onto the crane tower and setting the end set pin.

4.5 Safety Management System

Based on the mandatory requirements of Ch. 7 of the International Safety Management Code “*Development of plans for shipboard operations*”, Panoria’s Safety Management System (SMS) incorporated specific instructions and procedures for the vessel’s safe operation and working environment, including a Risk Assessment procedure in order to identify risks and hazards of executed operations and establish safeguards and precautionary measures. According to the wire rope replacement procedure, as described in the previous paragraph, some crew members were scheduled to work on the top of the crane tower in order to remove and reset the end set pin at the thimble side.

4.5.1 Risk Assessment Analysis

Before starting the wire rope replacement procedure, C/O prepared a Risk Assessment Analysis for “WORKING ALOFT” and “WORKING AT HIGH LEVELS” at the ship’s crane No.2. The Risk Assessment Analysis was recorded to the dedicated form and was signed by the C/O, the Chief Engineer and the Master, as provided by the respective SMS instructions. The identified hazards of said Risk Assessment Analysis included amongst others the “unsafe working practice” and provided a list of safeguards which inter alia included the use of PPE, harness, or railings, the implementation of safe working practices as per the SMS as well as the completion of a “Work Aloft Permit”, following the relevant provisions of Panoria’s SMS¹¹. With regard to the aforementioned safe working practices, the SMS¹² provided amongst others that safety harnesses should be worn when there is a fall hazard of more than two meters, and if securing

¹¹ Section 7.6 “Preparation of plans & Shipboard Operations” of the Safety Management System (SMS)

¹² Par. 7.6.2.2 “Procedures for working aloft/overside/at high levels.

points were not available necessary arrangements should be made to provide adequate points i.e. by using a gantline with loop splices. It is noted that said provision was incorporated to a Master's Standing Order¹³ "Chief Officer and Bosun responsibilities for safety work at deck" as well.

Furthermore, it was reported that before starting the wire rope replacement the C/O had a short meeting with the work team and explained to the crew the wire replacement procedure and assigned the specific tasks to the involved crew members. However, during said meeting the potential jamming of the wire sleeve as it was passing through the crane's structural parts was not examined.

It is noted that as presented in paragraph 4.4 the crane's operating manual clearly stated that special attention should be given during that time. On this ground it could be expected that the potential jamming of the wire while winding should had been taken into account during the work planning and preparation of the Risk Assessment Analysis and certain safeguards and controls could had been laid down for a safe unblocking procedure. Nonetheless, this did not transpire to have been the case. No specific procedures were available in case wire ropes would become jammed. The Risk Assessment Analysis did not identify that specific hazard and consequently no control measures were described or put in place to safeguard those who were involved with the operation. The lack of specific controls to minimize the risk of the unblocking procedure is considered as a contributing factor to the examined marine casualty.

Such control measures could include for example the following:

- Suitable means of access to the work area in a safe condition clearly marked and unobstructed. On this case the use of scaffolding arrangements as indicated in Figure 11, would assure a safe access to the work area (Figure 14),
- An adequate level of supervision, constantly during the whole work process,
- A new work aloft permit verifying also that the above mentioned control measures, have been put in place.

¹³ Master's Standing Orders are a set of instructions to ensure safe ship navigation and operations whether at sea or at port. This set of directives by the Master encompasses a very wide list of aspects of navigation and rules for the crew. Standing Orders are to be followed at all times by the crew and are duly signed by the referred crew members.

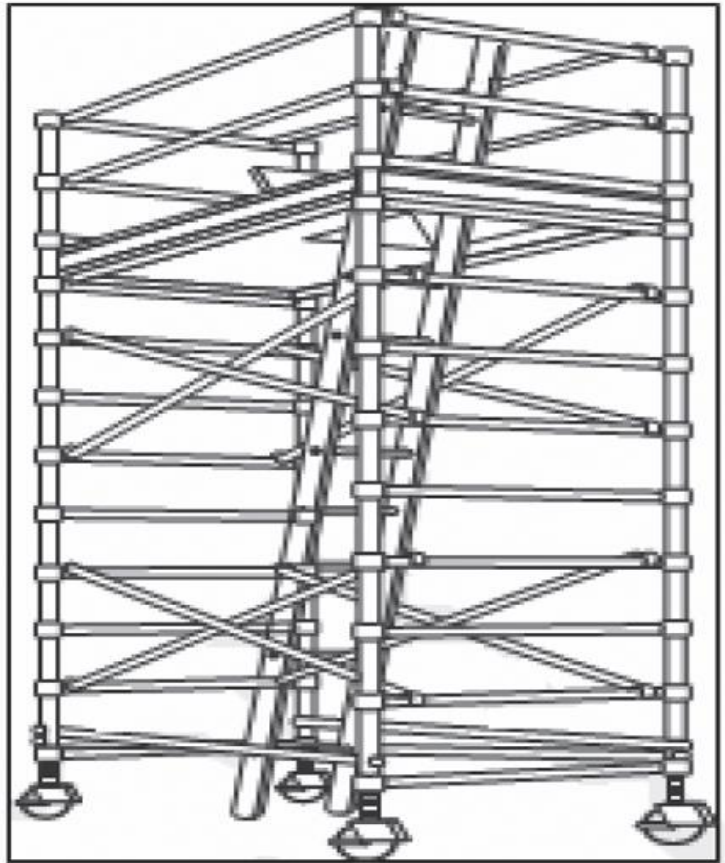


Figure 14: Mobile scaffold with an access ladder and trapdoor to provide the largest possible hazard-free working platform.

4.5.2 Working Aloft Permit

The Working Aloft Permit was issued by the C/O and it was valid from 13:00 until 17:00, for the date of the accident. It included a description of the work, the involved crew members as well as specific checks performed by the C/O before the beginning of the work which comprised the following:

1. *The persons assigned to carry out the work should be experienced and wearing the appropriate PPE,*
2. *Cradles stages and bosun chairs should be in good condition before use,*
3. *Safety harnesses and ropes should be checked,*
4. *Blocks, securing ropes, gantlines and other supporting equipment should be checked,*
5. *Securing points should be adequate to support the weight of equipment and persons using it,*
6. *A lookout should be assigned on deck for the duration in order to call for assistance and take action in the event of an emergency.*

Moreover, the Working Aloft Permit included an associated checklist that should be completed by the authorized Officer prior to the commencement of the work. Said checklist included amongst others a dedicated field for informing the C/O or the 2nd Engineer about the work to be

performed and it was completed by the C/O before starting the hoist wire replacement procedure.

It is noted that the work description to the Work Aloft Permit stated in general the “renewing hoisting wire on crane No.2” only, and did not provide a more detailed description of the specific tasks that was referring to. Considering the wire replacement procedure, as presented in par. 4.4, it is suggested that the Permit was valid for the usual and planned working aloft procedures which involved the disconnecting and connecting of the wire end at the top of the crane tower. However, this was not clarified to the involved crew members either by the Permit itself or during the short meeting performed prior to the beginning of the work. Thus, misconceptions that it was valid for the total procedure for the wire replacement could be created to the involved crew. It is apparent that the unblocking of the snagged wire sleeve was unexpected and therefore the access of a crew member to the area of the boom where it got snagged, if decided to be necessary, would require a separate Working Aloft Permit by which the C/O would have been informed as per the Permit’s checklist. On this grounds, it is suggested that had been clarified or discussed the specific tasks for which the Work Aloft Permit was valid, the Bosun could had requested a new Work Aloft Permit in order to access the boom’s cross section to unblock the wire.

Considering the above, the general description of work stated at the Work Aloft Permit which was not clarified that it was valid only for the usual and planned procedures is considered as a contributing factor to the examined marine casualty.

4.6 Bosun’s Decision

The Bosun’s decision was made clearly without proper consideration of the risk involved. Personnel working at a height may not be able to give their full attention to the job and at the same time guard themselves against falling. Proper precautions should therefore always be taken to ensure personal safety when work has to be carried out aloft or when working overside. Work should only be carried out at height if there is no reasonably practicable alternative of doing so. Where a reasonably practicable alternative does exist it should be adopted. The crane boom is not a safe working area and cannot be used as a safe means of access. Therefore, if accessing to the area where the wire sleeve got snagged deemed necessary, alternatives means had to be used such as scaffolding arrangements.

Nonetheless, it is noted that the exact way of the wire sleeve snagging at the boom’s cross section could not be established. However, taking into account the boom’s cross section structure and the wire sleeve’s assembly, as presented in Figures 3 and 13, it is suggested that

the accessing to the area may had not been necessary, as the wire sleeve could be unblocked either by a reverse rotation of the hoisting drum to slack the wire or by using other equipment such as a wooden stick extension which could be used from the main deck to free the jammed connected part of the wire sleeve.

During the investigation process, the reason for the Bosun's decision to jump the guardrail and walk on the boom to access the wire jammed area could not be determined. It was reported that he was experienced. Moreover, his relations with the other crew members were described as very good, and no personal or health issues were known by his colleagues or had been reported by him that could affect his performance from the time he had joined the vessel. Therefore the Bosun could be characterized as medically fit and familiar with his duties.

He was involved with the crane's hoist wire replacement procedure from the beginning, around 10:30 and the examination of his previous work/rest schedule did not indicate any fatigue issues. Moreover, it was reported that the wire replacement of No.2 crane did not affect the cargo discharging operations, as the other 3 cranes were used. No.2 crane was scheduled for operation morning hours of the next day and the whole procedure was estimated to last until afternoon hours of the same day. On these grounds possible time related stress for completion of the wire replacement within a short timeframe could be excluded.

Taking into consideration the above, the Bosun's decision could be described as a spontaneous act possibly driven by the desire to "get the job done" and a "can-do attitude" disregarding proper guidelines and procedures. In general, it has been observed that crews on board vessels don't see the need to follow all the rules and established safe practices. For example they don't see the need to follow 'permit-to-work-procedures", even if they are familiar with them. Their job is seen more as to get stuck in and get the job done and many times do not follow the provisions and guidelines of the relevant safety management forms. In time this behavior, if not controlled, can become a custom practice and could lead to accidents. Additionally, people have the tendency to overestimate their abilities and knowledge and disregard even the obvious hazards like falling from a high level. An objective self-assessment sometimes isn't easy or even possible. On this context it is essential for the crew to operate as a team and motivate each member to alert other crew members on their unsafe attitudes leading to unsafe situations.

The Bosun's spontaneous act to overcome the crane railings and walk on the boom was seen only by the AB standing on top of the cargo hold cover, however it was reported that he did not attempt to talk to him or to the C/O about the hazardous situation due to the ranking difference.

In view of the above it could be inferred that the AB was not efficiently motivated to report hazardous actions performed by higher ranking crew members and is considered as a contributing factor to the examined marine casualty.

4.7 Panoria's safe working practices

For the safe operation and maintenance of the cargo cranes Panoria's SMS made reference to the Code of Safe Working Practices for Merchant Seamen (CSWP)¹⁴, published by the UK Maritime and Coastguard Agency, which should be followed by the crew.

Said code, although not being mandatory, concerns with improving health and safety on ships, by providing guidance on safe working practices for vessel managers and crews and has been widely implemented in the maritime industry.

According to the aforementioned code, the workers are required to:

“ take reasonable care for their own health and safety and that of others on board who may be affected by their acts or omissions;

• co-operate with anyone else carrying out health and safety duties – including compliance with control measures identified during the employer's or Company's evaluation of risk;

• report any identified serious hazards or deficiencies immediately to the appropriate officer or other authorized person;

• make proper use of plant and machinery, and treat any hazard to health or safety (such as a dangerous substance) with due caution.”

As stated in paragraph 4.5.1, Master's standing orders mandated the safety requirements for the deck crew when working aloft. By these orders it was apparent that no person should undertake any job on board where there would be a risk of falling more than two meters below deck or in cranes, if not worn a safety belt or safety harness attached to a lifeline secured, as a protection from falls. In addition, it was stated that PPE, would be selected according to the specific hazard and the kind of work which was to be undertaken in accordance with the findings of the risk assessment. Finally, any defects affecting the safety of life should be reported immediately to the Master. These orders were signed by the responsible deck officers and the Bosun. However said orders were not signed by the rest of the deck crew and this could possibly had contributed to the AB's decision not to report the Bosun's unsafe act to the C/O.

¹⁴ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282659/coswp2010.pdf

4.8 Supervision

Before the beginning of the hoist wire replacement a “toolbox meeting” was held and the duties of the crew were assigned and discussed. Chief Officer was in charge of the operation and was stationed inside the crane control cabin to control the operation of heaving and slacking of the wire rope. From his position he had visual contact with the front part of the crane and the boom as well as with the inner part of the crane tower where the two AB's were paying out the old wire and arranging the new wire's winding on the drum (Figure 5). He also had access to the crane's control levers and he was controlling the operation of the hoist drum for winding the wire. Bosun was stationed on the platform directly below the crane cabin from where he had visual contact to the crane's front part and the boom as well as with the crane's inner part through the front door. From his position he was monitoring the proper winding of the hoist wire on the drum and was informing the C/O when to start or stop. He could communicate with the C/O, the AB standing on top of No.3 cargo hold cover greasing the new wire and the two AB's inside the crane tower by physical voice without the need of any portable device.

At the beginning of the winding process, Bosun told the C/O to stop the hoisting operation due to a problem at the hoist drum. C/O stopped the operation of the crane and looked into the crane tower where the two ABs and the Bosun were arranging the cable on the hoist drum. At the same time the hoisting wire rope became snagged on the horizontal cross-member of the crane's boom. This was noticed only by the Bosun; however he didn't report it to the C/O and in clear contravention with the safe working practices and the Master's orders as mentioned in the previous paragraph, took the decision to walk on the crane's boom wearing his safety harness but without connecting it to a secure point. A new evaluation of the existing risks under the current conditions was never carried out, since it was not reported to the C/O, who at that time had his attention inside the crane tower. It is noted that the C/O had clear view to the crane's boom and he could see the Bosun walking on it; however at that moment he was paying attention at the inner part of the tower.

In view of the above it can be inferred that during the winding procedure Chief Officer's attention was mainly focused on operating the winch and the proper winding of the wire on the hoist drum inside the crane's tower. This prevented him from noticing the snagging of the wire at the boom's cross section and the Bosun's movement to jump the railing and walk on the boom without any precaution. The lack of efficient supervision is considered a contributing factor to the examined marine casualty.

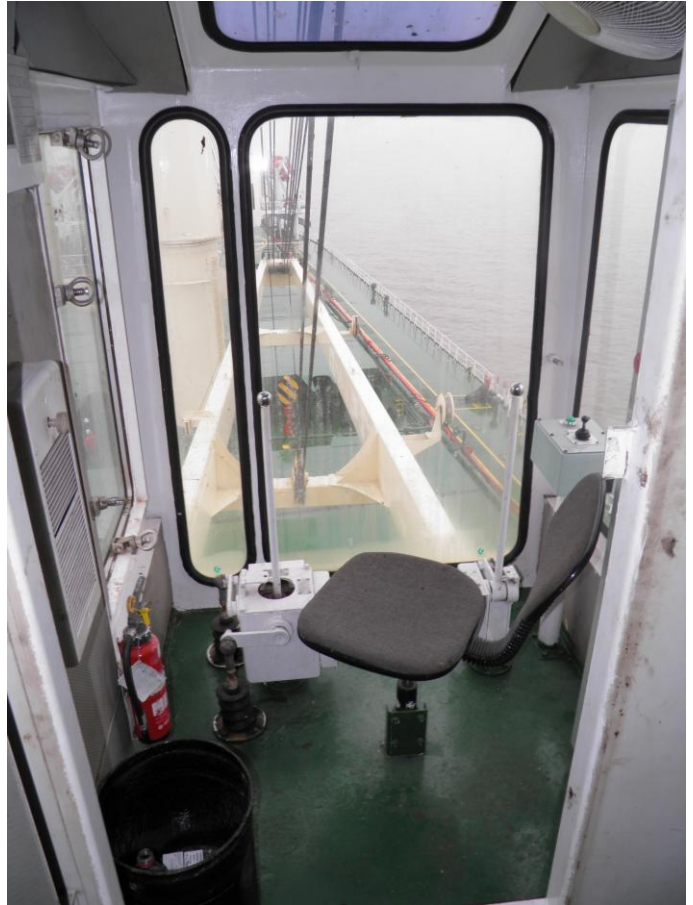


Figure 15: View of the crane's control cabin

4.9 Personal Protective Equipment

As a general rule the appropriate PPE should be selected and used for providing sufficient protection against the involved hazards as the wrong selection of PPE may generate further risks. PPE should also be compatible with the tools and equipment the worker is using so that it remains effective against the risks.

When the Bosun walked on the crane boom he was wearing a full body safety harness as shown in Figure 16, consisting of straps passed over the shoulders, across the chest, and around the legs. The safety harness was in turn connected with a rope lanyard and a hook.

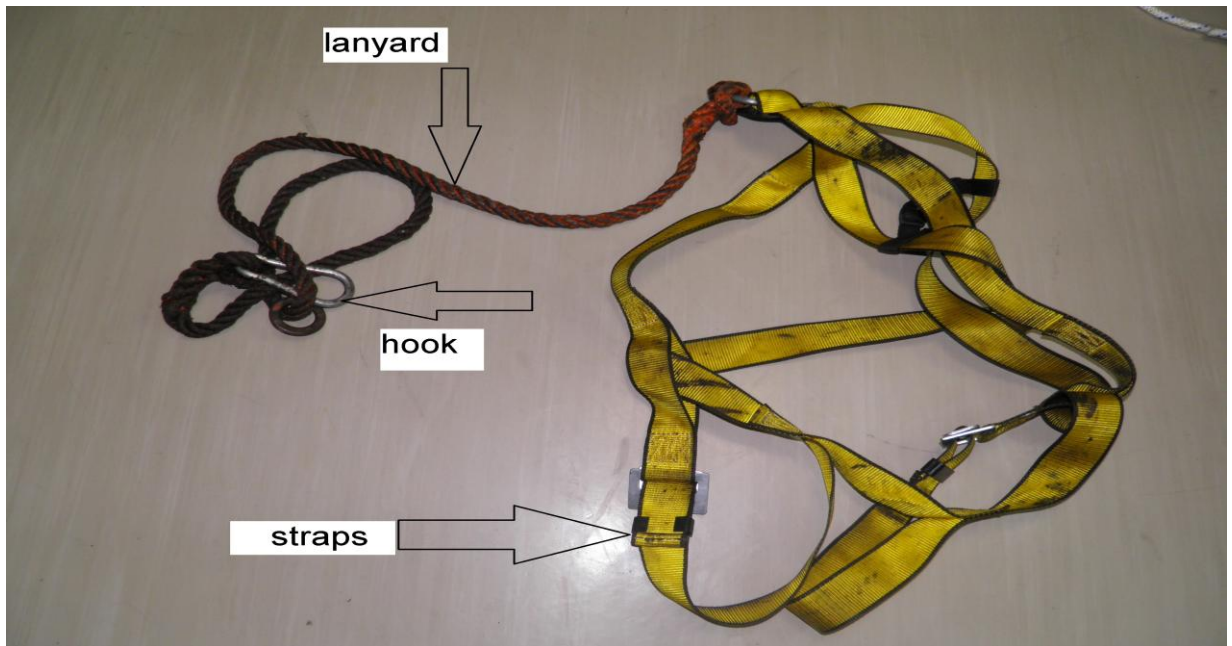


Figure 16: Full body safety Harness used by the Bosun on the day of the accident

The selection of this equipment is generally appropriate when working aloft, since a full body harness can protect someone better than a safety belt, because it distributes the force of the impact over a greater area of the body avoiding severe back and abdominal injuries.

On the top side of the boom there were welded pad eyes, as shown in Figure 17, which were used during the manufacturing process of the cargo crane to rig and lift the jib in place. These pad eyes if used as a fixed point to secure the lanyard of the safety harness theoretically would provide a better protection in case of falling. However, practically it is considered difficult and dangerous to secure the hook in these eye-pads, while keeping balance at the same time on the narrow passage of the crane's jib. The crane boom had neither a protected guard rail nor could provide a safety access, as it is not designed to be used as a walkway and therefore it's not considered as a safe working area that can be used to carry out maintenance or any other work in any case.

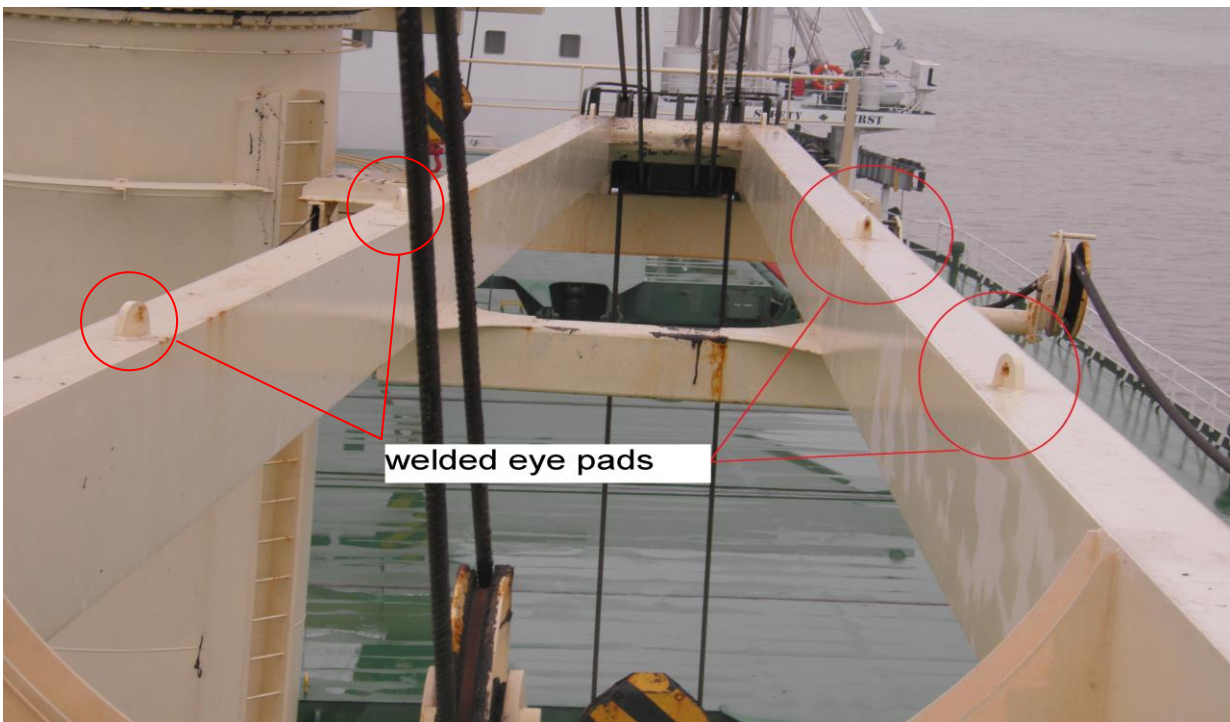


Figure 17 :The welded eye pads on the top of the crane boom

When the Bosun got at the boom's cross section where the hoist wire got snagged, he connected his lanyard to the loose wire which was not connected to any secure point and in fact was hanging free. Had the Bosun connected his safety harness to one of the two pad-eyes close to the boom's cross section would have prevented his fall onto the cargo hold cover and may have prevented his fatal injury.

The Bosun's judgment to connect the lanyard to the wire and not to one of the two welded pad-eyes could not be analyzed. Nonetheless, it is suggested that it was related to the narrow space on the crane boom which limited his movements.

4.10 Vessel's crew

At the time of the accident *Panoria*, had a crew of 20 persons on board. The Master, Chief Officer, 2nd Officer, Chief engineer, Second engineer and the Chief Cook were Greek nationals, whereas the rest of the crew was from Philippines. The working language on board was English and no issues had been reported related to the communication between the crew.

The vessel according to her valid certificate of class was carrying a UMS notation and her Minimum Safe Manning Document pursuant to SOLAS Regulation V/14 as applied, provided a crew of 11.

According to the vessel's SMS records, sufficient training had been carried out on board by the ship's senior staff, to ensure that the crew was aware of the safety and emergency procedures and the proper use of the Personal Protective Equipment available.

4.10.1 The Master

The 50-year-old Master graduated from the Greek Merchant Marine Academy in 1988. He acquired his Master's COC certificate, by the Greek Maritime Administration in 2008. He joined *Panoria* on 29/08/2014 and this was his first contract with the Managing Company of the vessel. His experience as a Master started on 2011, and he had served only on similar to *Panoria* type of vessels.

4.10.2 The Chief Officer

The 52 year old Chief Officer acquired his Master's Class B' license in 2001, issued by the Greek Maritime Administration. This was his second time on board the vessel *Panoria* as a Chief Officer, and he joined the vessel together with the Master. From 2001 he had served mainly as a Chief Officer on Bulk carriers similar to *Panoria*. His duties also included being the Safety Officer of the Vessel and also carrying out bridge watches as an OOW. He was also responsible for the cargo loading and discharging operations of the vessel.

4.10.3 The Bosun

The 51 year old Bosun had acquired his license issued by the Maritime Administration of Philippines in March 2014, according to Regulation II/5 of the STCW revised Manila amendments convention. He had served as a Bosun for more than 15 years on board vessels. Until the day of the accident he had been about 7 months on board, since May 2014. Records from November 2010 of his seaman's book records, showed previous experience as a Bosun in three vessels, for almost one year every time. It was reported that he was an experienced seaman, who knew his job and could take initiatives when and where required. His main duties involved deck operation (maintenance/repair), cargo handling and stowage.

4.10.4 The Able Seaman

The 37-year-old AB, who was the only eye-witness of the casualty, had acquired his license issued by the Maritime Administration of Philippines in March 1998. He joined *Panoria* on 02nd of October 2014. He had worked again with *Panoria's* managing company vessels in 2001 and he had 14 years of experience on board Bulk Carriers, in total.

4.11 Fatigue

Based on the IMO/ILO Guidelines for the "Development of Tables of Seafarers Shipboard Working Arrangements and Formats of Records of Seafarers' Hours of Work and Rest",

Panoria’s Safety Management System, incorporated a “Shipboard Working Arrangement” table as well as a “Personnel rest hours” table, on ship’s working language, as summarized below:

“Shipboard Working Arrangement” table

The “Shipboard and Working Arrangement Table” was recording the servicing crew and their capacities along with the hours of working duties, namely “watch keeping” duties and “non-watch keeping duties” (daytime work) at sea or at port.

“Personnel rest hours” table

The monthly illustrated “Personnel rest hours” table, was recording the working or watch keeping hours as well as the resulting resting hours for each crew member. The daily recordings were entered and signed by the crew members. The monthly table was signed and approved by the Chief Officer, for the deck department, at the end of every month and was countersigned and endorsed by the Master.

According to the vessel’s “Shipboard working arrangement” as presented below in Table 3, the watch keeping schedule at sea for the deck personnel was comprising of three 4-hours watches at day and night respectively assigned to Chief, 2nd and 3rd deck officers, together with one AB as a look out. The designated post look outs were rotated between the 4 available ABs, who had the required qualifications to be part of the navigation watch, in weekly terms. The Bosun with the remaining one AB, who was not in the weekly watch schedule, the OS and the deck cadet were involved on day time operations.

	Position/rank	Watchkeeping hours	Non Watch keeping Duties
1	Master	-	0800-1200/1300-1700
2	Chief Officer	0400-0800/1600-2000	08:00-12:00
3	2 nd Officer	0000-0400/1200-1600	1600-1800
4	3 rd Officer	2000-0000/0800-1200	1300-1500
5	BOSUN	-	0600-1200/1300-1700
6	AB 1	0000-0400/1200-1600	0800-1200
7	AB 2	-----	06:00-12:00/13:00-17:00
8	AB 3	08:00-12:00/20:00-00:00	13:00-17:00
9	AB 4	0400-0800/1600-2000	08:00-12:00
10	O.S	-	0600-1200/1300-1700
11	Deck Cadet	-	0600-1200/1300-1700

Table 3: Panoria shipboard watch and working arrangements for the deck personnel at sea, for the period prior to the arrival to Brownsville Texas.

The examination of said records indicated that the “Shipboard watch and working arrangement” implemented on board Panoria, was complying with the relevant provisions of ILO 180 Convention (Seafarers’ Hours of Work and the Manning of Ships Convention) and STCW Convention and were reflecting the work schedules followed on board.

Panoria arrived at the port of Brownsville following a long trip. Specifically Panoria arrived on Brownsville, Texas in 30th November 2014, after approximately a 30-day voyage from Novorossiysk, Russia. It was Sunday, an established day-off on board. Therefore except for the established bridge watches, the remaining deck crew was not involved in other tasks and was resting. Standby operations for berthing alongside the dock were commenced around 19:00 and the ship was safely berthed around 22:30. At around 00:00 the crew was released and went to rest. The following morning the work for the preparation of cargo discharging started at approximately 08:00. Cargo hatches were opened to ventilate the cargo holds and at approximately 10:30, the cargo wire replacement procedure started. The job continued with an one-hour break for lunch at 12:00 until the time of the accident, at 15:25.

In terms of the above and considering the vessel's records for the crew's work/rest hours fatigue is not considered as a contributing factor to the examined marine casualty.

4.12 Environmental Conditions

On the day of the accident, the prevailing weather conditions at Brownsville port were reported to be very good with slight west wind of 3 knots. It was light with temperature at 21°C and a very good visibility. The associated, with the work to be performed, checklist was completed by the Chief Officer verifying that the sea was calm and the ship was not rolling as Panoria was safely moored at her berthing position. Therefore weather conditions are not considered to have been a contributing factor leading to the marine casualty.

5. Conclusions

The following conclusions, safety measures and safety recommendations should not under any circumstances be taken as a presumption of blame or liability. The juxtaposition of these should not be considered as an order of priority or importance.

1. The annual inspection of the Panoria's deck cranes was at the time of the casualty, within the applicable timeframe period for the year 2014, since it could be carried out from 5th July 2014 until 5th January 2015 (§4.3.1.1).
2. The next annual survey due date was not recorded to the Cargo Gear Book. Similarly, the post to the marine casualty annual survey was not recorded to the Cargo Gear Book when carried out and when recorded the next annual survey due date was not filled (§4.3.1.2).
3. The missing recording of the next Cargo Gear annual survey due date provided clear grounds to the stevedore's inspection team for a more thorough inspection of Panoria's cargo gear equipment, including a detailed inspection of the deck crane wires (§4.3.2).

4. Panoria's SMS did not include reference to the 3month periodical inspection, provided by national legislative framework and did not incorporate any specific guidelines to the crew for said inspection particularly for the inspection of the wires (§4.3.3.1).
5. Panoria's crew did not observe the broken wires during the inspection carried out on 29/11/2014 or during any other previous inspection (§4.3.3.1).
6. Panoria did not carry any wire rope's manufacturer documentation or any other valid document stating the removal criteria which contributed to the decision making for the replacement of the wire, following the request of stevedores inspection team (§4.3.3.2).
7. National and International legislative framework, does not include any specific reference or instructions with regard to wire rope inspection, deficiencies or discard criteria. Moreover, it does not set any mandatory requirement to carry on board the wire rope manufacturer's discard criteria (§4.3.4.1).
8. The applicable Rules of Panoria's Classification Society for the wire rope discard criteria were not incorporated into the vessel's SMS (§4.3.4.1).
9. In the absence of wire rope's manufacturer instructions and according to ISO 4309:2010, the observed broken wires justified the wire rope's replacement. More specifically, according to the relevant Table of the Standard, the wire rope should be discarded if two broken wires were observed over a length of "6d" (§4.3.4.2).
10. The Risk Assessment Analysis did not identify as hazard the potential jamming of the wire as clearly stated to the crane's operating manual. Therefore no control measures were described or put in place to safeguard the involved with the operation crew (§4.5.1).
11. The description of work stated at the Work Aloft Permit was generic and it was not clarified that it was valid only for the usual and planned procedures (§4.5.2).
12. There were no findings regarding possible time related stress for completion of the wire replacement within a short timeframe (§4.6).
13. Bosun's decision to jump the railing and walk on the boom disregarded established guidelines and procedures and may be described as a spontaneous act possibly driven by the desire to "get the job done" and a "can-do attitude" (§4.6).
14. The AB was not efficiently motivated to report hazardous actions performed by higher ranking crew members (§4.6).
15. Bosun was aware that no person should undertake any job on board Panoria where there would be a risk of falling more than two meters below deck or in cranes, if not worn a safety belt or safety harness attached to a lifeline (§4.7.1).
16. Master's standing orders regarding the prohibition to undertake any job on board where there would be a risk of falling more than two meters below deck or in cranes, if not worn a

safety harness, were not signed by the lower rank deck crew and this could possibly had contributed to the AB's decision not to report the Bosun's unsafe act to the C/O (§4.7.1).

17. Bosun didn't report to the C/O that the hoisting wire rope became snagged on the horizontal cross-member of the crane's boom and the existing risks under the current conditions were not evaluated (§4.7.2).
18. The crew and the wire replacement procedure was not efficiently supervised by the C/O (§4.7.2).
19. Bosun didn't connect the lanyard to one of the two welded pad-eyes possibly due to the narrow space on the crane boom which limited his movements (§4.8).

6. Actions Taken

After the casualty the ship's managing company informed all the other fleet vessels. According to the SMS procedures concerning the corrective actions that must be implemented after an accident or hazardous occurrence on board, the casualty was thoroughly discussed in the next safety meeting of the vessel. Extra training was provided to all crew members, concerning the safe working practices that should be followed when working aloft. Moreover, Company's DPA carried out an internal audit on board in order to verify the proper implementation of the above corrective actions.

Following the conduction of an incident analysis, management company's Safety Management Manual has been redrafted to also take into account Greek P.D. 316/2001 and the guidelines included therein.

Moreover, crew members on board all company's vessels have been offered training for working aloft and have been instructed and trained to use a new applicable form when doing so. Relevant training has also been included in company's Safety Management Manual. The management company has also increased the number of personnel safety belts and purchased a new rolling scaffold.

7. Safety Recommendations

Taking into consideration the analysis and the conclusions derived from the safety investigation conducted, the following recommendations are issued:

7.1 Safety Recommendations addressed to the Panoria's managing company

The Owners/Managers of Panoria are recommended to:

- 49/2014 Provide guidelines to the vessel's Masters in order to assure that vessel's documentation is properly filled by Class or RO surveyors following necessary inspections.
- 50/2014 Review the vessel's SMS in order to:
- include instructions for the cranes' wire inspection procedure so that all sections of the wires are inspected, including the sections between the sheaves,
 - include instructions to the crew for the wire discard criteria taking into account the manufacturer's discard criteria, the Class Rules and the relevant Standards
- 51/2014 Provide clarification concerning the "Working Aloft/Overside Permit" procedure, so that the tasks for which the Permit is valid are recorded and described in detail and are well understood by every involved crew member.
- 52/2014 Enhance the motivation of the lower crew to report unsafe and hazardous situations to Officers, regardless the ranking.
- 53/2014 Provide instructions to the Masters so that standing orders referring to safe work procedures are well understood and signed by all the crew members.
- 54/2014 Provide clear instructions to the crews for the safe access to the crane booms when it is deemed necessary.
- 55/2014 Review the procedures, concerning the on board risk assessment in order to take into full account all the risks involved during the process of changing a crane wire.

7.2 Safety Recommendation addressed to the Greek Maritime Administration

The Ship's Inspection General Directorate of the Greek Maritime Administration is recommended to:

- 56/2014 Examine the necessity of amending or supplementing the relevant national legislation in force, by providing relevant instructions or guidance for the survey and discard criteria of the wire ropes used in lifting appliances as

deemed appropriate.

7.3 Safety Recommendation addressed to the Recognized Organization

Lloyds Register as the Recognized Organization of the vessel is recommended to:

- 57/2014 Review the established procedures for inspections carried out in Greek registered vessels by its worldwide Office network so that Cargo Gear Book is properly filled, following annual surveys or other kind of inspections, regarding the due date of the next annual survey.
- 58/2014 Consider the necessity of introducing guidelines for its vessels certified according to P.D. 316/2001 so that clear discard criteria for the wires of lifting appliances are provided to the crew either by the manufacturer, or by the managing company taking into consideration the Class Rules and the relevant ISO Standard.

Produced and edited by the Hellenic Bureau for Marine Casualties Investigation (HBMCI), under the provisions of the article 16 of Law 4033/2011 (Government Gazette A' 264)

This report was written solely for the purposes of the investigation and is uploaded on the website of HBMCI (see below).

Accident Investigation Report 07/2014

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