MARINE SAFETY INVESTIGATION REPORT

Safety investigation into the fatality of a crew member following a fall inside cargo hold no. 1 on board the Maltese registered container vessel

CORELLI

in position 40° 45’ N  006° 25’ E

on 30 November 2015

201511/032

MARINE SAFETY INVESTIGATION REPORT NO. 20/2016

FINAL

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 30 November 2015. 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.

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Crew members MV Corelli
Managers MV Corelli
# GLOSSARY OF TERMS AND ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>American Bureau of Shipping</td>
</tr>
<tr>
<td>CPR</td>
<td>Cardiopulmonary resuscitation</td>
</tr>
<tr>
<td>FEU</td>
<td>Forty foot equivalent unit</td>
</tr>
<tr>
<td>Gt</td>
<td>Gross tonnage</td>
</tr>
<tr>
<td>ILO</td>
<td>International Labour Organization</td>
</tr>
<tr>
<td>IMO</td>
<td>International Maritime Organization</td>
</tr>
<tr>
<td>ISM Code</td>
<td>International Maritime Safety Code</td>
</tr>
<tr>
<td>kW</td>
<td>Kilowatt</td>
</tr>
<tr>
<td>LT</td>
<td>Local time</td>
</tr>
<tr>
<td>LTD</td>
<td>Limited</td>
</tr>
<tr>
<td>m</td>
<td>Metres</td>
</tr>
<tr>
<td>mm</td>
<td>Millimetres</td>
</tr>
<tr>
<td>MRCC</td>
<td>Maritime Rescue Coordination Centre</td>
</tr>
<tr>
<td>MRSC</td>
<td>Maritime Rescue Sub-Centre</td>
</tr>
<tr>
<td>MSIU</td>
<td>Marine Safety Investigation Unit</td>
</tr>
<tr>
<td>MV</td>
<td>Motor vessel</td>
</tr>
<tr>
<td>No.</td>
<td>Number</td>
</tr>
<tr>
<td>Rpm</td>
<td>Revolutions per minute</td>
</tr>
<tr>
<td>SMS</td>
<td>Safety management manual</td>
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<tr>
<td>TEU</td>
<td>Twenty foot equivalent unit</td>
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SUMMARY

On 30 November 2015, the Maltese registered container vessel Corelli, was underway from Fos, France to Cagliari, Italy for cargo operations as part of her scheduled trading pattern.

At about 1340 (LT), one of the ship’s fitter who had entered the cargo hold no. 1 with a team of two other crew members to carry out scheduled maintenance works, fell from one of the stringers and was fatally injured after hitting hard onto the tank top inside the cargo hold.

Efforts by the crew members to resuscitate him right after the accident were unsuccessful. The deceased was landed ashore on the following day, upon the vessel’s arrival at the port of Cagliari, Italy.

The safety investigation concluded that the immediate cause of the accident was the (unintentional) close proximity of the crew member to the edge of the stringer, which had no protection.

As a result of the safety actions taken by the Company, no recommendations have been made.

1 Unless otherwise stated, all times quoted in the report are local.
## 1 FACTUAL INFORMATION

### 1.1 Vessel, Voyage and Marine Casualty Particulars

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
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<tr>
<td>Name</td>
<td>Corelli</td>
</tr>
<tr>
<td>Flag</td>
<td>Malta</td>
</tr>
<tr>
<td>Classification Society</td>
<td>American Bureau of Shipping</td>
</tr>
<tr>
<td>IMO Number</td>
<td>9126766</td>
</tr>
<tr>
<td>Type</td>
<td>Container</td>
</tr>
<tr>
<td>Registered Owner</td>
<td>Merak Shipping Company Limited</td>
</tr>
<tr>
<td>Managers</td>
<td>Arkas Denizcilik Ve Nakliyat A. S.</td>
</tr>
<tr>
<td>Construction</td>
<td>Steel (Double bottom)</td>
</tr>
<tr>
<td>Length overall</td>
<td>168.78 m</td>
</tr>
<tr>
<td>Registered Length</td>
<td>158.00 m</td>
</tr>
<tr>
<td>Gross Tonnage</td>
<td>15120</td>
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<tr>
<td>Minimum Safe Manning</td>
<td>16</td>
</tr>
<tr>
<td>Authorised Cargo</td>
<td>Containers</td>
</tr>
<tr>
<td>Port of Departure</td>
<td>Fos, France</td>
</tr>
<tr>
<td>Port of Arrival</td>
<td>Cagliari, Italy</td>
</tr>
<tr>
<td>Type of Voyage</td>
<td>Short International</td>
</tr>
<tr>
<td>Cargo Information</td>
<td>Containers</td>
</tr>
<tr>
<td>Manning</td>
<td>15</td>
</tr>
<tr>
<td>Date and Time</td>
<td>30 November 2015 at 1340 (LT)</td>
</tr>
<tr>
<td>Type of Marine Casualty</td>
<td>Very Serious Marine Casualty</td>
</tr>
<tr>
<td>Place on Board</td>
<td>Cargo hold</td>
</tr>
<tr>
<td>Injuries/Fatalities</td>
<td>One fatality</td>
</tr>
<tr>
<td>Damage/Environmental Impact</td>
<td>None</td>
</tr>
<tr>
<td>Ship Operation</td>
<td>Normal Service – In Passage</td>
</tr>
<tr>
<td>Voyage Segment</td>
<td>Transit</td>
</tr>
<tr>
<td>External &amp; Internal Environment</td>
<td>Daylight and clear sky. Northwesterly sea and Northerly Force 5 wind. It was dark inside the cargo hold.</td>
</tr>
<tr>
<td>Persons on Board</td>
<td>19</td>
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</tbody>
</table>
1.2 Description of Vessel

*Corelli*, a 15120 gt gearless container vessel was built by CSBC Corp., Taiwan in 1997 and registered in Malta. She was owned by Merak Shipping Company Ltd, managed by Arkas Denizcilik Ve Nakliyat A. S. and classed with American Bureau of Shipping (ABS).

*Corelli* (Figure 1) had four centre cargo holds, equipped with cell guides and eight cargo hatch covers (two per cargo hold). *Corelli* was fitted with a traditional transverse framing system, double bottoms and a main deck with longitudinal framing. The cargo holds were fully cellular for the carriage of forty foot equivalent units (FEU) and twenty foot equivalent units (TEU). The vessels’ total cargo capacity was 1445 TEUs of which, 564 could be stored in the cargo holds and 881 on deck. The vessel’s length overall was 168.80 m, a moulded breadth of 27.30 m and a moulded depth of 13.50 m. *Corelli* had a summer deadweight of 19532 tonnes at a corresponding draught of 8.62 m.

Propulsive power was provided by a 7-cylinder Mitsui MAN B&W 7S50MC, slow speed direct drive diesel engine, producing 8606 kW at 119 rpm. This drove a single, four-bladed, fixed pitch propeller, 5680 mm in diameter, to reach a service speed of 18.0 knots.

*Figure 1: MV Corelli*
1.3 Cargo Hold No. 1 Configuration

Cargo hold no. 1 is the first cargo hold fitted aft of the forecastle. It was designed to carry TEUs in bays 01, 03, 05 and 07 and FEUs in bays 02 and 06 (Figure 2).

The accident happened at the bottom aftermost area of cargo hold no. 1, in way of bay 07 on starboard side. The cargo hold is fitted with longitudinally intermediate stringers, between the tank top and the main deck. The intermediate stringers may also serve as walkways for longitudinal passage / access inside the cargo hold (red lines) spaces.

Access to cargo hold no. 1 from the main deck was possible via one of the two access trunks. One of the access trunks was located on the aft port side of the cargo hold, whereas the other one was on the forward starboard side. The descent from the main deck to the tank top of the cargo hold through the aft port side access was possible by means of Australian ladders (with intermediate transverse platforms) fitted to the aft transverse bulkhead of the cargo hold, reaching the cargo hold’s tank top (Figure 3).
Figure 3: The access to the cargo hold no. 1 and the starboard side stringers

The cargo hold side stringers constituted intermediate walkways, between the tank top and the second deck (Figure 4). No guard rails or other fall protection barrier (fences or safety net) were fitted at the open side of these walkways.

Figure 4: Gap between horizontal stringers edge and containers
The walkways on the second and third stringer levels were configured in a way that a gap was created between the unprotected edge of each walkway and the side panel of the adjacent tier’s container, which partially rests on the stringer level (Figures 5a and 5b). In this respect, tier 04 outmost container (i.e. the one in row 04) had its floor panel resting on the edge of second stringer, while the outmost container of the above tier (i.e. the container in tier 06 / row 06) was partially supported on the third stringer level. Figure 5 shows this arrangement and the gap formed between container 04/04 in bay 07 and the second stringer level.

![Figures 5a and 5b: Gap formed between tier 04 outmost container (row 04) resting position and the second stringer](image)

**1.4 Crew Members**

At the time of the accident, Corelli had a crew complement of 19, comprising of the master, officers and ratings. All crew members were Turkish, except the chief engineer and the second engineer who were from Azerbaijan. The working language on board the vessel was Turkish.

The crew complement was in excess of the minimum specified in the Minimum Safe Manning Document issued by the flag State Administration on 16 April 2012 and valid until 10 June 2017.

The master had completed 99 days on board Corelli at the day of the accident and had been working with the same Company for almost one year. The rest of the crew members reportedly had long experience on board vessels managed by the Company and the majority had also served in the past either on board Corelli or her sister vessels.
1.4.1 The fatally injured crew member and witnesses to the accident

The fitter, who was the fatally injured crew member, was 58 years old from Turkey. He had been working on board Company vessels since 29 June 2012 and had served on board Corelli once before for about 10 months (being his first contract with the Company). He had joined Corelli on 13 November 2015 at the port of Iskenderun, Turkey. The fitter held all the required certificates. The vessel’s records indicated that he had received the necessary safety and familiarization training in general. However, the fire fighting training manuals had not been signed.

The fitter did not have any documented health problems or recent illness before the accident and had only been using mild medication, such as aspirins and pain relievers, as required.

Two other crew members, i.e. the chief mate and the bosun, were together with the fitter in a scheduled maintenance work assignment in cargo hold no. 1 when the fatal accident happened. However, they did not witness the accident and its exact circumstances as they had only noticed the fall of the fitter to the cargo hold tank top after the occurrence.

The chief mate, who had 12 years of seagoing experience, had served on board Company vessels for the previous three years, while the bosun, an experienced mariner with almost 30 years of service at sea, had sailed for 14 years on board vessels operated by the Company.

1.5 External and Internal Environmental Conditions

1.5.1 Weather conditions

At the time of the accident, Corelli was navigating the Western Mediterranean Sea, 180 nautical miles East of Barcelona and 90 nautical miles Northwest of Sardinia. The weather was reported in the logbook as Northwest 4 to 5, with clear skies and good visibility. The forecasts also indicated Northwest weather with a sea state of 6 to 7 (‘very rough’ to ‘high’) decreasing to 4 to 5 (‘moderate’ to ‘rough’).

It was reported that neither the prevailing weather conditions around the time of the accident nor the sea state, had any influence on the crew’s movement or stability in
the cargo hold no. 1. Available evidence suggested that the weather was not a
causative factor to the accident.

1.5.2 Cargo hold atmosphere / lighting conditions
The space inside cargo hold no. 1 was reportedly measured with an oxygen analyzer /
multigas detector by the chief mate at about 1130, i.e. two hours before the accident
and the atmosphere was verified to be acceptable for space entry.

It was observed that the structural arrangements within the cargo hold did not
facilitate adequate lighting in the spaces for crew members to work or walk by,
especially when the cargo hold was loaded. In particular, sufficient lighting was
provided only for the cargo hold’s areas situated close to the vertical ladders, which
were used to descend from the main deck to the bottom of the cargo hold (tank top).

Three light fixtures\(^2\) were available for the provision of illumination in way of the aft
cargo hold spaces, as indicated in Figure 3 above. Two light fixtures were installed in
the intermediate platforms and an additional one was fitted at the tank top level.
These light fixtures arrangements did not provide any illumination to the cargo hold
side areas, which remained completely dark when the hatch covers were closed
(absence of natural source of light) and especially when the cargo hold was loaded
with containers.

Passage of crew through respective cargo hold spaces and moreover carrying out
work in a safe manner required either temporary lighting arrangements cabled in those
areas or, the use of suitable torch lights (with appropriate illumination and beam
width).

\(^2\) Halogen cargo lights each rated at 500 Watts.
1.6 Narrative

*Corelli* sailed out from Fos, France at about 0140 on 30 November 2015, carrying containers on deck and in her cargo holds. Her destination was the port of Cagliari, Italy.

1.6.1 Maintenance work in cargo hold no. 1

Scheduled maintenance work, which necessitated the replacement of a corroded segment of a ventilation pipe for water ballast tank no. 1 starboard (Figure 6), was planned to be carried out during the voyage from Fos to Cagliari. The corroded segment of pipe was located inside cargo hold no. 1.

![Figure 6: Corroded pipe section inside the cargo hold](image)

The pipe replacement had been recorded in the vessel’s list of scheduled maintenance works for more than one month prior to the accident and was recently given a high priority repair task by the Company’s management (superintendent engineer). In this respect, the chief mate, along with the bosun had reportedly inspected the work area one week before the accident in order to plan the necessary repairs.

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3 The work concerned the replacement of a 0.80 m curved steel pipe.
During breakfast, on 30 November 2015, the chief mate and the bosun discussed the work plan for the specific repairs and during lunchtime (at about 1200) the particulars were again discussed between the master, the chief mate, the chief engineer and the first engineer. It was decided that if safe\textsuperscript{4}, the chief mate, the bosun and the fitter would enter cargo hold no. 1 soon after lunch to measure the dimensions of the corroded/holed pipe in order to determine spares requirements/availability before repairs commencement.

In the meantime, the chief mate had already requested the opening of the two cargo hold access hatches (fore and aft) during the morning hours of the same day, to generate natural ventilation of the cargo hold. The cargo hold’s atmosphere was measured at about 1130 and the results indicating an acceptable oxygen content for entry and work\textsuperscript{5}.

\textbf{1.6.2 On-site inspection}

After lunch, at about 1325, the team of three crew members (the chief mate, the bosun and the fitter) gathered at the forward main deck area and accessed cargo hold no. 1 through the access hatch located on the aft port side of the cargo hold. The bosun entered first, using a handheld flood/spot light equipped with lanyard, followed by the chief mate who had a head torch fixed to his protective helmet. The chief mate was also carrying a strong flashlight with a lanyard. Following the chief mate was the fitter. Being the last crew member to enter inside the cargo hold, he neither had a flashlight nor any other source of light. All crew members were reportedly wearing appropriate overalls, shoes with steel toecaps, antiskid and oil resistant soles (for foot protection), safety helmets with chinstraps (for head protection) and hard wearing gloves (for hand protection).

Figures 7a, 7b and 8a, 8b provide a representation of the crew members’ access to cargo hold no. 1 starboard side bottom area, where the fatal accident occurred, entering from the main deck (through the aft access trunk of the cargo hold).

\textsuperscript{4} The cargo hold atmosphere was measured to ensure safe access.

\textsuperscript{5} Oxygen concentration reported to be 21\%. 

9
Upon reaching the tank top, the crew members walked to the starboard side of the cargo hold, passing through a transverse walkway (formed between bay 07 containers cell guides and the aft hold bulkhead) and reaching the cargo free area on the starboard side of the cargo hold (Figure 7b). This particular area, as well as the upper stringer levels, were not illuminated by a fixed lighting arrangement (lamp, etc.)\(^6\).

Following an on-site discussion, the chief mate and the fitter proceeded from the area to the upper platforms in succession \(i.e.,\) the second and then the third stinger, in order to measure and find out if they could reach the position of the corroded area on the pipe, which was situated close to the underside of the third stringer in way of bay 05 on starboard side.

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\(^6\) The light seen in the figure was provided by strong spotlights during the course of the safety investigation.
At the same time, the bosun reportedly assisted the chief mate and fitter’s ascent to the upper stringers by illuminating the ladder between the tank top and the second stringer with his spot light (Figures 9a and 9b).

![Figures 9a and 9b: Bosun pointing with his spot light to provide illumination for the chief mate and the fitter to ascend to the second stringer level](image)

After ascending to the third stringer level (two levels above the tank top), the chief mate and the fitter noticed that the pipe section which required replacement was not directly accessible from this deck and that they had to revise their plan and possibly use a ladder to have better access. Thereupon, the two crew members returned to the second stringer level and the bosun was called by the chief mate to climb up from the tank top in order to collectively discuss the matter.

### 1.6.3 The fall from the second stringer

The time was about 1335 and after reaching the second stringer, the bosun proceeded forward, passing the fitter from the left side (i.e. between the fitter and the deck opening) in order to catch up with the chief mate. It was reported that at that instant the bosun cautioned the fitter to keep clear of the unprotected opening, as he was standing too close to the edge and the gap between the deck’s unprotected border and the outmost tier 04 container.

The bosun continued to the forward end of the second stringer level, in order to see the problem for himself and discuss a possible solution with the chief mate. It was reported that the bosun was holding his flashlight, aiming the beam backwards at the

---

7 The pipe section was not reachable due to the obstruction imposed by bay 05 / tier 06 stack of containers.
forward part of the second stringer, in order to illuminate fitter’s standing position\(^8\)
and assist him to see his surroundings\(^9\).

At that instance, the bosun was almost at the forward end of the second stringer level, the chief mate was about 2.0 m behind him, and the fitter was standing further behind, approximately 1.75 m from the chief mate (Figures 10a and 10b).

The time was about 1340. It was reported that during the discussion about the repairs between the chief mate and the bosun, the two heard a thump noise coming from the left / down direction (relative to their standpoint), which they initially considered as a result of containers movement. They did not hear any voice or shouting, neither before nor after the noise was heard. Then, the vessel was reportedly sailing steadily without any abrupt movements or other weather induced motion (pitching / rolling).

Both crew members looked back and soon noticed that the fitter was no longer standing behind them on the second stringer level. The chief mate started calling him and after illuminating the lower level through the second stringer opening, both crew members saw the fitter on his side on the tank top, approximately 2.5 m below them. It was immediately evident that the fitter had fallen down from the second stringer level.

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\(^8\) The fitter was not equipped with a flashlight.

\(^9\) During the course of the safety investigation, it was noted that the chief mate could not conclusively confirm this.
After descending to the tank top, they found the fitter lying on the tank top with his body facing forward. His head and lower legs were resting against the first transverse frame’s (frame 165) lower side bracket as simulated in figures 11a, 11b and 11c.

![Simulation of the fitter’s position after his fall from the second stringer level down to the tank top](image)

The fitter was lying unconscious on the tank top, with his eyes closed and reportedly breathing but not reacting to their stimulations. A sharp cut was noticeable on his head, in way of the left side temple, which started bleeding immediately after the crew members reached the fitter. It was reported that the safety helmet was found several metres from the fitter (i.e. close to the aft cargo hold bulkhead).

The injured fitter was shifted by a few steps away from the fall position by the two crew members and subsequently the bosun took off the fitter’s t-shirt and used it to stop the bleeding by applying pressure to the head (in way of the wound). Subsequently, he taped it around the fitter’s head using electrical tape.

The chief mate walked out of the cargo hold and made his way to the ship’s office from where he informed the bridge\textsuperscript{10} and the master about the accident. He then returned to the cargo hold to assist the bosun and to administer first aid. Artificial

\textsuperscript{10} At the time, the second mate was the navigational officer of the watch.
respiration and cardiac massage were given by the chief mate and the bosun respectively.

At about 1350, the second mate arrived at the accident site, carrying the ship’s first aid kit, neck collar and portable oxygen cylinder. He observed that the injured fitter had no pulse and blood was coming out of his left ear. At the same time, one of the ABs arrived with the ship’s stretcher. Cardiopulmonary resuscitation were continued until 1355; however, all efforts to revive that injured fitter were in vain and he remained unresponsive.

The master notified the Company of the accident at 1355 and subsequently, in coordination with the Company, he contacted the port authorities and medical provision centres in the geographical area of the vessel (including the Italian Medical Centre, the Italian Coast Guard / MRCC Rome, MRSC Cagliari, and MRCC La Garde, which was the responsible MRCC closest to the ship’s position11.

At about 1410, the injured fitter was carried on the ship’s stretcher outside cargo hold no. 1. The crew members kept administering oxygen and CPR on the main deck port side12.

At 1455, the efforts of the crew members to resuscitate the fitter were discontinued as the fitter remained unresponsive. The master contacted the Company, and thereafter MRCC La Garde, to inform them about the death of the fitter. The medical evacuation was consequently cancelled.

1.7 Cause of Death

The autopsy concluded that the fitter’s cause of death was due to a traumatic shock to his cranium after falling from height.

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11 Initially, the master altered ship’s course to the South, in an effort to reach Sardinia and stay within the range of a helicopter.

12 At this time, the Company informed the master that the ship was within the coverage area of MRCC La Garde (rather than MRSC Cagliari). The ship’s course was altered to North and the master contacted the relevant Centre, requesting the dispatch of a helicopter for emergency medical evacuation of the injured crewmember. The vessel was reportedly informed that the helicopter from MRCC La Garde would approach the ship’s position within the next two hours, i.e. by about 1600.

The Code of Safe Working Practices for Merchant Seamen (COSWPMS) identifies special provisions and precautions for the proper planning and the safe conduct of work at places, like the cargo holds, where a fall from a height is a risk. In particular, the following is recommended to ensure personal safety in similar conditions:

- ensure the work is properly planned, including carrying out of a risk assessment, appropriately supervised and carried out in as safe a manner as practicable;
- work is only done by experienced people or, if not, then be accompanied by an experienced person;
- only done by people wearing a safety harness with lifeline or other such fall arresting device at all times. Lifelines are to be attached to a strong point above to reduce the fall height. The equipment should be tested periodically and checked before being used; and
- rigging a safety net where necessary and appropriate.

The International Labour Organization’s (ILO) Code of Practice for Accident Prevention on Board Ship at Sea and in Port stipulates that:\(^1\)

- any openings through which a person might fall should be fitted with secure guards or fencing of adequate design and construction; and
- guard-rails or fencing should consist of an upper rail at a height of 1.0 m and an intermediate rail at a height of 0.50 m. The rails may consist of taut wire or taut chain.

ILO Convention No. 152 (Occupational Safety and Health)\(^2\) stipulates that:

- any time that a workplace has become unsafe, effective measures shall be taken (such as by fencing) to protect the workers; and
- all places where dock work is being carried out shall be suitably and adequately lit.

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\(^1\) Chapter 9 “Safe movement about the ship,” “Accident prevention on board ship” articles 9.5.5 and 9.5.6.

\(^2\) The Convention makes reference to dock work, however, it contains relevant information for this occurrence.
The American Bureau of Shipping (ABS) Guide for Ergonomic Notations provides the general principles to the design of walkways and the details of the safety railings requirements:

- handrails/guardrails shall be provided at the exposed side of any walking or standing surface that is 600 mm or higher above the adjacent surface and where a person could fall from the upper to the lower surface;\(^\text{15}\)

- rails shall be installed parallel to the deck along deck edges and walkways and around open hatches, elevators, working platforms and along other boundaries in the following areas:
  i. wherever there is danger of operators or maintainers falling to a lower level of ≥ 600 mm;
  ii. wherever there is danger of operators or maintainers becoming enmeshed with operating machinery; and
  iii. around openings with a coaming height below 760 mm.

\(^\text{15}\) Temporary rails may be erected around unprotected openings in which a person may either slip, trip or fall.
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 Accident Dynamics and Immediate Cause

It has not been possible for the safety investigation to determine with absolute certainty the accident dynamics. The bosun and the chief mate, who were the only persons close to the fitter before the accident inside the cargo hold, neither witnessed his fall nor the preceding actions/movement of the victim. Both crew members claimed that the fitter was cautioned not to get too close to the unprotected opening.

Taking into account the circumstances surrounding the fitter’s movement during the ascent to the starboard side second stringer level in conjunction with two other crew members, the safety investigation concluded that it is very likely that the fitter stepped into the opening (gap) unexpectedly, possibly unaware of his close proximity to the edge. The fact that the fitter was unfamiliar with the cargo hold arrangements and given that the lighting conditions in the area were very poor, supports the hypothesis that he had been walking too close to the opening.

2.3 Fatigue

Records of rest and work indicated that the fitter had been working for four hours before the accident happened (from 0800 on 31 November 2015), while 32 hours of rest had been taken (fitter did not work on Sunday 29 November 2015). The records did not suggest that the deceased had worked in excess of the maximum permitted hours. Moreover, although there were no records of the hours of quality of sleep\(^\text{16}\), the safety investigation did not reveal factors which could have suggested that fatigue was contributory to this accident.

\(^\text{16}\) It has to be clarified that although quality and quantity of sleep are related to fatigue, there are no requirements which specify that hours of quality sleep have to be recorded.
2.4 Occupational Safety Inside the Cargo Hold

2.4.1 Absence of a physical safety barrier system

Corelli’s cargo hold design included stringers on the side shell plating, which were occasionally used by crew members as a means of access to the cargo holds internal structures. Although used by crew members, these walkways were not fitted with guardrails, safety barriers or other type of fencing in way of the unprotected edge to prevent a fall to the lower tank top level (Figures 12a, 12b and 13a, 13b).

![Figures 12a and 12b: The second stringer without any safety barrier system](image)

![Figures 13a and 13b: View from the third stringer (left) and the second deck walkway (right) without any safety barrier system](image)

In addition to the absence of physical barriers, it was also noticed that the paint used was neither of the anti-skid type nor did its colour forewarn the crew members of the risk of falling because of the unprotected edge.

Although the horizontal width of these transverse walkways was adequate (between 1.5 m and 2.0 m) for crossing and working on them, the safety investigation was of the view that the absence of any type of a physical safety barrier system exposed the crew members to the risk of falls, especially under particular environmental and working conditions.
The safety investigation found that apart from the opening formed on the second stringer level (which was a contributing factor to the accident), the configuration of the stringer platforms above (i.e. the third stringer and the second level) was almost identical. As it is shown in figures 12 and 13, openings of the same shape existed in the upper decks as well, especially when the outer container cells remain empty.

Entrance to the cargo hold and work in way of the stringers, under particular circumstances (the vessel’s design did not envisage any type of physical barrier systems against fall protection in those areas), necessitated the installation of (temporary) physical safety barriers in way of the unprotected edge of each walkway (say, either railings or a safety net covering the free-fall openings). It was possible that in the absence of a risk assessment exercise, these safety barrier systems have not been considered.

2.4.2 Absence of a symbolic safety barrier system
While the lack of railings or other physical fall protection devices in way of the stringer platforms were critical, high-visibility markings in the area would have been equally important. It is acknowledged that this type of safety barrier system is less effective than a physical safety barrier system in terms of addressing risk exposure. However, as much as it is important, it is highly probable that the high visibility paint was not used because the stringer was not a conventional walkway exposed to water and its use by the crew members was less frequent than other standard walkways.

2.4.3 Light intensity in the accident area
The lighting conditions were poor to pitch darkness at the stringer levels. It was observed that there were no dedicated light fittings servicing these particular areas. In fact, sufficient illumination was only provided for the descent from the main deck to the bottom of the cargo hold by means of light fittings at the centre of the intermediate transversal deck. This light, however, could not reach the stringer areas when cargo was loaded in the cargo hold (obstruction by the containers).

In this respect, accessing or working in these spaces required, (depending on the purpose of entrance), either the use of temporary light arrangements (cabled into the access spaces), or the use of handheld torch lights with proper illumination and beam width. Moreover, the use of appropriate and portable light sources (temporary
installation or handheld) was absolutely necessary for the occupational safety of every crew member, who accessed the cargo hold areas.

2.5 Crew Training and Safe Working Practice

Although the fitter was an experienced crew member on board container vessels and had served on board Corelli for the second time, he was neither familiar with vessel’s cargo hold access, nor with the internal arrangements (configuration of stringer platforms, web frames, ladders, etc.). During the course of the safety investigation on board, the MSIU was informed that the fitter had never entered cargo hold no. 1. This is being stated because the MSIU is of the view that the fitter may have been oblivious to the hazards in way of the stringer.

It was also determined that the safety helmet belonging to the fitter was not properly secured (not firm) on his head, possibly because the chin strap was not worn. However, although this may have provided no head protection, the safety investigation was unable to determine whether the safety helmet would have prevented the head injuries sustained by the fitter during the fall had it remained strapped.

2.5.1 Risk assessment

During the course of the safety investigation, a number of inconsistencies were identified:

- a risk assessment\textsuperscript{17} prior to the entrance into the cargo hold had not been carried out, although the Enclosed Space Entry Checklist, which was compiled at 1130 before entrance to cargo hold no. 1, indicated otherwise (\textit{Annex A}). In this respect, several safety assessment steps that could have revealed risks involved with the access and work in the cargo hold may have been omitted;

- the three crew members who entered the cargo hold were not equipped with a safety lifeline and / or a safety harness, although the Enclosed Space Entry Checklist indicated otherwise\textsuperscript{18};

\textsuperscript{17} As per vessel’s SMS Manual 1.3.4.11.

\textsuperscript{18} The MSIU appreciates that a safety line / safety harness arrangements would not have been practical for the crew members to walk around. The point being made, however, is that the checklist was not adequate to address these practicalities.
• the fitter did not carry a handheld flashlight during his access to the cargo hold, although the Enclosed Space Entry Checklist indicated that crew members accessing the cargo hold were all equipped with a safety torch; and

• although the fitter was neither properly equipped (flashlight) nor familiar with the cargo hold access, he was the last crew member to access the cargo hold, following the descent of the bosun and the chief mate (in that order). This order hindered efficient supervision of the fitter inside the cargo hold. Although this matter was not considered to be a contributory factor to the accident, it suggested that the planning was not detailed enough for the intended work, in terms of mitigating the risks inside the cargo hold.

Moreover, it became evident that the fitter was temporarily left alone in the dark surroundings of the second stringer level, while the other crew members (the chief mate and bosun) were discussing a revised access plan (on how to reach the holed pipe) several metres away. There was neither any visual contact with the fitter nor supervision of his actions while he was standing about 0.5 m from the unprotected edge of the stringer level. In fact, none of the crew members witnessed the actual fall of the fitter to the tank top.

2.6 Performance Shaping Factors

In the previous sub-sections, reference was made to missing safety barrier systems and risk analysis exercises, which had not been carried out prior to the entry inside the cargo hold. Whilst risk can be seen as a concept which can be measured, anticipated and therefore managed, studies have shown that this is more complex than it actually sounds.

Research in safety-critical domains suggests that there is a general acceptance that a risk-free domain cannot be achieved. Per se, this is indicative that there exists a degree of risk acceptance – irrespective of whether ‘acceptable risk’ or ‘unacceptable risks’ actually exist. However, the statement may also be understood in a way that actually, a certain amount of risk is seen to be necessary – in terms of benefits of risk exposure vs. a more conservative approach. Hence, the decision on whether a
particular risk is acceptable or not is, in reality, the result of an assessment, which takes into the equation the perceived risk and perceived benefits of taking that risk.

Studies have shown that risk perception may be seen as mental short-cuts, done by individuals who judge the risks vs. the benefits of hazards. Such considerations may be made either consciously or even unconsciously. Research in safety-critical domains also identifies three main factors which influence performance and which are also applicable to the context under investigation. On the basis of the evidence collected, the safety investigation believes that the main factors, which influenced the decision to access the space during that particular time of the voyage were:

- **Knowledge factors** – before gaining access to the area, the crew member had limited information, if any on what was required to fix the leaking pipe. Gaining access to the area was therefore very important to rectify the problem;

- **Attentional factors** – the environment inside the cargo hold was dark and the crew members had limited artificial light. The safety investigation did not have evidence which suggested that the crew members inside the cargo hold had to perform multiple tasks and which could therefore have affected cognitive processes. However, under the prevailing circumstances, it was difficult for all the crew members to maintain an accurate situation awareness; and

- **Strategic factors** – going inside a dark cargo hold with limited light, an unfamiliar crew member, and in the presence of hazards (walking on the stringer level) may be seen as a trade-off which was made under uncertainty and risk. The trade-off was actually more of an emergent process of a small number of crew members, rather than the conscious decision of a particular crew member.

Taking into consideration the above, the crew members had to address a goal-conflict situation, necessitating the need to analyse the problem with the pipe inside the cargo hold but which, in turn, exposed them to the risk of falling down from a height.
THE FOLLOWING CONCLUSIONS, SAFETY ACTIONS AND RECOMMENDATIONS SHALL IN NO CASE CREATE A PRESUMPTION OF BLAME OR LIABILITY. NEITHER ARE THEY BINDING NOR 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

.1 The immediate cause of the accident was established to be the crew member walking unexpectedly into the gap on the second stringer level, which had no protection.

3.2 Latent Conditions and other Safety Factors

.1 The fitter was neither familiar with vessel’s cargo hold access, nor with the internal arrangements (configuration of stringer levels, web frames, ladders, etc.);

.2 Although the stringers were occasionally used by crew members as walkways, the structures were neither fitted guardrails and safety barrier systems, nor with other type of fencing in way of the unprotected edge, to prevent a fall to the lower tank top;

.3 The paint used was neither of the anti-skid type nor did its colour forewarn the crew members of the risk of falling because of the unprotected edge;

.4 A risk assessment prior to the entrance into the cargo hold had not been carried out;

.5 The lighting conditions on the side stringer level areas were poor to pitch darkness;

.6 The fitter did not carry a handheld flashlight during his access to the cargo hold;

.7 Although the fitter was neither properly equipped (flashlight) nor familiar with the cargo hold access, he was not supervised in an effective manner;

.8 There was neither any visual contact with the fitter nor supervision of his actions while he was standing about 0.5 m from the unprotected edge of the stringer level;
The main factors, which influenced the decision to access the space during that particular time of the voyage were knowledge, attentional and strategic.

3.3 Other Findings

.1 Records of rest and work did not suggest that the deceased had worked in excess of the maximum permitted hours;

.2 The safety helmet belonging to the fitter was not properly secured (not strapped) on his head, possibly because the chin strap was not worn;

.3 The weather conditions and ship movements were not considered to be contributing factors to the accident.
4 ACTIONS TAKEN

4.1 Safety Actions Taken During the Course of the Safety Investigation

The Company carried out an internal investigation in accordance with Section 9 of the ISM Code. On the basis of the findings of the internal investigation, the Company took action in order to address safety issues which were classified as follows:

- **Illumination** – aimed to improve the lighting condition in situations when work in dark spaces is necessary;
- **Quality** – aimed to ensure that entry into enclosed spaces and work carried out inside is well addressed in the safety management system of the vessel;
- **Technical** – aimed to minimise the risks at the work site by the erection of physical barriers and adoption of symbolic barriers;
- **Safety and First Aid** – aimed to ensure adequate response to assist and provide medical care to injured crew members;
- **Personal** – aimed to ensure evaluation of personal records related to accidents which are suffered whilst serving on board; and
- **Education** – aimed to provide safety information to crew members, including during vacation leave periods (on line training). The action also includes vessel visits by Company auditors and information on risk prevention and operational health and safety.
LIST OF ANNEXES

Annex A Enclosed Space Entry Checklist
## Annex A  Enclosed Space Entry Checklist

<table>
<thead>
<tr>
<th>No</th>
<th>AÇIKLAMA / DESCRIPTION</th>
<th>Evet</th>
<th>N/A</th>
<th>Hayır</th>
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<td>Risk değerlendirmesi EYS 1.3.4.11’e göre yapıldı mı? / Has a risk assessment</td>
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<td>been carried out as per SMS 1.3.4.11?</td>
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<td>Yes</td>
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<td></td>
<td>Yapılcak iş sıcak çalışma gerektiriyor mu? / Does the job involve any hot</td>
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<td></td>
<td>work? (Eğer cevap evet ise, Kaynak Kullanımı kontrol listesi yapıldı mı? /If</td>
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<td>yes, the Hot Work Permit must be completed.)</td>
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<td></td>
<td>Yapılcak iş yüksekte çalışma gerektiriyor mu? / Does the job involve any</td>
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<td>mi? / If yes, working aloft checklist must be completed.)</td>
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<td></td>
<td>Girelcek mahal iyice havalandırıldı mı? / Has the space thoroughly</td>
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<td>ventilated by mechanical means?</td>
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<td>Girelcek mahal, komşu diğer mahallerle elektriksel ve atmosferik alanında</td>
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<td>boru devreleri kapatıldıklar ya da enerji kesilerek ayrıştırıldı mı? / Has the</td>
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<td>space been segregated by blanking off or isolating all connecting pipelines or</td>
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<td>valves and electrical power/equipment?</td>
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<td></td>
<td>Girelcek mahal için kapatılan / kesilen boru devrelerine ve ekipmanlara</td>
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<td>uyarı yazısı asılı mı? / Have valves on the pipelines serving the space been</td>
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<td>secured to prevent accidental opening?</td>
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<td>No</td>
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<td>Girelcek mahal gerekli görülüse temizlendi mi? / Has the space been</td>
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<td>cleaned where necessary?</td>
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<td></td>
<td>Atmosfer ölçüm cihazı, atmosfer ölçümünden evvel kalibre edilip test</td>
<td></td>
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<td>edilerek doğru çalıştığı kontrol edildi mı? / Have the atmosphere monitoring</td>
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<td>equipment been calibrated, tested and found satisfactory prior to testing the</td>
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<tr>
<td></td>
<td>atmosphere?</td>
<td></td>
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<td>No</td>
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</tbody>
</table>
Kapalı mahalle giriş kontrol listesi

Enclosed Space Entry Checklist

Girilecek mahalin atmosferi kontrol edildi mi? / Has the space atmosphere been tested? (Not 2’ye bakınız / See note 2)
- Hidrokarbon / Hydrocarbon % LFL (% LFL ‘den az olmalıdır
- Oksijen / Oxygen (%L / % vol (%21)
- Zehirli Gazlar / Toxic Gases ppm (%50′den az olmalıdır. H₂S için max. 5ppm, CO için max. 25ppm / less than %50. For H₂S; max. 5ppm, for CO max. 25ppm) (Not 3’e bakınız / See note 3)

İş devam ederken ve paydosaldan sonra testin tekrarlanması konusunda gerekli tedbirler alındı mı? / Have arrangements been made for frequent atmosphere checks to be made while the space is occupied and after work breaks?

İş devam ederken ve paydosaldan hava çalısmalarının devam etmesi için gerekli tedbirler alındı mı? / Have arrangements been made for the space to be continuously ventilated throughout the period of occupation and during work breaks?

Giriş ve çıkışlarda yeterli mı? / Are access and illumination adequate?

Girişte kurtarma ve hayata döndürme ekipmanı hazır ve acil kullanıma uygun mu? / Is rescue and resuscitation equipment available at the entrance of the space for immediate use?

Girişte sorumlulu bir kişi beklemek üzere atandı mı ve bu kişinin sorumlu zabıt ile direkt iletişim var mı? / Has a responsible person designated to stand by at the entrance of the space and is he/she direct contact with the responsible officer?

Köprüyü, makine ve kargo kontrol vardıya zabitleri giriş hakkında bilgilendirildi mi? / Has the officer of the watch (bridge, engine room and cargo control room) been advised of the planned entry?

Kapalı mahale girişle ilgili tüm taraflar arasında iletişim ve yöntem hakkında test yapıp acil durum sinyali hakkında mutabakat sağlan mı? / Has a system of communication between all parties been tested and emergency signals agreed?

Acil durum ve acil çıkış prosedürü tüm taraflar arasında anlaşılıp kara bağlı mı? / Are emergency and evacuation procedures established and understood by all personnel involved with the enclosed space entry?

İçeri giren kişilerin kaydı edildiği bir sistem oluşturuldu mu? / Is there a system for recording who is in the space?

Mahale kullanılan tüm ekipman girişten önce kontrol/test edildi mi? / is all equipment used in good working condition and inspected prior to entry?

Mahale girecek personel gerekli kişisel koruyucu ekipmanla donatıldı mı? / Are personnel properly clothed and equipped?
### EM-07H-Kapalı mahalle giriş kontrol listesi / Enclosed Space Entry Checklist

**Ship Name/Gem:**

**Assessed by/Değerlendirilen:**

**Location/Ipın Tanesi:**

**Date/Tarih:**

<table>
<thead>
<tr>
<th>Task – premises/Ipın Tanesi:</th>
<th>Assessment Team Members/Değerlendirmeye Ekp Üyeleri</th>
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<tbody>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Hazard/Risk</th>
<th>Existing measures to control risk/Risk Kabul edilecek seviyeye indirilmesi önlemleri</th>
<th>Risk Probability Olasılık</th>
<th>Risk Severity Sıvvet</th>
<th>Risk rating Sıvvet</th>
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<tbody>
<tr>
<td>1</td>
<td>DANGEROUS GAS INSIDE. CHECK THE OXYGEN AND OTHER GAS</td>
<td>3 x</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
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<td>x</td>
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<td>3</td>
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<td>6</td>
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### Revised Risk Assessment Form

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<th>Hazard No/Risk No:</th>
<th>Further action taken for preventing risk/Rud Önləyi Tədbirlər</th>
<th>Revised Risk Probability /Yeni olasılık</th>
<th>Revised Risk Severity Yeni Süvvet</th>
<th>Revised Risk rating Yeni süvvet</th>
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<tbody>
<tr>
<td>1</td>
<td>IF POSSIBLE, OPEN THE ENCLOSED AREA AND WAIT FOR OXYGEN AND DON'T BE ALONE IN ROOM</td>
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<td>4</td>
<td>=</td>
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<td>2</td>
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<td>x</td>
<td>=</td>
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<tr>
<td>3</td>
<td></td>
<td>x</td>
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<tr>
<td>4</td>
<td></td>
<td>x</td>
<td>=</td>
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