



Case Study:

Shelters for Anhydrous Ammonia Release

The installation of Shelter-in-Place and Safe Havens to provide safe refuge at the site's Ammonia Muster Points.

Preparing for an Accidental Ammonia Release

An unplanned chemical release is a known hazard at petrochemical facilities. While they are an anomaly, accidents can occur and due to the high-risk nature of substances present on site, can be deadly.

Mitigation against the risk of an accidental release is critical to any responsible petrochemical facility. However, having the right procedures in place in case the event ever occurs should not be ignored.

The Australia site, facilitated the import and export of resources and chemicals such as iron ore, salt and anhydrous ammonia. Assessments conducted by the site determined that there was a potential risk of exposure due to loss of containment at any point in the anhydrous ammonia delivery pipeline, through to loading at the wharf. An anhydrous ammonia emergency response plan was developed, detailing the actions required in the event of an unplanned release and position of on-site safe havens and Shelter-in-Place (SIP).



Pictured: AirBANK installed on a Shelter-in-Place to help provide an airtight environment.



The Hazard: Anhydrous Ammonia

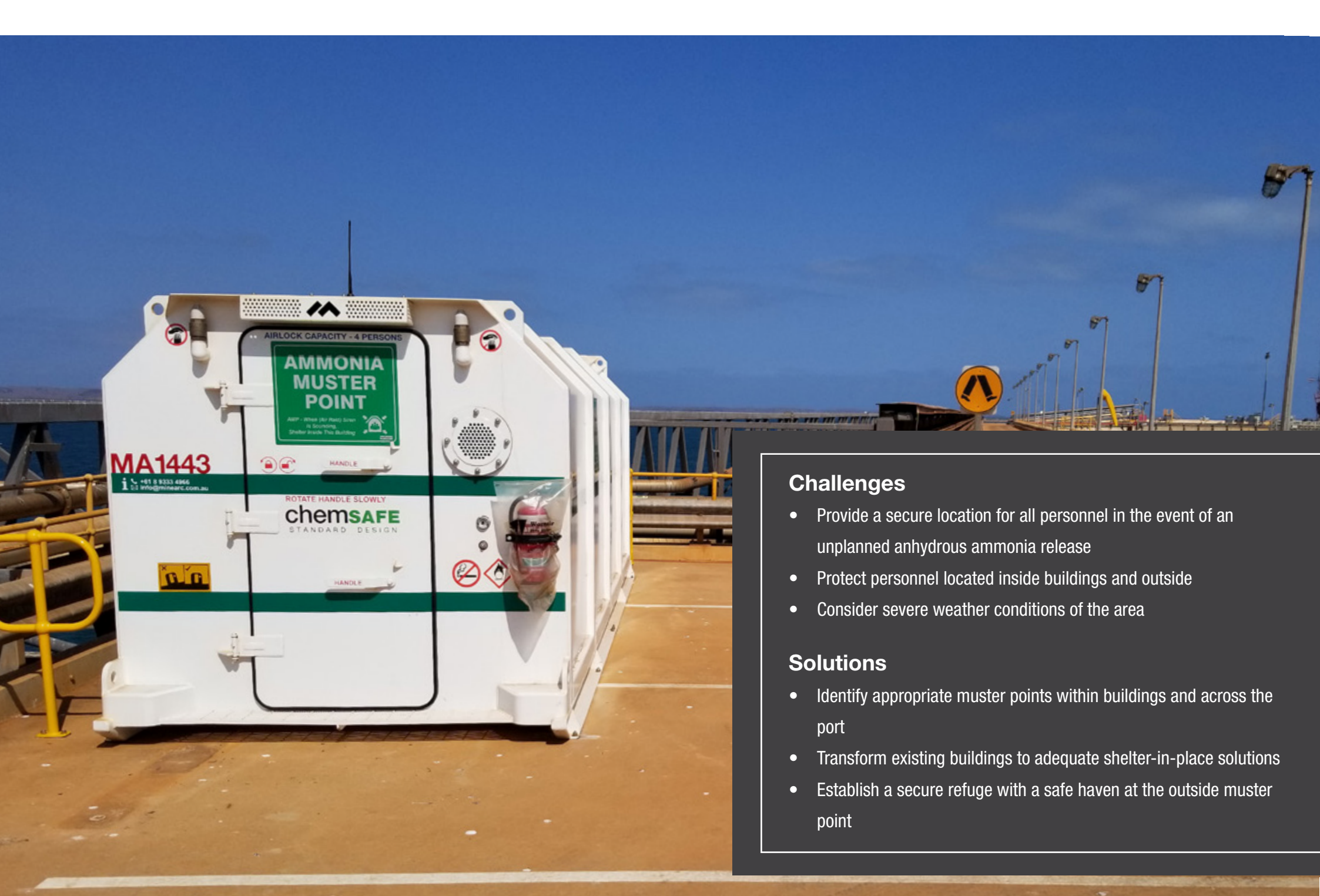
Anhydrous ammonia is a colourless gas with a strong odour. The chemical is often used as an agricultural fertiliser, industrial refrigerant and in the manufacture of ammonium nitrate based fertilisers and explosives.

Ammonia is a toxic gas; releases have the potential for harmful effects on personnel and the surrounding public. Inhaling anhydrous ammonia can cause severe health effects ranging from respiratory irritation and corrosive burns to the possibility of fatality.

Rapid release and potential explosions are additional risks. If the ammonia is under pressure, the dangers of exposure increase as more substantial quantities have the potential for swift release into the air. Some explosions have also been attributed to releases of ammonia contaminated with lubricating oil.

Amount (ppm)	Health Effects
<100 ppm	Detect a sharp pungent odour, no adverse effects on individuals with average health
400 ppm	Immediate irritation of the nose and throat, no serious effect for 30 mins to one hour
700 ppm	Immediate eye irritation, no serious effect for 30 mins to one hour
1,700 ppm	Convulsive coughing, severe eye, nose and throat irritation, possible fatality after 30 mins
2,000 – 5,000 ppm	Convulsive coughing, severe eye, nose and throat irritation, possible fatality after 15 mins
> 5,000 ppm	Respiratory spasms, rapid asphyxia, fatality within minutes

Table 1: Health Effects of Anhydrous Ammonia¹



Challenges

- Provide a secure location for all personnel in the event of an unplanned anhydrous ammonia release
- Protect personnel located inside buildings and outside
- Consider severe weather conditions of the area

Solutions

- Identify appropriate muster points within buildings and across the port
- Transform existing buildings to adequate shelter-in-place solutions
- Establish a secure refuge with a safe haven at the outside muster point

01.

Identify Appropriate Muster Points Within Buildings and Across the Port

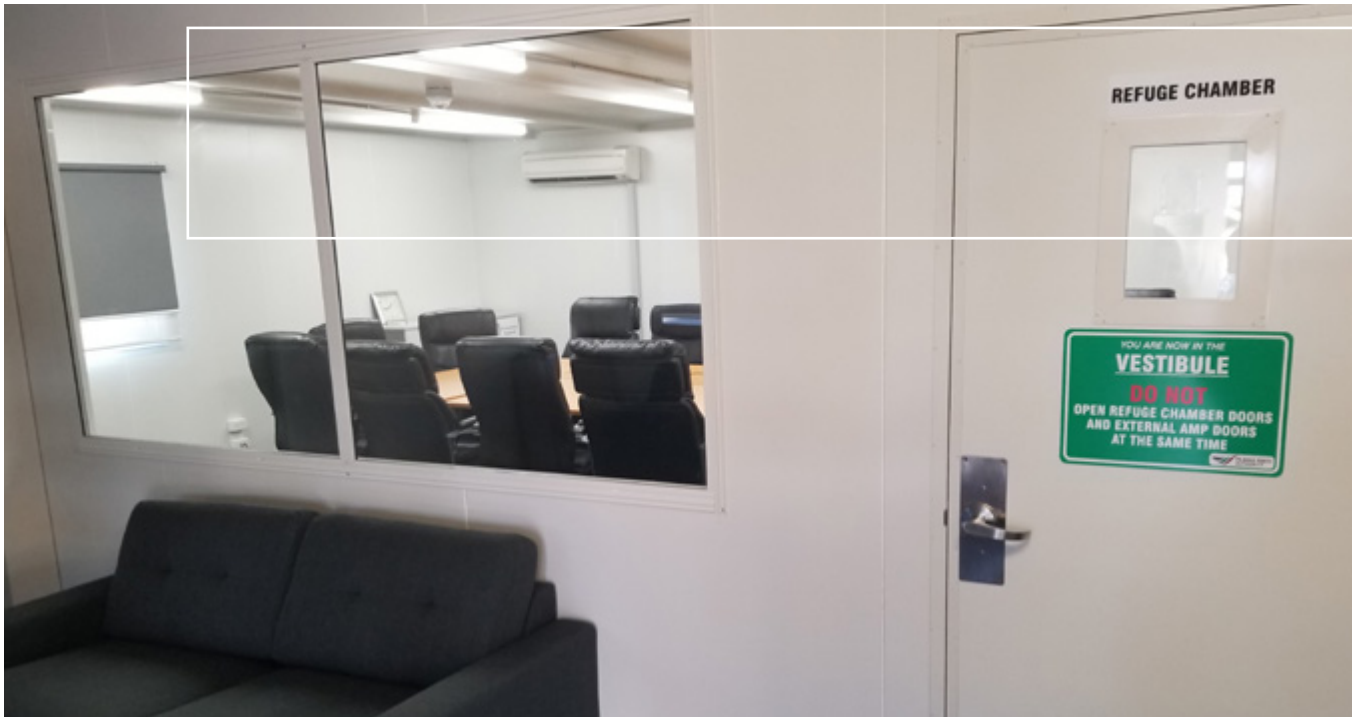
Once the ammonia alarm is activated, personnel should be able to access a secure shelter until the release is contained, and it is determined safe to evacuate the site.

Muster points provide a secure location, easily reached and identified by staff, visitors and contractors on-site. Determining appropriate locations for these muster points ensures that each refuge is positioned to accommodate a timely shelter. MineARC worked closely with the site to understand the hazard dynamics in relation to personnel working areas and densities throughout the facility.

Three separate locations were highlighted as cluster points across the petrochemical work-site; ideal locations for each refuge include the administration and wharf services buildings as well as the bulk liquids wharf area. Where no existing building was suitable for conversion to provide a safe room, standalone refuges were required.



Pictured Right: An Ammonia Muster Point containing a certified MineARC ChemSAFE Sealed Room, with AirBANK and Satellite UPS



Pictured Right: Inside a multipurpose Shelter-in-Place.

MineARC Systems were commissioned to design and install shelter-in-place systems across the site operation and wharf loading areas.

Dual custom **ChemSAFE Sealed Rooms** were constructed utilising the existing structures; providing the highest level of chemical protection during an emergency while creating useable spaces for daily activities. Two buildings were converted into a 60-person and 40-person shelter, respectively.

Each SIP was equipped with automated life support systems; CO and CO₂ scrubber, fixed internal and external digital gas monitoring, positive pressure maintenance systems, and climate control. All systems are supported by dedicated, uninterrupted power supplies, guaranteed to continue functioning throughout a significant event. This approach generates a Class 1 Safe Room for sheltering in place.

A vestibule is placed between the sealed rooms and surrounding entry, to prevent the ingress of smoke and toxic gases. This vestibule acts as a staging area between the refuge and the outside environment. To ensure correct entry, the emergency response plan included the entry procedures, highlighting the strict requirement not to open the refuge door if the external door is open.

02.

Transform Existing Building into a Shelter-in-Place Solution

03.

Install Chemical Safe Havens at External Muster Points

Personnel located on the wharf and outside at the time of accidental release need a secure, safe location to shelter. A safe haven is a purpose-built refuge, explicitly designed for the hazards of the petrochemical industry.

The site installed a 12-person ChemSAFE Standard Design Safe Haven on the bulk liquids wharf. The refuge provides operational personnel along the wharf shelter, from a potential chemical release. The chamber creates a controlled environment, equipped with life support systems such as a chemical scrubber, digital gas monitor, air-conditioning and back-up power supplies. An integrated positive-pressure flushing vestibule, allows personnel to enter without contaminating the interior chamber.

Additionally, the custom unit was built to withstand constant exposure to high salt conditions and extreme weather. An insulated panel was installed over the rear of the chamber to protect the batteries and air-conditioning systems from the elements.



Pictured Right: A 12-Person customised MineARC ChemSAFE Standard Design Safe Haven.

MineARC worked to install a combination of sealed rooms and safe havens to provide a comprehensive shelter-in-place solution to an unplanned ammonia release. The site needed a system that would allow personnel to rapidly and safely shelter from toxic substances. Due to the proximity of the pipeline to personnel within the facility, combined with the volume and likelihood of a chemical plume, pre-warning of release was limited.

Furthermore, the engineering specification of each shelter required extreme robustness due to seasonal severe tropical cyclones.



Pictured: Inside the ChemSAFE Safe Haven

Tailored Industry Solutions

Refuge Chambers

- ChemSAFE Standard Design Safe Haven
- ChemSAFE Sealed Rooms

Life-Supporting Technology

- Aura-FX Digital Gas Monitoring
- Series IV Scrubbing System
- Positive Pressure Flushing Systems
- Automated Oxygen Delivery System
- AirBANK
- Satellite UPS
- Vestibule

Training & Education

- On-site operational training
- On-site certified refuge chamber servicing
- Operational guides
- e-learning access

For More Information

To learn more about how MineARC Systems can support your site, visit minearc.com

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