IMCA Safety Flash 31/16

November 2016

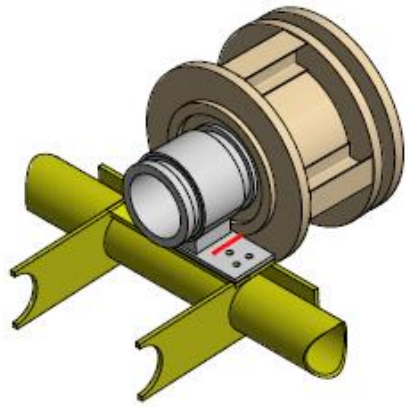
Focus: Diving Incidents

This safety flash contains five incidents related to diving. In the first, a diver lost consciousness briefly following a blow back. In the second, a diver injured his hand recovering damaged equipment from the seabed. The third is a most interesting near miss incident in which a diver was approached and harassed by a Leopard Seal. The fourth incident relates to the consequences of incorrect installation of hose fittings, and the fifth to the build-up of hydrogen gas inside the cockpit of a Self-Propelled Hyperbaric Lifeboat.

1 Diver Loss of Consciousness During Underwater Burning Activities

A member has reported an incident in which a diver lost consciousness during underwater burning activities. The incident occurred during decommissioning and removal of a subsea structure. Originally planned to be completed using cold cutting techniques, issues were experienced when attempting to remove the flowline towhead within the structure using cold cutting techniques. Bolts and gusset plates on the securing collar were understood to be preventing removal of the towhead. A management of change (MoC) and a specific risk assessment (SRA) for underwater burning operations was conducted, to assess the risks in burning these bolts and gusset plates.

Following this risk assessment, the removal of the bolts, gusset plates and other cuts were completed successfully and without incident using burning equipment. The diver was nearing completion of the final horizontal cut on the securing collar doubler plate when a suspected ‘blow back’ occurred. This ‘blow back’ is believed to have caused the diver to lose consciousness.



Showing horizontal cut on doubler plate

Showing diver position at the moment of the suspected blowback

Our members' investigation revealed the following:

- The initial task, which was risk assessed, ultimately changed. As the task evolved this change was not recognised and the job was not stopped and re-assessed. There was a perception that the scope of work and associated risks had not actually changed – the additional burning required was not recognised as change and the job was not stopped and re-assessed;
- The SRA was not collectively reviewed by the offshore team conducting the task. Some control measures within the risk assessment were not adhered to;
- The company procedure for burning operations and use of burning equipment was not fully complied with;
- The diver and dive supervisor were experienced in burning operations; however, it is an activity which no longer commonly takes place;
- The engineers responsible for the development of the procedures had limited experience in underwater burning operations;
- The **immediate cause** was believed to be a build-up of gas in a location within the doubler plate and structure, which had not been identified in the risk assessment or procedure as a hazard. As the investigation remains ongoing, the **root cause** of the incident cannot be fully determined until the structure has been recovered to surface and assessed further.

Our member drew the following **lessons** from the incident:

- This incident highlighted challenges regarding necessary competencies for underwater burning operations. As this methodology is not widely used everywhere, it can be a challenge to maintain the required level of competency;
- Decommissioning, particularly of older assets, is becoming more prevalent and presents additional hazards not routinely encountered during IRM or construction activities;
- Consulting detailed as-found surveys before the development of engineering procedures for decommissioning may prove a good use of time and effort. This will allow for early identification of potential hazards and will assist in the identification and implementation of the appropriate mitigations to manage the risks presented;
- The importance of being able to verify that personnel are fully aware of, understand and are able to follow company procedures.

Our member took the following **actions**:

- Suspended underwater burning operations until the root cause of this incident has been fully determined and a programme established and verified to ensure all lessons learned/actions from this incident have been met;
- Assessment of the company systems and processes for:
  - assurance of competency of personnel
  - effective MoC
  - identification and adequate control of risk
  - ensuring personnel comply with company process and procedures;
- Thorough review of dive project plans and scope of work procedures;
- Verification with client of 'As Built'/'As Found' information and data;
- A review of the operational MoC and SRA process to determine opportunities for improvement in relation to the timeline of this specific incident.

Our member notes that experience has shown that we should 'expect the unexpected' in decommissioning operations, and that therefore the MoC process becomes even more critical.

Members may wish to refer to the following incident (search words: *diver, blowback*):

- IMCA SF 05/04 – Incident 7 – *Underwater explosions.*

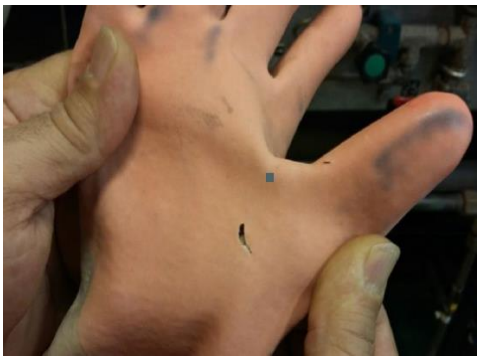
2 Hand Injury During Diving Operations

A member has reported an incident in which a diver received a hand injury during diving operations. The event occurred during joint rectification activities on a riser flange at 169 msw, following a report of a leak during commissioning. The divers were de-tensioning the flanges, and once the flanges were separated, the ring joint became free and fell off the middle of the flange to the seabed. A diver went to recover the ring joint from mud unaware that it was damaged (see photo showing details of damaged ring joint).

The damaged part of the ring joint punctured the divers' soft neoprene glove and caused two small penetration wounds to his right hand, between the thumb and index finger (see below). The injured diver returned to the diving bell and received first aid (the wounds were washed with fresh water and cleaned). The bell run was terminated.

Once the bell was locked on, the injured diver returned to the Sat chamber and received further treatment by the Diver Medic Technician (advised by on-board doctor and company Hyperbaric Doctor) including:

- Further thorough cleaning of the wounds with antiseptic solution, an application of antibacterial cream and the dressing of the wound;
- Tetanus vaccination and oral antibiotics as preventive measures.



Our member noted the following:

- The ring joint had been installed on a previous diving project by another diving subcontractor;
- The ring joint came free and fell down into the mud as soon as the flanges were separated;
- There was no chance for the diver to ascertain the ring joint conditions;
- This occurrence was unlikely – it was the first occurrence in over twenty years of a similarly damaged ring joint;
- The **direct causes** of the incident were found to be:
  - improper installation of the ring joint during a previous diving campaign with consequent deformation and damage of the latter
  - ring joint falling to the seabed
  - mud on the seabed;
- Other **causal factors** identified were:
  - great difficulty in ascertaining the condition of the ring joint before recovery from the mud
  - the diver's gloves (fit for diving purpose) were not designed to protect against cut and perforation.

The following **actions** were taken to avoid the recurrence of the event:

- Before recovery from mud by hand of potentially damaged equipment having possible sharp edges or points, divers should:
  - wear anti-cut/anti-perforation gloves
  - perform a preliminary check of the equipment using a hook.

Members may wish to refer to IMCA SF 28/16 which focuses on hand injuries.

3 Near Miss – Leopard Seal Interference with Diver

A member has reported a near miss incident in which diving operations had to be aborted when leopard seals started interfering. The incident occurred during IRM operations on an SPM and PLEM in the South Atlantic. Whilst all divers, equipment and animals were unharmed, the potential risk of harm was very high and could not be ignored.

Leopard Seals are apex marine predators that typically grow to over 3m in length and over 500kg in weight.

In the first instance the animals were displaying a high level of curiosity, showing a gaping mouth and fast circling around the diver. The diver was safely recovered to the LARS basket and brought back to surface as the Leopard Seal got closer and closer. The Leopard Seal continued to remain in the area, beaching itself on the floating hoses, but after a period of no sightings, diving operations were resumed.

A week later the diver was working on the subsea valves when he received a strong push from behind. The diver took refuge between the valves whilst the animal closely investigated the diver, again with high speed swimming and a wide open mouth. The diver was brought back to the LARS basket and recovered to surface but the seal forced the diver to take refuge in the bottom of the basket during the ascent. The diver was badly shaken by the experience.

After consultation with British Antarctic Survey, divers, underwater cameramen and environmental researchers who regularly dive in the South Atlantic and Antarctic waters, the following procedures were put in place:

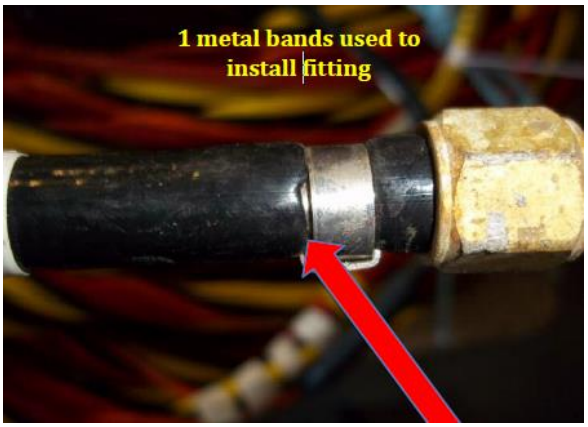
- A watch for marine mammals should be in place for 30 minutes before starting a dive;
- The marine mammal watch should be maintained throughout diving operations. If a Leopard Seal, or an Orca (killer whale), be seen, this is to be communicated to Dive Control and the diver recovered to deck;

- If the Leopard Seal comes into contact with the diver, the diver is to return as calmly as possible to the LARS basket along the seabed, keeping arms close to the body, and not touching or pushing the animal;
- Midwater swimming is to be avoided when a Leopard Seal is known to be in the area – travel in the basket instead;
- Diving operations should be suspended until 4 hours after the last sighting of the Leopard Seal.

4 Correct Installation Methods for Diving Umbilicals and Hoses

A member has reported an incident in which a complaint was received about an odour or smell in a divers' breathing hose or gas hose. It was discovered that the umbilical hose fittings had been installed in a way that was not recommended by the manufacturer. The purpose of this safety flash incident is to explain a safety issue that exists with some methods used to install fittings and the use of re-usable fittings on diving umbilicals and hoses.

Fittings on 3/8" Gas Hoses (HDA0106) were installed with three metal bands;



Fittings on the ¼" Pneumo Hose (HDA0104) were installed with a single metal band;

Red arrow indicating cut jacket, exposing braid

Fitting installed on the ½" Hot Water Hose (HDA1108) were re-usable fittings.

Our member noted the following:

- Use of the illustrated methods for fitting hoses in the field can compromise diver safety;
- The illustrated methods are not recommended or approved by manufacturers, nor is the use of re-useable fittings;
- The use of re-useable fittings can lead to pressure loss and/or water ingress, which can occur when the outer jacket of the hoses is compromised. This can lead to catastrophic failure at the fitting if the metal bands were to compromise the pressure control braid in the hoses – see above middle photograph;
- Water ingress into the hose layers can contribute to the build-up of bacteria leading to hose odours.

The following **recommendations** were made by our member:

- Use only standard fittings involving a swaging or crimping technique;
- Do not remove bend restrictors from the hoses as this can allow movement at or around the fitting that could lead to early damage of the fitting spigot and accelerate the damage to the hose jackets and linings;
- Do not use reusable fittings as they can fail or come off at pressure if not exactly sized and correctly installed.

Showing crimped fittings

Showing a bend restrictor

Proper care of hoses applies, of course, not only to diving umbilicals but also to hoses used for hydraulics, and hoses used for Oxy-Arc systems. Members may wish to refer to the following incident:

- IMCA SF 16/14 – Incident 5 – *Ruptured hydraulic hoses.*

5 SPHL Battery Charging – Build-Up of Hydrogen

A member has reported an incident in which there was a build-up of hydrogen gas inside the cockpit of a Self-Propelled Hyperbaric Lifeboat (SPHL), and has submitted information to IMCA for use in a safety flash.

The following points were noted:

- Many designs of battery charging ventilation systems consist of a forced air system from battery compartments/boxes in order to comply with IMCA D 055 – *Prevention of explosions during battery charging in relation to diving systems*;
- The members SPHL had a ventilation system consisting of a fan on one battery box that pushed air through a further two battery boxes via vent pipes to a discharge pipe overboard. This was complemented by an alarm system if the fan failed;
- It was discovered that there was no flow in the ventilation system;
- It was shown in this case that if the vent pipes are blocked or have a restricted flow then the fan alarm will not register;
- In this particular incident, the original equipment manufacturer indicated that faulty battery lid seals have also been recorded as a potential problem (causing venting through the lid and into the cockpit instead of the vent pipe).

For designs of HLB battery charging systems that consist of a forced ventilation system, our member recommended the following **actions**:

- Check that fan(s) are operational and unobstructed;
- Check vent pipe openings on the inside of any battery boxes are clear of obstructions;
- Check vent pipes between boxes are free from damage (not kinked);
- Check battery lid seals are intact and lid catches are fully engaged;
- Check there is a flow through the actual system (easiest method is to put a polythene bag over the final discharge vent pipe);
- Modify planned maintenance systems to require a weekly check of the air flow of the ventilation system;
- If the final discharge point is on the outboard side of the SPHL, then check the flow by disconnecting the vent pipe from the hull penetration inside the cockpit, using a polythene bag or similar over the pipe.

Members may wish to refer to the following incident (search words, *build, hydrogen, battery*):

- IMCA SF 05/13 – Incident 1 – *Explosion causing fatal injury during maintenance of metocean buoy* [battery explosion].

Members may wish to refer to the UK Health and Safety Executive (HSE) industry guidance *Using electric storage batteries safely* which can be found here.