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REVISION OF THE RECOMMENDATIONS FOR ENTERING ENCLOSED SPACES ABOARD SHIPS

Enclosed space entry issues

Submitted by the Marine Accident Investigators' International Forum (MAIIF)

SUMMARY	
Executive summary:	This document provides information on enclosed space entry incidents that have occurred since 1998, and which have given MAIIF serious cause for concern and discussion at recent meetings
Strategic direction:	5.2
High-level action:	5.2.1
Planned output:	-
Action to be taken:	Paragraph 8
Related documents:	IMO resolution A.864(20); DSC 13/20, annex 4; MSC 85/26, paragraph 23.7; FSI 17/20, paragraphs 6.6 and 6.7; MSC 86/26, paragraphs 10.18 and 13.22 and DSC 14/22, section 16

Background

1 IMO resolution A.864(20) on Recommendations for entering enclosed spaces aboard ships was adopted at the twentieth Assembly on 27 November 1997. It invites Governments to bring the recommendations to the attention of shipowners, ship operators and seafarers, urging them to apply the recommendations, as appropriate, to all ships.

2 The object of the Recommendations is to encourage the adoption of safety procedures aimed at preventing casualties to ships' personnel entering enclosed spaces where there may be an oxygen deficient, flammable and/or toxic atmosphere. They are practical recommendations that apply to all types of ships and provide guidance to seafarers, which are intended to complement national laws or regulations, accepted standards or particular procedures which may exist for specific trades, ships or types of shipping operations.

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3 A preliminary survey of MAIIF members (attached at annex) reveals that there have been at least 101 enclosed space incidents resulting in 93 deaths and 96 injuries, since the Recommendations were adopted in November 1997.

4 Areas of concern identified in the reports include, *inter alia*:

.1 lack of knowledge, training and understanding of the dangers of entering enclosed spaces;

.2 Personal Protective Equipment (PPE) or rescue equipment not being used, not available, of inappropriate type, improperly used, or in disrepair;

.3 inadequate or non-existent signage;

.4 inadequate or non-existent identification of enclosed spaces on board;

.5 inadequacies in Safety Management Systems; and

.6 poor management commitment and oversight.

5 MAIIF believes that the investigations show that, from many of the casualties investigated, it is evident that training was inadequate, and that the necessary drills were not carried out in the procedures for safe entry and safe rescue from enclosed spaces. Training may remain ineffective if not backed up by a positive management level commitment to managing safety, assessing competence and training needs on board, and developing a safety culture from the company head office to the master, the officers and the ratings.

6 MAIIF notes from the report of the MSC 85 the new work programme item to revise, as necessary, the specific provisions of the Recommendations for Entering Enclosed Spaces Aboard Ships, under the coordination of the DSC Sub-Committee.

7 At the eighty-sixth session of the Maritime Safety Committee, the Committee agreed to invite MAIIF to provide the Organization with the outcome of its work on deaths in enclosed spaces, as the findings thereof may be relevant to the consideration of the issue of explosions on small chemical tankers. However, it is clear from the work already done by MAIIF, that some of the provisions of the Recommendations for Entering Enclosed Spaces Aboard Ships are not being universally applied. MAIIF therefore considers that the information provided will assist the work of the Sub-Committee in coordinating the revision of the Recommendations for entering enclosed spaces aboard ships, and will provide any additional information as may become available.

Action requested of the Sub-Committee

8 The Sub-Committee is invited to note the contents of this document in the context of consideration of agenda item 10 and to take action as appropriate.

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ANNEX

PRELIMINARY SURVEY REPORT ON ENCLOSED SPACE INCIDENTS

Incident	Approx. Date	Ship Type	Reporting Authority	Confined Space	Condition of Space	Deaths	Injuries	Comments	Notes on Investigation	Vessel Flag (if other than reporting authority)
1	01/03/1998	Cargo	Cyprus	Tunnel	Tunnel, below loaded cargo holds	3	0	The vessel carried wheat and the cargo had been fumigated with Aluminum phosphide - Phostoxin. Water was observed in Hold No.1 and in the duct keel. Three crew members entered tunnel for inspection, but they lost their lives due to the presence of phosphire gas. A Fumigation notice stated that the above product generates phospire gas (PH3) and that the fumigated spaces must be completely sealed for ten days. The presence of water was due to minor hull damage.		
2	28/04/1998	RoRo Vehicle/ Passenger ferry	UK MAIB	Deck locker		0	1	Young female passenger, who was under the influence of alcohol, crossed security chains and entered restricted space on small ferry. She was located after vessel had shut down for the night in a small deck locker. She was suffering from smoke inhalation having inadvertently placed clothing on a heater.		
3	14/05/1998	Aggregates Dredger	UK MAIB	Engine Room	Unknown	0	1	Using a burning torch to cut a pipe ring in the engine room caused a vapor to be given off. Work stopped and both the personnel involved with the task moved away. One of them experienced breathing difficulty. it is thought that the burner vaporized sealant of some other substance trapped below the pipe ring. The work was completed using a grinder.		
4	02/10/1998	Fishing Vessel	U S C G	Pipe Tunnel Void	Low O2 and Toxic Environment, Access Procedures	1	4	Crewman was asphyxiated by lethal levels of hydrogen sulfide, carbon monoxide, and depleted oxygen when he entered a pipe tunnel void researching an odor and clam hold drain leak onboard moored clam dredge vessel. The following rescue personnel were also treated for hydrogen sulfide exposure: 1 crewman from the same vessel, 2 crewmen from an adjacently moored F/V, and 1 police officer.		
5	05/01/1999	Bulk/oil carrier	UK MAIB	Duct Keel	Unknown	0	1	Seaman overcome by fumes while working in duck keel of tanker. All proper precautions taken and other crew with him were not effected.		Bahamas
6	16/01/1999	Oil tanker	UK MAIB	Cargo Oil Tank	Gasoline	0	1	Crewman entered cargo oil tank. After placing eductor pump in suction well he collapsed. Atmosphere had been tested before entry. Tested immediately after incident and found gas free. Presumed cause was isolated pocket of gas in tank.		Gibraltar
7	03/02/1999	Tug/anchor handling vessel	UK MAIB	Store Space	Carbon monoxide	0	1	Use of petrol driven salvage pump in store space caused one crew member to suffer minor carbon monoxide poisoning .		
8	18/02/1999	General cargo multi-deck	UK MAIB	Hold	Oxygen depletion	1	0	Crew member entered partitioned area of hold during carriage of steel turnings. He died of asphyxiation.	Investigated by Bahamas Maritime Authority	Bahamas
9	23/04/1999	Chemical Tanker	IOM	Cargo Tank - previous cargo HMD and Nitrogen blanket	Nitrogen, Oxygen depletion	2	0	Very similar to Bow Wind comments. There was a practice on board of taking a deep breath and going to first platform to see if clean, cutting corners to save time. Pumpman died, cadet tried to rescue wearing a filter mask and also died. Subject of "Silent Assassin" video.		

10	19/07/1999	Barge	U S C G	Cargo Tank	Low O2 and Toxic Environment, Access Procedures	1	0	At a Barge Cleaning Facility, a shipyard worker entered the #1 cargo tank. He was later found by co-workers lying unconscious on the bottom of the hold and was extracted from the hold, and personnel conducted CPR until an ambulance arrived. He was transported to Hospital where he was pronounced dead. Apparent cause of death was asphyxiation due to exposure to an oxygen deficient environment. Investigation found that he had received the safety training Respirator fit test and training, Confined space entry, Workplace safety training (hazardous communications) and concluded that cleaning facility had inadequate enforcement of their confined space entry and securing procedures.		
11	26/08/1999	Naval support	UK MAIB	Unknown	Sodium metabisulphite	0	1	Accidental release of sodium metabisulphite vapor during cleaning of reverse osmosis plant. Injured crew member was not wearing sufficient personal protective equipment.		
12	25/09/1999	RoRo Vehicle/ Passenger ferry	UK MAIB		Ammonia	0	1	Crew member suffered injury due to accidentally inhaling ammonia gas while moving a faulty refrigerator. Ammonia refrigerators to be removed from vessel.		
13	03/02/2000	Tanker	Latvia	Cargo tank	Ventilated. cargo fumes	1	0	While climbing up the stairs after cargo tank cleaning sailor fell back to the tank bottom from five meter height and lost his life. The causes of the accident: 1) lack of the tank-working permit; 2) lack of the safety line while climbing up.		
14	01/04/2000	Dry Cargo -Reefer	Liberia	Cargo Hold	Oxygen Deficiency	1	0	Cocaine Smuggler found dead in Cargo Hold.		
15	05/04/2000	Ore carrier	UK MAIB	Hold	Bulk coal	2	1	Military intelligence decided to search vessel using combined naval, marine and specialized army search team. Holds to be searched if ventilated/time allowed. 2 army entered hatch, no pre-entry tests. Both men became unconscious, corporal entered space without pre-testing, became unconscious.	Investigated by MAIB http://www.maib.gov.uk/publications/investigation_reports/2001/mv_diamond_bulker.cfm	Philippines
16	18/05/2000	Tank Ship	U S C G	Cargo Tank	Entering Toxic Environment without protective clothing, access procedures	1	0	Vessel enroute Houston, TX after discharging a cargo MTBE. Two days after departure the pumpman entered number #1 center cargo tank for cleaning with a respirator & EEBA. The pumpman retrieved from inside the tank by ships crew. CPR was administered but was unsuccessful. Autopsy concluded the pumpman died of "toxic fumes intoxication secondary to MTBE exposure."		
17	10/06/2000	Fish Catching	UK MAIB	Engine Room	Carbon Monoxide	1	0	Portable petrol-engined pump being used to pump bilges of fishing vessel. Pump and engine placed in engine room with no ventilation. Engineer was fatally affected by carbon monoxide fumes from engine's exhaust.	Investigated by MAIB http://www.maib.gov.uk/publications/investigation_reports/2001/fv_mariama_k_fr242.cfm	
18	10/09/2000	General cargo - single deck	UK MAIB	Cargo hold	Carbon monoxide	1	0	Seaman found lying at bottom of no.2 hold access shaft. Atmospheric tests on access shaft to hold showed very low levels of oxygen & high levels of carbon monoxide. Apart from distinctive smell, chemical reaction in shaft or in timber in hold. Tests on timber sample showed no evidence of preservatives or any apparent reason for low oxygen & high carbon monoxide atmosphere.	Investigated by MAIB http://www.maib.gov.uk/publications/investigation_reports/2001/baltyskiy.cfm	Russia
19	19/10/2000	Tanker/ combination carrier	UK MAIB	Cargo tank	Inert gas	0	1	Crew member entered a cargo tank after cleaning to retrieve a pair of gloves despite being aware of the dangers from inert gas. He collapsed, a rescue using "SCBA SEDS" was carried out and the man rescued.		
20	29/10/2000	General cargo single deck	UK MAIB	Cargo hold	Oxygen depletion, Carbon Monoxide	1	0	Master entered cargo hold on coaster, whilst at anchor sheltering and was overcome by fumes from coal cargo. Oxygen content found to be below 3.5% and carbon monoxide found present.		Holland

21	24/11/2000	General Dry Cargo Ship	NOR NMD	Cargo Hold	Probably low O2-level in cargo hold	2	1	OS painted access hatch for cargo hold. The hatch was open. Observed unconscious. Two persons entered the cargo hold without BA to rescue the OS. One of them survived due to resuscitation.		
22	01/12/2000	Chemical tanker (Inland)	Netherlands	Cargo tank	Low O2 environment, Access Procedures	1	0	After discharging a naphtha cargo, the cargo inspector declared the cargo tank unfit for the intake of different chemical load, remains of the naphtha still being present. The master decided to clean the tank himself. Although all the right equipment was available and the master was well informed and experienced, he nevertheless entered the tank relying on a full face mask with filter for naphtha vapors. He did not take a possible low oxygen level into account and died of oxygen deficiency.		
23	10/05/2001	Oil tanker	Latvia	Ballast tank	Insufficient ventilation during spray-painting	1	1	During spray painting with toxic paint in the ballast tank safe working regulations were violated – air respirators were used instead of breathing apparatus. As a result one worker lost his life and another got toxic poisoning. The accident was facilitated by prolonged evacuation of victims from the tank (almost 5 hours).		Liberia
24	04/09/2001	Chemical Tanker	IOM	Cargo tank-previous cargo Naphtha	30% LEL and no O2 checks	1	1	Educting tank residues all day, occasionally checking atmospheres, crew refusing to wear SCBA only filter masks, condoned by C/O - lucky they didn't all die! Cutting corners to save time and effort in port. Master died of a heart attack during rescue.		
25	05/10/2001	Oil Tanker	Liberia	Ballast tank	Oxygen Deficiency	1	1	One Ship yard Worker died due to asphyxiation while painting ballast tank and one Ship yard Worker injured due to intoxication by hydrocarbon gas.		
26	02/11/2001	Pelagic Fishing Vessel	SAMSA	Fishhold	Oxygen depletion	2	0	2 crew members entered the fishhold to clean, 2 days after a catch of pelagic fish had been discharged. Oxygen content too low to sustain life.		
27	30/11/2001	Tanker	Latvia	Double bottom fuel tank	Ventilated	1	0	Severance was performed in ships double bottom fuel tank (DB FT). Gas cylinders were located on the main deck and gas hoses were put through openings down into DB FT. In same time the electrical welding was performed in the pump room above the DB FT. After a short break, steel cutting works were being recommenced and fire in DB FT broke out. As a result the worker lost his life. The probable causes of accident were: gas hose damage after contact with hot metal surface inside DB FT or hose contact with drops of melted steel from the pump room.		

28	17/11/2001	Bulk Carrier	Australia ATSB	Ballast Tank	ntilated, non-intrinsi	8	0	With the ship waiting at anchor off Dampier to load, the crew were preparing and painting the interior of no.1 port topside ballast tank. At about 1430 on a hot Sunday afternoon, the eight-man deck crew started work painting the steelwork inside the tank. One man was spray painiting inside the empty tank while the rest of the deck crew maintained the paint reservoir and tended a cargo light lowered into the tank through the after manhole. An open-ended compressed air hose was led from the forecastle, along the deck and down through this after manhole, while an electrically driven fan was positioned over the after manhole to ventilate the tank. The paint being used was a two-part epoxy mix, excessively thinned because of the hot day. At about 1640 a large explosion ripped through the tank. It is likely that the cargo light was inadvertently dropped into the tank which caused the incandescent bulb to break which then ingnited the heavier-than-air paint fumes trapped in the frames spaces at the bottom of the tank. The tank was ruptured and three men were blown down the length of the main deck, killing The explosion also blew four other men over the ship's side. One man, who had been inside the tank, still alive although severely burned was assisted out of the tank, through the ruptured maindeck plating, and airlifted ashore. He died 18 days later in hospital.		Hong Kong
29	17/12/2001	Bulk Carrier	Liberia	Cargo Hold	Oxygen Deficiency	1	0	Chief Mate died due to lack of oxygen in the cargo hold		
30	04/01/2002	Oil/chemical tanker	UK MAIB	Cargo Tank	Gasoline fumes	0	1	AB developed problem with BA mask and removed/lost his face mask, became unconscious. Enclosed spaces checklist and company procedures were not followed.		Gibraltar
31	10/01/2002	Oil tanker	UK MAIB	Cargo or other tank space	Unknown	0	1	Bosun entered untested enclosed space and collapsed as a result		Gibraltar
32	08/02/2002	Prawn Freezer Trawler	SAMSA	Machinery space	Oxygen depletion	1	0	Chief Engineer found dead in machinery space after working on refrigeration system.		
33	31/03/2002	Ro-Ro Cargo Ship	U S C G	Engineroom	Low O2 Environment, Fire fighting and recovery procedures	2	0	The vessel had a fire in the engine room. At approx 0645, the vessel master released CO-2 to extinguish the fire. At approx 0745, a team led by the Chief Mate entered the engine room and reported that the fire was out. At approx 0815, the team made a second entry to further evaluate the extent of the damage and the ability of the ship to get underway. During this entry, the Chief Engineer fell unconscious down a stairwell near the start-air tanks to the lower engine room deck. He was assisted by the Chief Mate, 1st Asst Engineer and 3rd Asst Engineer. The 3rd Asst Engineer exited to get help.The Chief Engineer awoke alone at the bottom of the stairwell wearing an emergency air pack (ELSA). He departed the engine room through a nearby escape trunk. A rescue team, entering to assist, found the Chief Mate and 1st Asst Engineer aft of the MDE. It appears they were in the process of exiting the engine room when they ran out of air. After extracting them from the engine room, the crew initiated CPR efforts but were unable to revive them. The autopsies ruled that the crewmembers died of asphyxia due to oxygen deficiency combined with carbon dioxide inhalation.		

34	20/04/2002	Freezer Trawler	SAMSA	Machinery Space	Oxygen depletion/refrigeration gas	2	0	Greaser was instructed to clean the filter on a refrigeration system. Filter not isolated. R22 entered the compartment displacing the oxygen, being heavier than air. Chief Engineer went to check on progress noted the Greaser collapsed on the plates and entered the compartment. Both died.		
35	06/08/2002	Hopper Barge	MAI Hong Kong	Void Space adjacent to cargo hold	Oxygen depletion, Carbon Monoxide	2	0	Two local seamen died after entering the void space adjacent of a cargo hold. Carbon monoxide gas had accumulated in the space and depletion of oxygen took place inside the space due to rusting of vessel structure. The space had not been ventilated before they entered into it.	Investigated by MAI Hong Kong http://www.mardep.gov.hk/en/publication/pdf/mai020806.pdf	Locally licensed barge in Hong Kong
36	06/08/2002	Tanker	NOR NMD	Cargo tank	Low O2 Environment, Methane atmosphere	0	2	AB entered the Tank in connection with tank cleaning. The tank was not ventilated and the atmosphere was not tested. The AB lost consciousness due to Methane poisoning.		
37	29/08/2002	Offshore	U S C G	Leg of drilling rig, void spaces	Low 02 environment	2	0	2 shore staff were working on the rig. They were sent into a leg of the rig to install ventilation and lights. According to findings the leg was Oxygen deficient. The two personnel who entered the compartment died of "Asphyxiation".		
38	01/09/2002	General dry Cargo Ship	U S C G	Cargo Hold	Low O2 Environment, Access Procedures	0	1	While in a cargo hold collecting stacking cones, an AB fell approximately 10 feet to the level below. He was found by a shipmate several minutes later in a pool of blood. There were no witnesses to the actual fall, and the victim does not remember what happened. He sustained several injuries, including a fractured skull, a broken rib, a punctured lung, and a broken left wrist. Inestigating officer theorized that oxygen deficiency in the space may have caused the mariner to pass out and fall.		
39	09/09/2002	Fishing Vessel	U S C G	Engineroom	Refrigerant leak	0	1	In the Pacific Ocean, 112 nm west of point St. George, a refrigeration leak occurred in the engine room. Crew member attempted to repair the leak but was overcome by freon gas in the enclosed space and lost consciousness for 20-25 seconds. The victim was medevaced and transported to hospital. Vessel ventilated the engine room and the leak was repaired.		

40	02/12/2002	Bulk Carrier	U S C G	Cargo Hold	Low O2 and Toxic Environment, Access Procedures	1	1	At Dar Es Salaam, Tanzania hatches to #3, #5, #6 and #7 were opened for discharge of cargo. At about 0935 two Tanzanian Agricultural inspectors arrived to inspect holds #5 and #7 for quality of cargo. At about 1030 another inspector arrived aboard with 24 Agricultural trainees, requesting they be allowed to observe the inspection process. Although the master refused initially he eventually relented and referred the matter to the Chief Officer who instructed the students to view the cargo operations from the deck level only. At about 1125 the master was notified a man collapsed in cargo hold #3. A rescue team was formed. Deck crew responded with a first aid kit and noticed an individual lying about six feet below on top of the cargo inside the #3 cargo hold trunk hatch. The Chief Mate return with a gas mask, used for fumigant whcih had been used to fumigate the carge after loading, and an EEBD. The Chief Mate put on the gas mask and entered the space. The Chief Mate attempted to put the EEBD on the down person but collapsed. When the master arrived on scene he instructed AB to get an SCBA who then entered the space with a rescue line and block. At about 1135 the Chief Mate was recovered. The master checked the Chief Mate for vitals, found no pulse or respiration, and immediately started CPR. At about 1137 the Chief Mate responded to CPR, breathing on his own. At about the same time the original man down was brought up. The master checked for vitals, found no pulse or respiration. and immediately started CPR. He did not respond to CPR and the master then used the vessel's portable AED to defibulate the patient. He did not respond and CPR was continued until paramedics arrived at about 1215. At about 1230 the Chief Mate was removed to an awaiting ambulance and was taken to the hospital in critical condition. At about 1240 the original person found in the hold was removed to an awaiting ambulance but was pronounced dead. At 1330 atmospheric readings were taken from the #3 cargo hold trunk and found to be 3% Oxygen. The post-Mortem Examination stated that the primary cause of death was due to head injury. The deceased was not authorized entry into the #3 cargo hold. The Chief Mate did not follow proper procedures for confined space entry.		
41	12/04/2003	Pair trawler	UK MAIB	Cargo – fishroom	Hydrogen sulphide fumes	0	2	Two crew who were working in the fish hold ended up with very sore eyes and extremely bad head aches. A study following a similar accident suggested that hydrogen sulphide fumes were to blame. The problem was eventually solved by removing the concrete floor, and replacing it, sealing it correctly.		
42	21/05/2003	Scallop/ queenie dredger	UK MAIB	Cargo - fishroom	R409A	0	1	A shoreside engineer was overcome by gas R409A while working on the refrigeration system. In future the skipper intends to open all the fish room hatches when the refrigeration system is being worked on.		

43	26/06/2003	Barge	U S C G	Cargo Tank	Low O2 and Toxic Environment, Access Procedures	0	2	2 collapsed while working in the barge. The first crew member entered the barge to pump out the water when he was overcome by the lack of oxygen in the space. He fell approximately 10 ft, injuring his head. The second crew member went in to provide assistance. He was also overcome by the lack of oxygen. A third person was lowered into the tank via rope and was also overcome but was able to be pulled out. The owner of the cleaning company notify Emergency Response and then placed a ventilator into the space. A Good Samaritan provided assistance, holding his breathe went down into the tank placing a rope around both individuals. Both crew members were pulled safely out of the barge and transferred to Hospital. Both men were breathing but unconscious when they arrived at the hospital. They since recovered.		
44	08/07/2003	Bulker	RMI	#6 Fwd Cargo Hold	Oxygen Deficiency	0	2	Fitter and Chief Officer fainted in the first platform of No.6 Fwd Cargo Hold entry due to lack of oxygen.		
45	10/09/2003	Surface craft	UK MAIB	Other internal deck/space	Hydrogen sulphide	0	1	Whilst conducting planned maintenance cleaning of a sewage treatment plant with two assistants the engineer officer was overcome by hydrogen sulphide after disturbing the sludge with a fire hose. The plant had been shut down previously for several days but the hose was required to break up the heavy sludge.		
46	13/10/2003	Liquid gas carrier	UK MAIB	Engine room	Hydrogen gases	1	1	2 shore workers chemically cleaning a main boiler, the steam drum door had been opened to allow for inspection of the clean. As the contractors approached the drum a non-intrinsically safe halogen lamp was passed into the drum. There immediately followed an explosion which caused fatal injuries to the UK worker and serious 30% burns to a Danish national. The chemical used to remove the boiler scale and corrosion was nitro's descalex. This inhibited Sulphamic acid cleaner also contained a coloring agent to indicate the acid strength. The inhibitor Provided a protective coating on the internal steel surfaces of the boiler so that it was protected From acid attack, which produces hydrogen gas.	Investigated by MAIB http://www.maib.gov.uk/publications/investigation_reports/2007/hilli.cfm	
47	24/10/2003	Container	Germany	Scavenge Air Receiver	The autopsy report revealed cardiovascular failure due to hyperthermia as cause of the death	1	0	Engineer entered scavenge air receiver again after work was completed, no safety watch was posted; he got locked inside due to construction of “dogs” used for locking the access hatch; inappropriate search measures were applied when it became known that the engineer was missing; time/commercial pressure and relationship between crew members might had contributed; even though the scavenge air receiver was known to be the last working place of the engineer it had not been opened before departure as the main engine had already been started and opening of the access hatch would had required to shut down the main engine again; the engineer was found dead two days later in the next port of call.	Investigated by BSU; http://www.bsu-bund.de/	
48	18/11/2003	Bulk Carrier (Carrying lumber)	MAI Hong Kong	Access passage to cargo hold	Oxygen depletion, Carbon Monoxide	1	0	A seaman died after entering the access passage. The space had not been ventilated before entry. The bio-deterioration characteristic of lumber absorbed the oxygen from the surrounding atmosphere and through the access door into the access passage.	Investigated by MAI Hong Kong	

49	24/11/2003	Tank Ship	U S C G	Forepeak Tank	Low O2 and Toxic Environment, Access Procedures	0	1	A shipyard worker was incapacitated by paint fumes when he entered the forepeak tank. The tank had been recently painted and everyone was told not to enter the tank, however when the job supervisor returned from locating an extension cord for the forced air blower, he found the worker lying at the bottom of the tank unconscious. He immediately notified the Master, who had the ship's emergency evacuation detail don SCBAs and remove the individual from the tank. EMS and ship's medical personnel administered oxygen to the victim until he was evacuated to a nearby hospital, treated and released.		
50	12/12/2003	Oil Tanker	Liberia	Cargo Tank	Oxygen Deficiency	1	0	Death of Ordinary Seaman by asphyxiation due to explosion inside the cargo tank during repair works at Lisnave shipyard.		
51	03/01/2004	Tanker/combination carrier	UK MAIB	Engine Room	Carbon monoxide	0	2	While discharging gas oil, an engineer became unconscious. About 55 minutes later, a motorman who had been working him also lost consciousness. Engine room was vented. Higher levels of CO, were detected and the IG plant, which had been kept working to provide a positive pressure on the tanks, was immediately shut down. A high concentration of co was found aft of the funnel, where the plant's atmospheric outlet valve is sited. This was due to the low discharge rate. It was assessed that the co was carried into the engine room by a vent fan.		Germany
52	25/01/2004	General cargo	Finland	Cargo Hold casing	Low O2 Environment, Access Procedures	2	1	Young OS, new on board went look for brushes to clean hatchcovers after deck cargo (logs) discharge. Fell down to bottom of the casing. Chief officer went to help, fell down. Third man tried to go down to help, felt dozy…managed to climb back to deck.		
53	01/04/2004	Bulk Carrier	MAI Hong Kong	Bilge space enclosure beneath cargo hold	Oxygen depletion	2	0	A Chief Officer and a Cadet died inside a bilge space enclosure after entry. The space had not been opened for some time and was not ventilated before entry. The Chief Officer was likely to have consumed more alcohol than he was allowed under the prescribed limit.	Investigated by MAI Hong Kong http://www.mardep.gov.hk/en/publication/pdf/mai040104.pdf	
54	02/04/2004	Bulker	Vanuatu	Cargo hold	Oxygen deficiency	1	1	AB entered the hold to take cargo samples without standby personnel and without PPE. Cadet attempted to rescue him.		
55	27/05/2004	Oil tanker	CHILE	Cargo Tank	Gasoline	0	5	Crew members were manually cleaning the cargo tanks, which had been ventilated previously. Fuel leaks in the waste disposal hoses polluted the environment. Oil gases were detected by safety teams, however the crew did not notice this fact. There was no autonomous breathing system available.		
56	12/06/2004	Chemical Tanker	MAI Hong Kong	Cargo Tank	Nitrogen, Oxygen depletion	1	0	A pumpman died after taken a quick dash to the upper ladder platform of a cargo tank in an attempt to retrieve the helmet for the cargo surveyor. The tank had been purged with nitrogen.	Investigated by MAI Hong Kong http://www.mardep.gov.hk/en/publication/pdf/mai040612.pdf	
57	15/09/2004	Naval support	UK MAIB	Store space	Formaldehyde	0	1	Leaking cans of fluid for chemical toilets created noxious fumes, which were inhaled by this crew member. The data sheet on board was for the chemical toilet fluid that did not contain formaldehyde, however the fluid actually carried did contain formaldehyde.		
58	29/03/2005	General Dry Cargo Ship	U S C G	Cargo Hold	Low O2 Environment, Access Procedures	0	3	Vessel sailed from Oakland. A day later while approximately 150 miles West of LA, 3 crew members went into a hold (with wood pellets) to try to secure some cargo that had broken loose and were overcome by oxygen depravation. They were removed, treated and have recovered..		

59	29/04/2005	Stern trawler	UK MAIB	Machinery space	R22	0	1	Contractor inadvertently drilled into a R22 refrigerant liquid line, thinking it to be gas free. This immediately released liquid/gas into the machinery space. Four contractors were taken to hospital to be checked over and one remained in hospital for 2 Nights for observation and was then released.	Investigated by UK Health and Safety Executive	
60	21/05/2005	Tanker	RMI	Tank #5- Port COT	Oxygen Deficiency	2	0	While removing the suction hose, one AB said to another he felt bad, then his eyes rolled up and he collapsed. . The Chief Mate exited the tank to put on a SCBA and returned the tank to find another AB was motionless. The two A.B.s were unable to be revived. The autopsy revealed the 2nd individual to collapse had abrasions on his head, which could have been consistent with hitting it as a result of a fall.		
61	01/06/2005	Fishing	Sweden	Hold entry.	Non vent.	2	1	Was going to clean the hold from rotting herring		Lithuania
62	01/08/2005	Gen.cargo	Sweden	Hold entry.	Non vent.	1	0	Entered without breathing app. when fetching tools for hold cleaning	Investigated by SMSI Sweden http://www.transportstyrelsen.se/Global/Sjofart/Dokument/Haverirapporter/E_2005/2005_08_19_torrlastfartyget_eken_sbji_olycka_med_dodlig_utgang.pdf (In Swedish)	
63	24/10/2005	Oil Tanker	Liberia	Cargo Tank	Oxygen Deficiency	1	0	Ordinary Seaman asphyxiated while cleaning liquid residue from the cargo tank during vessel's passage from Mangalore, India to Dubai, UAE.		
64	10/12/2005	Fish catching	UK MAIB	Cargo – fishroom	Carbon monoxide	0	2	A portable engine driven pump was lowered into the fish room to relieve flooding. Two crewmen were overcome by the pump's exhaust fumes, one of them losing consciousness.		
65	30/01/2006	Fish catching (25gt)	UK MAIB	Cabin	Carbon monoxide	1	0	Crew member using vessel as temporary accommodation placed portable petrol driven generator in fish hold adjacent to cabin area to provide power to cabin area. The bulkhead between the spaces was not gas tight and the crewman died from inhaling exhaust fumes.	Preliminary examination carried out by MAIB http://www.maib.gov.uk/publications/comlpleted_preliminary_examinations/completed_preliminary_examinations_2006/pamela_s.cfm	
66	04/03/2006	General cargo	CHILE	Ballast tank/ Cargo hold	Sulfuric Acid	1	1	Crew members entered a tank in which fish oil had been transported and which afterwards had been filled with ballast water. They worked inside for several hours without any problems. A pocket of sulphuric acid that was formed inside the tank intoxicated them. There was no autonomous breathing system available.		
67	26/04/2006	Bulker	RMI	#4 Cargo Hold Manifold	Oxygen Deficiency	1	1	While the vessel was discharging coal one A.B. died and another A.B. was injured due to lack of oxygen in #4 Cargo Hold Manhole.		
68	10/07/2006	Container	UK MAIB	Tank container	Hydrochloric acid	0	8	8 people, 6 dock workers and two crew, were slightly injured when a cargo of titanium tetrachloride, which was being carried in a tank container, was contaminated by water in the container's steam heating system. The subsequent reaction cause hydrochloric acid to escape in vapor form and it was breathing this that caused the injuries.	German investigation carried out http://emsa.europa.eu/Docs/accidents/10-212.pdf	Korea
69	27/08/2006	Container	RMI	Hold #4	Oxygen Deficiency	1	0	While the vessel was enroute to Istanbul, Turkey, the engine cadet was engaged in entry into hold #4 in order. He consequently lost consciousness due to oxygen deficient atmosphere due to leakage of tank container containing liquid argon IMO 2.2 U.N. 1951.		

70	25/09/2006	Bulker	RMI	Cargo Hold	Oxygen Deficiency	1	1	The O/S and Bosun went down into the cargo hold for taking cargo sample without specific instruction not received from Master nor Chief Officer. The crew members went down into cargo hold #5 in order to retrieve a cargo sample, and suffocated while in the cargo hold.		
71	12/10/2006	Chemical Tanker	NOR NMD	Cargo tank	Not ventilated. Nitrogen atmosphere, Low O2	1	0	Cleaning the tank. Chief officer entered tank without Breathing Equipment. The Tank had less than 2 % O2.		
72	16/11/2006	Bulk Carrier (Carryingwooden pellets)	MAI Hong Kong	Access passage to cargo hold	Oxygen depletion, Carbon Monoxide	1	4	A seaman died and a shore worker seriously injured after entering the access passage. The space had not been ventilated before entry. The bio-deterioration characteristic of lumber absorbed the oxygen from the surrounding atmosphere and transferred to the access passage. (According to Sweden 7 others were sent to hospital but were released.)	Investigated by MAI Hong Kong and SMSI Sweden http://www.mardep.gov.hk/en/publication/pdf/mai061116_f.pdf. http://www.transportstyrelsen.se/Global/Sjofart/Dokument/Haverirapporter/D_2006/2006_11_16_bulkfartyget_saga_spray_vrww5_dodsfall.pdf (In Swedish)	Sweden
73	01/12/2006	Gen.cargo	Sweden	Hold entry.	Non vent.	1	0	Entered without breathing app.		
74	01/12/2006	Tanker	Sweden	Deck	Open air	0	2	Opened a pipe to take cargo sample	Investigated by SMSI Sweden http://www.transportstyrelsen.se/Global/Sjofart/Dokument/Haverirapporter/D_2006/2006_12-27_oljetankfartyget_stoc_regina_sgox_peronskada.pdf (In Swedish)	
75	06/12/2006	Fish catching	CHILE	Fishhold	Sulfuric Acid	1	0	A crew member entered the fish cargo hold, without previously measuring the gas conditions, after which he fell down inside the hold as he lost consciousness because of the sulphuric acid released from decomposing fish.		
76	13/12/2006	Chemical Tanker	NOR NMD	Cargo tank	Not ventilated. Cargo atmosphere (hexene-1)	0	2	Deck cadet entered tank on bosun's order without PE, lost consciousness. Bosun entered tank without PE to assist, lost consciousness. AB stationed at hatch raised alarm, AB and Chief Officer. entered tank with PE and rescued cadet and Bosun.		
77	01/01/2007	River launch (15 gt)	UK MAIB	Wheelhouse	Carbon monoxide	0	2	Over a period of up to two months several crew from a river launch were exposed to carbon monoxide in the wheelhouse. The air intake to the heater was located in the engine compartment. The possibility of exhaust leaks in the trunking or of engine exhaust re-entering through the engine vents considered the most likely source of co.		
78	07/02/2007	Fish catching liner	UK MAIB	Shark oil storage/ cargo tank	Unknown	1	3	Shore contractors at non UK port boarded the vessel to clean the shark oil storage/cargo tank. The atmosphere was not tested before entering; no breathing apparatus was being worn and no forced ventilation was provided. One worker succumbed to the fumes (& later died). Three other workers also suffered from the effects while rescuing their colleague.	Investigated by Spanish authorities (Capitnaeria Maritime) from Vigo.	

79	04/03/2007	Oil Tanker	Liberia	Slop Tank	Oxygen Deficiency	2	0	Death of OS and AB due to entry into VOID spaces and inhalation of toxic gases. OS and AB (to rescue the OS) entered into slop tank without carrying breathing apparatus and wearing only a portable dust mask which was not appropriate. The OS and the AB did not receive the Chief Officer's permission and they apparently ignored three other crew members' protests forbidding them to enter the slop tank.		
80	15/03/2007	Refrigerated Cargo Ship	U S C G	Cargo Hold	Low O2 Environment, Access Procedures	2	0	Investigation conducted jointly with Liberia. Vessel is constructed to carry fruit concentrate. Cargo tanks are clustered independently in segregated cargo holds with typical cargo and nitrogen gas supply piping. During cargo operations, 2 officers were found unconscious in the number cargo hold and were extracted by the crew. The first responders began CPR before EMS paramedics arrived but officers were pronounced dead at the scene. The deck officer entered the cargo hold for routine pre-departure checks. When he didn't return topside, the Chief Mate entered the cargo hold to look for him. It was determeind that the rupture disk (safety device) installed on the cargo tanks, overfill tank, failed allowing nitrogen gas to be released into the cargo hold. The date and time of the breach of the rupture disc is unknown.		Liberia
81	Apr-07	Tanker	Cyprus	Cargo Tank	Empty, last cargo was naphtha, not inerted.	1	0	Pumpman carried out stripping of the tanks. Flow rate was slow, so he entered the tank without permission, without proper equipment and without notifying anybody. It was his first day as Pumpman.		
82	23/05/2007	General Cargo	IOM	Cargo hold - completed laden voyage with pulp logs	No Oxygen and carbon monoxide	2	1	Bosun entered hold via access hatch to collect equipment. Discovered missing and Master entered tank without SCBA during search. Crew aware of dangers of O2 depletion with timber cargo. Hold not treated as enclosed space and entry was quick attempt to save time.		Sweden
83	31/05/2007	Pelagic Fishing Vessel	SAMSA	Fishhold	Low O2 Access Procedures	1	3	Skipper died after entering fishold to rescue 2 crew members who had been overcome while trying to rescue another crew member who had entered to clean the hold.		
84	20/09/2007	Bulker	RMI	Cargo Hold #5	Pet Coke Fumes	1	0	While retrieving samples of the Pet Coke cargo from Cargo Hold #5 through the forward manhole, the boatswain lost consciousness while equipped with an EEBD.		
85	23/09/2007	Offshore supply	UK MAIB	Starboard chain locker	Oxygen depletion	3	0	2 persons entered chain locker to secure noisy anchor chain & collapsed, likely 2nd person entered in an attempt to recover 1st. 3rd person donned breathing apparatus & carried 10 minute Emergency Escape Breathing Device (EEBD) to place on casualty. 3rd person of large build unable to fit down hatch wearing BA so donned EEBD. EEBD became removed.		
86	27/09/2007	Tug	RMI	Barge Tank	Oxygen Deficiency	2	1	Despite the Chief Officer instructing the Bosun to not enter the tank, the Bosun went inside and shortly thereafter fell unconscious. Immediately, the A.B. went to rescue the Bosun and also fell unconscious. After witnessing the two men descend into the tank, the Messboy rushed to enter the tank and also fell unconscious. The A.B. and Bosun died inside the tank. The only survivor was the Messboy, who was hospitalized and recovered from his injuries.		

87	14/10/2007	Workboat	UK MAIB	Other internal deck/space	Carbon monoxide	0	2	Vessel flooding, 2 crew members moved portable, petrol driven, pump into the confined space adjacent to accommodation space. The pump later lost suction and one of the crew members went into the space to investigate. His colleague then joined him in the space to assist. The first crewman to enter the space then reported feeling dizzy and collapsed and lost consciousness. The second man then stopped the pump and left the space to get a rope to pull his colleague out.	Preliminary examination carried out by MAIB http://www.maib.gov.uk/publications/comlpleted_preliminary_examinations/completed_preliminary_examinations_2007/panurgic_II.cfm	
88	29/10/2007	General cargo - single deck	UK MAIB	Accommodation	Phosphine poisoning	1	0	Vessel carrying feed wheat into her two holds. Once loading was complete, the cargo was fumigated by applying aluminum phosphide pellets loose into the cargo. The fumigation process was intended to progress during the voyage, as the tablets decomposed and gave off phosphine gas. The following morning, crewman found dead in his cabin. No obvious leakage path for the fumigant gas was located, even after smoke testing the hold and stripping back the bulkhead linings. However, following de-scaling of the area, some pin holes were discovered in the underside of the cabin deck that overhung the cargo hold.	Preliminary examination carried out by MAIB http://www.maib.gov.uk/cms_resources/Fumigated_cargo_Flyer.pdf http://www.maib.gov.uk/publications/completed_preliminary_examinations/completed_preliminary_examinations_2008/monika.cfm	Antigua & Barbuda
89	13/01/2008	Chemical Tank Ship	U S C G	Cargo Tank	Low O2 Environment, Access Procedures	1	0	3rd Officer fell into one of the tanks, was exposed to nitrogen, was extracted and taken to hospital. Investigation found the 3rd Officer was taking oxygen content readings of nitrogen tank during purging operations at 15 to 30 minute intervals. The purging operation commenced at 0600. At approximately 0645-0650 3rd Officer went to take his second set of readings. After several minutes the Chief Officer tried to radio the 3rd Officer to get the readings but the 3rd Officer never responded. The Chief Officer sent an AB to check on the 3rd Officer. The AB discovered the oxygen monitoring equipment and hardhat on deck but the 3rd Officer was missing. He immediately looked into the cargo tank and saw the 3rd Officer lying on the deck. The alarm was sounded @ 0700 and the crew removed the 3rd Officer from the cargo tank. The 3rd Officer apparently dropped part of the air testing equipment into the tank and he went in to retrieve it wearing only an air purifying respirator. Once in the tank, the 3rd Officer was overcome with nitrogen. There were no signs that he fell into the tank. He remained on life-support but died 11 days later.		
90	17/01/2008	Fishing Vessel	UK MAIB	Fish Hold	Carbon Monoxide	0	1	Bilge system became blocked and pump put in fish hold to clear water. Crew member lay down to clear blockage and became unconscious. 3 other crew in hold had 12, 14 and 16% CO in their blood stream. In future pump will only be used on open deck.		UK
91	18/01/2008	Fish catching	UK MAIB	Fishhold	Carbon monoxide	0	1	Flooding. Bilge pump suction pipe blocked in fish hold. Purchased petrol driven pump which was eventually placed in hold with 4 crew standing in hold. 1 person injured. 3 others admitted to hospital for less than 24 hours, the carbon monoxide levels in their blood were 12%, 14% and 16%.		

92	18/01/2008	General Cargo	UK MAIB	Forward Store	IMDG Code Class 4.2 ferrous metal turnings had been in a nearby hold and depleted oxygen levels.	2	0	Prohibited cargo self-heated causing reduced levels of oxygen inside the forward store, resulting in the death of 2 crewmen.	http://www.maib.gov.uk/publications/investigation_reports/2008/sava_lake.cfm	Latvia
93	21/02/2008	Ro-Ro Passenger Ferry		Funnel	Carbon Monoxide	0	1	Crew member suffered carbon monoxide poisoning while cleaning inside of funnel. Fans to be left on in future, permit to work to be introduced, and gas alert micro clip to be worn.		
94	25/02/2008	Fishing Vessel	Vanuatu	Engine Room	Ammonia leak	1	0	During a blackout caused by an ammonia leak from the refrigeration plant which displaced all the oxygen in the engine room, the chief engineer attempted to enter the engineroom without breathing apparatus and succumbed in the ammonia rich/oxygen poor atmosphere.		
95	24/03/2008	General Cargo	UK MAIB	Forepeak	Tested to approx 19.6% oxygen no CO or hydrocarbons	0	1	Hydrochloric acid had been released in area. Same crew member entered on two successive days. First day had minor eye and skin irritation. Second day became unconscious and stopped breathing. No harmful substances detected	Isle of Man believed to have conducted investigation	Isle of Man
96	10/04/2008	Bulk Carrier	Liberia	Cargo Hold	Oxygen Deficiency	1	0	Cargo receiver's surveyor lost consciousness, after entering into cargo hold No. 8 to conduct survey during discharge operation at Bilbao, Spain. Extensive emergency efforts to revive him failed.		
97	11/06/2008	Cruise Ship	UK MAIB	Ballast Tank	Insufficient oxygen due to corrosion of steel	1	1	Asphyxiation in ballast tank		Bahamas
98	25/07/2008	Tanker-Gas Carrier	Liberia	Cargo Tank	Oxygen Deficiency	2	0	Two men hired by subcontractor in the shipyard died after falling into a tank on board the vessel at St. Marine Shipyard.		
99	16/10/2008	Bulker	Norway AIBN	Cargo hold	Probable oxygen deficiency	0	2	Under investigation		
100	06/04/2009	Naval Support	UK MAIB	Deep Freeze	Ozone	0	5	Seven crewmen were loading frozen meat in to the deep freeze when they displayed symptoms of respiratory distress. They immediately evacuated the refrigeration compartment. The atmosphere was tested the presence of refrigeration gas and oxygen depletion. The results appeared to be normal and the work party returned to the space. The symptoms reappeared and work was stopped again. On investigation it was found that the compartment was fitted with an ozone generator which had been commissioned a week earlier, at the end of a refit period. The compartment had remained empty for the week and ozone had accumulated within the deep freeze and food handling spaces.		

101	06/05/2009	Chemical Tanker	UK MAIB	cargo tank	Hydrogen Sulphide	0	2	AB overcome by release of hydrogen sulphide as he prepared to remove the water wash hose from the open hatch. The Ch Officer attempted a rescue and he too was overcome. Both were hospitalised in ICU. Ch Officer was released after one day and the AB after 6 days. To note that the fixed cleaning system was defective which required use of the portable cleaning system.	As at 17 June 2009 Investigation underway, vessel name is Jo Eik. Progress can be monitored at http://www.maib.gov.uk/latest_news/current_investigations.cfm	Norway
					TOTAL	**93**	**96**			

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