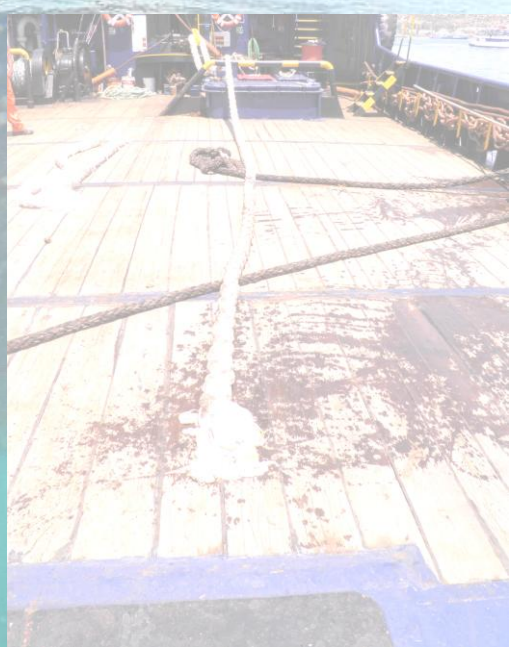
HELLENIC REPUBLIC
HELLENIC BUREAU FOR MARINE CASUALTIES INVESTIGATION

MARINE CASUALTY SAFETY INVESTIGATION REPORT 11/2015

ENTAGLEMENT OF THE TOWLINE USED FOR TOWING C/V "HAMMERSMITH BRIDGE", FLAG PANAMA, IMO 9395147 RESULTING TO THE DEATH OF THE MOTORMAN OF T/B "CHRISTOS XXII", FLAG GREECE, IMO 7230135



July 2018

Contents

Glossary of Abbreviations and Acronyms

1.	AB	Able seaman
2.	Bf	Beaufort (wind force measuring unit of Beaufort Scale)
3.	CCTV	Closed-circuit Television
4.	CoC	Certificate of Competency
5.	C/V	Container Vessel
6.	CPP	Controllable Pitch Propeller
7.	CPR	Cardiopulmonary resuscitation
8.	E	East
9.	EC	European Commission
10.	EMSA	European Maritime Safety Agency
11.	EU	European Union
12.	GRT	Gross Register Tonnage (ship's total internal volume expressed in "register tons", each of which is equal to 100 cubic feet (2.83 m3)
13.	GT	Gross Tonnage (dimensionless measure of a ship's overall internal volume)
14.	HBMCI	Hellenic Bureau for Marine Casualties Investigation
15.	HCG	Hellenic Coast Guard
16.	IMO	International Maritime Organisation
17.	ISM Code	International Safety Management Code
18.	kg	Kilogram (mass unit)
19.	kg/dm^3	Kilogram per cubic decimeter (specific gravity unit)
20.	kN	Kilo Newton (force unit)
21.	kn	Knot (speed unit equal to one nautical mile (1.852 km) per hour)
22.	kW	kilo Watt (power unit)
23.	L_{OA}	Length Overall
24.	m	Meters (length unit)
25.	MBL	Minimum Breaking Load (force that is much less than that required to make the equipment fail or yield)
26.	MBP	Maximum Bollard Pull (the highest force measured during the conventional measure of the towing force of a tugboat)
27.	M/E	Main Engine
28.	mm	Millimeters (length unit)
29.	M/V	Motor Vessel
30.	N	North
31.	nm	Nautical mile (length unit defined as 1852 meters)
32.	NT	Net Tonnage (dimensionless index calculated from the total moulded volume of the ship's cargo spaces)
33.	port	The left-hand side of a vessel, facing forward
34.	S	South
35.	SBP	Steady Bollard Pull (conventional measure of the towing force of a tugboat)
36.	SMS	Safety Management System
37.	SOLAS	The International Convention for the Safety of Life at Sea
38.	stbd	Starboard (the right-hand side of a vessel, facing forward)
39.	STCW	The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
40.	T/B	Tugboat
41.	ton	Force unit
42.	UTC	Coordinated Universal Time
43.	W	West

Foreword

The Hellenic Bureau for Marine Casualties Investigation was established by Law 4033/2011 (Government Gazette 264/12.22.2011), 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 them 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 into 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 the events that occurred on the 08th of July 2015 and resulted in the examined very serious marine casualty and aims to prevent and deter repetition.

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 times (UTC +3) unless otherwise stated.

Under the above framework HBMCI has been examining the circumstances of a towline entanglement at one of the propellers of T/B CHRISTOS XXII following the towing of C/V HAMMERSMITH BRIDGE, resulting in the fatal injury of one crew member of the T/B.

1. Executive summary

On 08th July 2015 at 07:48, the Motorman of port Tug CHRISTOS XXII was fatally injured during the towing operation of M/V HAMMERSMITH BRIDGE in the port area of Piraeus Container Terminal, Greece.

On the day of the casualty T/B CHRISTOS XXII was engaged as a stern tug in the unberthing operation of M/V HAMMERSMITH BRIDGE by pulling her stern away from the dock. Harbour Tug CHRISTOS XXVII was as well engaged in the operation, standing by at HAMMERSMITH BRIDGE port bow for additional assistance, if required.

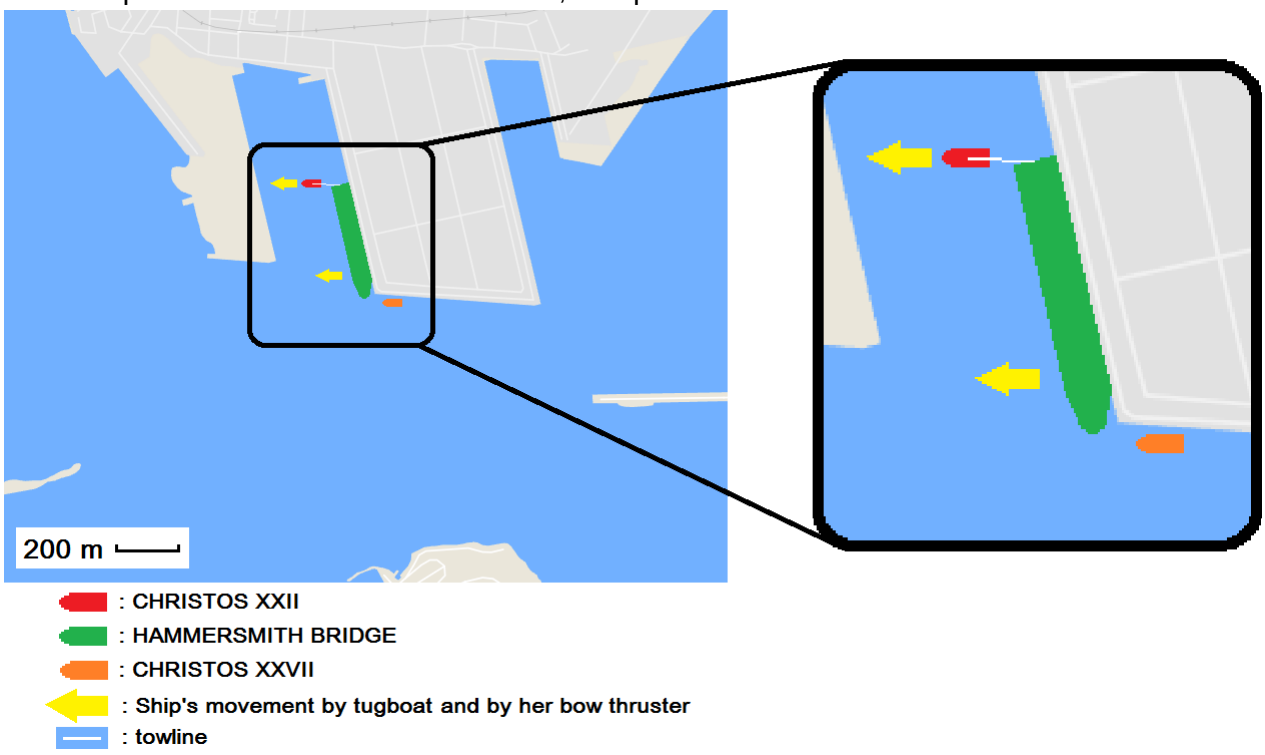


Figure 1/1: Intended towing procedure for the departure of HAMMERSMITH BRIDGE. Dimensions of the vessels and the towline are not scaled.

CHRISTOS XXII had also assisted HAMMERSMITH BRIDGE during her berthing operation, on the previous day of the casualty, in the afternoon.

The Port Pilot boarded her at 07:00. At approximately 07:15, the unberthing operation commenced. CHRISTOS XXII provided a 60m tow line, the one end eye of which was secured onto its towing hook, whereas the other end of the towline was received by the ship using a 30m messenger line connected with a ship's heaving line. The towline's eye was placed on a bollard located at the starboard poop deck. At 07:28 CHRISTOS XXII was made fast and waited for further instructions and the unberthing maneuvers. By that time HAMMERSMITH BRIDGE was moored alongside by her port side. At 07:36 her mooring lines were released from the dock and CHRISTOS XXII started pulling the vessel's stern away from the berth. At the same time HAMMERSMITH BRIDGE bow thruster was operated in order to clear her bow while the Main Engine was running at Dead Slow Ahead and she moved along the berth towards the open sea. During that time none of the tugboat's crew was standing on its deck. Almost 05 minutes later, at about 07:43, the ship was cleared from the berth and her Main Engine was stopped, in order to release the tow line.

The tugboat approached HAMMERSMITH BRIDGE aft by its stern, as the towing assistance was completed, in order to haul in the towline that was about to be slacked. Almost 03 minutes later, at approximately 07:45':30'', HAMMERSMITH BRIDGE started maneuvering Dead Slow Ahead, although the towline hadn't been unfastened from her stern yet. Immediately the Master of CHRISTOS XXII advised the Port Pilot to stop the ship's movement and vessel's M/E was stopped. CHRISTOS XXII moved astern to approach HAMMERSMITH BRIDGE again and the

towing line was being slackened progressively. The middle part of the towline got floating on the sea, whereas the part of the towline which was at the tugboat's deck had moved onto its starboard bulwark, due to the relative movement between the ship and the tug. At that time HAMMERSMITH BRIDGE aft unmooring team continued to lower progressively the towline by lowering the attached messenger line so as to control the towline's release until it reached the sea level.

The two ABs of CHRISTOS XXII seeing the towline's eye being lowered almost 3 to 4 meters below the HAMMERSMITH BRIDGE's deck, assumed that it was ready to be released into the sea in order to be retrieved by them on the T/B main deck. Following, they went out on deck and attempted to pull the towline from the starboard bulwark back towards the tug's centerline, that is in position for heaving it in the tug. They started hauling in the towline manually as the tug was not equipped with a winch suitable for the task. The Motorman who was watching the two ABs went also out on deck to assist them, although it was not within his duties. He along with one AB entered the zone between the rope and the starboard bulwark so as to push the rope towards the tug's centerline. At that time and while the tug crew members were handling the towline, the floating part of the towline, due to the swirling water generated by the operating propellers of both the ship and the tug and their relative movement, got caught in the tug's starboard propeller and was entangled around it. The towline was instantly taut and consequently struck and dragged the AB and the Motorman on to the starboard bulwark against which they were compressed for a few seconds until the towline parted. The messenger line by which the towline was lowered by HAMMERSMITH BRIDGE also parted.

HAMMERSMITH BRIDGE Master was not informed regarding the casualty and at 07:48 the vessel maneuvered again at Dead Slow Ahead to exit the port area and sail for her following destination.

The Motorman of CHRISTOS XXII was fatally injured whereas the AB who had also been trapped between the towline and the bulwark fainted but recovered after a while, without suffering any injury.

2. Factual information

2.1. Vessels' details

2.1.1. CHRISTOS XXII

CHRISTOS XXII was a 545 GT conventional twin screw, twin rudder Anchor Handling Salvage Tug with controllable pitch propellers and a total Horsepower of 2,940 kW. On the day of the casualty it was engaged in the unberthing operation of M/V HAMMERSMITH BRIDGE by pulling her stern away from the dock. The vessel's details are included in the following table:

Name of Vessel	CHRISTOS XXII
Flag State	Greece
Port of Registry	Piraeus (Reg. no 12109)
Call Sign	SVA 3834
Type of Vessel	Tugboat
IMO Number	7230135
L_{OA} (Length over all)	43.84 m
Breadth	10.30 m
Year built	1972
Place built	BODEWES Shipyards BV, Netherlands
Hull material	Steel
Gross Tonnage	545
Net Tonnage	163
G.R.T.	477.21

Statutory Certificates Issuing Authority	Hellenic Republic / Ships' Inspection General Directorate
ISM Certificates Issuing Authority	Hellenic Republic / Ships' Inspection General Directorate
Classification Society	Lloyd's Register
Engine / Power /Speed	2xSTORK-WARTSILA/2x1470 kW/14 kn
Steady Bollard Pull (SBP)	66 tons
Maximum Bollard Pull (MBP)	76 tons
Minimum Safe Manning	05
Crew on board	05
Trading Area	Port Area
Owner	CHRISTOS XXII SPANOPOULOS TUGS MARITIME Co

Figure 2.1.1/1: T/B CHRISTOS XXII.

2.1.2. HAMMERSMITH BRIDGE

M/V HAMMERSMITH BRIDGE had arrived laden at Piraeus port, having departed from Singapore on 24th June 2015. The vessel's details are included in the following table:

Name of Vessel	**HAMMERSMITH BRIDGE**
Flag State	Panama
Port of Registry	Panama (Reg. no 40300-09-A)
Call Sign	3FQE8
Type of Vessel	Fully Cellular Containership
IMO Number	9395147
Loa (Length over all)	336.00 m
Breadth	45.80 m
Year built	2008
Place built	IHI Marine United Inc., Japan
Hull material	Steel
GT (Gross Tonnage)	98,747
NT (Net Tonnage)	35,315
Classification Society	Nippon Kaiji Kyokai
Engine / Power /Speed	KAWASAKI-MAN B&W/66260 Kw/ 24.5 kn
Crew on board	22

Trading Area	International
Managing Company	SHUNZAN KAIUN CO., LTD.

Figure 2.1.2/1: C/V HAMMERSMITH BRIDGE.

2.2. Voyage details

On 07th July 2015 at approximately 19:00, M/V HAMMERSMITH BRIDGE had arrived laden at Piraeus port. On 08th July 2015, at morning hours she was under towing operation in the port area of Piraeus Container Terminal, Greece for her unberthing and departure for her next port of call, at Brixham, UK. The ship was manned with 22 crew members, including her Master. Tugboat CHRISTOS XXII was involved in the towing operation. The T/B crew on the day of the casualty consisted of 05 Seafarers that is the Master, the Chief Engineer, 02 ABs and 01 Motorman.

2.3. Marine casualty information

Vessel's name	**CHRISTOS XXII**
Type of casualty	Very serious
Date and time	08th July 2015, 07:48 Local Time
Position	Piraeus Container Terminal area, Greece (Lat.: 37° 56.873' N / Long.: 23° 35.442' E)
External environment	Wind NE 3-4 Bf / Sea state smooth / Good visibility
Ship operation	Towage
Location on board	T/B Main Deck, Aft part
Consequences	Fatal injury of 01 crew member

2.4. Emergency response actions and shore Authorities involvement

Following the parting of the towline, after having been entangled in the tugboat's starboard propeller and injured the 02 crew members who had been trapped between the towline and the bulwark, the T/B Master reacted by stopping the M/E by pressing the "EMERGENCY STOP" button located on the Bridge console. After that he rushed down to the main deck, where he tried along with the Chief Engineer to perform CPR to the injured Motorman.

The Master informed the Managing Company regarding the casualty at approximately 07:50 and the Company's Operation Department ordered the T/B CHRISTOS XXV which was at the area, to proceed for assistance. After a few minutes T/B CHRISTOS XXV reached CHRISTOS XXII and towed it towards the New Pier of Drapetsona, where they arrived at 08:20.

The Keratsini port Coast Guard Authority personnel and a manned National Emergency First Aid Centre ambulance were already at the pier, having been informed by the T/B Company. The Motorman was transferred to the General State Hospital of Nikaia, Piraeus where he was pronounced dead.

3. Narrative

3.1 Arrival of M/V HAMMERSMITH BRIDGE at the Piraeus Container Terminal

On 07th July 2015, at approximately 18:00, M/V HAMMERSMITH BRIDGE arrived laden at Piraeus port, having departed from Singapore on 24th June 2015. During her berthing operation, T/B CHRISTOS XXII was one of the tugboats involved. However, for her berthing, no towline was used by any of the tugs, since the operation involved only her assistance by the tugboats by breasting her alongside in order her port side to be aligned with the pier. The operation did not last long and was completed for the tugs before 19:00.

CHRISTOS XXII after a few minutes returned to its base port at Ampelaki, Salamis, which is at a distance of approximately 02 nm from the Container Terminal and its crew's daily work was completed.

3.2. The unberthing operation

On 08th July 2015, at approximately 07:00, the Port Pilot boarded HAMMERSMITH BRIDGE and at about 15 minutes later, her unberthing operation commenced. By that time HAMMERSMITH BRIDGE was moored alongside by her port side. CHRISTOS XXII provided a 60m towline which consisted of two fibre ropes with their eyes linked together (**Fig. 3.2/1**). The first part of the towline whose end was to be secured on the ship was 40m long whereas the second part ("pennant") was 20m long and its length was not exceeding the tugboat's stern. The tugboat had the one end of the towline secured on to its towing hook whereas the other end of the towline was received by the ship using a 30m messenger line connected with a ship's heaving line. The towline's eye was placed on a bollard located at the starboard poop deck. At 07:28 Christos XXII was made fast and waited for further instructions and the unberthing maneuvers.

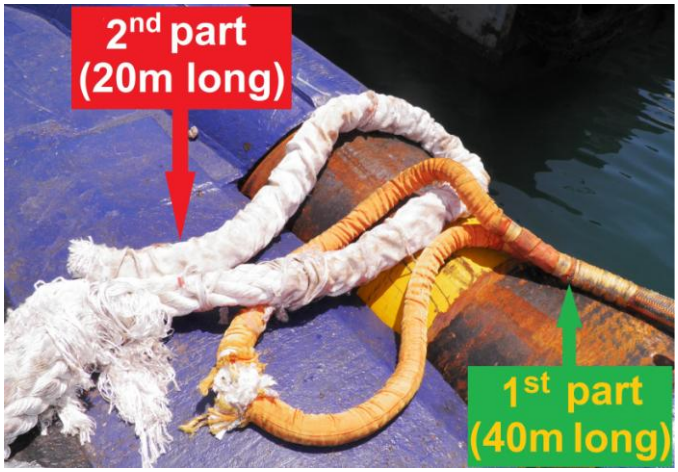


Figure 3.2/1:
eye-to-eye connection of the two lines used for the 60m CHRISTOS XXII towline (photo taken after the casualty, with the parted towline placed indicatively at the state it was used before it, for depiction purposes).

At 07:36 her mooring lines were released from the dock and CHRISTOS XXII started pulling the vessel's stern away from the berth. At the same time HAMMERSMITH BRIDGE bow thruster was operated in order to clear her bow while the Main Engine was running at Dead Slow Ahead and she moved along the berth towards the open sea. During that time none from the tugboat's crew was standing on its deck. Almost 07 minutes later, at about 07:43, the ship was cleared from the berth and her Main Engine was stopped, in order to release the tow line.

3.3. The casualty

The tugboat approached HAMMERSMITH BRIDGE aft by its stern, as the towing assistance was completed, in order to haul in the towline that was about to be slacked. Almost 2.5 minutes later, at approximately 07:45':30'', HAMMERSMITH BRIDGE started maneuvering Dead Slow Ahead,

although the towline hadn't been unfastened from her stern yet. Immediately the Master of CHRISTOS XXII advised the Port Pilot to stop the ship's movement and vessel's M/E was stopped. CHRISTOS XXII moved slowly astern to approach HAMMERSMITH BRIDGE again and the towing line was being slacked progressively. The middle part of the towline got floating on the sea, whereas the 20m towline pennant which was at the tugboat's deck had moved onto its starboard bulwark, due to the swirling water generated by the operating propellers of both the ship and the tug and their relative movement (**Fig. 3.3/1**). At that time HAMMERSMITH BRIDGE's aft unmooring team continued to lower progressively the towline by lowering the attached messenger line so as to control the towline's release until it reached the sea level.

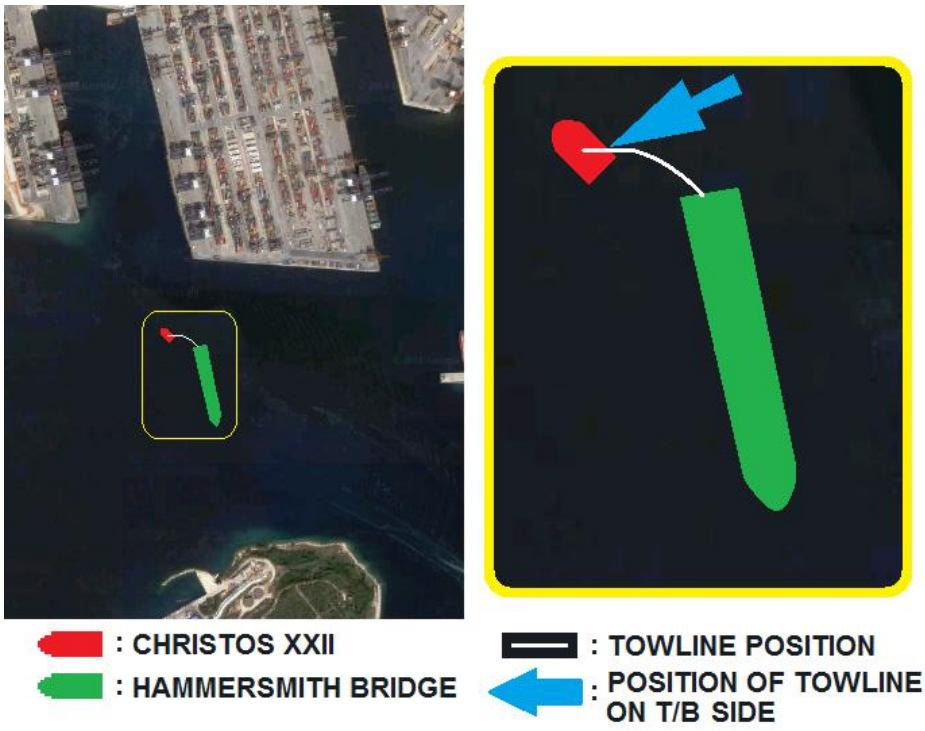


Figure 3.3/1: Overview of the vessels' relative position at some point after the towing procedure and prior to the release of the towline by HAMMERSMITH BRIDGE, as estimated by descriptions during the interviews' process.

The two ABs of CHRISTOS XXII seeing the towline's eye being lowered almost 3 to 4 meters below the HAMMERSMITH BRIDGE's deck, assumed that it was ready to be released into the sea and ready to be heaved in the tug (**Fig. 3.3/2**).

Figure 3.3/2:
Indicative position (red arrow) of the towline's eye while being released by the HAMMERSMITH BRIDGE aft unmooring team and prior the exit of the T/B crew on its deck.

Following, they went out on deck and attempted to pull the towline from the starboard bulwark back towards the tug's centerline, that is in position for heaving it in the tug. They started hauling in the towline manually as the tug was not equipped with a winch suitable for the task.

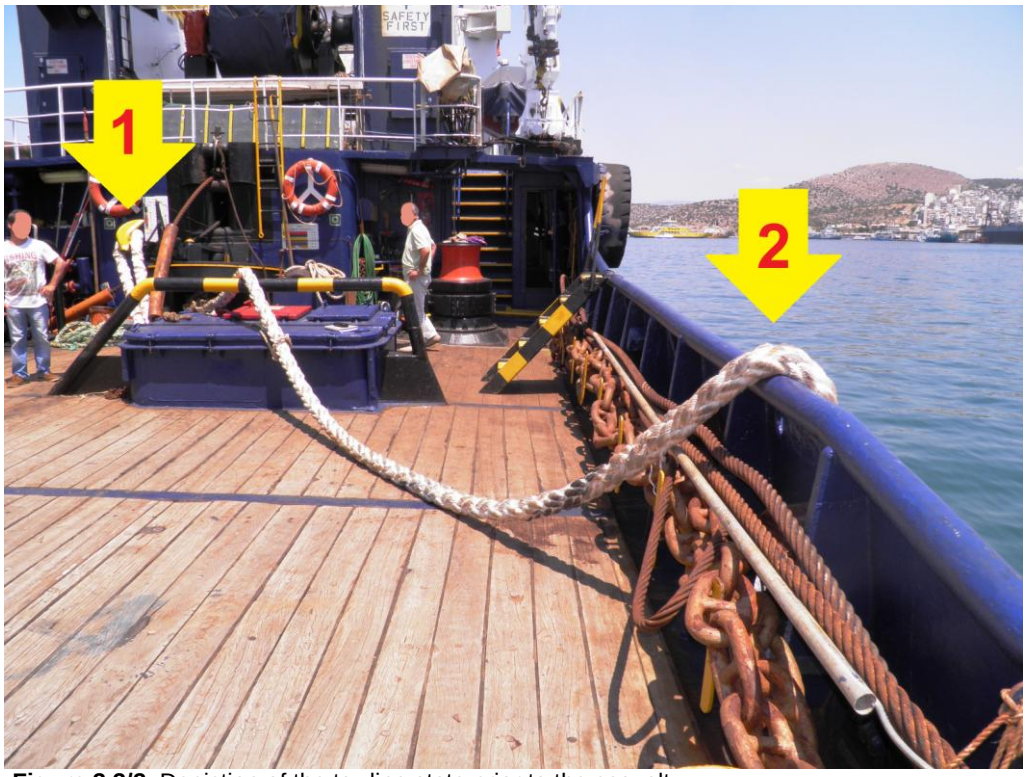


Figure 3.3/3: Depiction of the towline state prior to the casualty:
Position 1: Towline end secured to the towing hook.
Position 2: Position of the towline over the stbd bulwark.
The A/B and the Motorman were pressed by the towline against that bulwark.

The Motorman who was watching the two ABs went also out on deck to assist them, without having received any such instruction and although it was not within his duties. He along with one AB entered the zone between the rope and the starboard bulwark so as to push the rope towards the tug's centerline.

While the tugboat crew members were handling the towline, the floating part of the towline got caught in the tug's starboard propeller and was entangled around the propeller shaft. The towline

was instantly taut and consequently struck and dragged the AB and the Motorman on to the starboard bulwark where they were pushed with extreme force against it for a few seconds until it parted (**Fig. 3.3/4**). The messenger line by which the towline was lowered by HAMMERSMITH BRIDGE also parted.

The vessel's bridge was not informed regarding the situation and HAMMERSMITH BRIDGE sailed towards her destination.

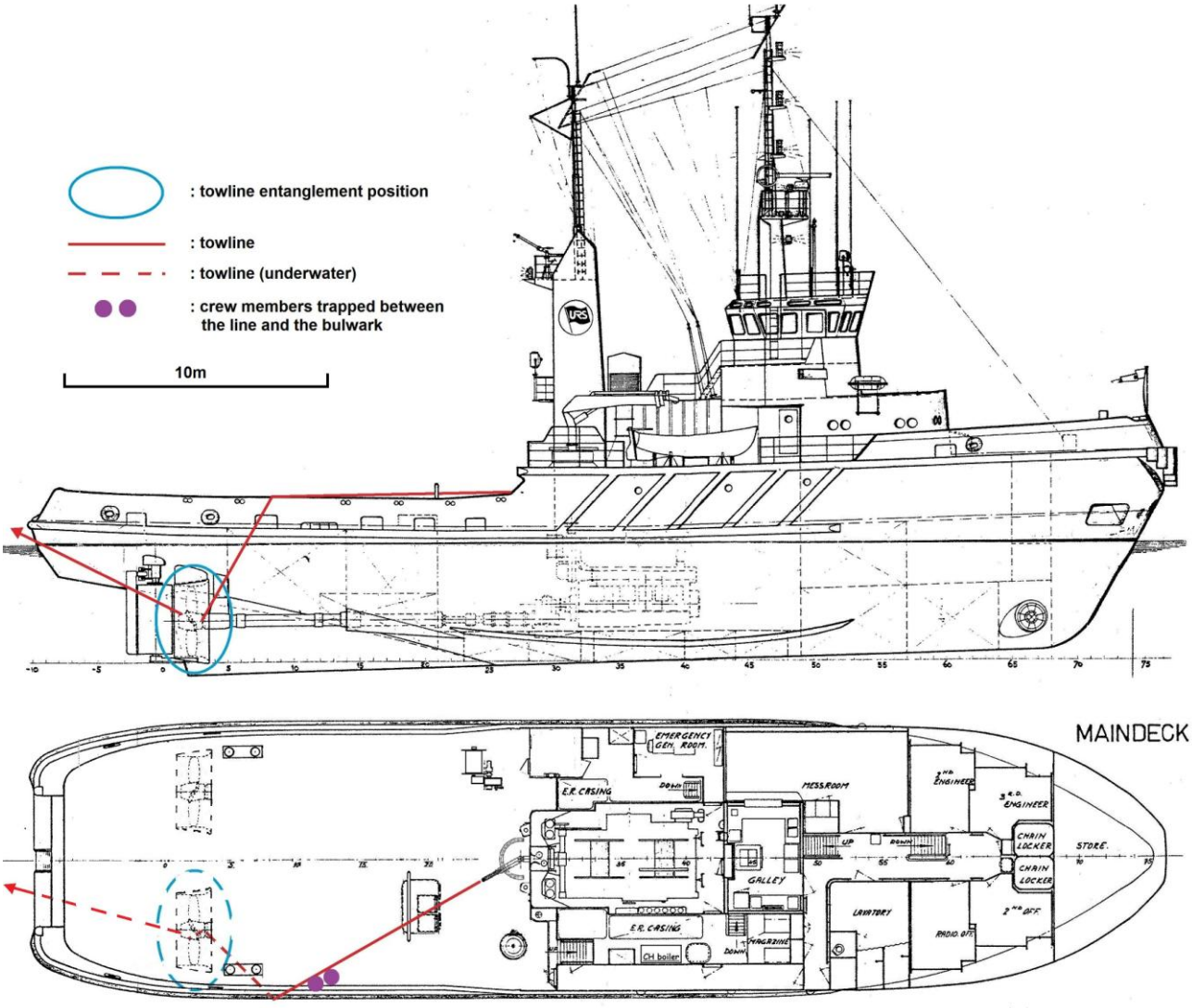


Figure 3.3/4: Depiction of the position of the towline and the trapped A/B and Motorman during the casualty.

3.4. Consequences of the casualty

The Motorman, aged 43, suffered severe chest injuries, when the towline unexpectedly became taut and pinned him against the tugboat starboard bulwark. His heart and thoracic aorta were ruptured and both his lungs collapsed by the hit, resulting to his death.

The A/B, aged 45, who also got trapped between the towline and the bulwark, lost his senses for a few seconds only and fell on the main deck. He recovered without any other consequence for his health.

3.5. Actions after the casualty

A few seconds after the towline was entangled around the starboard propeller shaft and after it was taut and struck the two crew members against the bulwark, it was cut by the propeller blades, freeing both men, who fell on the main deck unconscious. The other A/B who was standing between the towline and the port side of the tugboat, started shouting and signaling towards the tugboat bridge, to stop the engines. The tugboat Master on the bridge, who saw his

signals, pushed the “EMERGENCY STOP” buttons for both Main Engines, located at the bridge console (**Fig. 3.5/1**), and rushed his way to the main deck. The Chief Engineer, who was inside the Engine Control Room, was alerted by the stopping of the M/Es and also exited the Engine Room and saw the injured Motorman lying on the deck. All three, the Master, the Chief Engineer and the other A/B, tried to assist their colleague by performing CPR but he was so severely injured that he could not be resuscitated.

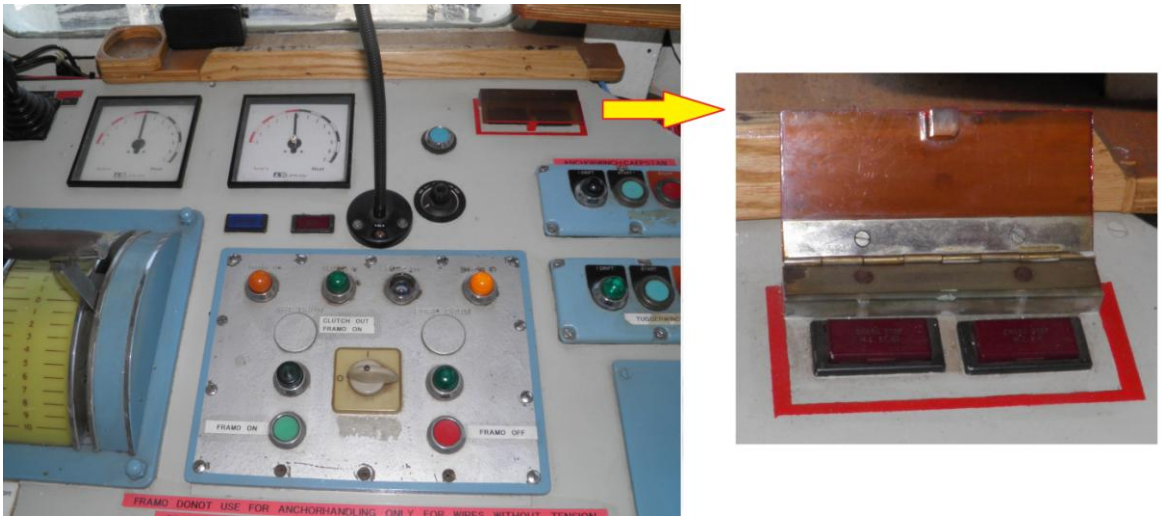


Figure 3.5/1: The “EMERGENCY STOP” buttons for both Main Engines, located at the bridge console.

Simultaneously, at approximately 07:50, the Master reported the casualty to the Managing Company of CHRISTOS XXII and the Operations’ Department in turn ordered another T/B, CHRISTOS XXV, to proceed towards the casualty, for assistance. The Operations’ Department also called for an ambulance at the “New Drapetsona Pier” and informed the Local Coast Guard Authority regarding the casualty at 08:00.
T/B CHRISTOS XXV arrived at the casualty location at approximately 07:55 and after connecting a tow line, started the towing operation of CHRISTOS XXII to the nearest pier, which was the “New Drapetsona Pier”.

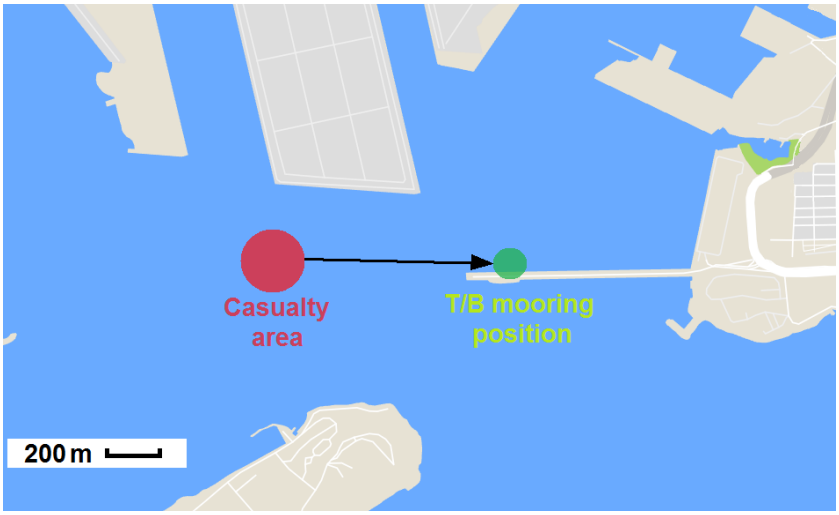


Figure 3.5/2: Towing of CHRISTOS XXII to the “New Drapetsona Pier”, at a distance less than 0.5 nm away from the casualty area.

CHRISTOS XXII was moored alongside at the pier at 08:15 and the Motorman was taken over by the National Emergency First Aid Centre ambulance crew at 08:20 and was transferred to the General State Hospital of Nikaia “Agios Panteleimon” where he was pronounced dead.

4. Analysis

The analysis of the examined marine casualty aims to identify the factors and causes 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.
It is noted that during the investigation process the majority of the information derived from the interviewing process, the Engine telegraph logger of HAMMERSMITH BRIDGE and the examination of the stern areas of both vessels.

4.1. The crew of T/B CHRISTOS XXII

T/B CHRISTOS XXII counted a crew of 5, as per its Minimum Safe Manning Document issued by the Hellenic Coast Guard Authority, for harbour towings. All crew members were of Greek nationality with Certificates of Competence according to their grades on board. The established working language on the vessel was Greek for the tugboat's harbour operation.

4.1.1. The Master

The tugboat's Master was 44 years old and had been working as a Master on board tugboats for 11 years prior to the casualty. In March 2015 he was appointed on CHRISTOS XXII. He also had a sea experience of approximately 5 years as a 2nd Mate and Chief Mate on cargo vessels from 1999 up to 2004. Based on his previous sea experience he was considered to be an experienced tugboat Master.

4.1.2. The Chief Engineer

The tugboat's Chief Engineer was 51 years old and he was serving for the first time on CHRISTOS XXII. His past experience included several years on passenger and cargo vessels since 1986 and had served on tugboats for 2 years in the past, from 2007 until 2009. He had joined CHRISTOS XXII on January 2015, approximately 6 months prior to the casualty.

4.1.3. The Motorman who was fatally injured

The Motorman who was fatally injured during the investigated casualty had joined CHRISTOS XXII in November of 2014. He was 43 years old and he had never served on a tugboat in the past. According to the relevant SMS document he had completed his familiarization procedure on 17th November 2014. His previous sea experience included services on passenger and cargo vessels.

4.1.4. The AB who was injured

The 44 years old A/B who was pushed against the tugboat's stbd bulwark along with the deceased Motorman, by the taut towline pennant, had joined CHRISTOS XXII approximately 2 years prior to the casualty, in October of 2013. His entire sea experience was on board tugboats. He had been serving as an O/S and later on as an A/B since 2001. Taking into account his previous sea experience he was considered to be an experienced tugboat crew member.

4.1.5. The AB who was not injured

The 35 years old A/B who also participated in the towline heaving procedure but was not improperly positioned inside the dangerous zone between the towline and the tugboat's stbd bulwark, had joined CHRISTOS XXII along with the deceased Motorman, on 17th November 2014. He had a long sea experience as a seaman since 1995 on board passenger vessels and prior to the casualty he had been serving for approximately 5 years on board tugboats. He also had a Boatswain's CoC issued under the provisions of STCW in 2007 and was considered to be an experienced tugboat seaman.

4.2. The actions of CHRISTOS XXII crew during the casualty

The crew on board CHRISTOS XXII on the day of the casualty was considered to be experienced for the work each one of them had been assigned to perform. Both ABs who comprised the working deck team had long sea experience on board tugboats. Their decision to exit on the working deck for the retrieval of the towline followed their presumption that the towline was about to be released into the sea by the Container Vessel, after seeing its eye hanging below the mooring deck of the Container Vessel's stern and being held by the messenger line. The 3 phases of the actions of the tugboat's crew until the occurrence of the casualty are shown in Figure **4.2/1**:

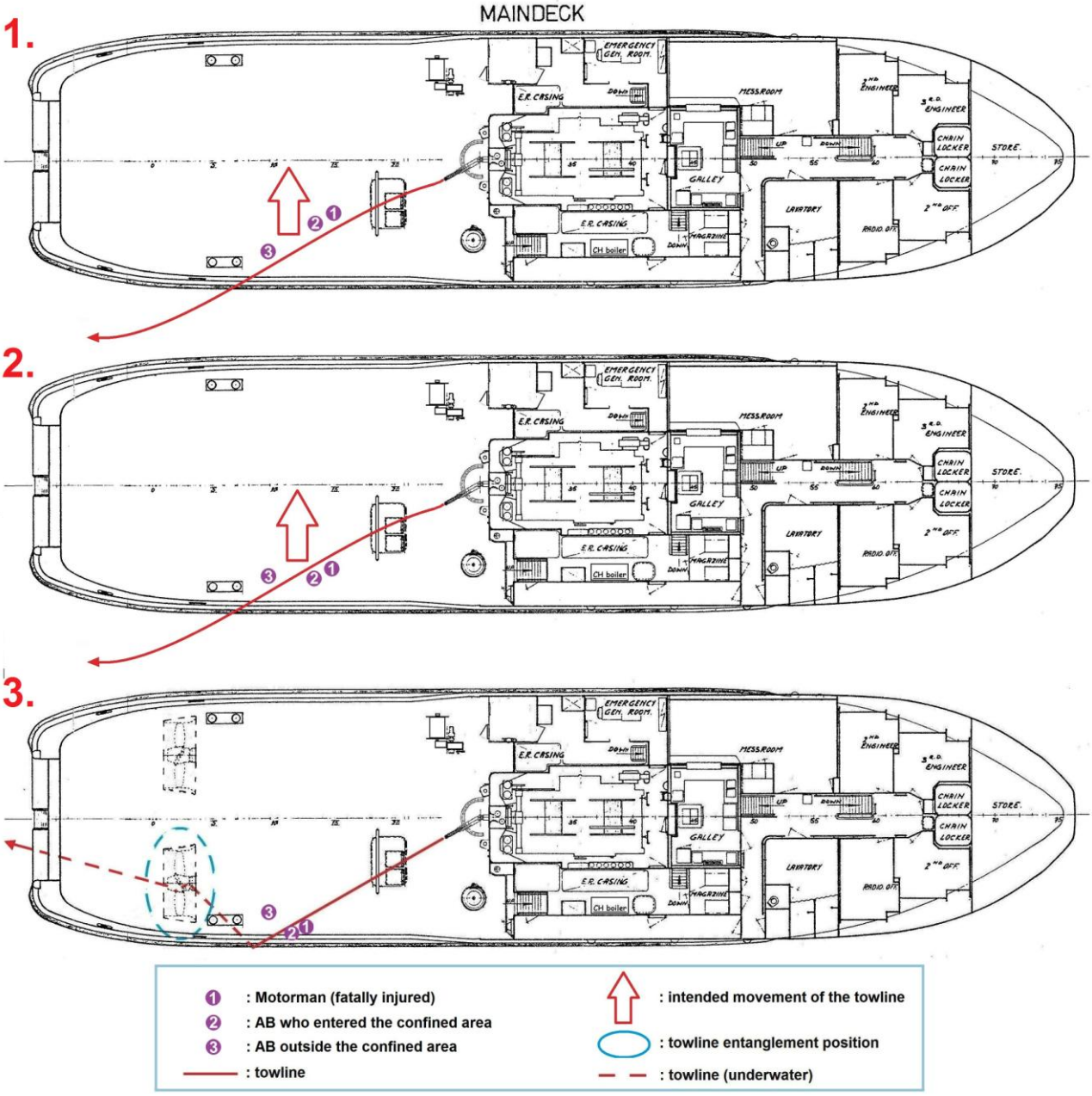


Figure 4.2/1: Phase 1: Pulling of the towline from all 3 crew members standing on its left side (looking forward).
Phase 2: Entrance of one AB and the Motorman in the confined area between the towline and the stbd bulwark.
Phase 3: Entanglement of the towline and entrapment of the AB and the Motorrman.

The tugboat's Motorman's duties as crew member of the Engine Department did not include any works related to the handling of the towing equipment and he also had a limited sea experience of less than one year on board tugboats. His decision to exit on the main deck for the retrieval of the towline was probably motivated by his intention to assist his colleagues on their effort to

heave in the heavy towline pennant which had already passed over the tugboat's starboard bulwark and they would have to move it towards the tug's centerline.
Although all 3 crew had commenced pulling the towline pennant standing on its left side, one A/B decided to enter the zone between the pennant and the stbd bulwark of the tug, in order to push it towards the intended position. His decision to enter that area which was confined between the towline and the bulwark was against the safety measures provided for towing operations.
The Motorman's decision to follow him inside that area was probably a result of his lack of experience regarding deck operations during towage (in contrast with his assigned duties) and his reliance on his colleague's competence.
The combination of the AB's misjudgment of the hazardous deck areas during the operation and the reliance of the inexperienced Motorman on the AB's skills is considered to have been a contributing factor in the examined marine accident.

4.3. Towing equipment of T/B CHRISTOS XXII

4.3.1. The installed equipment

CHRISTOS XXII was equipped with two towing drums used for tow wires at open-sea tows. A vertical capstan mounted on the main deck starboard side was also used for tow wires only.
The tug also had a pair of towing pins installed mid-astern. The towing pins were used to prevent a towing wire moving onto the tug's beam during open-sea tows.
For the tug's operation as a harbour tug a towing hook was installed almost amidships. The towing hook had a quick release system which could only be activated locally and not from the wheelhouse.
Taking into consideration that there was no winch installed for the fibre rope tow line used in harbour operation and that the operation was executed with the use of the towing hook only, the tow line hauling operation on deck required the presence of experienced crew on the deck for its handling, at least during its heaving, and skill and experience from the tug master also.
The need for the presence of crew on the exposed main deck during the harbour operation is considered to have been a contributing factor in the examined marine accident.

4.3.2. The towing line provided by the T/B

4.3.2.1. The towing line physical properties

For its harbour operation, CHRISTOS XXII was equipped with a 60m towing line consisting of two fibre ropes with their eyes linked together, as already described in previous par. § 3.2. The line had been purchased on 26th May 2015, that is less than 1.5 month prior to the casualty and no signs of defects that could characterize it unfit for use were observed during the examination of its parts after the casualty.
The first part of the towline was a 40m Polyethylene fibre rope of a 52mm diameter (orange color rope) and the second part ("pennant") was a 20m 8-strand Polyamide ("nylon") fibre rope of an 88mm diameter (white color rope).

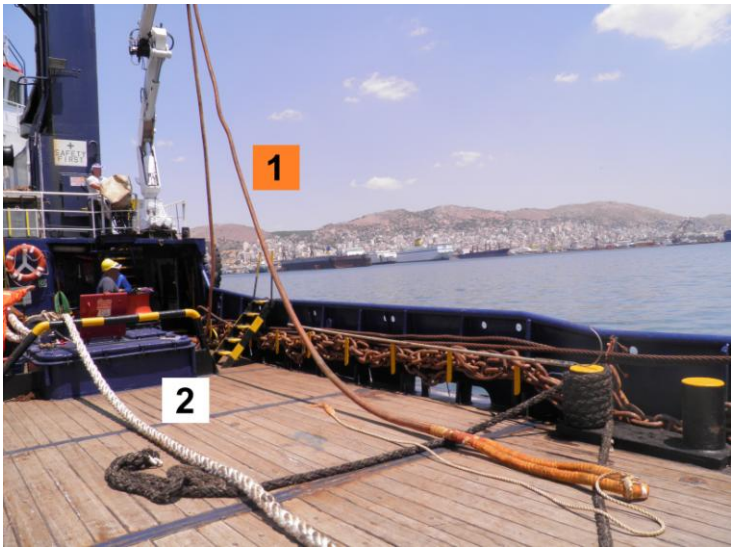


Figure 4.3.2.1/1:
The two fibre rope parts which consisted the 60m towline, after the casualty.
1: 40m Polyethylene rope,
2: 20m Polyamide rope ("pennant").

According to the fibre ropes general specifications as mentioned in the relevant International Standard (ISO 9554:2010[1]), a Polyethylene fibre rope has an approximate specific gravity of 0.95 kg/dm^3, whereas a Polyamide fibre rope has an approximate specific gravity of 1.14 kg/dm^3. Taking into consideration that the average density of the Sea Water at the surface is approximately 1.025 kg/dm^3, it arises that the Polyethylene fibre rope would remain afloat, whereas the Polyamide fibre rope would sink. Indeed those were their physical properties, as seen also in **Figures 4.3.2.1/2 & 3**, which show photos of both ropes in the water, taken by the Investigating team after the casualty.

Figure 4.3.2.1/2:
Part of the 40m Polyethylene fibre rope (orange color) floating at sea.

Figure 4.3.2.1/3:
Part of the 20m Polyamide fibre rope (white color) submerged in sea water.

The pennant (20m white color rope) was fitted at the tugboat hook end of the towline in order to provide additional elasticity and reduce the dynamic loads induced in the towing line, allowing the tugboat to respond more freely to various combinations of loads induced by the relative movement between the tug and the tow and the prevailing weather and sea circumstances. Its total weight was 134 kg and its length had been determined equal to 20m in order not to exceed the tugboat's main deck and enter the sea, when extended parallel to its centerline.

[1] ISO 9554:2010 Fibre ropes – General specifications

However, no measure had been provided to prevent the pennant from falling into the sea from the tugboat side, as was the case in the investigated casualty. As can be seen from **Figure 3.3/4**, the total distance from the towing hook up to the propeller, taking into consideration the stern hull structure (**Figure 4.3.2.1/4**), was approximately 14m, that was less than the pennant length.

Figure 4.3.2.1/4: View of CHRISTOS XXII at a shipyard, showing the distance from the estimated point of the bulwark where the towline was taut until the propeller shaft (although the photo shows the port side of the tug, the same estimation stands for the stbd side as well).

In the following **Figures 4.3.2.1/5 & 6** there are photos showing the towline's entanglement, as taken by the professional diver who inspected the tailshaft after the casualty.

Figures 4.3.2.1/5 & 6: Underwater photos showing the entanglement of the towline at CHRISTOS XXII stbd propeller shaft

After the towline's entanglement at the stbd propeller shaft, the 20m pennant parted probably due to the induced friction by the shaft's rotation and the propeller blades' effect. The parts of the parted fibre rope are shown in the following **Figures 4.3.2.1/7 to 9**.

Figure 4.3.2.1/7:
Both ends of the fibre rope parts of the 20m towline pennant, after the casualty.

Figure 4.3.2.1/8:
The end of the pennant's part that was affected by the shaft's and the blades' rotation.

Figure 4.3.2.1/9:
The end of the pennant's part on the tugboat side.

The 20m pennant had a diameter of 88mm and a nominal MBL of 190 tons, according to its manufacturer's certificate. In fact, its remaining part was tested a few days after the casualty, on 17th July 2015, in order its Braking Load to be determined, and could not be broken by a force of 80.4 tons which was applied by the test machine, as shown in **Figure 4.3.2.1/10** test result. Although its MBL could not be reached by the test machine that was used, due to the machine's dimensional restrictions, no signs of decreased performance of the line could be observed.

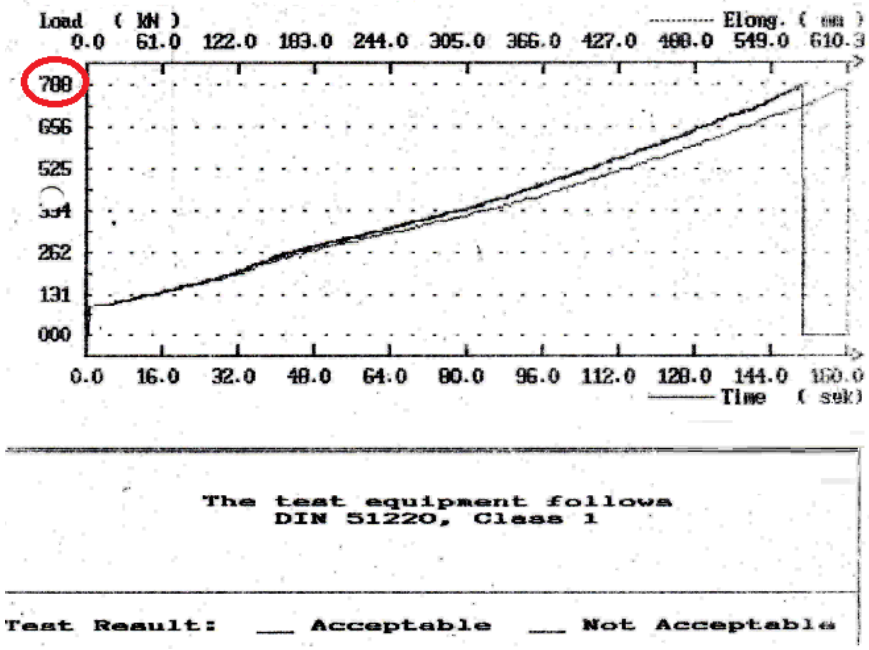


Figure 4.3.2.1/10:
Abstract of the test result of the remaining part of the parted towline pennant.
The line bore a Load of 788 kN (80.4 tons) before the test machine reached its maximum elongation distance.

Taking into consideration the above mentioned test result as well as the fact that the towline pennant's deterioration was attributed to its wearing due to the induced friction by the shaft's rotation and the propeller blades' effect it derives that the towline prior to the casualty was considered to be fit for the intended use by CHRISTOS XXII.

4.3.2.2. The handling of the towline in relation to the T/B stern construction

CHRISTOS XXII stern construction can be seen in the following **Figures 4.3.2.2/1 & 2**.

Figure 4.3.2.2/1 & 2: The stern construction of the tugboat viewed from its deck and from the shore, respectively.

The rounded shape of the stern and its adjacent bulwark, allowed the movement of the towline from the aftmost position along the tugboat's side, when no towline restraining equipment was used.

The tugboat's retractable towing pins, located at the aft part of its main deck, were used for the purpose of keeping the towing line in the centre of the tug. However, the towing pins were only used in open-sea tows, where steel wires of lengths of hundreds of meters were used. The towing pins were not used with fibre ropes in harbour operations, as according to information collected from the interviews process, their low height and inability to accommodate a relevant freedom of movement of the tow line in the horizontal plane would diminish significantly the towing performance of the tugboat within constrained harbour areas.

The use of removable poles at the stern port and stbd bulwark sides was also conducted in some open-sea tows with steel wires, as can be seen in **Figure 4.3.2.2/3** which was taken during a towing operation prior to the investigated casualty.

Figure 4.3.2.2/3:
Photo from a towage conducted by CHRISTOS XXII using a steel wire tow line, where removable poles (indicated by the red arrows) were used.
(Image Source: www.marinetraffic.com)

However, such poles' strength was small and their contribution to the operation was limited to the collection process of the steel tow line, where no major forces would apply. Therefore, they could not be used through the entire operation.

4.3.2.3. The use of a Gog Rope in open-sea tows

A Gog Rope (**Figure 4.3.2.3/1**), sometimes referred to as a guest rope or bridle, is a short rope secured to the tug, usually passing through a fairlead or appropriate bollard on the centerline of the work deck, with its end holding a large shackle, attached around the towline, used to move the effective towing point closer to the towing vessel's stern. This prevents the towline from being taken across the towing vessel's beam, and therefore reduces the danger of girting.

Figure 4.3.2.3/1:
Indicative photo from a towage with the use of a gog rope (yellow color line) attached to a towline (blue & white color line).
(Image Source: http://kingmarine.eu/tug-deckhand-course)

Gog ropes are commonplace on conventional tugs and are commonly used when a tug is running astern behind a vessel to act as braking/steering tug. While moving the towing point aft reduces the risk of girting and capsize, it can restrict maneuverability by reducing the tug's ability to turn on its own axis. It is therefore advantageous to have the gog rope led from a winch, which can then be used to vary the length of the gog rope. Although the gog rope cannot be shortened when it is under tension, a winch allows a permanently rigged gog rope to be rapidly adjusted to suit the requirements of each particular towage operation (**Figures 4.3.2.3/2 to 4**)

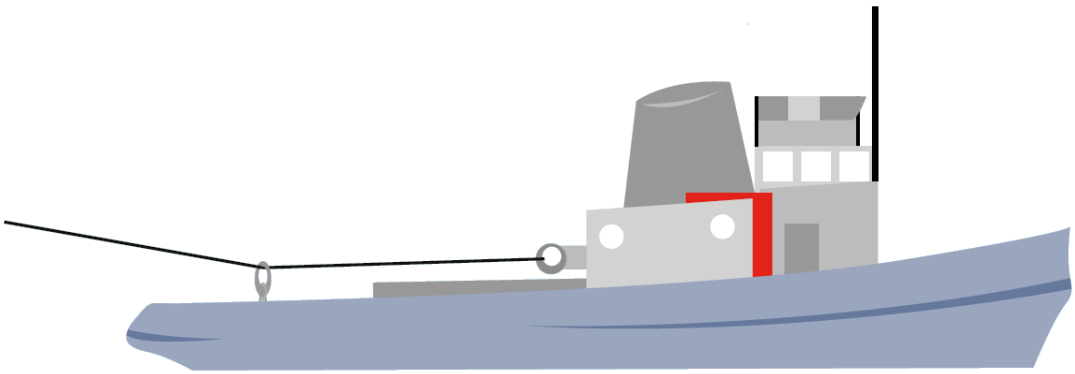


Figure 4.3.2.3/2: Side view of a T/B using a gog rope, showing its effect to the effective towing point.

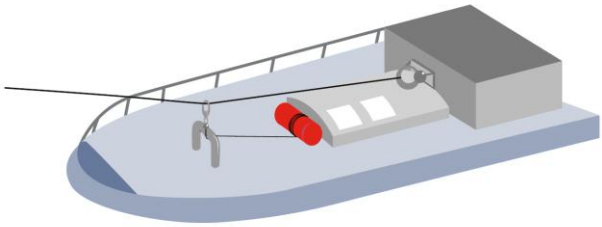


Figure 4.3.2.3/3: Gog rope led from a winch, used to vary the length of the gog rope.

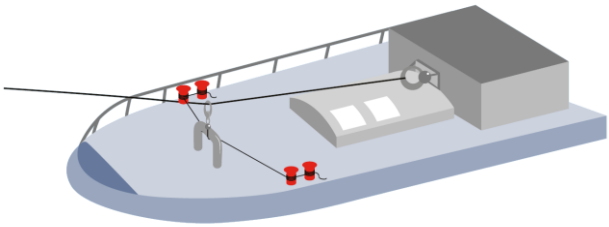


Figure 4.3.2.3/4: Permanent length gog rope.

Just like the towing pins, referred in the previous paragraph (§ 4.3.2.2.), a gog rope arrangement could also not be used in harbour operations, as according to information collected from the interviews process by various tug operators, its use would diminish significantly the maneuverability and the general towing performance of the tugboat within constrained harbour areas.
Therefore, CHRISTOS XXII did not have a gog rope to prevent the towing line moving onto the tug's beam, neither used any other preventing method.
The lack of use of a method to prevent the towing line from moving onto the tug's side bulwarks, is considered to have been a contributing factor in the examined marine accident.

4.3.3. The towing hook release mechanism

The arrangement and operation of the towline's quick release mechanism on Harbour Tugs are not governed by specific national or international regulations. Said issue is regulated by general rules of Recognized Organizations or rules issued by Administrations' Inspection and Certification Services, responsible with the task of monitoring the construction and the operation of a Tugboat.
In such a framework specifications or standards for the arrangement or the operability of a quick release mechanism for a certain range of loads and angles or for the activation modes of the system, the inspections and tests of its operation and their frequency may be included.
It is noted that this parameter of the investigation had also been thoroughly examined by HBMCI in the past, for the investigation of the casualty of T/B "ARTEMIS V"[2]. In the context of the investigation process tugs of various sizes and ages with different towline release mechanisms (mechanical, hydraulic, electrical) had been examined and it was found that for safety reasons the arrangement of the towline release mechanism could be equipped with two or three alternative (backup) releasing modes in order to be operated from more than one locations of the tug.

4.3.3.1. The quick release mechanism of CHRISTOS XXII

The arrangement and operation of the towline's quick release mechanism of CHRISTOS XXII was mechanical and provided only one mode of activation and only from one location, at the main deck. More specifically, it consisted of a jointed arm coupled to the base of the towing hook which was connected to a wire and ended to a handle mounted at the stbd side of the accommodation aft bulkhead (**Fig. 4.3.3.1/1 to 3**).
The operation of the quick release mechanism was inspected (with no tension applied) after the casualty and was found to be functioning adequately.

[2] The Investigation Reports for the casualty of "ARTEMIS V" (in greek and in English language respectively) are uploaded in HBMCI's website, at the following links:
http://www.hbmci.gov.gr/js/investigation%20report/final/04-2013%20ARTEMIS%20V-GRE.pdf
http://www.hbmci.gov.gr/js/investigation%20report/final/04-2013%20ARTEMIS%20V-ENG.pdf

Figure 4.3.3.1/1: The towing hook quick release mechanism's wire route is indicated by the red arrows.

Figures 4.3.3.1/2 & 3: The towing hook quick release mechanism's wire route and handle are indicated by the red arrows.

The handle simply remained hanging by the wire at the accommodation superstructure's aft bulkhead.

No arrangement for the towline's quick release mechanism operation from the wheelhouse of CHRISTOS XXII was fitted. Therefore, in an emergency situation in which the Master of CHRISTOS XXII would decide that the towline needed to be released, he would have to order someone from the crew to operate the quick release mechanism, from the open deck area.

In the investigated casualty, it was reported that the development of the dangerous situation following the entanglement of the towline to the propeller shaft until the parting of the line was so rapid that nobody from the crew had the chance to even try to use the quick release mechanism. However, its design was such that had the Master foreseen the course of events and intended to release the towline prior to its entanglement, he wouldn't have the equipment to accomplish such an action.

The towline's quick release mechanism arrangement may be described as a simple construction with no specific technical safety standards for its sufficient operation at all potential dangerous situations as it could not facilitate the direct and prompt activation from the navigating position. The lack of an arrangement that would allow the activation of the towline's quick release mechanism from the wheelhouse, is considered to have been a contributing factor in the examined marine accident.

It should be mentioned that after the casualty, a second point of activation of the quick release mechanism was added at CHRISTOS XXII, in order the mechanism to be operated from the wheelhouse

4.3.3.2. Alternative (back-up) activation location of the release mechanism

The arrangement of the towline release mechanism on CHRISTOS XXII provided only one activation mode located on the open deck and in the usual manner was triggered by an AB.
The potential setting of a second arrangement located on the wheelhouse would allow activation by the Master of the Tug and that is considered to be a safety issue that needs to be appropriately appraised.

4.4. The SMS Manual of CHRISTOS XXII

4.4.1. The Manual Section related to "Towing Operations"

Under the requirements of ISM Code/Chapter 7 "Shipboard operations"[3], CHRISTOS XXII Safety Management System Manual, in its relevant Chapter 7 "Procedures for the preparation of plans and instructions for key shipboard operations" / Section 7.5 "Towing Operations", according to the copy provided by the tugboat's Company to the HBMCI Investigating Team after the casualty, laid down instructions for the preparation of a towing procedure, as follows:

" 7.5.1.3 Procedure
When a vessel becomes disabled, the primary objective is to keep it away from hazards or shallow water. It must then affect repairs or rely on another vessel for towing to a safe place for repairs.
Before attempting to tow or to be towed by another vessel, the Master must bear in mind that his primary duty is to save lives and must first assess the dangers or risks involved in this type of operation. Emergency towing will usually be undertaken with the most suitable vessel available in the vicinity, considering the suitability of own vessel for such an operation and assessing the possibility of damage. However, in the unlikely event of the Master having a choice of vessel able to provide a tow, the most likely order of preference would be a salvage tug, anchor handler, harbour tug, warship and then any other suitable vessel. Vessels have identified suitable strong points, fairleads and other equipment needed for this task.
A towage contract is essentially a contract of service; the service has been defined a long time ago in simplistic terms as "the employment of the vessel to expedite the voyage of another, when nothing more is required than the accelerating of her progress."
The service of towage can sometimes be converted into salvage if there is a change in the circumstances under which it is performed. There are significant differences between towage and salvage, but the line of demarcation may sometimes be indistinct. Just as a towage service may at any time during its performance be transformed into salvage, salvage may also be turned into towage.
The (Tow) Master and officers should have the following in their minds when the tug is to be employed:

- ✓ *Early communication with ship Masters to ascertain position of rendezvous and projected ETA should be ensured.*
- ✓ *Master should clarify whether the ships towing springs are to be used or the tug's lines.*
- ✓ *The relative position that the tug will secure to the vessel and how the lines are to be secured should be established.*
- ✓ *When approaching ships a continuous lookout should be maintained and the operation of securing tugs should not be allowed to distract from essential watch keeping duties.*
- ✓ *The Tow Master should make an early chart assessment of the area of rendezvous in order to be ensured that it is clear of obstructions and without heavy traffic density.*
- ✓ *Deck preparations by way of crew at deck stations, heaving lines and towing springs flaked and make ready to pass to tugs, should all be ready by the time the vessel makes visual contact with tugs.*

[3] The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

- ✓ *The engines should be on 'Stand By ' and the vessel at maneuvering speed.*
- ✓ *The nature and extend of the damage to the distressed vessel will be relevant in deciding whether it should be towed from the bow or the stern to minimise further damage while under tow.*
- ✓ *It should be noted that during towing, the greatest stresses on the towing system occur when the inertia of the disable vessel is being overcome and, later, during its tendency to yaw.*
- ✓ *In order to minimise the risk of parting the tow line, the highest possible resilience should be incorporated. One possible means of achieving this is by lowering the vessel's anchor and cable a little way and connecting the tow line directly to the cable with the anchor still attached.*

(…)

7.5.2 Agreed procedures and responsibilities

(…)

(c) Tug Master's authority

(…)

The tug Master will require certain information from the vessel in order to decide how the vessel can best be towed. Where a point is unclear, the tug Master will ask for clarification or further explanation as he develops the towage plan. The following information will be normally required:

1. Time, date and geographical position of accident.
2. Present position, weather, and drift rate.
3. Heading of casualty and relative aspect to weather.
4. Draft forward, aft and mean before accident.
5. Present best estimated / calculated drafts and trim.
6. Present displacement and list (if any).
7. Whether deck / auxiliary power is available for heaving on board towing gear.
8. Number of crew on board the vessel, which sustained the casualty.
9. Type / nature and tonnage of cargo and / or quantity of ballast on board.
10. Whether there is any loss of cargo / pollution.
11. Is the casualty making any water / leaking.
12. What radio frequencies / channels will be guarded by casualty?
13. Radio contact schedules.

7.5.3 Equipment

(…)

To ensure rapid deployment of the emergency towing arrangements the Master shall ensure that:

- ✓ *Aft Emergency towing arrangement should be pre-rigged and capable of being deployed in a controlled manner in harbour conditions in not more than fifteen (15) minutes.*
- ✓ *Forward emergency towing arrangement should be capable of being deployed in harbour conditions in not more than one (1) hour.*

Because these systems are intended for use in emergency situations, it is important that they are readily available for use at all times and that the crew has good knowledge of equipment stowage location and accessibility. The topic of emergency towing is comprised in the crew standard training and in the familiarization process of deck officers and crew. Also a deployment exercise (without actually deploying the equipment) should be conducted on annual basis, to familiarize all personnel with the procedures. These demonstrations should emphasize any hazards which may arise during the deployment.

The components of the system should be located permanently at, or near to, the strong point site and kept free of obstructions so they are always ready for immediate deployment.

The emergency towing arrangements fitted on certain vessel, may not be suitable for a long distance tow, although are more than adequate for a limited duration of tow, to pull the ship away from, or restrict her drifting towards immediate danger. The crew dealing with an emergency

situation should be aware of the power availability required for winches and tools, as well as for deck lighting.
Given that not all ships have the same degree of shipboard equipment that may imposing limits to possible towing procedures, towing information and methods for connecting the forward and aft emergency tow are provided permanently displayed on the Bridge.
A safe method of passing the main towing pendant from the installation to the towing vessel should be established, with a clear understanding of the procedures to be used by all parties.
If a messenger is used to pass the tow-wire to the towing vessel, it should be of adequate strength to support the entire weight of the towing bridle and fore-runner or at least long enough to allow an adequate strength messenger to be on the winch of the towing vessel before the weight of the gear is taken.
Recovery wires led to appropriate winches on board the installation may be used to relieve weight on the towing vessel's equipment during connection/disconnection but these should not be so taut as to hold the weight of the gear above the water level or in any other way pose a danger to the towing vessel crew. The installation crew must take instruction from the towing vessel master as to the use of these winches.
As soon as the towing vessel is connected and commences towing operations, winches on the vessel being towed (if used in the towing gear) must be continuously manned during the initial stages of the tow, and be under control of the towing vessel's Master.
Once the tow is safely connected, the crew should "clear the deck" and stay clear until the tow is streamed to towing length and the Master authorizes fitting of chafing gear or other necessary maintenance.
(…)

7.5.7 Connecting the tow
Prior to commencing the towing operation, communication procedures should be established between the vessels. No action should be taken in regard to navigation or engine maneuvers by each Master without first informing the other.
Effective radio communications should be maintained between the distressed vessel and the towing vessel. Adequate manpower should be standing by to make the connection.
If the vessel is to be towed by a dedicated towing vessel, the tug will use its own wire and chain combination. In the event of the assisting vessel not being a dedicated towing vessel, the vessel's own towing system will be utilized.
(…)
When taking the tugs connection onboard, remember that it is not easy to hold a large tug in one position and:
- ✓ *The quicker the connection is made, the less risk of the tug getting in difficult position.*
- ✓ *The less risk of failing to make the connection.*
- ✓ *The less risk to vessel and personnel involved in the operation.*

Finally, it is recommended that very regular radio contact is maintained with the approaching rescue tug and preparations are made to:
- ✓ *Rig a pilot ladder on the lee side.*
- ✓ *Lower a long boat rope on lee side.*
- ✓ *Have heaving lines and gantlines ready beside the pilot ladder to enable personnel from the tug to board the vessel safely and expeditiously, if found necessary.*

(…)

7.5.8.1 Manned Tow
It is the responsibility of the personnel on board the towed vessel to:
1. *maintain the proper navigation signals on a manned tow and to follow the instructions issued by the tow master.*

2. *to maintain the vessel properly ballasted and trimmed and not to make changes without the prior knowledge and agreement of the Master of the tug.*
3. *There should be a continuous communications link on a dedicated channel established and maintained between the tug and tow for the duration of the tow."*

Considering all the procedures described in Chapter 7 of the Company's SMS Manual of CHRISTOS XXII and more precisely its above quoted abstracts, it derives that the instructions given, in relation to towing operations, although to some extent detailed, were not specifically adjusted to parameters related to the vessel type (Tugboat) to which they applied.
Therefore, no special instructions were given for instance regarding the crew responsibilities during the towage or regarding the use of specific equipment such as the towline emergency quick release mechanism.

4.4.2. The "Pre Towing Tasks Checklist"

According to the documentation provided by CHRISTOS XXII Managing Company to the HBMCI Investigating after the casualty, a Checklist Form with the following characterization:
"*S-038 – Spanopoulos Tugs Pre Towing Tasks Checklist*"
had been issued on 01st April 2015, that is approximately 04 months prior to the investigated casualty (the entire Form is presented in Appendix 1 of this report).
Said Form had been prepared in order to be incorporated to the existing SMS Manual, taking into consideration the nature of the work executed on board a tugboat and containing specific inspections that had to be conducted prior to a towing operation by the tug Master and other crew members.
Amongst others, it was itemizing a cluster of elements related to the investigated casualty to be considered prior to the towing operation, as presented in the following **Table 4.4.2 / 1**:

1.8	*Identify safe areas on deck*
1.13	*Identify where different phases of the tow may require different towing requirements*
1.16	*Monitor the tow to take timely and effective corrective action when required*
1.17	*Aware of the importance of avoiding large dynamic forces on the tow line*
2.5	*Assess number, experience and qualifications of crew*
3.1.1	*Conduct a pre-tow briefing with crew*
3.1.2	*Conduct the use of hand signals and state the importance of nonverbal signals*
3.1.3	*Conduct the use of hand held radios and state the importance of correct radio procedures*
3.2.1	*Ensure tow set up briefing with external stakeholders*
3.2.2	*Ensure agreement of terminology with pilot*
4.2	*Verify Actions to be taken in the event of failure of gog arrangements*
4.6	*Verify Actions to be taken in the event of loss of external communication to pilot/port control etc*
4.8	*Verify Actions to be taken in the event of rope in propulsion system*
4.15	*Verify use of the emergency controls*
4.17	*Verify emergency release of the tow procedure*

Table 4.4.2 / 1: Checks related to the examined casualty, included in the inspections provided in Checklist Form "S-038 – Spanopoulos Tugs Pre Towing Tasks Checklist"

However, the Checklist Form "S-038" had not been incorporated to the Chapter 7 of the existing - at the time of the casualty - SMS Manual, as the manual's last amendment had been made on 31st December 2014, as was also evident from the relevant list of the SMS Manual Forms (Section 7.12 of the SMS Manual), which is also presented in Appendix 2 of this report.
Apart from the lack of these forms, a matter of major importance is that it is doubtful whether the required information regarding the safety of an operation had been circulated among the masters and the crew members of the tugboat. Consequently, it is concluded that it was not a common practice on board a "toolbox" meeting to be conducted among the crew members of the tug, prior to a towing operation, in order the sequence of the unberthing operation of a vessel to be

discussed and appropriately planned and specific duties to each one of the crew to be assigned. The decision regarding the use of arrangements such as a gog rope could also be taken in such a meeting.
Having scrutinized the aforementioned, it is considered that CHRISTOS XXII towing planning was not developed in full regard of all given or likely to be encountered parameters.
The failure to fully appraise the towing planning procedure is considered to have been a contributing factor into the examined casualty.
It should be mentioned that after the casualty, the company's SMS Manual was completely reformed, in order to properly apply to their managed tugboats. The new Manual was written in Greek, in order for it to be comprehensible by the crew.

4.5. Risk assessment

4.5.1. General requirements

The International Safety Management Code (ISM Code-SOLAS 74), as applied in Chapter. 1.2.2 & 1.2.2.2 states that: "*The Safety Management objectives of the Company should inter alia assess all identified risks to its ships, personnel and the environment and to establish appropriate safeguards*".
Even though the ISM Code does not provide any further explicit reference apart from the above general requirement, risk assessment[4] or risk analysis is fundamental for the compliance with most of the Code's clauses.
It is to be noted that although there is not an exact formal definition of risk, IMO defines it as: "*The combination of the frequency and the severity of the consequence*"[5].

4.5.2. Risk Assessment procedure of CHRISTOS XXII

The CHRISTOS XXII Managing Company's SMS comprised in the SMS Manual the risk assessment procedure, for all hazardous tasks carried out on board. During the investigation process, the relevant Form Detailed Risk Assessment "DRA – 002" with work activity assessed by the company or by the responsible crewmembers before performing the harbour towing operation being "Harbour Towages" was presented, having an assessment date of 08th July 2015, that is the day of the investigated casualty (the entire Form is presented in Appendix 3 of this report).
The above mentioned Risk Assessment Form contained one column with the title "Description of Identified Hazards", however the fields of that column contained 11 general areas to which control measures needed to apply, without identifying the specific risks associated to each area.
In spite of the above oversight, within the column "Existing Control Measures to Protect Personnel from Harm", a number of instructions were placed, as presented in the following **Table 4.5.2 / 1**:

4.	*The decision to put crew on the working deck to handle the towline and messenger in order to connect from the escorted ship will rest solely with the Tug Master. The criterion for this task will be whether the crew can safely carry out the task*
6.	*The Pilot and Tug Master should, as a minimum, discuss the following issues:* *i. Passage details while accompanied by the tug(s), particularly details of any swing manoeuvre, release position and sequence of release;*
7.	*The Tug Master should immediately inform the Pilot/Master of any concerns that he may have as to the safety of his tug and crew. The Pilot and Tug Master should take immediate action to ensure the safety of both the tug and assisted vessel; if necessary*

[4] Risk management may be defined as: "The process whereby decisions are made to accept a known or assessed risk and/or the implementation of actions to reduce the consequences or probability of occurrence." (ISO 8402:1995/BS 4778)
[5] Reference to (MSC Circ.1023/MEPC Circ.392)

	they should abort the operation as soon as it is safe to do so.
9.	*Ensure that working areas are safe and free from trip or slip hazards, particularly around bollards. Remain alert to the ongoing operations. Listen to orders from the tug master. Hold a line by the side of the eye or the standing part. Be aware of lines (towing or mooring) suddenly coming under tension. Stay clear of snap back zones. Not any personnel is allowed on the towing area of the deck when a unit is being towed. During the towage operation good communication between wheelhouse, working deck and engine room MUST remain in place. Additionally all personnel must understand agreed hand signals. Deck hands to handle the towing gear during the course of the operations (towing, mooring, unmooring, collection of the towing gear etc).* ***Additional Risk Control Measures:*** *During the towage operation good communication between wheelhouse, working deck and engine room MUST remain in place. Additionally all personnel must understand agreed hand signals. Deck hands to handle the towing gear during the course of the operations (towing, mooring, unmooring, collection of the towing gear etc).*
10.	*At all times during the connecting process, the Pilot/Master should be aware of the position and intention of all relevant shipping movements in the area..*

Table 4.5.2 / 1: "Existing Control Measures to Protect Personnel from Harm" included in the Detailed Risk Assessment ("DRA – 002") Form of the SMS Manual of CHRISTOS XXII

Considering the aforementioned measures, it is inferred that had they been applied as appropriate, it is highly possible that the release method of the towline would have been discussed in detail by the Tug Master and the Pilot/Master of the Container Vessel and the towline wouldn't have been allowed to remain hanging or floating for more than the absolutely necessary time after the towage.

Besides, the tugboat deck area would have been identified as a hazardous area by the tug Master and the crew for the time the towline was suspended and the exit of CHRISTOS XXII ABs and Motorman for the pulling of the towline, prior to the confirmation of its release, would have been prevented.

The failure to apply the control measures provided by the risk assessment procedure is considered to have been a contributing factor in the examined marine casualty.

4.6. The delay of the towline retrieval by the Tugboat after the towage

According to information collected from the Engine telegraph logger of HAMMERSMITH BRIDGE and from the interviewing process, it was evident that the towline's release from the aft unmooring team of M/V HAMMERSMITH BRIDGE was made at a slower rate than the one expected by the T/B CHRISTOS XXII Master and crew. The faulty perception of the T/B lower rank crew that the towline was about to be released into the sea by the M/V, while her aft unmooring team was still holding the messenger line connected to the towline's eye, releasing it progressively, was one of the reasons which led to their mistimed exit on the T/B working deck for the retrieval of the towline.

4.6.1. The aft unmooring team of HAMMERSMITH BRIDGE

The aft unmooring team of HAMMERSMITH BRIDGE comprised of 3 crew members: A 39 year-old 2nd Officer and 2 ABs, all Philippine nationals. The 2nd Officer had been ordered by the ship's 53 year-old Korean Master to release the towline at a slow rate after the towage, in order for it to be placed on board the tugboat's deck, instead of being dropped into the sea and near the ship's propeller. Both the Master and the 2nd Officer were under the impression that CHRISTOS XXII would receive the towline on its deck presumably by using a winch for that purpose, without taking into consideration that the tugboat was not equipped with such towing gear.

4.6.2. The release of the towline by the aft unmooring team of HAMMERSMITH BRIDGE

According to information collected by the interviewing process and the analysis of the Engine telegraph logger of HAMMERSMITH BRIDGE (**Figure 4.6.2/1**) it derived that she started maneuvering for her unberthing procedure at 07:17:00 ("Dead Slow Ahead").

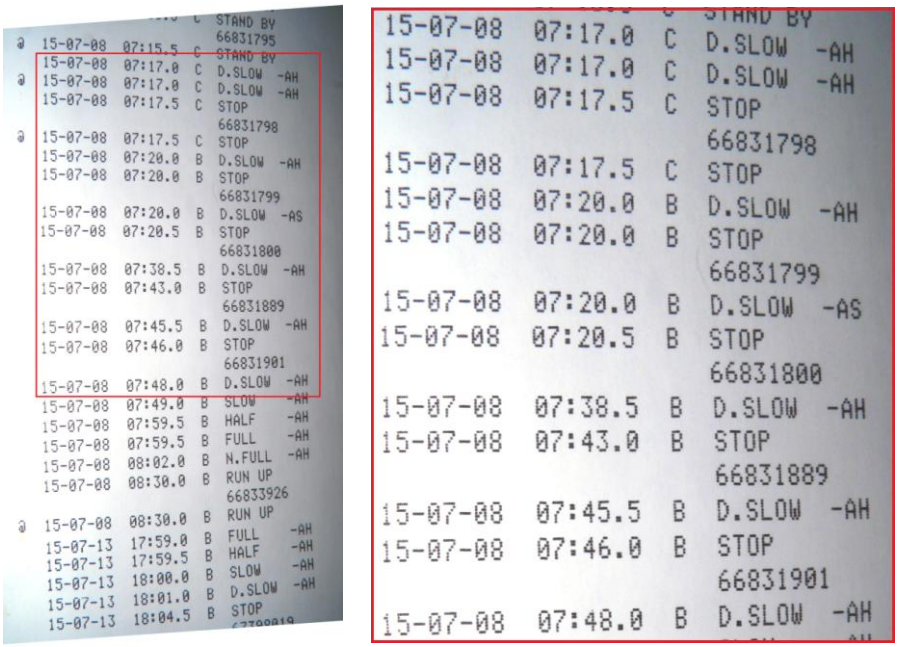


Figure 4.6.2/1: Abstract from the Engine telegraph logger of HAMMERSMITH BRIDGE, showing her M/E movements from the beginning of the unberthing operation until the exit from the port.

From that time and until 07:43:00'', when her M/E was stopped, her M/E was set to "Dead Slow Ahead" and "Stop" alternately, while the T/B was pulling her (by her stern) away from the berth, and her bow thruster was also used for the same purpose.

For approximately 2.5 minutes after the stopping of her M/E, that is from 07:43:00'' until 07:45:30'', the tugboat was at a distance of almost 20-25m from the stern of HAMMERSMITH BRIDGE, waiting for the release of the towline from the vessel, presumably within the casualty area, as indicated by the grey disk area in **Figure 4.6.2/2**.

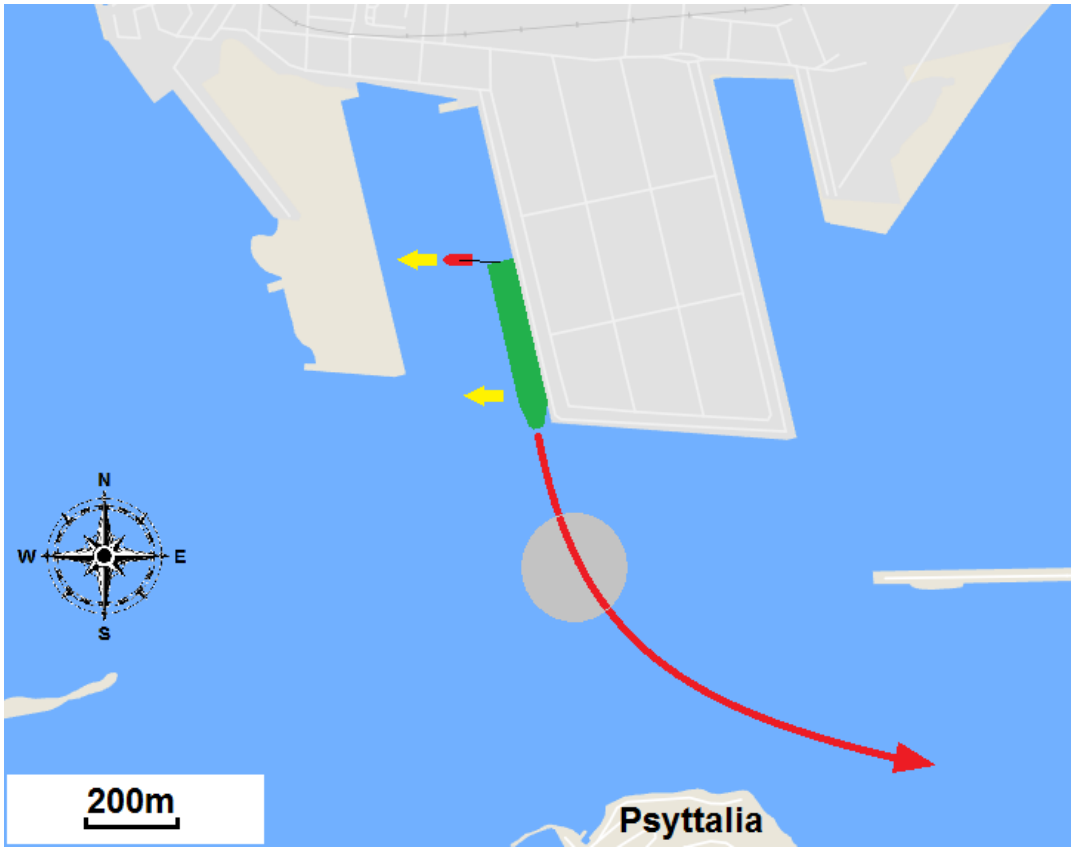


Figure 4.6.2/2: The appraised course of M/V HAMMERSMITH BRIDGE during her departure. The grey disk area indicates the estimated casualty area.

When the M/E of HAMMERSMITH BRIDGE was stopped, her 2nd Officer, being Head of her aft unmooring team comprising of him and 2 ABs, was ordered by her Master to slowly release the towline. The 2nd Officer held the messenger line and waited for the tugboat to approach the vessel's stern, in order the towline to be slacked without tension, so that he could order the ABs to cast off the towline eye from the bollard (**Figures 4.6.2/3 & 4**).

At some point when the distance between the two vessels was instantly shortened, the towline tension was decreased and the stern team cast it off. After that, the 2nd Officer kept holding the messenger line which was turned around another mooring bollard, trying to control the slow lowering of the towline. During that time he was expecting from the tugboat to approach the vessel, in order the towline eye to be delivered onboard the tugboat's main deck, without falling into the sea. Although based on information derived by the interview process, the 2nd Officer could see the tugboat crew (its 2 ABs and the Motorman) signing at him and shouting "let go – let go" in order for him to release the towline, he wouldn't release the messenger line, as he expected its tension to be reduced even more.

Figure 4.6.2/3:
Depiction of the positions of the towline and the messenger line relevant to the stern bollards of HAMMERSMITH BRIDGE used during the towage.

Figure 4.6.2/4:
Representation of the messenger line's position after the towline's eye had been released and was hanging from the stern of HAMMERSMITH BRIDGE.

Meanwhile HAMMERSMITH BRIDGE was navigating Southerly, because of the momentum induced by her preceding maneuvers, towards the northern coast of Psyttalia island, at a low speed. At 07:45':30'' her M/E was set to "Dead Slow Ahead" in order her course to be amended, towards the port exit.

The tugboat had not yet approached considerably the Container Vessel and their relative positioning was still changing. The ship's M/E operated for approximately 30 seconds, until the time when the Tugboat Master apprehended the situation and required from the vessel's bridge to stop the M/E in order the towline to be released.

The stern team of HAMMERSMITH BRIDGE was still waiting for the approach of the tugboat, when the part of the towline which had been slackened and was floating on the sea surface, got caught in the tug's starboard propeller and was entangled around it due to the swirling water generated by the operating propellers of both the ship and the tug and their relative movement. The towline was instantly taut and consequently the messenger line as well. At that point the 2nd Officer released the messenger line, which parted under the induced peak dynamic loading (**Figure 4.6.2/5**).

Figure 4.6.2/5:
The part of the messenger line attached to the towline, after the recovery of the towline by the tugboat, after the casualty.
The elongation of the parted messenger line segment was caused by its dynamic tension.

The Master of HAMMERSMITH BRIDGE was only informed by the 2nd Officer that the towline had been released, without any other comments regarding the casualty and at 07:48 the vessel maneuvered again at Dead Slow Ahead to exit the port area and sail for her following destination.
The fact that the stern team of HAMMERSMITH BRIDGE was waiting for the approach of the tugboat, in order the towline eye to be delivered onboard the tugboat's main deck, despite the fact that CHRISTOS XXII was not equipped with a winch for such an operation, is indicative of the lack of the coordination between the two vessels regarding the release of the towline.
The lack of briefing among the tugboat Master and the Master and Pilot of the Container Vessel prior to the operation regarding critical issues of the operation is considered to have been a contributing factor in the examined marine casualty.
The omission of the 2nd Officer as head of the stern team to establish direct communication with the tug and his practice to rely only on the radio communication with the vessel's Master in order to involve in the operation is also considered to have been a contributing factor in the examined marine casualty.

4.6.3. The efforts by the crew of CHRISTOS XXII to retrieve the towline

As already described in the previous paragraph (§ 4.6.2), it is evident that the towline's release from the aft unmooring team of M/V HAMMERSMITH BRIDGE was made at a slower rate than the one expected by the T/B CHRISTOS XXII Master and crew. The tugboat would expect the towline's release into the sea, in order its crew to retrieve it manually, as no winch was fitted on the tugboat for such a harbour operation.
After CHRISTOS XXII stopped pulling the stern of HAMMERSMITH BRIDGE, the tugboat Master's maneuvering was aiming to align its centerline with the towline's projection on the sea surface and to approach the stern of HAMMERSMITH BRIDGE, in order the towline's tension to be decreased. In order to achieve his purpose, he moved CHRISTOS XXII "slow astern" assessing both the relative movement between the two vessels and the effect of the waves induced during the towing operation. In order to execute such maneuvers he would adjust accordingly the pitch of both Controllable Pitch Propellers of the tugboat.
At some point when the towline tension was decreased, the stern team of HAMMERSMITH BRIDGE cast it off its stern bollard but it was still being held by them via the messenger line. At that moment, the two ABs of CHRISTOS XXII, seeing the towline's eye hanging and improperly presuming that the towline was about to be released into the sea by the Container Vessel, went out on the main deck of the tugboat, for the retrieval of the towline, manually. The tugboat's

Motorman, seeing his colleagues rushing to the main deck to carry out such a task, followed them in order to assist them, although that was not within his duties as crew member of the Engine Department.

At that point, the towline pennant had already passed over the tugboat's starboard bulwark and all 3 tried to move it towards the tug's centerline (as shown in **Figure 3.3/4**). They also started signing towards the stern team of the Container Vessel and shouting "let go – let go" in order for them to release the towline completely.

As the procedure was being prolonged due to the gradual releasing of the towline by the stern team of the Container Vessel, the 3 tugboat's crewmembers kept trying to remove the towline pennant from the tugboat's stbd bulwark. Although all 3 crew had commenced their efforts by pulling the towline pennant standing on its left side, one A/B decided to enter the zone between the pennant and the stbd bulwark of the tug, in order to push it towards the intended position. The Motorman followed him and they were both positioned at that area.

During their efforts, their exact position was not clear to the tugboat Master, as his stern view was partially blocked by towing equipment stowed abaft the wheelhouse (as shown in **Figure 4.6.3/1**).

Figure 4.6.3/1: Astern view from the wheelhouse of CHRISTOS XXII. The red arrow indicates the position of the stowed equipment that blocked the view of the main deck stbd area.

The communication between the T/B main deck and the wheelhouse was feasible via an internal communication system which was operating during the casualty, as was stated during the interviewing process, however no communication between them was stated to have been carried out prior to the casualty.

At some point during the maneuvering of CHRISTOS XXII for its approach to the Container Vessel's stern, as already mentioned in the previous paragraph, the part of the towline which had been slackened and was floating on the sea surface, got caught in the tug's starboard propeller shaft and was entangled around it due to the swirling water generated by the operating propellers of both the ship and the tug and their relative movement. The towline was instantly taut and

confined the A/B and the Motorman between the rope and the bulwark, causing the fatal injury of the Motorman.
The A/B who was standing outside the casualty zone, on the left side of the towline pennant, moved further to the port side of the tugboat's main deck and signed towards the tugboat Master for the stopping of the M/Es. The Master saw the A/B's signals and pressed the "Emergency Stop" buttons on the navigating console. After the towline's entanglement at the stbd propeller shaft and prior to the stopping of the M/Es, the 20m pennant had already parted probably due to the induced friction by the shaft's rotation and the propeller blades' effect, freeing the two crew members and allowing their bodies to fall on the deck.
From the above description it derives that the following actions and omissions by the tugboat crew and Master contributed to the occurrence of investigated casualty:

ii. The failure of the crew to recognize the zone between the towline and the stbd bulwark as a dangerous zone.
iii. The failure of the crew to realize that the towline had not been completely released by the towed vessel and assess the ongoing situation, taking into account the effect of the towed vessel to the towline's behaviour.
iv. The failure of the tugboat's Master to prevent its crew's exit to the main deck while the tugboat's maneuvering for the retrieval of the towline had not been completed.
v. The failure of the tugboat's Master to see that two crewmembers had entered the dangerous zone between the towline and the stbd bulwark and order them to exit that area.
vi. The lack of communication between the working deck and the wheelhouse of the tugboat.

All 5 above mentioned points had been generally described within the "Existing Control Measures" for Hazard no.9 of the Risk Assessment Form filled on the day of the casualty, as seen in Table 4.5.2/1 in paragraph § 4.5.2 of this report, however there was a considerable inadequacy in their implementation.
Regarding the tugboat crew actions, it should also be mentioned that their decision to exit to the main deck while the tugboat's maneuvering for the retrieval of the towline had not been completed, 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 being hit by a heavy object. 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 failure of the tugboat crew and Master to implement critical control measures for the towline retrieval procedure and their failure to confront unsafe attitudes are considered to have been contributing factors in the examined marine casualty

4.6.4. The role of the Port Pilot

During the departure of HAMMERSMITH BRIDGE from the port of Piraeus Container Terminal, a Port Pilot had boarded the vessel and supervised her maneuvering from her bridge. He was an experienced 54 year-old Master and had been a Port Pilot for approximately 7 years prior to the casualty. An important part of his role during the towing procedure was the coordination of the

communication between the vessel and the tugboat. He was positioned inside the wheelhouse of HAMMERSMITH BRIDGE and from that position he didn't have a view of CHRISTOS XXII.
At some point after the clearance of the vessel from the berth, the Pilot was informed by the tugboat's Master that the towline had been slackened and part of it was floating on the sea surface. The tug Master asked for the towline's release and the Pilot transmitted that request to the Master of HAMMERSMITH BRIDGE. The Master ordered by his turn the aft unmooring team to release the towline, however the feedback he had from his 2nd Officer who was Head of the team was that he couldn't release the towline unless the tugboat approached more.
The ship's Master passed that information to the Pilot who communicated it to the tugboat's Master.
During that time, no specification was made from either side regarding the method that needed to be implemented for the release of the towline, that is whether it would be dropped into the sea or slowly released onto the tugboat's deck.
After 2 to 3 minutes, which was considered to be a long period for the release of the towline, the bridge of HAMMERSMITH BRIDGE was informed by the aft unmooring team Head that the towline had been released without any other comment regarding the situation of the tugboat and navigated further, towards the port exit.
The Master of HAMMERSMITH BRIDGE had received no information regarding the casualty on board CHRISTOS XXII and neither had the Port Pilot, who was informed regarding it only after more than 1 hour after he had disembarked the vessel.

4.6.5. The lack of planning prior to the towing procedure

Although according to the Risk Assessment procedure of CHRISTOS XXII the communication between all parties involved in the towage and the discussion regarding the release of the tugboat were considered essential, the sequence of the events that led to the investigated casualty shows that the planning prior to the operation had been poorly conducted.
Therefore, no discussion had been made regarding the release method of the towline after the towage and the expectation of the tugboat crew was completely different from the one of the vessel's crew, as already described in paragraphs § 4.6.2 and § 4.6.3.
The lack of planning prior to the operation and the lack of coordination among all parties are considered to have been contributing factors in the examined marine casualty.

4.7. Fatigue

According to the data collected regarding the working-resting hours records, as well as the interviewing process, no indication was evident that fatigue had contributed to the investigated marine casualty.

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.

5. Conclusions

1. One tugboat A/B misjudged the hazardous deck areas and decided to enter the confined area between the pennant and the stbd bulwark of the tug, against the safety measures provided for towing operations. The deceased Motorman's decision to follow him inside that area which was an action inconsistent with his assigned duties was probably a result of his lack of experience regarding deck operations during towage and his reliance on his colleague's competence (§ 4.2).
2. Taking into consideration that there was no winch installed for the fibre rope towline used in harbour operations and that the operation was executed with the use of the towing hook only, the tow line management on deck required the presence of crew on the deck for its handling during its retrieval (§ 4.3.1).
3. T/B CHRISTOS XXII crew did not use any method to prevent the towing line moving onto the tug's beam (§ 4.3.2).
4. There was no arrangement on the wheelhouse which would allow the activation of the towline's quick release mechanism by the tugboat Master (§ 4.3.2).
5. The instructions given by the SMS Manual of CHRISTOS XXII, in force on the date of the casualty, in relation to towing operations, were not specifically adjusted to parameters related to the vessel's type (Tugboat) (§ 4.4.1).
6. T/B CHRISTOS XXII towing planning was not developed in full regard of all given or likely to be encountered parameters (§ 4.4.2).
7. The control measures provided by the risk assessment procedure for T/B CHRISTOS XXII were not applied as appropriate (§ 4.5.2).
8. The fact that the stern team of HAMMERSMITH BRIDGE was waiting for the approach of the tugboat, in order the towline eye to be delivered onboard the tugboat's main deck, despite the fact that CHRISTOS XXII was not equipped with a winch for such an operation, is indicative of the lack of the coordination between the two vessels regarding the release of the towline and also of the poor planning of the operation (§ 4.6.2 and § 4.6.5).
9. No briefing among the tugboat Master and the Master and Pilot of the Container Vessel regarding the release method of the towline had been conducted prior to the operation (§ 4.6.2, § 4.6.4 and § 4.6.5).
10. The tugboat crew and Master failed to apply safe working methods regarding the following items of the operation (§ 4.6.3):
    i. The crew failed to recognize the zone between the towline and the stbd bulwark as a dangerous zone.
    ii. The crew failed to realize that the towline had not been completely released by the towed vessel and assess the ongoing situation.
    iii. The tugboat's Master failed to prevent its crew's exit to the main deck while the tugboat's maneuvering for the retrieval of the towline had not been completed.

iv. The tugboat's Master failed to see that two crewmembers had entered the dangerous zone between the towline and the stbd bulwark and to order them to exit that area.
v. The communication between the working deck and the wheelhouse of the tugboat between its crew and Master was not conducted as appropriate during the operation.

6. Actions taken

According to information provided by the T/B CHRISTOS XXII Managing Company during the consultation period of the draft investigation report, following actions were taken after the investigated marine casualty:

1. The instructions given by the SMS Manual of the Company's managed tugboats, were amended in relation to towing operations, in order to be specifically adjusted to parameters related to those vessels' type. Master's Standing Orders related to the towing operations were also prepared for the T/B involved in the casualty.
   Above documents were written in Greek, in order for them to be comprehensible by the crew.
2. Regarding the arrangement for the activation of the towline's quick release mechanism, after the casualty, a second point of activation of said mechanism was added at CHRISTOS XXII, in order for it to be operated from the wheelhouse.

7. Safety recommendations

Taking into consideration the analysis and the conclusions derived from the safety investigation conducted, as well as the actions taken after the investigated marine casualty, the following recommendations are issued:

7.1. The owners/managers of CHRISTOS XXII are recommended to:

62 /2015: Apply methods to their managed vessels, compatible with their structure, to prevent the towing line from moving onto the tug's side bulwarks during harbour operations.

63 /2015: Instruct the Masters of their managed vessels to conduct a planning of a towage with the Pilot and Master of the towed vessel in order the applied methods regarding critical parameters of the operation to be appropriately analyzed.

64 /2015: Provide CCTV units for the blind sectors perimetrically of the tugboat's wheelhouse.

7.2. The owners/managers of HAMMERSMITH BRIDGE are recommended to:

65 /2015: Instruct the Masters of their managed vessels to conduct a proper planning of a towage with the Pilot and Master of the tugboat in order the applied methods regarding critical parameters of the operation to be appropriately analyzed.

7.3. The tugboat and salvage associations are recommended to:

66 /2015: Instruct their members to use a method to prevent the towing line from moving onto the tug's side bulwarks during harbour operations and to ascertain that the towline quick release mechanism arrangements on their tugboats have at least two handling positions, one being inside the wheelhouse.

7.4. The competent authority of the Hellenic Maritime Administration / Department of Pilotage Services is recommended to:

67 /2015: Instruct all Port Pilots to conduct a proper planning of a towage with the Master of the towed vessel and the Master of the tugboat in order the applied methods regarding critical parameters of the operation and of the used towing equipment to be appropriately analyzed.

7.5. The competent authority of the Hellenic Maritime Administration / Ships' Inspection General Directorate is recommended to:

Reassess HBMCI's Safety Recommendation No.18/2013 regarding the tugboats' quick release mechanism arrangements which had been made after the investigation of a harbour tugboat casualty in the past[6], which was the following:

18/2013: Consider the need for setting up a regulation with respect to:

- regulating issues relating to the operation of the towline release mechanism on Tugs used in Ports, its testing methods and frequency.
- compulsory provision of an alternative arrangement and location for the handling of the towline release mechanism.

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Accident Investigation Report 11/2015
Hellenic Bureau for Marine Casualties Investigation
150 Grigoriou Lambraki Str,
Postal Code: 18518, Piraeus, Greece
Tel.: +30 213 1371970
FAX: +30 213 1371269
E-mail: hbmci@yen.gr
Website: http://hbmci.gov.gr

[6] The Investigation Reports for the casualty of "ARTEMIS V" (in greek and in English language respectively) are uploaded in HBMCI's website, at the following links:
http://www.hbmci.gov.gr/js/investigation%20report/final/04-2013%20ARTEMIS%20V-GRE.pdf
http://www.hbmci.gov.gr/js/investigation%20report/final/04-2013%20ARTEMIS%20V-ENG.pdf

Appendix 1

S-038 – Spanopoulos Tugs Pre Towing Tasks Checklist

CHRISTOS XXII SPANOPOULOS TUGS M.C		Safety Management System Manual Forms	
Issue No.	: 01	Date of issue	: 01/04/2015
Amendment No.	: 00	Date of Amendment	:

S-038 - Spanopoulos Tugs Pre Towing Tasks Checklist

1) Safe Towage Operations Checklist

	Task / Duty	Officer's Initials	Date
	When preparing to undertake a towage operation:		
1	Identify the principle risks and method of assessment		
2	Identify and understand the reasons for the towage method to be used		
3	Visual inspection of the towing wire		
4	Identify suitable towage points and the chafing areas		
5	Identify the characteristics of the tow		
6	Ensure rigging and correct deployment of the towing gear		
7	Knowledge of safe handling of the towing gear		
8	Identify safe areas on deck		
9	Ensure adequate lighting of working areas		
10	Identify the stability of the tug and tow		
11	Prepare a passage plan		
12	Identify local byelaws that may affect the operation		
13	Identify where different phases of the tow may require different towing requirements		
14	Identify berthing arrangements on arrival		
	On Passage		
15	Follow correct procedures to connect, let go and change of the towing gear		
16	Monitor the tow to take timely and effective corrective action when required		
17	Aware of the importance of avoiding large dynamic forces on the tow line		

2) Fitness for Purpose Checklist

	Task / Duty	Master's Initials	Date
	For an intended passage:		
1	Check correct documentation for the tug		
2	Check correct documentation required for the tow		
3	Verify tug requirements for the tow		
4	Assess fitness and suitability of navigation equipment for proposed passage		
5	Assess number, experience and qualifications of crew		
6	Assess the suitability of the towing equipment		

3) Internal & External Communications Checklist

	Task / Duty	Master's Initials	Date
	Verify Internal Communications		
	Conduct:		
1	A pre-tow briefing with crew		
2	The use of hand signals and state the importance of nonverbal signals		
3	The use of hand held radios and state the importance of correct radio procedures		
4	The use of on-board CCTV		
5	The use of on board alarms, signage and announcements		
	Verify External Communications		
	Ensure:		
1	Tow set up briefing with external stakeholders		
2	Agreement of terminology with pilot		
3	Check communications with other tugs and vessels		
4	Check traffic reports and communication with VTS / Port Control/vessel		

4) Emergency Procedures Checklist

CHRISTOS XXII SPANOPOULOS TUGS M.C		Safety Management System Manual Forms	
Issue No.	: 01	Date of issue	: 01/04/2015
Amendment No.	: 00	Date of Amendment	:

	Task / Duty	Master's Initials	Date
	Verify Actions to be taken in the event of:		
1	Failure of towing lines and equipment		
2	Failure of gog arrangements		
3	Failure of engines, steering, electrical systems		
4	Failure of steering gear		
5	Failure of electrical systems		
6	Loss of external communication to pilot /port control etc		
7	Mechanical problem on the towed vessel		
8	Rope in propulsion system		
9	Compromise of watertight integrity of tug when towing		
10	Collision		
11	Grounding of tug and/or tow		
12	Man overboard		
13	Fire		
14	Pollution		
	Verify:		
15	Use of the emergency controls		
16	Deployment of the emergency tow line		
17	Emergency release of the tow procedure		
18	Crew preparedness at emergency stations		
	Awareness of:		
19	The statutory requirement to render assistance		
20	The difference between responding to a Mayday and rendering salvage assistance		

Appendix 2

SMS Manual section 7.12 "Relevant Forms"

CHRISTOS XXII SPANOPOULOS TUGS M.C		Safety Management System Manual	
Issue No.	: 01	Date of issue	: 04/2012
Amendment No.	: 02	Date of Amendment	: 31/12/2014

7.12 RELEVANT FORMS

S 001 "Passage Planning"
S 002 "Pilot Card"
S 003 "Pre-Arrival Checklist"
S 004 "Operational Guidance for Officers in Charge of Bridge watch"
S 005 "Check List Prior to Sailing"
S 006 "Instructions for Keeping Engine Room Watch At Sea
S 007 "Checklist for Vessels Entering E.U. Ports"
S 008 "Instructions For Deck Watch-keeping in Port"
S 009 "Instructions for Engine Room Watch in Port"
S 010 "Checklist "Anchoring and Anchor watch"
S 011 "Emergency Batteries Log"
S 012 "Bunkering Check List"
S 013 "Watch/Rest Hours Schedule"
S 014 "Monthly Safety Committee Minutes"
S 015 "Bridge Checklist Daily Tests and Checks".
S 016 "Master/Pilot Relationship"
S 017: "Taking Over the Watch Check List"
S 018 "Radio Check List"
S 019 "Checklist for Navigation in Restricted Visibility Circumstances"
S 020 "Check List for Navigation in Heavy Weather or in Tropical Storm Conditions"
S 021 "Bridge Check List for Navigation in Ice"
S 022 "Hot Work Permit"
S 023 "Cold Work Permit"
S 024 "Enclosed Space Entry Check List"
S 025 "Unannounced Alcohol Test Log"
S 026 "Watch/Rest Hours Records"
S 027 "Master's Standing Orders (guideline)"
S 028 "Working Aloft/Overside Permit"
S 033 "Bridge Check List. Navigation in Narrow Waters"
S 035 "Chief Engineer's Standing Orders When Bunkering"
S 036 "Check List for Helicopter Operations"
S 037 "Check List on Steering Gear Test Routines"
TOWAGE CERTIFICATE

Appendix 3

CHRISTOS XXII Detailed Risk Assessment for Harbour Towages

Chapter 7 **Detailed Risk Assessment Form**

Ship name:CHRISTOS XXII

Record Number: DRA - 002

Current assessment date:08/07/2015 **Last assessment date**: 07/07/2015

Work activity being assessed: Harbour Towages

Section 1

Assessment of Risk Factor

Severity of Harm		Likelihood of harm				
		1	2	3	4	5
		Extremely Impossible	Improbable	Probable	Very Probable	Frequent
1	Negligible	1	2	3	4	5
2	Slight Harm	2	4	6	8	10
3	Moderate Harm	3	6	9	12	15
4	High Harm	4	8	12	16	20
5	Intolerable	5	10	15	20	25

Determine tolerability of risks:

Category of risk	Evaluation of tolerability
Negligible	Acceptable
Slight Harm	Tollerable
Moderate Harm	Risks should be reduced so that they are tolerable or acceptable
High Harm	
Intolerable	Unacceptable

Details:

Negligible: Considered acceptable. No further action is necessary other than control measures are maintained.

Slight harm: No additional control measures necessary. Actions to further reduce these risks considered low priority.

Medium Harm: Consideration to be given where risk can be lowered to a tolerable level and preferably, acceptable level.

High Harm: Substantial efforts should be implemented urgently to reduce the risk.

Intolerable: Considered unacceptable. Substantial improvement in risk control measures is necessary to reduce risk at tolerable or acceptable level.

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Risk Categories:		
Low (RF=1-6) No additional risk control measures are required. Risk is already "As Low As Reasonably Practicable"(ALARP). Monitoring is required to ensure that existing controls are maintained	Medium (RF=7-15). Efforts are required to reduce risk to "As Low As Reasonable Practicable"	High (RF=16+): Work shall not be started or continued until the risk has been reduced. If reduction is not possible, the activity shall be prohibited.

Section 2

Hazard Analysis of the Intended Work Activity

Hazard no.	Description of Identified Hazards	Likelihood Of Harm	Severity of Harm	Risk Factor	Existing Control Mesures To Protect Personnel from Harm	Additional risk control measures
1.	Tug Master and Crew	5	2	10	National certification of tug crew is set by the Maritime and Coastguard Agency as per the Port Marine Safety Code. All crew must meet these requirements and the tugs must be safely and adequately manned. In addition all Masters of Forth Ports Licensed tugs are required to hold a Certificate of Competency (CoC) to STCW standards or Boatmaster License (or equivalent) with the an appropriate towage endorsement. This applies to General Towage (towing and pushing), however Forth Ports requires all tugs that engage in ship assist towage to be operated by STCW certificated masters. Also Tug Masters and crew must meet the local knowledge standards, this aspect should be managed by the towage company.	
2.	Experience	4	2	8	Licensed towage providers must ensure their crews are trained with a firm understanding of the tugs they operate, towage techniques and the area in which they operate.	
3.	Working hours	3	2	6	All tug crew members must be properly rested in line with the recommendations of national and international legislation.	
4.	PPE	3	4	12	Personnel on exposed decks are to wear appropriate Personal Protective	

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					Equipment (PPE) including hazardous duty (working) lifejackets in line with the tug's risk assessment. It is the Tug Master's responsibility to enforce the wearing and use of safety equipment. All PPE should be approved and in date. The decision to put crew on the working deck to handle the towline and messenger in order to connect from the escorted ship will rest solely with the Tug Master. The criterion for this task will be whether the crew can safely carry out the task. Crew members are recommended to only proceed on deck during towage operations with the following equipment: Boilersuit or suitable alternative High Visibility Jacket Lifejacket Safety shoes or boots Safety Helmet fitted with chinstrap or approved safety head wear Gloves	
5.	Communicattion	2	6	**12**	Throughout towage operations good VHF communications between all parties is a vital component of safe towage operations. At all times tugs crew, ships crew and shore side staff must be able to communicate efficiently and clearly.	
6.	Pilot / Tug Master	5	2	**10**	The Pilot and Tug Master should, as a minimum, discuss the following issues: The SWL of the vessel's bollards, fairleads, strong points etc to be used for towing. (Failure to provide this information could result in broken equipment); The tug hook up point, taking into account the prevailing weather and sea conditions, or escorting operation (if appropriate) and berthing; The planned (optimum) ship speed when connecting to the tug's lines; If active escorting, the	

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					start point of the escorted passage; - The maximum speed of the tug; - Passage details while accompanied by the tug(s), particularly details of any swing manoeuvre, release position and sequence of release; - Berthing details in their entirety, including tug positioning around the vessel's hull and the vessels required position on the berth; - Any significant weather forecast/anticipated; - Intended and emergency use of ships anchors; - Any unusual items regarding the particular vessel as gleaned from the Master/Pilot exchange; - If appropriate, any shallow water or bank effect areas where significant surges may be experienced that might add to the tug loads; - The Tug Master should advise the Pilot immediately if there is any reduction in the tug's operational characteristics such as ability to manoeuvre, deliver bollard pull or any other operational and relevant defects which could affect its capabilities.; and - When confirming that the tug is fast and ready to assist, the Tug Master should also confirm both the tug's name and her position on the vessel	
7.	Operation concerns during towage / harbor towage assistance	4	2	**8**	The Tug Master should immediately inform the Pilot/Master of any concerns that he may have as to the safety of his tug and crew. The Pilot and Tug Master should take immediate action to ensure the safety of both the tug and assisted vessel; if necessary they should abort the operation as soon as it is safe to do so.	

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8.	Tug Watertight/ Weathertight openings	2	2	**4**	It is essential that a watertight seal is maintained on maindeck and towing deck, at all times whilst towing, to avoid water entering below decks. This applies to all watertight doors, hatch openings and emergency escapes. Openings that are required to be closed; should be marked accordingly with an appropriate sign. Rubber seals and locking dogs are to be kept in good working condition at all times and properly fitted. Always operate all closing devices and dogs fitted; it is not sufficient to lock two dogs on a watertight door fitted with six. If entry is required through a hatch or door during towage operations, the Tug Master should be informed and the hatch or door closed immediately after use. Do not leave open, even if access is required for a short period of time. Recommendations following towage incidents regarding watertight/ weather tight	
9.	Tow Gear and Handling	4	4	**16**	All towing gear should be tested on a regular basis and replaced when unsatisfactory. All towing equipment in use should be checked before undertaking and towage operation and after completion. Inspection of towing equipment shall include all ropes, wires, shackles, messengers, winches, hooks and any other item specifically designed or used, to provide towage services. In date test certificates shall be held on board for all relevant equipment in use. Damaged or suspect items of equipment are to be immediately withdrawn from service. If any item of equipment is damaged during towage operations, the Master / Pilot of the vessel shall be informed.Wear PPE (hard hat, safety footwear, high visibility clothing / vests. Ensure that working areas are safe and free from trip or slip hazards, particularly around bollards. Remain alert to the ongoing operations. Listen to orders from the tug master. Hold a line by the side of the eye or the standing part. Be	During the towage operation good communication between wheelhouse, working deck and engine room MUST remain in place. Additionally all personnel must understand agreed hand signals. Deck hands to handle the towing gear during the course of the operations (towing, mooring, unmooring, collection of the towing gear ect).

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					aware of lines (towing or mooring) suddenly coming under tension. Stay clear of snap back zones. Not any personnel is allowed on the towing area of the deck when a unit is being towed. During the towage operation good communication between wheelhouse, working deck and engine room MUST remain in place. Additionally all personnel must understand agreed hand signals. Deck hands to handle the towing gear during the course of the operations (towing, mooring, unmooring, collection of the towing gear ect).	
10.	Tow Quick release	4	2	8	The emergency release mechanisms on winches and towing hooks should be tested both locally and where fitted remotely. Towing winch and towing hook release mechanisms are to be frequently tested for correct operation. All methods of "tripping" or "run out" are to be tested (Pneumatic, manual pull, lever or knock out etc). Release mechanisms are also to be tested at other times, if a fault is suspected or an exceptional shock loading has been experienced. Records of testing the emergency release mechanisms should be kept and made available to the Harbour Authority on request. Under no circumstances is towing equipment be connected to any winch or hook that has a suspect release mechanism. Correct maintenance and operation are essential. **It could save your life.**	
11.	Speed during towage	4	2	8	The required speed should be agreed in advance between the Master (and Pilot if embarked) and with (all) the Tug and Master(s) involved. **The recommended maximum safe speed through the water for a centre-lead forward tug is six knots**. At all times during the connecting process, the Pilot/Master should be aware of the position and intention of all relevant shipping movements in the area..	

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Section 3

After Additional Control Mesures to Reduce the Risk Factor

Hazard no.	Likelihood Of Harm	Severity of Harm	Risk Factor
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.	3	2	6
10.			

1. Present Risk Assessment should periodically reviewed.
2. Assessment review date: 08/07/2015
3. Prepared and Accepted By: Master_Capt
4. Forwarded to Office on: 08/07/2015
5. Accepted by: Ops Manager / Capt , DPA