Significant Incident Report No. 228

Subject: Worker seriously injured when sprayed by anhydrous ammonia after failure of flexible rubber hose

Date: 09 October 2015

Summary of incident

Note: The Department of Mines and Petroleum's investigation is ongoing. The information contained in this significant incident report is based on materials received, knowledge and understanding at the time of writing.

A process worker and colleague were preparing for a scheduled maintenance task in the ammonia storage area of a processing plant.

As part of a routine purging operation, the process worker connected a flexible rubber hose via a coupling to a purge connection point. The purge hose was charged with nitrogen and the valve was being opened slowly, allowing nitrogen to flow into the system, when the hose ruptured above the connection point.

The worker was exposed below the waist to pressurised anhydrous ammonia at about -33°C, and was enveloped in the ensuing ammonia cloud. His colleague was able to get the worker to a nearby safety shower before contacting the site's emergency services. The worker was air lifted to a city hospital and treated for serious chemical burns.

Flexible rubber hose and assembly connected to anhydrous ammonia purge point. Close up (right) shows rupture in hose above connection point

Direct causes

- The purge hose failed as the valve was opened.
- The worker was next to the hose when it failed.

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Contributory causes

- It appears that the hose was not in a serviceable condition, with factors including:
  - lack of information about its recommended use, either visible on the hose or provided by the site
  - repeated bending of the hose to less than its minimum design radius during routine use, damaging the steel braiding and inner rubber lining
  - loss of structural integrity can be difficult to identify from visual examination.
- Although there were several procedures covering flexible hose safety and integrity, the procedures were either past their review date or under review, and most operators were not aware of their availability.
- The processing plant had experienced other hose failures over the previous 12 months and had implemented a training program for all workers covering:
  - specific requirements for flexible hose use
  - pre-start or pre-use checks for hose integrity
  - how to confirm that a hose is fit for its intended purpose
  - removal from service of old or degraded hoses
  - removal from service of unidentified hoses.

In this incident, it appears that not all aspects relating to flexible hose safety and integrity were followed when the hose was selected for the task.

Actions required

As part of an operation's safety management system, responsible persons are reminded of the importance of monitoring and reviewing the safety and integrity of equipment over its life. Some recommendations are listed below for flexible hoses.

- When selecting flexible hoses, consider their specific application and whether they comply with the appropriate Australian standard. Take into account factors such as:
  - pressure, temperature, type of fluid, gas or chemical being conveyed
  - any special hose requirements (e.g. abrasion-resistant, fire-resistant, anti-static, cryogenic service, minimum bend radius).
- Implement a management system that defines:
  - an appropriate inspection, testing and maintenance regime, based on a risk assessment, manufacturer specifications, supplier recommendations and applicable Australian standards and previous experience
  - how each hose type will be inspected and tested (e.g. competent person using appropriate testing equipment), and marked or tagged accordingly
  - how each hose type will be stored, based on manufacturer recommendations.
- Implement a training program so that workers understand:
  - the risks associated with using flexible rubber hoses under pressure
  - how to do a pre-task inspection on a flexible hose to confirm that it is fit for purpose before being used
  - the actions to take when a hose is found not to meet the requisite standards for the task.

Note: Workers are not in a position to identify internal degradation of the hose, hence the need for periodic testing by a competent person.

- Hoses deemed to be at the end of their life should be rendered unserviceable and discarded to prevent further use.

Flexible rubber hoses showing external damage. Only testing by a competent person will reveal whether the internal integrity of the hose has been compromised

Further information

- Australian Standards, www.standards.org.au

  AS/NZS 2554 *Hose and hose assemblies for air*

  AS 2594 *Hose and hose assemblies for liquid chemicals*

  AS 3791 *Hydraulic hose*

  AS/NZS 4233.1 *High pressure water jetting systems – Safe operation and maintenance*

This Significant Incident Report was approved for release by the State Mining Engineer on 09 October 2015