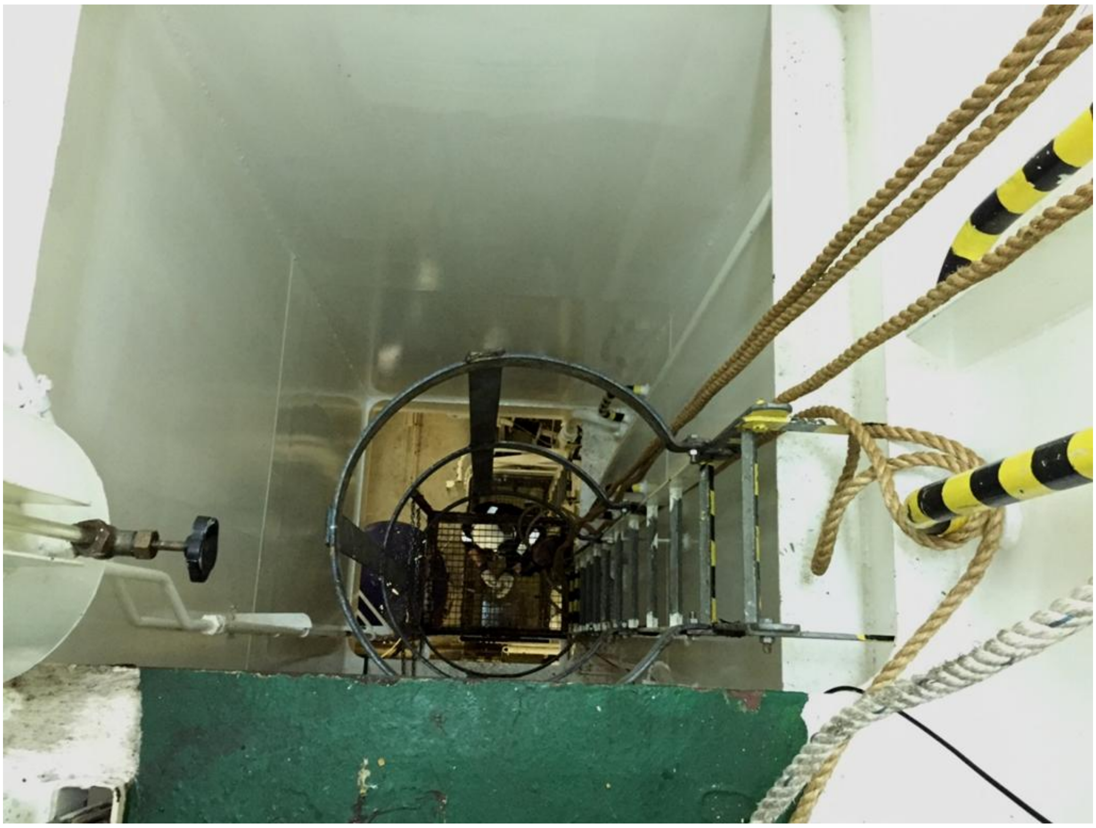
Marine Safety Investigation Unit

Transport Malta



MARINE SAFETY INVESTIGATION REPORT

Safety investigation into the fatality on board the Maltese registered chemical tanker

SCOT BERLIN

at the Oil Tanking Terminal, M'Xlokk, Malta on 13 August 2017

201708/011

MARINE SAFETY INVESTIGATION REPORT NO. 15/2018

FINAL

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 13 August 2017. 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
Maritime House
Lascaris Wharf
Valletta VLT 1921
Malta

CONTENTS

LIST OF REFERENCES AND SOURCES OF INFORMATION

Crew members MT *Scot Berlin*;

IMO Resolution A.1050(27) – Revised Recommendations for Entering Enclosed Spaces Aboard Ships, adopted 30 November 2011;

ISM Managers MT *Scot Berlin*;

Resolution MSC.133(76) – Adoption of Technical Provisions for Means of Access for Inspections, adopted 12 December 2002;

Standard Club – A Master's Guide to Enclosed Space Entry.

GLOSSARY OF TERMS AND ABBREVIATIONS

°C	Degrees Celsius
ABs	Able seafarers
BA	Breathing apparatus
GMT	Greenwich Mean Time
GT	Gross Tonnage
IMO	International Maritime Organization
ISM	International Safety Management
kW	Kilowatt
LR	Lloyd's Register of Shipping
m	Metres
mm	Millimetre
MSIU	Marine Safety Investigation Unit
MT	Motor Tanker
$m^3 hr^{-1}$	Cubic metres per hour
mt	Metric Tonnes
N100	N100 masks are designed to protect the wearer from inhaling non-oil-based particulates and, according to OSHA standards, they must prevent 99.97 % of those particulates from getting in when properly worn. They block dangerous hazards like lead, cadmium, arsenic and methylenedianiline
OOW	Navigational officer of the watch
P3	The half-masks are used to protect against atomised small-sized solid particles, such as dusts, smokes, mists (do not protect against gases). The protective half-masks, made of fabric, are classified into three filtration effectiveness classes, P1, P2 and P3. P3 masks retain about 99.95% of particles smaller than 0.5 micrometer
Rpm	Revolutions per Minute
SMS	Safety Management System
UMS	Unmanned machinery space

SUMMARY

The vessel arrived at Marsaxlokk Oil Tanking Terminal loaded with two parcels of cargo. Following the successful completion of the cargo operation, the crew members started the ballasting of the vessel since her next trip to Spain was a ballast voyage. Ballasting in the forepeak tank started under the supervision of the second mate.

About an hour later, at about 1300, a high bilge level alarm in the bow thruster compartment sounded on the vessel's Alarm Monitoring System. The bosun proceeded forward to investigate. He immediately noticed water escaping from the forepeak tank's manhole, reaching the bow thruster entrance, flowing over the sill plate and cascading on the bow thruster motor. Consequently, one of the bilge alarms in the bow thruster compartment triggered the high level alarm.

Aware of possible issues with the bow thruster motor, the chief engineer instructed the electrician to inspect the motor for any water damages. Prior to the commencement of the work, three safety documents were signed. The bow thruster electrical supply to the ventilation fan and the bow thruster motor was isolated. As part of the cleaning process, the electrician sprayed the motor with an electrical cleaner using a pneumatic spray gun. He then proceeded to the messroom and returned to the bow thruster compartment at around 1600. About 20 minute later, the bosun went to check on the electrician and found him unconscious, lying over the bow thruster tunnel.

Crew members were mustered and attempts made to lift the electrician from the bow thruster compartment. Eventually, shore assistance was requested and personnel from the local Civil Protection Department lifted the electrician to the open space on the forecastle deck. However, he was pronounced dead on board.

In view of the safety actions taken by the Company during the course of the safety investigation, no recommendations were made by the Marine Safety Investigation Unit (MSIU).

1 FACTUAL INFORMATION

1.1 Vessel, Voyage and Marine Casualty Particulars

Name	*Scot Berlin*
Flag	Malta
Classification Society	Lloyd's Register of Shipping (LR)
IMO Number	9255804
Type	Chemical Tanker – Type II & III
Registered Owner	Scot Berlin S.A.
Managers	Scot Gemi Isletmecilgi AS
Construction	Steel (Double Hull)
Length overall	116.90 m
Registered Length	110.40 m
Gross Tonnage	5145
Minimum Safe Manning	13
Authorised Cargo	Liquid Bulk
Port of Departure	Aliaga, Turkey
Port of Arrival	Marsaxlokk, Malta
Type of Voyage	International
Cargo Information	2998.2 mt of Cutter Stock 4697.6 mt of Aromatic oil
Manning	16
Date and Time	13 August 2017 at 16:20
Type of Marine Casualty	Very Serious Marine Casualty
Place on Board	Bowthruster compartment
Injuries/Fatalities	One fatality
Damage/Environmental Impact	None
Ship Operation	Normal Service – Alongside/moored
Voyage Segment	Arrival
External & Internal Environment	Daylight, good visibility, and North Northwesterly force 4 wind. Sea temperature was 22 °C and the air temperature was recorded at 30 °C.
Persons on Board	16

1.2 Description of Vessel

The Maltese registered *Scot Berlin* (Figure 1) is a double hulled chemical / product carrier, built in 2003 at Santierul Naval Damen Galati S.A., Romania. The vessel has a gross tonnage (GT) of 5,145 and is classed by Lloyd's Register of Shipping (LR).

Scot Berlin is owned by Scot Berlin S.A., and the technical management is carried out by Scot Gemi Isletmecilgi AS, based in Istanbul, Turkey (Company). The Company's safety management system (SMS) met the requirements of the International Safety Management System (ISM) Code for tankers. The SMS was audited by LR and the vessel was issued with a Safety Management Certificate valid until 09 April 2021. The Company operates eight other chemical/oil tankers under the Maltese flag.

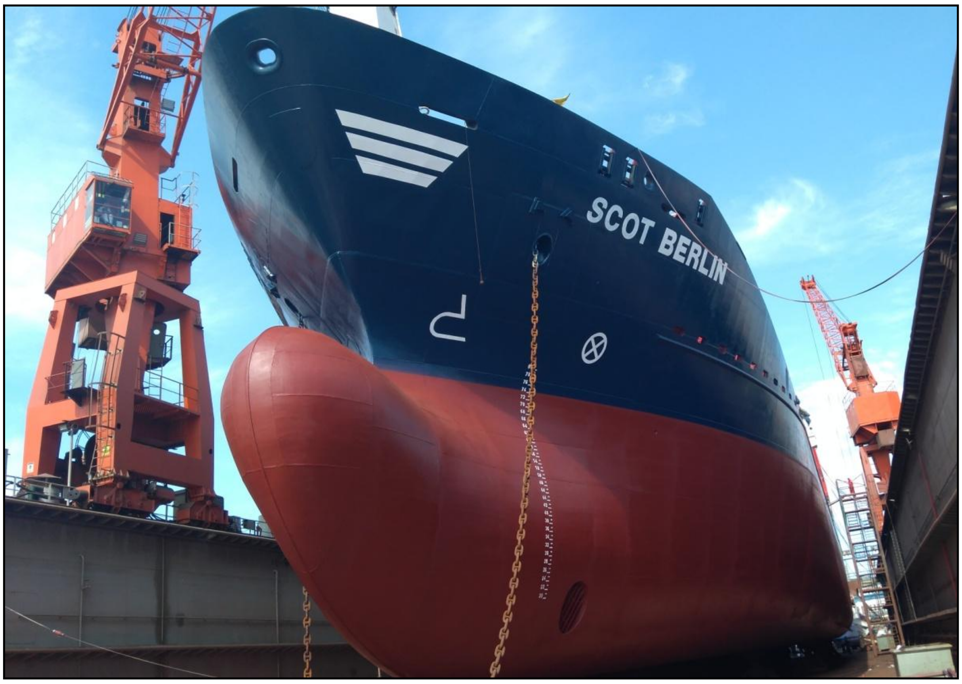


Figure 1: MT *Scot Berlin* (during her latest dry-docking several days before arriving in Malta)

The vessel has a length overall of 116.90 m and a beam of 18.0 m. Her depth is 9.40 m and the maximum deadweight is 8,254 tonnes at a summer draught of 7.40 m. *Scot Berlin*'s propulsive power is provided by two 6-cylinder MAN-B&W, medium speed diesel engines, producing a total of 3,600 kW at 750 rpm. The engines drive two controllable pitch propellers through reduction gearboxes, to reach a service speed of 15.0 knots.

Scot Berlin is also equipped with a tunnel bow thruster, rated at 400 kW.

1.3 Manning and Crew on Board *Scot Berlin*

At the time of the accident, *Scot Berlin* was manned with a compliment of three navigational officers of the watch (OOW), three able seafarers (ABs) and one deck rating. In addition, the vessel had a master, chief engineer, second engineer, a pumpman and three engine-room ratings. An electrician was also part of the vessel's manning. All crew members were Turkish nationals, bar for two ABs and two oilers, who were Georgian nationals.

The working language on board was English.

Scot Berlin manning was in excess of the Minimum Safe Manning Certificate issued by the flag State Administration. The engine-room was required to be manned by only the chief engineer and the second engineer since the vessel had a certified UMS engine-room.

All crew members held the necessary certificates of competency to serve on board *Scot Berlin*. The crew member who lost his life had signed on board as the vessel's electrician. He was 36 years old and had been working as an electrician on board tankers since 2013. He had previously worked for about 18 months with two other companies before he applied to work on Company tankers on 09 August 2016. *Scot Berlin* was his third tanker with the Company. He had signed on board on 24 July 2017 and the duration of the contract was one month.

1.4 The Bow Thruster Compartment

Access to the bow thruster compartment, where the accident happened, is from the main deck through the mast house (Figure 2). Down the first flight of stairs, one would reach the bosun's store, which had an access that led to the bow thruster compartment (Figure 3). The bow thruster compartment is located between frames 150 and 154.

Figure 2: Access to the bow thruster compartment *via* the mast house

Figure 3: Access leading down to the bow thruster compartment from the bosun's store

The bow thruster motor is located inside the compartment, which is also fitted with the bow thruster tunnel, running atwartships (Figure 4). The bow thruster compartment is mechanically ventilated (12,000 $m^3 hr^{-1}$). An electrical motor, rated at 4.0 kW runs the ventilation fan at 2,840 rpm. Air intake is *via* a louvered opening on the mast house (Figure 5).

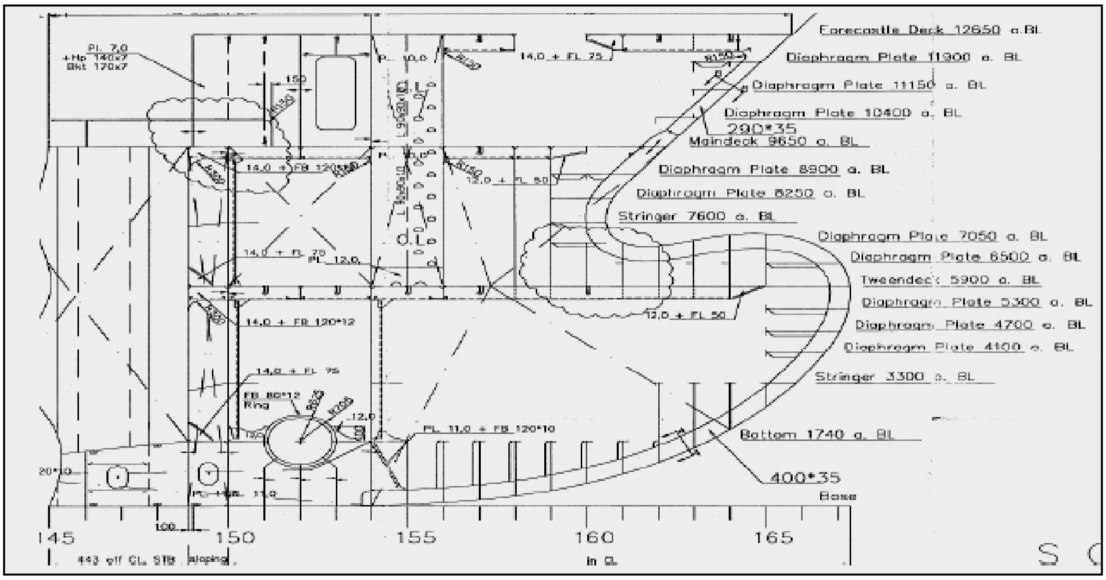


Figure 4: Bow thruster compartment

Figure 5: Ventilation intake leading down to the bow thruster compartment

1.5 Cargo on Board

The vessel arrived at Marsaxlokk Oil Tanking Terminal loaded with two parcels of cargo *i.e.*, 2,998.2 mt of Cutter Stock and 4,679.6 mt of Aromatic Oil. Safety Data sheets for these two cargoes were available on board.

1.5.1 Cutter Stock

Cutter Stock is a complex combination of hydrocarbons obtained by the distillation of steam cracking heavy residues. It consists predominantly of highly alkylated heavy aromatic hydrocarbons, having carbon numbers C10+, and boils in the range of 170 °C and 400 °C. It is black in colour, with a gasoline-like odour. Cutter Stock has a wide range of uses, mainly:

- in the fuel industry;
- as a solvent;
- in the manufacturing industry; and
- as an industrial feedstock formulation functional fluid.

The cargo is highly hazardous with respect to its inhalation even because it is carcinogenetic. Cutter Stock can also cause genetic defects and may be fatal either if ingested or if it enters the airways.

1.5.2 Aromatic Oil

Aromatic Oil is a petroleum residue (steam-cracked light) and a flammable liquid. It has a dark brown to black viscous appearance and also has an aromatic/gasoline odour.

Aromatic Oil also has a wide range of use, mainly:

- in the manufacturing industry;
- as an industrial feedstock; and
- as an industrial fuel.

The cargo liquid / vapour may be toxic if inhaled and even fatal either if swallowed or if it enters the airways. Similar to Cutter Stock, this cargo may cause genetic defects and is also carcinogenic.

1.6 Environment

At the time of the accident, the weather in Malta was characteristically hot, with an outside air temperature of 30 °C. The sea temperature was recorded at 22 °C. The temperature inside the bow thruster compartment was humid and hot, estimated at 35 °C, although no records were maintained on board. A North Northwesterly fresh breeze prevailed in the area, with rough sea outside the port area and a Northwesterly low swell. The sky was clear.

The bosun's store and the bow thruster compartment were well illuminated with artificial lights.

1.7 Narrative[1]

1.7.1 Background to the voyage

Prior to her arrival at Marsaxlokk, the vessel had been in dry-docks (Figure 1) between 26 July 2017 and 05 August 2017, when the dock was refloated again. During her stay in the dry-docks, the vessel underwent planned maintenance programmes, Class and Statutory surveys.

Following her sea trials, *Scot Berlin* proceeded to Izmir, Turkey. She arrived alongside on 07 August 2017. Berthing operations were completed without any problems and the vessel was all fast at 1245. The vessel loaded two parcels of cargo – Cutter Stock and Aromatic Oil. Loading of Cutter Stock was completed on 08 August at 1700. The loading of Aromatic Oil was completed at 1000 on 10 August 2017.

1.7.2 Accident dynamics

Following the necessary formalities, the vessel departed Izmir with a draft of 7.41 m (even keel). Her discharge port was Marsaxlokk, Malta. The voyage was uneventful and the vessel arrived at Marsaxlokk Fairway Buoy on 12 August 2017. The pilot was picked up and the vessel manoeuvred inside Marsaxlokk Oil Terminal, were she was alongside and all fast at about 2100 (Figure 6). Discharge of cargo commenced several hours later on 13 August 2017, shortly after midnight.

---

1 Unless otherwise stated, all times are local (GMT +2).

Figure 6: Marsaxlokk Oil Terminal and location of the vessel at the time of the accident

Following the successful completion of the cargo discharge operation, the crew members started ballasting the vessel for the ballast trip to Spain. Ballasting in the forepeak tank started under the supervision of the second mate. About an hour later, at 1300, a high bilge level alarm in the bow thruster compartment sounded on the vessel's Alarm Monitoring System. Noticing the alarm, the chief mate instructed the bosun to proceed to the area to investigate and report back on his findings.

As instructed, the bosun made his way to the bow thruster compartment. Going down to the bosun's store level, he immediately noticed water escaping from the forepeak tank's manhole (Figure 7). The bosun also noticed that the overflowing water from the leaking forepeak tank manhole cover had reached the bow thruster compartment entrance and was flowing over the sill plate (Figure 8), cascading on the bow thruster motor. One of the bilge alarms in the bow thruster compartment, triggered the high level alarm when the water level reached a height of about 145 mm (Figure 9).

Figure 7: Forepeak tank manhole cover

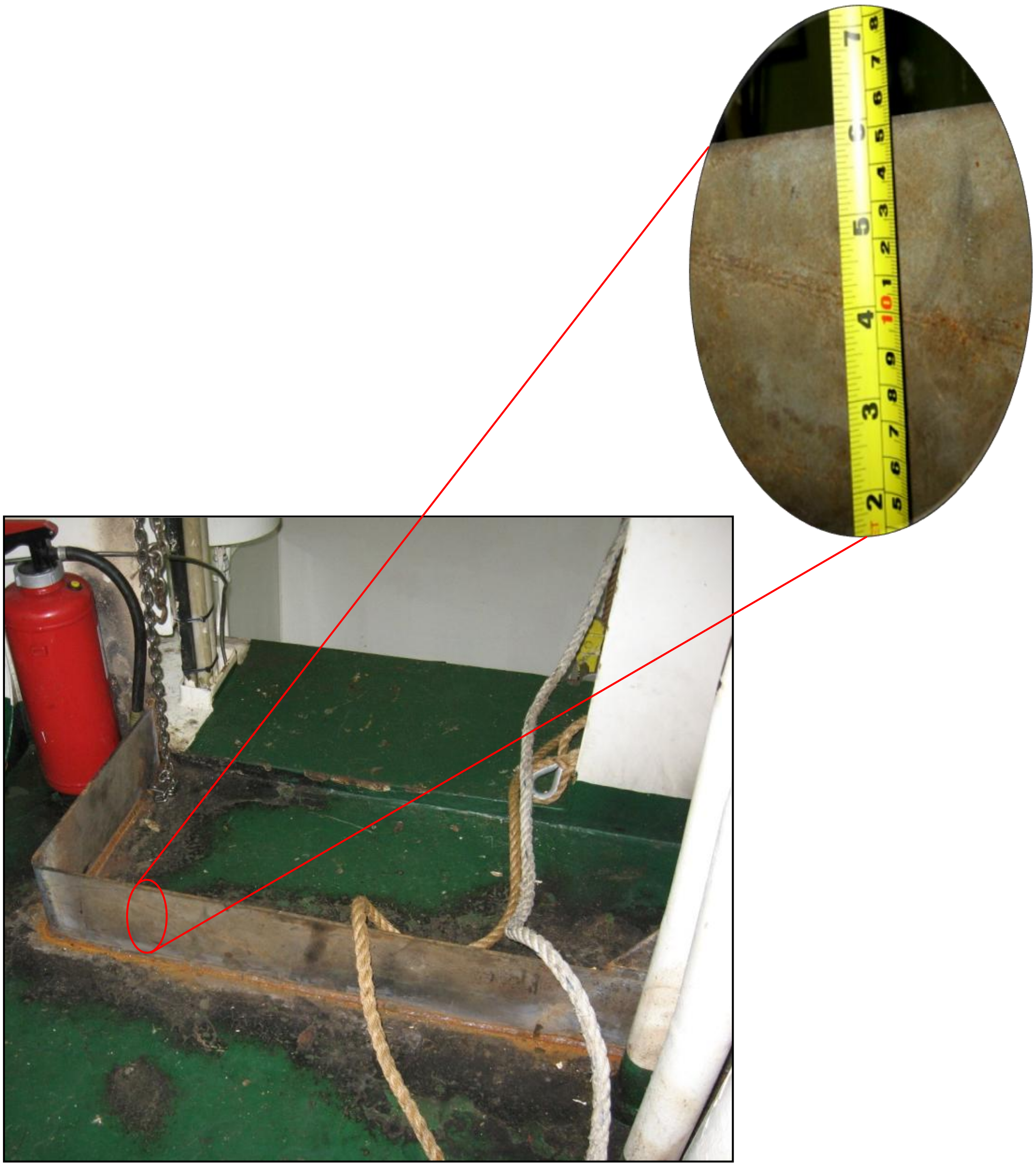


Figure 8: Entrance sill which had a height of 150 mm.

Figure 9: High level alarm inside the bow thruster compartment bilges

The situation was reported to the chief mate and the ballasting operation was stopped immediately. However, the bow thruster motor was already wet with the overflowing water from above. The chief mate informed the master and the chief engineer of the situation and instructed several other crew members to start cleaning the bosun's store and the bow thruster compartment. Aware of the possible issues with the bow thruster motor, the chief engineer advised the electrician to inspect the motor for any water damage.

Prior to the commencement of the work, three documents were signed (on the day of the accident):

- a Risk Assessment Form, signed by the master, chief engineer and the chief mate;
- a Lock Out & Tag Out Permit, signed by the chief engineer and the electrician; and
- an Electrical Circuit Work Permit, signed by the chief engineer and the electrician.

By the time the electrician and the bosun entered the forecastle space for the inspection of the bow thruster motor, the water had already been pumped out of the compartment. The bow thruster's electrical supply to the forward auxiliary switchboard was isolated and both crew members made their way to the bow thruster compartment for the initial assessment of the condition. Following their assessment, both the electrician and the bosun left the space at about 1500 and the former proceeded to the chief engineer's cabin to discuss his findings. The matter and the way forward were further raised with the Company.

Following these discussions, both the bosun and the electrician proceeded again to the bow thruster compartment, carrying some tools. They also lowered a spray gun. Air supply was available right at the entrance to the bow thruster compartment (Figure 10).

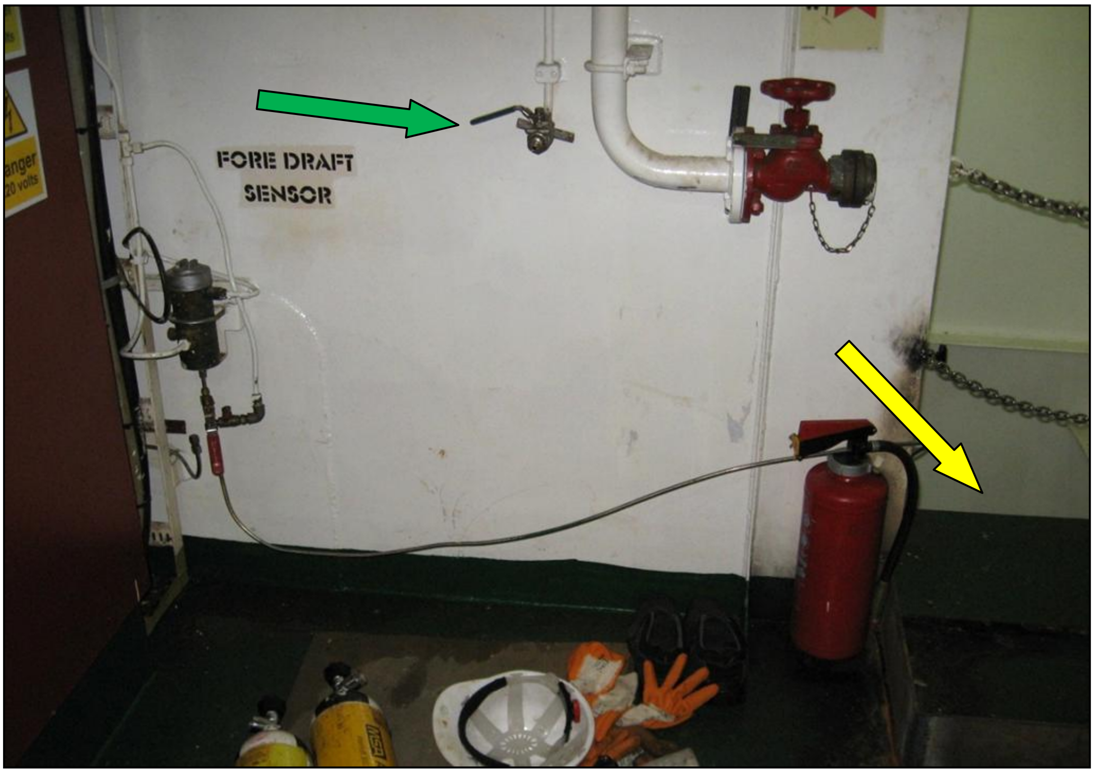


Figure 10: Working air pressure supply at the bow thruster compartment entrance (yellow arrow)

A small container of electrical cleaner was also carried down to the bow thruster compartment. Electrical terminals to the bow thruster motor were disconnected. In the meantime, the bosun left the bow thruster compartment to resume his work on the main deck. The bosun recalled that about 10 minutes after he had left the bow thruster compartment, he noticed that the electrician had returned on the main deck. There, the latter informed the bosun that he had sprayed the motor with the electrical cleaner and that he was proceeding to the messroom for a coffee break.

At about 1600, the bosun observed the electrician on the main deck again, carrying three bottles of water and making his way towards the bow thruster compartment. The bosun talked to the electrician briefly, who told him that his intentions were to clean the bow thruster motor with fresh water. In the meantime, the cargo operations were completed at 1615 and five minutes later, after finishing off his work on the main deck, the bosun proceeded to the bow thruster compartment to enquire whether the electrician needed assistance.

Upon reaching the entrance to the bow thruster compartment to climb down the ladder, the bosun noticed the electrician lying face down on the bottom platform (Figure 11).

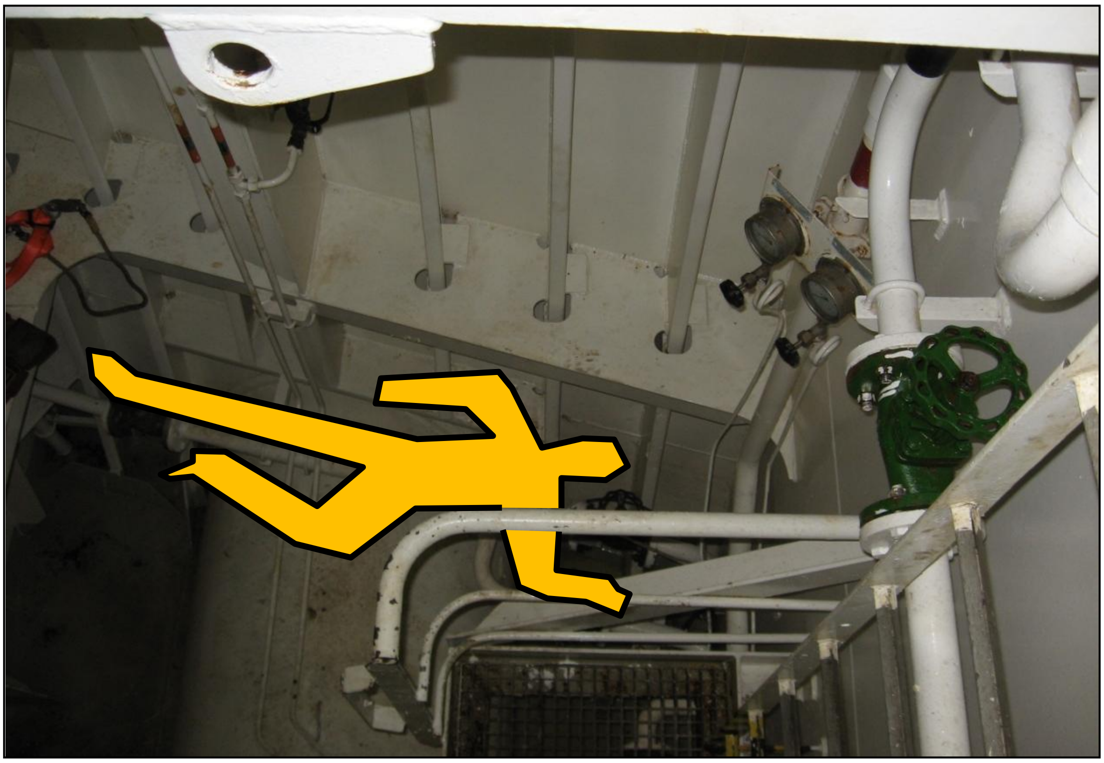


Figure 11: Position of the electrician, as found by the bosun

Concerned, the bosun called the electrician but there was no response. The bosun ran to the cargo control room to inform the master and the chief mate of the situation. The master and the chief mate made their way to the bow thruster compartment and the master even climbed down to the bow thruster compartment. He checked the condition of the electrician, who remained unresponsive. The master had to leave the space shortly due to the strong smell of chemicals.

In the meantime, the ship's rescue team had been mustered. The chief mate and the second engineer donned their breathing apparatus (BA) sets and climbed down the bow thruster compartment. The master called the ship's agent and medical assistance was requested. In the meantime, the rescue team was busy administering first aid and trying to resuscitate the electrician. It had also become evident that it would not be possible to recover the electrician from the bow thruster space and at about 1633, the local Civil Protection Department was called to assist. Eventually, at about 1720, the electrician was recovered from the space. Medical assistance continued on the main deck, however, at 1810, the electrician was pronounced dead.

1.7.3 Cause of death

The cause of death was identified as cardio respiratory failure. However, at the time of writing the safety investigation report, the autopsy and toxicological reports had not yet been released by the local authorities.

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 The Flooding inside the Bow Thruster Compartment

Prior to her laden voyage to Malta, the vessel had been in the shipyard for her scheduled dry-docking. The shipyard is a location where the workload on the crew members is significantly higher than the usual, normal, routine operation of a ship. The physical and mental demands are high and the vessel's schedule would have barely left time to the crew members to recover, not to mention the inevitable interruptions and other distractions, which one would typically expect to encounter under these circumstances.

Under high workload conditions, detailed attention to all specifics is simply difficult to achieve. Particular aspects can (and will) compete for attention with one another. Such is the nature of work at a shipyard that it is very likely that a necessary check (*e.g.*, that all manhole covers are tight) can be inadvertently omitted because of some local distraction. Research in error varieties suggest that interruptions may easily lead a person to get involved into something else, leading to omissions in the original sequential actions.

Naturally, these errors do not happen in a vacuum and a number of factors would have possibly contributed to an omission to check the tightness of the manhole covers. The safety investigation did not have any evidence to identify clearly these factors. However, considering the nature of the work in the dry-docks, it was not excluded that the following factors may have contributed to this omission:

- *Documentation*: documents are important because they communicate instructions and serve as a record of the tasks being carried out and completed. Unless comprehensive / exhaustive (which is not necessarily achievable), a crew member who has to coordinate various tasks simultaneously may potentially omit steps within a procedural activity;

- *Time pressure*: inspections and functional tests are normally carried out towards the end of the maintenance tasks, when time pressures to resume the schedule are likely to be high, thereby compromising these final checks; and
- *Coordination and Communication*: the complexity of tasks carried out in a shipyard, brought about by the multitude and potential time pressures, may lead to coordination and communication breakdowns.

2.3 Conditions inside the Bow Thruster Compartment

The fact that the occurrence happened inside the bow thruster compartment necessitated an analysis of the internal environment, *i.e.*, the bow thruster space. IMO Resolution A.1050(27), adopted on 30 November 2011, provides a set of revised recommendations for entering enclosed spaces on board ships. All preventive and protective barrier systems relevant to enclosed spaces depend on whether the space is actually considered as enclosed.

The IMO Assembly Resolution defines an enclosed space as one with the following characteristics:

1. limited openings for entry and exit;
2. inadequate ventilation; and
3. is not designed for continuous worker occupancy.

The Resolution then goes on to present a list of spaces which are considered as enclosed spaces. Bow thruster compartments are not included in the list, although the document makes it clear that the list is not exhaustive.

The Company did not consider the bow thruster as an enclosed space and consequently, this space was not addressed as such in the SMS.

The safety investigation was also of the view that the bow thruster compartment did not classify as an enclosed space on the basis of:

- the opening, which was not limited and was adequate and provided a safe means of access;
- the ventilation, which was mechanical and provided adequate flow of fresh air from the outside on the main deck; and
- the space was adequately lit artificially through the access shaft, down to the actual bow thruster space.

By virtue of the above, the preventive (corporeal) barrier systems focussed on the hazard related to the bow thruster motor, *i.e.*, electric shock. The MSIU believes that the environment inside the bow thruster compartment had changed to a hazardous one just before the accident happened for two main factors:

1. presence of toxic, flammable, vapours; and
2. absence of proper ventilation.

As a direct result of the change in the bow thruster compartment conditions, the safety investigation concluded that at the time of the accident, the bow thruster compartment's characteristics were similar to those of an enclosed space, without actually being declared as such.

2.3.1 Presence of toxic, flammable vapours

The chemical used for the cleaning of the bow thruster motor was 'ER-Elektrik', a transparent electric cleaner (Figure 12), and was applied by means of a spray gun (Figure 13).

Figure 12: The chemical used in the bow thruster room

Figure 13: The spray gun used inside the bow thruster compartment, after it was recovered by the Civil Protection Department personnel

As explained elsewhere, the pneumatic supply was taken from a working air outlet valve, located inside the bosun's store, just outside the entrance to the bow thruster compartment (Figure 9). A pneumatic spray gun produces a consistent spray of thousands of tiny, atomised droplets, as soon as the trigger is pulled.

The chemical composition of the substance was tetrachloroethylene (between 30 % and 50 % by weight) and other chemicals, which did not contribute to the classification of the product – hence, not classified (50 % to 70 % by weight). The electro cleaner available on board was carried in a 25-litre blue, plastic container. The label on the container carried a number of hazard and precautionary statements, the most relevant being that if inhaled, the exposed person should be removed to fresh air and to keep comfortable for breathing. In addition, as a first aid measure, artificial respiration had to be applied.

The Safety Data Sheet (**Annex A**) also specified that vapours, mist or gas should not be inhaled. In particular, body protection (complete suit protection against chemicals) was also required, depending on the contamination and amount of chemical used. A full-face particle respirator type N100 or P3 respirator cartridge as a back-up to engineering controls was required. A full-face air respirator was necessary if the respirator was the sole means of protection.

The safety investigation could not determine whether the electrician was aware of these instructions, perhaps by virtue of previous use of the chemical. It was clear, however, that these were not referred to on the day of the accident. The electrician was not wearing any respiratory safety equipment; the limited amount of (liquid) volume used may have led the electrician to believe that extensive protective clothing was not necessary in this particular case.

2.3.2 Absence of proper ventilation

Prior to commencing any work, the electrical supply to the bow thruster compartment was isolated from the auxiliary switchboard. It was hypothesised that this was a precautionary measure by the electrician to test the insulation of the bow thruster motor windings. As indicated elsewhere in this safety investigation report, the isolation of the auxiliary switchboard resulted in the isolation of the compartment's ventilation fan, thereby compromising the supply of fresh air.

It was also considered possible that the electrical supply to the ventilation fan was isolated by the electrician following the decision to use the spray gun to apply the electro cleaner. It is definite that the proper application of the electro cleaner would have been compromised had the rather strong air flow generated by the ventilation fan been maintained and perhaps this was also one reason why the ventilation was stopped. However, the MSIU did not have any evidence to support this hypothesis.

Nonetheless, it may be considered plausible to conclude that any (released) vaporised cleaning chemical would have been entrapped inside the bow thruster compartment; this was confirmed by the strong odour detected by the master when he first entered the space soon after the alarm was raised. The exposure to the chemical could have lasted about 20 minutes and it was considered possible that the vapour may have knocked the electrician unconscious, soon after he reached the lower area of the bow thruster compartment / access point.

2.4 Position of the Body inside the Bow Thruster Compartment

Evidence collected by the MSIU confirmed that the body was found on the bow thruster tunnel in a fore and aft position (Figure 11). This was suggestive that the electrician was most probably going down the ladder but was also somewhere close to the ladder's lower platform. It was considered rather difficult for the electrician to fall on the bow thruster tunnel from the inside of the ladder's safety cage. Nonetheless, it has to be stated that the electrician was noticed walking towards the bow thruster compartment, carrying three bottles of water.

The bottles of water were found in the bow thruster compartment bilges and it was apparent that these may have been dropped from a height. As indicated in sub-section 1.5.3 of this safety investigation report, the MSIU did not have access to the autopsy and toxicological reports and therefore, the cause of death remains unconfirmed to this safety investigation. The crew members recalled that the electrician had an injury in the thoracic area, suggesting a fall from a height. It was not excluded that the electrician may have also lost his grip and fell from the lower section of the ladder / lower platform onto the bow thruster tunnel.

2.5 Communication and Work Preparation

During the course of the safety investigation, the chief engineer stated that he had communicated with the electrician, following the latter's assessment of the bow thruster motor. The chief engineer claimed that he was informed of a small issue only with the electrical motor. The chief engineer also clarified that he had discussed a two-stage approach, *i.e.*:

- measure the motor windings insulation; and, if necessary,
- use fresh water to clean salt residues from the motor's terminal box.

The chief engineer recalled seeing the electrician carrying bottles of fresh water but he explained that he neither saw him carry the electro cleaner nor was he aware that the chemical had actually been used to clean the motor.

Taking into consideration the information provided by the chief engineer and the fact that the electrician was not accompanied by any crew member when he was in the bow thruster compartment (bar for a brief period of time when the bosun was present), this was suggestive that the cleaning of the electrical parts using the electro cleaner had not been discussed in any way.

It may be stated that communication in a group, including crew members on board a ship, is a key process by means of which, tasks are coordinated and eventually carried out. Academic research shows that actions are effectively co-ordinated by virtue of instructions, clarifying intentions and transmitting / receiving information. It is clear that the absence of communication may result in problems because different mental models are not communicated.

It was apparent to the safety investigation that for instance, the chief engineer was neither privy of the intentions of the electrician, nor the situation inside the bow thruster compartment.

Barriers to communication are manifested in several ways and not just by failures in spoken and / or non-verbal communication. Message failure also occurs when the vehicle to communicate exists but the necessary information is actually either not transmitted or delayed. Evidence collected during the course of the safety investigation suggested that the use and application of the electro cleaner was an initiative, which was adopted with all good intentions and to minimise as much as possible the damage to the electrical components of the bow thruster motor. Nonetheless, it was not communicated to the senior management of the engine-room.

The bosun also did not communicate the actions of the electrician. However, this is understandable; the bosun being aware that the electrician was more knowledgeable and therefore must have had control of the situation. As yet, the use of the electro cleaner (and the way it was applied) was critical, safety information that had not been communicated.

Similarly, no assistance was requested by the electrician with respect to the carriage of the three water bottles while going down inside the bow thruster compartment. It was evident that the risk involved was considered manageable by the electrician and it would have necessitated neither the assistance of other crew members nor the need to lower the bottles before going down the ladder.

Irrespective of whether the issue was the use of the chemical or the descent with limited articulation, effective team interaction and coordination would have been crucial because the electrician was otherwise working as an individual and on his own. This was problematic in the sense that the electrician was unable to make use of knowledge and skills which his colleagues could have contributed towards a safer task[2]. Rather, the tasks were affected on the basis of how the risks and their controls were perceived at the time.

The safety investigation was of the view that the nature of the tasks and the competence[3] of the electrician were perceived as not necessitating formal team / group collaboration.

[2] This is known as interdependencies of team dynamics.

[3] The electrician was considered to be a highly knowledgeable and motivated crew member, whose approach was such that tasks that may be readily executed were not procrastinated.

2.6 Acceptance of Risk and Emotions

During the course of the safety investigation, it was observed that as soon it was reported that the electrician was lying motionless at the bottom of the bow thruster compartment, the behaviour of the crew members on the main deck (including the master) changed to active members trying to recover the unfolding situation.

At a time when team dynamics should have been applied, the complexity and urgency of the circumstances contributed to a condition where the master took initiatives of his own and even accessed the bow thruster compartment where, on his way down, he could smell a strong, chemical odour. Evidence indicated that the master accessed the bow thruster compartment without a rescue harness and safety lines, possibly because these may have been viewed as a hindrance to act quickly and time consuming to don at such critical time.

Academic research suggests that acceptance of risk can be situational, *i.e.* it depends on the prevailing situation and hence can change on the basis of the situation. Therefore, in line with this school of thought, the fact that risk acceptance comes at different levels, is also suggestive that safety comes at different levels. It is therefore evident that any decisions taken on the basis of risk acceptance, would have influenced the level of safety – and the decision of the master to access the bow thruster compartment has so demonstrated. Decision-making in terms of risk is mentally framed, depending on the prevailing situation.

In addition to the prevailing situation, it is also claimed that the mind frame's impact (*i.e.* the degree of risk-aversion or risk-seeking) is significantly influenced by emotions. This depends on the type of problem, such as a life and death situation and, of course, the type of emotion under consideration. Thus, when the same problem is perceived from a different perspective (due to emotions), the decision outcome may be different (than expected). In other words, emotions may affect risk selection – (risk-aversal or risk-seeking) and the framing of the risk decision.

It has been mentioned that the decision-making process occurs in the presence of cognitive processes and emotional influences. It is important to clarify, however, that it is not necessarily the case that cognitive processes and emotions work in tandem. In fact, scholars claim that emotion and cognitive responses may very well compete with one another. Thus, for instance, not only a negative frame (*e.g.*, death) is normally correlated with risk-seeking behavioural alternatives, but is even less prone to be affected by decision-making and conscious avoidance when the emotion is the result of a life and death situation.

In this particular occurrence, it was evident that the decision of the master to access the bow thruster compartment without taking the necessary precautions, was reached in critical short time and affected by life and death emotions.

Several studies have indicated that the concepts of emotional reactions and risk assessments may be conflicting with one another. In fact, it has been submitted that the two concepts can even be antagonistic to one another, with emotional reactions leading to a more risk-seeking behaviour. Having said that, there are academic contributions, which while subscribing to the concepts of emotional reactions and risk assessments (*i.e.* cognitive processes), emphasise the possibility that exhibited behaviour is the outcome of interplay between emotions and cognitive considerations.

This suggests that the emotional preferences chosen by the master, who opted to make the (personal) entry initiative, were seen to be more efficient in achieving the intended goal of (possibly) saving a crew member inside the bow thruster compartment. Therefore, in this case, it was indicative that rather than having a faulty perception of potential losses, the master had a positive affect associated with the perception of potential opportunities, *i.e.*, saving the life of the electrician.

THE FOLLOWING CONCLUSIONS AND SAFETY ACTIONS SHALL IN NO CASE CREATE A PRESUMPTION OF BLAME OR LIABILITY. NEITHER ARE THEY 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 the entry into a space which had a significant presence of toxic gases suspended in the air.

3.2 Latent Conditions and other Safety Factors

.1 Preventive (corporeal) barrier systems focussed on the hazard related to the bow thruster motor, *i.e.*, electric shock;

.2 The environment inside the bow thruster compartment changed to a hazardous one just before the accident happened;

.3 At the time of the accident, the bow thruster compartment’s characteristics were similar to those of an enclosed space without being declared as such;

.4 The hazard and precautionary statements related to the use of the chemical were not discussed on the day of the accident;

.5 The electrician was not wearing any respiratory safety equipment;

.6 The limited amount of volume of chemical used may have led the electrician to believe that the extensive protective clothing was not required in this case;

.7 The isolation of the auxiliary switchboard resulted in the switching off of the bow thruster compartment ventilation, compromising the supply of fresh air inside the space;

.8 Vaporised cleaning chemical would have been entrapped inside the bow thruster compartment;

.9 It was not excluded that the electrician may have also lost his grip and fell from the lower section of the ladder / lower platform onto the bow thruster tunnel while holding the bottles of fresh water;

.10 The use of the electro cleaner (and the way it was applied) was critical, safety information that had not been communicated;

.11 The risk involved with the carriage of the three water bottles while going down the ladder was considered manageable by the electrician and it would have necessitated neither the assistance of other crew members nor the need to lower the bottles by a rope before going down the ladder;

.12 The electrician was unable to make use of knowledge and skills which his colleagues could have contributed towards a safer task.

3.3 Other Findings

.1 At the shipyard, the physical and mental demands were high and the vessel's schedule would have barely left time to the crew members to recover, not to mention the inevitable interruptions and other distractions which one would expect to encounter in similar places;

.2 Under high workload conditions, attention to all specifics in detail is simply difficult to achieve;

.3 Such is the nature of work at a shipyard that it is very likely that a necessary check (*e.g.* that all manhole covers are tight) is omitted because of some local distraction;

.4 Considering the nature of the work in the dry-docks, it was not excluded that the details in the documentation, time pressure, and coordination and communication breakdowns may have contributed to the omission of checking the tightness of the manhole cover;

.5 The bow thruster compartment did not classify as an enclosed space;

.6 The electrician was most probably going down the ladder but also somewhere close to the ladder's lower platform;

.7 The chief engineer neither saw the electrician carrying the electro cleaner nor was he aware that the electro cleaner was actually used to clean the motor;

.8 The use and application of the electro cleaner was an initiative, which was adopted with all good intentions to minimise as much as possible the damage to the electrical components of the bow thruster motor;

.9 The nature of the tasks and the competence of the electrician were perceived as not necessitating formal team / group collaboration;

.10 At a time when team dynamics should have been applied, the complexity and urgency of the circumstances contributed to a condition where the master took initiatives of his own and even accessed the bow thruster compartment where, on his way down, he could smell a strong, chemical odour;

.11 The master accessed the bow thruster compartment without a rescue harness and safety lines, possibly because these may have been viewed as a hindrance to act quickly and time consuming to don at such critical time;

.12 The emotional preferences chosen by the master, who opted to make the (personal) entry initiative were seen to be more efficient in achieving the intended goal of (possibly) saving a crew member inside the bow thruster compartment;

.13 Rather than having a faulty perception of potential losses, the master had a positive affect associated with the perception of potential opportunities, *i.e.* saving the life of the electrician.

4 ACTIONS TAKEN

4.1 Safety Actions Taken During the Course of the Safety Investigation

During the course of the safety investigation, the Company took the following safety actions, intended to prevent a recurrence of a similar accident:

1. An internal safety investigation report, compiled in accordance with Section 9 of the ISM Code, has been circulated on all Company managed vessels for training purposes;
2. An entry procedure for non-enclosed spaces with a vertical ladder has been drafted and implemented on board. The procedure includes STOP cards, notification posters and recovery procedures;
3. The procedures addressing the handling of chemicals and their restricted use has been strengthened and is now part of the work permit process;
4. The dry-docking procedure has been revised. A new section in the Company's 'Dry Docking Safety Checks' Form has been introduced to ensure a thorough check of all areas prior to refloating;
5. Drills for 'rescue from enclosed spaces' have been amended and are now more detailed. The frequency of the drills has also been increased.

5 RECOMMENDATIONS

In view of the conclusions reached and taking into consideration the safety actions taken during the course of the safety investigation, no safety recommendations have been made by the MSIU.

ANNEXES

Annex A Safety Data Sheet

ER-ELECTRIC

Worldwide Services

SAFETY DATA SHEET
according to Regulation (EC) No. 1907/2006
Regulation on the Safety Data Sheets Relating to
Hazardous substances and mixtures
(12/13/2014 Date and Official Gazette No. 29204)
Version 5.1 Revision Date 09.02.2016
Print Date 09.02.2016
GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY

1.1 Product Identifier

Product Name : **ER-ELECTRIC**
Product Code : SP-KS-059

1.2 Relevant identified uses of the substance or mixture and uses advised against

Product Type : Electrical equipments cleaner
Uses advised against: This product is not recommended for any industrial, professional or consumer use other than the Intended Uses above.

1.3 Details of the supplier of the safety data sheet

Producer : Ertek Kimya Tic. ve San. A.Ş.
Address : Esenkent Mah. Methiye Sok. No:1 Ümraniye İSTANBUL / TURKEY
Telephone : 90 0216 499 50 00 – 90 0216 499 50 01
Fax : 90 0216 499 50 02
E-mail&Web site : info@ertekkimya.com; www.ertekkimya.com

1.4 Emergency telephone number

Tel. No.: 90 0216 499 50 00 (including working hours)
NATIONAL POISON INFORMATION CENTRE :114

2. HAZARDS IDENTIFICATION

2.1 Classification of the mixture

Classification under EC 1272/2008 regulation - GHS classification.

Classification according to Regulation (EC) No 1272/2008
Skin irritation (Category 2), H315
Eye irritation (Category 2), H319
Skin sensitisation (Category 1), H317
Carcinogenicity (Category 2), H351
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336
Chronic aquatic toxicity (Category 2), H411
For the full text of the H-Statements mentioned in this Section, see Section 16.

Page Number:1/8 *Version 5.1 Revision Date 09.02.2016*

2.2 Label elements

Hazard Pictograms

SIGNAL WORD: DANGER

Hazard Statements

H315 Causes skin irritation.
H317 May cause an allergic skin reaction.
H319 Causes serious eye irritation.
H336 May cause drowsiness or dizziness.
H351 Suspected of causing cancer.
H411 Toxic to aquatic life with long lasting effects.

Precautionary Statements

P273 Avoid release to the environment.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.
P304 + P340 + P312 IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P333 + P313 If skin irritation or rash occurs: Get medical advice/ attention.
P337 + P313 If eye irritation persists: Get medical advice/ attention.
P391 Collect spillage.
Supplemental Hazard Statements none

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Chemical Composition:
Hazardous ingredients according to Regulation (EC) No 1272/2008

No	Ingredients name	CAS-NO	EC NO	Cons.(weight%)	Classification
1	Tetrachloroethylene	127-18-4	204-825-9 IndexNo.602-028-00-4	30-50	Skin Irrit. 2; Eye Irrit. 2; Skin Sens. 1; Carc. 2; STOT SE 3; Aquatic Chronic 2; H315, H317, H319, H336, H351, H411
2	Ingredients that do not contribute to the classification of the product (not classified)	-	-	50-70	-

For the full text of the H-Statements and R-Phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURE

4.1 Description of first aid measures
General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.
In case of skin contact
Wash off with soap and plenty of water. Consult a physician.
In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician..
4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11
4.3 Indication of any immediate medical attention and special treatment needed
no data available

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media
Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
5.2 Special hazards arising from the substance or mixture
Carbon oxides, Hydrogen chloride gas
5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.
5.4 Further information
No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.
For personal protection see section 8
6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.
6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
For precautions see section 2.2.
7.2 Conditions for safe storage, including any incompatibilities
Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.
Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects
7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters
Components with workplace control parameters

8.2 Exposure controls
Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment
Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).
Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.
The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
Full contact
Material: Fluorinated rubber
Minimum layer thickness: 0,7 mm
Break through time: 480 min
Material tested: Vitoject®(KCL 890)
Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0,2 mm
Break through time: 49 min
Material tested:Dermatril® (KCL 743)
data source: KCL GmbH, D-36124 Eichenzell, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).
Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Form: Liquid	**Air Active:** Not applicable	**Colour:** Transparent
Rel. vapour density: 5,73	**Odor :** Solvent	**Ignition temp:** Not established
Solubility in Water: Do not dissolve.	**Moleculer weight:** Not applicable	**Expl.limit:** Not established
MeltingPoint/range:-22 °C	**Density:** 1.40 – 1.50 gram / cm^3	**Vapour pressure:** 19 hPa at 20°C
Boiling Point : 121 °C (760 mm Hg)	**Saturaction conc :** Not applicable	**Decomposition temp.:** >150°C
Viscosity: ca.0,9 mPa.s 20°C	**Flash Point:** -	**pH (1% conc):** Not applicable

9.2 Other safety information
No data available

10. STABILITY AND REACTIVITY

10.1 Reactivity
No data available
10.2 Chemical stability
Stable under recommended storage conditions.
10.3 Possibility of hazardous reactions
No data available
10.4 Conditions to avoid
No data available
10.5 Incompatible materials
Strong oxidizing agents, Strong bases

10.6 Hazardous decomposition products
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - female - 3.005 mg/kg
(OECD Test Guideline 401)
LC50 Inhalation - Rat - male and female - 6 h - 28 mg/l
LD50 Dermal - Rabbit - 5.000 mg/kg

Skin corrosion/irritation
Skin - Rabbit
Result: Skin irritation - 4 h
(OECD Test Guideline 404)

Serious eye damage/eye irritation
Eyes - Rabbit
Result: Mild eye irritation - 24 h
Respiratory or skin sensitisation
- Mouse
Result: May cause sensitisation by skin contact.
(OECD Test Guideline 429)
Germ cell mutagenicity
Hamster
ovary
Result: negative
OECD Test Guideline 474
Mouse - male
Result: negative
Carcinogenicity
Limited evidence of carcinogenicity in animal studies
IARC: 2A - Group 2A: Probably carcinogenic to humans (Tetrachloroethylene)
Reproductive toxicity
No data available
Specific target organ toxicity - single exposure
May cause drowsiness or dizziness

Specific target organ toxicity - repeated exposure
No data available
Aspiration hazard

No data available
Additional Information
Repeated dose toxicity - Mouse - female - Oral - Lowest observed adverse effect level - 390 mg/kg
RTECS: KX3850000
narcosis, Liver injury may occur., Kidney injury may occur.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Oncorhynchus mykiss (rainbow trout) - 5 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 7,50 mg/l - 48 h
Toxicity to algae static test	EC50 - Skeletonema costatum - > 16 mg/l - 7 h

12.2 Persistence and degradability

Biodegradability: aerobic - Exposure time 28 d
Result: 11 % - Not readily biodegradable.
(OECD Test Guideline 301C)

12.3 Bioaccumulative potential

Bioaccumulation: Lepomis macrochirus (Bluegill) - 21 d
- 0,00343 mg/l
Bioconcentration factor (BCF): 49

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects

Toxic to aquatic life with long lasting effects.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

14.1 UN number

ADR/RID: 2810 IMDG: 2810 IATA: 2810

14.2 UN proper shipping name

ADR/RID: TOXIC LIQUID, ORGANIC, N.O.S.
IMDG: TOXIC LIQUID, ORGANIC, N.O.S.
IATA: TOXIC LIQUID, ORGANIC, N.O.S.

14.3 Transport hazard class(es)

ADR/RID: 6.1 IMDG: 6.1 IATA: 6.1

14.4 Packaging group

ADR/RID: III IMDG: III IATA: III

14.5 Environmental hazards
ADR/RID: yes IMDG Marine Pollutant: yes IATA: no

14.6 Special precautions for user
no data available

15. REGULATORY INFORMATION

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture
no data available
15.2 Chemical Safety Assessment
no data available

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Aquatic Chronic Chronic aquatic toxicity
Carc. Carcinogenicity
Eye Irrit. Eye irritation
H315 Causes skin irritation.
H317 May cause an allergic skin reaction.
H319 Causes serious eye irritation.
H336 May cause drowsiness or dizziness.
H351 Suspected of causing cancer.
H411 Toxic to aquatic life with long lasting effects.
Skin Irrit. Skin irritation
Skin Sens. Skin sensitisation

This safety data sheet has been prepared on the basis of information given by our suppliers and our present knowledge. Information given is intended to present guidelines for safe handling, use, processing, storage, transport, disposal and discharge; it is not intended to be a guarantee or quality specification. The intent of this safety data sheet is to give a description of the product with regard to safe storage, handling and use. Information given applies only to the product itself, and not in combination with other products or in any processed form, unless this is specified in the text. We believe that all information in this safety data sheet (which replaces all previous versions) was correct at the date of issue. It is the responsibility of the recipient of this safety data sheet to ensure that information given here is read and understood by all who use, handle, dispose of or in any way come in contact with the product.