Report on the investigation of the accident on board

MV VIGOROSO

on

28th April 2009

This report is subject to the Gibraltar Merchant Shipping (Accident Reporting & Investigation) Regulations 2006.

Government of Gibraltar
Maritime Administration
Watergate House
2/8 Casemates Square
Gibraltar

Extract from
The Gibraltar Merchant Shipping
(Accident Reporting and Investigation)
Regulations 2006 – Regulation 5

"The sole objective of the investigation of an accident under these Regulations shall be the prevention of future accidents through ascertainment of its causes and circumstances. It shall not be the purpose of an investigation to determine liability nor, except so far as is necessary to achieve its objectives, to apportion blame"

NOTE

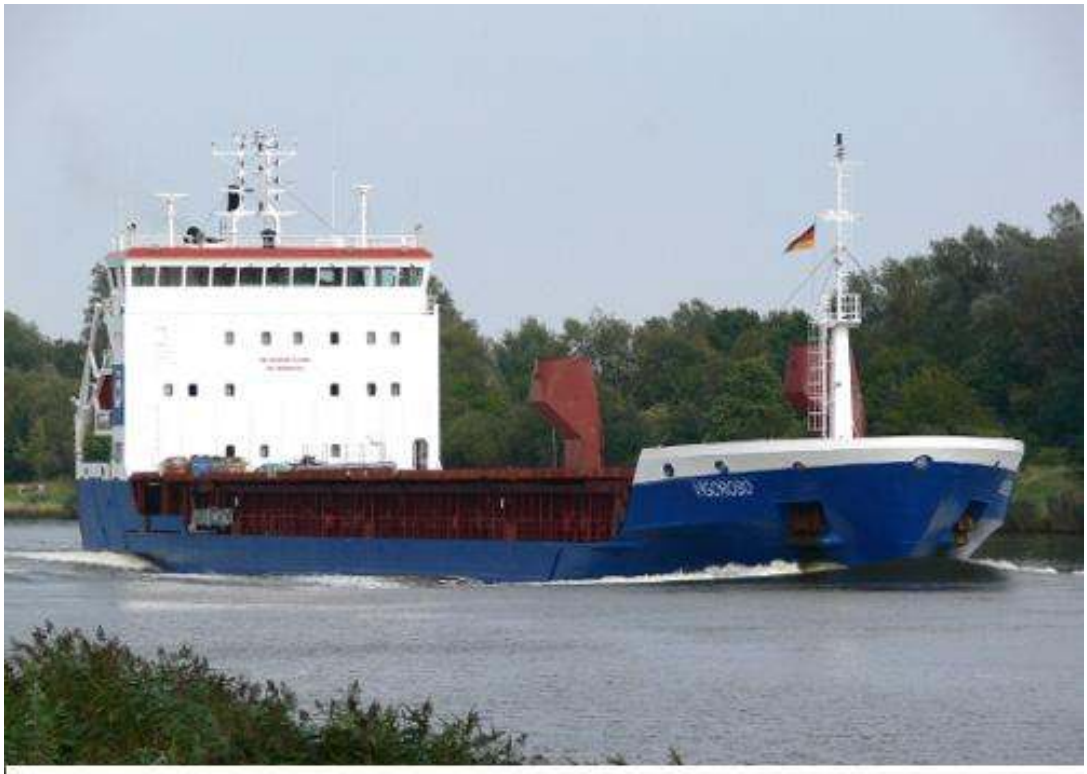
This report is not intended to be used for the purpose of litigation. It endeavours to identify and analyse the relevant safety issues pertaining to the accident, and to make recommendations aimed at preventing similar accidents in the future.

CONTENTS

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

bhp	-	brake horsepower
BCSN	-	Bulk Cargo Shipping Name
°C	-	Centigrade
BC Code	-	Code of Safe Practice for Solid Bulk Cargoes
CPR	-	Cardio - pulmonary resuscitation
DoC	-	Document of Compliance
GMA	-	Gibraltar Maritime Administration
IMDG Code	-	International Maritime Dangerous Goods Code
IMO	-	International Maritime Organisation
ISM	-	International Safety Management (Code)
kW	-	Kilowatts
SCBA	-	Self Contained Breathing Apparatus
ST	-	Ship's Time
n.miles	-	Nautical miles
MT	-	metric tonnes
m	-	metre
mb	-	millibars
O2	-	Oxygen
SMS	-	Safety Management System
SOLAS	-	International Convention for the Safety of Life at Sea
UTC	-	Universal Co-ordinated Time

MV Vigoroso



SYNOPSIS

S1.1 On the 28th April 2009, the Gibraltar registered general cargo ship, *Vigoroso* was on a voyage from St Petersburg to Barcelona with a cargo of ferrous scrap when it was discovered that the Second Engineer had collapsed at the bottom of the aft hold access ladder. He was recovered from the hold by crew members. The ship diverted towards the Swedish port of Karlskrona and the Second Engineer was transferred by helicopter from the ship to hospital. The Second Engineer did not regain consciousness and died on 25th December 2010 in hospital. This publication of this report has been delayed pending the outcome of the medical treatment of the Second Engineer.

S1.2 Following the helicopter transfer, the ship proceeded to Brunsbuttel to await the arrival of a replacement second engineer before continuing on passage to Barcelona.

S1.3 Between 24th and 26th April, the *Vigoroso* had loaded a cargo of "Secondary ferrous metals (metal) scrap) – Steel swarf", IMDG Code 4.2, *ferrous metal turnings*, at St Petersburg, Russia, for discharge in Barcelona, Spain.

S1.4 The ship arrived in Barcelona on 7th May and the cargo was discharged without incident. However, "smoke" was observed emanating from the cargo when the hatch covers were opened.

S1.5 Gibraltar Maritime Administration was informed of the incident by the ship's operators on 7th May and an investigation started in accordance with IMO guidelines for accident investigations.

S1.4 Factors contributing to the accident included:

S1.4.1 Reduction of oxygen levels in the hold due to the nature of the cargo.

S1.4.2 Failure to observe the correct procedures for the entry into an enclosed space.

S1.4.3 Lack of proper temperature monitoring equipment

S1.4.4 Appropriate recommendations have been made which can be found in Section 4 of this report.

SECTION 1 – FACTUAL INFORMATION

1.1 PARTICULARS OF MV VIGOROSO & ACCIDENT

1.1.1 Vessel Details

Name:	**:**	**Vigoroso**
IMO Number	:	9191943 .
Registered owner.	:	Shipcom Bereederungs GmbH & Co Betreibs KG MS 'Scaldis' Gartenstr 2, Haren, Germany
Operator	:	ShipCom Bereederungs GmbH Rheinallee 14, Duisburg, Germany
Charterer	:	Österströms Hotellgatan 5, SE-601 02 Norrköping, Sweden
Crew Managers	:	Marlow Navigation Co Ltd 13 Alexandrias St, CY-3720 Limassol Cyprus
Port of registry	:	Gibraltar
Flag	:	British
Type	:	Multi Purpose Dry Cargo
Built	:	2007
Classification society	:	Germanischer Lloyd
Construction	:	Steel
Gross Tonnage	:	4,244
Engine power	:	4505.76 bhp, 3360 kW

1.1.2 Accident details

Injuries to personnel	:	Asphyxiation of Second Engineer
Damage to ship	:	Nil
Pollution	:	Nil.
Location of Accident	:	50° 06'.9 N 016° 38'.7 W (South east of the Swedish island of Oland in the Baltic Sea)
Date and Time	:	Approx 1140 (UTC + 2) on 28th April 2009

1.2 BACKGROUND

1.2.1 The *Vigoroso,* launched in 2002, was a single hold general cargo ship with her main superstructure, accommodation and bridge situated aft.

1.2.2 At the time of the accident, the hold contained a cargo of "steel turnings" which had been loaded in St. Petersburg.

1.2.3 The *Vigoroso* held valid *Document of Compliance for the Carriage of Dangerous Goods* and *Document of Compliance for the Carriage of Solid Bulk Cargoes*.

1.2.4 The *Vigoroso* mainly traded in the Baltic / North Europe area carrying timber products. Previous cargoes had included sawn timber, logs, wood chips and occasionally steel products. The cargo carried immediately prior to the accident had been asphalt granules.

1.2.5 The official working language of the ship was English and the ISM documentation was in English.

1.2.6 The company operating the ship was experienced in the management and operation of small general cargo ships. The company had a valid *Document of Compliance* for the operation of this type of ship, issued by the Det Norske Veritas on behalf of the Government of Antigua & Barbuda and a valid ISM Code *Document of Compliance (Letter of Acceptance)* issued by the Government of Gibraltar.

1.2.7 The ship had a valid *Safety Management Certificate* issued by the Gibraltar Maritime Administration and had been subject to an external ISM audit and Flag State inspection in May 2007. During the month prior to the accident, the ship had been inspected in Germany under the Paris MOU for port state inspections. No deficiencies were identified during that port state inspection. During the previous two years, four further inspections had been completed during which no major deficiencies had been identified. A number of minor deficiencies related to accident prevention and safety operations had been raised.

1.3 NARRATIVE (ALL TIMES SHIP'S TIME)

1.3.1 The Master was first informed of the nature of the cargo (steel turnings, IMO 4.2) to be loaded in St Petersburg approximately six weeks prior to arrival. This was confirmed by email from the charterers in which the cargo was described as *"min 5200 mts of steel turnings, imo 4.2".*

1.3.2 The Master was familiar with this type of cargo and consulted the BC Code and the ship's *Document of Compliance for the Carriage of Solid Bulk Cargoes*.

1.3.3 On 24th March the Master brought to the attention of the charterers that the ship did not have on board temperature sensors for measuring the temperature of the cargo as required by the DoC and BC Code.

1.3.4 The ship departed Sillamäe, Estonia on 21st April, having discharged a cargo of asphalt granules. On the same day, the operators instructed the Master to advise them if the proposed steel cargo was oily and brought to the Master's attention, pages 126 and 127 of the BC Code which refer to Ferrous Metal Borings, Shavings, Turnings or Cuttings, UN 2793.

1.3.5 The ship berthed in St Petersburg at 0350 ST on 24th April and commenced loading that afternoon. The Master was unable to obtain any temperature sensors at St Petersburg through the agent or charterer. The Second Engineer offered to fabricate two sensors during his free time, using temperature measuring devices from the ship's incinerator, which was not in use. He completed this and installed the sensors, one forward and one aft, with remote readouts in the aft cargo office and in the fo'c'sle workshop

1.3.6 A domestic thermometer had been obtained from a chandler in St Petersburg to enable measure cargo surface temperatures before and during loading.

1.3.7 The Master was provided with a *Certificate of Cargo Characteristics at Time of Loading* and a *Declaration of the Transportation Characteristics and Conditions for the Safe Shipment of Bulk Cargo* issued by the Russian Maritime Register of Shipping.

1.3.8 Loading was completed on 26th April. The cargo was levelled and compacted. In compliance with the requirements of the DoC for CSBC, the cargo had been loaded such that there was a 3 metre space between the cargo and the aft hold bulkhead and clear of the forward gasoil fuel tanks. Thus the forward and aft access ladders to the hold were clear of cargo. On completion of loading, hatches were closed, ventilation fans isolated and hold access hatches secured. The Chief Officer tested the atmosphere in the hold and recalls that the oxygen level was low. The actual value was not recorded.

1.3.9 Notices regarding enclosed entry were displayed adjacent to each hold access hatch and in the accommodation.

1.3.10 Temperatures of the cargo were recorded, commencing 26th April at 0800, 1200, 1600 & 2000 hours by one of the seamen in a note book. The temperature record shows that no temperature was recorded from the aft sensor at 0800 ST, 27th April. Temperatures were not recorded in the logbook.

1.3.11 There were no records of testing the atmosphere in the hold.

1.3.12 On 27th April the Master informed the operators that the Second Engineer had made and installed electronic devices, fore and aft, to enable cargo temperature to be monitored and requested confirmation of payment of a bonus to be made to the Second Engineer for completing this work.

1.3.13 On the morning of the 28th April, at about 1100, the Chief Engineer, on his way to the engine room control room, recalled seeing the Second Engineer in the cargo office having a coffee break. At this time the bosun was working on the bridge deck, one seaman was painting hatch covers and the Master was on watch on the bridge.

1.3.14 At about 1140 ST, the bosun passed the aft hold access on his way to the deck store and noticed the access lid was open. He collected a torch, looked into the hold and saw the Second Engineer collapsed at the foot of the hold ladder. He immediately contacted the Master on the bridge and called the deck crew to assist. The Master called the Chief Officer to prepare SCBA equipment and the Second Officer to go to the bridge.

1.3.15 One seaman entered the hold wearing SCBA with a rescue line and the Second Engineer was hauled up onto the deck. He was not breathing and no pulse could be detected. The Chief Officer and seamen immediately commenced CPR. The Master arrived on deck having collected the oxygen resuscitation equipment from the ship's hospital. At about 1205 ST the Second Engineer started to breath spontaneously and oxygen was administered. The seaman / cook brought a stretcher from the hospital and the Second Engineer was transferred into the shelter of the accommodation

1.3.16 After relieving the Master on the bridge, the Second Officer prepared a medical information card for transmission. When the Master returned to the bridge, they altered course towards the nearest port. The ship was approximately 20 n.miles from Karlskrona so they were able to contact Karlskrona pilots by VHF who directed them to VHF Channel 16 and 81 to the Swedish Rescue Service. Contact with the rescue service was established at 1250 ST. At 1320 ST the rescue boat *Bjornchister* was in attendance. At 1405 ST a Swedish rescue helicopter lifted off the Second Engineer and transferred him to Karlskrona hospital.

1.3.17 Following the helicopter evacuation, the Master consulted the operators and crewing agent and the Vigoroso proceeded to Kiel Canal, approximately 170 n.miles away. The ship anchored on arrival at Brunsbuttel to await the arrival of a replacement Second Engineer and a representative of the crew management company before continuing on passage to Barcelona.

1.3.18 The cargo was discharged at Barcelona without incident but the cargo was observed to start emitting "smoke" shortly after the hatch covers

were opened and continued to “smoke” throughout the discharge operation. On completion of discharge, both temperature sensors were recovered. The sensor situated aft was found to be damaged.

1.3.19 A report dated 5th May from Blekinge Hospital, Karlscrona stated that CT scans had revealed that the Second Engineer had no apparent bleeding, infarction or increased intracranial pressure but following further tests, the assessment was that he had been exposed to carbon dioxide causing severe anoxic brain damage.and epileptiformic seizure.

1.3.20 On 25 December 2010 it was confirmed by the crew managers that the Second Engineer had died while still in hospital in a coma

1.4 CREW

1.4.1 The *Vigoroso* had a complement of officers and crew in compliance with the requirements of the ship’s Safe Manning Document. The ship’s Master was Ukrainian, and officers and crew were Russian, Ukrainian and Bulgarian.

1.4.2 All of the crew were employed by crewing agency Marlow Navigation who were contracted by the operators to supply officers and crew to comply with the Safe Manning Document.

1.4.3 The official working language of the ship was English, but Russian was more commonly in general use.

1.4.4 The crew on board *Vigoroso* consisted of the Master, Chief Officer, Second Officer, Chief Engineer, Second Engineer, three seamen and a seaman/cook. The Master, officers and crew were experienced seafarers and were holders of appropriate certificates of competency.

1.4.5 The Master had served at sea for more than eighteen years, had qualified as Master - STCW II/2 in April 2003 and had served as Master for five years. He had completed specialised training in the carriage of dangerous & hazardous substances in compliance with STCW Section B-V.

1.4.6 The Second Engineer was 41 years old with a valid medical certificate for service at sea. During his service on board the *Vigoroso* he had received treatment for an ear infection and had been observed by the Second Officer to apparently use an inhaler. An inhaler was not found in the Second Engineer’s cabin or on his person following the accident. Small quantities of *salicylic acid* tablets (aspirin), *diclofenac gel* (analgesic) and *otrivin* (nasal decongestant) were found in his cabin. According to the Chief Engineer, neither ear problem nor use of an inhaler appeared to affect his ability to carry out his duties.

1.4.7 The ship had a UMS notation and the Chief Engineer and Second Engineer normally worked on a day-work system between the hours of 0800 and 1800. The engineers alternated “on call“ responsibility for answering any engine room alarms during the period 1800 to 0800.

1.4.8 The Chief Engineer reported that he and the Second Engineer had obtained sufficient rest prior to their periods of duty. This was supported by Records of Hours of Rest on board. These records indicate that the Second Engineer had been working for three hours prior to the accident and had been off duty for fourteen hours before prior to that.

1.5 CARGO

1.5.1 The cargo loaded was steel turnings. These are the by-product of, and are produced by, the machining, turning, milling and drilling of steel.

1.5.2 The cargo was described by the charterer in their voyage instructions to the Master as steel turnings IMO 4.2.

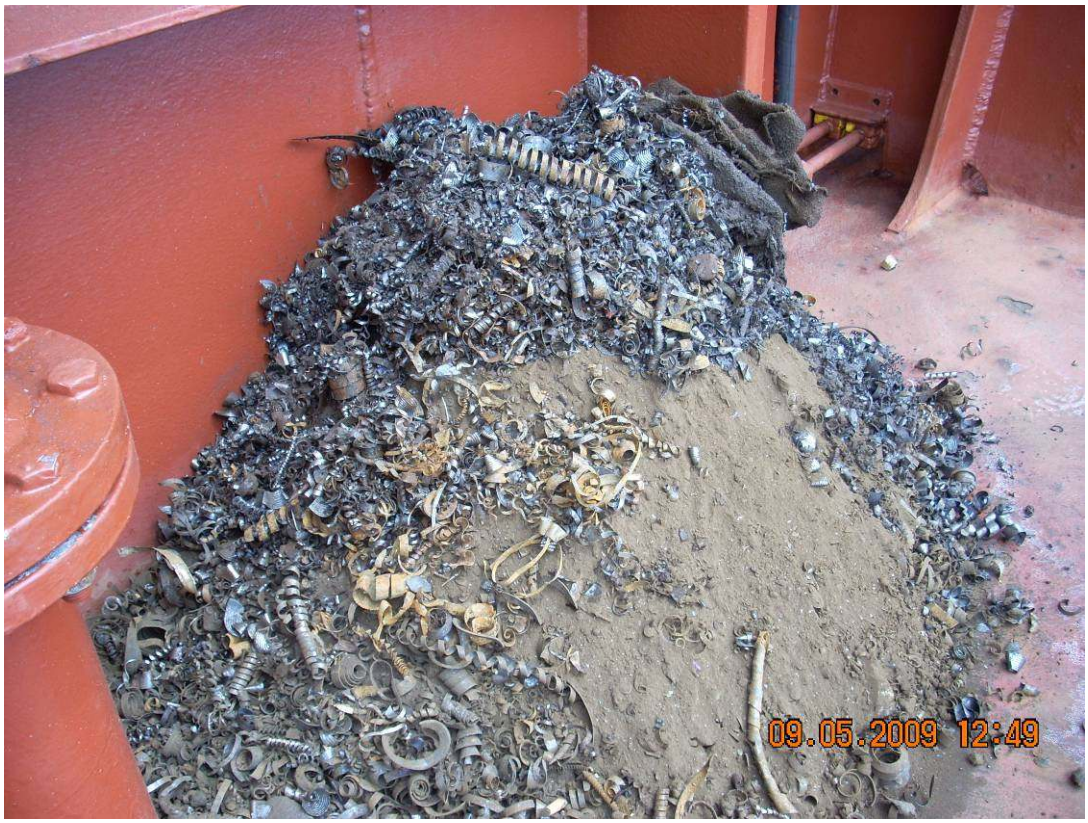
1.5.3 The Russian Maritime Register of Shipping issued cargo documentation to the ship, describing the cargo as Secondary ferrous metals (metal scrap) – Steel swarf IMO Code Class 4.2 having the appearance of:

- Steel swarf No.1 – a finely divided material,
- Steel swarf No. 2 – a finely divided material which does not contain
- balls of spiral-like steel swarf and
- A spiral – swarf, to be used for processing purposes

1.5.4 The Bulk Cargo Shipping Name (BCSN) for steel turnings is *Ferrous Metal, Borings, Shavings, Turnings or Cuttings UN 2793 in a form liable to self heating.*

1.5.5 Steel turnings are liable to self-heat and ignite spontaneously, particularly when in a finely divided form, wet, or contaminated with cutting oil, oily rags or other combustible material. This process reduces the oxygen content within the space containing such cargo.

1.5.6 Steel turnings are also subject to simple oxidisation (rusting) which will also reduce the oxygen content of enclosed spaces in which the turnings are stored. Oxidisation is accelerated if the turnings are damp.



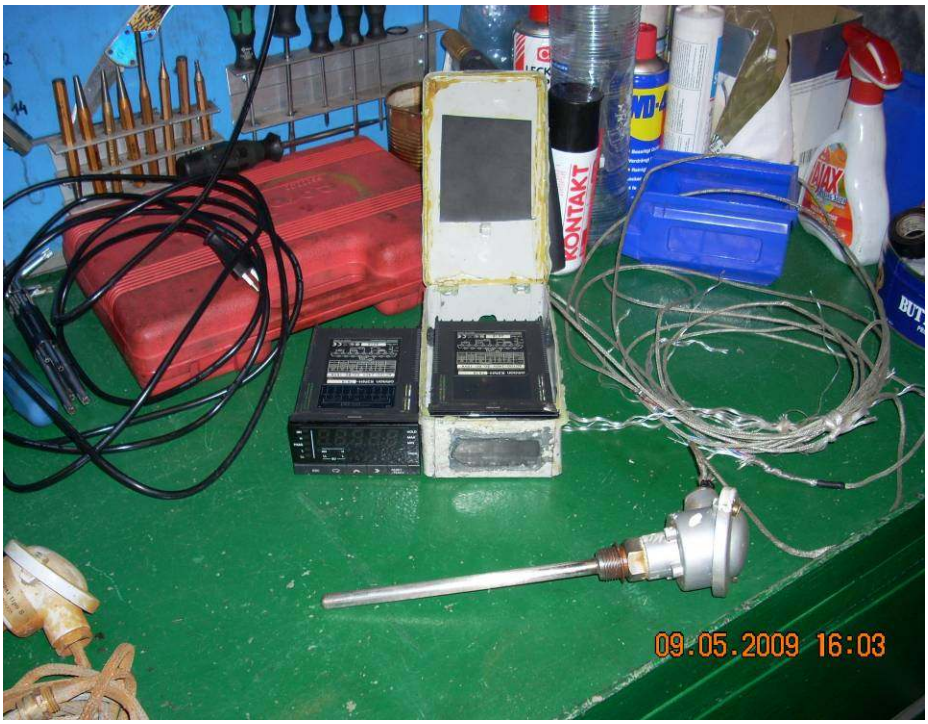
Cargo sweepings

1.5.7 The cargo was stored ashore in the open and was observed by the Master and Chief Officer to be damp and rusty.

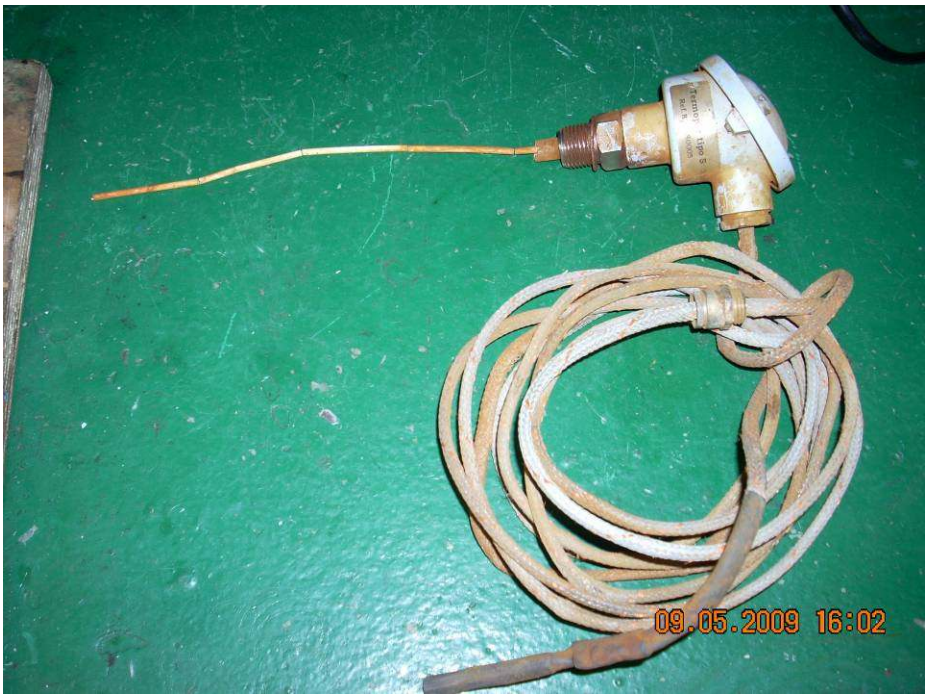
1.5.8 Prior to loading the cargo, the hold was swept clear of previous cargo residue and was dry

1.5.9 Monitoring of the temperature of this cargo is required by the BC Code. The charterer and operators had failed to provide a suitable temperature sensor system to enable remote monitoring despite being made aware, in ample time by the Master, the required equipment was not on board. The Master was unable to purchase the necessary equipment at the load port. The Second Engineer offered to make up a sensor system using materials on board and was paid a bonus for this. If he had not done so, the ship would have been delayed loading.

1.5.10 The cables from the sensor to the read-out displays were passed through the hold access hatches. These hatches could therefore not be fully screwed down tight without damaging the cables.



Temperature monitoring equipment.



Damaged temperature sensor

1.6 REGULATION

1.6.1 Ferrous Metal Turnings are an IMDG Code Class 4.2 material: Substances liable to spontaneous combustion

1.6.2 Both IMDG Code and the BC Code entries for *Ferrous metal boring, shavings turnings or cuttings in a form liable to self heating (UN No. 2739)* note the self heating properties of these cargoes, particularly when carried in a finely divided form, wet or contaminated with cutting oil or combustible material.

1.6.3 The Codes state that:

Self heating or inadequate ventilation may cause a dangerous depletion of oxygen in the stowage spaces and that *swarf should be protected from moisture prior to and after loading.*

1.6.4 The BC Code also states that:

After loading, the cargo should be trimmed to eliminate peaks and compacted. The cargo should not be ventilated.

1.6.5 The BC Code Recommendations for entering enclosed spaces aboard ships, states:

The atmosphere in any enclosed space may be deficient in oxygen and / or contain flammable and / or toxic gases or vapours. Such an unsafe atmosphere could also subsequently occur in a space previously found to be safe.

No person should open or enter an enclosed space unless authorised by the master or nominated responsible person and unless the appropriate procedures laid down for the particular ship have been followed.

Entry into enclosed spaces should be planned and the use of an entry permit system, which may include the use of a checklist, is recommended.

1.6.6 Copies of the IMDG and BC Codes were held on board the *Vigoroso.*

1.7 DOCUMENTATION

1.7.1 In accordance with the BC Code, a cargo of steel turnings should be assigned a Bulk Cargo Shipping Name (BCSN) and a United Nations (UN) number prior to shipping, confirmed in writing and supported by appropriate shipping documents prior to loading.

1.7.2 Charterer.
The charterer informed the Master by email that the cargo to load at St Petersburg would be steel turnings, IMO 4.2.

1.7.3 Operator
The ship operators were aware of the possible hazards of this cargo and brought to the attention of the Master, by email, the relevant pages in the BC Code regarding the cargo, including the BCSN & UN number and highlighting the hazards and precautions during loading, carriage and discharge. They also instructed the Master to inform them if the cargo was oily.

1.7.3 Shipper
The Russian Maritime Register of Shipping issued a *Certificate of Cargo Characteristics at the Time of Loading* and a *Declaration of the Transportation Characteristics and Conditions for the Safe Shipment of Bulk Cargo*. These documents provide details of the cargo owner and shipper, a description of the cargo and the safety requirements and measures to be taken to ensure safe cargo handling.

1.7.4 Classification Society.
The ship had been issued with a *Document of Compliance for the Carriage of Solid Bulk Cargoes* by Germanischer Lloyd on behalf of the Gibraltar Government. Attached to this DoC was a *Supplement* listing the cargoes categorised in Group B of the BC Code that the *Vigoroso* could carry. The list included the UN No., IMO Class and footnotes relevant to each cargo

1.7.5 The Supplement included Ferrous Metal Borings, Shavings, Turnings or Cuttings, in a form liable to self heating, UN No. 2793, IMO Class 4.2. The relevant footnote (28) stated:

Suitable instruments for measuring the surface temperature of the cargo are to be provided. In case of portable temperature sensors the arrangement shall enable the measurement of temperature without entering the hold.

1.7.6 Germanischer Lloyd has also issued, on behalf of the Government of Gibraltar, a *Document of Compliance for the Carriage of Dangerous Goods*. Attached to this DoC was *Schedule 1(a)* which permits the carriage of IMO Class 4.2 cargo in packaged or bulk form. For bulk cargo Class 4.2, a minimum 3 metre separation from the engine room bulkhead is stipulated. Special arrangements / requirements are listed in *Schedule 2* of the DoC.

1.8 HOLD ATMOSPHERE

1.8.1 The ship was equipped with portable gas detecting equipment (RKI Instruments Model GX-2001) capable of monitoring lower explosive limit (LEL), oxygen (O_2) and carbon monoxide (CO). The equipment appeared to be functioning correctly but no recent calibration certificate was available.

1.8.2 No record of testing of the hold atmosphere was available.

1.8.3 On completion of loading the hatches were secured. As is the normal safe practise for this type of cargo, the hold was not ventilated during the voyage.

1.8.4 Hospital reports on the Second Engineer's condition indicated that he had not suffered from any injury that would have caused bleeding, brain infarction or inter-cranial pressure and did not suggest that carbon monoxide poisoning was a factor. Similarly, the reports did not indicate the presence of alcohol or drugs.

1.8.5 The hospital staff's diagnosis was anoxic brain damage due to exposure to carbon dioxide. This could also be described as exposure to an atmosphere deficient in oxygen. The reference to CO_2 may have been influenced by the ship's medical report which stated *"Has presumably lost consciousness because of disadvantage of oxygen at hold. Poisoning CO_2 ".*

1.8.6 Oxygen (O_2)
The Chief Officer recalled testing the hold for atmosphere on completion of loading and found oxygen levels to be low but did not record the level.

1.8.7 The cargo was observed to "smoke" when the hatch covers were removed at the discharge port and the sample of hold sweepings showed evidence of rusting. It may be deduced from this that oxidisation had occurred after loading which would have significantly reduced the level of oxygen in the hold.

1.8.8 The normal ambient level of oxygen is about 30% by volume. Exposure to an atmosphere containing less than 18% by volume of O_2 is a significant risk. Levels below 11% by volume may result in fainting within a few minutes of exposure. Levels below 6% by volume result in fainting almost immediately with a high risk of brain damage.
(ref: University of Oxford Policy Statement S/403 – Health & Safety)

1.8.9 Carbon Dioxide (CO_2)
In moderate to high concentrations, CO_2 is a respiration stimulant and acts as an asphyxiant.

1.8.10 The ship's fixed fire fighting systems include compressed carbon dioxide. There was no indication of any release of CO_2 into the hold.

1.8.11 Carbon Monoxide (CO)
CO is extremely flammable and forms an explosive mixture with air with explosive limits between 12.5 – 74 % by volume. Raised levels of CO are common in this type of cargo. However, there are no records of CO levels during loading, carriage or discharge. Raised levels of CO cause increased carboxyhemoglobin levels in the blood which may result in toxic anoxia. Medical reports available do not indicate any symptoms associated with carbon monoxide poisoning.

1.9 ENCLOSED SPACE ENTRY

1.9.1 Procedures for enclosed space entry were included in the ship's safety management system (SMS). These procedures include *Form 09 – Permit to Work* and *Checklist CL 05 – Checklist for Work Permits – Entry into enclosed or confined spaces.*

1.9.2 Further information regarding entry into enclosed spaces is contained in *The Code of Safe Working Practises for Merchant Seamen*, a copy of which was on board the ship.

1.9.3 Specific instructions regarding entry into spaces containing cargo carried by the *Vigoroso* were contained in the cargo documentation provided by the Russian Maritime Register of Shipping and in the BC Code.

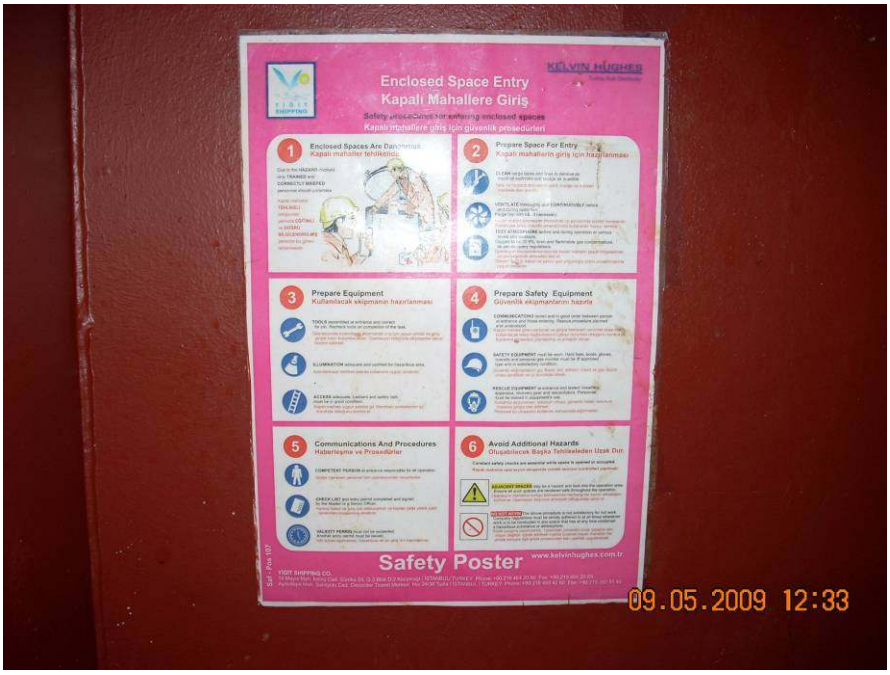
1.9.4 Signage regarding entry into the hold was displayed adjacent to the hold access hatches, fore and aft. Further notices were displayed on bulkheads in the accommodation.

1.9.5 The hold access hatches could not be dogged down completely because of the temperature sensor cables. The access hatches were not marked with tape, tie-wraps or anything similar to make them more conspicuous and so alert the crew to the danger or to make it more difficult to open them.

1.9.6 The Master discussed the nature of the cargo and associated dangers with the crew and posted signs in the messrooms prohibiting entry into the hold without his permission.

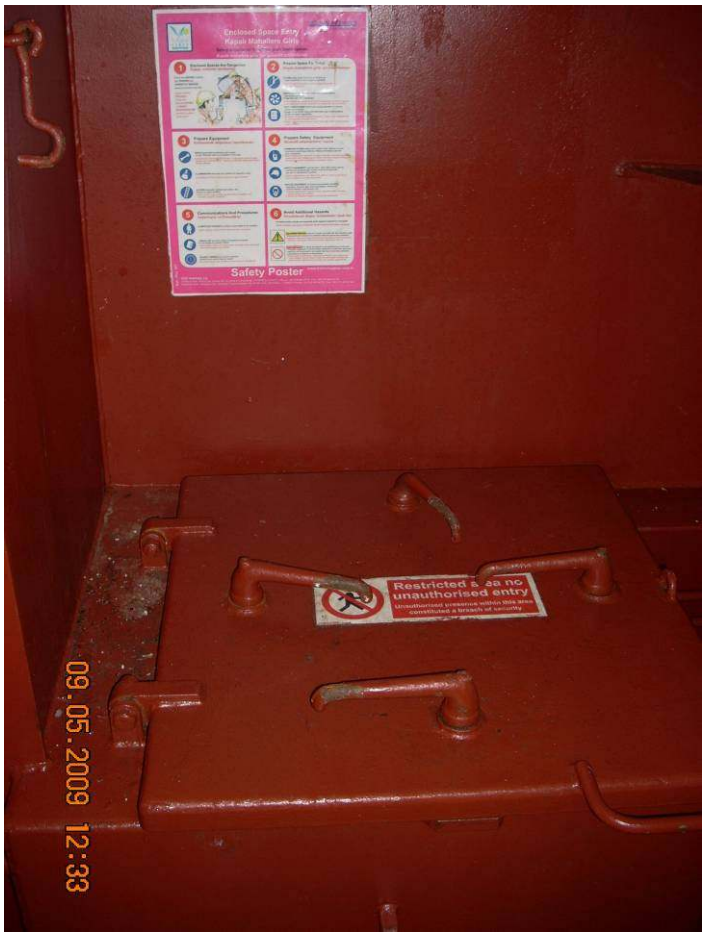
1.9.7 The Second Engineer joined the ship on 13th March 2009. On that day he completed the SMS *Checklist CL 11 – Familiarisation Check List*. The remarks section of this checklist includes the statement,

"Furthermore he is instructed not to enter enclosed spaces, to weld, to work aloft and to work in un-manned machinery spaces without permission".

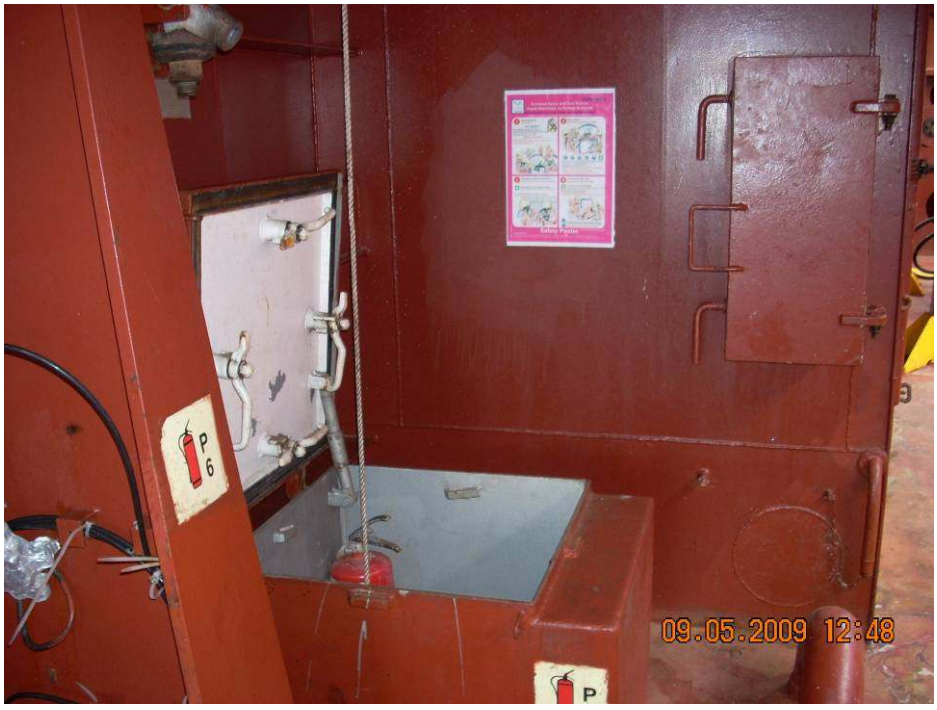


Warning notice at hold access hatch

Warning Notice in accommodation



Aft hold access hatch



Forward hold access hatch

SECTION 2 - ANALYSIS

2.1 AIM

2.1.1 The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2.2 THE ACCIDENT

2.2.1 The cargo of ferrous metal turnings had been stored ashore outside and was loaded damp, resulting in conditions for self heating / oxidization of the cargo causing in depletion of oxygen within the cargo space.

2.2.2 It is not possible to state with certainty why the Second Engineer decided to enter the hold without taking the normal precautions and without consulting any other member of the crew. However, it may be surmised that, while in the cargo office, he noted that the aft temperature sensor was not working properly, and, having received a bonus for constructing the sensor, felt a personal responsibility to maintain it.

2.2.3 The evidence suggests that he the entered the hold and, very shortly afterwards, collapsed due to the oxygen depleted atmosphere

2.3 FATIGUE

Fatigue is not considered to have been a contributory factor to this accident. The ship was UMS and the Chief and Second Engineer worked a day work system which enabled them benefit from regular periods of unbroken rest. Immediately prior to the accident the Second Engineer had been at work for about three hours before which records indicate that he had been resting for more than 14 hours.

2.4 SAFETY MANAGEMENT

2.4.1 The ship had an ISM Safety Management System manual which included procedures for a permit to work system for entry into enclosed spaces.

2.4.2 The last recorded issue of a work permit for enclosed space entry was dated 10 November 2007 for work in the fore peak tank.

2.4.3 The Master was aware of the dangers associated with the cargo and discussed these dangers with the crew informally.

2.4.4 The SMS required the Master to conduct safety committee meetings on a monthly basis (refer SMS 6.9) and report the results to the Company. Such a meeting was held on 30th March 2009 and would have been an ideal opportunity to communicate to the crew the precautions necessary while carrying the cargo in a more formal way. The meeting report shows that the following safety matters were raised:

- ISM Code- interpretation
- Shipboard operations
- Safety work on board
- Checklists
- Designated Person ashore and on board

The meeting was concluded after 30 minutes.

2.4.5 An internal ISM audit was conducted by the Company on 20th October 2008 at which time the auditor identified a need for an improvement in crew knowledge of the SMS, particularly with regard to maintenance and record keeping, including enclosed space entry, and regular inspections and audits

2.5 ON BOARD RESPONSE

2.6.1 The ship's crew's response to the accident was rapid, recovering the Second Engineer within minutes of the alarm being raised. Their subsequent actions - applying CPR, administering oxygen, obtained advice and assistance were prompt and well organized

2.6.2 The seaman that discovered the Second Engineer in the hold was sufficiently aware of the dangers related to the cargo to raise the alarm rather than enter the cargo hold alone or without the appropriate equipment.

2.6.3 The actions of the crew after the alarm was raised indicated that they were aware of the nature and danger posed by the cargo.

2.6.4 A safety committee meeting was held on 29th April 2009. The main topics covered were:

- IMDG Code
- Work in enclosed spaces, individual protection
- Safety work on board
- Checklists
- Opening and closing hatch covers
- Accident report 28.04.2009 – Incident with 2nd Engineer
- Action of crew for the rescue of injured person

2.6.5 The meeting minutes also recorded a drill, “Injured person/ stretcher” had been completed on 13th April 2009.

2.7 COMPANY RESPONSE

2.7.1 Following the accident the Company arranged the attendance of a representative of the crew managers to attend on board at Brunsbuttel to conduct a preliminary investigation and to provide the Master and crew with support should they need it.

2.7.2 The Company issued:

- Standing Order No. 04 – Subject: Entering cargo hold
- Standing Order No. 05 – Subject: Cargo Information
- A4 Poster “Enclosed Spaces can kill” with instructions to display the poster in the messroom

2.7.3 The Company circulated an email to the Master of each of their ships reminding them of the need to follow the BC Code, SOLAS Dangerous Cargo, IMDG Code and the Company ISM procedure regarding “Enclosed spaces with checklist and works permit.”

2.7.4 The email to the Masters also included a link to the UK MAIB website with a request that Masters print a copy of the MAIB report of the *Sava Lake* case which relates to the death of crew members on a ship carrying a similar cargo to that of the *Vigoroso.*

2.7.5 The Gibraltar Merchant Shipping (Accident Reporting & Investigations Regulations) 2006, require, in the event of accident or serious injury, a report be sent to the Maritime Administrator as soon as practical following the accident and by the quickest means available.

2.7.6 The Company did not advise Flag State until 9 days after the incident. Consequently the formal investigation into the incident was significantly delayed.

SECTION 3 – CONCLUSIONS

3.1 SAFETY ISSUES

3.1.1 The following are safety issues identified by the investigation. They are not listed in any order of priority:

3.1.1.1 Use of cargo monitoring equipment not specifically designed for purpose. [1.3.3, 1.3.5, 1.3.6, 1.3.11, 1.5.9, 1.7.5, 2.2.2]

3.1.1.2 Easy access to potentially hazardous spaces [1.5.10, 1.9.5]

3.1.1.3 Lack of appreciation of the hazards associated with certain cargoes. [2.2.2, 2.4.4, 2.4.5]

3.1.1.4 Delayed reporting of a serious accident to the Flag State. [2.7.6]

SECTION 4 – RECOMMENDATIONS

Safety recommendations shall in no case create a presumption of blame or responsibility

4.1 The Owners / Operators of *Vigoroso* are recommended to:

4.1.1 Review their Safety Management System to:

4.1.1.1 Identify all dangerous and potentially hazardous spaces on board their vessels. [1.9.5]

4.1.1.2 Identify means to prevent access to potentially hazardous spaces [1.4.5]

4.1.1.3 Ensure appropriate procedures and equipment are in place for the monitoring and recording of the temperature and atmosphere in cargo spaces as appropriate. [1.3.6, 1.3.8, 1.3.10, 1.3.11, 1.5.9, 1.7.5, 17.6, 1.8.2, 1.8.6]

4.1.1.4 Ensure that the responsibility for the provision of specialised equipment required for the carriage of potentially hazardous cargoes is clearly defined. [1.3.3, 1.3.5, 1.3.6, 1.5.9]

4.1.1.5 Ensure that the appropriate authorities are informed of serious accidents and incidents without unnecessary delay. [2.7.6]

4.1 The Crewing Management Company are recommended to:

4.1.1 Review the safety training requirements for crew joining multi-purpose general cargo ships. [2.4.5]

4.1.2 Review the information provided to crew prior to joining a ship to identify ISM and safety related topics specific to the ship. [2.4.5]

Government of Gibraltar
Maritime Administration
24 January 2011.