IMCA Safety Flash 20/17

August 2017

Summary

In the following four unconnected incidents, we move through different areas of concern for IMCA members. We begin with an incident of electrical power loss in dive control, before looking at a second diving incident where there was a stored energy release following failure of a valve on a diving gas bottle. The third incident also covers a potentially serious stored energy release, where incorrect valves were fitted to a high-pressure steam piping system. The fourth incident covers a small fire discovered in oxy-acetylene hoses. No personnel were injured in any of these incidents. IMCA welcomes the reporting of near miss incidents, as these can often provide the best lessons for the industry in terms of improving overall safety.

1 Power Loss Within Dive Control

What happened?

During diving operations, there was a power loss scenario within dive control whereby both circuit breakers after the uninterruptible power supply (UPS) tripped, causing a loss of power to the electronic components of the dive system. Power was re-established using the UPS bypass switch. The dive was aborted to carry out investigation. No-one was harmed.

What went wrong? What were the causes?

During setup of the dive system the UPS was set to work on approx. 220VAC input (the input from a vessel generator power supply typically fluctuates). The UPS was also set up on the assumption that the power from the vessel would not drop below 85% of the expected supply voltage (a drop to 187VAC).

Investigation confirmed that this is in fact what happened – the supply voltage did indeed drop below the minimum threshold of 187VAC. When this happened, an automatic and internal bypass in the UPS kicked in to keep power supplied to the outlet side. Therefore, the low voltage was transferred through the internal UPS bypass and into the circuit breakers that protected all the electronic equipment in dive control.

When attached to a fixed output load (such as electronic equipment), a voltage drop will necessarily cause an increase in current flow. The current increased to the point where the circuit breakers tripped to further protect the electronic equipment. This disconnection of the power to the electronics shut them down without the UPS taking over or giving any sort of alarm condition.

This voltage drop may have been gradual and therefore was not noticed. It wouldn't have affected any other circuit breakers as there wouldn't have been any power spike. However, since the UPS corrects to 85% of the input voltage, once that limit was reached it automatically transferred to the bypass, thereby immediately causing a power spike on the output side as the voltage changed from 220VAC (UPS corrected) output to <187VAC (UPS bypassed output).

Further investigation revealed that the low voltage was a result of a large current draw, in turn as a result of other equipment on the same power bus being used at the same time. In this case, it was discovered that the ROV was being recovered from the water at the time of the power loss. On this vessel, the dive system power is taken from the same power bus as that which is used for the ROV.

What actions were taken? What were the lessons learned?

- Immediate Action: Verify that the ROV BUS tie breaker on the vessel 440VAC power distribution panel was in the open position. This circuit breaker needs to remain in the open positon at all times during diving and chamber operations;
- Set the UPS on all similar vessels to prohibit the use of the internal bypass again. This means that if at any point a low voltage scenario occurs again, the UPS will switch onto the battery backup, give an audible alarm and the internal bypass will never be used;
- The dive supervisors should be made aware that this alarm may occur at any time a high draw/low voltage situation is experienced again and all they need to do is to call the dive techs to confirm the UPS status;
- A daily "health" check of the UPS system has been added to the planned maintenance system for all company UPS systems;
- Due to the nature of the issue, the manufacturer was contacted during the investigation to seek advice on the UPS. The manufacturer had not reported similar occurrences, but a report will be sent to them for their records.

Members may wish to review the following incident:

- Dynamic positioning (DP) vessel blackout.

2 High Potential Near Miss: Failure of Valve on Gas Bottle

What happened?

The Royal New Zealand Navy has reported an explosion during the refilling of gas bottles used for naval diving operations. A crewman was refilling bottles when he heard a loud explosion and looked up to see the charging whip thrashing around violently. Upon establishing that it was safe to do so, the crewman closed all gas supply and receiver valves. After confirming that the situation had been stabilised, he reported the situation to his supervisor.

Though the filling components had been correctly connected, one of the bottle valves has failed and was violently expelled from the high pressure (HP) cylinder. As a result of the failure, the charging whip and valve remnant had forcefully impacted a nearby wall. Had these parts hit the crewman the consequences could have been very much more serious.

Normal Flask Filling

Post-incident outcome

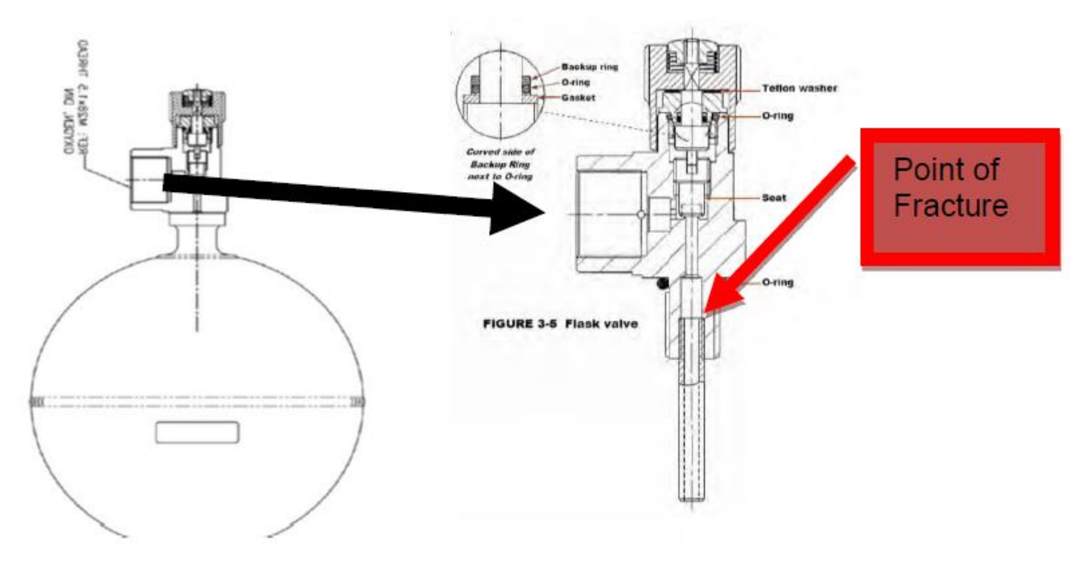


Figure 7: Flask Valve

What went wrong? What were the causes?

- The valve failure was mechanical in nature; a metallurgical failure of the integrity of the valve assembly, rather than being due to the process of filling the flask. Analysis determined that a combination of corrosion induced cracking and fatigue in the dipper tube thread roots lay at the heart of the failure;
- The exact cause of the corrosion could not be identified; however, the presence of dezincification and small particles of Verdigris in the cracks suggested that insufficient rinsing, after the 24-monthly application of mildly acidic BIOX cleaning compound, was the most probable cause;
- The level of Verdigris and the lack of oxygen caps and written emergency procedures show a need for further development of management systems;
- There was a post incident procedural failure, in that the person involved was not checked by a medic. Despite this he does not appear to have suffered any lasting detrimental effects as a result of the incident.

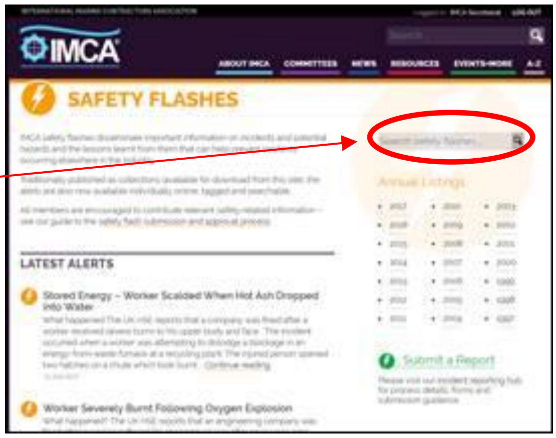
The following points, not strictly causal factors, were also identified by the investigation:

- While there can be statutory obligations relating to the testing and inspecting of *cylinders*, no such rules apply to the valves fitted to them;
- The lack of an appropriately defined operational life for valves of this nature (manufactured of non-magnetic brass vs. more conventional/durable materials) potentially missed an opportunity for them to have been 'retired' prior the failure;
- Oversights in regulatory compliance around correctly permanently marking or labelling valves;
- Lack of regulatory compliance in relation to ensuring that personnel involved in filling high pressure cylinders should hold appropriate (locally required) certification;
- Potential 'oxygen cleanliness' issues in relation to adherence to the fitting of valve caps when cylinders are not in use and limited the permissible levels of Verdigris build up on valve threads.

What actions were taken? What were the lessons learned?

- All similar valves of a similar age have been removed from service and replaced with new;
- Appropriate record-keeping measures were put in place for controlling the age of valves in use;
- A new method of securing filling arrester whips to cylinder necks was devised to prevent the potential thrashing around of loose whips under pressure;
- A review was made of procedures for valve oxygen cleanliness to ensure they meet the minimum internationally recommended standards;

- Recommendation was made that local regulations associated with the acquisition, introduction into service, on-going maintenance, marking and establishing a defined maximum operational life of valves used in association with HP cylinders, should be amended to reflect the lessons identified in this incident;
- Consider further development of training course for persons involved in filling HP cylinders.



Failure of gas bottle valves is unfortunately not uncommon. Members may wish to look through IMCA safety flashes themselves on our website:

In this box:

Type in the words you wish to search for. For example, valve failure**.**

Herewith a selection of the results:

- Bailout Cylinder And Pillar Valve Compatibility Failure;
- Pillar Valve Failure;
- Injuries Due To Failure Of Diver’s Emergency Gas Cylinder.

3 Incorrect Pressure Gauge on High Pressure Supply Line

What happened?

The International Association of Oil & Gas Producers (IOGP) has published Safety Alert 284 relating to a small steam leak from a pressure gauge on the high pressure steam supply to a turbine. An incorrect gauge was installed. The pressure gauge was rated to one Bar(g) and the safety seal failed when it was exposed to 55 Bar(g) steam during re-commissioning. The pressure gauge in question was brand new and had been fitted during the recent maintenance period.

What went wrong? What were the causes?

From the IOGP alert:

- The pressure gauge was inspected and found to be a **“0-100%”** gauge, where a **“0-100 Bar”** pressure gauge should have been installed;
- The 0-100% gauge had been ordered in error for a prior boiler shutdown and had been subsequently stored in the utilities equipment room, rather than returned to the warehouse for disposal;
- Technicians had established a culture of storing some small items in equipment rooms to allow easy access for small maintenance tasks;
- On the day of installation, the 0-100% gauge was mistaken for a 0-100 Bar pressure gauge (due to the near identical appearance) and was taken from the utilities equipment room and installed on the steam turbine high pressure steam supply line.

Corrective Actions and Recommendations:

IOGP recommendations were:

- Check all stores stock to ensure that all pressure gauges are stored in the correct place and in the correct boxes;
- Ensure that all unused equipment is returned to the place of issue at the end of each day. This ensures that only the correct equipment for a specific work order can be withdrawn;
- Ensure that all pressure gauges are function checked and fit for purpose before installation;
- Review stores stock items and material numbers to establish those that are no longer used or required. Block all numbers that are not required so as to prevent re-ordering by accident;
- For legacy assets, review and rationalize all local pressure gauges across each facility with a view to removing those that are no longer used or required.

See the full alert on the IOGP website. Members may wish to review the following incidents:

- Failure of hydraulic fitting at pressure;
- Incorrect pressure-rated manifold fitted to diver's bail-out.

4 Oxygen and Acetylene Hose Caught Fire

What happened?

A small fire was discovered in oxygen/acetylene hoses. Workers heard an "air blowing sound" and left their work location to investigate. Smoke and flames were noticed and a closer look revealed oxygen and acetylene hoses on fire. The fire alarm was raised; one person immediately grabbed and kinked the hoses to close the supply of gas. This ceased the fire before another person came with an extinguisher, which at that point was no longer needed. The valves on the gas cylinders (located some distance away) were closed, and the hoses depressurized and disconnected. There were no injuries, just some slight material damage.

At the time of the incident:

- No personnel were working in the area;
- No hot work activities were ongoing in the area;
- Gas hoses were found contaminated with a few hydraulic oil stains;
- Gas hoses were in a narrow-edged area.

What went wrong? What were the causes?

Oxygen is very reactive. Pure oxygen, at high pressure – such as from a cylinder – can react violently with common materials, such as oil and grease, resulting in a spontaneous fire. Also, other materials may catch fire spontaneously. A leaking valve or hose in a poorly ventilated room or confined space also can quickly increase the oxygen concentration to a dangerous level. The air we breathe contains about 21% oxygen. Even a small increase in the oxygen level (called oxygen enrichment) in the air – to just 24% – can create a dangerous situation. To avoid the risk of fires and explosions when oxygen comes into contact with oil and grease, it is important that equipment used for welding and cutting is not allowed to become contaminated with these materials.

What lessons were learnt?

Our member notes that in this particular case the following workplace conditions could have contributed to the incident:

- Sharp edges and a surface that could have damaged the hose;
- Oil residues that could have contaminated the hose;

- Narrow, almost confined space conditions, with potential lack of ventilation that could have contributed to the build-up of the oxygen level.

Actions – what should you do if you suspect oxygen enrichment from an oxygen leak?

1. turn off the oxygen supply;
2. extinguish cigarettes and open flames;
3. make sure the room is well ventilated;
4. identify and repair the source of the leak.

Useful information regarding these hazards can be found in the leaflet *Oxygen Use in the Workplace*, published by the UK Health and Safety Executive (UK HSE).

Members may wish to review the following incidents:

- Near-Miss: Potential Use Of Petroleum-Based Grease In An Oxygen-Rich Environment;
- Hose Fire Caused By Flashback In Oxygen And Acetylene Hoses;
- Worker Severely Burnt Following Oxygen Explosion.