Isle of Man Ship Registry

Casualty Investigation
Report No. CA116

Isle of Man Registered "Iron Queen"

Enclosed Space Fatality and Near Fatality

25th November 2011

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Foreword

The fundamental purpose of investigating a casualty, an accident or an incident under the Regulations[1] is to determine its circumstances and the cause with the aim of improving the safety of life at sea and the avoidance of accidents in the future.

It is not the purpose to apportion liability, nor, except so far as is necessary to achieve the fundamental purpose, to apportion blame.

Under Section 4 of the Isle of Man Merchant Shipping Act 1985 a person is required to answer an Inspector's questions truthfully. If the contents of this report were subsequently submitted as evidence in court proceedings then this would contradict the principle that a person cannot be required to give evidence against themselves. Therefore the Isle of Man Ship Registry makes this report available to interested parties on the strict understanding that it will not be used in any court proceedings anywhere in the world.

Acknowledgements

The author would like to acknowledge the following for their valuable help and assistance during this investigation;

- South African Maritime Safety Authority (SAMSA)
- The Dutch Safety Board, Customs and Harbour Police

Author's Note

During this report the deceased crewman is referred to as OS1 and the injured crewman is referred to as AB1. These references do not relate or refer in any way to any documents and records on board the vessel.

[1] Merchant Shipping (Accident Reporting and Investigation) Regulations 2001

Abbreviations Used In This Report

2/O	Second Officer
AB	Able Bodied seaman
BA	Breathing apparatus
ºC	Degrees Celsius
C/O	Chief Officer
GT	Gross Tonnage
ISM	International Safety Management
IMO	International Maritime Organisation
IMSBC	International Maritime Solid Bulk Cargo
Kts	Knots measured in Nautical Miles per hour
LMT	Local Mean Time
m, m³, cm	Metres, cubic metres, centimetres
nm	Nautical Miles (1nm=1852 metres)
OS	Ordinary seaman
PPM	Parts per million
SD	Statutory Document
SMS	Safety Management System
SOLAS	IMO Convention for Safety Of Life At Sea
STCW	IMO Convention for Standards of Training, Certification and Watchkeeping
t	Tonnes (where 1t=1000kg)
UTC	Universal Coordinated Time
VHF	Very High Frequency

Summary

Iron Queen – Main Deck (looking to starboard), Hold #2 aft access hatch

On the 25th November 2011 at 1128LMT the Isle of Man registered bulk carrier “Iron Queen” departed the port of Richards Bay, Rep. of South Africa fully loaded with coal bound for Rotterdam, The Netherlands. Shortly after letting go the mooring lines and retrieving the lines on board two crewmen were discovered collapsed and incapacitated in a cargo hold access space.

The alarm was raised and a rescue was quickly initiated. Two crewmen were retrieved from the stairway of a hold access space and brought to the main deck were first aid was administered.

The report concludes that one crewman died and another crewman was seriously injured as a result of making an unauthorised entry in an enclosed space for reasons that are unknown whilst not following the ship’s safety procedures.

This case does not present the need for a change to any regulations (ref. SOLAS I/21a).

Iron Queen

Source: Shipspotting.com

Ship Particulars
Flag – Isle of Man
Port of Registry – Douglas
Ship Type – Cape Size Bulk Carrier
Official No. – 727812
IMO No. – 9116747
Year Of Build – 1996
Call Sign – MVNW9
Owner – Breeze Shipping Ltd, Grand Cayman
Technical Managers – Enterprises Shipping and Trading SA, Greece
Classification Society – Bureau Veritas
Length Overall – 280.09m
Beam – 45.00m
Depth – 23.80m
Summer Draught – 17.52m
Sailing Draught – Fwd 16.9m, Aft 17.2m (Richards Bay 25th Nov 2011)
Gross Tonnage – 81155
Net Tonnage – 52207

Casualty Details
Date / Time – 25th November 2011 / 1135LMT
Classification – Very Serious Casualty
Location – Port of Richards Bay, Republic of South Africa
Vessel Status – underway with pilot on board
Injuries / Fatalities – 1 / 1
Vessel damage – none
Crew Complement – 22 (Ukrainian nationals)
Cargo on board – Coal, 9 holds fully loaded 153708t (Richards Bay 25th Nov 2011)

1. Narrative of Events

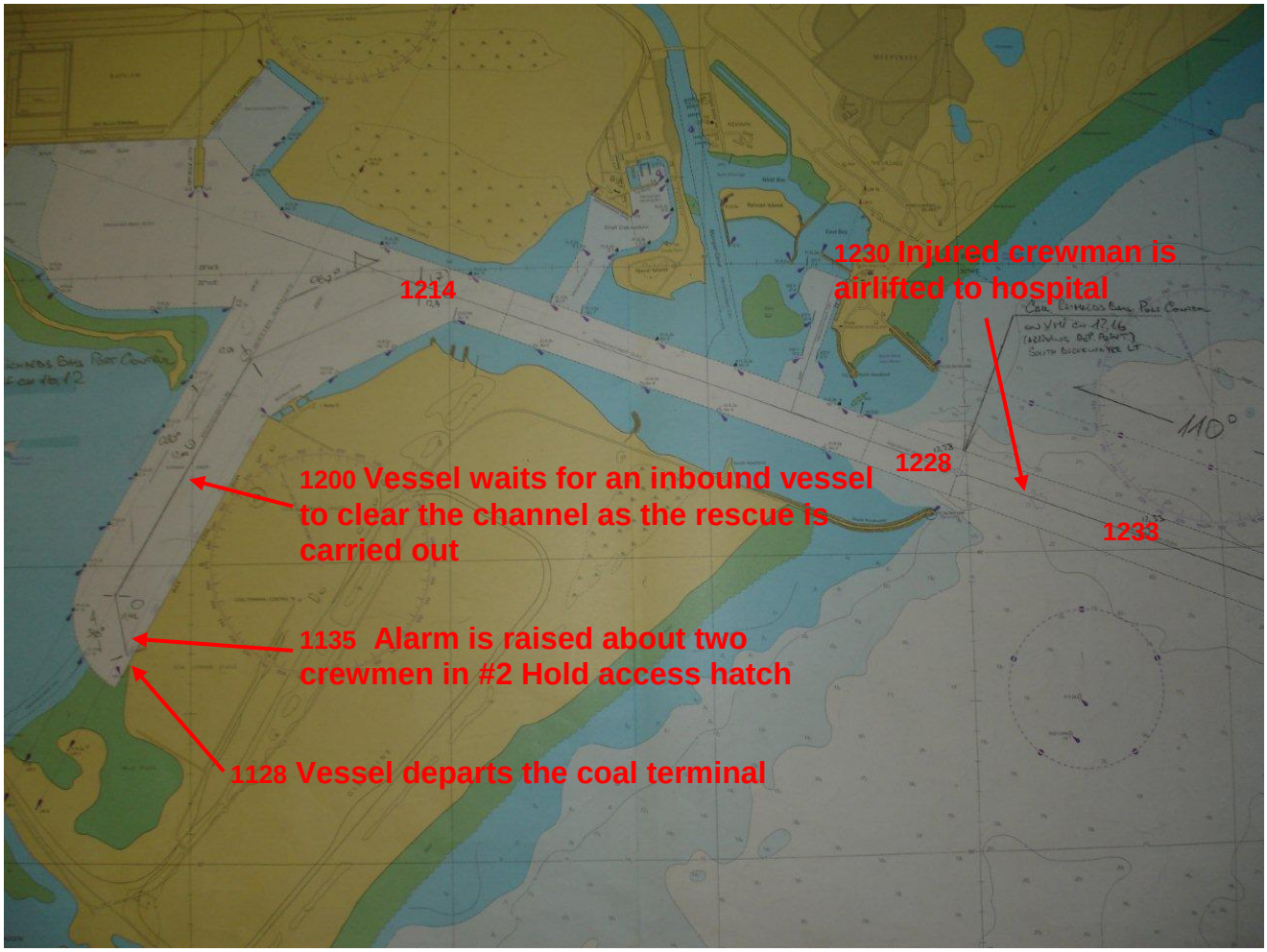
The following is a narrative of events based on the Iron Queen's actions. This Narrative is based on interviews with those involved and evidence collected on board the Iron Queen.

All times are the Iron Queen's ship time which had been set to Local Mean Time (UTC +2hrs).

1.1 Location of Casualty

Port of Richards Bay, Republic of South Africa

The picture below shows the port of Richards Bay and indicates key times and events. Times are ship time (UTC+2)



Section of Chart BA 4174 – "Republic of South Africa, East Coast, Richards Bay Harbour". Reproduced by permission from the UK Hydrographic Office.

Environmental Factors - Weather : fine, sunny.
Temperature: 25°C
Wind SW moderate
High tide
Sea inside harbour: calm, outside swell 3 meters.
Visibility very good
Navigation: no obstruction

1.2 Sequence of Events
All times are ship time (UTC+2)

The vessel arrived at Richards Bay on 16th November 2011. The vessel berthed on arrival and cargo operations commenced the same day. On the 22nd November 2011 cargo operations were completed at the coal terminal. The hatch covers were closed and the vessel prepared to shift berth to another coal terminal.

23rd November 2011

Following a delay due to strong winds, the vessel departed the berth late in the evening and proceeded to Richards Bay outer anchorage.

24th November 2011

0210 Vessel anchors at sea near Richards Bay.

0500 Vessel weighs anchor and proceeds back to Richards Bay port.

0814 Vessel fast alongside (different coal terminal to the previous one).

0945 Commence cargo operations.

25th November 2011

0806 Commence stowaway search of vessel using a local private company. 3 teams with dogs covering all areas of the vessel. Security seals are placed on cargo hold access hatches on the main deck area.

0930 Vessel completes all cargo loading operations.

0947 Stowaway search complete.

1000 All relevant crew called for their respective mooring stations

1030 Main Engine Ready for departure.

1110 Pilot on Board

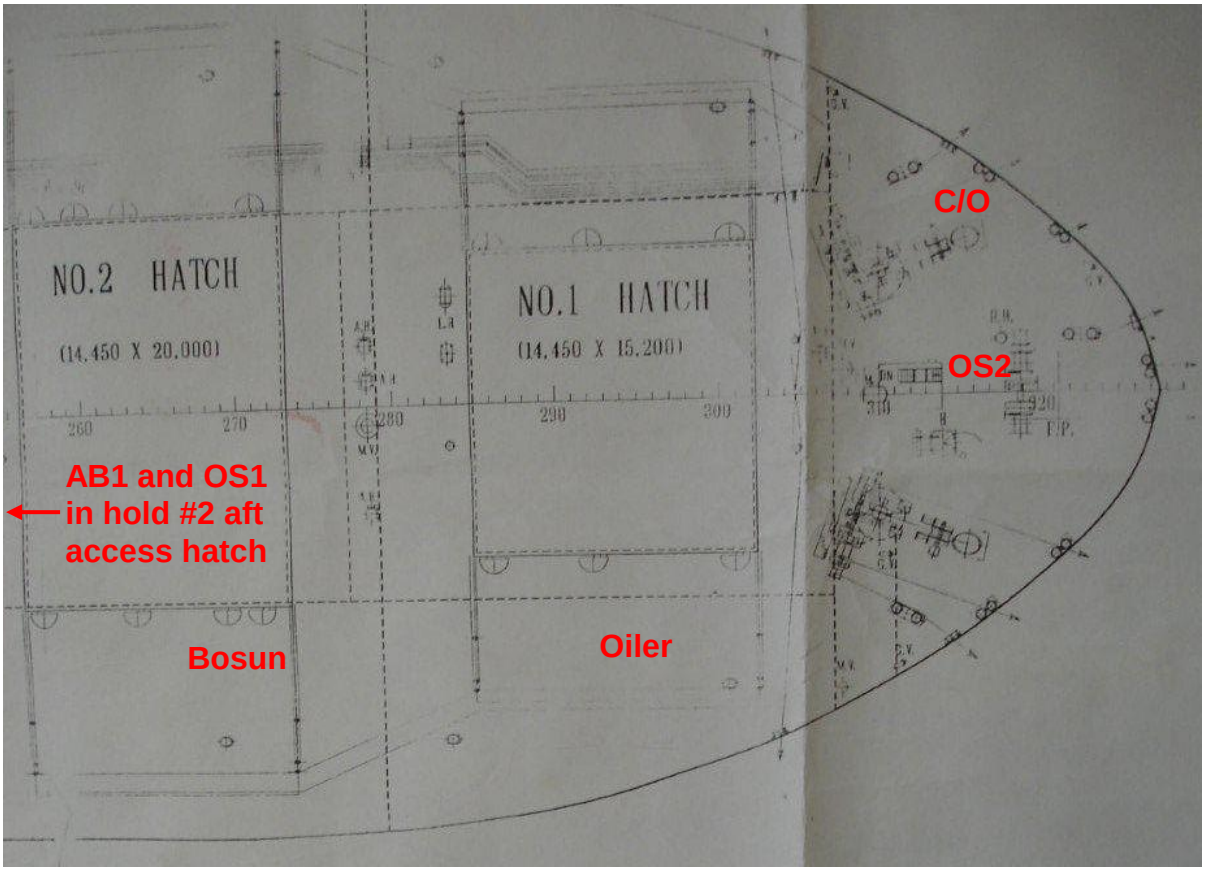
1115 Tug Fast forward, commence unmooring forward and aft

1123 Problem retrieving the forward spring line as the line is caught on a fender.

1128 All lines on board, vessel under way. Master and pilot on starboard bridge wing. OS1 and AB1 are coiling the forward starboard spring as the bosun is operating the starboard spring winch.

1134 Bosun proceeds forward. Bosun hears shouting from inside hold #2 aft access hatch space.

The crew positions at fwd mooring is as per the following diagram.



1135 Bosun informs by VHF radio that two men have “fallen down” into access hatch for hold #3. [nb is the wrong hold reported – actual hold is hold #2.]

C/O contacts the Master by VHF radio informing him “people fell down in manhole hold #3”.

1137 2/O announces emergency by Public Announcement system. Master informs pilot of the situation. Pilot contacts port control and orders helicopter with medical aid.

Vessel holds position in inner harbour waiting for an inbound vessel to clear the channel before proceeding outbound to sea.

1140 Cargo hold hatch cover for hold #3 opened and secured. Two men in fireman suits and Breathing Apparatus arrive at the scene. First aid team with first aid kit, 2 stretchers, and medical oxygen arrive at the team also.

1143 After quick instructions and check of clothing and equipment by C/O, two firemen wearing BA enter hold#2 aft access hatch and find AB1 collapsed on first platform down. Commence raising AB1 to main deck using a safety belt.

Let go Tug forward. Vessel is still waiting for an inbound vessel to clear the channel before proceeding outbound to sea.

1147 AB1 is raised to main deck. His condition is checked, no breathing is evident. Chest compressions and medical oxygen is administered.

Two firemen wearing BA re-enter #2 aft access hatch.

1153 OS1 is raised to the main deck. His condition is checked, no breathing is evident. Chest compressions and medical oxygen is administered.

1155 AB1 appears to have a weak pulse and shallow breathing. Chest compressions and medical oxygen continues to be administered.

OS1 shows no indication of pulse or breathing. Chest compressions and medical oxygen continues to be administered.

1223 Helicopter arrives with doctor on board. Doctor proceeds immediately to hold #2 aft access hatch with quick briefing by C/O.

1225 Doctor checks condition of the casualties. Doctor notices AB1 to have a weak pulse and shallow breathing.

Doctor declares OS1 to be dead at the scene.

1230 AB1 is carried to the helicopter by stretcher for transportation to shore hospital.

OS1 is carried to the ship's hospital by stretcher for later transfer to shore.

Hold #3 hatch covers are closed.

1245 Pilot departs the vessel by helicopter.

1340 Let go port anchor at anchorage position.

1400 Master telephones local agent to explain the situation.

1410 Finished with main engine.

Master telephones the technical managers to explain the situation.

Injuries

OS1 Pronounced dead at scene by the attending doctor on board the vessel.

AB1 Asphyxiation requiring first aid on scene including administering chest compressions and medical oxygen. Weak pulse and shallow breathing detected before being transported directly to hospital by helicopter.

AB1 spent 13 days on a ventilator in intensive care before being transferred to a 'high care' ward in hospital. AB1 was unable to recollect his actions on the 25th Nov 2011 when he eventually began to talk again.

2. Comment and Analysis

Foreword

This section aims to analyse the factors affecting the crewmen, why the crewmen entered the space, the properties of the cargo carried and how this affected the hold access space, the hold access as an "enclosed space" and how the technical managers manage enclosed spaces. The rescue is also assessed for its effectiveness.

2.1 The Injured Crewmen

AB1(injured)
Joined the vessel 23/10/2011. AB1 was a 35 years old qualified able-bodied seaman who is also a rating forming part of navigation watch. Crew and medical certification were examined and found in accordance with STCW and Flag State requirements appropriate to his rank on board.

AB1 was employed as a rating on board (Able Bodied Seaman). AB1 has a total sea-time of 40.5 months. This comprises of 20 months as an AB on container vessels and 20.5 months as an AB on bulk carriers.

OS1(deceased)
Joined the vessel 23/10/2011. OS1 was 21 years old. He had recently gained his Officer of a Navigation Watch (STCW II/1) licence on 08/09/2011 although he was not permitted to sail in this capacity due to not having the required amount of sea-time. Crew and medical certification were examined and found in accordance with STCW and Flag State requirements appropriate to his rank on board.

OS1 was employed as a rating (Ordinary Seaman/Multi) on board. His previous experience included 4 months as a messman on a container ship (>500GT foreign going), 5.5 months as an apprentice rating on a general cargo ship (181GT), 2 months as a trainee on a passenger catamaran (657GT). OS1 was therefore inexperienced in working on deck on cargo ships and the Iron Queen was OS1's first bulk carrier. OS1's role as "multi" was not defined on board but he was in the process of gaining sufficient sea-time to permit him to serve as an Officer of a Navigation Watch in the future.

There was no evidence to suggest that AB1 and OS1 were suffering from any effects of alcohol or drugs. Both crewmen were reported to be good workers, generally happy on board with no known personal or emotional problems. The hours of rest records for AB1 and OS1 for the preceding days until 25th Nov 1130am indicate the following:-

AB1 23rd – 00-04 rest, 04-08 work, 08-24 rest (vessel alongside, no cargo operations)
24th – 00-04 rest, 04-09 work, 09-12 rest, 12-18 work, 18-24 rest
25th – 00-06 work, 06-10 rest, 10-1130 work
23rd Total rest – 20 hours, total work – 4 hours
24th Total rest – 13 hours, total work – 11 hours
25th Total rest – 4 hours, total work – 7.5 hours

OS1 23rd – 00-08 rest, 08-12 work,12-24 rest (vessel alongside, no cargo operations)
24th – 00-05 rest, 05-09 work, 09-12 rest, 12-18 work, 18-24 rest
25th – 00-06 work, 06-10 rest, 10-1130 work
23rd Total rest – 20 hours, total work – 4 hours
24th Total rest – 14 hours, total work – 10 hours
25th Total rest – 4 hours, total work – 7.5 hours

In accordance with the established procedures on board AB1 and OS1 formed part of the

forward mooring party along with the Chief Officer, Bosun, another OS and an Oiler. At 10am on the 25th Nov AB1 and OS1 were called in preparation for departure.

The deck watch schedule states AB1 and OS1 to be on watch on the 12-6 watch in the morning and evening whilst in Richards Bay. On the 23rd the vessel was alongside with no cargo operations. Berth transfer was delayed due to strong winds and the crew were given extra rest after port operations and in preparation for going back into port. Ordinarily at sea AB1 is on the 4-8 watch and OS1 is on the 12-4 watch morning and evening.

On the 24th November AB1 and OS1's routine was disrupted in the morning when the vessel left the anchorage and arrived in port. Sufficient opportunity was provided for rest later in the day. On the 25th November AB1 and OS1 were called for mooring stations prior to departure at 10am. This call follows a rest period of 4 hours following 6 hours deck work.

2.2 Cargo Carried

The vessel departed Richards Bay with all 9 cargo holds fully loaded with "South African Steam Coal". Hold #2 was fully loaded with 16896t of coal.

The Master was supplied a "Shipper's Declaration" in accordance with SOLAS VI/2 and IMSBC Code Section 4. The information supplied to the Master stated the properties of the coal are as follows:-

BC No.:010
Group: B
IMO Class: former IMO class "A" – Appendix "B"
EMS: B14
MFAG: 311 – 616 6.1.1

All ships carrying solid bulk cargoes in general and dangerous solid bulk cargoes in particular are required to comply with the International Maritime Solid Bulk Cargoes (IMSBC) Code, irrespective of their keel-laying date or gross tonnage. This code became mandatory on 1/1/2011 replacing the Code of Safe Practice for Solid Bulk Cargoes (BC Code).

The IMSBC Code states Coal is "Group B" and Class "MHB".
"Group B" means cargoes which possess a chemical hazard which could give rise to a dangerous situation on a ship.
"MHB" (Materials hazardous only in bulk) means materials which may possess chemical hazards when carried in bulk other than materials classified as dangerous goods in the IMDG Code.

The IMSBC Code states a description and properties of coal carried as cargo on ships, see Appendix 1. The IMSBC code states one of coal's main hazards as **"may deplete the oxygen concentration"**. The general dangers to ship's personnel associated with the carriage of bulk cargoes are further outlined in IMSBC Code which refers to IMO Res A20/864, see Appendix 2. The vessel has a copy of the IMSBC Code on board.

The cargo documentation supplied to the Master did not state any hazards associated with the carriage of coal by ship with the exception for personnel protection "dust masks" should be warn and in the event of fire water should be used. The use of water contradicts the IMSBC Code which specifically states that in the event of fire "Do not use water".

The Material Safety Data Sheet (MSDS) sheet supplied to the Master did not provide any information about the hazards associated with the carriage of coal by ship citing "Not regulated as a hazardous material" despite the IMSBC Code classing coal as "Group B" and "MHB". The cargo documentation supplied to the Master by the Shipper did not contain sufficient

information concerning the hazards associated with the carriage of coal in bulk by ship. The documentation supplied was concerned with transportation and storage of coal on land. The best source of information concerning the hazards associated with the carriage of coal in bulk by ship is the IMSBC Code.

2.3 Is The Hold Access Space an "Enclosed Space"?

The access space to hold#2 aft is serviced by a single access hatch with vertical ladders in the upper section leading to a spiral stairway leading down to the bottom of the hold. The access space is partitioned from the cargo space by doors with small viewing windows. The access space does not become covered with cargo, is not gas tight and has poor ventilation.

The atmosphere of hold#2 aft access space was tested just inside the entranceway of the access hatch on the 26th Nov 2011. The results were as follows:-

- Oxygen 5.6%
- Methane 7-8 ppm

Entering the hold access space under such atmospheric conditions is extremely dangerous since the atmosphere is not sufficient to support human life. Human life expectancy in such conditions is severely limited without appropriate safety equipment and procedures. IMSBC Code 13.2.12 references IMO Res A20/864 "Recommendations for Entering Enclosed Spaces Aboard Ships" – see Appendix 2. These recommendations are therefore a requirement when entering a cargo hold space when coal cargo is being carried on board ships.

Hold #2 Aft main deck access hatch


Looking down hold #2 aft access hatch from the main deck

When the vessel arrived in Rotterdam on the 25th Dec 2011 the atmosphere of hold#2 aft access space was tested, the results were as follows:-

- Oxygen 1.6%
- Methane 0%
- Carbon Monoxide 0ppm

When the cargo hold is fully loaded with coal the access space should be treated as an

"enclosed space" because:-

- There is single entry;
- Poor ventilation;
- The cargo hold was full of coal that caused oxygen depletion;
- Crew members would not have a need to enter the space under normal operating conditions after the cargo hold had been loaded;

In order for a person to safely enter the space without the aid of safety equipment the space needs to be thoroughly ventilated with the access hatch and main cargo hatch covers open and only when the cargo hold is empty or nearly empty. This condition frequently arises when the ship is in port discharging cargo and the crew would use the access space for hatch cleaning and inspection.

2.4 Safety Management System and Enclosed Spaces

The vessel is required by Isle of Man regulations (SD421/98) to comply with the International Safety Management (ISM) Code. The ISM Code states requirements for the Management of Safe Operation of Ships. The vessel has procedures on board known as the Safety Management System (SMS) in order to operate the vessel safely and respond to emergencies in compliance with legislative, industry and company requirements. The SMS is audited at frequent intervals by the company and Flag State authority. Recent audits indicated no issues regarding enclosed spaces and enclosed space entry procedures.

The vessel's SMS has procedures to identify enclosed spaces on board and to ensure the safe entry into and effective rescue from enclosed spaces. See Appendix 3. The SMS:-

- defines an enclosed space which includes the hold access space although not specifically stated;
- Identifies various hazards associated with different enclosed spaces;
- Requires any person not enter the space unless an enclosed space entry permit is completed;
- Details the requirements and checks when completing an enclosed space entry permit including testing of the atmosphere;
- Details preparations for entry, working in and rescue from an enclosed space;

The company regulations in the SMS for enclosed space entrances state:-
"Except where entry is necessary, the Master shall ensure that all entrances to unattended dangerous spaces on the ship are either kept closed or otherwise secured against entry, except when being used for access, with suitable IMO approved notices posted at all entrances."

The hold access hatch lid was secured using the clamps (not locked to prevent access). There were no notices displayed indicating the danger of entering the space. A breakable security seal was fitted to the lid following a stowaway search earlier in the day.

The notice stated on the access hatch lid is a security notice specifically aimed at non-crew members.

There are no specific notices prescribed by IMO signifying enclosed spaces however several types of enclosed space notices exist commercially such as the following examples.

It was noted that some of the crew members could not speak English. If such a notice (in English and native crew language) were in place to remind the crewmen of the dangers it is speculative how effective a deterrent this would have been to prevent the crew members entering the space.

The SMS prescribes work involving entry into enclosed spaces can only be sanctioned by the Master or nominated "Competent Person" of the ship's management team (ie Chief Officer, Chief Engineer or Second Engineer). Entry is then only permitted once an "Enclosed Space Entry Permit" is completed and signed by the Competent Person after the relevant safety checks prescribed by the permit have been completed satisfactorily.

AB1 and OS1 joined the vessel on 23rd Oct 2011. As part of the SMS the crewmen are required to undergo "Safety and Environmental Familiarisation" training by means of a checklist and practical demonstration. Part of the familiarisation training requires crewmen to "show evidence of knowing enclosed space entry procedures". It was explained this was achieved through discussion with the Chief Officer. The familiarisation checklists were found completed in accordance with SMS requirements dated 14th Nov 2011.

The SMS requires drills simulating the rescue from an enclosed space at intervals not exceeding 2 months. The most recent drill was a rescue from a void space conducted on 8th Nov 2011. AB1 and OS1 were present at this drill conducted 2.5 weeks before AB1 and OS1 entered the space. The drill was reported to be conducted satisfactorily with a practical drill and further familiarisation training and discussion held about enclosed space entry procedures.

The vessel is equipped with suitable equipment to test the atmosphere in enclosed spaces in accordance with SMS requirements. The equipment is calibrated at regular intervals.

2.5 Why Did The Crewmen Enter The Space?

The reason why the crewmen entered the space is not known. None of the officers and crew questioned during interview claimed not to know why the crewmen entered the space.

At departure AB1 and OS1 were assisting the bosun retrieve the starboard spring mooring lines aboard. The bosun was operating the spring line mooring winch whilst at times communicating with the C/O on VHF radio. The mooring winch is situated between holds #2 and #3 on the starboard main deck in the vicinity of hold #2 aft access hatch.

At 1128 all lines were on deck. At approximately 1134 the bosun stated he started to walk forward to the C/O when he heard shouting from within the access hatch and ran approximately 10m from his position to hold #2 aft access hatch to investigate. At 1134 the alarm was raised by the bosun on VHF radio regarding the two men down the access hatch.

Between 1128 and 1134 the bosun started to walk forward down the starboard main deck to let

go the tug boat. During this time it is claimed the access hatch lid clamps were undone, the lid was opened (breaking a security seal) and secured with a securing pin by one of or both AB1 and OS1. The bosun claims not to have spoken to or witness any actions by AB1 and OS1 after the starboard spring line was brought on board.

No Instructions given to the crewmen to enter - (Unauthorised entry)
No Instructions were given to the crewmen by the Master or nominated "Competent Person" of the ship's management team (ie Chief Officer, Chief Engineer or Second Engineer) or any other crew member to enter.

It is reasonable to assume the crewmen had been previously made aware of the risks associated with entering enclosed spaces through their familiarisation on board training and the recent enclosed space rescue drill. No enclosed space entry permit was completed and no known safety precautions were undertaken. To enter the space the crewmen either forgot or ignored the SMS procedures.

To enter the space the crewmen made a deliberate act by undoing all five hatch clamps and breaking the security seal. The crewmen therefore made a deliberate unauthorised entry.

No operational reason to enter
The Master, Officers and Crew interviewed could not think of any operational reason why they should suddenly need to enter the space bypassing the safety procedures for any vessel operations.

No known defects or damage within the space
The Master, Officers and Crew interviewed stated there were no known defects or damage in hold #2 aft access that should warrant the crewmen to enter the space bypassing the safety procedures.

It is not known if both crewmen decided to enter the space together or if one crewman decided to enter the space alone and the other crewman saw him in difficulty and tried to help him. Whilst it claimed that both crewmen were sufficiently familiarised with the dangers of enclosed spaces on board, OS1 may not have fully appreciated the dangers associated with entering the space as he was very inexperienced in deck work on cargo ships. AB1 was experienced in deck work on cargo ships and may have either forgot the risks or misjudged the situation.

The crewmen may have entered the space with honest intentions based on ill-judgement and inexperience or they may have entered the space for illegitimate reasons. If the crewmen felt there was a legitimate reason to enter the cargo hold access space they should have stated their reasons to a senior officer (a "nominated competent person"). Only then can safe entry be conducted following SMS procedures under controlled conditions. If a crewman finds a fellow crewman in difficulty in an enclosed space he should not attempt to enter and raise the alarm for an enclosed space rescue.

On the 27th November 2011 hold#2 aft access hatch was sealed by the attending investigator to permit further inspection at a later date under safe atmospheric conditions. When the vessel arrived at the discharge port the seal was broken by investigators and hold#2 aft access space was inspected. Nothing of significance was found.

AB1 was eventually interviewed in hospital when his condition permitted. He stated he does not remember any details on the 25th Nov 2011 as to why he entered hold#2 aft access space. Short-term memory loss is a common symptom of injuries relating to oxygen deprivation.

The reasons why the crewmen entered the space will remain speculative unless further facts are presented.

2.6 The Rescue

A quick and effective rescue is paramount when performing a rescue of a casualty from an enclosed space. The longer a person is starved of oxygen, the chances of survival or full recovery diminishes. See Appendix 3 for the SMS requirements for “rescue from enclosed spaces”.

The ships crew were made aware of the emergency by public address announcement from the bridge. No general alarm was sounded and no muster of the crew occurred. Key people were effectively able to communicate using VHF radios already in their possession from unmooring.

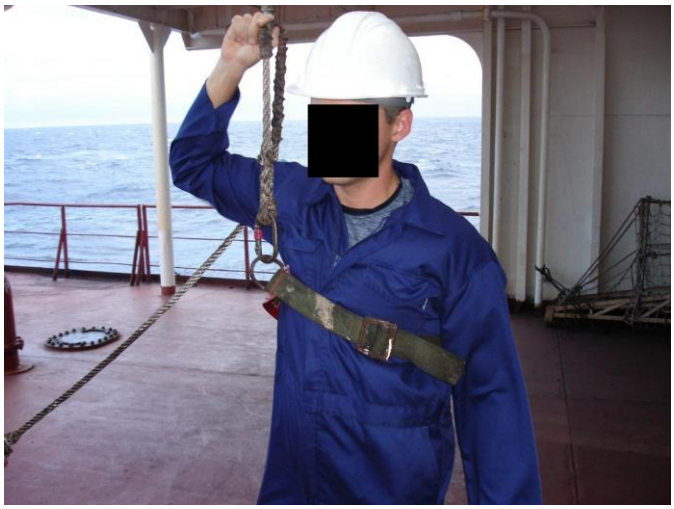
The crew members on fo’c’sle mooring party ran to the access hatch. The crew members on the aft mooring party ran to the emergency equipment store on the starboard main deck. At the emergency equipment store some crewmembers paused waiting for the designated rescue people to arrive (AB1 would normally have been the key man entering the space for an enclosed space rescue). When it was realised AB1 was missing another crewman was designated to adorn the fireman’s outfit and breathing apparatus.

Two rescuers reached hold #2 aft access hatch dressed in fireman’s outfits and breathing apparatus. The C/O quickly checked their equipment and gave quick instructions.

At the same time other members of crew were retrieving medical and rescue equipment to the scene. In an attempt to introduce more oxygen into the space cargo hold #3 hatch lids were fully opened. Unfortunately this had no effect as the access space fed hold #2 aft and not hold #3 forward which was presumed to be the applicable hold during the rescue.

The first rescuer entered the space on-air with a safety line attached approximately 8 minutes after the alarm was raised. He noticed AB1 collapsed and unconscious on the first platform down as shown below.

Picture below shows how the injured crewmen were extracted from the space.



On reaching the first platform the rescuer attached a safety belt under AB1’s arms similar to the above picture. AB1 was hoisted out of the space by crew on the main deck whilst being manoeuvred by the rescuers in the space. AB1 was raised to the main deck 4 minutes after the first rescuer entered the space. The rescuers re-entered the hold access space straight

away for the other crewman. First aid was immediately administered to AB1.
OS1 was found on the second platform down with his head jammed between the platform and the stairs. The rescuer had to move his head from an obstruction (causing minor cuts to his forehead) before attaching the safety line. OS1 was extracted from the space in a similar manner to AB1. OS1 was extracted approximately 6 minutes later to the main deck where first aid was administered immediately.

From the time the alarm was raised AB1 was in the space for 12 minutes and OS1 was in the space for 18 minutes. The helicopter and doctor arrived on the vessel approximately 46 minutes after the Master requested the pilot to call for assistance. First aid was administered continuously to AB1 and OS1 until the doctor arrived at the scene.

When performing the rescue it was assumed that the rescue was for two people only. Since no crew muster was carried out there is a danger that if more than two people were in the space more time could have been wasted in ascertaining the whereabouts of all crew members. This would prolong the rescue of any other crewmen that may have been in the space also. A prolonged rescue from an enclosed space would therefore further diminish chances of survival or full recovery of a casualty.

The rescue was effective and well executed within a reasonable time. AB1 and OS1 were extracted from the space without injury to any other crew members.

Conclusions

OS1 died and AB1 suffered serious injury as a direct consequence of making an unauthorised entry into an enclosed space. The reason why the crewmen entered the space is not known and will remain speculative unless further facts are presented.

The hold#2 aft access space was an enclosed space which falls under the company's SMS definition (though hold access hatches are not specifically stated). None of the hold access spaces had a visible warning notice in place in accordance with the SMS.

OS1 was very inexperienced in working on deck on a cargo ship, especially on bulk carriers. AB1 was an experienced rating and adequately experienced on bulk carriers. Both crewmen had undergone the vessel's familiarisation which includes a 'discussion' about enclosed spaces. Both crewmen had recently undergone enclosed space training in a recent tank rescue drill. When the crewmen decided to enter the space they either:-

- forgot or ignored the risks and procedures or;
- did not identify the hold access hatch as an enclosed space

The vessel has enclosed space entry procedures and safety equipment as prescribed by the SMS concerning the identification and safe entry into enclosed spaces. The crewmen did not follow the safety procedures on board and made an unauthorised entry into the enclosed space. Following the SMS procedures is likely to have prevented injury and death.

The crewmen were effectively extracted from the space within a reasonable time. However, there was no General Alarm sounded and no muster of the crew. Despite two crewmen initially reported to the bridge it is important to account for the whereabouts of everyone on board so the exact number of people to be rescued can be determined.

There is no evidence to suggest that drugs or alcohol was a contributing factor. Fatigue is not considered contributing factor despite the crew member's short rest period before entering the space.

The cargo information supplied to the Master was inadequate and inaccurate relating to the dangers of the transportation of coal by ship. Ship staff and managers should continue to rely on the relevant information contained within the IMSBC Code. The cargo information supplied was not a direct factor in crewman entering the space.

Recommendations
The Isle of Man Ship Registry is recommended to:-

Distribute this report to Masters and Technical Managers concerned with Isle of Man ships to further emphasize the dangers associated with enclosed spaces and to highlight the importance of effective enclosed space familiarisation and entry procedures.

Consider further investigation into the actions of the crew should any further information emerge as to why the crewmen entered the space.

Enterprises Shipping and Trading is recommended to:-

Review the familiarisation training associated with all enclosed spaces on board vessels.

Ensure clearer identification of all potential enclosed spaces within the SMS and warning notices are placed at the entrances to such spaces in a format the crew members can understand.

Consider further fleet training and fleet information notices concerning the identification of enclosed spaces which includes cargo spaces containing oxygen depleting cargoes.

Ensure that adequate cargo information is supplied is supplied to the Master that is relevant to the carriage of cargo by ship.

Nb Safety recommendations shall in no case create a presumption of blame or liability.

Appendix 1

IMSBC Code – International Maritime Solid Bulk Cargoes Code Resolution MSC.268(85)

Coal

DESCRIPTION

Coal (bituminous and anthracite) is a natural, solid, combustible material consisting of amorphous carbon and hydrocarbons.

CHARACTERISTICS

ANGLE OF REPOSE	BULK DENSITY (kg/m^3)	STOWAGE FACTOR (m^3/t)
Not applicable	654 to 1266	0.79 to 1.53
SIZE	**CLASS**	**GROUP**
Up to 50 mm	MHB	B (and A)

HAZARDS

Coal may create flammable atmospheres, may heat spontaneously, may deplete the oxygen concentration, may corrode metal structures. Can liquefy if predominantly fine 75% less than 5 mm coal.

STOWAGE & SEGREGATION

Refer to the appendix to this schedule.

HOLD CLEANLINESS

Clean and dry as relevant to the hazards of the cargo.

WEATHER PRECAUTIONS

When a cargo may liquefy during voyage in case that the moisture content of the cargo is in excess of its TML and the cargo is carried in a ship other than a specially constructed or fitted cargo ship complying with the requirements in subsection 7.3.2 of this Code, the following provisions shall be complied with:

.1 the moisture content of the cargo shall be kept less than its TML during voyage;

.2 unless expressly provided otherwise in this individual schedule, the cargo shall not be handled during precipitation;

.3 unless expressly provided otherwise in this individual schedule, during handling of the cargo, all non-working hatches of the cargo spaces into which the cargo is loaded or to be loaded shall be closed;

.4 the cargo may be handled during precipitation provided that the actual moisture content of the cargo is sufficiently less than its TML so that the actual moisture content is not liable to be increased beyond the TML by the precipitation; and

.5 the cargo in a cargo space may be discharged during precipitation provided that the total amount of the cargo in the cargo space is to be discharged in the port.

LOADING

Trim in accordance with the relevant provisions required under sections 4 and 5 of the Code.

Without reasonable trimming, vertical cracks into the body of the coal may form permitting oxygen circulation and possible self-heating.

PRECAUTIONS

Bilge wells shall be clean, dry and covered as appropriate, to prevent ingress of the cargo. Refer to the appendix to this schedule.

VENTILATION

Refer to Special precautions in the appendix to this schedule.

CARRIAGE

Refer to the appendix to this schedule.

DISCHARGE

No special requirements

CLEAN-UP

No special requirements

EMERGENCY PROCEDURES

SPECIAL EMERGENCY EQUIPMENT TO BE CARRIED
Nil
EMERGENCY PROCEDURES
Nil
EMERGENCY ACTION IN THE EVENT OF FIRE
Batten down. Exclusion of air may be sufficient to control the fire. **Do not use water**. Seek expert advice and consider heading to the nearest port.
MEDICAL FIRST AID
Refer to the Medical First Aid Guide (MFAG), as amended.

REMARKS

The use of CO_2 or inert gas, if available, should be withheld until fire is apparent.

Appendix - Coal

Properties and characteristics

1.. Coals may emit methane, a flammable gas. A methane/air mixture containing between 5% and 16% methane constitutes an explosive atmosphere which can be ignited by sparks or naked flame, e.g., electrical or frictional sparks, a match or lighted cigarette. Methane is lighter than air and may, therefore, accumulate in the upper region of the cargo space or other enclosed spaces. If the cargo space boundaries are not tight, methane can seep through into spaces adjacent to the cargo space.
2.. Coals may be subject to oxidation, leading to depletion of oxygen and an increase in carbon dioxide or carbon monoxide concentrations in the cargo space. Carbon monoxide is an odourless gas, slightly lighter than air, and has flammable limits in air of 12% to 75% by volume. It is toxic by inhalation with an affinity for blood haemoglobin over 200 times that of oxygen.
3.. Some coals may heat spontaneously and the spontaneous heating may lead to spontaneous combustion in the cargo space. Flammable and toxic gases, including carbon monoxide, may be produced.
4.. Some coals may be liable to react with water and produce acids which may cause corrosion. Flammable and toxic gases, including hydrogen, may be produced. Hydrogen is an odourless gas, much lighter than air, and has flammable limits in air of 4% to 75% by volume.

Segregation and stowage requirements

1.. Unless expressly provided otherwise, boundaries of cargo spaces where this cargo is carried shall be resistant to fire and liquids.
2.. This cargo shall be “separated from” goods of classes 1 (division 1.4), 2, 3, 4 and 5 in packaged form (see IMDG Code) and “separated from” solid bulk materials of classes 4 and 5.1.
3.. Stowage of goods of class 5.1 in packaged form or solid bulk materials of class 5.1 above or below this cargo shall be prohibited.
4.. The master shall ensure that this cargo is not stowed adjacent to hot areas.
5.. This cargo shall be “separated longitudinally by an intervening complete compartment or hold from” goods of class 1 other than division 1.4.
Note:. For interpretation of these terms, see section 9.

General requirements for all types of these cargoes

1.. Prior to loading, the shipper or his appointed agent shall provide in writing to the master the characteristics of the cargo and the recommended safe handling procedures for loading and transport of the cargo. As a minimum, the cargo’s contract specifications for moisture content, sulphur content and size shall be stated, and especially whether the cargo may be liable to emit methane or self-heat.
2.. Before loading, the master shall ensure the following:
2.1. All cargo spaces and bilge wells are clean and dry. Any residue of waste material or previous cargo is removed, including removable cargo battens; and
2.2. All electrical cables and components situated in cargo spaces and adjacent enclosed spaces are free from defects. Such cables and electrical components are safe for use in an explosive atmosphere or positively isolated. The provisions of this clause need not apply to engine-rooms where the engine-room is separated from the cargo space by a gastight bulkhead with no direct access.
3.. The ship shall be suitably fitted and carry on board appropriate instruments for measuring the following without requiring entry in the cargo space:
.1. concentration of methane in the atmosphere;
.2. concentration of oxygen in the atmosphere;
.3. concentration of carbon monoxide in the atmosphere; and
.4. pH value of cargo space bilge samples.

4.. These instruments shall be regularly serviced and calibrated. Ship personnel shall be trained in the use of such instruments. Details of gas measurement procedures are given at the end of this appendix.
5.. It is recommended that means be provided for measuring the temperature of the cargo in the range 0°C to 100°C to enable the measurement of temperature of the cargo while being loaded and during voyage without requiring entry into the cargo space.
6.. Smoking and the use of naked flames shall not be permitted in the cargo areas and adjacent spaces and appropriate warning notices shall be posted in conspicuous places. Burning, cutting, chipping, welding or other sources of ignition shall not be permitted in the vicinity of cargo spaces or in other adjacent spaces, unless the space has been properly ventilated and the methane gas measurements indicate it is safe to do so.
7.. Prior to departure, the master shall be satisfied that the surface of the material has been trimmed reasonably level to the boundaries of the cargo space to avoid the formation of gas pockets and to prevent air from permeating the body of the briquettes. Casings leading into the cargo space shall be adequately sealed. The shipper shall ensure that the master receives the necessary co-operation from the loading terminal.
8.. The atmosphere in the space above the cargo in each space shall be regularly monitored for the concentration of methane, oxygen and carbon monoxide. Details of gas monitoring procedures are given at the end of this appendix. The results of monitoring shall be recorded. The frequency of the monitoring shall be determined based upon the information provided by the shipper and the information obtained through the analysis of the atmosphere in the cargo space.
9.. Unless expressly provided otherwise, surface ventilation shall be conducted in all cargo spaces carrying this cargo for the first 24 hours after departure from the loading port. During this period, the atmosphere in the cargo spaces shall be monitored once from one sample point per cargo space and for the purpose of the gas monitoring, the ventilation shall be stopped for an appropriate period prior to the gas monitoring.
10. When the methane concentrations monitored within 24 hours after departure are at an acceptably low level, the ventilation openings shall be closed and the atmosphere in the cargo spaces shall be monitored. When the methane concentrations monitored within 24 hours after departure are not at an acceptably low level, surface ventilation shall be maintained, except for an appropriate period for gas monitoring, and the atmosphere in the cargo spaces shall be monitored. This procedure shall be followed until the methane concentrations become acceptably low level. In any event, the atmosphere in the cargo spaces shall be monitored on a daily basis.
11.. When significant concentrations of methane are subsequently observed in unventilated cargo spaces, the appropriate special precautions for coals emitting methane shall apply.
12.. The master shall ensure, as far as practicable, that any gases which may be emitted from this cargo do not accumulate in adjacent enclosed spaces.
13.. The master shall ensure that enclosed working spaces such as storerooms, carpenter's shop, passageways, tunnels, etc., are regularly monitored for the presence of methane, oxygen and carbon monoxide. Such spaces shall be adequately ventilated.
14.. Regular hold bilge testing shall be systematically carried out during voyage carrying this cargo. If the pH monitoring indicates that a corrosion risk exists, bilges shall be frequently pumped out during the voyage in order to avoid possible accumulation of acids on tanktops and in the bilge system.
15.. If the behaviour of the cargo during the voyage differs from that specified in the cargo declaration, the master shall report such differences to the shipper. Such reports will enable the shipper to maintain records on the behaviour of the coal cargoes, so that the information provided to the master can be reviewed in the light of transport experience.

Special precautions
1 *Coals emitting methane*
. When the shipper has informed that the cargo is liable to emit methane or analysis of the atmosphere in the cargo space indicates the presence of methane in excess of 20% of the Lower Explosion Limit (LEL), the following additional precautions shall be taken:
.1. Adequate surface ventilation shall be maintained, except for an appropriate period for the purpose of gas monitoring.
.2. Care shall be taken to remove any accumulated gases prior to operation of the hatch covers or other openings for any reason, including discharging. Care shall be taken to operate hatch covers of the cargo spaces and other openings to avoid creating sparks. Smoking and the use of naked flame shall be prohibited.
.3. Personnel shall not be permitted to enter the cargo space or enclosed adjacent spaces unless the space has been ventilated and the atmosphere tested and found to be gas-free and to have sufficient oxygen to support life. Notwithstanding these provisions, emergency entry into the cargo space may be permitted without ventilation, testing the atmosphere or the both, provided that the entry into the cargo space is undertaken only by trained personnel wearing self-contained breathing apparatus under the supervision of a

responsible officer and special precautions are observed to ensure that no source of ignition is carried into the space.
.4. The master shall ensure that enclosed working spaces such as storerooms, carpenter's shops, passageways, tunnels, etc., are regularly monitored for the presence of methane. Such spaces shall be adequately ventilated and, in the case of mechanical ventilation, only equipment safe for use in an explosive atmosphere shall be used.

2 *Self-heating coals*
. When the shipper informed that the cargo is likely to self-heat or analysis of the atmosphere in the cargo space indicates an increasing concentration of carbon monoxide, then the following additional precautions shall be taken:
.1. The cargo spaces shall be closed immediately after completion of loading in each cargo space. The hatch covers may also be additionally sealed with a suitable sealing tape. Only natural surface ventilation shall be permitted and ventilation shall be limited to the absolute minimum time necessary to remove methane which may have accumulated.
.2. Personnel shall not enter the cargo space during voyage, unless they are wearing self-contained breathing apparatus and access is critical to safety of life and the safety of the ship.
.3. Prior to loading, temperature of this cargo shall be monitored. This cargo shall only be accepted for loading when the temperature of the cargo is not higher than 55°C.
.4. When the carbon monoxide level is increasing steadily, a potential self-heating may be developing. In such a case, the cargo space shall be completely closed and all ventilation ceased, and the master shall seek expert advice immediately. Water shall not be used for cooling material or fighting coal cargo fires at sea, but may be used for cooling the boundaries of the cargo space.
.5. When the carbon monoxide level in any cargo space reaches 50 ppm or exhibits a steady rise over three consecutive days, a self-heating condition may be developing and the master shall inform the shipper and the company of, at least, the following information if an accurate assessment of the situation is to be achieved:
.1. identity of the cargo spaces involved; monitoring results covering carbon monoxide, methane and oxygen concentrations;
.2. if available, temperature of the cargo, location and method used to obtain results;
.3. time gas sample taken (monitoring routine);
.4. time ventilators opened/closed;
.5. quantity of coal in hold(s) involved;
.6. type of coal as per cargo information, and any special precautions indicated on information;
.7. date loaded, and ETA at intended discharge port (which shall be specified); and
.8. comments or observations from the ship's master.

3 *Gravity fed self-unloading bulk carrier*
3.1. A gravity fed self-unloading bulk carrier means a vessel that has gravity fed systems from the bottom of cargo holds, using gates that may be opened or closed to feed the cargo onto conveyor belts. Such belts run in fore and aft direction underneath the holds; from there the cargo is carried by means of conveyor systems to the deck and discharged onto shore with a self-unloading boom that can extend over the shore and has a conveyor belt. This is not applicable for the vessels with unloading systems such as cranes and grabs.
3.2. When this cargo is carried on a gravity fed self-unloading bulk carrier, the following requirements of this appendix need not apply:
–. paragraph 1 of "Segregation and stowage requirements"; and
–. paragraph 9 of "General requirements for all types of these cargoes".
3.3 Loaded voyage procedures for atmospheric monitoring of cargoes
3.3.1. Bulk coal cargo safety procedures
3.3.1.1. These requirements apply when these cargoes are to be carried on a gravity fed self-unloading bulk carrier. It is recommended that a document, such as a flow chart, describing cargo operations and carriage procedures for these cargoes be provided to the ship by the vessel's operator.
3.4 Ventilation
3.4.1. When ventilating, it shall be ensured that excess air does not ingress excessively into the body of the cargo of coal as this may eventually promote self-heating.
3.4.2. Due to the presence of non-airtight unloading gates at the bottom of the cargo hoppers just above the tunnels, the following methods of ventilation shall be used:
–. if methane is detected in the tunnel, it shall be "positive pressure" ventilated (more supply than exhaust in the tunnels to remove methane gas); and
–. if carbon monoxide is detected in the tunnel, it shall be "negative pressure" ventilated (more exhaust than supply in the tunnels to remove carbon monoxide). The release of carbon monoxide may be an indication of self-heating.

Procedures for gas monitoring of coal cargoes

1 *Observations*

1.1. Carbon monoxide monitoring, when conducted in accordance with the following procedures, will provide a reliable early indication of self-heating within this cargo. This allows preventive action to be considered without delay. A steady rise in the level of carbon monoxide detected within a cargo space is a conclusive indication that self-heating is taking place.

1.2. All vessels engaged in the carriage of this cargo shall carry on board an instrument for measuring methane, oxygen and carbon monoxide gas concentrations, to enable the monitoring of the atmosphere within the cargo space. This instrument shall be regularly serviced and calibrated in accordance with the manufacturer's instructions. Care shall be exercised in interpreting methane measurements carried out in the low oxygen concentrations often found in unventilated cargo holds. The catalytic sensors normally used for the detection of methane rely on the presence of sufficient oxygen for accurate measurement. This phenomenon does not affect the measurement of carbon monoxide, or measurement of methane by infrared sensor. Further guidance may be obtained from the instrument manufacturer.

2 *Sampling and measurement procedure*

2.1 *Equipment*

2.1.1. An instrument which is capable of measuring methane, oxygen and carbon monoxide concentrations shall be provided on board a ship carrying this cargo. The instrument shall be fitted with an aspirator, flexible connection and a length of spark-proof metal tubing to enable a representative sample to be obtained from within the square of the hatch.

2.1.2. When recommended by the manufacturer, a suitable filter shall be used to protect the instrument against the ingress of moisture. The presence of even a small amount of moisture will compromise the accuracy of the measurement.

2.2 *Siting of sampling points*

2.2.1. In order to obtain meaningful information about the behaviour of this cargo in a cargo space, gas measurements shall be made via one sample point per cargo space. To ensure flexibility of measurement in adverse weather two sample points shall be provided per cargo space, one on the port side and one on the starboard side of the hatch cover or hatch coaming. (Refer to the diagram of gas sampling point.) Measurement from either of these locations is satisfactory.

2.2.2. Each sample point shall comprise a hole of diameter approximately 12 mm positioned as near to the top of the hatch coaming as possible. It shall be sealed with a sealing cap to prevent ingress of water and air. It is essential that this cap is securely replaced after each measurement to maintain a tight seal.

2.2.3. The provisions of any sample point shall not compromise the seaworthiness of the vessel.

2.3 *Measurement*

. The explanation on procedures for measurement is as follows:

.1. remove the sealing cap, insert the spark-proof metal tube into the sampling point and tighten the collar to ensure an adequate seal;

.2. connect the instrument to the sampling tube;

.3. draw a sample of the atmosphere through the tube, using the aspirator, until steady readings are obtained;

.4. log the results on a form which records cargo space, date and time for each measurement; and

.5. put back the sealing cap.

2.4 *Measurement strategy*

. The identification of incipient self-heating from measurement of gas concentrations is more readily achieved under unventilated conditions. This is not always desirable because of the possibility of the accumulation of methane to dangerous concentrations. This is primarily, but not exclusively, a problem in the early stages of a voyage. Therefore it is recommended that cargo spaces are initially ventilated until measured methane concentrations are at an acceptably low level.

2.5 *Measurement in unventilated holds*

. Under normal conditions one measurement per day is sufficient as a precautionary measure. However, if carbon monoxide levels are higher than 30 ppm then the frequency shall be increased to at least twice a day at suitably spaced intervals. Any additional results shall be logged.

2.6 *Measurement in ventilated holds*

2.6.1. If the presence of methane is such that the ventilators are required to remain open, then a different procedure shall be applied to enable the onset of any incipient self-heating to be detected.

2.6.2. To obtain meaningful data the ventilators shall be closed for a period before the measurements are taken. This period may be chosen to suit the operational requirements of the vessel, but it is recommended that it is not less than four hours. It is vital in the interests of data interpretation that the shutdown time is constant whichever time period is selected. These measurements shall be taken on a daily basis.

2.7 *Measurement in cargo and self-unloading spaces of gravity fed self-unloading bulk carrier*

2.7.1. Measurement in unventilated cargo and self-unloading spaces

2.7.1.1. When the shipper has declared that the coal cargo has or may have self-heating characteristics, the holds shall not be ventilated unless otherwise specified in this section.
2.7.1.2. Under normal conditions one measurement per day is sufficient as a precautionary measure. If carbon monoxide levels are higher than 30 ppm then the frequency of measurements shall be increased to at least twice daily, at suitable intervals. Any additional results shall be logged.
2.7.1.3. If the carbon monoxide level in any hold indicates a steady rise or reaches 50 ppm a self-heating condition may be developing and the owners of the vessel shall be notified as outlined in the procedures. Above this level, the vessel shall operate on ”negative pressure” ventilation, in order to reduce the amount of carbon monoxide. Regular monitoring of carbon monoxide levels shall continue.
2.7.1.4. Persons entering cargo or unloading spaces with carbon monoxide levels higher than 30 ppm shall not do so without self-contained breathing apparatus.
2.7.2. Measurement in ventilated cargo and self-unloading spaces
2.7.2.1. If the presence of methane is indicated by monitor, and such that ventilation is required, then a different procedure shall be applied to enable the onset of any possible self-heating to be detected. “Positive pressure” or “through ventilation” shall be operated to remove the methane.
2.7.2.2. To obtain meaningful data the ventilators and/or ventilation shall be closed for a period before measurements are taken. This period may be chosen to suit the operational requirements of the vessel, but it is recommended that it is not less than four hours. It is vital in the interests of data interpretation that the shutdown time is constant whichever time period is selected. These measurements shall be taken on a daily basis. If the carbon monoxide results exhibit a steady rise, or exceed 50 ppm on any day, the owner shall be notified.
2.7.2.3. In addition the following points shall be considered:
–. at no time shall ventilation be shut down when crew members are in the self-unloading spaces;
–. special fire-fighting equipment and/or procedures may be necessary for the vessel; and
–. establish specific crew training for gravity fed self-unloading bulk carriers.

Appendix 2

Selected sections of IMO Res A20/864 “Recommendations for Entering Enclosed Spaces Aboard Ships” (referred to in IMSBC Code 13.2.12) state:-

“ "Enclosed space" means a space which has any of the following characteristics:
.1 limited openings for entry and exit;
.2 unfavourable natural ventilation; and
.3 is not designed for continuous worker occupancy,
and includes, but is not limited to, cargo spaces, double bottoms, fuel tanks, ballast tanks, pump-rooms, compressor rooms, cofferdams, void spaces, duct keels, inter-barrier spaces, engine crankcases and sewage tanks.

4 Authorization of entry
4.1. No person should open or enter an enclosed space unless authorized by the master or nominated responsible person and unless the appropriate safety procedures laid down for the particular ship have been followed.
4.2. 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. An Enclosed Space Entry Permit should be issued by the Master or nominated responsible person, and completed by a person who enters the space prior to entry.

9 HAZARDS RELATED TO SPECIFIC TYPES OF CARGO
9.3 Solid bulk
On ships carrying solid bulk cargoes, dangerous atmospheres may develop in cargo spaces and adjacent spaces. The dangers may include flammability, toxicity, oxygen depletion or self-heating, which should be identified in shipping documentation. For additional information, reference should be made to the Code of Safe Practice for Solid Bulk Cargoes.

9.4 Oxygen-depleting cargoes and materials
A prominent risk with such cargoes is oxygen depletion due to the inherent form of the cargo, for example, self-heating, oxidation of metals and ores or decomposition of vegetable oils, animal fats, grain and other organic materials or their residues. The materials listed below are known to be capable of causing oxygen depletion. However, the list is not exhaustive. Oxygen depletion may also be caused by other materials of vegetable or animal origin, by flammable or spontaneously combustible materials, and by materials with a high metal content:
…
.9 charcoal, coal and coal products;
…

10 CONCLUSION
Failure to observe simple procedures can lead to people being unexpectedly overcome when entering enclosed spaces. Observance of the principles outlined above will form a reliable basis for assessing risks in such spaces and for taking necessary precautions.”

Appendix 3

Selected sections of the Company SMS regarding Enclosed Spaces.

Access
Cargo spaces should always be well ventilated before entry is made. If it is necessary to enter a cargo tank or other enclosed cargo space , the precautions set out in par.2 should be followed . Whenever practicable, the permanent means of access should be used. In other cases, portable rigid ladders should always be used. When necessary, lifelines and safety harnesses should be available and used. Company's form "Enclosed space entry permit".

ENCLOSED SPACES ENTRY
DEFINITION
ALL spaces, normally closed to atmosphere, which are not continuously ventilated by means of a fixed mechanical ventilation system and are not a normal place of work and where the atmosphere is dangerous to life or there is the possibility that it may become so.
This definition includes:

- All Cargo, Ballast and Bunker tanks;
- All other tanks, double bottoms and empty spaces;
- Cofferdams and barrier spaces;
- Duct Keels;
- Access trunking to double bottoms and duct keels;
- Chain Lockers;
- Battery Lockers;
- Storage rooms for CO2 and other media used for fire extinguishing;
- Any other item of machinery or equipment that is not routinely ventilated and entered such as
- Boilers and Main Engine crankcases and pressure vessels;
- Pipelines or fittings connected to any of the above;

COMPANY REGULATIONS
The atmosphere of any enclosed or confined space may put at risk the health or life of any person entering it. It may be deficient in oxygen and/or contain flammable or toxic fumes, gases or vapours. Should there be any unexpected reduction in or loss of the means of ventilation of those spaces that are usually continuously or adequately ventilated then such spaces should also be dealt with as dangerous spaces. When it is suspected that there could be a deficiency of oxygen in any space, or that toxic gases, vapours or fumes could be present, then such a space should be considered to be a dangerous space.

PERSONNEL MUST NEVER ENTER ANY DANGEROUS SPACE TO ATTEMPT A RESCUE WITHOUT TAKING SUITABLE PRECAUTIONS FOR HIS OWN SAFETY SINCE NOT DOING SO WILL PUT HIS OWN LIFE AT RISK AND ALMOST CERTAINLY PREVENT THE PERSON HE INTENDED TO RESCUE BEING BROUGHT OUT ALIVE.

IDENTIFICATION OF POTENTIAL HAZARDS
The following are of particular relevance:
Oxygen deficiency
Oxygen deficiency must be suspected in any enclosed or confined space:

- Which has been closed for any length of time without adequate ventilation.
- Which have contained water, have been subjected to damp or humid conditions where
- rusting is present, causing the oxygen content to fall.
- Where Carbon Dioxide (CO2) or other fire-extinguishing media has been injected to
- extinguish a fire.
- Where there has recently been a fire.
- Where oxygen-absorbing chemicals have been used to prevent rusting within boilers or
- other pressure vessels.
- Where cargo that absorbs oxygen, e.g. grain or coal, has accumulated.
- In spaces such as duct keels, especially where such spaces allow entrance into cargo holds.

PREPARATIONS PRIOR TO ENTRY

- Space is to be thoroughly ventilated.
- Atmosphere tested and found safe for entry without breathing apparatus.

- Rescue and available resuscitation equipment to be ready at the entrance, including means of hoisting an incapacitated person from the space, if appropriate.
- The Responsible Officer is to be in attendance at the entrance to the space while it is occupied.
- Communications procedures are to be agreed and acknowledged by all those involved.
- Communications between the Responsible Officer in attendance at the entrance and the Officer On Watch (Bridge / Cargo Control Room or Engine Control Room) should be established.
- There is to be safe/adequate access to the space and the space should be well illuminated.
- All equipment to be used is to be of an approved type and in good working order. No sources of ignition or non-intrinsically safe electrical equipment should be taken into the space unless the Responsible Officer is satisfied that it is safe to do so.
- When appropriate, a rescue harness should be worn to facilitate recovery in the event of an accident.

An Enclosed Space Entry Permit should be authorized by a Competent Person prior to personnel entering an enclosed space.
NO ONE SHOULD ENTER ANY ENCLOSED SPACE UNLESS AN ENCLOSED SPACE ENTRY PERMIT HAS BEEN AUTHORIZED BY A COMPETENT PERSON

RESCUE FROM ENCLOSED SPACES
ON NO ACCOUNT SHOULD ANYONE ATTEMPT TO ENTER A SPACE IN ANY EMERGENCY BEFORE ADDITIONAL HELP HAS ARRIVED. NO ONE SHOULD ATTEMPT A RESCUE WITHOUT WEARING BREATHING APPARATUS AND A RESCUE HARNESS AND, WHENEVER POSSIBLE, USE OF A LIFELINE.

The alarm should be raised so that the Control group can be mustered quickly and directed as necessary.

As much preparation as possible should be made in the time available. At the very least, this will consist of:

- Minimum Safety Equipment required on site at the entry location;
- Adequate lighting, where appropriate.
- Sufficient personnel at or near the entrance to meet foreseeable requirements, replenish equipment etc.
- Proper checking and donning of Self Contained Breathing Apparatus (SCBA).
- Use of a SCBA control board; estimation of the time allowed within the space by the SCBA set air supply.
- SCBA wearers should have an intrinsically safe torch to check their air gauge pressure.

A Responsible Officer should be appointed by the Master to continuously supervise the operations from outside the space from where the most effective control can be exercised. The Responsible Officer must check BA set air pressures, calculate times allowed in the space and to organise back-up team entry times. Two (2) man entry teams may be required to:

- Manoeuvre a casualty out of the space
- Search a smoke-filled space
- Handle fire-hoses.

While within the space, SCBA wearers should NEVER remove their facemasks for any reason. The first priority must be to remove a casualty to a fresh air supply, irrespective of his injuries. In the case of a serious or suspected back injury, alternative arrangements to get an air supply to the casualty should be made, while arranging for his evacuation so that damage to the spine is minimised.

SCBA wearers must exit the space before their air is exhausted and should endeavour to do so before the low pressure whistle is activated. If necessary, back-up teams should be available ready to enter and continue the operation so that the first entrants leave the space before their low-pressure warning alarm sound (approx. 4 minutes air supply).

It is imperative that every member of the rescue team should know what is expected of him. The above procedures cannot be improvised on the spot. Regular drills are required to simulate and practice the emergency entry into a space.