**Ammonia safety requirements and hazard identification**

**Recommendations and advice for owners and occupiers**

**Ammonia air mixtures and sources of ignition**

Escaped ammonia can create a flammable air mixture under certain conditions and can be ignited from common sources of ignition.

The most likely sources of ignition found in ammonia refrigeration machinery rooms relate to electrical items.

Ammonia’s relatively high lower explosive level (LEL) allows for ammonia air concentrations to be monitored and alarmed at levels well below the LEL. Australian and international standards indicate that specially protected electrical items are not required in ammonia refrigeration machinery rooms, provided all electrical circuits are isolated at a safe location should the ammonia concentration detected inside the machinery room reach 20 per cent of LEL or 30,000 parts per million (ppm).

The only exceptions are the exhaust fan/s which must be fitted with EXN or explosion proof motors (as per ISO60079), and ideally, wiring systems complying with zone two AS/NZS 2381.1:1999 Electrical equipment for explosive atmospheres – Selection, installation and maintenance – General requirements – cable; and the emergency lighting, which also must be explosion proof with individual battery back-up. The LEL ammonia detection system only needs to be explosion proof if it is to operate at high levels and have a UPS (battery back-up) good for at least 1 hour. Unprotected electrical equipment should not be installed within one metre of charging and draining points or safety relief valve outlets.

The indication that specially protected electrical items are not required means that the ammonia refrigeration machinery room will not be declared a hazardous area under AS/NZS2430.1.1:1997 Classification of hazardous areas and standard electrical equipment can be installed and used within the machinery room space.

**Note:** AS/NZS 2430.1.1:1997 – Classification of hazardous areas in respect to the refrigeration plant. This document reviews the classification of hazardous areas of a refrigeration ammonia plant in regard to AS/NZS2430.1:1997.

Ammonia has a flammability range of 15 to 34 per cent, and the LEL of ammonia is 150,000 ppm, which is well above easily detectable levels, and in orders-of-magnitude is above accepted levels of occupational health exposure of less than 50 ppm.
Attention to personal health and safety in ammonia plants for ammonia concentrations lower than the explosive limit is listed in AS/NZS 2430.3.9:1997.

In reference to section 7.2.3 (AS/NZS 2430.3.9:1997) Filling or unloading points and the discharge of relief valves. The area within 1m in all directions surrounding each point is classed as a zone 2 hazardous area.

Providing the plant room is adequately ventilated the areas as listed above would be classed as zone 2 hazardous areas. Maintenance procedures should be put in place to ensure operation of the installed exhaust fan/s or natural ventilation. In practice the filling and unloading points within the ammonia plant room, should be reviewed to ascertain that a 1m separation is maintained between any of the described points and any hazardous electrical equipment installation.

Isolating all electrical circuits from a “safe location” means a location outside of the machinery room in a safe area where ammonia – air mixtures are very unlikely to be present. The safe area may be an electrical switch room separated from the machinery room by a sealed gas tight wall.

The static or forced ventilation requirements must comply with AS/NZS1677.2:1998.

The nature of refrigerated spaces is that they are usually well sealed. Therefore it is possible that high concentrations of ammonia in air could occur in spaces directly refrigerated using ammonia if there were a rupture in the evaporator/s.

Detecting ammonia concentrations reliably in air can be difficult at temperatures below freezing. It is of great importance to select a suitable ammonia detector for this type of application. Generally speaking, refrigerated spaces using direct ammonia are not required to be fitted with detectors for AS1677 compliance, but may be good risk management practice. They are not deemed to be occupied spaces. While there are no records of ammonia fires or explosions in refrigerated spaces in Australia or New Zealand, there have been incidents reported overseas. Direct refrigerated spaces need to be considered when evaluating risks with ammonia.

**Fire sprinklers in machinery rooms**

Most common ammonia refrigeration compressors are open driven by drip proof squirrel cage electric motors.

Some compressors are fitted with TEFC (totally enclosed fan cooled) motors (which are weatherproof) and weatherproof control systems. These machines are generally installed outdoors. Deluging a drip proof motor with water will be likely to cause major damage and burnout. Therefore it is undesirable to use water based fire sprinklers in an ammonia refrigeration machinery room with drip proof motors. In the unlikely event that all of the equipment in the machinery room is weatherproof, then sprinklers would be acceptable.

**Note:** The decision regarding the type and installation of sprinklers in machinery rooms will consequently be determined by the fire engineer, the building surveyor and the user’s insurance company.

**Other equipment considerations**

Air compressors must not be located in ammonia refrigeration machinery rooms.

Possible issues – ingress of ammonia into the processed air will distribute it throughout the plant.

Ingress of dust and ammonia in case of a refrigerant leak. The walls and doors between the control room and the plant room should be at least 1 hour fire rated.
If evaporative condensers are used, the surface around and under the condensers should be impervious and drained to sewers. Water treatment chemicals must not be allowed to enter the storm water drains.

In some instances explosion vents are installed in the walls or roof of ammonia refrigeration plant rooms. They should be provided where reasonably practical, and some international insurance companies require them as mandatory.

**Hazard identification, risk assessment and controls**

Hazard identification and risk assessment enables a site to control risks associated with any product, process or plant that has the ability to cause injury or harm to people on the site.

This process can either be simple or complex depending on the number of hazards and the association of those hazards present on the site, in some instances a hazard identification and risk assessment flow diagram may be used or alternatively more complex hazards may require an OHS specialist with specific knowledge to provide assistance.

Risk assessment determines whether there is a direct risk of injury or damage to property from the identified hazards. The purpose of the risk assessment is to:

- determine those risks that need to be controlled;
- assist you to make decisions about the order in which risks should be controlled.

Risk control is the process of determining and implementing appropriate measures to control the risks associated with hazards and risks identified for a site. You have a duty to ensure that any risk/s associated with your premises is controlled. The primary duty is to eliminate these risks. If this is not possible, the risk must be reduced as far as practicable.

**Emergency planning**

The purpose of an emergency plan is to minimise the effects of any emergency that occurs at premises where anhydrous ammonia is stored and handled.

Emergencies, although undesirable, are not altogether unavoidable. Although we all aim to minimise the risk of an accident occurring, there is a need to ensure that preparations are in place to protect, people, property, neighbours and the environment when an accident occurs. This is done by devising an emergency plan.

An emergency plan is a written document detailing how a site/facility and its occupants deal or manage emergency events that may possibly occur. An effective emergency plan consists of the preparedness, response and recovery activities and includes the agreed emergency management roles, responsibilities, strategies and system arrangements of the site. The level of detail in an emergency management plan will depend on the complexity of the site involved and how much ammonia is being used in the plant and stored.

These plans should be simple, flexible, tested and reviewed. It should be communicated to and available to all employees in the workplace. Employees should be trained in all emergency procedures and regularly practice various emergency scenarios to ensure that the documented procedures and plans work successfully.

A company has a legal obligation and duty of care to prepare an emergency plan as required by legislation such as the Occupational Health and Safety Act and regulations and the Dangerous Goods Act and regulations.

**What is an emergency?**

Although definitions vary between organisations, an emergency can simply be described as an event or situation that threatens serious damage to human welfare in a place, or environment of a place or the property of a place.

There are generally three types of emergencies that could occur on a site that stores/uses Ammonia:

- local area emergency, eg. plant room
- site emergency incident confined to site; and
- external emergency incident impacting offsite.

When describing the emergency response for each type of incident, the facility will need to consider in which situation the emergency plan applies.

In general, the facility should consider incidents such as:

- Fire
- Security
- Medical
- Electrical outage
- Mechanical or process failure
- Natural events such as storms or cyclones; and
- Hazardous materials releases.

**Note 1:** Response procedures should be developed when considering training of people working in and around an ammonia plant, specialist knowledge and available PPE and PPC.

**Note 2:** It is understood that it is a major concern of all business owners to keep their facility operating in an emergency. A well formulated emergency plan and response will assist a site in the safe and timely management of an emergency helping to minimise product loss and interruption. A robust emergency plan will also assist a site to work more closely with the emergency services leading to an earlier resolution to an emergency situation.

**Note 3:** Business continuity should be considered as part of a company’s emergency plan development. Companies should confirm with their insurance provider that adequate coverage is provided for any emergency services attendance in times of a HazMat / Chemical incident (eg. Ammonia leak). The fire levy component of insurance policies only covers fire service attendance for fire.

Next month’s skills workshop will complete the series on ammonia safety. It will provide an overview of developing an ammonia emergency plan, procedures for maintenance and personal protective equipment. 

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Turn to page 22 for details on upcoming Ammonia training.