August 2012 www.nautinst.org

Seaways

The International Journal of The Nautical Institute

Crew Resource Management

Making the most of the bridge team

The Nautical Institute

Contents

August 2012

Cover photo: Carnival

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Mariners' Alerting and Reporting Scheme

MARS Report No. 238 August 2012

MARS 201236

Breathing apparatus air compressor explosion

Official report : Edited from AMSA MO-2011-007

➔ The 3/O on board a cargo ship suffered burns to his hands and face when he wrongly used a self-contained breathing apparatus (SCBA) air compressor to refill an oxygen breathing apparatus (OBA) cylinder, causing it to explode.

Background of incident

The vessel's managers had decided to supplement ship's mandatory SOLAS fire-fighting equipment with additional OBA sets, but this was not followed up with proper crew familiarisation and maintenance training for this specialised equipment. The 3/O, who had already served as a rating on a few contracts on vessels of the fleet that were supplied with OBA sets, was fundamentally ignorant of the differences between air and oxygen, and the breathing apparatus using these two mediums. He was also unaware that the oxygen cylinders were meant to be refilled only ashore.

On the day of the incident, he had informed the C/O of his intention to carry out the routine inspection and maintenance of BA sets after his bridge watch. The C/O agreed to assist, but, not wanting to disturb the C/O's pre-arrival preparations, the 3/O unilaterally decided to use the assistance of an able seaman (A/B) for the task.

Having noticed that the residual pressure in one of the OBA cylinders had fallen to well below the optimum, the 3/O removed the set to the steering gear compartment, where the SCBA air compressor was located. He tried to screw the SCBA air compressor discharge hose connector on to the OBA cylinder valve, but it did not fit. He then found an adaptor in the box next to the compressor that fitted both the OBA cylinder and the compressor discharge hose connector, tightened all the connections and opened the OBA cylinder valve. Within a few seconds of starting the compressor, the air discharge tube exploded. A fire started around the compressor, temporarily engulfing the 3/O and inflicting serious burns to his face and hands. As he rushed to the accommodation to get medical help, the A/B raised the fire alarm and managed to extinguish the fire with a portable extinguisher.

In the accommodation, the 3/O encountered the C/O and two cooks, who promptly removed the 3/O's burnt coveralls and proceeded to cool the injured skin with running water. They then removed the casualty to the ship's hospital where further first aid treatment was provided.

Later that evening, in the course of filing a routine position report, the Master indirectly advised the shore of the incident and requested radio medical advice. After due consideration, the shore authorities made arrangements for a rendezvous and helicopter medical evacuation (medevac). The injured person was transferred to a hospital ashore for further treatment, after which he was discharged and repatriated to his home country.

Analysis of incident

1 The investigation found that the explosion occurred as a result of a fire that started within the compressor when oil ignited in the hot, oxygen-rich environment. When the 3/O opened the OBA cylinder outlet valve, gaseous oxygen (pressurised to about 7 MPa) flowed from the cylinder into the compressor discharge hose and tube which contained air at atmospheric pressure (0.1 MPa). The oxygen continued to flow until the pressure inside the discharge hose and tube reached equilibrium with the pressure inside the OBA cylinder. During this process, it is likely that the temperature of the oxygen-rich environment within the discharge hose and tube dramatically increased as a result of adiabatic compression. Calculations indicate that the temperature of the oxygen may have reached about 700°C as a result of adiabatic compression alone.

2 When oxygen within a system is compressed rapidly, with no heat loss to the surrounding materials, it causes a rapid temperature rise in the gas. Within seconds, the temperature of the oxygen-rich environment would have exceeded the auto ignition temperature of any oil that had been trapped in the discharge tube filter, or any other part of the discharge circuit. Once the oil ignited, a near instantaneous over-pressurisation within the compressor caused the rupture of the discharge tube and hose. A flame front was then blown out of the compressor, engulfing the 3/O.

3 Although the compressor adaptor was fitted with a relief valve, it was not designed to cope with the instantaneous pressurisation that occurred inside the compressor when the oil was ignited in the oxygen-rich environment.

4 There are internationally recognised colour schemes used in industry so that high pressure cylinders containing different gases can be easily identified. There are also a number of different types of engineering controls that prevent a high pressure cylinder from being connected to an incompatible system – e.g. an oxygen / acetylene set - the threads on the high-pressure oxygen cylinder are right handed, whereas the threads on the acetylene cylinder are left handed, preventing incorrect connections. The SCBA and OBA sets supplied on board were compliant with European and Japanese standards respectively, and had different threaded connections. But, due to an unfortunate coincidence, the spare compressor discharge hose adaptor that was found in the box near the SCBA compressor allowed the connection of the Japanese-made OBA cylinders to the European-made air compressor.

5 The 3/O had been sailing in that rank for about 3 months, and was considered to be sufficiently trained in the use and maintenance of SCBA sets, having participated in many fire drills and the refilling of such cylinders.

6 The crew on board understood that the OBA sets had been supplied to all ships as an additional resource for fighting fires. However, they were not all familiar with the operation and maintenance requirements associated with them. The Master and C/O understood that the OBA set cylinders contained oxygen and that they had to be sent ashore for re-filling, but the 3/O was not aware of this requirement.

7 Since OBA sets are not part of a ship's mandatory SOLAS fire fighting equipment, they were not included in approved seafarer training courses. Therefore, the responsibility for appropriately training the crew lay solely with the vessel's operators and its senior officers. It also was apparent that all onboard fire drills on the vessel invariably involved only the use of SCBA sets.

8 Copies of the OBA set operating manual were available onboard, but had inadvertently been omitted from the SOLAS training manual, presumably due to the fact they were supplied afterwards.
9 The onboard Safety Management System (SMS) included a fire fighting manual, which contained some basic information regarding the differences between BA sets and OBA sets, but no information regarding their operation and maintenance.

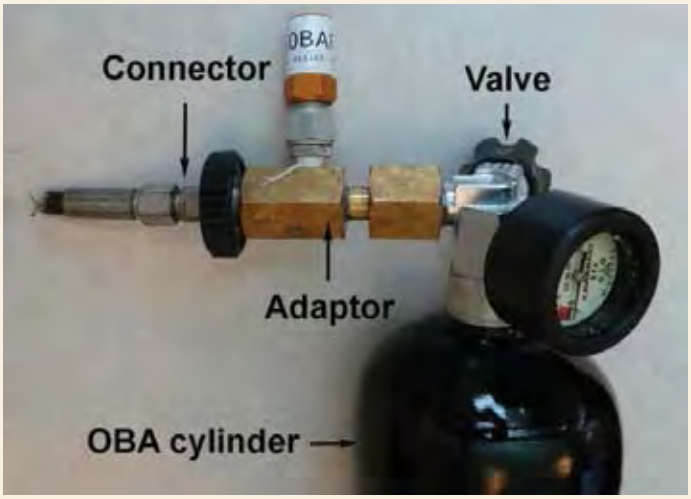
Root cause/contributory factors

1 The ship's safety management system did not provide the crew with appropriate guidance in relation to the operation and maintenance of the OBA sets;
2 The air compressor was not fitted with a filter designed to prevent contaminants or oil from carrying over with the discharge air.

Corrective / preventative actions

1 The ship's safety management system documentation to include appropriate guidance in relation to the operation and maintenance of OBA sets;
2 The company has forwarded a safety bulletin to all ships advising staff to:
- re- fill all OBA oxygen cylinders ashore;
- clearly mark the word 'oxygen' in English on all OBA oxygen cylinders;
- post signs on all breathing apparatus compressors stating that they are only to be used to re-fill air breathing apparatus and emergency escape breathing device (EEBD) cylinders;
- seek approval from a responsible person prior to re-filling cylinders; and
- assign more than one crew member to the task of re-filling cylinders.

3 All OBA cylinders to be supplied in the future will be permanently labelled to indicate that the re-filling of the cylinders with oxygen must only be carried out ashore.



View of adaptor that allowed the dangerous connection of SCBA air compressor discharge line to OBA oxygen cylinder

View of fragment of discharge tube after explosion

MARS 201237

Gangway (Accommodation ladder) fall wire rope parted

➔ Our product tanker was approaching port to pick up the inward pilot. The designated accommodation ladder (gangway) had been unlashed in preparation for berthing. The Ordinary Seaman (O/S) who was helping the Bosun went aft to get the stanchions while the Bosun was retrieving other components from the midship store. At this time, the Master and duty officer who were on the bridge saw the gangway fall wire rope part. The ladder fell into the water and was dragged along, held only by the upper platform fastenings. The Master immediately reduced speed and stopped engine. The gangway was picked up using chain blocks prior to embarking the pilot. As a precaution, pending wire renewal, the vessel used the portable ladder during her port stay, in agreement with the pilot / terminal. The next day, a new wire fall was fitted and the system was successfully tested.

Root causes/contributory factors

1 The fall wire had a kink in way of the failure location, believed to be a permanent stress point when the gangway is swung out to upper deck level;
2 The reeving arrangement of the fall wire consisted of a multi-drum winch, meant to rotate simultaneously for lowering / hoisting. It is believed that a slight disparity in synchronisation imposed high stress on the fall wire;
3 The crew failed to properly monitor the stress on the wire and the movement of the winch drums when preparing the gangway;
4 Inadequate inspection by the crew prior to breaking out the gangway;
5 Ineffective inspection/maintenance/record-keeping of the gangway, wire and fittings by the crew during routine maintenance;
6 There was no crew standing by in the vicinity when the gangway lashings were removed and the gangway was being prepared for use;
7 The fall wire had a fibre core.

View showing parted fall wire and gangway winch with multiple drums

Ladder section trailing in the water after fall wire parted

Corrective/preventative actions

Onboard procedures revised to ensure that the crew:

1. Properly inspect the gangway, fall wires, and all standing and moving parts for proper condition and operation prior to unlashing / rigging and after securing the gangway;
2. Confirm that the winch drums are properly synchronised;
3. Update and keep inspection and maintenance records as per PMS;
4. Do not leave the gangway unattended once the lashings are removed until the gangway is fully rigged or secured.

MARS 201238

Scald injury during maintenance of steam valve

➔ During routine maintenance, the fitter on one of our vessels was engaged in changing the leaking gland packing of a valve on a steam return line. Before commencing the task, he isolated the line by shutting off the main distribution valves as well as the inlet valve for the steam heating coil from where the return line issued. The main stop valve of the boiler remained open to maintain other auxiliary services. After loosening and separating the valve flange, the fitter did not notice any pressure in the line, and continued his work. All of a sudden and without any warning, a jet of steam and hot water spurted out of the open flange, scalding the fitter's face.

Result of investigation

1. It was established that despite being shut, the steam distribution and inlet valves were not holding. Consequently, steam slowly built up pressure on the condensed water in the heating coil, and when it was sufficient to overcome the internal resistance and head of the water, it spurted out of the open flange resulting in the accident.
2. No formal risk assessment was carried out before commencing the work on the steam line.

Lessons learnt

1. In order to avoid recurrence of such accidents, it is imperative that, apart from isolating the branch lines, the main stop valve on the boiler should be kept shut or the line blanked off upstream at a suitable point before opening any part of the steam lines;
2. Risk assessment must be carried out without fail before commencement of such jobs.

MARS 201239

Hazards of partially opened hatch covers

➔ I was overseeing a bulk carrier self-discharging cargo by deck cranes and grabs. Being the rainy season, the crew had opened only the after half of the hatch covers. This is an unsafe practice, as there is an unacceptable risk of the grab hitting and damaging the exposed end of the closed hatch cover. Such damage can impair the hatch cover's weathertightness and can render the vessel unseaworthy. Furthermore, it must be remembered that effective repairs to hatch covers and associated sealing devices always involves high cost, delays, special materials, equipment and skills.

In the case of dry bulk cargoes that can be poured or pumped, vessels can often work such granular or free-flowing cargoes in rain with hatches closed, leaving a small section open for the cargo line(s) or pipe(s). However, when grabs are in use, it is strongly suggested that, if a cargo is susceptible to damage by rain, snow or precipitation, the vessel should opt to discontinue cargo operations altogether during inclement weather and avoid working cargo through partially open hatchways.

MARS 201240

Contact and fender damage during Ship to Ship (STS) operations

➔ Our loaded VLCC was preparing to carry out an STS operation offshore. The 'daughter' or receiving vessel into which cargo was to be lightered was also a VLCC and was at anchor. Our vessel stopped parallel to the receiving tanker and approximately 150 metres off it, and then two large tugs began pushing our VLCC bodily towards the lightering vessel. When the two vessels were about 10 metres apart, a strong gust of wind caused the lightering vessel's bow to yaw to starboard in her anchored position and the two vessels' bows made contact. Apart from inflicting some damage to the internals in way of the side ballast tanks, the impact ruptured the forward pneumatic fender. As the deflated fender was crushed between the two hulls, its external chains and metal fittings created deep gouges and scratches on the shell plating of both vessels. While a tug was deployed to control the yaw of the lightering vessel, lines were quickly passed between the vessels and the mooring operation was completed without further incident.

Result of investigation

1. The mooring operation had been properly planned and an experienced mooring contractor specializing in STS operations had been appointed by the charterers;
2. Sufficient number of fenders were deployed on the lightering vessel by the mooring company;
3. STS checklists were completed correctly and the mooring plan was agreed with the Mooring Master;
4. The mooring operation was planned for daylight hours only;
5. The weather and sea conditions at the time of approach were favourable for the planned operation, however, when the vessels were about 10 metres apart a gust estimated to be about 25 knots suddenly blew across the heading of the two vessels;
6. Drug and alcohol tests were conducted onboard and all were negative.

Root cause/contributory factors

1. Too much reliance being placed on the Mooring Master's knowledge and experience;
2. Own ship's bridge team failed to observe the approach of strong gust, being fully engrossed only in the mooring operation.

Corrective/preventative actions

Fleet instructions issued reminding Masters and bridge teams to:

1. Be aware that the master is overall in charge of STS operations and the Mooring Master operates only in an advisory capacity;

Damaged pneumatic fender hanging by wire sling and chain

Deep gouges on topsides of own ship caused by deflated fender's metal fittings

Buckled stringer inside side ballast tank caused by contact in bow region

2 Promptly raise any concerns with regard to the manoeuvre(s) being planned or executed, with the master exercising his authority to override actions of the Pilot / Mooring Master to ensure safety of life, property and environment;
3 Be aware of the prevailing and developing environmental and traffic conditions, and abort the manoeuvre or operation in progress if the safety of the vessel should be compromised;
4 Record all events and information in the bridge log book correctly.

MARS 201241

Hot cooking oil splashed into cook's eye

➔ The cook was shallow frying vegetables in the galley. When transferring the raw, cut vegetables into the heated oil in the saucepan from above, most of it fell as a large lump, resulting in the oil splashing out and some of it entering the cook's right eye. The cook immediately washed the affected eye with cold running water, and thinking his self-administered first aid was sufficient, failed to report the incident for several days until the eye developed a blister and became painful. He was given more treatment onboard and sent for follow-up treatment ashore at the next port.

Result of investigation

As the incident was not reported for several days, it is presumed that one or more of the following situations may have existed and contributed to the incident:

1 Excessive quantity of frying fat in the pan / wok;
2 Momentary lapse of concentration on the part of the cook;
3 Allowing raw food to drop into hot oil from an unsafe height instead of transferring it by means of ladle or spoon.

Corrective/preventative actions

The incident report was circulated to the fleet, reminding crews that;

1 It is important to report injuries immediately after occurrence, regardless of degree;
2 Potential chronic / delayed damage can occur with eye injuries, especially if first aid is not administered immediately;
3 The galley is one of the high risk areas onboard ship;
4 The importance of donning proper PPE appropriate to the task in hand;
5 They must be aware of hazards and injury risks in the galley.

MARS: You can make a difference.

You can save a life, prevent injury and contribute to a more effective shipping community.

Everyone makes mistakes or has – or sees – near misses. By contributing reports to MARS, you can help others learn from your experiences. Reports concerning navigation, cargo, engineering, ISM management, mooring, leadership, design, training or any other aspect of operations are welcome, as are alerts and reports even when there has been no incident. The freely accessible database (http://www.nautinst.org/mars/) is fully searchable and can be used by the entire shipping community as a very effective risk assessment, loss prevention and work planning tool and also as a training aid.

Reports will be carefully edited to preserve confidentiality or will remain unpublished if this is not possible.

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The Nautical Institute gratefully acknowledges sponsorship provided by:

American Bureau of Shipping, AR Brink & Associates, Britannia P&I Club, Cargill, Class NK, DNV, Gard, IHS Fairplay *Safety at Sea International*, International Institute of Marine Surveying, Lairdside Maritime Centre, London Offshore Consultants, MOL Tankship Management (Europe) Ltd, North of England P&I Club, Sail Training International, Shipowners Club, The Marine Society and Sea Cadets, The Swedish Club, UK Hydrographic Office, West of England P&I Club.

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