Marine Safety Investigation Unit

Transport Malta

MARINE SAFETY INVESTIGATION REPORT

Safety investigation into the failure of a lifeboat wire rope fall resulting in five fatalities and three injuries on board the Maltese registered passenger ship

THOMSON MAJESTY

while alongside in Santa Cruz de La Palma on 10 February 2013

201302/008

MARINE SAFETY INVESTIGATION REPORT NO. 05/2014

FINAL

The MSIU gratefully acknowledges the assistance and cooperation of the Spanish Comisión Permanente de Investigación de Accidentes e Incidentes Marítimos (CIAIM), during the safety investigation of this accident.

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

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

The objective of this safety investigation report is precautionary and seeks to avoid a repeat occurrence through an understanding of the events of 10 February 2013. Its sole purpose is confined to the promulgation of safety lessons and therefore may be misleading if used for other purposes.

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

MARINE SAFETY INVESTIGATION UNIT
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CONTENTS

LIST OF REFERENCES AND SOURCES OF INFORMATION

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GLOSSARY OF TERMS AND ABBREVIATIONS

A	Amperes
AB	Able Bodied Seaman
AMOS	Asset Management Operating System, a commercially available planned maintenance system
CCTV	Closed Circuit Television
CIAIM	Comisión Permanente de Investigación de Accidentes e Incidentes Marítimos
DNV	Det Norske Veritas
FPDs	Fall Prevention Devices
GMDSS	Global Marine Distress Safety System
GT	Gross Tonnage
IEC	International Electrotechnical Commission
IMCA	International Marine Contractors Association
IMO	International Maritime Organization
ISM Code	The International Management Code for the Safe Operation of Ships and for Pollution Prevention
ISO	International Organization for Standardization
ISPS Code	International Ship and Port Facility Security Code
Kg	Kilogrammes
$Kmhr^{-1}$	Kilometre per hour
kN	KiloNewtons
kW	KiloWatts
m	metre(s)
MSC	Maritime Safety Committee
MSIU	Marine Safety Investigation Unit
mm	millimetres
nm	Nautical mile
Nmm^{-2}	Newton per square millimetre
Observation	A statement of fact made during a safety management audit and substantiated by objective evidence
PSSC	Passenger Ship Safety Certificate
RPM	Revolutions per minute
SOLAS	The International Convention for the Safety of Life at Sea, 1974, as amended
SMS	Safety Management System
STCW	The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended

SWL	Safe working load
UTC	Coordinated Universal Time
VHF	Very high frequency

SUMMARY

At about 0830, on 10 February 2013, *Thomson Majesty* arrived in Santa Cruz de La Palma from Las Palmas as part of a seven-day cruise commencing in Tenerife. On board were 1498 passengers and a crew of 594, giving a total number of persons on board of 2092.

At around 1030, the ship commenced a general emergency and lifeboat drill for all officers, staff and crew. On completion of the General Emergency Drill, three lifeboats on the outboard (starboard) side were to be lowered to the water and sent away for training purposes. At approximately 1154, during hoisting of lifeboat no. 9 with eight crew members on board, the forward wire rope fall parted, causing the lifeboat to swivel on the aft hook. When the lifeboat reached an angle of approximately 45° to the horizontal, the aft end of the lifeboat and the hook failed and the lifeboat dropped approximately 20 m to the sea, turning upside down, either just before or as it entered the water.

One crew member was thrown out from the lifeboat as it entered the water, and two crew members managed to escape from the upturned lifeboat by their own efforts. The remaining five crew members were subsequently removed by local divers and were declared deceased at the scene.

The safety investigation found that:

- the wire rope fall had parted near or around the forward davit's upper sheave;
- the laboratory analysis revealed that the wire rope had parted at a site of pre-existing corrosion wastage and that it appeared dry and void of lubricant;
- the cause of the corrosion was due to the wire rope strands opening up under tension, allowing seawater and other contaminants to penetrate the inner core and corrode the strands;
- the wire rope fitted was not in accordance with the manufacturer's recommended specifications; and
- the grease with the incorrect specifications had been used to lubricate the wire rope during periodic maintenance.

Core Marine Ltd. has conducted an internal investigation that has resulted in changes in its safety management system procedures, intended to enhance lifeboat safety.

Additionally, the Marine Safety Investigation Unit has made one recommendation to the managers of the vessel and two recommendations to the flag State Administration in order to raise awareness and address the management of wire rope integrity.

1 FACTUAL INFORMATION

1.1 Vessel, Voyage and Marine Casualty Particulars

Name	*Thomson Majesty*
Flag	Malta
Classification Society	Det Norske Veritas
IMO Number	8814744
Type	Passenger
Registered Owner	Majesty Trading Opco LLC
Managers	Core Marine Ltd.
Construction	Steel (Double bottom)
Length overall	207.1 m
Registered Length	191.4 m
Gross Tonnage	40876
Minimum Safe Manning	21
Authorised Cargo	Not Applicable
Port of Departure	Las Palmas
Port of Arrival	Santa Cruz de La Palma
Type of Voyage	Coastal
Cargo Information	Not Applicable
Manning	594
Date and Time	10 February 2013 at 1154 (UTC)
Type of Marine Casualty	Very Serious Marine Casualty
Place on Board	Ship – Boat Deck
Injuries/Fatalities	Five fatalities and three injuries
Damage/Environmental Impact	None
Ship Operation	Normal Service – Alongside/Moored
Voyage Segment	Arrival
External & Internal Environment	Daylight, light winds and calm sea and clear skies.
Persons on Board	2092

1.2 Description of Vessel

1.2.1 Vessel overview

Thomson Majesty was built by Kvaerner Masa Yards Inc., Turku, Finland in 1992. As a passenger cruise liner, she was certified to carry a total of 1,256 passengers and 490 crew. She was originally known as *Royal Majesty* but later changed her name to *Norwegian Majesty* and *Louis Majesty* before being named *Thomson Majesty*.

In 1999, the ship was lengthened by inserting a new 33.7 m mid-section at the Lloyd Werft shipyard in Bremerhaven and re-certified to carry 1,850 passengers and a crew of 660. This lengthening included the fitting of two new sets of lifeboat tenders along with two new sets of semi-enclosed lifeboats, all with associated davits. The lifeboat tenders subsequently became nos. 9 and 10 lifeboats. *Thomson Majesty* is registered in Malta and is classed by Det Norske Veritas (DNV). The vessel was managed and operated by Core Marine Ltd., the ship management subsidiary of Louis Cruise Lines. At the time of the accident, the vessel was on time charter to Thomson Cruises[1].

Propulsive power is provided by four 6R46 Wärtsilä single acting, four-stroke, medium speed diesel engines. Each engine develops 5277 kW at 500 rpm. The engines drive two controllable pitch propellers at 145 rpm through flexile couplings and two single reduction gearboxes. The ship has a service speed of about 19.0 knots[2].

1.2.2 Lifeboats and davits

Thomson Majesty was fitted with 14 lifeboats. The inclusion of the liferaft stations in the sequential numbering process of the life safe saving appliances meant that the lifeboats on the starboard side were numbered 1-5-9-11-13-15-17. The lifeboats were constructed by Fassmer GmbH & Co. KG. Lifeboat davits nos. 9 and 10 were made by Umoe Schat Harding GmbH and fitted in 1999 when the ship was lengthened along with lifeboat davits nos. 11 and 12.

None of the lifeboats were self-righting, nor was there any requirement for them to be.

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1 Thomson Cruises has a fleet of five vessels trading under the Thomson Cruises and Island Cruises brands. Three of these vessels are operated by ship managers directly employed by Thomson Cruises. *Thomson Majesty* was hired on a time charter from Louis Cruise Lines; day-to-day management and operations were conducted by Core Marine Ltd.

2 One knot or one nautical mile per hour equals 1.852 $kmhr^{-1}$.

1.2.3 Lifeboat davits nos. 9 and 10

Lifeboat davits nos. 9 and 10 (Figure 1) are described as "Multiple Pivot Gravity Davits Type "MP 246", similar to those originally installed, but modified by the manufacturers to suit the type of the lifeboat to be installed. They were originally fitted with 24 mm wire rope falls of Python 505 construction, having a tensile strength of 1770 Nmm^{-2} and a minimum breaking load of 474 kN.

The winch motors were electric, type IEC 7 BA L04, with an output of 12.3 kW, 25 A.

The maximum lifeboat weight varied as indicated below:

- Turning out with four persons: 12300 kg
- Lowering with 150 persons: 23250 kg
- Hoisting with four persons: 12300 kg
- Pulling in with four persons: 12300 kg

The davits were fitted with a combined bowsing/tricing system that would be considered as standard equipment on a lifeboat davits system of this age.

1.2.4 Operation of the davits

To lower the lifeboat, the gripes are released and the winch brake handle lifted. A hydraulic speed control is activated by lifting the brake handle to control the speed of descent. The lifeboat is brought in level with the embarkation deck by the combined bowsing / tricing system, ready to commence embarkation.

Once embarkation is completed, the bowsing / tricing lines are slackened off until the falls are hanging vertically. The lifeboat is then lowered to the water and the falls released (the hooks are of the 'on-load' release type). To recover the lifeboat, the above sequence is reversed.

The lifeboat is secured on the davits with weight on the wire ropes. Gripes are then used to secure the lifeboat against movement.

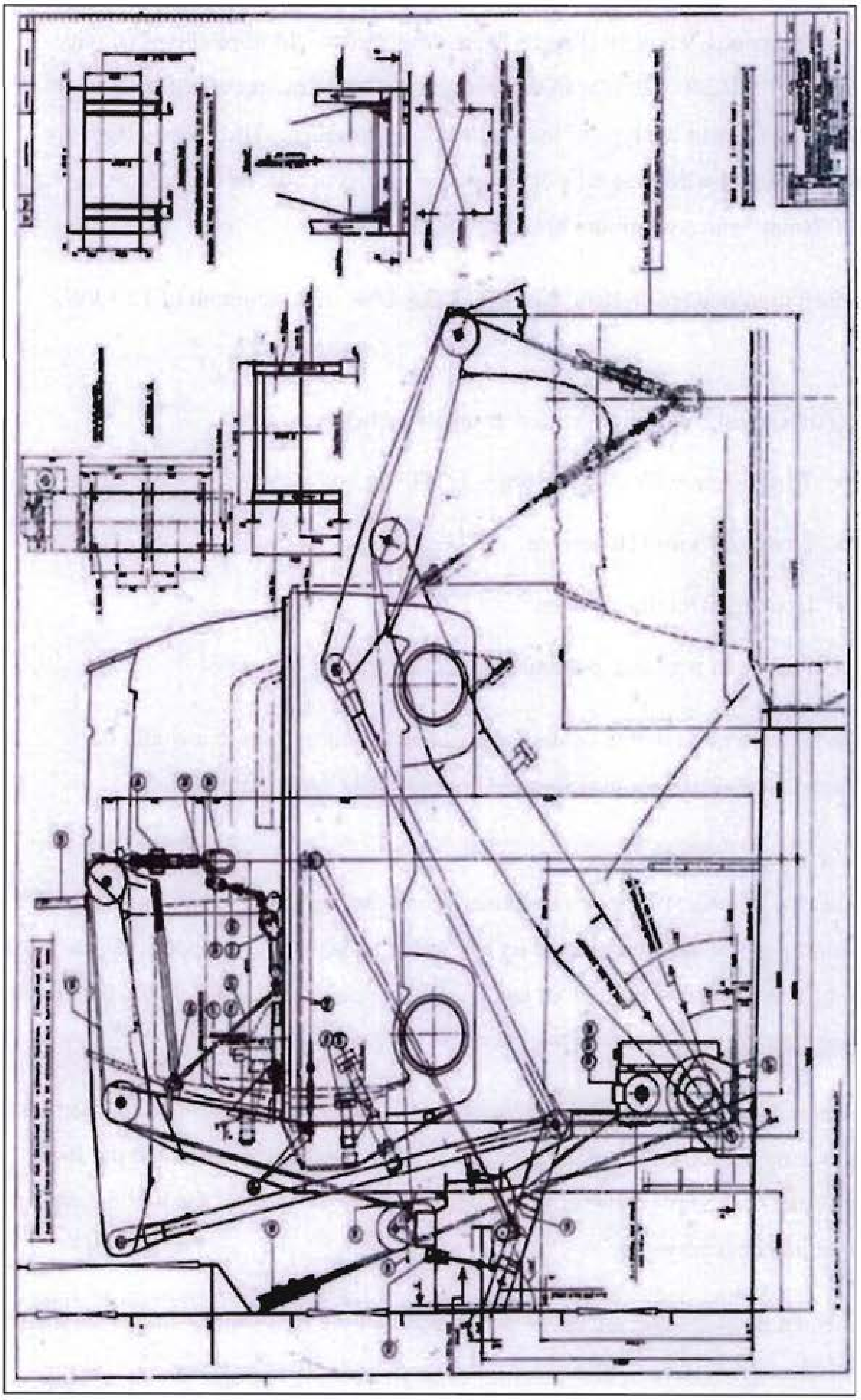

Figure 1: Davits Arrangement Plan

1.2.5 Details of the parted wire rope

The wire rope that parted had been manufactured by the Jiangsu Changjiang Steel Wire Rope Co., Ltd, Zhuhang, Peoples Republic of China. It was sold to Cargo Gear S.R.T. Ltd of Piraeus, Greece. The wire rope was part of 11 sets of galvanised steel wire ropes ordered by Cargo Gear S.R.T. in January 2008. All the wire ropes were of 36 x 7 construction, but of varying diameters ranging from 12 mm to 28 mm.

In July 2010, Cargo Gear S.R.T supplied *Louis Majesty (Thomson Majesty)* two lengths of 95 m of 24 mm galvanized steel wire rope, taken from a coil of 1000 m. The same wire rope was used by the crew to renew the falls fitted to davits no. 9 on 22 August 2010. The certificates of quality provided by the manufacturer and supplier of this wire rope, which can be found at **Annex A**, stated that it had a tensile strength of 1670 Nmm^{-2} and an actual breaking strength of 306.3 kN.

A chronology of the wire rope can be found at **Annex B**.

1.2.6 Changes to the davits and wire rope

In February 2010, the Merchant Shipping Directorate of Transport Malta waived the requirement for davits to be fitted with "Davits Span Wires" and "Lifelines". This was a requirement when the vessel had been fitted with open lifeboats. The requirement is now considered redundant as the davits were fitted with semi-enclosed lifeboats.

Following the publication of the International Maritime Organization (IMO)'s MSC.1/Circ.1392, all lifeboats on board the then *Louis Majesty* were fitted with Fall Prevention Devices (FPDs)[3]. These were fitted and approved by Fassmer GmbH & Co. KG (the original manufacturer) to comply with the requirements of MSC.1/Circ.1392. This resulted in introducing a locking pin to the lifeboats' hooks to prevent the inadvertent release of the lifting hooks during operations (Figure 2).

[3] FPDs are either pins or strops fitted to lifeboats' on-load release hooks, to prevent the lifeboat from falling to the water in the event of equipment failure. The scope is to reduce the risk of injury and death.

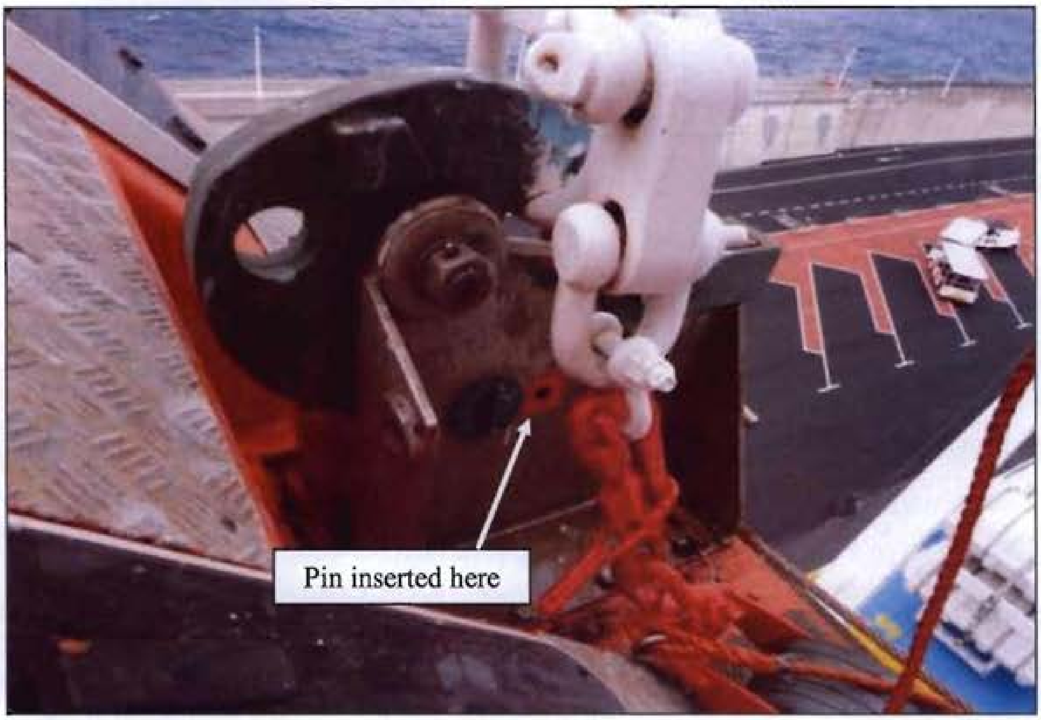

Figure 2: Locking pin arrangement as an FPD

1.3 Planned Maintenance

The Company's procedures in its safety management system (SMS) provided guidance to the safety officer who was responsible for the maintenance of all safety and safety-related equipment on board. He was responsible for all weekly and monthly inspections, and routine three monthly maintenance of the lifeboats and their launching appliances.

The Company operated a planned maintenance system using an Asset Management Operating System (AMOS). This system provided the user with information on the required upcoming maintenance, recorded all the undertaken planned maintenance, and had a searchable historical maintenance log. The inspection of the wire rope falls for condition and lubrication was undertaken on a monthly basis. The last inspection of the wire rope was carried out in January 2013. Last greasing of the wire ropes took place between 20 and 21 November 2012.

In accordance with IMO's MSC.1/Circ.1206/Rev.1, all other inspections, servicing and repairs were conducted by the manufacturer's representative or other persons appropriately trained and certified.

1.4 Last thorough Examination

In April 2012, all the lifeboats and their launching gear were due for their five yearly thorough examination and overload testing of appliances / winches brakes and on load release gear of lifeboats as required by the International Convention for the Safety of Life at Sea, 1974, as amended (SOLAS).

MSC.1/Circ.1206/Rev.1 requires that:

> [t]he following items should be examined for satisfactory condition and operation:
>
> .1 davits structure, in particular with regards to corrosion, misalignments, deformation and excessive free play;
>
> .2 wires and sheaves, possible damages such as kinks and corrosion:
>
> .3 lubrication of wire, sheaves and moving parts.

The davits arms and falls were examined and tested by Norsafe Watercraft Hellas SA and a load test of 1.1 times the safe working load (SWL) was carried out on the davits in the presence of the surveyor of the Recognised Organisation issuing the vessel's Passenger Ship Safety Certificate (PSSC). The load test consisted of releasing the brake fully and allowing the falls to pay out. The brake was then suddenly applied and the results noted. This procedure was repeated three times. A full report on this test can be found at **Annex C**.

The lifeboats and release gear were examined by Fassmer Service GmbH & Co. KG, who were the servicing arm of Fassmer GmbH & Co. KG, the original manufacturers of the lifeboats. The report of this inspection can be found at **Annex D**.

All lifeboats and launching appliances passed the examination and load test, and based on these two inspections, DNV issued the vessel a clean survey report on 30 April 2012 (**Annex E**).

1.5 Relevant SOLAS Requirements

The requirements for lowering and operating lifeboats as required by SOLAS are contained in SOLAS Chapter III Part B: Life-Saving Appliances and Arrangements:

- each lifeboat shall be launched, and manoeuvred in the water by its assigned operating crew, at least once every three months during an abandon ship drill. (regulation 19.3.3.3);
- falls used in launching shall be inspected periodically[4] with special regard for areas passing through sheaves, and renewed when necessary due to deterioration of the falls or at intervals of not more than 5 years, whichever is the earlier. (regulation 20.4);
- all lifeboats, except free-fall lifeboats, shall be turned out from their stowed position every month, without any persons on board if weather and sea conditions so allow. (regulation 20.7.1);
- monthly inspection of the life-saving appliances, including lifeboat equipment, shall be carried out. (regulation 20.7.2);
- launching appliances shall be:
  - maintained in accordance with instructions for on board maintenance as required in regulation 36;
  - subjected to a thorough examination and operational test during the annual surveys required by regulations I/7 and I/8 by properly trained personnel familiar with the system; and
  - upon completion of the examination referred to in (.2) [above point] subjected to a dynamic test of the winch brake at maximum lowering speed. The load to be applied shall be the mass of the survival craft or rescue boat without persons on board, except that, at intervals not exceeding five years, the test shall be carried out with a proof load equal to 1.1 times the weight of the survival craft or rescue boat and its full complement of persons and equipment (regulation 20.11.1).

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[4] Refer to the Measures to Prevent Accidents with Lifeboats (MSC.1/Circ.1206/Rev.1).

1.6 Lifeboat Manning

Lifeboat no. 9 was assigned an operating crew of six:

- one lifeboat commander;
- one assistant lifeboat commander (engine operator);
- two deck crew (attend the forward and aft pendant and tackle); and
- two entertainment staff (passenger guides).

At the time of the accident, the lifeboat was being lowered for training and familiarisation purposes and the following personnel were in the lifeboat (Table 1).

Table 1: Crew members inside the lifeboat

Position	Nationality
Chief mate	Greek
Chief mate	Greek
Second engineer	Ghanaian
Able Bodied Seaman (AB)	Indonesian
AB	Indonesia
AB	Indonesia
First Upholsterer	Filipino
Oiler	Filipino

All personnel were found to be properly trained and qualified in accordance with the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended (STCW) regulations.

1.7 Safety Management System

Thomson Majesty complied with the International Management Code for the Safe Operation of Ships and Pollution Prevention (ISM Code) and held a valid Safety Management Certificate that expired on 21 March 2015. Core Marine Ltd. also held a valid Document of Compliance.

The last external audit was carried out on 21 March 2010. The last annual internal audit, which was held on 24 January 2013, was conducted by a Core Marine Ltd internal auditor. The scope of the audit covered the ISM Code and the International Ship and Port Facility Security Code (ISPS Code). The audit resulted in one observation relating to refresher training for deck officers in the operation of the Global Marine Distress Safety System (GMDSS) equipment.

1.8 Narrative

1.8.1 Events leading up to the accident

At 0752 on 10 February 2013, *Thomson Majesty* arrived off the port of Santa Cruz de La Palma in the Canary Islands and by 0830 was berthed port side alongside. She had on board 1498 passengers and a crew of 594, giving a total number of persons on board of 2092. The vessel was on a seven day cruise which had started in Tenerife on 8 February and was scheduled to end on 15 February after calling at Funchal, Agadir and Arrecife.

Figure 3: Lifeboat no. 9 awaiting lowering

At 1030, the ship's crew conducted a general emergency and lifeboat drill that included all officers, staff and crew. Following the drill, lifeboat nos. 9, 13 and 17 were to be lowered and cast off for training. Extra crew was assigned to lifeboat no. 9 for familiarisation training, such that the lifeboat contained eight seafarers. The safety officer was in charge of the operations that were being conducted from the embarkation deck.

Shortly after 1100, the nominated crew embarked lifeboat no. 9. The lifeboat was lowered to the water by the bosun, who released the winch brake. However, during the lowering process, he noticed a hydraulic oil leak from a pipe near the brake handle. He stopped lowering and went to inform the chief engineer. The safety officer decided to try and 'drive' the lifeboat to the water using the electric lowering system. However, this system also releases the brake, and had the effect of increasing the hydraulic leak, so he stopped lowering again.

The chief engineer arrived with one of his fitters and disconnected the leaking pipe and took it to the engine-room workshop for repair. The lifeboat remained suspended about 1 m above the water level (Figure 4). The repair took around 40 minutes and when it was replaced, the safety officer decided to abort the training exercise and hoist the lifeboat back up.

Figure 4: Lifeboat no. 9 stopped about one metre above water while the hydraulic leak was being repaired

1.8.2 The accident

The safety officer stood at the hoisting position (Figure 5) and hoisted the lifeboat. The lifeboat was raised to a position where the bowsing tackles could be re-attached. This was successfully done, but when lowering the lifeboat to bring it level to the embarkation deck, he found that the aft tackle was too slack to bring the lifeboat safely alongside. The lifeboat had to be hoisted again to further adjust the aft bowsing tackle.

Figure 5: Hoist position

The safety officer re-hoisted the lifeboat and just as the blocks had engaged with the davit head and the davit arms had started to move upwards (Figure 6), the forward wire rope fall parted (Figure 7). The lifeboat then swung through around 45° and as the weight of the lifeboat was taken by the aft wire rope, the transom of the lifeboat and the aft lifting hook failed. The lifeboat dropped about 20 m, landing upside down in the water. The time of the accident, as recorded by the vessel's Closed Circuit Television (CCTV) footage, was 1154.

Figure 6: Block engaging with davits head (lifeboat no. 10)

Figure 7: Lifeboat no. 9 forward davits arm showing the parted wire rope

1.8.3 Emergency response

The safety officer immediately broadcast "Man Overboard" over the VHF radio and ordered boarding ladder no. 9 to be released and lifebuoys to be thrown over the side. He saw that one of the lifeboat's occupants had been ejected clear of the lifeboat. The bosun went down to deck no. 2 and opened the shell door next to the lifeboat (Figure 8). After about two minutes, the safety officer saw another survivor swim clear of the lifeboat, followed by a third about a minute later. The survivors were rescued from the water and were administered first aid by the vessel's doctor. At least four crew members then entered the water from the side door embarkation ladder in an attempt to rescue their colleagues.

In the meantime, the master had informed the port authorities of the developing situation and by 1210, the first harbour boat arrived on scene with one diver, followed by another boat and a team of paramedics in an ambulance at 1215. At 1225, the three survivors were transferred to the local hospital by the ambulance.

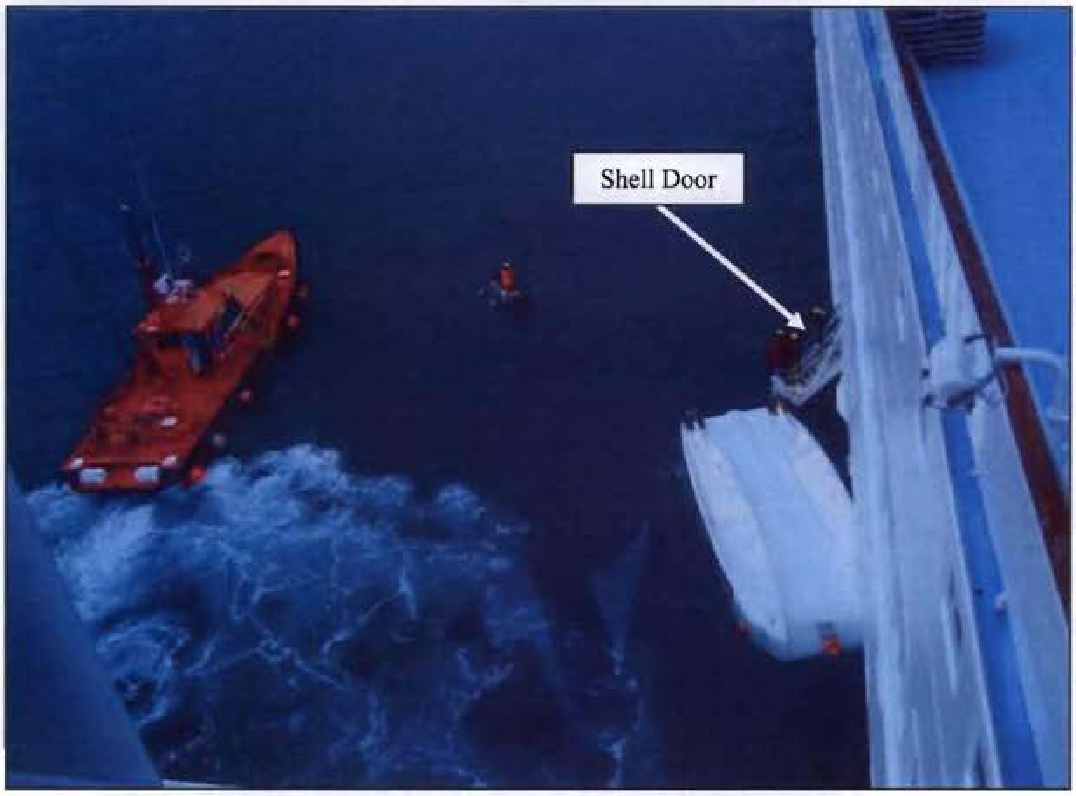

Figure 8: Shore assistance in close proximity of the upturned lifeboat

The safety officer subsequently lowered lifeboat no. 17 to try and assist, but by the time he got to the scene, the shore boats and another diver were already in attendance and he therefore stayed clear of the ongoing operation. By 1234, the first trapped crew member was freed from the capsized lifeboat but was declared deceased. The on-scene rescue team were reinforced by a search and rescue helicopter that arrived at 1239.

Subsequently, a further four bodies were recovered from the capsized lifeboat. In total, there were five fatalities.

1.8.4 Post-accident events

Thomson Majesty remained in port while initial investigations were undertaken by DNV to attempt to identify the cause of the wire rope failure. As no immediate cause was identifiable, it was decided that the ship should remain in port. On 11 February, the Merchant Shipping Directorate of Transport Malta required the vessel to conduct a full dynamic test on all the lifeboat wire rope falls before she would be issued with a Short Term PSSC to sail. The Merchant Shipping Directorate also required the vessel's managers to arrange for the replacement of all lifeboats' wire rope falls within one month, with the exception of boats nos. 10, 11 and 12, which had been changed during the previous 12 months.

Thomson Cruises decided to cancel the cruise and repatriate all the passengers. This would have given the managers the opportunity to undertake the tests required and have the vessel ready for her next cruise on 15 February from Tenerife.

1.9 Safety Investigation

By the time the accident investigation team arrived on site, the davit arms had been raised and secured (Figure 9). The outboard wire rope which had parted, had been removed from the sheaves and the Spanish authorities had cut and removed as evidence one of the parted ends of the broken wire rope.

Figure 9: Davits arm hoisted after the accident

Although, this made it very difficult to ascertain the exact position where the wire rope had parted, the team was able to establish (with the help of witnesses and photographs taken by the crew) that it had parted in the region around or near the fall block and davit's head (Figure 10).

Figure 10: Davits and parted wire

Davits no. 9 appeared to have suffered no visual damage, although the forward block was lost during the accident. Due to the shock loading, the davits would require a detailed inspection and re-approval by the manufacturer before being put back into service.

The lifeboat suffered severe damage (Figures 11 and 12). The initial damage due to the impact with the water was to the lifeboat's canopy, transom and the aft lifting hook. However, it sustained further damaged when it was lifted out of the water and placed ashore.

Figure 11: Extensive damage to the lifeboat tender

Figure 12: Damage to aft end of lifeboat tender no. 9

The safety investigation established that all the sheaves and moving parts were running free except the aft davit's arm base swivel (Figure 13), which was seized and had been modified by welding a large nut to the inboard edge.

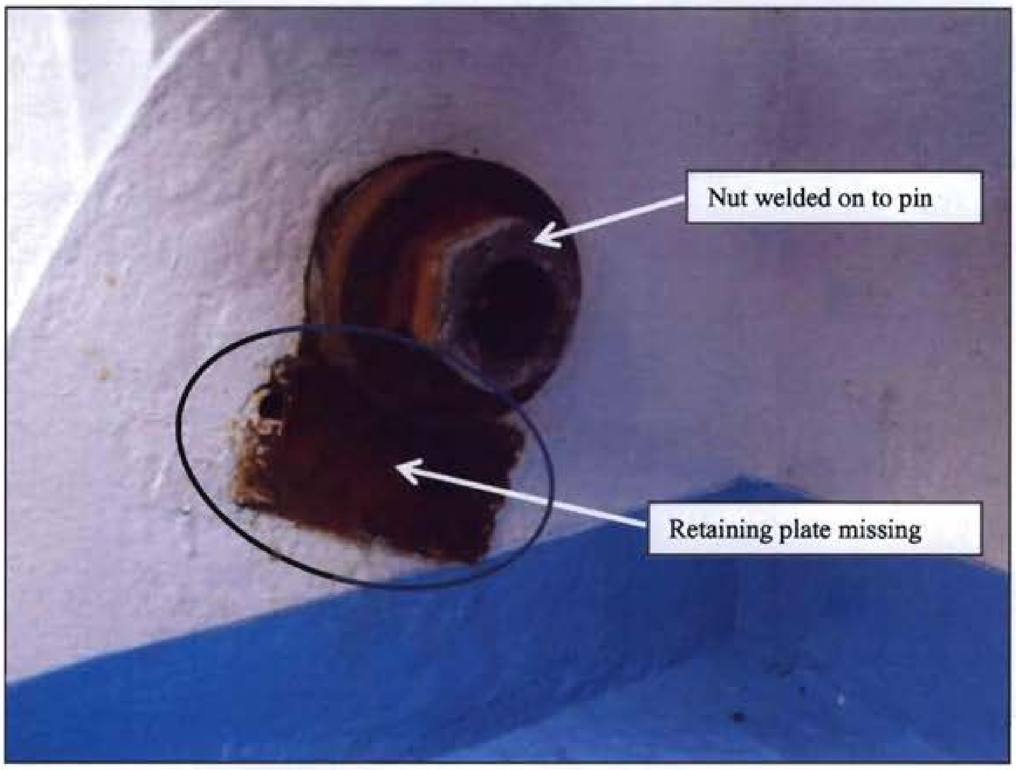

Figure 13: Seized davits arm with modification

The inner (standing) section (approximately 10 m) of the parted wire rope that included a section of good rope was sent to The Test House (Cambridge) Ltd. for destructive and non-destructive testing. A report on the outcome of these tests can be found at **Annex F**.

Similarly, a sample of Mobilarma 798 grease that was used by the vessel, and another sample of the grease found on the parted wire rope was collected and sent to Alcontrol Laboratory to establish whether the two samples were the same grease. The results of this test can be found at **Annex G**.

The davit's manufacturers (Schatt Harding) attended the ship to conduct an investigation and their report is attached at **Annex H**.

1.10 Safety Alert

In February 2013, the Marine Safety Investigation Unit issued a safety alert highlighting the initial finding of the investigation and recommended that all owners and masters should be alert of the potential hazards related to wire rope failure and to:

- ensure that wire rope falls are continuously well lubricated with an approved type of grease, particularly those areas that are difficult to inspect, where the falls pass through and around sheaves;
- regularly, frequently and thoroughly inspect all visible parts of wire ropes in order to detect general deterioration and deformation, including corrosion, abrasion, and mechanical damage; and
- review the contents of MSC.1/Circ.1206/Rev.1 (Measures to Prevent Accidents with Lifeboats) and act accordingly.

The full text of the safety alert can be found at **Annex I**.

2 ANALYSIS

2.1 Purpose

The purpose of a marine safety investigation is to determine the circumstances and safety factors of the accident as a basis for making recommendations, to prevent further marine casualties or incidents from occurring in the future.

2.2 Cause of the Wire Rope Failure

Examination and failure analysis on the section of the parted end of the wire rope was conducted by The Test House (Cambridge) Ltd.

The examination and tests concluded that the wire rope parted at a site of very severe pre-existing corrosion wastage of the wire rope's construction. The corrosion had consumed all the zinc plating and the core of the wire rope appeared dry and totally void of lubricant (Figures 14 to 17).

The laboratory report also identified a number of additional factors that contributed to the parting of the wire rope. These were:

- the wire rope was not of a high strength type and did not meet the minimum break load strength specified by the manufacturer. The presence of clearly resolvable microstructural products would suggest that the wire had only received a limited heat treatment after the cold drawing process;
- the failure to maintain a suitably protective level of lubricant at sheave locations where the wire rope resided under tension when the lifeboat was stowed; and
- the apparent failure to monitor the wire rope's deteriorating condition through regular effective inspections.

Figure 14: Break site

Figure 15: Evidence of residual galvanization

Figure 16: Inner strands of the wire rope

Figure 17: Close up of inner strands showing advanced corrosion

2.3 Cause of Corrosion to the Wire Rope

There are a number of factors that resulted in the corrosion of the wire rope. When the lifeboat was secured in position, the strands in the section of the wire rope resting on the sheave (and under tension) opened slightly (Figures 18 to 20). Unlike other davit designs, these davits did not have the facility (chocks) to relieve the tension of the wire on the sheaves. As such, the wire rope has a relative high load when the lifeboat and davits are in a stowed position. Without relieving the tension, the wire rope would have been exposed to additional dynamic loads over time when the vessel is moving in different sea states.

Figure 18: Davits no. 9 in the hoisted position

This opening up of the tensioned wire rope strands allowed salt water and / or other contaminants to enter the internal part of the wire rope and start the corrosion process.

This is considered to be the most likely cause of the corrosion that caused the wire rope to eventually part.

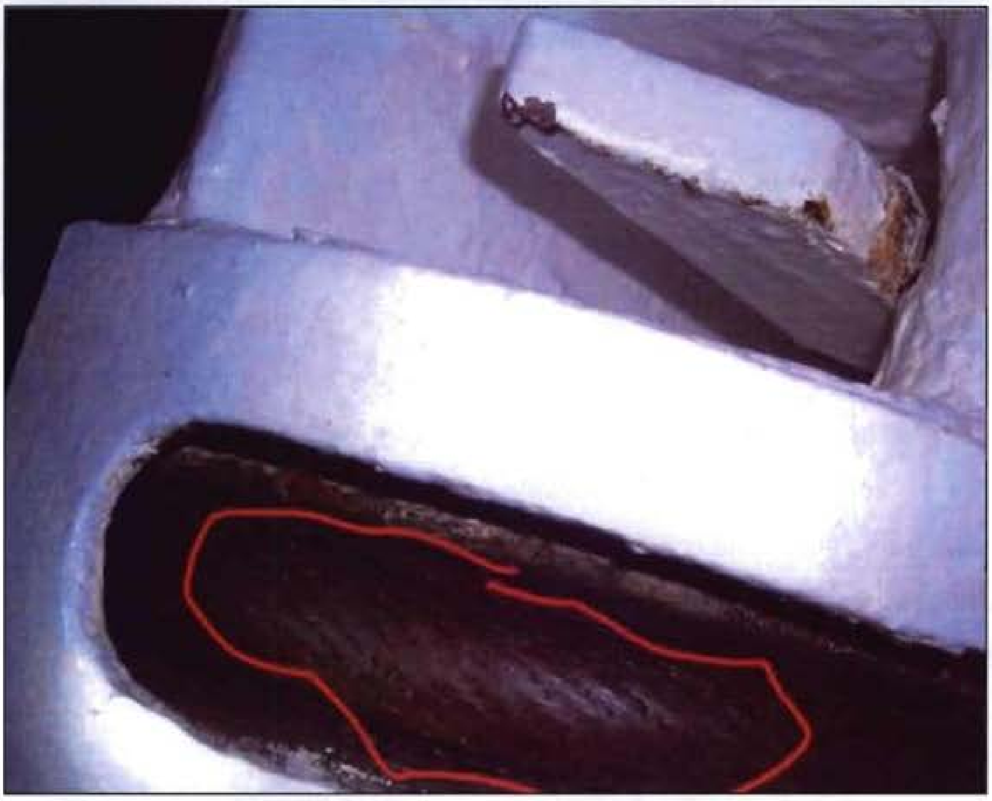

Figure 19: Wire rope strands 'opening up'

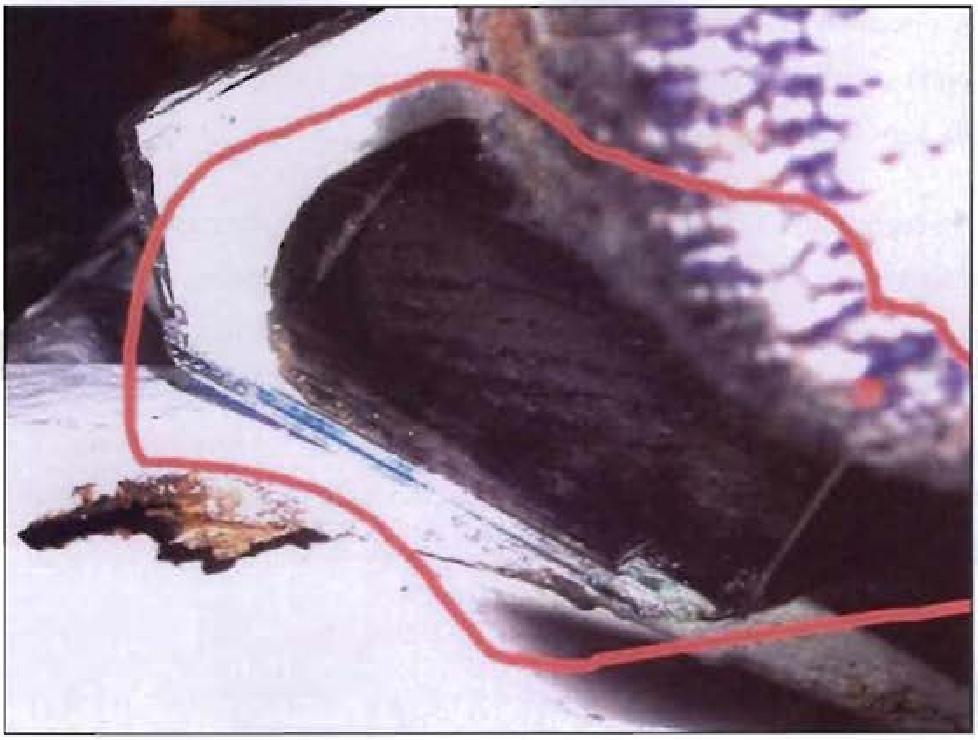

Figure 20: The wire rope open strands seen through a mirror

Rust removers or inhibitors, which are corrosive chemicals, are generally used around a passenger ship, including *Thomson Majesty*. The possibility that they may have contaminated the internal strands of the wire rope and contributed further to the corrosion process was not ruled out.

2.4 Maintenance of the Wire Rope

The wire rope was inspected on a monthly basis by the safety officer, and examined annually by an approved contractor (NorSafe). It was clear that these inspections did not identify the deterioration of the wire rope - neither in the areas from where it parted nor at other locations. As the crew inspections are only limited to the external condition of the wire rope, it is debateable whether they would have detected any internal corrosion without conducting an internal inspection. However, this would have been a very difficult task to conduct and for which, they may not have the necessary experience and training.

Had any corrosion been present at the time of the last thorough examination of the wire rope, the authorised service engineer, who had the necessary training and skill, should have been able to detect any deterioration in the conditions of the wire rope[5]. Detection of deteriorating conditions, however, is not necessarily straight forward and will be discussed in section 2.7. Although the wire rope was subjected to a load test and found satisfactory nine months before the accident (April 2012), the likelihood of internal corrosion being present cannot be ruled out.

SOLAS regulation III/20.4 reiterates the requirement of inspecting wire ropes periodically with special regard for areas passing through sheaves. These requirements are contained both in paragraph 2.8 of the Appendix of Annex 1 to MSC.1/Circ.1206/Rev.1, and the Company's procedures. Inspection of wire ropes that particularly run over sheaves is a difficult task due to the location and construction of the davits. Therefore, these areas would have to be inspected in more detail by a person trained appropriately for the purpose.

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[5] The service engineer was experienced and had been trained in accordance with the specifications of MSC.1/Circ.1277, both at Norsafe and the davits' manufacturers as well.

Records showed that the wire rope falls on all the lifeboats were last greased in November 2012. The crew members responsible for greasing the wire ropes were experienced on how to carry out the greasing. This was normally done either by brushing in the grease or with a rag; both methods, however, just provide a protective outer layer and grease did not penetrate the inner strands of the wire rope. All other wire ropes that were inspected had a good external coating of grease, which was applied over time.

2.4.1 Designated grease for wire ropes

The designated grease for wire ropes was MOBILARMA 798, which is a petroleum-based grease designed for marine use and recommended for use on wire ropes such as the ones on *Thomson Majesty*. However, the testing of the sample of grease taken directly from the wire rope revealed that it was not MOBILARMA 798, but a soap-based grease. The safety investigation was unable to identify the reason for this. However, it may be hypothesised that being a passenger vessel, the crew may have wanted to keep the davits clean by using a soap-based grease and which would wash off easily as opposed to a dark petroleum-based grease.

Nonetheless, the use of the soap-based grease is not believed to be contributory to the accident because unless grease is applied under hydraulic pressure (which was not), neither type of grease would have penetrated the outer strands of the wire rope and reached the inner strands. However, while the petroleum-based grease would have provided a protective layer against the elements, the soap-based grease would have easily washed off by rainfall or sea spray.

2.5 Davit's Maintenance

The pin supporting the aft davit's arm of lifeboat no. 9 around which the base swivelled (Figure 13), had been modified by welding a large bolt to the inboard edge. The retaining plates had also been either removed or had sheared off. It was hypothesised that this would have allowed the shafts to swivel in the frame of the davits rather than rotate around a bush, as designed. Although not directly contributory to this accident, this would have had a long term effect on the wire ropes as increased turning-in force was required when hoisting, putting further strain on the system.

This defect was clearly visible but records indicated that it had not been reported as a defect to the Company. Although it was difficult to say how long this defect had existed, it may well have been in place at the last examination and dynamic test in April 2012. The main purpose of planned maintenance by the ship's staff, and the annual and five-yearly examinations by an approved contractors, is to identify and rectify defects in a timely manner and before they can lead to unacceptable levels of risk.

2.6 Quality of the Wire Rope

It is not known where and in what conditions the wire rope had been stored since its manufacture in 2008. This could have affected the internal lubrication of the wire rope. However, examination of the undamaged end of the wire rope had clear evidence of lubrication penetration, which confirmed that the wire rope had originally been supplied suitably lubricated. The grease lubrication in this area also appeared to be effective.

However, the wire rope fitted to davits no. 9 was neither in accordance to the specifications of the davits' manufacturer, nor to that ordered by the ship. The results of the Vickers hardness test conducted on the wire rope sample were lower than one would expect to find on a high strength patented wire rope. Additionally, a break load test carried out on an undamaged section of the wire rope achieved a breaking load of 263.1 kN, *i.e.* 85.9% of the original certified value of 306.3 kN.

Moreover, this was 167.7 kN below the minimum specified strength by the original davit's manufacturer. Although the vessel had ordered a wire rope with a break load strength of 565 kN (which was in excess of the specified 474 kN that was originally fitted), *Thomson Majesty* had been provided with a wire rope with a break load strength of only 306 kN. This error was neither noticed when the wire ropes were delivered to the ship, nor were the figures cross-checked before the wire ropes were fitted to the falls in August 2010.

"Guidance on Wire Rope Integrity Management for Vessels in the Offshore Industry" produced by the International Marine Contractors Association (IMCA), provides comprehensive guidance on the inspection, maintenance and ordering of wire ropes[6]. A comparison of the wire rope requisition sent by the vessel with what IMCA suggest in Appendix 2 of the Guidelines (Wire Rope Purchase Specification) of this document **(Annex J)**, revealed a stark contrast between the two. A more comprehensive requisition would have possibly ensured that the vessel was supplied by the correct strength and quality of wire rope.

Over the years, the manufacture of wire ropes has vastly improved as a result of advances in technologies. However, this has led to a varying quality of wire ropes available on the market; this makes it extremely important for the relevant crew members and vessel's managers to ensure that the wire rope, which they would have ordered, is fit for purpose and in accordance with the original equipment manufacturer's recommendations.

2.7 Maintenance Decision-making and Non-detection Errors

The fact that corrosion in the wire ropes went undetected played a major role in the way the accident dynamics evolved. It is an established fact, even by the adoption of planned maintenance processes, that in an environment similar to the one on board a ship, continuous monitoring is a necessity. Decision-making on maintenance issues requires at least the following:

1. monitoring of the situation;
2. taking appropriate actions; and
3. re-evaluate the results on the actions taken.

Maintenance decision-making happens in two-stages, *i.e.* the carrying out of a situation assessment and eventually the making of an informed decision. By virtue of the situation awareness process, it would be possible to determine the prevailing condition of the material in question. One process leads to the other.

6 The document specifies that it does not cover all types of wire ropes. In fact, wire ropes for lifeboat falls are not included. However, the document may serve as an excellent framework for the necessary adaptations to compile a specific guidelines for wire ropes used on board.

Situation awareness is crucial for the maintenance decision-making process because it involves and requires a concentrated effort to identify how the condition of the wire rope would have changed over the months. This should then lead to the eventual making of the necessary decision. Situation assessment depends on a number of factors, one of which is the level of expertise of the person carrying out the assessment.

The available evidence and the actual condition of the wire rope did not suggest that the level of expertise amongst the crew members was high enough to develop an informed mental model, which could then be referred to during the monitoring process and focus on the assessment to be made. This would have meant that the level of knowledge and skills, which the crew members had, for instance, to analyse the condition of the wire rope, did not allow them to achieve problem recognition. This may have been also a contributory factor for not detecting the corrosion on the wire rope.

Applying the same school of thought, it may be argued that the service provider may have also missed the corrosion during the last inspection on board. However, as indicated in section 2.4, the likelihood of severe internal corrosion being present nine months before the accident was debatable. Moreover, the service provider explained that the five-yearly inspection of the launching systems includes a visual inspection of the wire rope, as specified in the manufacturers checklists, based on MSC.1/ Circ.1206, as amended. For this particular inspection, the service provider used its checklists, while the Schat-Harding checklist was used as reference for this job (given that the davits and winch were manufactured by Schat Harding.

It was also clarified that whilst on the basis of these checklists, the service engineer did not observe any damages or irregular conditions of the wire rope at the time of the inspection, the wire rope was of a rotation resistant type, and it was not possible to visibly check the inner strands of the wire rope on a davits without having a sample test.

MSC.1/Circ.1277, which was adopted on 23 May 2008, provides interim recommendations on conditions for the authorisation of service providers for lifeboats, launching appliances and on-load release gear[7]. However, the Circular is not specific on the requirement of any skills and knowledge for wire rope familiarisation and inspection; it only refers to launching appliances as a generic term.

The absence of any specific reference to wire rope inspection also means that there is no internationally agreed criteria on, say, the extent of the inspection *vis-à-vis* the actual length of wire rope which is to be inspected and the number of wraps on the winch drum, which need to be paid out and inspected.

Even more, there are no specific requirements for non-destructive testing reports and detailed record keeping of the tests carried out and the testing / inspection methodology used, especially for areas where the wire rope could risk deterioration[8].

Further to the above, irrespective of whether or not the service provider has wire rope inspection skills and knowledge, maintenance is not carried out in vacuum. Without an inspection regime and a *detailed* history of the findings (inspection records), the judgement of a service provider may be subjective. This is so because without the detailed history of periodic inspections (and subject to an adequate inspection procedure), it would be very difficult for any inspector / technician to make an informed decision on whether the wire rope can remain in service, by which latest time it needs to undergo its next periodic inspection, or whether it needs to be immediately withdrawn[9].

Therefore, aside from the skill and expected experience of a service provider, wire rope inspections on board *Thomson Majesty* (and any other SOLAS vessel) were carried out without established international practices on detecting general

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7 MSC.1/Circ.1277 makes reference to MSC.1/Circ.1206, which had been superseded by MSC.1/Circ.1206/Rev. 1 on 11 June 2009.

8 For instance, the general examination of a wire rope would necessitate the application of two clamps with adequately sized jaws and of a material, which do not damage the wire rope. The clamps need to be rotated in opposite directions to the rope lay so that the outer strands separate and move away from the core – thereby opening the rope but not excessively. Debris and grease need to be removed with an adequate tool in order to ensure an accurate analysis of the degree of corrosion and reveal indentations / broken wires and the state of lubrication. Once the procedure is completed, a lubricant has to be applied in the open section before the clamps are rotated again to close the wire rope, which is dressed again with grease on the outside. A similar procedure needs to be applied at the termination of the wire rope. This is not specified in any of the mentioned IMO documents.

9 This matter is further discussed in section 2.8.

deterioration of the wire rope. This could have potentially led to what is termed as *recognition error of the non-detection type*. Thus, it would have been very probable that due to, *inter alia,* the unavailability of specific tools and techniques to inspect the inner strands of the wire rope, corrosion on the inner strands would have been missed even if it was not at a level which could have compromised the wire rope strength in the short term. Non-detection errors could have been influenced by a number of factors, two of which being dirt / grease and unsatisfactory access to the specific areas.

2.8 Conceptualising Wire Rope Integrity Management

Lifeboat release mechanisms, in particular on-load and off-load release gear, have been long debated at international fora. The debate has been mainly instigated by a considerable number of lifeboat accidents as a result of either the inadvertent release, or operation of the hooks' mechanisms during inspections and drills. A significant number of these accidents have led to either crew members' fatalities and / or severe injuries – some of which contributing to permanent disabilities.

On-load mechanisms have been discussed at length at (then) the IMO's Sub-Committee on Ship Design and Equipment, and also at the Maritime Safety Committee. The main objective remained the design and use of safer on-load release hooks. Amendments to chapter III of SOLAS have now entered into force on 01 January 2013 to prevent accidents during launching of lifeboats.

These amendments address on-load release mechanisms and their replacement if they do not comply with new requirements in the Life-Saving Appliances Code. As an interim measure, FPDs and secondary safety devices had been agreed upon for on-load release mechanisms.

The very serious accident on board *Thomson Majesty* brings awareness of a system of which, the hooks are just one component, albeit an important one. However, an equally important component is the wire rope falls. As any wire rope ages and remains regularly exposed to the marine environment, crew members, safety managers and superintendents need to ensure that there remains enough redundancy.

This includes the wire ropes used for lifeboats' launching systems. On this matter, the MSIU believes that the maritime industry needs to go further.

As much as the *Herald of Free Enterprise* accident raised awareness on safety management systems in 1989, the industry needs to adopt (as part of a company's safety management system), a concept of wire rope integrity management, that not only encompasses lifeboat wire rope falls, but all types of wire ropes that are used on board ships. In so doing, the maritime industry needs to study in detail practices already conceptualised in the offshore industry, complimented with the relevant International Organization for Standardization (ISO) Standard.

The ISO Standard (ISO 4309:2010) on Cranes, Wire ropes, Care and maintenance, inspection and discard[10] amongst other things provides standards and guidance on the handling and inspection of wire ropes. These standards can provide the basic framework for formalising wire rope integrity management into the company's SMS. A recent loss prevention briefing entitled "Wire Ropes and Their Uses" produced by The North of England P&I Association (**Annex K**) is an excellent example of the range of wire rope guidance that can be incorporated in a safety management system.

2.9 Rescue Operations

The safety officer and crew members on the embarkation deck appeared to have responded well to the situation. When presented with a situation that they would not have practiced for, they had the presence of mind to call 'man overboard', lower the boarding ladder and throw the lifebuoys over the side before launching another lifeboat.

The bosun realised that there was a shell door opening near where the lifeboat had fallen and immediately went to open the door to allow closer access to the lifeboat. Evidence indicated that four crew members entered the water from the shell door at deck no. 2 to attempt to rescue the lifeboat's occupants; unfortunately these attempts were unsuccessful.

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[10] The ISO Standard is labelled proprietary and therefore is not reproduced in this safety investigation report.

Although it was a laudable and natural reaction for the crew members to attempt to rescue their colleagues in these difficult circumstances, trying to enter an upturned lifeboat without diving equipment could easily have led to further loss of life. The command team should have considered this and urged them not to enter the water. However, in general, there was nothing more that the crew could have done to rescue their colleagues.

The shore authorities were alerted by the ship and responded very quickly. They deployed high speed crafts, qualified divers, paramedics with ambulances, and even scrambled a rescue helicopter. The only reported delay was that the first diver on the scene had to wait until a second diver arrived before they could commence the rescue / recovery mission. This, however, was considered to be the safest approach and a perfectly acceptable procedure.

2.10 Loss of Life

The post mortem examination concluded that four of the men trapped in the lifeboat died from drowning and one died of fatal wounds to vital organs. While the safety investigation could not establish whether or not all those in the lifeboat were wearing buoyancy lifejackets, it is not known if the lifejackets were contributory to the drowning as they became trapped under the lifeboat.

It is recognised that seafarers need to be familiar with the life-saving appliances on board their vessels and should have the confidence to operate such systems. To this effect, they need to regularly exercise in addition to their initial shore based training. However, to do so, drills should be planned, organised and performed in accordance with shipboard occupational health and safety requirements so that recognised risks are minimised.

The vessel had completed an On board Risk Assessment Form (F-SQA-402-02), but this only dealt with the risks of the lifting blocks / hooks during lowering the lifeboat. It would appear that none of the advise or guidance contained in MSC.1 Circ.1206/Rev 1, or the instructions contained in the vessel's SMS were considered.

The vessel's SMS recommended that the lifeboat is first lowered and recovered without persons on board. This would have ascertained whether the system was functioning correctly and would have identified the hydraulic leak that resulted in the lifeboat crew hanging idle for 40 minutes. It is possible that this advice was not heeded because of a false sense of security as the lifeboats were fitted with approved FPDs. However, these devices are meant to stop the accidental release of the hooks, and are ineffective against failure of the wire rope or any other part of the lifeboat launching system.

The lifeboat was assigned an operating crew of six persons but on 10 February, it was launched with eight persons. This increase in the number of persons was to provide newly joined crew members training. The intention is very clear, however, the manufacturer's guidance suggests that the lifeboat should have been hoisted with only four crew members. The additional weight of the extra crew members probably did not directly contribute to the parting of the wire rope, but it did have the effect of unnecessarily placing four crew members at risk of injury.

MSC.1 Circ.1206/ Rev 1 allows lifeboats to be lowered without their operating crews. This was introduced following accidents due to on-load / off-load release gear. It would certainly have reduced the numbers of fatalities had the lifeboat been lowered empty and then the crew boarded, or the lifeboat lowered with the minimum number of crew and then those under training, boarded once the lifeboat was in the water. As already indicated above, the false sense of security as a result of the FPDs could have prevailed and altered the risk perception of the participating crew members to an acceptable one.

THE FOLLOWING CONCLUSIONS, SAFETY ACTIONS AND RECOMMENDATIONS SHALL IN NO CASE CREATE A PRESUMPTION OF BLAME OR LIABILITY. NEITHER ARE THEY BINDING OR LISTED IN ANY ORDER OF PRIORITY.

3 CONCLUSIONS

Findings and safety factors are not listed in any order of priority.

3.1 Immediate Safety Factor

The fall of the lifeboat was the result of a parted wire rope fall that was caused by severe internal corrosion at the break point.

3.2 Latent Conditions and other Safety Factors

.1 The wire rope was of a lower grade than that recommended by the davit's manufacturer and was 167.7 kN below the minimum specified strength;

.2 Notwithstanding the monitoring and regular inspections, the crew members did not detect the wire rope's apparent deteriorating condition;

.3 The level of knowledge and skills, which the crew members had, for instance, to analyse the condition of the wire rope, did not allow them to achieve problem recognition;

.4 Due to the location and design of the davit, inspecting the wire rope for signs of internal corrosion was difficult.

3.3 Other Findings

.1 The ship's lifeboats were retro-fitted with approved pins through the cheeks of the hook assembly as FPDs. It is unclear if these were in place at the time of the accident, but they would have had no effect either way on the lifeboat falling after the wire rope had parted;

.2 The number of people in the lifeboat was above the recommended hoist crew of four persons. Notwithstanding, this was not considered a contributory factor to the parting of the wire rope;

.3 The wire rope was not being lubricated with the recommended grease, even though the correct grease was available on board;

.4 The wire ropes and the davit were examined by an approved contractor in April 2012 and overload tested to 110% of the maximum load at the same time;

.5 The aft arm of davit no. 9 showed signs that the shafts and bushes at the base were seized. A nut had been welded to the aft shaft, which was probably an attempt to free the bush. This should have been noted both by ship's staff and the service provider's technician at the time of the annual examination.

4 ACTIONS TAKEN

4.1 Safety actions taken during the course of the safety investigation

Soon after the accident, Core Marine Limited ensured that wire rope falls on all the ships under its management are inspected in accordance with the davits' manufacturers specifications. No discrepancies were found. Moreover, a dynamic load test (110%) of the wire rope falls was carried out on *Thomson Majesty* and completed on 14 February 2013. Notwithstanding the satisfactory results, all wire rope falls on the vessel were replaced during the month of February 2013.

The Company has also affected changes in its drill, maintenance and wire rope purchasing management as follows:

i. *Manropes and davits span wires:* although *Thomson Majesty* had an exemption for davits span wires and manropes, these have been re-rigged on. Crewmembers are required to use them if and when they are in a lifeboat that must be hoisted.

ii. *Changes to lifeboat drill procedures:* where feasible, the first lifeboat to be launched is to be a lifeboat, which the crew members can embark from an adjacent side door when it is waterborne. This lifeboat is then used to ferry the crew members to the other launched lifeboats. The same procedure is to be followed during the recovery; the ferry lifeboat shall take the crew from each lifeboat prior to its recovery. In this way, the lifeboats are recovered without crew members. Where it is not possible to follow this procedure, the Company is requesting strict compliance with IMO MSC Circ. 1206/Rev.1.

iii. *Maintenance procedures:* frequent checks and greasing of the static part of the wire falls, especially in areas that are exposed or difficult to reach (such as davit heads) are required. Only manufacturers' approved/recommended lubricants are allowed to be used.

iv. *Check and maintenance programme:* a thorough check and maintenance programme on all lifesaving equipment was assigned to the manufacturers of the davits/lifeboat systems. The programme was initiated on *Thomson Majesty* shortly after the accident and is presently carried out on board the rest of the fleet. The check and maintenance programme includes replacement/overhaul of all the components as necessary, and parts of winches, davits and fittings.

v. *Use of FPDs:* strict compliance with the instructions concerning the use of FPDs has been highlighted.

vi. *Purchasing of wire rope falls:* when purchasing wire rope falls, the supplying company is required to furnish the original manufacturer's certificate, in addition to its own certificates. This will ensure the identification of the wire ropes' origin. The Company is now instructing its port captains not to sign the purchase order unless the certificates have been attached. Once the wire ropes are on board the vessel, the master is required to send copies of the certificates accompanying the wire ropes to the Marine Operations Department, in order to double check that the specifications have been satisfied.

vii. *Crew training:* In addition to the training carried out on the use of lifesaving appliances on a regular basis, the crew received additional training on the importance and use of the FPDs. Furthermore, the recommended training for relevant crew members on inspection and maintenance of wire falls has been carried out on *Thomson Majesty* during the summer of 2013 (during the annual survey period). The training was provided by service engineers from the davits and the launching equipment manufacturers. Another training session was carried out in January 2014 for the rest of the crew members serving on the rest of the fleet. This has been arranged as part of the training on the inspection and maintenance of life saving equipment, which is carried out on an annual basis on each of the vessels under the Company's management. It has also been decided that the combined training is carried out on an annual basis and provided by service engineers from the manufacturer's company.

viii. *Fleet instructions:* Instructions highlighting the importance of early detection of any defects on lifesaving equipment as well as on the safety precautions during lifeboat drills have been posted on all the ships under the Company's management.

5 RECOMMENDATIONS

In view of the conclusions reached and taking into consideration the safety actions taken during the course of the safety investigation,

Core Marine Ltd. is recommended to:

05/2014_R1 Disseminate the findings of this safety investigation on board its vessels and ensure a thorough discussion during safety management meetings.

The Merchant Shipping Directorate within Transport Malta is recommended to:

05/2014_R2 make a submission to the IMO and:

.1 requests that the management of wire rope integrity is placed on the agenda of the Maritime Safety Committee for assignment to its relevant technical Sub-Committee for appropriate research and analysis to determine how wire ropes in general can be inspected to detect internal corrosion, and review methods for maintaining wire ropes, taking into consideration the information contained in the attached Steel Rope Technical Information attached at Annexes 'J' and 'K' and practices within the offshore industry, and to eventually issue guidance to the maritime community;

.2 consider a requirement for all vessels to ensure that davits' instructions clearly state the type and specifications for the davits' wire ropes, that replacement wire ropes are to be of the same type and specifications, and whether this should be permanently marked on the lifeboat davits.

05/2014_R3 bring the findings of this safety investigation report to the attention of ship owners and managers of Maltese registered ships.

LIST OF ANNEXES

Annex A	Wire Rope Certificates of Quality
Annex B	Chronology of the Wire Rope
Annex C	Report on Wire Rope Load Test
Annex D	Report on the Lifeboats and Release Gear Examination
Annex E	Classification Society's Survey Report
Annex F	Destructive and Non-Destructive Tests on the Failed Wire Rope
Annex G	Chemical Test Report on the Grease Samples
Annex H	Davits Manufacturers' Post-accident Report
Annex I	Safety Alert issued by the MSIU
Annex J	IMCA's Wire Rope Purchase Specification[11]
Annex K	The North of England P&I Association briefing on Wire Ropes and their Uses

[11] This Annex was reproduced by permission of the International Marine Contractors Association (IMCA).