HELLENIC REPUBLIC
HELLENIC BUREAU FOR MARINE CASUALTIES INVESTIGATION

MARINE CASUALTY SAFETY INVESTIGATION REPORT
09/2013

Cruise Ship "MSC Magnifica"

Impact of MSC Magnifica on Piraeus Port entrance breakwater

August 2015

Foreword

The Hellenic Bureau for Marine Casualties Investigations 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 it through analysis and to draw useful conclusions and lessons learned that may lead, if necessary, to safety recommendations addressed to parties involved or stakeholders interested in the marine casualty, aiming to prevent or avoid similar future marine accidents.

The conduct of Safety Investigations into marine casualties or incidents is independent from criminal, discipline, administrative or civil proceedings whose purpose is to apportion blame or determine liability.

This investigation report has been produced without taking under consideration any administrative, disciplinary, judicial (civil or criminal) proceedings and with no litigation in mind. It does not constitute legal advice in any way and should not be construed as such. It seeks to apprehend the sequence of events occurred on the 20th of November 2013 that resulted in the examined serious marine casualty.

Fragmentary or partial disposal of the contents of this report, for other purposes than those produced may lead to misleading conclusions.

The investigation report has been prepared in accordance with the format of Annex I of respective Law (Directive 2009/18/EC) and all times quoted are vessels´ times (UTC +2) unless otherwise stated.

Under the aforementioned framework HBMCI has been examining the impact of MSC “Magnifica” on Piraeus port entrance breakwater occurred during her arrival at Piraeus Port, on the 20th of November 2013.

Note: The presenting data on figures, as snap shots from electronic bridge navigational equipment, such as VDR and ECDIS may slightly vary from the referred periods in the respective sections of the narrative reported information.

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

1.	AB	Able seaman
2.	Air draft	The distance from the waterline to the highest point of a vessel
3.	AIS	Automatic identification system
4.	bfrs	Beaufort unit. Measurement unit of Beaufort wind force scale, used for the measurement of the observed conditions at sea or on land in relation to wind speed.
5.	Cable	Measurement nautical unit of distance equal to one tenth of a nautical mile, that is approximately 185.2 m
6.	CoC	Certificate of Competency
7.	COG	Course Over Ground: The actual path (track) of a vessel in respect to the seabed
8.	DOC	Document of compliance
9.	Gusts of wind	fluctuations in wind speed with a variation of 10 knots or more between peaks and lulls and duration usually close to 20 sec.
10.	GMDSS	Global Maritime Distress Safety System
11.	gt	gross tonnage
12.	HCG	Hellenic Coast Guard
13.	INMARSAT	International Maritime Satellite Organization
14.	IMO	International Maritime Organization
15.	ISM	International Safety Management Code for the safe operation of ships and for pollution prevention
16.	LT	local time
17.	NAVTEX	Navigational Telex
18.	nm	nautical miles
19.	OOW	Officer of the watch
20.	SMC	Safety management certificate
21.	SMS	Safety management system
22.	SOLAS	Convention for the Safety of Life at Sea 1974
23.	STCW	International Convention on Standards of Training, Certification and Watchkeeping for seafarers
24.	TSS	Traffic Separation Scheme
25.	UTC	Universal Time Coordinated
26.	VDR	Voyage data recorder
27.	VTS	Vessel Traffic Service for monitoring vessels traffic

1. Executive summary

On 20 November 2013 MSC at approximately 0530 Magnifica was underway in the Traffic Separation Scheme of Piraeus approaching the central Port being on a scheduled round cruise at Mediterranean Sea. Master was on the bridge and had taken over the conning.

At approximately 0625 while she was close to port entrance pilot boarded and a port tug was following at her stern.

Almost 02 cables before entering the port, Magnifica wind anemometer was recording southeast winds up to 22 knots and she was running at maneuvering speed close to 5 knots.

At the time her bow was approximately less than a cable away from the port entrance the wind suddenly gusted from southeast and rabidly reached approximately 40 knots, causing Magnifica drift to port. Despite the fact that Master counteracted in order to avoid the imminent danger of impacting the head of the port breakwater, at 0629 Magnifica port bow made contact with the breakwater causing the concrete round-hut red light located at the head to detach and collapse into the sea.

Master of Magnifica carried on with the berthing manoeuvring as the mooring dock was approximately 03 cables from the port entrance and safely docked at 0700. No injuries to passengers or crew was reported as well as no pollution.

Following an inspection by her Class and Port State Control Officers of Piraeus Coast Guard Authority she was found to have suffered structural damages on her port side and more specifically a crack was reported over the waterline on her port bow while scratches and hull deformations and indents were sustained lengthwise on her port side under her waterline. No water ingress was reported to had occurred.

Magnifica´s departure was sustained and passengers followed the scheduled activities´ program. Repairs were carried out by a marine service company and following an inspection by her Class, she departed from the port of Piraeus at morning hours on 21 November 2013 and continued with her planned cruise voyage.

2. FACTUAL INFORMATION

2.1 Particulars of MSC Magnifica

Name of Vessel	MSC Magnifica
Call Sign	3FL04
Company (ISM Code A 1.1.2)	Mediterranean Shipping Company Cruise Technical Department S.R.L.
Ownership	S32 Leasing Company LTD.
Flag State	Panama
Port of Registry	Panama 12147F
IMO Number	9387085
Type of Vessel	Passenger cruise Ship
Classification Society	Bureau Veritas
Year built	Completed January 2010
Ship Yard Construction	STX Europe AS Saint Nazaire France
Construction	Steel
LOA (Length over all)	293,8 m
Breadth overall / height	37.05 m / 59.64 m
Decks	16
Gross tonnage	95.128
Net Tonnage	66.135
Main Engine / Power /Speed	5 x 11,6 Mw Diesel Generator (Wartsila) 2 x 17,5 Mw Propulsion Motor Generator (Converteam)
Maneuvering gear	bow thrusters 3 Brunvoll x 2300 kW at 255 rpm stern thrusters 2 Brunvoll x 2000 kW at 200 rpm
Document of Compliance	RINA issued 14 March 2013 at Buenos Air
Last port State control inspection	15 August 2012 at Tallinn Estonia

2.2 Voyage Particulars

Vessel´s name	MSC Magnifica
Port of departure	Mykonos Island, Greece
Port of arrival	Piraeus, Greece
Type of voyage	International
Passengers	2,469
Crew	976

2.3 Marine casualty information

Vessel´s name	MSC Magnifica
Type of casualty	Serious
Date and time	20 November 2013 at approximately 0629 LT (UTC +2)
Position – location	At Piraeus central port entrance
External environment	Wind force 5 - 6 bfrs / gusty Sea state slight to moderate / swell sea visibility good – scattered clouds – rain showers - dark
Ship operation	Underway – entering to port manoeuvring
Voyage segment	Port arrival procedure

Consequences (to individuals, environment , property)	• 1m x 0.40 m crack on port bow section close to 4m over the waterline and deformation on shell plating on port side • 4 m indent at port aft section close to stern post • deformations and scratches on port side hull plating lengthwise under the waterline • No injuries • No pollution

2.4 Emergency response

Authorities - Services involved		
Piraeus Coastguard Authority	→	Coast Guard Officers /Two Port State Control Inspectors
Ship´s Class	→	One Inspector
Tug services	→	02 port tugs
Marine service repairing company	→	01 tug – 08 technicians

3. Narrative

3.1 MSC Magnifica

MSC Magnifica is a cruise ship operated by MSC Cruises. She was built by STX Europe AS in Saint Nazaire, France.

Magnifica was launched in January 2009 and her building was completed in January 2010. She entered into service in March 2010, mostly operating in cruises in the eastern and western Mediterranean.

Magnifica can reach a maximum speed of 23 knots at full displacement and full capacity of passengers is between 3,013 and 3,223 for long and short international voyages respectively. Her crew could reach the total number of 1027 persons.

From 20 March 2010, Magnifica operated on seven-day cruises in the eastern Mediterranean, visiting ports in Italy, Greece, Turkey and Croatia. Magnifica also operated in the eastern and western Mediterranean during the autumn of 2013 while she was following itineraries in South America during the winter season and Northern Europe in the summer months.

Figure 1. MSC Magnifica

3.2 Voyage segment from Mykonos to Piraeus

During the time of the examined marine accident, MSC Magnifica was following an itinerary in the eastern Mediterranean Sea including calls in several Greek Islands as well as Piraeus Port.

On 20 November 2013 at approximately 1730 MSC Magnifica departed the port of Mykonos and commenced her voyage to Piraeus. According to her regular sailing schedule she was anticipated to arrive at the next port of call at approximately 0700, as most of the excursions and visits to Athens City were planned after 0900.

During her cruise to Piraeus, MSC Magnifica was sailing at low average speed of 7.6 knots and her voyage lasted for approximately 12:24 hours. She was accommodating 2,469 passengers and was operating under 976 crew members.

3.3 Arrival at Piraeus Port

3.3.1 Piraeus Port

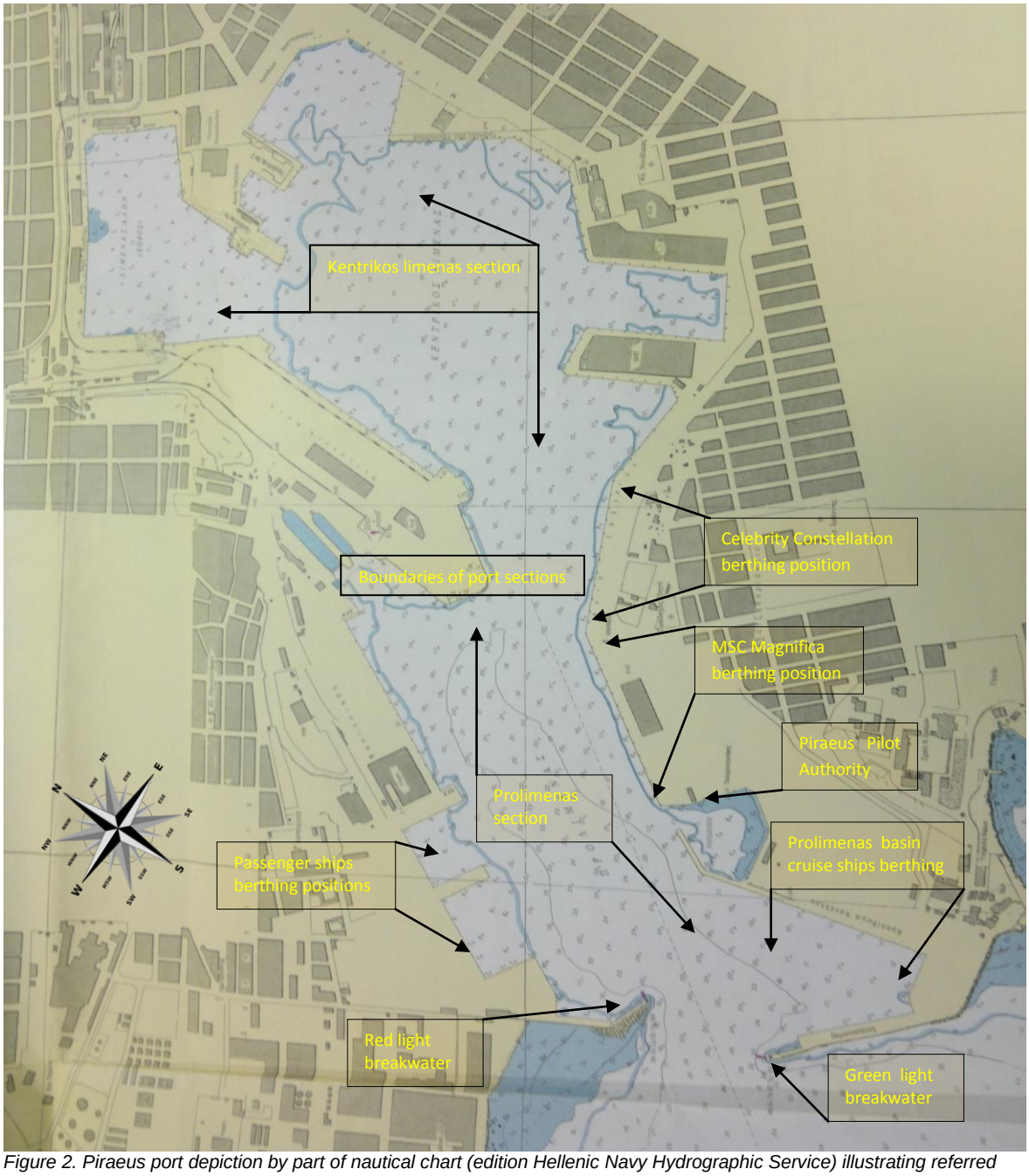

Figure 2. Piraeus port depiction by part of nautical chart (edition Hellenic Navy Hydrographic Service) illustrating referred information of the marine accident.

3.3.1.1 Description – topography

The Port of Piraeus is entered between two breakwaters. The northern breakwater extends initially southwards for about 150 m and continuous south-eastwards for 80 m; its width is close to 10m. At the head of the northern breakwater a concrete round-hut red light is situated, based on a concrete pedestal construction as shown in figure 3.

Figure 3. The round-hut concrete red light that was situated at north breakwater head

The southern (green light) breakwater, extends initially west-northwestwards for 160 m and north-westwards for about 320 m; its width varies between 10 to 15 m. At the head of the breakwater a concrete round-hut green light is located based on a concrete pedestal construction.
The distance between the heads of the two breakwaters is approximately 230 m.
The Port of Piraeus is mainly divided in two sections; “Prolimenas” section (outer port) and “Kentrikos Limenas” section (Central Port - inner port), as shown in figures 2 & 4.

Figure 4. Overview of Piraeus port inner (Kentrikos limenas) and outer (Prolimenas) sections

3.3.1.2 Prolimenas section

Prolimenas section is servicing passengers ships´ berthing as well as cruise ships.
Entering Prolimenas section the port docking arrangement facilitates the mooring positions of 6 coastal passengers ships.
Entering the port, the docks´ topography on starboard forms a basin capable of servicing the arrivals and berthing of two cruise ships.
Following the basin´s section, a 335 m quay lies, that is directed east-northeast and operated for the berthing of cruise ships. At the day of the marine accident said quay was

arranged to service MSC Magnifica mooring.
The outer section´s length (draught) extends approximately 870m with width close to 300m and narrows to a width of approximately 180m. Entering the inner section dimensions ranges following the formulation of docks and quays (figures 2 & 5).

Figure 5.Part of the inner section (Kentrikos limenas) for servicing coastal shipping.

3.3.1.3 General information

Piraeus Port is the connecting point of the Aegean islands and Crete with the rest of Greece as well as the main gateway to the European Union at its south-eastern end, establishing it as the largest and the most paramount port in Greece.
The Port is also an important destination for cruise ships in the Mediterranean Sea.
According to traffic statistics from 2011 to 2014, the Port serviced on average about 17,500 calls of coastal passenger ships and approximately 9,300,000 of passengers while the average cruise ships´ calls were approximately 700 with 2,170,000 passengers.
In general, the port offers:

- 11 positions for the simultaneous berthing of cruise ships and can provide services to the largest cruise ships with two passengers´ terminals
- 32 berthing positions for coastal passengers and ferry ships with 5 passengers´ terminals
- Total quay length of approximately 8,500 m
- Total sea area of approximately 110,000 m²

Figure 6. Prolimenas basin

Figure 7. General overview of Prolimenas right section

Figure 8. Overview of the berthing areas for cruise ships.

On 12 September 2013 Piraeus port serviced seven (7) cruise ship calls, as quoted below:

- Pacific Princess, 181 meters, 770 passengers plus crew
- Legend of the Seas, 265 meters, 2.076 passengers plus crew
- Carnival Sunshine, 273 meters, 3.006 passengers plus crew
- MSC Fantasia, 333 meters, 3.900 passengers plus crew
- Costa Romantica, 219 meters, 1.600 passengers plus crew
- Royal Princess, 330 meters, 3.600 passengers plus crew
- Costa Magica, 271m., 3.450 passengers plus crew

Figure 9. General overview of the cruise ships´ berthing positions

Figure 10. Cruise ship at passenger terminal

Figure 11. Cruise ship´s passenger terminal overview

3.4.1 Piraeus Port arrival arrangements

Following regulations for the arrival procedures at Piraeus Port, MSC Magnifica send a notification of her ETA to her agent and the interested Authorities, including the Pilot Station and the Coast Guard Authority as soon as she had departed from Mykonos.
Notwithstanding MSC Magnifica was operating on the same itinerary for the previous months amongst the required documents by the Authorities, ship´s particulars were also included.
Furthermore as pilotage is compulsory for all vessels under foreign flags as well as the use of port tugs for vessels over 1000 grt for entering and docking in the port, a pilot and one port tug were arranged by her Agent to service MSC Magnifica´s arrival and mooring operations.

3.4.2 Approaching at Piraeus Port

At 0400 MSC Magnifica was entering the Piraeus Traffic Separation Scheme under 336º course and speed at approximately 7.5 knots. By that time the Bridge called a “two hours notice” to the Engine Control Room for the arrival at Piraeus Approaches.
At 0500, while Magnifica was underway in the middle of Piraeus Traffic Separation Scheme an “one hour notice” was ordered to the Engine Control Room. The estimated time of arrival at Piraeus Pilot yellow buoy was expected at approximately 0610 and was reported to Piraeus Traffic Control and Piraeus Pilot Station.
At approximately 0530 the Master of Magnifica came on the bridge and took over the command while the ship was exiting Piraeus TSS and had to run approximately 6 nm to Piraeus port entrance. The OOW reported to Piraeus Traffic the exit from TSS passage and informed about the time of arrival. Magnifica was sailing under 337º at a speed of 7.79 knots. The wind speed recordings by her anemometer indicated south-southeastern winds with varying speed from 20 knots to 28 knots.

3.4.3 Weather conditions

3.4.3.1 Forecasted weather conditions

According to the weather bulletin issued by the National Meteorological Service[1] on 19 November 2014 at 24:00 (22:00 UTC), prevailing winds for the Saronic Gulf that is the last voyage passage MSC Magnifica had to sail before entering Piraeus Port, were forecasted to be South force 4-5 bfrs to Southwest force 5 bfrs.
However, the aforementioned weather bulletin included a general notice, drawing the attention to Mariners that wind gusts can be 40% stronger than those given in the bulletin and max wave height up to twice the significant.

3.4.3.2 Actual weather conditions

Actual weather conditions were reported to be moderate; prevailing winds in the Saronic Gulf were South-southeasterly force 5 to 6 bfrs and sea state was moderate with swell, however in respect to the type and size of the ship they were not considered as an issue for Magnifica´s last passage segment to Piraeus.
It was also reported that weather was unstable with squalls, showers and gusts.

3.5 Pilot and port tugs

At approximately 0610 a pilot launch sailed from her berthing at Piraeus Pilot Station, located in Piraeus port, about 2.5 cables away from the port entrance.

[1] The Hellenic National Meteorological Service provides weather and sea Bulletins for shipping and warnings for the METEAREA III (only for Eastern Mediterranean Sea and the Black Sea) as well as NAVTEX Marine Safety Information

Port tug “Alexander III” was assigned to escort MSC Magnifica during her entry into the port by keeping a close to her stern course and was already underway approaching her, following communication with the Master and the Pilot. Port Tug “Armadores II” was a “stand-by” tug in the port.

At 0618 the pilot boat was approaching MSC Magnifica from her port lee side. Due to the fact that the ten meters launch was encountering difficulties in sailing under the existing sea state conditions with wave height close to 1,5 m, the Pilot had requested the Master to further approach the port´s entrance in order to facilitate his embarkation. By that time Magnifica was underway at manoeuvring speed of approximately 5 knots, keeping a course close to 005, yet continuously altering to starboard in order for her bow and centerline to get aligned with the port entrance.

At approximately 0625 the Pilot got on board MSC Magnifica from port forward crew access door at deck no 4 and a security officer escorted him to bridge.

3.6 Arrival manoeuvring procedures at Piraeus Port

Note: The presenting data on figures, as snap shots from electronic bridge navigational equipment, such as VDR and ECDIS may slightly vary from the referred periods in the respective sections of the narrative reported information due to technical VDR data processing issues.

3.6.1 Time period A - time related 06:00:00 to 06:22:59

At approximately 0600, MSC Magnifica was close to 3nm south southeast of Piraeus port entrance at a speed of 7.6 knots and heading 338º; wind was at 22 knots Southeast.

The bridge navigational team apart from the Master was consisted by the Staff Captain, the First Deck Officer, two Third Deck officers, one Apprentice Officer and one AB, as helmsman.

At 0612 the Master ordered “Stand by with Engines” and the Engine Control room was notified accordingly as Magnifica was approaching Piraeus Port entrance.

By that time MSC Magnifica was approximately 1.8 nm south of Piraeus entrance under course 338º.9 and speed close to 7.15 knots; wind speed was close to 25 knots Southeast.

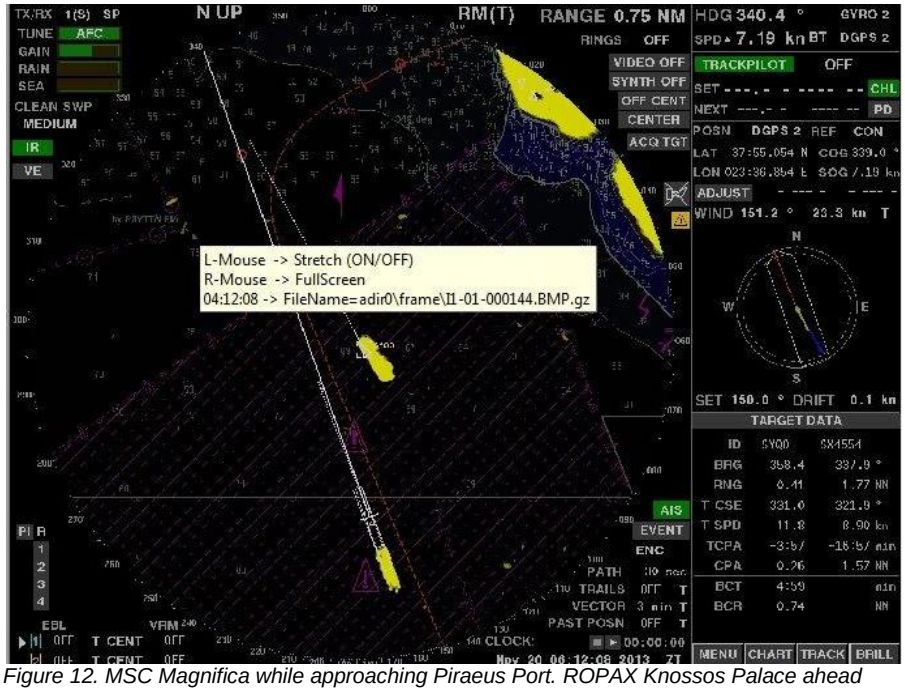

Figure 12. MSC Magnifica while approaching Piraeus Port. ROPAX Knossos Palace ahead of her starbord bow had just overtaken her.

ROPAX Knossos Palace of approximately 214 m of length and 26 m of breadth had just overtaken Magnifica, arriving from Crete Island and was heading towards Piraeus Port entrance. Being a liner passenger ship under Greek Flag she was to enter port without pilotage prior to MSC Magnifica´s entry. Knossos Palace entered Piraeus port at approximately 0619.

At 06:13:30 the Master of Magnifica contacted the Pilot through VHF and reported that he was in proximity to the pilot embarkation position yellow buoy, located at approximately 1.5 nm west-southwest off Piraeus port entrance. The pilot advised the Master to “stand-by” and contacted Piraeus Traffic Control for consulting the arrival entry priority of the vessels approaching the port entrance. It was arranged that ROPAX Knossos Palace would enter first and MSC Magnifica would follow.

At that time MSC Magnifica was underway approximately 1.1 nm South-southwest of Piraeus port entrance under course 340º.7 and speed 6.9 knots; wind was close to 24 knots Southeast.

At 06:14:30 Master called the Pilot again and was advised to proceed further from the pilot´s embarkation position at the yellow buoy and to follow Knossos Palace that was to enter first in Piraeus Port. The Pilot also requested the Master to try to make a lee for the pilot boat and the pilot embarkation on MSC Magnifica due to the swell sea that could endanger pilot´s embarkation.

The Master acknowledged and proceeded with maneuvering to starboard.

At 06:16:55, the Master having maneuvered MSC Magnifica, contacted the pilot and informed him that the pilot boat could proceed alongside MSC Magnifica as she was in position for pilot´s embarkation. By that time she was approximately 0.9 nm south-southwest of Piraeus entrance under course 350º and speed 6.41 knots; wind speed was recorded at 27.1 knots Southeast.

Knossos Palace was under maneuvering entering the port, keeping a course close to the green light of the breakwater and had passed through the entrance at 06:19:10.

At 0622, the Master of Magnifica, while maneuvering altering the course to starboard in order to line her stem post with the port entrance, called the pilot to confirm the arranged berthing position, astern of Cruise ship Celebrity Constellation that had entered Piraeus Port approximately one hour earlier.

At that time, MSC Magnifica was almost 6 cables southwest off Piraeus green light breakwater and the pilot boat was underway approaching her; the recorded wind speed was between 20 to 22 knots Southeast but seconds after got increased to 25 knots and at approximately 06:22:51 gusted to 30 knots (table 1 figure a.5).

Table 1. Figures´ table of video screen shots of MSC Magnifica passage for time period (A) 06:00:00 to 06:22:59. Data extracted from ECDIS.Note: Depicted data may slightly vary from those chronicled reported in respective narrative sections.

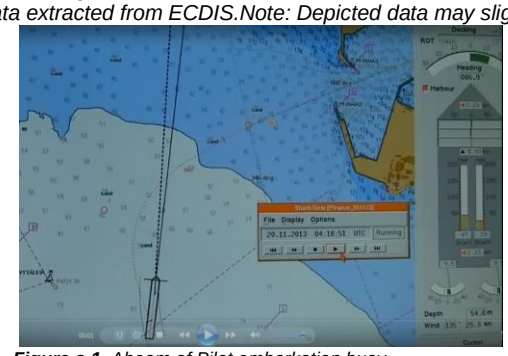

***Figure a.1**. Abeam of Pilot embarkation buoy.*

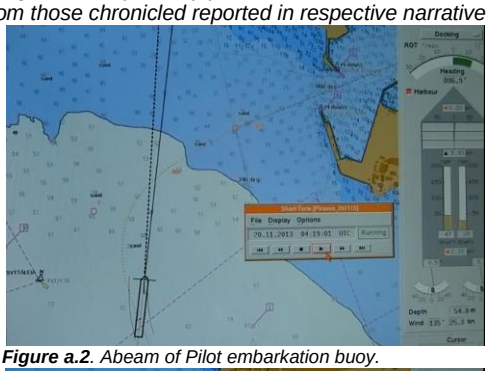

***Figure a.2**. Abeam of Pilot embarkation buoy.*

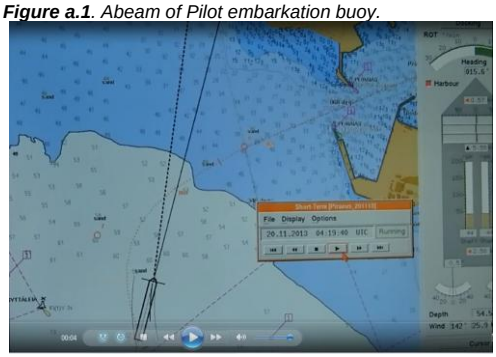

***Figure a.3**. Turning to starboard manoeuvre for bringing the bow into alignment with the port entrance.*

***Figure a.4**. Turning to starboard manoeuvre for bringing the bow into alignment with the port entrance.*

***Figure a.5**. Turning to starboard manoeuvre for bringing the bow into alignment with the port entrance.*

3.6.2 Time period B - time related 06:23:00 to 06:24:59

At 06:23:11, MSC Magnifica heading was 59°.3 and she was running at a speed of approximately 4 knots; wind was recorded close to 24 knots southeast hitting her starboard side freeboard almost vertically.

Despite the fact that according to the gyro compass, her heading was close to 59º and Magnifica´s stem post was in line towards the middle of the port entrance, her recorded COG[2] was 042º.3 and her bow and stern were drifting to port at 0.50 knots and 3.14 knots respectively, as the wind had gusted to 30 knots shortly before whilst the Master, being on maneuvering procedure, was gradually turning MSC Magnifica to starboard (figure 13).

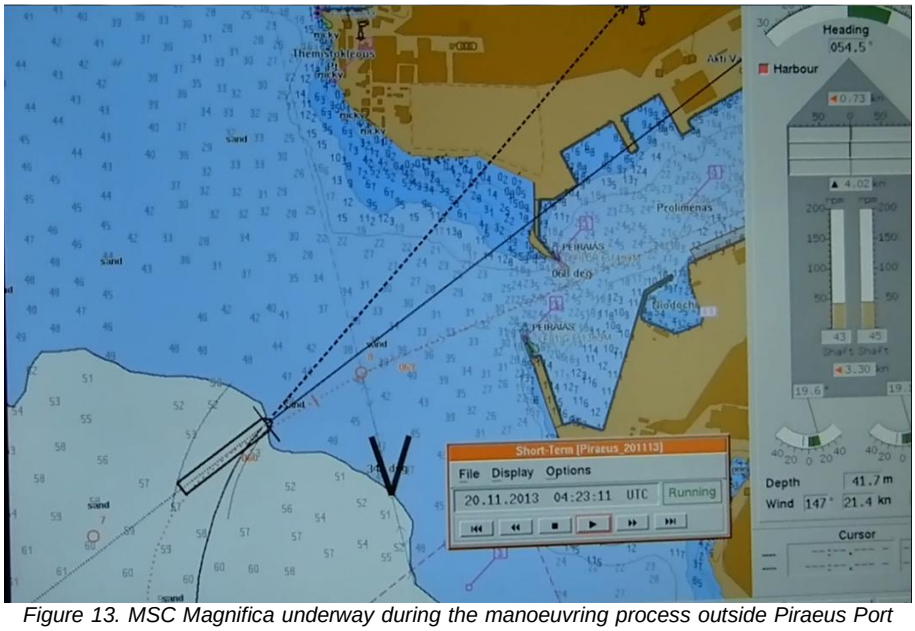

Figure 13. MSC Magnifica underway during the manoeuvring process outside Piraeus Port at 06:23:11.

At approximately 06:24:27, according to the helmsman report to the Master, MSC Magnifica was running at approximately 4 knots with a course of 075º, as indicated through the gyro compass on the steering console. However the COG value indicated a course of 058º.1; the wind speed, recorded by her anemometer was at 24.1 knots, Southeastern. According to ECDIS data MSC Magnifica´s bow had a leeway to port at nearly 0.9 knots whilst her stern was encountering leeway to port close to 3.35 knots.

By that time MSC Magnifica centerline was heading towards Piraeus port entrance and close to the green light breakwater.

Port tug Alexander III was about 1 cable abeam of MSC Magnifica´s port bow heading to

[2] The actual path (track) of a vessel in respect to the seabed.

her stern (figure 14).
Slightly afterwards, the wind was recorded to gust again to 29.5 knots (table 2 figure b.2)

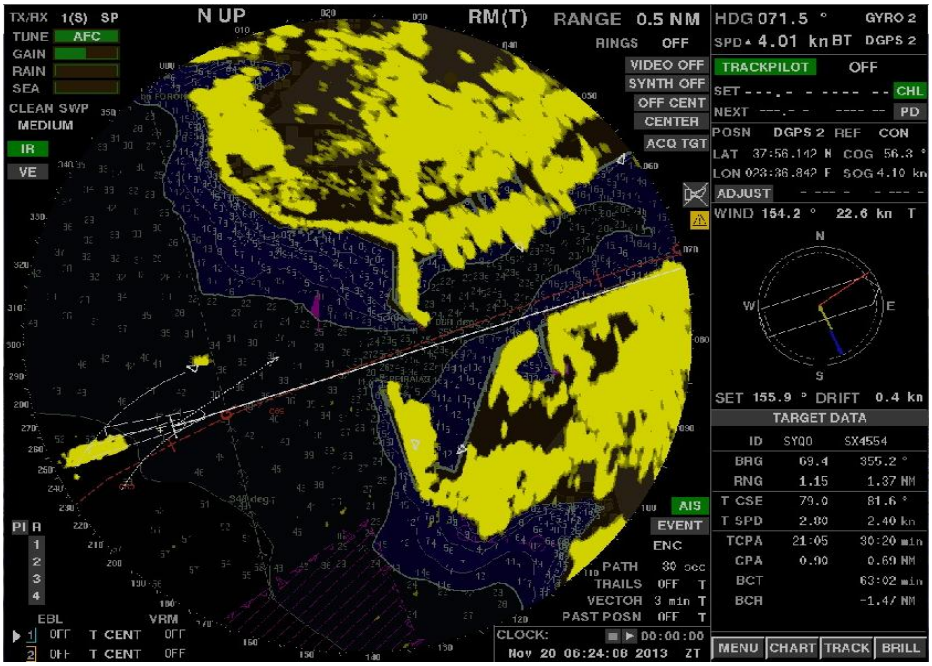

Figure 14. MSC Magnifica underway during manoeuvrings outside Piraeus Port just prior to pilot´s boarding at 06:24:08. Port tug Alexander III abeam.

Table 2. Figures´ table of video screen shots of MSC Magnifica passage for time period (B) 06:23:00 to 06:24:59. Data extracted from ECDIS.
Note: Depicted data may slightly vary from those chronicled reported in respective narrative sections.

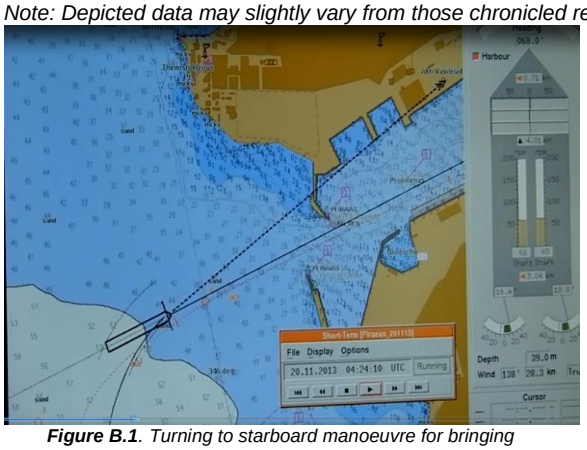

***Figure B.1**. Turning to starboard manoeuvre for bringing the bow into alignment with the port entrance.*

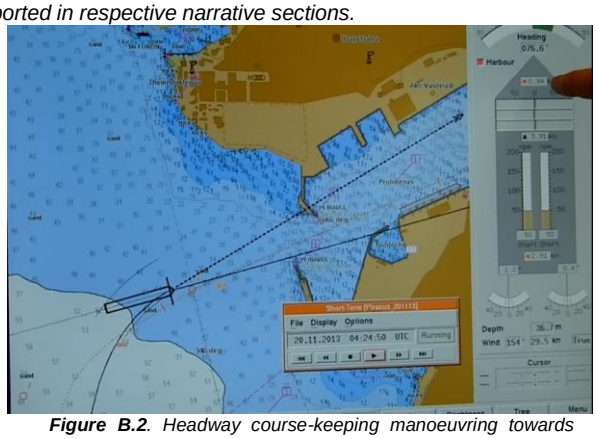

***Figure B.2**. Headway course-keeping manoeuvring towards port entrance.*

3.6.3 Time period C - time related 06:25:00 to 06:26:59

Time 06:25:10 and after

At 06:25:10 MSC Magnifica was almost 4 cables off the port entrance on continuous manoeuvring at a speed of 4.04 knots. Her course was close to 078.4º and Master ordered heading course to 090º; wind indications recorded were close to 23 Knots south-southeast; her fore drifting was at 1.42 knots to port while aft drifting was at 1.78 knots to port too, showing an almost lateral leeway. Despite the fact that MSC Magnifica´s bow was pointing close to the starboard breakwater approximately 100m from its head, her COG, recorded at 057.3º, was pointing the port breakwater, (relevant data shown in figure 16 and table 3 figure c.1).
By that time the Officer at the embarkation pilot door reported to the Bridge that the pilot got on board.

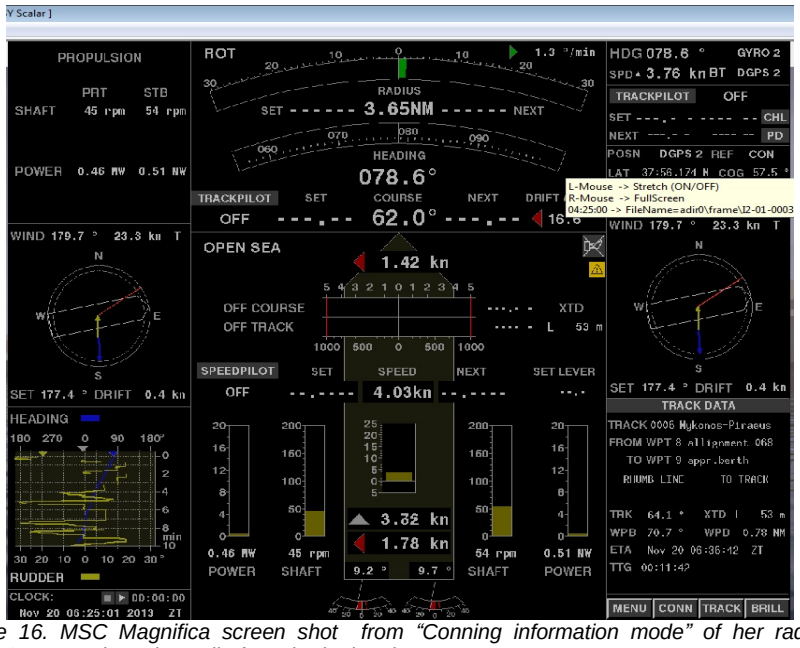

Figure 16. MSC Magnifica screen shot from "Conning information mode" of her radar at 06:25:01,approximately at pilot´s embarkation time.

Time 06:25:30 and after

At 06:25:30, as MSC Magnifica was approaching the port entrance at a speed of 4.37 knots, maintaining a course close to the head of the starboard breakwater at about 70m port from its head, the Southeastern prevailing wind started abruptly to increasing and gusted to approximately 30 knots vertically impacting her freeboard starboard side.

Master ordered the helmsman starboard 10º and immediately starboard 20º and then midship and steady to course, that was close to 080º, still heading 60 m to 70 m from the head of the starboard breakwater; however the COG was 066º.9 almost pointing the head of the port breakwater.

The wind continued gusting and was recorded at 32.2 knots, vertically impacting the starboard side of MSC Magnifica´s windage[3], causing her bow to drift to port at 1.38 knots and her stern at 1.72 knots (relevant data figure 17 & table 3 figure c.2).

By that time the port tug Alexander III was escorting her close to her port stern quarter.

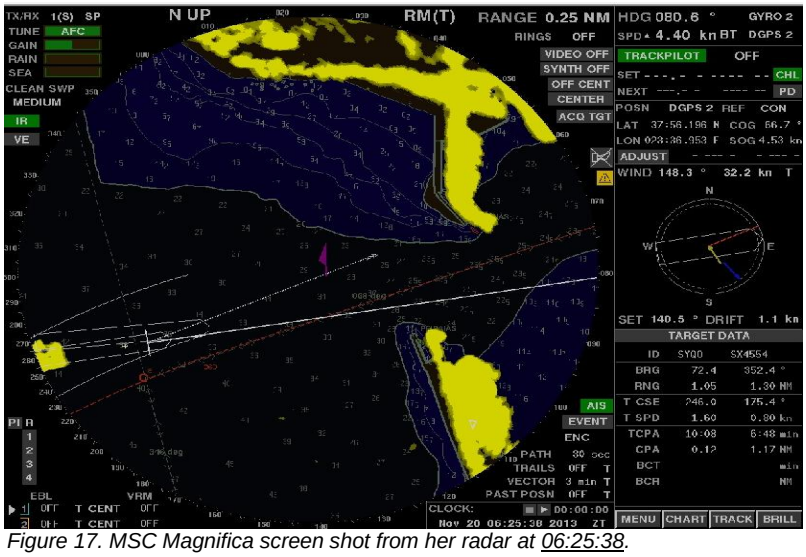

Figure 17. MSC Magnifica screen shot from her radar at 06:25:38.

[3] The part of the surface of a ship´s freeboard exposed to the wind.

Following, the Master ordered the helmsman 20º to starboard while MSC Magnifica was almost 650m away from Piraeus port entrance. The wind continued to increase up to 33 knots but dropped at 29 knots seconds after.
Notwithstanding the fact that Magnifica´s stem post was heading 70m to 80m to port, off the head of the starboard breakwater, she was under ongoing drifting to port and her bow was driven towards the head of the port breakwater (relevant data in table 3 figures c.2, & c.3).

Time 06:26:38 and after

At 06:26:38 MSC Magnifica was almost 400m off the starboard breakwater under 086º.6 course and running at 5.55 knots. Her bow was heading almost 80 m to port, off the head of the starboard breakwater. Nevertheless her COG was 73º.3 and her bow was still drifting to port at 1,47 knots while her stern was drifting at 1.66 knots. The Southeast wind gusted again and was recorded at 35.1 knots (figure 18).
By that time based on the processed data of her ARPA and ECDIS, it could be foreseeable that her bow could have a clear passage into the port yet her aft was heading towards the port breakwater (relevant data from depictions in figures 18 and table 3 figure c.4).
Nonetheless, within seconds, the wind started gusting again and at the specific time was recorded at 32 knots of speed, rabidly increasing to 35 knots (relevant data depicted in table 3 figures c.4 and c.5). Although seconds before, the Master had ordered the helmsman “Steady as we go”, counteracted again and ordered “hard to starboard” and seconds following “midship”.
MSC Magnifica was running at 5,99 knots almost 300m before passing abeam of starboard breakwater´s head.

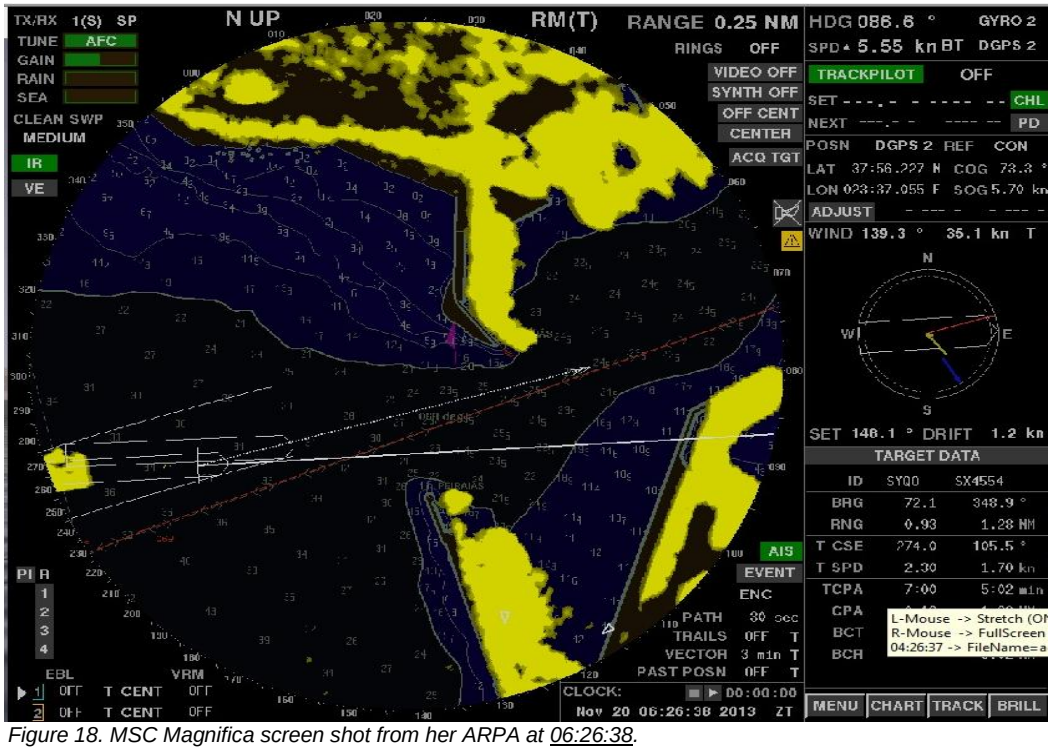

Figure 18. MSC Magnifica screen shot from her ARPA at 06:26:38.

Table 3. Figures table of video screen shots of MSC Magnifica passage for time period (C) 06:25:00 to 06:26:59. Data extracted from ECDIS.
Note: Depicted data may slightly vary from those chronicled reported in respective narrative sections.

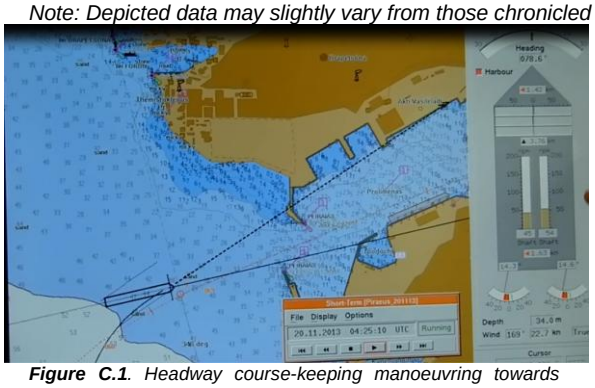

***Figure C.1**. Headway course-keeping manoeuvring towards port entrance.*

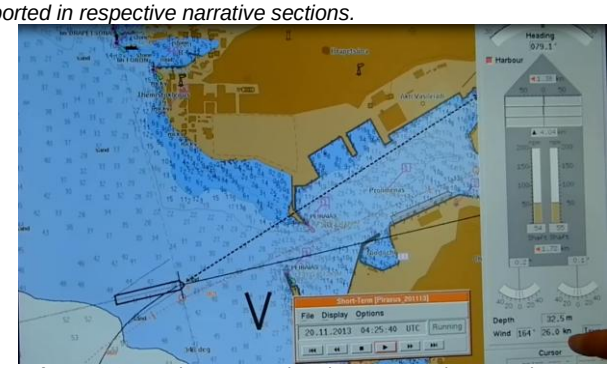

***Figure C.2**. Headway course-keeping manoeuvring towards port entrance.*

***Figure C.3**. Headway course-keeping manoeuvring towards port entrance.*

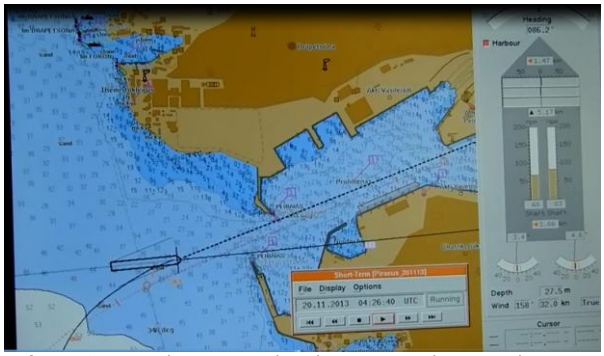

***Figure C.4**. Headway course-keeping manoeuvring towards port entrance.*

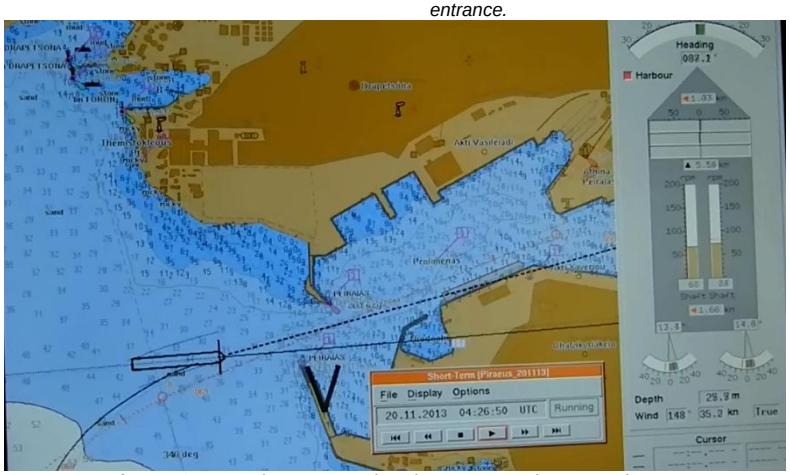

***Figure C.5** Headway course-keeping manoeuvring towards port entrance.*

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3.6.4 Time period D - time related 06:27:00 to 06:28:59

Time 06:27:00 and after

At approximately 06:27:00 the wind continued gusting and within the next 20 seconds hit 39.1 knots of speed, South and Southeastern directed (table 4 figures d.1 & d.2).

At 06:27:08, as MSC Magnifica was almost 200m off Piraeus port entrance under a speed of 5.89 knots, the wind was gusting to 36.7 knots almost South directed, severely impacting her starboard windage. Her recorded course was close to 089º.8 heading to port entrance, about 80m off the starboard breakwater´s head. The projected drifting vectors on her ARPA were showing a clear bow passage into the port, however her stern was still drifting towards the port breakwater (figure 19).

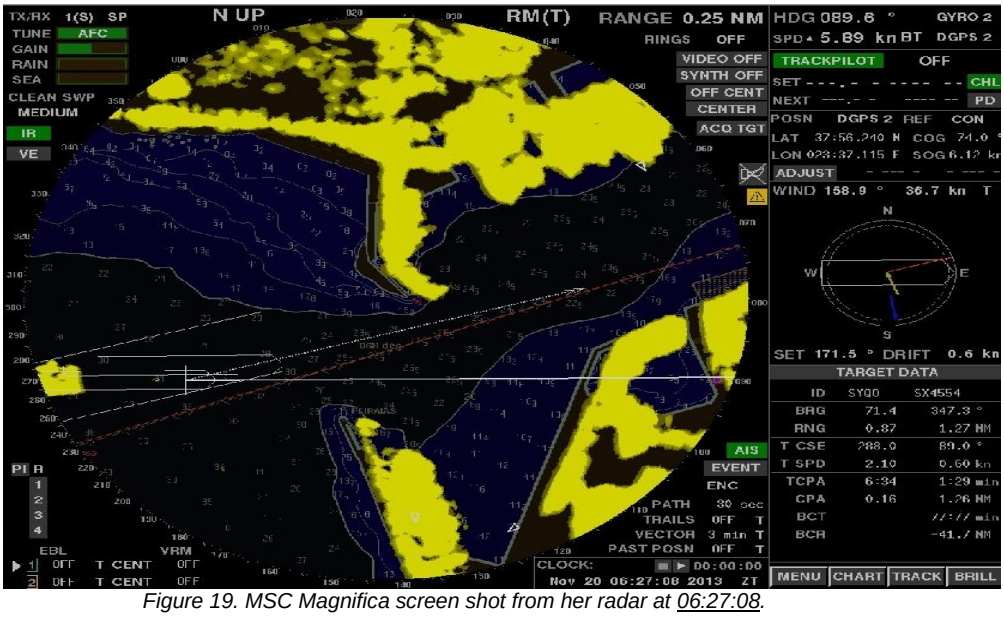

Figure 19. MSC Magnifica screen shot from her radar at 06:27:08.

Seconds after the wind was gusting at 39.1 knots and based on the data shown on her ECDIS, her speed was close to 5.74 knots while her bow had a leeway at 1.48 knots and her stern at 2.65 knots to port, respectively. Master counteracted by ordering the helmsman to put rudder firstly “20º to port” and immediately after “hard to port”. (table 4 figure d.1).

At 06:27:31 the Pilot entered the bridge. By that time the wind was still gusting to 39.1 knots as projected in ECDIS wind data (table 4 figure d.2).

At that time the Master ordered the helmsman hard to starboard and instantly midship, setting the bow thrusters to starboard (Table 4 figure d.3).

Directly after at 06:27:41 the Master ordered hard to port, set the bow thrusters thrusting to port and decreased port engine´s revolutions while maintained the revolutions on the starboard engine in order to stop MSC Magnifica´s stern leeway to port and to sheer off her port aft quarter from the imminent danger of impacting on the concrete head of the port breakwater (table 4 figure d.4).

Time 06:28 and after

By that time, at approximately 06:28, MSC Magnifica was heading 089º almost towards to the middle of the port entrance, however her COG was 076º.1. Her bow although drifting to port at 2.19 knots appeared to have a clear passage from the port breakwater, yet her stern was drifting on to its head. Her rudder was recorded to had been set 20º to port and her bow thrusters were thrusting to port (relevant data in table 4 figure d.5).

The wind continued gusting to 29.4 knots and got increased close to 35 knots at approximately 06:28:48. By that time MSC Magnifica was heading 088.4º under 5.17 knots while she her bow and stern were encountering leeway to port at approximately 1.95 knots and 1.45 knots, respectively. The Master had ordered hard to starboard and had set the bow thrusters thrusting to port (figure 20 & table 4 figures d.6 & d.7).

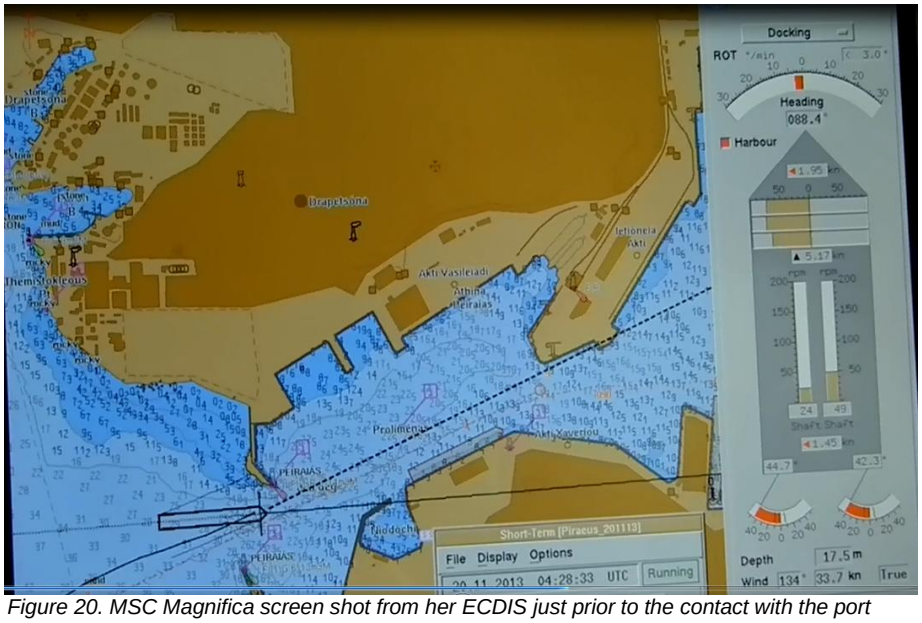

Figure 20. MSC Magnifica screen shot from her ECDIS just prior to the contact with the port breakwater at 06:28:33.

The pilot immediately contacted the Captain of port tug Alexander III and instructed him to proceed to the vessel´s port aft quarter in order to push her off the breakwater, if possible. However, although the Captain of Alexander III maneuvered towards the port aft quarter of the cruise ship, it was not feasible to assist her as she was underway exceeding the speed of 5 knots and continuously drifting to port, approaching perilously the port breakwater and the imminent danger of impact was inescapable (figure 21).

Figure 21. MSC Magnifica by the time impacting on the head of the breakwater.Tug Alexander III is shown standing down from the effort to push Magnifica´s stern section. Breakwater section appears on the right down part of image view.

As MSC Magnifica was approaching Piraeus port entrance, the Master continued to maneuver her by setting the rudder to port and back to midship and further reducing the port engine revolution and maintaining the revolution on the starboard engine. The pilot asked the Master to increase the speed and the Master replied that Magnifica was already at full maneuvering speed.

The wind gusted again close to 35 knots as MSC Magnifica´s port bow was tens of meters off the head of the port breakwater forcing her port bow to drift at approximately 2 knots towards the head of the breakwater (table 4 figure d.7).

Table 4. Figures´ table of video screen shots of MSC Magnifica passage for time period (D) 06:27:00 to 06:28:59. Data extracted from ECDIS.
Note: Depicted data may slightly vary from those chronicled reported in respective narrative sections.

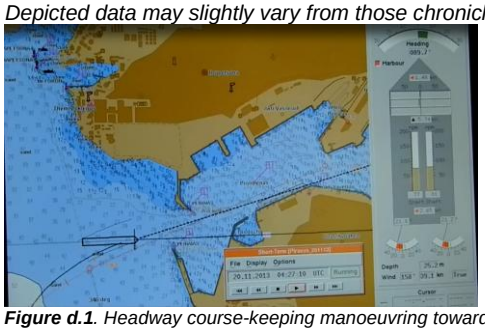

***Figure d.1**. Headway course-keeping manoeuvring towards port entrance.*

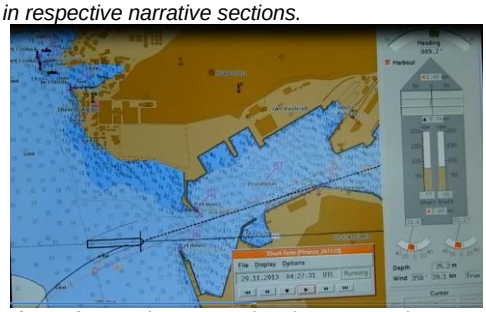

***Figure d.2**. Headway course-keeping manoeuvring towards port entrance.*

***Figure d.3**. Headway course-keeping manoeuvring at port entrance.*

***Figure d.4**. Headway course-keeping manoeuvring towards port entrance.*

***Figure d.5**. Headway course-keeping manoeuvring at port entrance.*

***Figure d.6**. Headway course-keeping manoeuvring at port entrance at 06:28:33*

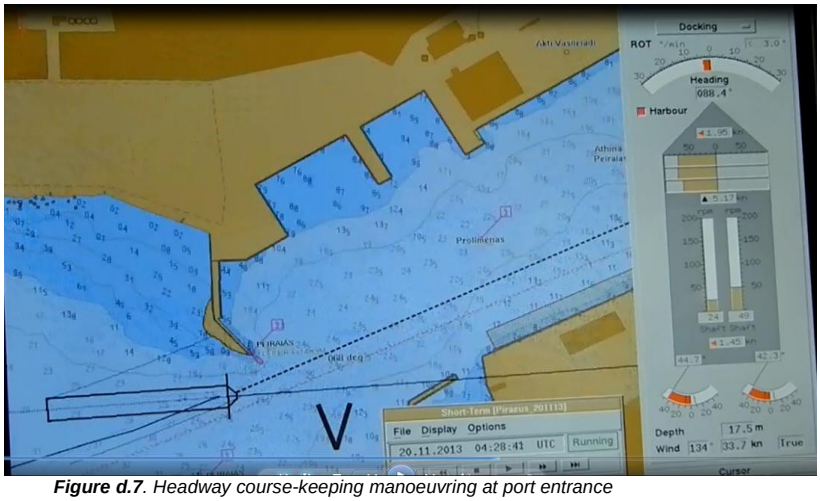

***Figure d.7**. Headway course-keeping manoeuvring at port entrance*

3.6.5 Time period E – time related 06:29:00 – 06:30:59

At 06:29:21 the huge cruise ship´s port bow impacted the top side structure of breakwater´s head. By that time the wind was recorded at 34.5 knots Southeast (figure 22 & table 5 figure e.1).

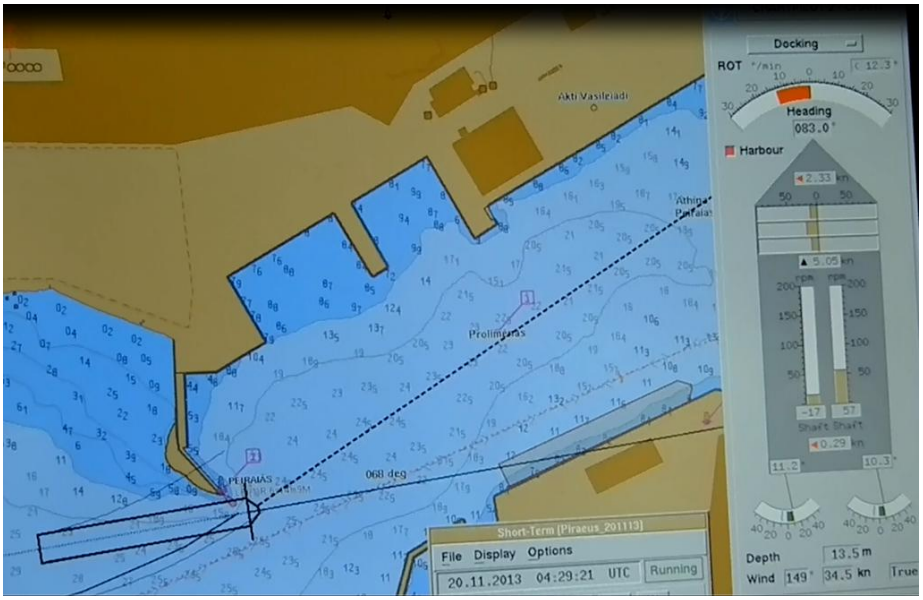

Figure 22. MSC Magnifica by the time her port bow impacted on the port breakwater head.

The impact of the 90,000 GT cruise ship with the head of the breakwater forced the concrete round-hut red light to comedown that was subsequently detached and collapsed into the sea (figures 23, 24, 25 & 26).

Figure 23. MSC Magnifica by the time her hull substructure was contacting with the port breakwater structrure under the sea. The red light has already collapsed into the sea.

As MSC Magnifica was entering the port entrance her port side hull section under the waterline was impacting the substructure of the breakwater under the sea level, causing indents and deformations on her underwater longitudinal port side plating (figures 31 & 32). During the impact of her port section on the breakwater her speed was reduced to 2.05 knots and her rudder was hard to port. Wind speed was recorded between 26 knots and 29 knots Southeast (table 5 figures e.2 & e.3).

At approximately 06:30:40 the Master managed to put off Magnifica stern from contacting the breakwater. She was still running at 2.95 knots and her rudder was hard to port (table 5 figures e.4 & e.5).

The Master immediately ordered the mooring deck crew, positioned at the fore mooring station, to drop the starboard anchor. The pilot instructed tug Alexander III to take a mooring line from the stern and contacted Piraeus traffic Control and Pilot Station for the deployment of a second tug.

Table 5. Figures´ table of video screen shots of MSC Magnifica passage for time period (E) 06:29:00 to 06:30:59.
Data extracted from ECDIS.
Note: Depicted data may slightly vary from those chronicled reported in respective narrative sections.

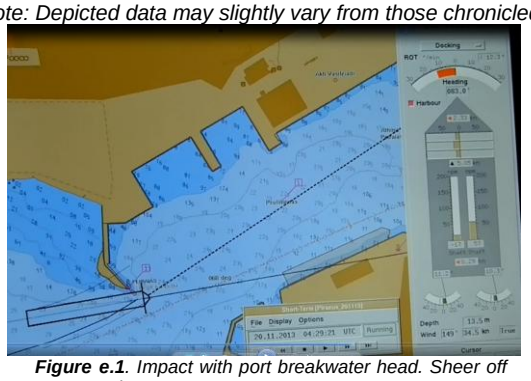

***Figure e.1**. Impact with port breakwater head. Sheer off manoeuvring.*

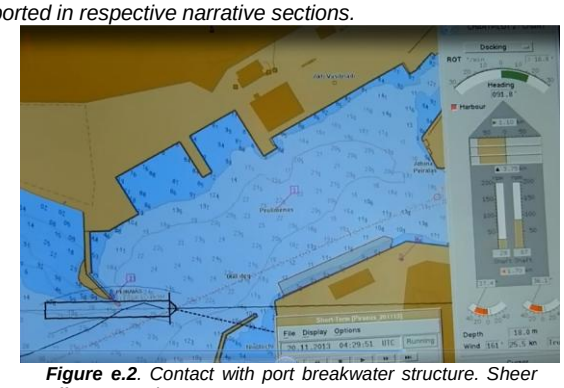

***Figure e.2**. Contact with port breakwater structure. Sheer off manoeuvring.*

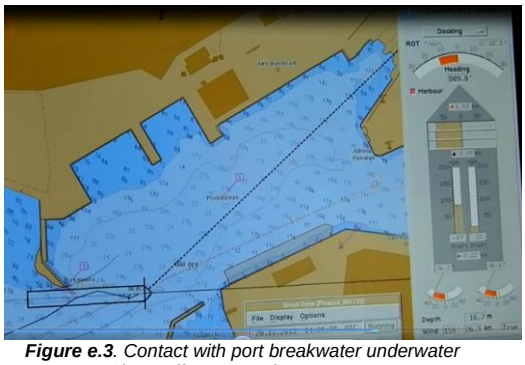

***Figure e.3**. Contact with port breakwater underwater structure. Sheer off manoeuvring.*

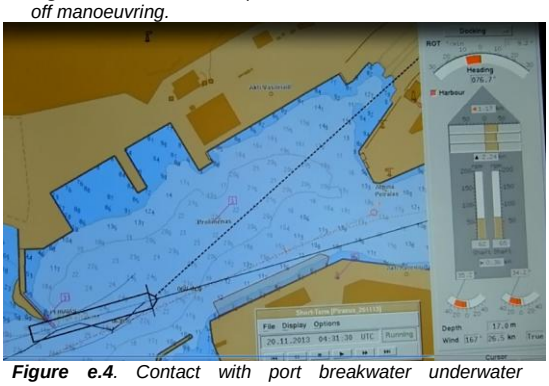

***Figure e.4**. Contact with port breakwater underwater structure. Sheer off manoeuvring.*

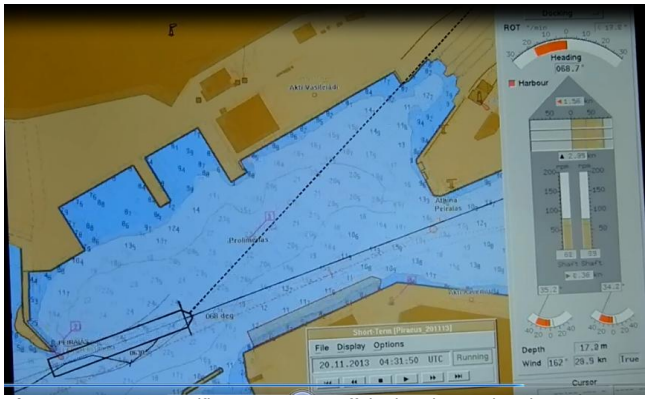

***Figure e.5**. MSC Magnifica port quarter off the breakwater head.*

3.6.6 Time period F – time related 06:32:00 – 07:10:00

At 06:32:10 MSC Magnifica´s starboard bow was already abeam and close to the berthing dock head. The wind was at 25.2 knots. The rudder was set hard to starboard, bow thrusters to starboard and speed at 2.84 knots (table 6 figure f.1).

At 06:35:00 MSC Magnifica was under manoeuvring almost 60m abeam of her berthing position with speed close to 2.06 knots; wind speed was recorded at 23.8 knots (table 6 figures f.2 & f.3).

The Master proceeded with the mooring plan with the assistance of the tug Alexander III that had already secured a towline on Magnifica stern and port tug Armadores II that was immediately deployed to assist her berthing.

At 0645 the first line was given ashore and at approximately 06:47 Magnifica was in berthing position alongside with her starboard side. At 0700 all lines were secured ashore and mooring procedure was completed. At 0705 two gangways were positioned and at 0706 “finish with engines” was ordered from the bridge.

The wind speed during the mooring procedure was recorded close to 18 knots.

Table 6. Figures´ table of video screen shots of MSC Magnifica passage for time period (F) 06:31:00 to 07:10:00.
Data extracted from ECDIS.
Note: Depicted data may slightly vary from those chronicled reported in respective narrative sections.

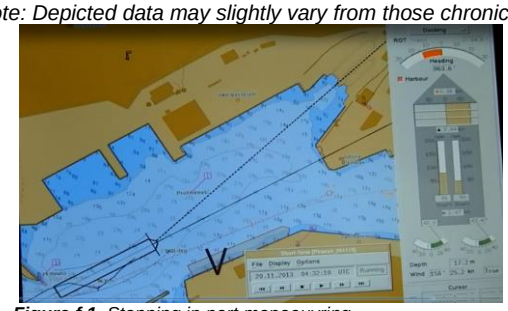

***Figure f.1**. Stopping in port manoeuvring.*

***Figure f.2**. Stopping in port manoeuvring*

***Figure f.3**. Berthing manoeuvring*

Figure 24. The damaged head of the breakwater. Abeam view.

Figure 25. The damaged head of the breakwater. View from Prolimenas section.

Figure 26. The damaged head of the breakwater. View from outer port section.

3.7 Post actions to the occurrence

Following the impact on the breakwater the Master ordered an immediate inspection at watertight compartments of the impacted areas of deck no 1. The Staff Captain contacted the engine room and instructed the Chief Engineer to inspect the integrity of the engine room compartments and the watertight compartments on port side.

According to the watertight monitoring system of the ship located on the bridge, no water ingress was detected.

The initial inspection conducted by the crew showed that MSC Magnifica had sustained structural deformations lengthwise of her port hull under the waterline (figures 31, 32) however there was not water ingress. One crack was found at the port bow section almost 4m above waterline due to the impact on the head of the breakwater (figures 27, 28 & 29). An intend was also found at her port aft section, close to the stern post of approximately 1.5m of length due to the contact of the escorting tug (figure 30). No injuries to passengers or to crew were reported.

Figure 27. The damaged port bow section of MSC Magnifica.

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Figure 28. The sustained deformation and crack to hull caused by the impact on the head of the breakwater

Figure 29. The sustained crack from inner view caused by the impact on the head of the breakwater.

Figure 30. The sustained indent of port stern section caused by Tug Alexander III on the effort to push the stern section.

Following the marine accident the Master, after having estimated the situation, decided not to make a public announcement to passengers as the majority of them were sleeping in their cabins. The passengers followed the activities´schedule of the cruise ship for the rest of the day.
The departure of MSC Magnifica was sustained following an inspection by Port Sate Control Officers of Piraeus Coast Guard Authority, until inspected by her class and a Certificate of Seaworthiness was issued.

Figure 31. The deformations sustained on the hull plating under the waterline caused by the contact on the breakwater substructure.

Figure 32. The indents sustained on the hull plating under the waterline caused by the contact on the breakwater substructure.

The required repairs were carried out by an authorized marine repairing contractor.
Following the inspection by her class MSC Magnifica departed the port of Piraeus at morning hours on the 21 November 2013.

Figures 33 & 34. MSC Magnifica sailing off the port entrance of Piraeus.

Figure 35. MSC Magnifica passing through Piraeus Prolimenas Section.
Piraeus Pilot Authority premises on the right.

4. Analysis

The analysis of the examined marine casualty aims to identify and determine the factors and causes contributed to the occurrence, taking into account the sequence of events and the collection of investigation information and data, both focusing on specific points of the temporal evolution of these, as well as to the root causes in order to draw useful conclusions leading to safety recommendations.

4.1 The key personnel of MSC Magnifica - The Tug Captain - The port Pilot

4.1.1 The Master

The 51 years of age Master of Magnifica started his seagoing career in 1972 after having graduated from two years of study in a Merchant Marine Academy in Italy.
He had served in various types of cargo and passengers vessels and had operated and experienced various types of propulsion and maneuvering systems such as fixed and pitch propellers as well as azipod systems. He had served as a Master on board passengers cruise ships for almost ten years.
He joined MSC Magnifica on 13 November 2013 at Civitavecchia port, Italy and took over his duties on 14 November 2013 at Messina port, Italy, following the hand over procedure according to Safety Management System of MSC Magnifica. His previous contract on board her had lasted for approximately six months.
He was regularly contracting with the managing Company of MSC Magnifica and was familiar with the Company´s Organization, policy and Safety Management System.
His contracting pattern was usually on six months on - four months off or five months on – three months off basis, respectively.

4.1.2 The Staff Captain

The Staff Captain had been contracting with MSC Company since he had been graduated from a Merchant Marine Academy in Italy, that is for almost 13 years.
He had been servicing on Company´s passengers cruise ships since 2007 and as Stuff Captain since 2012.
He was recruited on MSC Magnifica on 02 November 2013 at Civitavecchia port in Italy and it was his second contract on the same vessel.
His regular service pattern was under a six months on - five months off basis while occasionally could be on four to five months on - three to four months off pattern.

4.1.3 The First Officer “on the watch”

The First Officer started his seafarer´s career in 1976 as a deck hand. He was graduated from a Nautical Academy in Rijeka in 1989 and since then he had been contracting with MSC Company on cargo vessels until 2007 when he started serving on Company´s passengers cruise ships, as a Chief Officer.
It was his fifth contract with the Company for the year 2013 and the second on MSC Magnifica.
In May 2013 he joined MSC Magnifica for a two months relief and he had been on board, since 19th of September 2013.

4.1.4 The Third Officer “on the watch”

The Third Officer on the watch was graduated from the Nautical Academy in Italy in 2009. He was under his fifth contract with the Company while his three first contracts were on MSC Musica, sister ship of MSC Magnifica and MSC Orchestra.
He was regularly serving on Company´s cruise ships under a six months on – four months off pattern.

4.1.5 The AB - helmsman "on the watch"

The AB that was part of the navigational team with helmsman duties started his seafarer career in 1969.
He had been contracting with the Company of MSC Magnifica since 1995. It was his second time serving on board Magnifica; the first time lasted from October 2012 to March 2013 and his contacts length were usually on a six months basis.

4.1.6 The Tug Captain

The Tug Captain had been graduated from a Greek Nautical Academy in 1992.
He was a holder of a Chief Officer Certificate of Competency since 2000 and had been permanently contracting with the Tug Company for almost twelve years, out of which the last seven as a Captain.
He had been serving as a Captain on board Tug Alexander III for the past 6 years under a rotation service with a relief Captain on a 24 hours basis duty program.
At the day of the marine accident he was on duty from 0600.

4.1.7 The Port Pilot

The Pilot that boarded MSC Magnifica on the day of her arrival at Piraeus Port had been working in Piraeus Pilot Authority since 2007.
He was a holder of a Master certificate since 2000 and had exclusively served on Greek-flagged passengers ships in coastal shipping as a Master.
His seagoing career started in 1983 after graduating from a Greek Nautical Academy and had mainly serviced on Greek flagged passenger ships as Second Officer and as Chief Officer.
During his seafarers career as Deck Officer, Piraeus port was the home port of the vessels he was recruited.

4.2 Bridge watch pattern & navigational watch

MSC Magnifica was implementing a four hours navigational watch pattern.
According to her SMS Chapter IV, navigational watches were comprised of two Deck Officers, one senior as the OOW and one junior as a help watch and an AB as a Look Out Watch, as quoted in the following table 7:

Table 7. Navigational Watches

	Navigational watch	Position	Rank
1	0800-1200 / 2000-2400	OOW	Second Officer
2		Help OOW	Second Officer
3		Look Out / Helmsman	AB
4	0000-0400 / 1200-0400	OOW	First Officer
5		Help OOW	Third Officer
6		Look Out / Helmsman	AB
7	0400-0800 / 1600-2000	OOW	First Officer
8		Help OOW	Third Officer
		Look Out / Helmsman	AB

4.3 The Bridge Team during arrival at Piraeus port

MSC Magnifica´s bridge team during the arrival procedures in port was composed of the Master, the Staff Captain and the personnel of the navigational watch on duty.
The Master was positioned at the center of the bridge handling the maneuvering engine control levers and thrusters controls of MSC Magnifica fitted on the centre bridge console. He had the general command and was assisted by the Staff Captain.
The Staff Captain, being the senior Deck Officer of the Deck Department, was the direct assistant and advisor of the Master. He was relaying the Master´s Orders to the bridge

personnel, if required and to the mooring teams, positioned at fore and aft mooring stations.
The First Officer, in charge of the navigation watch on duty, was positioned at the port bridge wing and was assigned to report to Master the distances between MSC Magnifica´s bow and the breakwater head.
The Third Officer, help watch of the navigational watch on duty, was positioned at the starboard bridge wing reporting the distances to Master from the starboard breakwater.
The AB of the navigational watch was performing the helmsman´s duties and was executing Master´s steering commands. He was stationed at the centre steering console of the bridge about two meters behind the Master.
The aforementioned bridge team composition was practiced under MSC Magnifica´s Safety Management System and was followed during her arrivals in or departures from ports of calls.
The bridge team composition could cover all primary and essential positions for a safe entering procedure to port.

4.4 Steering communication

The verbal steering communication between the Master or the Conning Officer and the helmsman is imperative for a ship´s safe navigation or maneuvering.
Steering orders have to be clear and precise, communicated between the Master or the OOW and the Helmsman and properly executed by the latter.
Subsequently, a set of standard steering commands widely practiced on ships are ordered by the Master or the conning Officer and following, are repeated by the helmsman so as to confirm that the command have been heard and well understood.
The Helmsman adhering the steering commands, sets the steering rudder at the ordered angles, monitors the turning rate on the connected ratio indicator and reports the executed steering order to the Master or the conning Officer who acknowledges the execution of the command.
The Helmsman, depending on the conning orders, controls the ship´s steering:

- by the displayed angle on the rudder indicator;
- by the gyrocompass indications to the ordered course, requiring counter rudder to prevent the vessel swinging past the course when the helm is centred;
- visually towards a distant permanent object or landmark, requiring counter rudder setting in order to maintain the vessel´s course centered on to the object or landmark.

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW Code Part A/Chapter II/Section A-II/4) requires that a helmsman shall be able to understand and respond to helm orders in English.
The MSC Magnifica´s Master´s steering commands were directly ordered to the helmsman on duty, in English. The Helmsman was loudly repeating the order in English too and at the same time was setting the helm to the ordered angle while he was reporting to Master the exact setting of the rudders´ angles, as were displayed on the rudder indicator at the time of his command execution.
The time lapse between the ordering and the execution of the steering commands was minor and depended on the steering angle commanded, as the steering system of MSC Magnifica was operated by two electrohydraulic pumps and two rudders with steering particulars from hard over to hard over at 28 seconds.

4.5 Manoeuvring equipment and performance - steering commands

4.5.1 Manoeuvring equipment

MSC Magnifica was equipped with a diesel-electric propulsion system. The Electric propulsion was delivered by two Converteam electric motor engines of 17.5 MW each,

driving two conventional propellers and powered by five Wartsila diesel generators of 11,6 MW each and was able to sail at a maximum speed of 23 knots.
She was equipped with 2 fixed Pitch 4 blades propellers of 5.20m diameter and two Rolls Royce Marine flap type rudders 2x22,1m^2 .
Port maneuverability was provided by 3 Brunvoll 4 blades bow thrusters (3x2300 kW at 255 rpm each) and 2 Brunvoll 4 blades stern thrusters (2x2000 kW at 200 rpm each) while 2 Rolls Royce Stabilizers of 18,27m^2 were providing rolling reduce.
The Master of MSC Magnifica during the approaching and entering procedures in Piraeus Port was utilizing all the available means of maneuverability and no malfunctions to the equipment used was reported.
According to the VDR available data, prior to the final voyage segment for entering the port, the Master had good command of his vessel.

4.5.2 MSC Magnifica´s maneuvering standards

MSC Magnifica had successfully completed the maneuvering trials carried out following her launching from the shipyard in January 2010 under the IMO Standards for ships maneuverability (MSC.137(76)), including amongst others a direct and reverse spiral maneuvers, zig-zag, and lateral thruster use.
Indicatively, her main maneuvering performance characteristics are shown in below table 8:

Table 8. MSC Magnifica main maneuvering characteristics. Definitions in footnotes under IMO MSC.137(76).

	Maneuvering	Performance data & values
1	10 °/ 10° zig-zag test[4] 1st overshoot[5] angle 8° 2nd overshoot angle 8°	Time period (1st to 3rd crossing of initial heading) 157 sec. at speed 20 knots maximum heel 4.5°
2	20 °/ 20° zig-zag test 1st overshoot angle 16° 2nd overshoot angle 15°	Time period (1st to 3rd crossing of initial heading) 220 sec. at speed 19.8 knots maximum heel 5.6°
3	Turning circle[6] 35° to port at speed 20 knots	Tactical diameter[7] 517 m Turning diameter 523 m Advance[8] 737 m Max. advance 792 m Transfer[9] 149 m Max transfer 581 m Drift 42 deg
4	Turning circle 35° to port at speed 12 knots	Tactical diameter 619 m Turning diameter 546 m Advance699 m Max. advance 754 m Transfer 162 m Max transfer 681 m

[4] Zig-zag test is the manoeuvre where a known amount of helm is applied alternately to either side when a known heading deviation from the original course, is reached.
The 8 °/ 8° zig-zag test is performed by turning the rudder alternately by 8 to either side following a heading deviation of 8 from the original heading.
[5] The 1st overshoot angle is the additional heading deviation experienced in the zig-zag test following the second execute.
The 2nd overshoot angle is the additional heading deviation experienced in the zig-zag test following the third execute.
[6] Turning circle is the manoeuvre performed to both starboard and port with 35° rudder angle or the maximum rudder angle permissible at the test speed, following a steady approach with zero yaw rate.
[7] Tactical diameter is the distance travelled by the midship point from the position at which the rudder order is given to the position at which the heading has changed 180° from the original course. It is measured in a direction perpendicular to the original heading of the ship.
[8] Advance is the distance travelled in the direction of the original course by the midship point of a ship from the position at which the rudder order is given to the position at which the heading has changed 90° from the original course.
[9] Transfer is the distance travelled, perpendicular to the original course of the ship, at the point at which the heading has changed 90° from the original course.

5		Drift 34 deg
	Full astern stopping test[10]	Speed 20 knots
		Stopping distance 1698 m
		Lateral deviation 44 m
	Full astern stopping test	Speed 12 knots
		Stopping distance 709 m
		Lateral deviation 10 m

Described maneuverability trials, as provided by the respective IMO provisions, were performed under very good weather conditions of calm weather with winds close to 10 knots and calm sea, with no current and clean hull. The water depth was twice her draft and she was even keel at 7.72m of draught with displacement at 47,009 t.
It is noted that if one of the following conditions are varied, maneuverability performance and response is altered depending on the actual values´ variation experienced.
In the examined case, during MSC Magnifica approach to Piraeus Port the weather conditions, as one of the basic parameters for ships safe maneuvering were significant worst, with moderate swell sea; winds close to 25 knots and gusty while just prior to her entry into port the wind gusted to approximately 40 knots, severely affecting her steering course and path. Having examined the evidence collected it is deduced that the Master misjudged the development of Magnifica enter into port procedure which is considered a contributing factor in the marine accident.

4.5.3 MSC Magnifica maneuvering performance

MSC Magnifica, as already mentioned, could sail at open sea at 23 knots with her engines running at 180 rpm at maximum power propulsion output of 35,000 KW.
According to the recorded required data in the Pilot card, as provided by IMO Resolution A.601(15), part of her main maneuvering characteristics for the ship-handling during arrivals and departures at port of calls or in confined waters and so forth, is presented in the following table 9:

Table 9. MSC Magnifica main maneuvering characteristics

	Maneuvering engine order & data	RPM	Speed
1	Full ahead	90	12.5 knots
2	Half ahead	60	8 knots
3	Slow ahead	40	5.5 knots
4	Dead slow ahead	20	2.5 knots
5	Dead slow astern	20	
6	Slow astern	40	
7	Half astern	60	
8	Full astern	90	
	Maneuvering data		
9	Time limit astern	No limit	
10	Full ahead to full astern	540 sec	
11	Rudder hard-over to hard-over	28 sec	
12	3 bow thrusters	total output 6,900 KW	
13	2 stern thrusters	total output 4,000 KW	

Based on the above data it is considered that MSC Magnifica could maintain a sufficient level of maneuvering operability at various ship´s handling situations that could ensure safe port approaching and docking operations, whilst she could effectively manoeuvre sternway at sufficient time.

[10] Full astern stopping test determines the track reach of a ship from the time an order for full astern is given until the ships stops in the water.

4.5.4 Minimum manoeuvring standards for Master and Bridge Team

In pursuance of regulation II/1 of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as applied, Masters and Officers in charge of the navigational watch should be competent in navigational functions at operational level as listed in Table A-II/1 of said regulation.

Ship´s manoeuvring is classified and enumerated as a required competency for Masters and Deck Officers in charge of the navigational watch. In respect to aforementioned regulation, amongst others the knowledge, understanding and proficiency of the wind effects (ref. to paragraph 4.9 and its subparagraphs), stopping distances on ship´s manoeuvring and so forth are skills to be acquired mostly through in-service experience.

Based on the data and information provided through the interview process the Master of Magnifica, the Staff Captain and the members of the Bridge team at the time of the marine accident, qualified for performing the “Officer in charge of the navigational watch” duties had very good seagoing experience and were familiar with the ships manoeuvrability to the extent concerning their respective duties.

Nonetheless, on the grounds of the evolution of the events, MSC Magnifica´s VDR processed data of manoeuvring executions and actual weather conditions just prior to the marine accident as well as on the analysis recorted in paragraphs 4.10, 4.11 and their respective subparagraphs, it could be suggested that the Master and the bridge team performance was not effective, contributing to the impact of MSC Magnifica on the head of the breakwater.

Master and bridge team performance in relation to ship´s manoeuvring evaluation during the entry into Piraeus port passage is considered to have been a contributing factor to the examined marine accident.

4.6 Conning position´s vision & main bridge equipment arrangement

4.6.1 Conning position´s vision

MSC Magnifica bridge layout furnished an open one-room wheelhouse designed to allow almost 360º of vision with panoramic bridge full windows.

The horizontal vision field could offer an excellent aspect of the navigated sea area to the conning Officer and the bridge team, meeting the requirements of SOLAS 74/Chapter V/Reg. 22, as applied (figure 36).

Figure 36. Field vision from port side bridge wing.

4.6.2 Main bridge equipment arrangement

MSC Magnifica was designed under advanced standards of a modernized bridge layout. Her bridge equipment arrangement was ergonomic following adequately the respective principals set out in SOLAS ´74/Chapter V/Reg. 15 as applied, as well as the related guidelines of MSC/Circ 982 (73).

The referred requirements amongst others foresee that the tasks to be performed by the bridge team and the pilot are facilitated for the full appraisal of the encountering situation in navigating the ship safely under all operational conditions while promoting effective and safe bridge resource management.

MSC Magnifica bridge was fitted with an Integrated Bridge System (IBS), comprising of consoles allowing centralized access to information, command or control and rendering an efficient management for the ship´s safe navigation.

More specifically her IBS was featuring:

- one navigating and maneuvering workstation console at the centerline of the bridge (figure 37);

Figure 37. Navigation and manoeuvring workstation console.

- one helmsman workstation console fitted approximately two meters behind the foresaid console (figure 38);

Figure 38. Helmsman workstation consoles.

- two docking workstation consoles located at her port and starboard bridge wings respectively (figure 39);

Figure 39. The docking – manoeuvring consoles at bridge wings

MSC Magnifica bridge consoles were housing an Integrated Navigation System (INS) interconnected with several independent and different data sensors and components for planning, monitoring or controlling her operational progress, increasing safe and efficient navigation by performing the passage execution.
The bridge equipment layout could enable the Master and the bridge team to have direct access to essential navigational information and data processing as were presented in controls and displays in order to support their decision making.

4.6.3 Main navigational equipment & aids

4.6.3.1 Navigational charts

MSC Magnifica primary means for navigation were standard paper Nautical Charts of British Admiralty. The Electronic Navigational Charts through the provided ECDIS[11], installed as a component of her Integrated Navigation System and according to the Company´s Circular letter No 01/12 issued on 04 January 2012 it was considered as an auxiliary to the navigation system.

4.6.3.2 Radars

MSC Magnifica was equipped with three SAM Electronics - Multipilot X-Band radars and two SAM Electronics - Multipilot S-Band. According to the manufacturer they were capable of providing four main modes of operation depending on the navigational situation and selection by the OOW:

- Radar mode featuring all radar functionalities including ARPA and AIS;
- Chartradar mode providing radar control in combination with a vector chart presentation to the radar image;
- ECDIS mode providing nautical electronic charts included AIS utilities and real time radar video overlay;
- Conning information mode featuring data from configured sensors as well as engine and rudder information for rapid decision making by the conning Officer or the bridge Team. Such information could include indications of:
  Heading and Rate of Turn (ROT); course and drift angle; wind speed and direction; power of pitch and shaft; rudder and thruster performance; depth; trim and hill.

4.6.3.3 AIS

The AIS SAM Electronics DEBEG 3400 device was interfacing with the Integrated Bridge System fitted on MSC Magnifica, supporting the OOW by providing target and traffic information displayed on the Radars or Chartradar.

[11] ECDIS : Electronic Chart Display and Information System

4.6.3.4 DGPS (Differential Global Positioning System)

MSC Magnifica was equipped with two SAAB R4 DGPS Navigation Sensor features of the GPS Sensor and a dual channel beacon receiver for reception of IALA beacon DGPS corrections. A multitude of navigation functions such as Latitude and Longitude, heading, COG, speed and so forth were displayed as well as the ship´s position accuracy within the required value to about 10 cm in case of best transmissions.

4.6.3.5 NAVTEX

The Navtex receiver SAM electronics JMC DEBEG 2902 fitted on the bridge is dual channel narrow band direct printing radiotelex system to broadcast automatically navigational information. It is part of the Global Maritime Distress and Safety System (GMDSS).

It monitors simultaneously 518 kHz and a selectable secondary frequency either the national 490 kHz or 4209.5 kHz for long rage services.

4.6.3.6 Weather Fax Receiver

The weather facsimile receiver SAM electronics JMC DEBEG 2952 Magnifica was equipped, allows the selection of index and the reception and recordings of all weather chart programs of the International Meteorological Services automatically in frequencies from 80 to 160 kHz and 2 to 24 MHz.

4.7 Approaching at Piraeus Port

4.7.1 Communications with the Authorities & the port tug - working language

According to SOLAS Chapter V Safety of Navigation Reg. 14.3 & 4 working common language has to be established on board all vessels determined by Master or Company and to be recorded in the vessel´s Log Book in order to ensure effective crew performance in safety matters. Each seafarer is required to understand and, where appropriate, give orders and instructions and to report back in that language.

English language is to be used as the working language for bridge-to-bridge and bridge-to-shore safety communications as well as for communications on board between the pilot and bridge watchkeeping personnel, unless those directly involved in the communication speak a common language other than English.

The aforementioned requirements as well as provisions laid down by STCW A-IV/2 were satisfied by MSC Magnifica bridge team.

The communication established between MSC Magnifica bridge team and the port Authorities during her arrival procedures were efficient and comprehend under the basic Standards of Marine Communication Phrases as principally provided by Res. A.918(22)).

4.7.1.1 Communication with VTS

MSC Magnifica OOW had established an effective VHF communication, in English with Piraeus VTS and had promptly reported her positions at the respective segments of her passage across Piraeus Traffic Separation Scheme as well as the estimated time of her arrival at pilot boarding position.

4.7.1.2 Communication with Piraeus Pilot Station

The Master of MSC Magnifica having taken the command had established an efficient VHF communication with the Piraeus Pilot Station and with the Pilot that was to be deployed on board her.

The communication was periodic and regular and notifications of MSC Magnifica approaching progress were reported by the Master.

4.7.1.3 Communication with the port tug

The pilot deployed to board on MSC Magnifica had established VHF communication, in Greek with the Captain of port tug Alexander III, and all available information was notified.

Despite the fact that the pilot and the Tug Captain, although competent in speaking English, were communicating in their native language for practical and operable reasons, all the information required for the arrival procedures was passed to MSC Magnifica´s Master by the pilot in English.

4.8 Fatigue

Based on MSC Magnifica records of working and resting hours as well as on the interview process provided information, it is considered that the Master and the Bridge team were not affected by fatigue.
The pilot was on a 12 hours duty under the standard working program and there was no evidence that he was affected by fatigue.
The port tug Captain was on a 24 hours duty under the regular duty schedule and it was not evident that he was affected by fatigue either.

4.9 Environmental conditions

4.9.1. Forecasted weather conditions

On 19 November 2013, the Hellenic National Meteorological Service[12] had broadcasted a weather forecast bulletin at 2200 UTC (2400 LT) of "Securite"[13] priority with warning no 106.
The issued weather bulletin was concerning the NAV/METAREA III and its subdivided sea regions including the SE Aegean Sea (key area no 41 of METAREA III) and the Saronic Gulf (key area no 43 of METAREA III), areas that included MSC Magnifica´s voyage passage as well as departure and arrival ports.
The weather bulletin forecast for the SE Aegean Sea and the Saronic Gulf is recorded in the following table 10:

Table 10. Weather forecast for MSC Magnifica navigated sea areas.

Sea area	Parameter	Data
SE Aegean Sea	Wind	S 4 or 5 bfrs later SW 5 bfrs (corresponds to wind speed 11-16 knots and 17-21 knots respectively)
	Sea state	Slight (corresponds to wave height 0.5 to 1.25 m)
Saronic Gulf	Wind	S 4 or 5 bfrs (corresponds to wind speed 11-16 knots and 17-21 knots respectively)
	Sea state	Slight (corresponds to wave height 0.5 to 1.25 m)

Apart from the above, a general warning was also recorded in the referred weather bulletin, underlining that:
"Be aware: wind gusts can be 40 percent stronger than those given here and maximum wave height up to twice than significant".
Furthermore the weather bulletin was ending by the notice:
"Gale force winds not expected".
Aforementioned warning was issued in order to draw the attention to Masters, bridge teams or OsOW and Mariners in general so as to take heed and observe weather conditions in cases navigational situation or ships handling required to act accordingly.
However it is to be noted that the warning notice was general for the METAREA concerned and was not referred to specific key areas of it.

[12] The Hellenic National Meteorological Service is responsible for the dissemination via SafetyNet of Weather and Sea Bulletins for Shipping and Warnings for the Mediterranean Sea and the Black Sea (NAV/METAREA III).
[13] Securite priority: meteorological forecast or broadcast below "Urgency priority" indicating that the broadcasting station has an important safety navigational or meteorological warning to transmit. They are also broadcasted in radiotelephony. Meteorological warnings is information that include the development of weather systems such as and not limited to, rain squalls, big tidal drops, major current shifts, lightning storms, hurricane and tsunami warnings, high winds, and cyclones. It is normal practice to broadcast the Sécurité call itself on a distress and listening frequency such as VHF Channel 16 or MF 2182 kHz and then change frequency to a working channel for the body of the messages.

4.9.2. Recorded weather conditions

MSC Magnifica having departed from the port of Mykonos, followed her planned voyage, navigating through the SE Aegean and the Saronic Gulf.

During the navigational watches performed, the following weather recordings were listed on her Log Book:

Table 11. MSC Magnifica´s Log Book weather recordings.

Time	2400	0400	0530
Wind direction/speed	SSE 3-4 bfrs	SE 4bfrs	SE 6 bfrs
Sea state	Slight	Slight	Slight
Air temperature	17 ° C	17 ° C	20 ° C
Barometric pressure	1017 Mb	1017 Mb	1013 Mb
Visibility	7 nm	7 nm	7 nm

4.9.3 Actual weather conditions at Piraeus approaches

The weather conditions during MSC Magnifica approach at Piraeus Port were gradually worsening. More specifically the wind speed values as were being recorded by MSC Magnifica VDR were progressively increasing as it could be also practically concluded due to the rapid fall of the barometric pressure. Significant and indicative wind speed data recordings are depicted in following table 12.

The average wind recorded was close to 20-25 knots Southeast, corresponding to 5-6 bfrs wind state while sea state was reported to be slight to moderate with wave height close to 1-1.5 m.

Furthermore according to the presented data in table 12, the prevailing winds were gusty at certain times.

Likewise, the prevailing local weather condition at the WSW sea areas of the Saronic Gulf was reported to have been rather unstable with squalls, rain showers and gusts.

4.9.4 Actual weather conditions prior & during the marine accident

Having regard to the wind data extracted from MSC Magnifica VDR during the critical time period prior to entering the port, during and post to the occurrence as well as to data provided by the Hellenic Meteorological Service, as were half-hourly recorded by the weather station located close to Psitalia Islet, at approximately 1.3 nm W of Piraeus port entrance, the following table 12 have been drafted and collated for further conclusions.

Table 12. Correlation table of actual wind recordings by MSC Magnifica VDR and HMS.

MSC Magnifica				Hellenic Meteorological Service		
Time	Wind speed	Wind direction	Event Sequence	Time	Wind speed	Wind direction
06:00	27-28 knots	SE		06:00	24 knots	SE
06:01	30 knots	SE		-	-	_
06:01-06:15	Variable 25-27 knots	SE		-	-	_
06:15	29 knots	SE	Master - Pilot com we are in position for pilot boarding -entry after Knossos Palace make a lee for pilot boarding	-	-	_
06:16:00	31 knots	SE	_	-	-	_
06:20:00	27 knots	SE	_	-	-	_
06:22:00	29-30 knots	SE	_	-	-	_
06:24:00	28-29-30 knots	SE	_	-	-	_
06:25:30	30-31 knots	SE	Pilot boarded	-	-	_
06:26:04	30-32.5 knots	SE	_	-	-	_
06:26:27	33 knots	SE	_	-	-	_
06:26:38	35.8 knots	SE	_	-	-	_

06:26:42	38 knots	SE	_	-	-	_
06:27:00	39.1 knots	SE	_	-	-	_
06:27:23	35 knots	SE	Pilot in the bridge	-	-	_
06:27:47	30-31.7 knots	SE	Pilot – Tug ALEX III com to assist	-	-	_
06:28:05	34 knots	SE	-	-	-	_
06:28:20	30 knots	SE	Hard to port	-	-	_
06:28:40	36 knots	SE	Pilot increase speed Master speed is full	-	-	_
06:28:48	35 knots	SE	-	-	-	_
06:29:35	35-32 knots	SE	Contact	-	-	_
06:30:00	25.5 knots	SE	In the port	06:30	24 knots	SE

Having processed the quoted data above, the following annotations are presented:

- Actual wind speed was gradually being increased while approaching Piraeus port entrance;
- Actual wind speed was significantly increased just outside of Piraeus Port entrance;
- Wind speed recorded by MSC Magnifica anemometer was periodically gusty exceeding 30 knots, that is force 7 of Beaufort Scale;
  exceeded the speed of 35 knots, that is 8 bfrs, by the time MSC Magnifica was underway at a close distance from the port entry.
- The gusted wind speed values were estimated at a rate close to 40% stronger than the forecasted, confirming the “warning notice” in the weather bulletin issued by the Hellenic Meteorological Service (ref. par. 4.9.1).

On the grounds of the aforementioned and taking into account the sequence of the events leading to the marine accident it is considered that the Master and Bridge Team of MSC Magnifica had disregarded existing weather conditions as a factor for a safe into port passage.

4.9.5 Wind effect during maneuvering procedures

It is emphasized that wind is one of the main parameters that could remarkably and surprisingly, when gusty, affect the ship´s maneuverability and steering.
Wind forces and indubitably wind gusts could seriously decrease course-keeping, cause leeway to an extent that could result in complete loss of maintaining the planned and intended path and course.
It is furthermore underlined that in cases when the ratio of the wind speed is sweeping, the wind has a considerable effect on the ship manoeuvre and control.

4.9.5.1 The wind influence point

The wind influence point is the point on freeboard surface upon which the whole force of the wind is acting. The freeboard surface that the wind is acted upon is also called windage area. The point of the windage area is depending on the ship´s profile exposed to the wind. Indicatively, wind directed abeam to the windage area of cruise ships, similar to MSC Magnifica, results to wind influence point close to the mid-length of the accommodation superstructure and consequently cause ship´s leeway.

4.9.5.2 The wind Force effect calculation[14]

As reported above wind can have a significant effect on a ship handling and manoeuvring. The effect of the wind depends on the wind speed, its direction towards the ship´s exposed freeboard profile, that is the windage area.

[14] Reference to “A Master Guide to berthing” by Clubs

Having regard to the above, ships with high, long sides and great windage areas such as passenger cruise ships, car carriers etc, could be significantly influenced by wind force when manoeuvring.
Encountering wind force acting on the ship´s side when approaching, entering or berthing in ports could be practically estimated with the following indicative calculation.

$F = (V^2/18{,}000) \times \text{windage area}$	F is the wind force in tonnes V is the wind speed in m/s (metres per second) windage area is the area of ship exposed to the wind in m^2

Above calculation gives an estimation of the total wind force on a ship's side. It will give an indication of the total power that tugs will need in order to overcome the wind force or even of the manoeuvring planning that needs to be executed.
Following the above a practical "Rule of thumb" may be applicable for entering into port or berthing manoeuvring: *"double the figure obtained for F and an additional tug with a suitable bollard pull is required"*.

4.9.5.3 The wind Force effect on MSC Magnifica

MSC Magnifica , being a new built cruise ship had a length of 293.8 m and an air draft of 47.64 m with a 16 decks lay out. Her windage area is estimated to be more than 10,000 m^2.
Taking into account the actual weather conditions prior to the marine accident that MSC Magnifica encountered at certain times during her approach at Piraeus port, the wind forces acting on her windage area for the peak of gust values, could be calculated as in below table 13:

Table 13. Estimated wind forces during MSC Magnifica entry into port passage.

For 25 knots abeam wind	$F = (V^2/18{,}000) \times \text{windage area}$	$F=(12.861^2/18{,}000)\times 10{,}000\ m^2$ F= 91.9 tons
For 30 knots abeam wind	$F = (V^2/18{,}000) \times \text{windage area}$	$F=(15.43^2/18{,}000)\times 10{,}000\ m^2$ F= 132.3 tons
For 35 knots abeam wind	$F = (V^2/18{,}000) \times \text{windage area}$	$F=(18.0055555554^2/18{,}000)\times 10{,}000 m^2$ F= 180.1 tons

Taking under consideration the above results it could be concluded that the 10 knots wind speed increase almost doubles the wind force acting on MSC Magnifica massive windage area and respectively increases the required pollard pull to overcome the wind effect.
Above estimation, apart from the several factors affecting ship´s manoeuvrability is suggested to be considered by the Master as an indicative tool that could contribute to the decision-making process for manoeuvring planning and safe passage into a port or a berth.
In consideration of the above as well as in view of the prevailing weather conditions at the time MSC Magnifica was entering Piraeus port as scrutinized in paragraph 4.9.4, it is suggested that the Master´s unconcern of wind force effect on her windage area under the existing weather conditions prior to the commencement of the arrival procedures and entry into port passage, have been a contributing factor to the examined marine accident.

4.9.6 Actual wind data & wind effect reporting

Despite the fact that, as referred in par. 4.3, MSC Magnifica Bridge team composition could cover all primary and essential positions for a safe entering to port procedure, based on the processed VDR data as well as on the information provided through the interview process, it was not emerged that the wind actual data input was timely brought to the attention of the Master during the approach to Piraeus Port.
Consequently it is suggested that actual wind data input was not processed and evaluated as required, taking under consideration the significance of the wind effect in relation to MSC Magnifica windage area in particularly gusty weather conditions, as those she encountered just prior to the marine accident.

In light of the above it is considered that had an effective monitoring and processing management system for actual wind data and wind effect during MSC Magnifica´s entry passage into Piraeus Port been observed and respectively had data been passed to the Master, the entry procedure could have been reevaluated and respectively have led to otherwise decision-making, as laid down in par. 4.13.

4.10 MSC Magnifica Safety Management System for shipboard operations

MSC Magnifica was operating under an electronically based application of her "Safety Management System" utilizing, integrating and multitasking projected procedures pursuant to Company´s Safety and Environmental Policy.
In pursuance of ISM Code Chapter 7 "Shipboard operations", procedures, plans and instructions, including checklist, as appropriate, should be established concerning the safety of personnel, ship and protection of the environment. The various tasks should be identified and assigned to qualified personnel.
Procedures and instructions were laid down for carrying out the key shipborne operations on MSC Magnifica, under the aforementioned provisions.
The established procedures were ensured that were being followed through the completion of related check lists by the assigned Officer.
According to MSC Magnifica´s Safety Management System shipboard operations for her voyage from Mykonos Island to Piraeus Port included, amongst others, the following check lists of interest, as quoted in following table 14:

Table 14. MSC Magnifica Check list relevant to the examined case.

check list	Procedure	Officer assigned
No 2	preparation for sea, involving a risk assessment	Duty Officer Officer in charge –1st Mate
No 3	embarkation / disembarkation of pilot	Duty Officer
No 4	Master / Pilot information exchange	Duty Officer
No 6	Navigation, Coastal Waters, Traffic Separation Schemes	Duty Officer
No 7	Changing over the watch	Duty Officer
No 8	Preparation for arrival in port, involving a risk assessment	Duty Officer Officer in charge –1st Mate

4.10.1 Weather Bulletins obtaining process

Having scrutinized presented Check lists, it was arisen that weather conditions reference as a factor that should be taken under consideration and checked was only enlisted in Check list no 6 whilst in Check list no 8 there was a reference for the update of passage following receipt of the Shore to Ship and Pilot/Master exchange form and all latest navigational warnings.
In respect to Pilot/Master exchange form it is noted that the form is completed post to pilot embarkation, that is in ship´s position where there is enough sea room and time to reevaluate and update the entry into port passage, if encountering circumstances necessitate to that end.
Concerning the latest navigational warnings update, it is underlined that navigational warnings [15] are broadcast messages containing urgent information relevant to safe navigation such as casualties to lights and buoys; major new aids to navigation; towing operation; search & rescue or antipollution operations; cable or pipe-laying activities; naval exercises; significant malfunctioning of radio navigation services and shore-based maritime safety information radio or satellite service; and do not include any meteorological forecast and meteorological warnings.

[15] Reference to IMO Resolution A.706(17).

Consequently there was no specific reference for checking and elaborating the regular or under “Securite” priority weather bulletins, in order to assist the Master for the briefing with the Officers engaged in the approaching and entry into port procedures, as was provided in referred check list no 8.
Furthermore it was cropped up that there was no specific recorded instruction or procedure for checking the actual weather conditions (wind speed and direction) through shore up-to-date information input through VHF communication and consequently factual wind data was not taken into account for the Risk assessment conducted prior to MSC Magnifica´s arrival.
The lack of explicit instructions through MSC Magnifica´s Safety Management System for obtaining weather bulletins and shore up to date wind data for evaluation prior to the arrival procedures is suggested to have been a contributing factor into the examined case.

4.10.2 Weather bulletins elaboration

It is noted that in pursuance of SOLAS/Chapter V / Reg. 5 “Meteorological services and warnings” / par. 5, *“Forecasts, warnings, synoptic and other meteorological data intended for ships shall be issued and disseminated by the national meteorological service in the best position to serve various coastal and high seas areas…under the Global Maritime Distress and Safety System (GMDSS).”*
In relevance to the above provision, the respective SOLAS/Chapter IV set out the GMDSS requirements for sending and receiving distress alerts and Maritime Safety Information[16] that includes weather bulletins as well as the INMARSAT and NAVTEX provisions to automatically receive Maritime Safety Information.
However the wind data that were elaborated for the conduct of the Risk Assessment process on board MSC Magnifica were obtained from a web weather forecast service.
Under the acquired information, the processed wind speed was 16 knots South with gusts to 25 knots of Southern direction although the actual average wind speed was between 20 and 25 knots that is force 5 to 6 bfrs of the Beaufort Scale and the encountered gusts were reaching 30 to 35 knots of speed, that is almost 40% stronger than the wind speed forecasted in the weather bulletin broadcasted by the Hellenic Meteorological Service.
In respect to the above it is considered that the process followed by MSC Magnifica Bridge team to obtain and elaborate the web weather forecast data is indentified as a misguidance for the Risk Assessment conducted process.
On the grounds of the above it is suggested that the lack of explicit instructions through MSC Magnifica´s “Safety Management System” pertinent to:

- weather bulletins data reception and elaboration; and
- actual weather conditions data input,

in order to draw the Master´s and bridge team attention for updating and reassessing the entry into port segment that could had led to prompt actions for safe arrival procedures, are considered as contributing factors in the examined marine accident.

4.11 Risk Assessment process

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”*.

[16] Maritime Safety Information: Navigational and meteorological warnings, meteorological forecasts and other urgent safety-related messages - ref. to Res. A.706(17).

Even though, the ISM Code does not provide any further explicit reference apart from the above general requirement, risk assessment[17] 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”[18].
The risks concerned are those that are reasonably expected and are related to shipborne procedures or operations in respect to:

- → the health and safety of all those who are directly or indirectly involved in the activity, or who may be otherwise affected;
- → the property of the company and others;
- → the environment.

A hazard could be defined as a situation or practice that has the potential to cause harm. Hence a risk analysis process or management of risk could concisely include the following phases:

- ✓ the identification of hazards;
- ✓ the assessment of the risks associated with those hazards;
- ✓ the application of controls to reduce the risks that are deemed intolerable. The controls may be applied either to reduce the likelihood of occurrence of an adverse event, or to reduce the severity of the consequences;
- ✓ the monitoring of the effectiveness of the controls.

The ISM Code does not lay down any particular models for the management of risk and therefore the company is to stipulate methods in view of its organizational structure, its ships and operations. The methods should be systematic, if assessment and response are to be complete and effective, and the procedures should be documented so as to provide evidence for the decision-making process.

4.11.1 Magnifica Risk Assessment process

MSC Magnifica was operating under a “Safety Management System” utilizing, integrating and multitasking projected procedures.
The risk assessment policy was thoroughly promulgated through her SMS providing procedures for conducting risk assessments to key shipboard activities by the Safety Officer and to be recorded in specific checklist and documented.
The risk assessment conducted by the First Officer on the watch was evaluating risks concerned in relation to ships manoeuvre in the port, following the provided procedure for “Preparation for Arrival in port”, that is for the time period having entered the port.
Consequently the risk assessment procedure had not identified any specific risks related to the MSC Magnifica´s maneuvering during entering into Piraeus port in order to implement additional controls, if deemed necessary for a safe into port entry.
In respect to the aforementioned, MSC Magnifica Safety Management System gap to identify entry into port manoeuvring process as a separate procedure and to conduct a risk assessment process thereof, is considered as a contributing factor to the examined case.

4.11.2 Entry into port process

The entry into a port mostly concerns a very short passage from confined waters due to the port entrance width in relation to ship´s breadth and air draft as well as the ship’s windage.
Having regard to the aforementioned as well as to the wind effect, (ref. to paragraph 4.9.5 and its subparagraphs) MSC Magnifica encountered during her entry into Piraeus port, it is

[17] 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)
[18] Reference to (MSC Circ.1023/MEPC Circ.392)

deemed that “entry into a port” should be considered as a separate or additional procedure that implies a dedicated risk assessment process, in particular when weather conditions and especially prevailing winds are of concern, aiming to identify any potential hazards in order to minimize or eliminate posing risks to safe navigation related to human life, ship´s safety or to the environment.
On the grounds of the abovementioned and taking under consideration that:

- forecasted weather was issued under “Securite” warning;
- prevailing weather conditions had been worsen at the time MSC Magnifica was approaching Piraeus port;

it is suggested that had a risk assessment been conducted and foreseeable dangers due to the wind effect had been identified to lead to highlighted safeguards in the direction of preventing the loss of her navigating control and manoeuvring operability, such as the use of a second tug or entering the port with tugs fastened and in any case with the pilot timely boarded, the impact on the head of the breakwater could have been avoided.
On the grounds of the above it is considered that the Master´s and Safety Officer´s undervalue to identify entry into port passage as a separate procedure that required the conduct of a risk assessment have been a contributing factor to the marine accident.

4.12 Pilotage at Piraeus Port[19]

As already stated, pilotage is compulsory for entering Piraeus Port or Stenon Navstathmou for vessels under foreign flag or vessels greater than 1500 g.t. Vessels are required to comply with the requirements of the Pilotage Regulations there under.
Piraeus pilot boarding ground, as referred in nautical publications and charts, lies approximately 1.5 nm SSW off the port entrance in position Lat:37º 56´N, Long:023º 36´.5 E.
Communication is established on VHF channel 16 and working channel 12 during the arriving process and is frequent, especially following vessels´ exit from Piraeus Traffic Separation Scheme.
The pilots are deployed to vessels intended to enter the port of Piraeus or Stenon Navstathmou for entering Elephsis Gulf by pilot launches.
Pilot boarding is available on a 24 hours basis.

4.12.1 Pilot operational procedures

The pilotage operational framework at national level is regulated by a cluster of rules and regulations stipulating the functions and competencies of Piraeus Pilotage Authority.
The nature of pilotage services is specifically defined in art. 182 of the “Code of Public Maritime Law” (Legislative Decree 187/1973) stating that:
“The suggestions and directions provided by the Pilot to the Master are of advisory nature”.
In pursuance of IMO Assembly resolution A.960(23), amongst other issues *“Recommendation on Operational Procedures for Maritime Pilots other than Deep sea Pilots”,* have been adopted. More specifically Annex 2 par.2.1 states that:
“Despite the duties and obligations of a pilot, the pilot’s presence on board does not relieve the master or officer in charge of the navigational watch from their duties and obligations for the safety of the ship. It is important that, upon the pilot boarding the ship and before the pilotage commences, the pilot, the master and the bridge personnel are aware of their respective roles in the safe passage of the ship.”

[19] Source of information: Admiralty Sailing Directions NP48 Mediterranean Pilot Vol. IV edition 2012

4.12.2 Pilot boarding in bad weather conditions

One of the problems encountered by pilots, in general, is that of getting on board the ships, particularly under bad weather conditions.

Piraeus port approaches is a sea area that could be affected by strong winds while tide is negligible. Nevertheless, as Saronic Gulf and Piraeus port entrance are facing to south, South and Southeast directed winds are predominantly affecting the pilot boat proceeding to the fixed pilot embarkation position (yellow buoy).

In cases with prevailing south directed winds and when heavy swell[20] is encountered, that is mostly over 5 bfrs of wind force and moderate sea state, the pilot launch may not be able to embark or disembark a pilot at the pilot boarding position that is 1.5 nm off the port entrance.

On the day of the marine accident, due to the prevailing Southeast winds and the moderate swelling sea, that was reported to be close to 1.5 wave height, the pilot that was to be boarded on MSC Magnifica requested from the Master to proceed closer to port entrance as the pilot launch was withstanding difficulties in approaching her due to the encountering swell.

Nonetheless, pilot´s embarkation position was not consulted between the Master and the Pilot under the experienced weather conditions and MSC Magnifica´s manoeuvring operability in order for a practical and efficient pilot embarkation point to be arranged.

The inability of the pilot launch to approach MSC Magnifica at the Pilot boarding position, is suggested to have been a contributing factor to the examined case.

4.12.3 Actual wind parameters monitoring at Piraeus Port

During the investigation process it was emerged that the actual wind parameters are being monitored by a fixed wind indicator located at Piraeus Pilot Station premises.

It was nevertheless highlighted, following discussions with Piraeus pilots that actual wind indications inside the port could vary from those prevailing at Piraeus port entrance depending mostly on the encountered weather conditions, such as unstable weather with squalls and gusts.

Based on the above as well as on the wide operating sea area of Piraeus Port Authority it was furthermore noted that wind indicators fitted at certain locations of the commercial and passenger port could be advantageous, assisting pilots and Masters during the arrival and berthing manoeuvring procedures.

4.13 Master´s decision

The ISM Code in Chapter **5. "**Master´s responsibility and Authority" states that:

"5.1 The Company should clearly define and document the master's responsibility with regard to:

- *implementing the safety and environmental protection policy of the Company;*
- *motivating the crew in the observation of that policy;*
- *issuing appropriate orders and instructions in a clear and simple manner;*
- *verifying that specified requirements are observed; and*
- *reviewing the SMS and reporting its deficiencies to the shore based management.*

5.2 The Company should ensure that the SMS operating on board the ship contains a clear statement emphasizing the Master's authority. The Company should establish in the SMS that the master has the overriding authority and the responsibility to make decisions with respect to safety and pollution prevention and to request the Company's assistance as may be necessary".

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[20] Swell is a series of wind-generated waves by distant weather systems where wind blows for a duration of time, that are not or are hardly affected by the local wind at that time. Swell waves often have a long wavelength that varies due to the size, strength and duration of the weather system responsible. Swell can seriously affects the rolling and pitching of a vessel.

In respect to the above the Master of MSC Magnifica was delegated with all the duties and authorities empowered by Company´s Safety Management System.

Apart from the above provisions, Master´s decision making falls under the following regulated principals:

SOLAS 2004 Chapter V / Reg. 34.2	SOLAS 2004 Chapter V /Reg. 34
"Safe navigation and avoidance of dangerous situations" states that: "*The voyage plan shall identify a route which:* *.1 takes into account any relevant ships' routeing systems;* *.2 ensures sufficient sea room for the safe passage of the ship throughout the voyage;* *.3 anticipates all known navigational hazards and adverse weather conditions; and* *.4 takes into account the marine environmental protection measures that apply, and avoids as far as possible actions and activities which could cause damage to the environment."*	"Safe navigation and avoidance of dangerous situations" as amended by MSC 153(78). *Regulation 34-1/ "Master's discretion"* states that: *"The owner, the charterer, the company operating the ship as defined in regulation IX/1, or any other person shall not prevent or restrict the master of the ship from taking or executing any decision which, in the master's professional judgement, is necessary for safety of life at sea and protection of the marine environment."*

Based on the above provisions, it is inferred that the Master is vested with the authority to take actions deemed necessary to preserve the safety and integrity of the vessel under his command and the persons boarded. Furthermore the Master has the authority and duty to judge on the spot the situation of the ship in relation to weather conditions and to decide the proper safety measures need to be taken during the voyage and the operation of his commanding ship.

The Master may give priority to proactive actions, measures or safeguards intended to maintain the safety of the vessel if any issue arises between safety and ships commercial operation.

In the examined case and taking under consideration the evolution of the events that led to the marine accident, the following indicative actions, measures or safeguards, without being exhaustive could have been taken:

- steering and course keeping for pilot embarkation by ensuring sufficient sea room for the safe entry into port is available, contemplating actual weather conditions, remaining distance to port entry and sufficient level of ship´s maneuvering operability and control;
- reevaluation of MSC Magnifica position, following pilot´s boarding and if deemed necessary, maneuvering replanning for the port entry passage by exploiting ship´s manoeuvrability based on MSC Magnifica "Maneuvering Booklet"[21].
- Standing-by at the outer section of Piraeus port until gusty winds improve.

On the grounds of the above it is suggested that the Master´s decision to proceed close to Piraeus Port entrance without the prompt boarding of the pilot in relation to the ship´s safe position and sufficient sea room for entering the port as well as under the actual weather conditions have been a contributing factor in the marine accident.

Furthermore, based on the foregoing decision making as well as MSC Magnifica proceeding close to port entrance; the time needed for the pilot to enter the bridge;
the time needed for the Master/Pilot exchange of information and Pilot card completion, it could be concluded that the Master could had felt overconfident and was reassured that he could enter the port even without the Pilot´s actual advice.

[21] Ref. to Resolution A.601 (15) Appendix 3, par.5 "Manoeuvring characteristics in wind" & par. 6 "Manoeuvring characteristics at low speed" and so forth.

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

5. Conclusions

5.1 Conclusions and safety issues leading to safety recommendations

5.1.1 The Master and Bridge Team of MSC Magnifica had disregarded existing weather conditions as a factor for a safe into port passage (par. 4.5.2 & 4.9.4).

5.1.2 The Master did not give dully concern to the wind force effect on MSC Magnifica windage area under the existing weather conditions prior to the commencement of the arrival procedures and entry into port passage (par. 4.9.5.3).

5.1.3 MSC Magnifica´s Safety Management System did not include explicit instructions for obtaining weather bulletins and shore up to date wind data for evaluation prior to arrival procedures (4.10.1).

5.1.4 The procedure followed by MSC Magnifica Bridge Team for obtaining and elaborating the weather bulletin was identified as a misguidance for the Risk Assessment process (par. 4.10.2).

5.1.5 MSC Magnifica´s Safety Management System did not incorporate instructions for obtaining weather bulletins from National Meteorological Services (4.10.2).

5.1.6 MSC Magnifica´s Safety Management System did not incorporate instructions for elaborating actual weather conditions data for arrival in port. (4.10.2).

5.1.7 The risk assessment procedure had not identified any specific risks related to MSC Magnifica´s manoeuvring during entering into Piraeus port (par. 4.11.1).

5.1.8 MSC Magnifica Safety Management System did not incorporate entry into port manoeuvring procedure necessitating the conduct of a risk assessment thereof. (par. 4.11.1).

5.1.9 The Master and Safety Officer had not identified the entry into port passage as a separate procedure that required a risk assessment (par. 4.11.2).

5.1.10 The Master decided to proceed close to Piraeus Port entrance without the prompt boarding of the pilot in relation to the ships safe position and sufficient sea room for entering the port. (par. 4.13).

5.2 Conclusions and safety issues that did not lead to safety recommendations

5.2.1 Master and bridge team performance in relation to ship´s manoeuvring during the entry into Piraeus port passage was not effective (par. 4.5.4).

5.2.2 The prevailing weather conditions during MSC Magnifica approach at Piraeus port was unstable with gusts, squalls and rain showers (par. 4.9.3).

5.2.3 The pilot launch did not approach MSC Magnifica at the Pilot boarding position (par. 4.12.2).

5.2.4 The pilot embarkation position was not consulted and prearranged (par. 4.12.2).

5.2.5 The pilot embarkation position was not prompt in relation to MSC Magnifica´s remaining distance and time to enter the port (4.13).

5.2.6 The Master could had felt overconfident for entering the port in any event even without the Pilot´s advice and assistance (4.13).

6. Actions taken

During the consultation period of the draft safety investigation report involved parties, although invited to express their comments did not responded. Additionally no remedial actions taken by the Owners/Managers of MSC Magnifica following the examined marine casualty were notified to HBMCI.

7. Safety recommendations

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

7.1 The Managers of MSC Magnifica are recommended to:

56/2013 Supplement fleet´s Safety Management System accordingly, highlighting the importance of weather conditions and wind effect during the entry into port procedures.

57/2013 Review fleet´s Safety Management System by incorporating the entry into port passages as a separate process to be controlled and executed through appropriate instructions, documentation and risk analysis.

58/2013 Take effective actions to stress to your fleet´s Masters that pilot embarkation should be practiced at defined pilot embarkation positions or, if deemed necessary, at positions with sufficient sea room for ship´s safe operation and pilot prompt exchange information procedure.

59/2013 Review your Company´s Safety Management System by supplementing procedures for acquiring and elaborating shore up to date wind data as well as weather bulletins for shipborne operations related to navigation, primarily issued by National Meteorological Services.

7.2 Piraeus Pilot Authority is recommended to:

60/2013 Consider of requesting the expanding of the existing wind monitoring system with an advanced automated weather monitoring, recording and processing system interfacing fixed wind indicators installed at appropriate locations of the respective operational pilotage sea areas of interest, in order to identify and record actual weather conditions with alarming configurations where appropriate.

61/2013 Supplement existing procedures for pilotage by incorporating mandatory wind data information exchange with Masters of vessels calling at Piraeus port and within pilotage operation sea areas.

62/2013 Supplement existing procedures for pilot embarkation cases when pilot launches encounter difficulties for proceeding to the fixed pilot embarkation position.

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