IMCA Safety Flash 05/17

March 2017

Focus: Diving Safety

The first incident is a clarification and reissue by NOPSEMA of their Safety Alert 63 regarding quality assurance of diving system audits. The other two incidents are diving-related near miss incidents, covering firstly, suspected high levels of $C0_2$ in diver breathing gas, and secondly, bailout cylinder and pillar valve compatibility failures.

1 Clarification from NOPSEMA: Quality Assurance of Diving System Audits

The National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) of Australia published Safety Alert 63 regarding the quality assurance of diving system audits.

This was passed on to IMCA members as IMCA SF 03/17 – Incident 2 – *Quality assurance of diving system audits.* Additional information drawn to the attention of NOPSEMA has made some changes necessary. The alert has now been re-issued as Safety Alert 63 Rev. 1.

"A number of NOPSEMA inspections have identified a trend in the standard of audits conducted on diving systems and equipment. Specifically, a number of operators of diving projects and diving contractors have failed to ensure diving system audits have been conducted to an appropriate standard. While reviewing the audits conducted by the diving project operators and the diving contractors, NOPSEMA's inspectors identified the following deficiencies:

- *Man-riding wire destructive test certification was not adequately assessed, resulting in the failure to identify that the percentage deterioration was greater than that permitted by the relevant International Marine Contractor's Association (IMCA) code/guidelines and therefore should have been replaced;*
- *Inappropriate application of a management of change process to justify the deferral of man-riding wire destructive tests;*
- *Failure to make an emergency services umbilical available for SPHL connection to its life support package;*
- *A high pressure (200 bar) flexible oxygen hose was found during a NOPSEMA inspection to be too long, made up with joins and was damaged, however it was marked as compliant during an earlier audit;*
- *Older diving systems built to class have not been upgraded, where practicable, to meet current class requirements e.g. fire suppression systems within diving chambers unable to be externally actuated.*

Each of the deficiencies outlined above should have been identified and rectified as a result of the third party or in-house audits."

NOPSEMA notes that: *"Failure to identify audit non-conformances associated with safety-critical elements of a diving system may result in an increased level of risk to the air and saturation divers. The non-conformance examples provided above have the potential to compromise the integrity of the system components and reduce functionality in an emergency. Any loss of integrity or system redundancy has the potential to result in serious injury or fatalities to divers and others involved in diving operations."*

2 Near Miss: Suspected High Levels of CO_2 in Diver Breathing Gas

A member has reported an incident where there was an elevated level of CO_2 in the divers reclaim breathing gas during saturation diving operations. A dive team was performing diving operations with two divers working on the seabed at an approximate depth of 92m. The bellman was within the diving bell supporting the two divers in the water.

While working on the seabed the divers began to experience breathing difficulties but this was not reported to the Dive Supervisor. On return to the bell for his hydration break, one of the divers experienced difficulties climbing his umbilical to return to the bell but put this down to his own level of fitness. He mentioned this to the bellman during the hydration break but this was not reported to the Dive Supervisor. On his return to the worksite the diver again experienced breathing difficulties and asked the Dive Supervisor if everything was OK with the reclaim system. On checking the topside reclaim system and discussing his concerns with the bellman, he reported back to the diver that all was OK.

A short while later an alarm sounded on the CO_2 analyser for the divers reclaim return. The Dive Supervisor noted the analyser was displaying an incorrect reading. The divers then subsequently advised the Dive Supervisor of the problems they were experiencing, including; agitation, breathing difficulties and headaches.

The Dive Supervisor requested the divers flush their helmets, go on open circuit, return to the bell stage and changed the divers onto a secondary breathing mix. The Dive Supervisor also raised concerns regarding the analyser and requested that the analyser was changed. The Soda Sorb was also replaced in the divers reclaim system. Following the change of analyser, it was noted that the CO_2 reading displayed was out with normal operating parameters.

Both divers were subsequently recovered to the bell and the dive was aborted with no further ill effects experienced by either of the divers.

A formal investigation was initiated and a report was submitted to the regulatory authorities.

Soda Sorb is used within the diver reclaim system and absorbs CO_2 exhaled by the divers. This reclaimed gas is then recirculated through the topside process system and subsequently resupplied back to the divers.

In this incident, the Soda Sorb within the reclaim towers which absorbs the CO_2 was allowed to saturate. This resulted in elevated levels of CO_2 entering the reclaim loop and the divers experiencing symptoms indicative of an elevated level of CO_2 within their breathing gas.

- Our member suggested that the following things went wrong:
  - it appears a mistake had been made in calibrating the analysers which resulted in them not alarming at the expected threshold levels
  - the vessel specific dive system operating procedures did not contain sufficient detail on how to calibrate and set the alarms for the CO_2 analysers
  - industry practice is that Soda Sorb is changed based on the monitoring of the CO_2 alarms
  - the symptoms experienced by the divers at the time were not considered initially by the diver or supervisor significant enough to cause alarm
  - the incorrectly calibrated CO_2 analyser indicated a fault code. This was not known as a fault code and its significance was not recognised.
- Our member made the following observations:
  - it is essential to ensure manufacturers equipment guidance is up to date and available to all relevant personnel on board. Key information provided by the manufacturer must also be reflected in the operating processes and procedures to ensure the safe maintenance and operation of plant and equipment
  - it is essential to ensure persons responsible for the set up and calibration of equipment are familiar with the procedures for safety critical equipment
  - it is essential that persons in safety critical roles understand the importance of systems that have single point failures and the value of establishing effective risk control and mitigating barriers

  - the importance of effective training, competency and on-going assessment for personnel performing a safety critical role. This should include practical competence assessment, especially if the person performing the safety critical role has been absent from the worksite for an extended period of time
  - the importance of ensuring that sufficient detail is captured within dive system operating procedures, on how to calibrate and set up analysers including setting of alarms
  - the importance of ensuring that manuals used across multiple assets are consistent to ensure the same practices are applied.
- Our member took the following actions:
  - raising of awareness across the fleet of the key learning points identified during the course of this enquiry
  - engagement with equipment manufacturers to ensure up to date information is available, current and consistent
  - development of systems to ensure the dissemination of critical changes distributed by manufacturers or equipment suppliers are issued to appropriate onshore and offshore personnel
  - thorough review of diving operating manuals to ensure reflection of manufacturer's current recommendations
  - thorough review of diving emergency and contingency manuals to ensure scenarios of high CO_2 are captured and that the appropriate actions to be taken are fully detailed. This will include contaminated gas scenarios which must be incorporated into the emergency response drill matrix and practices at regular intervals
  - revision of the competency systems to identify all diving safety critical roles, specification of safety critical modules within the competency system to ensure all those personnel in safety critical roles are competent in using and calibrating safety critical equipment under their control
  - review and amendment of fleet failure modes, effects and criticality analysis (FMECA) documents to include scenarios of high CO_2 in divers breathing gas
  - all possible mitigations identified in the FMECA to be put in place to ensure risks are managed to as low as reasonably practicable.

Members may wish to refer to the following incidents (search words, *diver, faint, gas*):

- IMCA SF 04/15 – Incident 4 –*Diver fainted;*
- IMCA SF 01/16 – Incident 3 – *High potential near miss: poor o2 content in supplied air - diver temporarily lost consciousness.*

3 Bailout Cylinder and Pillar Valve Compatibility Failure

A member has reported a near miss incident in which there were failures of pillar valves. The incident occurred during visual inspection of bailout cylinders, when it was identified that six out of the twelve pillar valves tested, with GO/NO-GO thread gauges, failed the GO thread gauge test.

Of the six cylinders that passed the original test, four cylinders were rechecked at the next six-monthly planned maintenance check, and two of the pillar valves failed the GO gauge thread test. A possible cause of the later failure may have been wear & tear, continual emptying & recharging to 200 bar (at 200 bar there is almost 1 tonne of force on the pillar valve).

Our member has introduced a quality check of cylinder threads and pillar valves whereby GO/NO-GO thread gauges are used before accepting any new stock. When recently purchasing new cylinders and additional pillar valves the pre-acceptance tests were performed. It was identified that there was a surprisingly high failure rate when testing the new pillar valves. Of six pillar valves purchased, four failed the GO thread gauge test. It is to be noted that similar failure rate has also been the case with subsequent purchases of pillar valves.

Attached are photographs of both the six pillar valves which failed during the original test and two other, order replacement pillar valves which also failed the test. Also attached are photos of a new pillar valve with packaging and demonstration photos of successful & unsuccessful GO thread gauge tests.

All tests were conducted by a technician who is qualified as an “ASSET” Part 1 & Part 2 Cylinder Inspector using recently calibrated GO/NO-GO thread gauges.

Example of a GO Gauge PASS

Example of a GO Gauge FAIL

New Pillar Valve with Packing

Example of New Pillar Valves that FAILED

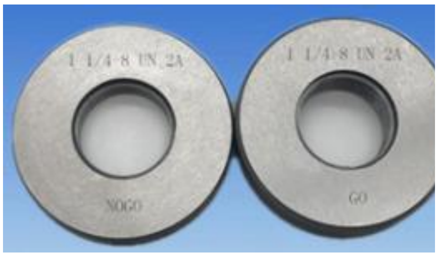
Six In-Service Pillar Valves that FAILED

Our member's recommendations and lessons learnt were:

- It is recommended that organisations using Bailout Cylinders:
  - establish a planned maintenance system procedure whereby on all 6 monthly internal visual inspections the cylinder and pillar valves threads are checked using the GO/NO-GO thread gauges
  - ensure that cylinders and pillar valves are checked when purchased and before putting into service to ensure correct fitting using calibrated GO/NO-GO thread gauge and by a trained technician
  - implement a method of marking the pillar valves so that a register can be created to record or link a particular pillar valve to a particular cylinder by serial number.

Members may wish to refer to the following incidents:

- IMCA SF 12/09 – Incident 1 – *Pillar valve failure;*
- IMCA SF 19/14 – Incident 1 – *Injuries due to failure of diver's emergency gas cylinder;*
- IMCA SF 01/16 – Incident 2 –*Injuries due to failure of divers emergency gas cylinder – use of incompatible threads.*



GO or NO-GO thread ring gauge

A thread RING gauge is used to check the accuracy of an outside thread.

The GO thread ring gauge should easily and completely slide over the outside thread. The NO-GO thread ring gauge should not be able to slide over more than 3 threads, if it does the outside thread is too small.

GO or NO-GO thread plug gauge

A thread PLUG gauge is used to check the accuracy of a threaded hole.

The longer end of the tool will be the GO end, while the shorter end is NO-GO. The longer end should be able to thread into the threaded hole easily and completely. If not the hole is too small. The NO-GO end should not enter beyond the third thread, if it does the threaded hole is too large.