

Bradfield Development Authority

# Building Two Advanced Manufacturing Research Facility

Section 4.55 Modification Report  
Appendix K – Dangerous Goods Assessment

13 November 2025

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# Dangerous Goods Report

*AMRF Building Two*

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## 1.0 Introduction

The AMRF (Advanced Manufacturing Readiness Facility) is an advanced manufacturing and research precinct located in the Bradfield City Centre at 215 Badgerys Creek Road, Bradfield. The AMRF precinct is being delivered in stages, with Stage 1 (Building 1) primarily housing office and general use workshop space for industry tenants. The First Building was officially opened in March 2025. This report concerns Stage 2 (Building Two) of the AMRF, which will house specialized semiconductor / micro-electronic fabrication and packaging resources.

AMRF Building Two (referred to hereafter as AMRF2) includes two semiconductor Cleanrooms and multiple levels of specialised research laboratory space. The facility will use materials classified as Dangerous Goods (DGs) under the ADG Code. These include large quantities of compressed gases, including flammable and toxic gases, and bulk quantities of corrosive substances and flammable liquids. The full manifest of Dangerous Goods that are proposed for storage at the AMRF2 facility is presented in Appendix A – Manifest of Dangerous Goods.

Umech Pty Ltd has been engaged by Architectus to provide consultation regarding the storage and handling of DGs at the new facility. This Dangerous Goods Report summarises the outcomes of a review of the DG design standards and regulations that are applicable to the proposed development.

### 1.1 Purpose & Scope

The purpose of this report is to provide an overview of the requirements for the storage and handling of Dangerous Goods at the AMRF2 facility. It considers the classes and quantities of Dangerous Goods that will be stored and outlines key considerations for the design and management of the facility. This report considers the final proposed configuration of the facility, inclusive of the two construction phases:

- Stage 1: Laboratories building and Advanced Manufacturing Hall (South building)
- Stage 2: + Conferencing facilities (North building)

The scope of this report includes:

- Register of the Classes of Dangerous Goods and a projection of their storage quantities
- Review of applicable regulations (ADG Code, NSW WHS Regulation 2017 and State Environmental Planning Policy) and Australian Standards based on the quantities/Classes of Dangerous Goods
- Summary of the key requirements for storage/handling derived from applicable Standards and regulations
- Recommendations for potential storage/handling arrangements

## 2.0 Site Description

### 2.1 Location and Site Layout

The AMRF2 facility will be located on a large lot in the Bradfield City Centre in Western Sydney (Figure 1). In addition to AMRF2 and the existing AMRF Building One, there are plans for future construction of 3-4 other buildings on the lot. A complete site plan of the AMRF lot is provided in Appendix B – Site Plan.

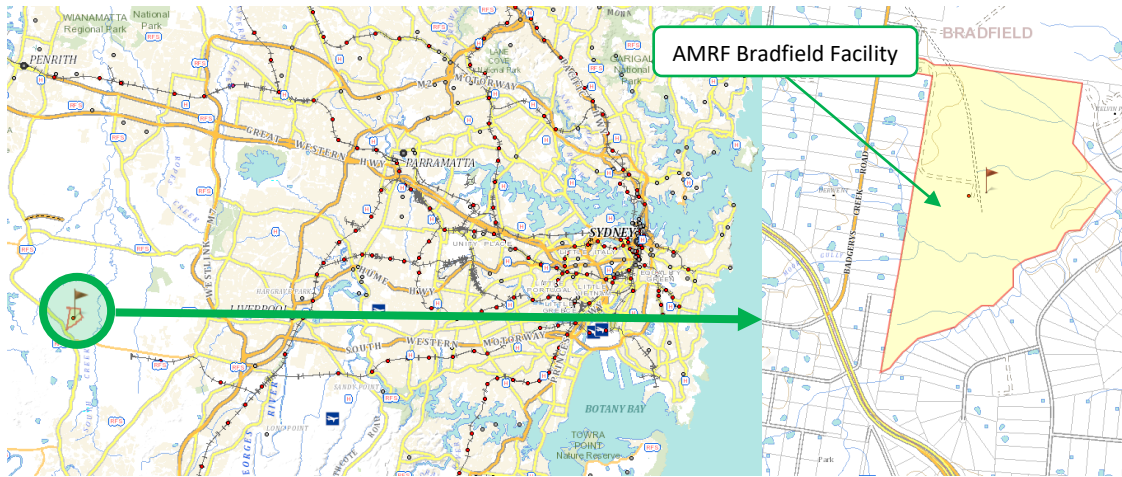


Figure 1 - Site Location, AMRF2 Facility

### 2.2 Building Overview

The AMRF2 consists of a North and South building that are connected at all levels above Basement 1. The building contains a total of 6 levels, including one underground basement level and a basement mezzanine. The usage of each level is summarised in the table below.

Table 1 - AMRF2 building overview

Level	Occupancy
Basement 1 / Mezzanine	Bay and chase cleanroom, diesel storage, acid waste neutralization plant, sprinkler tank / fire pump room, DI water plant room
Ground	Main gas store, main chemical store (flammable liquid, caustic and acid stores), hazardous waste store, loading dock, Advanced Manufacturing Hall
1	Ballroom cleanroom sub-fab, research workplace
2	Ballroom cleanroom, research workplace
3	Laboratory tenancy, research workplace
4	Open roof plant, diesel storage

The two buildings will be constructed separately in a staged process, starting with the South building. Because the occupancies that will have significant Dangerous Goods usage (both Cleanrooms and the Advanced Manufacturing Hall) are located in the South building, the majority of the DG storage provisions will be included in the first stage of construction.

## 2.3 Manifest of Chemicals

A manifest of the chemicals stored at the AMRF2 facility has been prepared based on the consultation report prepared by Industrial Technology Research Institute (ITRI) for the facility. This report contained the following information, which was used to extrapolate a Facility Utility Matrix (FUM) for AMRF2:

- Proposed tool list
- Estimated annual usage for all gases, DI water and cooling water
- Estimated hazardous waste production

The estimated quantities assessed in this report reflect the quantity of Dangerous Goods anticipated if the facility is operated at the maximum proposed capacity. The type and quantity of Dangerous Goods used on site is predominantly determined by the type of semiconductor tools that will be installed in the facility Cleanrooms and the type of processes that will be performed. The types and quantities estimated here may vary significantly if the tool set and processes differ from what has been selected in the ITRI report. Any significant changes will require reassessment. No additional Classes of Dangerous Goods (including Subsidiary Risks) may be stored at the facility without undertaking further assessment.

No limitation is imposed on the stock of chemicals that are not classified as hazardous (GHS classification) or classified as Dangerous Goods (ADG Code). Therefore, these chemicals are not considered in the scope of this report.

## 2.4 ADG Classification

Many of the regulations applicable to hazardous materials are derived from the framework set out in the Australian Code for the Transport of Dangerous Goods by Road & Rail (ADG Code). The ADG Code groups Dangerous Goods into classes and sub-classes (divisions) that correspond to their specific hazard characteristics. Dangerous Goods are also assigned a packing group based on a holistic assessment of the degree of danger they present:

- Packing Group I: Substances presenting high danger;
- Packing Group II: Substances presenting medium danger; and
- Packing Group III: Substances presenting low danger.

The ADG Code classifications and quantities of the hazardous chemicals stored at the AMRF2 facility are presented in Appendix A – Manifest of Dangerous Goods. The categories of Dangerous Goods that were identified are summarised in Table 2 below.

Table 2 – Summary of DG classes and packing groups

Substances	ADG Code			Stored Quantity (kg / L)
	DG Class (Subs.)	Hazard Description	Packing Group	
10% Methane in Argon	2.1	Flammable Gases	N/A	10 cylinders (500 L)
5% Hydrogen in Argon				
Difluoromethane (CH <sub>2</sub> F <sub>2</sub> )				
Forming Gas (5% H <sub>2</sub> in N <sub>2</sub> )				
Hydrogen				
Silane				
Argon (UHP)	2.2	Compressed Gases	N/A	21 cylinders (1,050 L)
Carbon Dioxide				
Carbon Tetrafluoride (CF <sub>4</sub> )				
Helium				
Hexafluoroethane (C <sub>2</sub> F <sub>6</sub> )				
Liquid Argon				
Liquid Nitrogen				
Nitrogen (UHP)				
Octafluorocyclobutane (C <sub>4</sub> F <sub>8</sub> )				
Sulfur Hexafluoride				
Trifluoromethane (CHF <sub>3</sub> )	2.2 (5.1)	Oxidising Gases	N/A	52 cylinders (2,600 L)
Nitrogen Trifluoride				
Nitrous Oxide				
Oxygen	2.2	Cryogenic Liquid	N/A	5,000 L
Liquid Argon				
Liquid Nitrogen	2.2	Cryogenic Liquid	N/A	25,000 L
Hexafluoro-1,3-Butadiene (C <sub>4</sub> F <sub>6</sub> )	2.3 (2.1)	Toxic Gases (Flammable)	N/A	1 cylinder (24 L)
Chlorine	2.3 (5.1, 8)	Toxic Gases (Oxidising and Corrosive)	N/A	1 cylinder (50 L)
Ammonia	2.3 (8)	Toxic Gases (Corrosive)	N/A	3 cylinders (98 L)
Boron Trichloride				
Hydrogen Bromide				
2-Propanol	3	Flammable Liquids	II	250 L
Acetone				
PGMEA (Propylene Glycol Monomethyl Ether Acetate)	3	Flammable Liquids	III	352 L
Photoresist				
Solvent / Flammable Liquid Waste				
Hexamethyldisilazane (HMDS)	3 (6.1)	Flammable Liquids (Toxic)	II	0.5 L
Hydrogen Peroxide (30%)	5.1 (8)	Oxidising Substances (Corrosive)	II	250 L
Potassium Dicyanoaurate(I)	6.1	Toxic Substances	I	1 kg

Substances	ADG Code			Stored Quantity (kg / L)
	DG Class (Subs.)	Hazard Description	Packing Group	
EKC265 post-etch residue remover	8	Corrosive Substances	II	662 L / kg
Hydrochloric Acid (>51%)				
Methanesulfonic Acid				
Potassium Hydroxide				
Sodium Hydroxide				
Sulphuric Acid (>51%)				
Tetramethylammonium hydroxide pentahydrate (TMAH)				
Alkaline Waste	8	Corrosive Substances	III	2,150 L
Acid Waste				
Ammonium Hydroxide (30-50%)				
Phosphoric Acid (25-85%)				
Nitric Acid (<65%)	8 (5.1)	Corrosive Substances (Oxidising)	II	50 L
Buffered oxide etchant (4:1)	8 (6.1)	Corrosive Substances (Toxic)	II	300 L
Hydrofluoric Acid (<60%)				
Copper(II) Sulfate	9	Environmentally Hazardous Substances	III	1,010 L / kg
Metallic Waste				
Nickel(II) Sulfate				
Diesel	9 (C1)	Combustible Liquid (Environmentally Hazardous)	III	6,000 L

### 3.0 Key Requirements

The requirements outlined in this section are a general overview of the relevant regulations and guidelines that must be followed to manage the Dangerous Goods at the AMRF2 facility. The discussion in this section is provided for information only and does not represent the standards or legislation in their entirety. Arrangement and storage of hazardous chemicals in the proposed development must be fully compliant with all relevant policies, legislation and standards.

The assessment in this Dangerous Goods Report has considered the following regulatory framework:

1. New South Wales Government, Work Health and Safety Regulation 2017
2. Australian Code for the Transport of Dangerous Goods by Road & Rail (ADG Code)
3. New South Wales Environmental Planning and Assessment Regulation 2021
4. New South Wales State Environmental Planning Policy (Resilience and Hazards) 2021

Based on the ADG/GHS classification of the chemicals used in the proposed development, the following Australian Standards have also been considered:

1. AS 1940:2017 - The storage and handling of flammable and combustible liquids
2. AS 4332:2004 – The storage and handling of gases in cylinders
3. AS 3780:2023 - The storage and handling of corrosive substances
4. AS 4326:1995 – The storage and handling of oxidizing agents
5. AS 60079.10.1:2022 – Classification of areas – explosive gas atmospheres
6. AS 1894:2025 - The storage and handling of non-flammable cryogenic and refrigerated liquids
7. AS 3833:2007 – The storage and handling of mixed classes of Dangerous Goods, in packages and intermediate bulk containers
8. AS 4452:2025 – The storage and handling of toxic substances
9. AS 4681:2000 – The storage and handling of Class 9 (miscellaneous) Dangerous Goods and articles

### 3.1 Placard and Manifest Quantities

The New South Wales Work Health and Safety Regulation 2017 Part 7.1 describes the requirements for the use, handling and storage of hazardous chemicals in the workplace. This regulation also defines requirements for reporting and documentation based on the stored quantities of different types of hazardous chemical. In Schedule 11 of the WHS Regulation 2017, two threshold quantities (“Placard” or “Manifest”) are defined for each category of hazardous chemical.

The WHS Regulation 2017 and standards/guidelines referenced in the regulation define further requirements for workplaces where the stored quantity of any chemical exceeds one of these thresholds. The quantities of each hazard category of chemical stored at the AMRF2 facility have been compared to the Schedule 11 thresholds and the results are presented in Table 3.

Table 3 - Assessment of hazardous chemical quantities according to WHS Regulation 2017 Schedule 11

Substances	GHS Classification		Max. stored quantity	WHS 2011 Schedule 11		
	Hazard Description	Category		Placard quantity	Manifest quantity	Category
10% Methane in Argon	Flammable Gases	1A	400L	200L	5000L	Placard
5% Hydrogen in Argon						
Hydrogen						
Silane						
Boron Trichloride	Gases under Pressure – with acute toxicity	2	172L	50L	500L	Placard
Chlorine						
Ammonia	Gases under Pressure – with acute toxicity	3	33,750L	1000L	10,000L	Manifest
Hexafluoro-1,3-Butadiene (C4F6)						
Hydrogen Bromide						
Argon (UHP)	Gases under Pressure	N/A	33,750L	1000L	10,000L	Manifest
Carbon Dioxide						
Carbon Tetrafluoride (CF4)						
Helium						
Hexafluoroethane (C2F6)						
Liquid Argon						
Liquid Nitrogen						
Nitrogen (UHP)						
Nitrogen Trifluoride						
Nitrous Oxide						
Octafluorocyclobutane (C4F8)						
Oxygen						
Sulfur Hexafluoride						
Trifluoromethane (CHF3)						
Hydrogen Peroxide	Oxidising Liquids	2	250L	250L	2500L	Placard
Ammonium Hydroxide (30-50%)	Skin Corrosion	1A	2,700L	50L	500L	Manifest
Buffered oxide etchant (4:1)						
Hydrofluoric Acid (<60%)						



Substances	GHS Classification		Max. stored quantity	WHS 2011 Schedule 11		
	Hazard Description	Category		Placard quantity	Manifest quantity	Category
Nitric Acid (<65%)						
Potassium Hydroxide						
Sodium Hydroxide						
Sulfuric Acid (>51%)						
Alkaline Waste	Skin Corrosion	1B	2,460L	250	2,500L	Placard
Acid Waste						
EKC265 post-etch residue remover						
Hydrochloric Acid (>51%)						
Methanesulfonic Acid						
Phosphoric Acid (25-85%)						
Tetramethylammonium hydroxide pentahydrate (TMAH)	Flammable Liquids	2	251L	250L	2500L	Placard
2-Propanol						
Acetone						
Hexamethyldisilazane (HMDS)						
PGMEA (Propylene Glycol Monomethyl Ether Acetate)	Flammable Liquids	3	352L	1,000L	10,000L	N/A
Photoresist						
Solvent / Flammable Liquid Waste						
Potassium dicyanoaurate(I)	Acute Toxicity	1	1kg	50kg	500kg	N/A
<p><b>NOTE 1:</b> If the quantity of Cat 2/Cat 3 flammable liquids does not exceed the respective manifest quantity individually, the combined total quantity of Cat 2 and Cat 3 must also be less than 10,000 L.</p> <p><b>NOTE 2:</b> If the quantity of Cat 1A/Cat 1B corrosives does not exceed the respective manifest quantity individually, the combined total quantity of Cat 1A and Cat 1B must also be less than 10,000 L/kg.</p>						

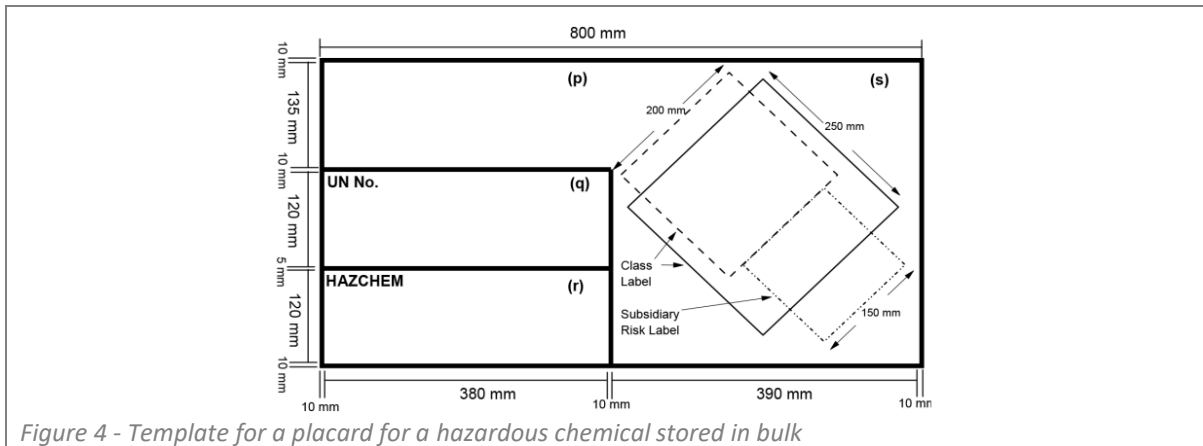
The Placarding requirements of the AMRF2 facility have been assessed based on the maximum capacity of the Dangerous Goods storage on site. On that basis, the following hazard categories require Placarding in accordance with Schedule 13 of the WHS Regulation 2017:

- Flammable gases
- Flammable liquids (Category 2)
- Gases under pressure
- Gases under pressure with acute toxicity, categories 1, 2, 3 or 4
- Oxidising Liquids (Category 2)
- Skin Corrosion (Category 1A and 1B)

The requirements for a Placard site are described in the WHS Regulation 2017, including but not limited to the key provisions summarised in Table 4 below.

Table 4 - Key requirements for Placard sites as per the NSW WHS Regulation 2017

Applicable Storage	Summary of Requirements
Entire Facility	<p>A person conducting a business or undertaking at a Placard site must ensure that outer warning placards are prominently displayed, located at each entrance to the workplace where emergency services may enter.</p> <p>Each outer warning placard is to show the words “HAZCHEM” in red lettering on white or silver background, with dimensions as shown in Figure 2 below.</p>
 <p>Figure 2 - Form and dimensions of outer warning placard</p>	
Chemicals in packages	<p>For Schedule 11 chemicals stored in packages, placards must be displayed indicating the Class of the stored chemicals (shown in Figure 3). For chemicals stored in an indoor area, the placards must be located:</p> <ul style="list-style-type: none"> <li>• at the main point of entry to the building where the goods are stored; and</li> <li>• either at every entry to a room or area where the goods are stored or adjacent to them.</li> </ul>
 <p>Figure 3 – Example form of placard for packaged Schedule 11 hazardous chemicals</p>	
Bulk storage	<p>Information placards (shown in Figure 4) must be provided in proximity to any bulk containers of Schedule 11 chemicals. The placard must contain the following information:</p> <ul style="list-style-type: none"> <li>• the proper shipping name</li> <li>• UN number</li> <li>• HAZCHEM code</li> <li>• ADG Code Class label</li> <li>• subsidiary risk label (if applicable). For more than one subsidiary risk, the width of the area on the right hand side for the subsidiary risk label may be extended.</li> </ul>



At its peak Dangerous Goods usage, the AMRF2 facility will also be classified as a Manifest Quantity Workplace (MQW) based on the quantity of the following chemicals stored on site:

- Gases under pressure (due to bulk cryogenic liquid storage)
- Skin Corrosion (Category 1A)

The additional requirements for a Manifest Quantity Workplace are described in the WHS Regulation 2017, including but not limited to the key provisions summarised in Table 5 below.

Table 5 - Key requirements for Manifest Quantity Workplaces as per the NSW WHS Regulation 2017

Clause	Summary of Requirements
347	<p>A person conducting a business or undertaking at a MQW must:</p> <ul style="list-style-type: none"> <li>• prepare a manifest of Schedule 11 hazardous chemicals</li> <li>• the manifest of Schedule 11 hazardous chemicals must comply with Schedule 12.</li> <li>• the manifest must be kept: <ul style="list-style-type: none"> <li>a. in a place determined in agreement with the primary emergency service organisation (FRNSW) that is readily accessible to emergency services; and</li> <li>b. available for inspection.</li> </ul> </li> </ul>
348	<p>A person conducting a business or undertaking at a MQW must ensure that the regulator (WorkSafe NSW) is given written notice:</p> <ul style="list-style-type: none"> <li>• when the quantity of Schedule 11 hazardous chemicals on the site first exceeds the manifest quantity; and</li> <li>• if there is a significant change in the risk of using, handling or storing of a manifest quantity of Schedule 11 hazardous chemicals.</li> </ul>
361	<p>A person conducting a business or undertaking at a MQW must:</p> <ul style="list-style-type: none"> <li>• develop an emergency plan in accordance with Part 3.2 Division 4 of the WHS Regulation 2017; and</li> <li>• provide a copy of the emergency plan to the primary emergency service organisation (FRNSW); and</li> <li>• revise the plan in accordance with any written recommendations given by emergency services about the content or effectiveness of the emergency plan.</li> </ul>

### 3.2 State Environmental Planning Policy (SEPP)

The State Environmental Planning Policy (Resilience and Hazards) 2021 defines the planning and consent requirements for potentially hazardous industry developments. This policy supersedes State Environmental Planning Policy No 33-Hazardous and Offensive Development (SEPP 33). However, the associated guideline “Applying SEPP 33” is still nominated by the NSW Government for application to the new planning regulations.

“Applying SEPP 33” recommends a screening process for assessing if a land usage that involves Dangerous Goods requires detailed hazard analysis. In this guideline, thresholds are defined based on the proposed quantities of Dangerous Goods and where they are stored in the development relative to site boundaries. If any of these thresholds are exceeded, the development is considered “potentially hazardous” and further assessment is required. A detailed hazard analysis must be documented in the form of a Preliminary Hazard Analysis (PHA) report and submitted to the relevant council authorities to obtain consent for the development.

The AMRF2 facility has been assessed according to the screening methods described in “Applying SEPP 33” and the results are presented in Table 6.

*Table 6 – Screening of Dangerous Goods according to “Applying SEPP 33”*

DG Class	Packing Group	Description	Stored Quantity (kg)	Applying SEPP 33		
				Screening Method	Threshold	Threshold exceeded?
2.1	N/A	Flammable gases	88	Table 1	100 kg	No
2.3	N/A	Anhydrous ammonia, kept in the same manner as for liquefied flammable gases and not kept for sale	23	Table 3	5 tonne	No
2.3	N/A	Chlorine and sulfur dioxide stored as liquefied gas in containers <100 kg	45	Table 3	1 tonne	No
2.3	N/A	Other poisonous gases	92	Table 3	100 kg	No
3	II	Flammable liquids	250	Table 1	5 tonne	No
3	III	Flammable liquids	280	Table 1	5 tonne	No
5.1	II	Oxidising substances	250	Table 3	1 tonne	No
6.1	I	Toxic substances	1	Table 3	500 kg	No
8	II	Corrosive substances	3,012	Table 3	25 tonne	No
8	III	Corrosive substances	2,150	Table 3	50 tonne	No

Based on this assessment, the quantity of Dangerous Goods stored at the AMRF2 facility does not exceed any threshold defined in “Applying SEPP 33”. Therefore, the development is not considered potentially hazardous and will not require a PHA report, subject to confirmation from the relevant planning authorities.

### 3.3 Storage Type Classification

The provisions required for Dangerous Goods storage depends on the Class and quantity of material being stored. The following sections classify the type of chemical stores present at the AMRF2 facility based on the applicable Dangerous Goods storage standards.

#### 3.3.1 Class 2 – Compressed Gases

The requirements for Class 2 Dangerous Goods (compressed gases) are described in AS 4332 - The storage and handling of gases in cylinders. Flammable (Class 2.1), toxic (Class 2.3) and oxidising (Class 2.2 with a Class 5.1 Subsidiary Risk) speciality gases are all used at the AMRF2 facility. The majority of gas cylinders are stored in the Main Gas Store located on Ground Floor of the building.

Table 2.1 of the gases in cylinders standard (AS 4332) defines the criteria for classification of a Class 2 compressed gas store as minor storage. The table below (Table 7) classifies the stores of Class 2 compressed gas at the AMRF2 facility as minor or bulk storage.

Capacity is given in terms of aggregate water capacity as defined in AS 4332 Clause 1.4.34. Assuming that cylinders of this size can be sourced, toxic gases with a projected demand below one cylinder per year (Hydrogen Bromide, Hexafluoro-1,3-Butadiene (C4F6) and Boron Trichloride) shall be stored in a maximum of E-sized cylinders (24L water capacity). All other gases used at the facility are assumed to be stored in G-sized cylinders (50L water capacity).

*Table 7 - Bulk/minor storage classification of Class 2 chemicals as per Table 2.1 of AS 4332*

Storage Location	Substances	DG Class (Subsidiary)	Cylinder Size	No. Cylinders	Total Capacity	Storage Classification	
Main Gas Store	10% Methane in Argon	Class 2.1 – Flammable Gas	G	1	50L	Bulk Storage (Section 4)	
	5% Hydrogen in Argon		G	3	150L		
	Difluoromethane (CH <sub>2</sub> F <sub>2</sub> )		G	1	50L		
	Forming Gas (5% H <sub>2</sub> in N <sub>2</sub> )		G	3	150L		
	Hydrogen		G	3	150L		
	Silane		G	1	50L		
	Argon (UHP)	Class 2.2 – Compressed Gas	G	4	200L		
	Carbon Dioxide		G	2	100L		
	Carbon Tetrafluoride (CF <sub>4</sub> )		G	2	100L		
	Helium		G	4	200L		
	Hexafluoroethane (C <sub>2</sub> F <sub>6</sub> )		G	2	100L		
	Nitrogen (UHP)		G	4	200L		
	Octafluorocyclobutane (C <sub>4</sub> F <sub>8</sub> )		G	2	100L		
	Sulfur Hexafluoride		G	2	100L		
	Trifluoromethane (CHF <sub>3</sub> )		G	2	100L		
	Nitrogen Trifluoride		Class 2.2 (5.1) – Compressed Gas (Oxidising)	G	1		50L
	Nitrous Oxide			G	6		300L
	Oxygen			G	48		2,400L

Storage Location	Substances	DG Class (Subsidiary)	Cylinder Size	No. Cylinders	Total Capacity	Storage Classification
	Ammonia	Class 2.3 – Toxic Gas	G	2	100L	
	Chlorine		G	1	50L	
	Hexafluoro-1,3-Butadiene (C4F6)		E	1	24L	
	Hydrogen Bromide		E	1	24L	
Sub-Fab	Boron Trichloride	Class 2.3 – Toxic Gas	E	1	24L	Minor Storage (Section 2)

### 3.3.2 Class 2 – Cryogenic Liquids

Two vacuum-insulated vessels will be provided at the AMF2 facility for bulk storage of cryogenic liquids:

- 1 off 5,000L vessel of Liquid Argon
- 1 off 25,000L vessel of Liquid Nitrogen

Both vessels will be located in an internal store located on Ground Floor of the building, adjacent to the Main Gas Store. Additional requirements for cryogenic liquids are described in AS 1894 - The storage and handling of non-flammable cryogenic and refrigerated liquids. The relevant capacity range applying to each store of liquid nitrogen (as per Table 5.1 of the refrigerated liquids standard - AS 1894) are presented in Table 8.

*Table 8 - Classification of stores of refrigerated liquids as per Table 5.1 of AS 1894*

Storage Location	Substances	DG Class (Subsidiary)	Storage Type	Capacity <sup>1</sup>	Capacity Range (AS 1894 – Table 5.1)
Cryogenic Vessel Store	Liquid Argon	Class 2.2 – Compressed gas	Tank	5,000L	<30,000 L
	Liquid Nitrogen		Tank	25,000L	
<b>NOTE 1:</b> Capacity is given in terms of aggregate water capacity as defined in AS 1894 Table 5.1.					

### 3.3.3 Class 3 – Flammable Liquids

The requirements for Class 3 Dangerous Goods (flammable liquids) are described in AS 1940 - The storage and handling of flammable and combustible liquids. Bulk quantities of solvent and other Class 3 flammable liquids will be stored in a dedicated Flammable Liquids Store located on Ground Floor of the building. This includes any quantities of solvent waste collected from the facility.

Diesel will also be stored on site to fuel back-up power generators for the facility, installed in the plant space on the facility roof. A 3,000L bulk diesel storage tank will be provided in the basement of the North building which will supply three 1,000L day tanks located in proximity to the generators on the roof. Diesel is classified as a Class 9 Environmentally Hazardous substance, but must be stored in accordance with the requirements of AS 1940 for Class C1 combustible liquids.

Table 2.1 of the flammable liquids standard (AS 1940) defines the criteria for classification of a Class 3 flammable liquids store as minor storage. The table below (Table 9) classifies the stores of Class 3 flammable liquids at the AMRF2 facility as minor or bulk package storage.

*Table 9 - Bulk/minor storage classification of Class 3 chemicals as per Table 2.1 of AS 1940*

Storage Description		Storage classification (AS 1940 – Table 2.1)	Substances	Packing Group
Location	Total Capacity			
Flammable Store – Bunded Area	500 L	Internal package store (Section 4)	2-Propanol	II
			Acetone	
			Hexamethyldisilazane (HMDS)	
Flammable Store - Cabinet	250 L	Storage in storage cabinets (Section 4.9)	Solvent / Flammable Liquid Waste	III
			PGMEA (Propylene Glycol Monomethyl Ether Acetate)	
			Photoresist	
Basement Fuel Store	3,000 L	Storage in tanks (Section 5)	Diesel	III
Roof Generator Day Tanks	3,000 L			

### 3.3.4 Class 5.1 – Oxidising Substances

The requirements for Class 5.1 Dangerous Goods are described in AS 4326 - The storage and handling of oxidizing agents. Clause 2.2 of AS 4326 defines the criteria for classification of a Class 5.1 oxidising substances store as minor storage. The only Class 5.1 oxidising substance proposed for storage at AMRF2 is Hydrogen Peroxide, which will be stored in a storage cabinet in the chemical dispense area of the main chemical store.

The table below (Table 10) classifies the stores of Class 5.1 oxidising substances at the AMRF2 facility as minor or bulk package storage.

*Table 10 - Bulk/minor storage classification of Class 5.1 chemicals as per Clause 2.2 of AS 4326*

Storage Description		Storage classification (AS 4326 – Clause 2.2)	Substances	Packing Group
Location	Total Capacity			
Chemical Dispense Room	250 L	Minor storage, storage in cabinets (Section 4.8)	Hydrogen peroxide (30%)	II

### 3.3.5 Class 6.1 – Toxic Substances

The requirements for Class 6.1 Dangerous Goods are described in AS 4452 - The storage and handling of toxic substances. Clause 3.2 of AS 4452 defines the criteria for classification of a Class 6.1 toxic substances store as minor storage. The only Class 6.1 toxic substance proposed for storage at AMRF2 is Potassium Dicyanoaurate(I), which will be stored in a storage cabinet in the chemical dispense area of the main chemical store.

The table below (Table 11) classifies the stores of Class 6.1 toxic substances at the AMRF2 facility as minor or bulk package storage.

*Table 11 - Bulk/minor storage classification of Class 6.1 chemicals as per Clause 3.2 of AS 4452*

Storage Description		Storage classification (AS 4452 – Clause 3.2)	Substances	Packing Group
Location	Total Capacity			
Chemical Dispense Room	15 L	Minor storage, storage in cabinets (Section 6.4.2)	Potassium dicyanoaurate(I)	I

### 3.3.6 Class 8 – Corrosive Substances

The requirements for Class 8 corrosive substances are described in AS 3780 - The storage and handling of corrosive substances. Bulk quantities of Class 8 corrosive substances are stored in two dedicated stores on Ground Floor of the building allocated for segregated storage of acids and caustics. The facility will also produce a large volume of hazardous waste that meets the requirements for classification as a Class 8 corrosive substance:

- The alkaline waste will be collected and stored in the hazardous waste store on Ground Floor.
- The acid waste will be treated in a Neutralisation Plant in the facility Basement using caustic and acidic chemicals dosed from the hazardous waste store.

Clause 2.2 of the corrosive substances standard (AS 3780) defines the criteria for classification of a Class 8 corrosive substance store as minor storage. Table 12 classifies the quantities of Class 8 corrosive substances at the AMRF2 facility as minor or bulk storage.

*Table 12 - Bulk/minor storage classification of Class 8 chemicals as per Table 2.2 of AS 3780*

Storage Description		Storage classification (AS 3780 Clause)	Substances	Packing Group
Location	Total Capacity			
Acid Store	710 L	Package store (Section 4)	Methanesulfonic Acid	II
			Nitric Acid	
			Sulfuric Acid (>51%)	
			Hydrochloric Acid (>51%)	
			Buffered oxide etchant (4:1)	
			Hydrofluoric Acid (<60%)	III
Caustic Store	302 L	Package store (Section 4)	Phosphoric Acid (25-85%)	II
			Ammonium Hydroxide (30-50%)	
			EKC265 post-etch residue remover	
			Potassium Hydroxide	
Hazardous Waste Store	4 off 1,000 L IBC	Storage in tanks (Section 6)	Sodium Hydroxide	II
			Tetramethylammonium hydroxide pentahydrate (TMAH)	
			Alkaline Waste	III

Storage Description		Storage classification (AS 3780 Clause)	Substances	Packing Group
Location	Total Capacity			
Acid Waste Neutralisation Plant	3 off 3000 L tanks 1 off 1,000 L IBC	Storage in tanks (Section 6)	Acid Waste	III

### 3.3.7 Class 9 – Environmentally Hazardous Substances

The requirements for Class 9 Dangerous Goods are described in AS 4681 - The storage and handling of Class 9 (miscellaneous) Dangerous Goods and articles. Clause 2.2 of AS 4681 defines the criteria for classification of a Class 9 store as minor storage.

The only Class 9 substances proposed for storage at AMRF2 are Nickel (II) and Copper (II) Sulphate, which are both classified as Environmentally Hazardous substances. Class 9 substances will be stored in a storage cabinet in the chemical dispense area of the main chemical store. All waste generated containing these compounds will be collected and stored in a 1,000 L IBC in the hazardous waste store on Ground Floor until disposal.

The table below (Table 10) classifies the stores of Class 9 substances at the AMRF2 facility as minor or bulk package storage.

*Table 13 - Bulk/minor storage classification of Class 9 chemicals as per Clause 2.2 of AS 4681*

Storage Description		Storage classification (AS 4452 – Clause 3.2)	Substances	Packing Group
Location	Total Capacity			
Chemical Dispense Room	30 L	Minor storage (Section 2)	Copper(II) Sulfate	III
			Nickel(II) Sulfate	
Hazardous Waste Store	1,000 L	Storage in tanks (Section 4.5)	Metallic Waste	III

## 4.0 Proposed Dangerous Goods Storage

### 4.1 General

The primary stores of Dangerous Goods at the AMRF2 facility will be located on Basement 1 and the Ground Floor. Layouts of these levels indicating the locations of the Dangerous Goods stores are presented in Figure 5 (Basement 1) and Figure 6 (Ground Floor). Each DG store is assigned a tag, which corresponds to the description given in Table 14. A site plan is also provided in Appendix B – Site Plan.

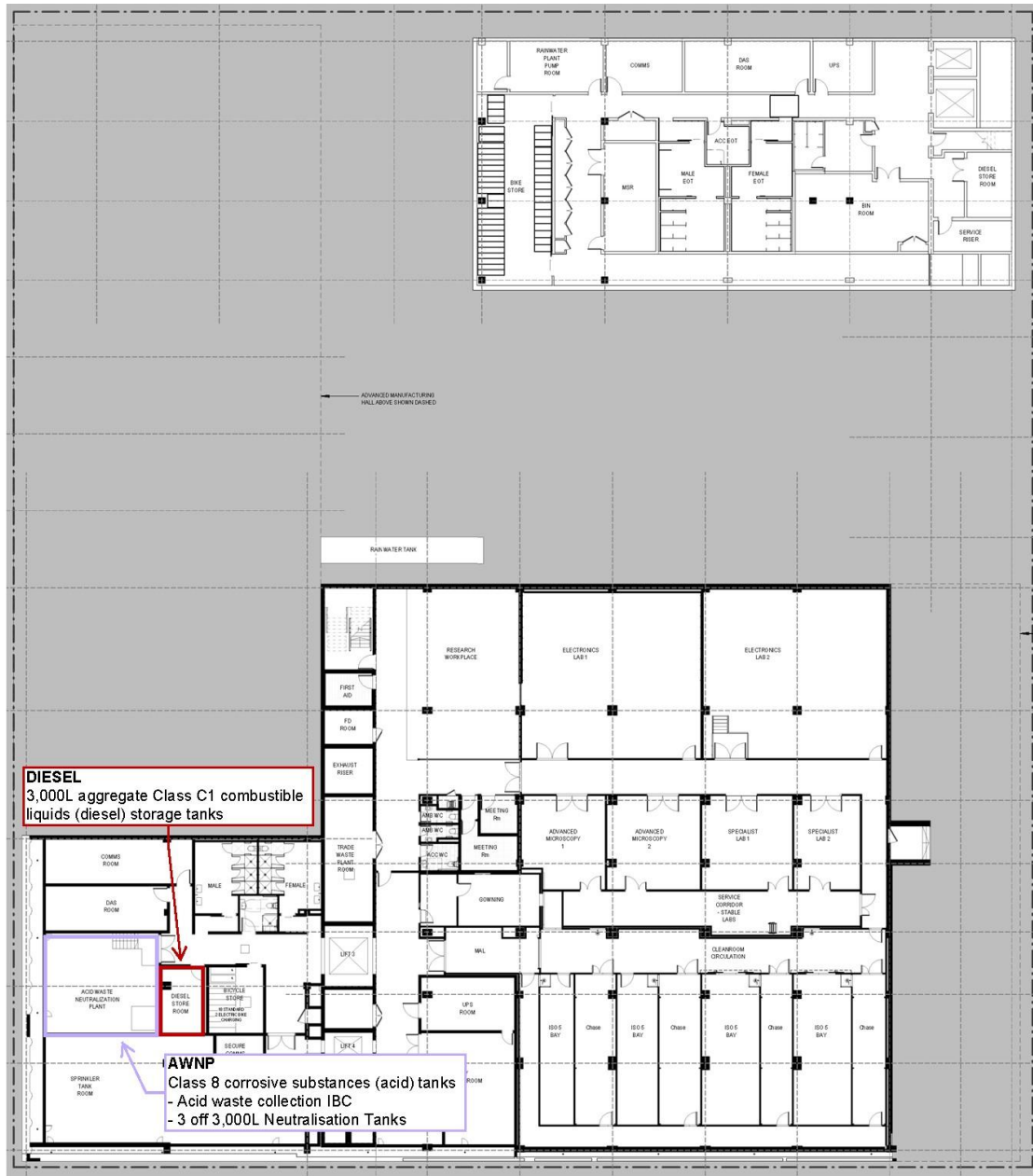


Figure 5 - Locations of Dangerous Goods stores at the AMRF2 Facility, Basement

	Class C1 Combustible Liquids Storage
	Class 8 Corrosives Storage - Acid

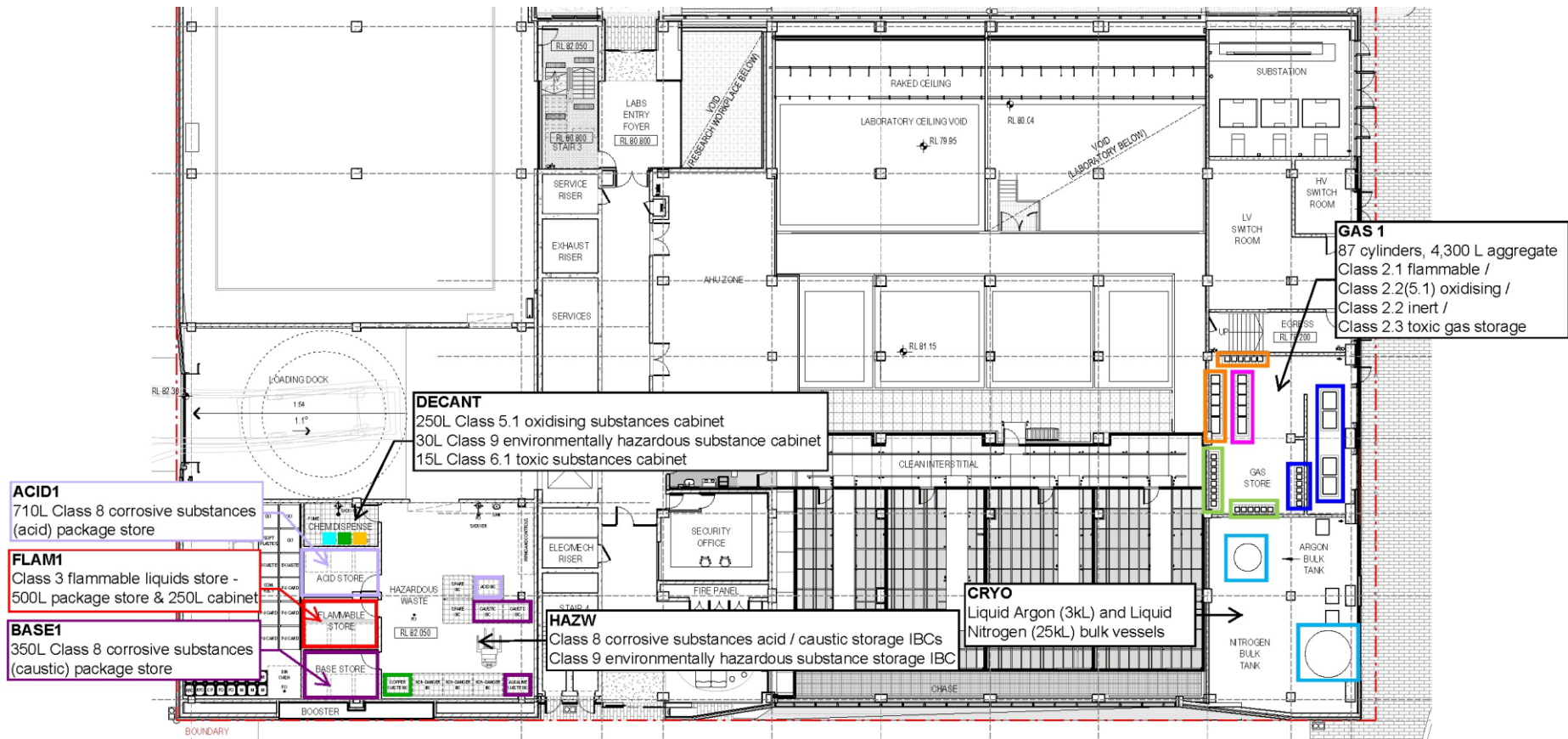


Figure 6 – Locations of Dangerous Goods stores at the AMRF2 Facility, Ground Floor

<span style="color: red;">■</span> Class 3 Flammable Liquids Cabinet / Storage	<span style="color: green;">■</span> Class 2.2 Inert Gas Storage	<span style="color: purple;">■</span> Class 8 Corrosives Storage - Caustic
<span style="color: orange;">■</span> Class 2.1 Flammable Gas Storage	<span style="color: blue;">■</span> Class 2.2(5.1) Oxidising Gas Storage	<span style="color: lightblue;">■</span> Class 8 Corrosives Storage - Acid
<span style="color: yellow;">■</span> Class 5.1 Oxidising Substances Storage	<span style="color: cyan;">■</span> Class 2.2 Inert Cryogenic Liquid Storage	<span style="color: magenta;">■</span> Class 2.3 Toxic Gas Storage
<span style="color: lightgreen;">■</span> Class 9 Environmentally Hazardous Substances Storage	<span style="color: lightcyan;">■</span> Class 6.1 Toxic Substances Storage	

Table 14 - Register of Dangerous Goods stores

Location	Tag	Description	Type	Design standard	Aggregate Capacity (L/kg)	
Basement	AWNPN	Acid waste collection IBC	Class 8 acid storage tank	AS 3780 Clause 6	1,000 L	
		Neutralisation tanks	Class 8 acid storage tank	AS 3780 Clause 6	9,000 L	
	DIESEL	Bulk diesel storage tank	Class C1 combustible liquid storage tank	AS 1940 Clause 5	3,000 L	
Ground Floor	FLAM1	Main flammable liquids store	Class 3 flammable liquids package store	AS 1940 Clause 4	500 L	
			Class 3 flammable liquids storage cabinet	AS 1940 Clause 4	250 L	
	ACID1	Main acid store	Class 8 acid package store	AS 3780 Clause 5	710 L	
	BASE1	Main caustic store	Class 8 caustic package store	AS 3780 Clause 5	352 L	
	DECANT	Oxidising liquids cabinet	Oxidising liquids cabinet	Class 5.1 oxidising liquid storage cabinet	AS 4326 Clause 2	250 L
			Toxic substances cabinet	Class 6.1 toxic substances storage cabinet	AS 4452 Clause 2	15 L
			Environmentally hazardous substances cabinet	Class 9 storage cabinet	AS 4681 Clause 2	30 L
	CRYO	Liquid Argon bulk vessel	Liquid Argon bulk vessel	Liquid Argon bulk vessel	AS 1984 Clause 4	5,000 L
			Liquid Nitrogen bulk vessel	Liquid Nitrogen bulk vessel	AS 1984 Clause 4	25,000 L
	GAS1	Main gas store	Class 2.1 flammable / Class 2.2(5.1) oxidising / Class 2.2 inert / Class 2.3 toxic gas storage	AS 4332 Clause 4	87 cylinders - 4,298 L	
	HAZW	Hazardous waste store IBCs	Class 8 acid storage tank	AS 3780 Clause 6	1,000 L	
Class 8 caustic storage tanks			AS 3780 Clause 6	3,000 L		
Class 9 environmentally hazardous substances tank			AS 4681 Clause 4	1,000 L		
Level 1 – Sub-Fab	GC1	Boron Trichloride gas cabinet	Class 2.3 toxic gas minor storage	AS 4332 Clause 2	1 cylinder (24 L)	
Level 4 –Roof	DSLDAY	Diesel day tanks	Class C1 combustible liquid storage tanks	AS 1940 Clause 5	3,000 L	



#### 4.2.1.1 Location and Separation

In accordance with Clause 4.3.3 of AS 1940, the flammable liquids store must be located on Ground Floor of the facility (the floor directly accessible from street level). The following separation distances must be maintained from the package store:

- Because the store is located within the facility building (considered an on-site protected place), a separation distance between the store and on-site protected places cannot validly be applied. Separation from the building must be achieved by passive fire protection (see Section 4.2.1.2 below).
- Any vent outlet from the package store must be separated from public places or off-site protected places (occupied buildings) by at least 3.0 m.

#### 4.2.1.2 Construction

The flammable liquids store shall be separated from the remainder of the building by fire walls with a FRL of at least 240/240/240. The construction of the fire walls must comply with the following requirements of Clause 4.4.2 of the flammable liquids storage standard (AS 1940):

- The fire wall shall be impervious to vapour apart from around fire doors or other protected openings.
- The floor of the store shall be of reinforced concrete having an FRL of at least 180/180/180/
- Any occupancy or usage above a flammable liquids store shall be separated by a barrier having an FRL of at least 180/180/180.
- The height of the fire wall shall be sufficient to shield a protected place from heat radiation and flame impingement in the event that a potential storage fire occurs.
- The entry door must be a fire door achieving a FRL of at least -/120/30.

#### 4.2.1.3 Spillage Containment

A bunded compound shall be constructed for the storage of carboys and other large packages in the flammable liquids store. The materials of construction selected for the bund and internal lining of the compound shall be chemically resistant and fire resistant as far as necessary to retain spillage. Suitable materials include:

- Buried HDPE
- Geosynthetic clay liners
- Concrete

The capacity of this bund has been defined based on an assumed maximum flammable liquids storage capacity of 500 L and the following requirements of Clause 4.4.3 of AS 1940:

- The capacity of the bund shall be at least 100% of the volume of the largest package plus 25% of the storage capacity up to 10,000 L.
- Because the store is sprinklered, the compound capacity shall be increased by a volume equal to the output of the system over 20 minutes.

According to the Fire Services Specification prepared for AMRF2 by ARUP (Reference: AMRF2-ARU-SPE-FI-0001, dated 27/09/2024), the building will be protected by an Ordinary Hazard 2 (OH2) sprinkler system. According to the automatic sprinkler system design standard AS 2118.1, an OH2 system must achieve the following coverage/performance:

- Clause 10.2.1: Ordinary Hazard systems shall be hydraulically designed to provide a flow of at least 60 L/min from each sprinkler.
- Clause 10.4.2: The maximum area covered by one sprinkler shall not exceed 12 m<sup>2</sup>.

Based on the floor area of the flammable liquids store (<12 m<sup>2</sup>), the spillage containment compound has been sized to retain 20 minutes of flow from a single OH sprinkler head. The required capacity of the bund must be verified following detailed design of the fire services in the store. The overall bund capacity resulting from these requirements is summarised in Table 15 below.

*Table 15 - Bund capacity of flammable liquids store*

Description	Basis of Design	Bund Capacity
The capacity of the bund shall be at least 100% of the volume of the largest package plus 25% of the storage capacity up to 10,000 L.	Maximum package size of 25 L Maximum storage capacity of 500 L	150 L
Because the store is sprinklered, the compound capacity shall be increased by a volume equal to the output of the system over 20 minutes.	60 L/min water flow from 1 OH2 sprinkler head	1,200 L
<b>Total</b>		1,350 L

Generally, a maximum vertical break (change in elevation) of 230 mm is permitted by the Building Code of Australia without providing stairs or a ramp. On the basis that a ramp will not be provided, the bund height shall not exceed 230 mm. To achieve the required bund capacity of 1,350 L with a bund height of 230 mm, the spillage containment compound must have a floor area of at least 5.9 m<sup>2</sup>.

#### 4.2.1.4 Ventilation and Ignition Control

Mechanical ventilation must be provided to the store in accordance with Clause 4.5 of the flammable liquids storage standard (AS 1940). The system must adhere to the following design criteria:

- Termination points within the store for fresh air supply and draw-off ducts must be immediately above the top of the bund and on opposite walls. Vapours from flammable liquids are heavier than air, so exhaust should scavenge vapours from the lower parts of the store.
- The distance between any two inlets or any two outlets shall not exceed 5 m.

- The system shall be capable of exhausting 5.0 m<sup>3</sup>/min and the air velocity at the air supply outlet shall exceed 300 m/min.
- Monitoring must be provided to indicate when exhaust ventilation is lost from the store.
- Fans used as part of the exhaust system shall be suitable for hazardous areas.
- Any vent opening inside the store shall be provided with barriers in both the inside and outside of the wall where necessary so that it cannot be blocked.
- Any intake or exhaust duct shall terminate in open air at least 2 m from any opening into a building, or 4 m from the outlet of any chimney or flue and 3 m above the ground. The external termination of any inlet duct shall be at least 5 m from the external termination of any exhaust duct.
- Any duct that passes through a building other than the storage area shall be constructed of or protected by material having an FRL of at least -/180/180.

A hazardous area assessment must be undertaken as per AS 60079.10.1 to determine the control of ignition sources that is required within the store. A preliminary assessment has been undertaken according to Appendix C of Supplement 1 to AS 60079.10.1, which describes example classifications for package storage of flammable liquids. Based on the descriptions in Clause C.4.2 for stores of large containers, the assessment is summarised in Table 16.

*Table 16 - Class 3 flammable liquids store, ignition control zones*

Clause	Description	Classification	Requirements
Supplement 1 to AS 60079.10.1 C.4.3 c) iii)	Where packages of volumes greater than minor storage defined by AS 1940 remain closed: <ul style="list-style-type: none"> <li>• within space from ground level to 1 m above the top of any package and;</li> <li>• 1 m laterally and;</li> <li>• From ground level to 1 m above ground and;</li> <li>• 3 m laterally from the bunded area.</li> </ul>	Zone 2 Hazardous Area	Electrical installations in this area must comply with AS 60079.14 for a Zone 2 Hazardous Area

These requirements are illustrated in Figure 8 below. Any electrical install in the indicated area must comply with AS 60079.14 for a Zone 2 Hazardous Area.

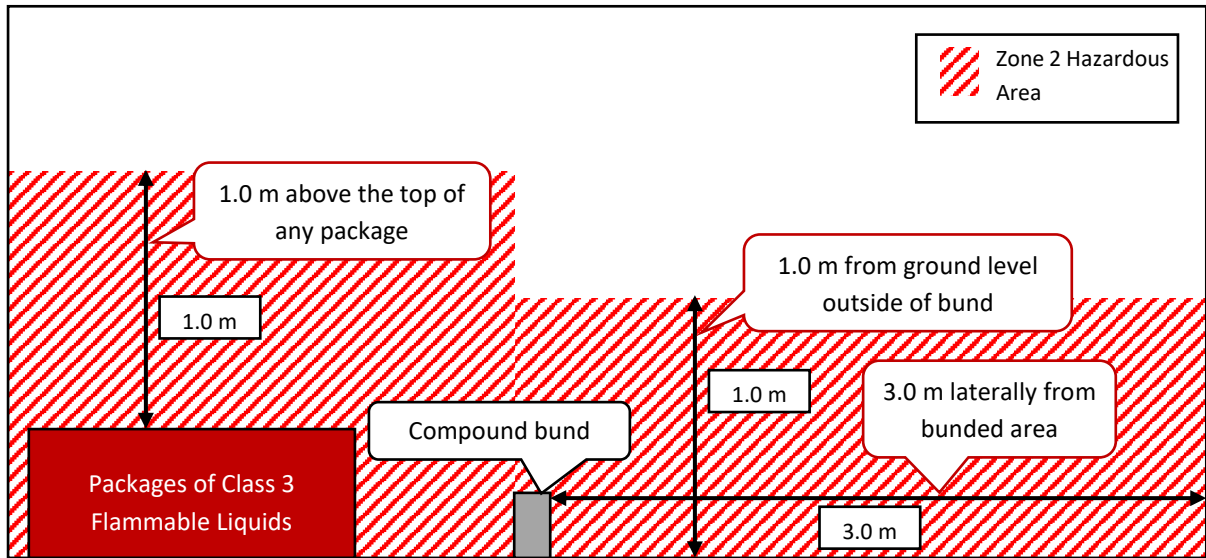


Figure 8 – Ignition control zones, flammable liquids store

4.2.1.5 Storage Cabinet

A 250 L Class 3 flammable liquids Dangerous Goods storage cabinet will be provided in the flammable liquids store for storage of small packages. The cabinet must comply with the requirements of Clause 4.9 of AS 1940 (Storage in storage cabinets). An example of a compliant Class 3 flammable liquids indoor storage cabinet is shown in Figure 9.



Figure 9 - Class 3 flammable liquids indoor storage cabinet in accordance with Clause 4.9 of AS 1940

To comply with Clause 4.9.6 of the flammable liquids standard (AS 1940), any additional flammable liquids cabinets installed on Ground Floor must adhere to the following:

1. The aggregate capacity of cabinets shall not be greater than 850 L per 250 m<sup>2</sup> of floor area.
2. Each aggregate quantity (850 L) shall be separated by at least 10 m.

4.2.1.6 Fire Protection

The fire protection requirements for package stores are given in Table 11.3 of the flammable liquids storage standard (AS 1940) based on the aggregate volume capacity of the store. For a roofed store with a stored volume less than 2.0 m<sup>3</sup> the following fire protection measures are required:

- One powder-type extinguisher
- One foam-type extinguisher

Portable fire extinguishers should be selected according to the guidelines in AS 2444 – Portable fire extinguishers and fire blankets — Selection and location, based on the class of fuel involved (Figure 10).

Type of extinguisher		Type of Fire, Class and Suitability						Comments (Refer Appendix B)
Colour scheme AS/NZS1841-1997 AS1941-1992	Extinguishant	A Wood, paper, plastics, etc	B Flammable liquids	C Flammable gases	E Energized electrical equipment	F Cooking oils and fats	D** Metal fires	
	Water							Dangerous if used on flammable liquid, energized electrical equipment and cooking oil/fat fires
	Wet Chemical							Dangerous if used on energized electrical equipment
	Foam***							Dangerous if used on energized electrical equipment.
	Powder	ABE						Special powders are available specifically for various types of metal fires (see **).
		BE						
	Carbon Dioxide							Generally not suitable for outdoor use. Suitable only for small fires.
	Vaporizing Liquid							Check the characteristics of the specific extinguishant.
	Fire Blanket							

\* Limited indicates that the extinguishant is not the agent of choice for the class of fire, but that it will have a limited extinguishing capability.  
 \*\* Class D fires (involving combustible metals). Use only special purpose extinguishers and seek expert advice.  
 \*\*\* Solvents which may mix with water, e.g. alcohol and acetone, are known as polar solvents and require special foam. These solvents break down conventional AFFF.

Australian Standard 2444-2001

Figure 10 - Extinguisher selection guide from AS 2444

4.2.2 Class 8 – Corrosive Substances, Acid and Caustic Stores

Both the acid and caustic stores must be designed in accordance with Section 5 of the corrosive substances standard (AS 3780), which describes the requirements for package stores.

4.2.2.1 Location, Separation and Segregation

As specified by Clause 5.4 of the corrosive substances standard (AS 3780), the acid and caustic stores must be located on Ground Floor of the facility (the floor directly accessible from street level). The

separation distances from protected places that apply to the stores are defined in Clause 5.3.2 of AS 3780. Assuming that packages remain closed within the stores, the following separation distances must be maintained:

- 3.0 m from any protected places (on-site / off-site / public places), including other stores of Dangerous Goods in quantities exceeding the threshold for minor storage.

The corrosive substances standard (AS 3780) defines additional requirements for segregation of corrosive substances that are incompatible or may react dangerously. Based on the definition in AS 3780 the chemical incompatibilities that have been considered are as follow:

- Acids may react dangerously with caustics
- Acids may react dangerously with flammable liquids
- Caustics may react dangerously with flammable liquids

Appropriate management of incoming chemicals is required to ensure that Class 8 corrosive substances are allocated to the correct store (acid / caustic). The proposed inventory of each of the stores is summarised in Table 17 below.

*Table 17 - Chemical inventory - acid and caustic stores*

Storage Location	Chemical Inventory
Caustic Store	Ammonium Hydroxide (30-50%)
	EKC265 post-etch residue remover
	Potassium Hydroxide
	Sodium Hydroxide
	Tetramethylammonium hydroxide pentahydrate (TMAH)
Acid Store	Buffered oxide etchant (4:1)
	Hydrochloric Acid (>51%)
	Hydrofluoric Acid (<60%)
	Methanesulfonic Acid
	Nitric Acid (<65%)
	Phosphoric Acid (25-85%)
	Sulfuric Acid (>51%)

The segregation of these chemicals must be as per Clauses 5.3.3 and 7.3.3 of AS 3780, which state that substances that may react dangerously must:

1. Be segregated by a distance of not less than 5 m; AND
2. Not be kept with the same compound, or in compounds that share a common drainage system; AND
3. Containers of corrosive solids must not be kept inside compounds provided for liquids.

#### 4.2.2.2 Construction

Clause 5.3.2 of the corrosive substances standard (AS 3780) states that segregation and separation distances may be measured laterally around an intervening screen wall if the wall:

1. Extends at least 1 m above the highest item in the store;
2. Is marked to indicate the maximum permissible storage height; and
3. Has a FRL (fire resistance level) of at least 120/120/120

To achieve the required separation and segregation distances described in Section 4.2.2.1, the walls and ceiling of the acid and caustic stores must have a FRL of 120/120/120. Fire-rating should extend to the full height of the walls.

All materials of construction used in the stores shall have a corrosion resistance appropriate to the type of chemicals being stored. Typically, this is achieved through chemically resistant coatings that can be applied to concrete to form an impermeable barrier.

#### 4.2.2.3 Spillage Containment

Space allowance has been made in each Class 8 corrosive substances store (acid and caustic) for a maximum of three full (4-Drum) bunded spill pallets for storage of large containers (20-60L). The pallets must adhere to the following requirements:

- The sump capacity of each pallet must be at least 25% of the aggregate volume of the liquids stored.
- The pallet must be entirely fabricated from corrosion resistant materials appropriate to the type of materials stored.
- Pallets must be permanently affixed to the ground to prevent them from being moved to an unsuitable location.

Spill containment pallets generally have a storage area of around 1.7 m<sup>2</sup> (1.3 m x 1.3 m) and are available with a range of sump capacities. For example, a 1.7 m<sup>2</sup> bunded pallet with a sump capacity of 250L may be used for storage of up to 1,000L of Class 8 corrosive substances.

Within the broad categories of acidic / caustic Class 8 corrosive substances, specific chemicals may also have additional incompatibilities that should be considered in the bunding arrangement for the stores. Clauses 5.3.3 and 7.3.3 of the corrosive substances standard (AS 3780) define the requirements for segregation of incompatible corrosive substances. Based on the definition in AS 3780 the chemical incompatibilities that have been considered are as follow:

- Organic acids / bases are incompatible with inorganic acids / bases
- Nitric Acid and Sulfuric Acid are both oxidising acids and therefore, should be segregated from all non-oxidising chemicals

- Solid corrosive substances should not be kept in the same spillage containment as liquids

Based on these incompatibilities, the proposed bunding arrangements are summarised in Table 18 for the acid store and Table 19 for the caustic store.

*Table 18 - Spill pallet allocation, acid store*

Spill Pallet	Pallet Size	Category	Chemicals
1	1-Drum (1/4) pallet	Organic Acids	Methanesulfonic acid
2	1-Drum (1/4) pallet	Oxidising Acids	Nitric Acid
3	Half pallet	Toxic Acids	Buffered oxide etchant (4:1) Hydrofluoric Acid (<60%)
4	Full pallet	Oxidising Acids	Sulfuric Acid (>51%)
5	Full pallet	Inorganic Acids	Phosphoric Acid (25-85%) Hydrochloric Acid (>51%)

*Table 19 - Spill pallet allocation, caustic store*

Spill Pallet	Pallet Size	Category	Chemicals
1	Full pallet	Organic Bases	Tetramethylammonium hydroxide pentahydrate EKC265 post-etch residue remover
2	Full pallet	Inorganic Bases (solid)	Sodium Hydroxide
3	Full pallet	Inorganic Bases	Potassium Hydroxide

#### 4.2.2.4 Ventilation

In accordance with Clause 5.4 of the corrosive substances standard (AS 3780), ventilation must be provided to maintain exposure levels in the storage area below recommended workplace exposure standards. These exposure standards for airborne contaminants are defined based on the Workplace Exposure Limits published by Safe Work Australia. In the Safe Work guidelines, exposure limits are given in terms of three concentration levels:

1. TWA (Time Weighted Average) = Concentration of an airborne contaminant for a conventional 8-hour workday and a 40-hour work week to which all workers may be exposed repeatedly without adverse effect.
2. STEL (Short Term Exposure Limit) = A 15-minute TWA exposure that should not be exceeded at any time during a workday.
3. Peak Limit = The maximum concentration of an airborne contaminant measured over the shortest time possible (less than 15-minutes). Exposure above this concentration can cause immediate and severe health effects and is not allowed at any time.

Based on a review of the chemical inventory of the caustic and acid stores, the chemicals that are subject to exposure limits are listed in Table 20. The ventilation system in the acid and caustic stores should be designed to prevent the airborne concentration of any of these chemicals from exceeding these limits both during normal operation (packages closed) and in the event of a spill within a bunded compound.

Table 20 – Acid and caustic stores – chemicals subject to Workplace Exposure Limits

Storage Location	Substance	Exposure Limits (mg/m <sup>3</sup> ) [1]		
		TWA	STEL	Peak Limit
Acid Store	Buffered oxide etchant (4:1)	0.4	Not specified.	1.6
	Hydrochloric Acid (>51%)	Not specified.	Not specified.	2.98
	Hydrofluoric Acid (<60%)	0.4	Not specified.	1.6
	Nitric Acid (<65%)	5.2	Not specified.	Not specified.
	Phosphoric Acid (25-85%)	1	3	Not specified.
	Sulfuric Acid (>51%)	0.1	Not specified.	Not specified.
Caustic Store	Ammonium Hydroxide (30-50%)	14	24	Not specified.
	Potassium Hydroxide	Not specified.	Not specified.	2
	Sodium Hydroxide	Not specified.	Not specified.	2

[1] Safe Work Australia, Workplace exposure limits for airborne contaminants, July 2025.

### 4.2.3 Chemical Dispense Room

No chemicals may be stored permanently in the chemical dispense room outside of the Dangerous Goods cabinets provided for specific classes. However, the area will be used for decanting and product transfer of multiple classes of Dangerous Goods. Therefore, the room has been designed with reference to the handling guidance provided in the relevant standards for all of the Dangerous Goods that may be used. This includes:

- Class 3 (flammable liquids)
- Class 8 (corrosive substances)
- Class 5.1 (oxidising substances)
- Class 6.1 (toxic substances)
- Class 9 (environmentally hazardous substances)

#### 4.2.3.1 General Requirements

Because packages of Dangerous Goods will be opened in the room, the following must be provided within 7 m:

- A safety shower conforming to AS 4775.
- Eye-wash facilities conforming to AS 4775.
- Water for washing of the hands.

#### 4.2.3.2 Construction

The floor of the dispensing area must be sealed and prevented from draining to town water. Floor coverings should be chemically resistant and compatible with the chemicals used in the room, particularly the Class 8 corrosive substances (strong acids / bases) and Class 5.1 oxidising liquids.

#### 4.2.3.3 Ventilation

A fume cupboard complying with AS 2243.8 is provided in the chemical dispense room. All decanting and solution preparation involving Dangerous Goods / Hazardous Chemicals must be undertaken in this fume cupboard. Adequate positive pressure conditioning or filtered make-up air must be provided to the room to prevent negative pressurisation due to the exhaust from the fume cupboard.

#### 4.2.3.4 Storage Cabinets

Three Dangerous Goods cabinets are provided in the chemical dispense room for storage of small quantities of chemicals:

- 250L Class 5.1 Oxidising Substances Cabinet
- 15L Class 6.1 Toxic Substances Cabinet
- 30L Class 9 Environmentally Hazardous Substances Cabinet

The specific requirements applying to each of these cabinets are described in Table 21 below.

*Table 21 - Requirements applying to Class 5.1, 6.1 and 9 indoor storage cabinets*

DG Class	Storage Standard	Requirements
Class 5.1 – Oxidising Substances	AS 4326	<ol style="list-style-type: none"> <li>1. A maximum of 250 kg/L of oxidising agents may be kept in a single indoor storage cabinet.</li> <li>2. No more than one cabinet shall be installed in each 100 m<sup>2</sup> of building area.</li> <li>3. The separation distance between any two cabinets shall not be less than 3 m.</li> <li>4. Cabinets designated for the storage of oxidising substances shall not be used for the storage of any other classes of Dangerous Goods.</li> </ol>
Class 6.1 – Toxic Substances	AS 4452	<ol style="list-style-type: none"> <li>1. A maximum of 50 kg/L of toxic substances of PG II may be kept in a single indoor storage cabinet.</li> <li>2. No more than one cabinet shall be installed in each 100 m<sup>2</sup> of building area.</li> <li>3. The separation distance between any two cabinets shall not be less than 3 m.</li> <li>4. Cabinets designated for the storage of toxic substances shall not be used for the storage of any other classes of Dangerous Goods.</li> <li>5. Cabinet shall be provided with a self-closing, close-fitting door that is lockable.</li> </ol>
Class 9.1 – Environmentally Hazardous Substances	AS 4681	<ol style="list-style-type: none"> <li>1. A maximum of one minor storage (1,000 kg/L) of Class 9 Dangerous Goods is permitted in each 500 m<sup>2</sup> of building area.</li> <li>2. The method of storage and types of containers used shall be selected to avoid leakage or spillage.</li> </ol>

#### 4.2.3.5 Fire Protection

Oxidising agents may enhance combustion when in contact with other materials, particularly organic chemicals such as Class 3 flammable liquids. Fire protection requirements for stores of oxidising

substances are given in Clause 12.7 of the oxidising substances storage standard (AS 4326). For indoor storage cabinets:

- At least one stored pressure water-type portable extinguisher having a rating of not less than 2A and a capacity of not less than 9 L must be provided.
- The extinguisher must be located within 3-10 m of the Class 5.1 oxidising substances storage cabinet.

### 4.3 Main Gas Store

A diverse range of gases are required for the semiconductor foundry tools proposed for installation in the AMRF2 Cleanrooms. This includes the following sub-classes of gases:

- Class 2.1 flammable gases
- Class 2.2 inert compressed gases
- Class 2.2 with a Class 5.1 subsidiary risk oxidising gases
- Class 2.3 toxic gases

Most of these gases will be stored and reticulated from a central gas store located on the Ground Floor of the facility. The overall anticipated inventory of the store is given in Table 23 on the following page, including the total quantity of each Division (Class 2.1, Class 2.2, Class 2.2(5.1), Class 2.3) permitted in the store.

The most significant quantity of compressed gas in this store is Oxygen, which will be supplied to the facility from an auto-changeover manifold connected to four manpacks (12 cylinders per pack). The main gas store must be designed in accordance with the requirements of the gas cylinder storage standard (AS 4332) with additional consideration of international standards developed for the semiconductor industry to inform the storage provisions for highly flammable and toxic specialty gases.

The Toxic Gas Ordinance (TGO) published by Santa Clara County in the United States Silicon Valley summarises the installation guidelines for hazardous toxic gases typically used in semiconductor processes. To inform the storage provisions required, the Class 2.3 toxic gases that will be used at AMRF2 have been classified according to the class rating system established by the TGO and the results are summarised in Table 22 below.

*Table 22 – Toxicity ranking of Class 2.3 toxic gases in main gas store according to Toxic Gas Ordinance (TGO)*

DG Class	Subsidiary Risk	Gas	TGO Toxicity Category	Description
2.3 – Toxic gases	8 – Corrosive substances	Ammonia	Not rated.	Median LC <sub>50</sub> concentration greater than 5,000 ppm
	8 – Corrosive substances	Hydrogen Bromide	II – Toxic Gas	Median LC <sub>50</sub> concentration between 200 – 2,000 ppm
	8 – Corrosive substances 5.1 – Oxidising gases	Chlorine		
	2.1 – Flammable gases	Hexafluoro-1,3-Butadiene (C <sub>4</sub> F <sub>6</sub> )		

Table 23 – Storage inventory, main gas store

DG Class	Gas	Cylinder Size	Reticulation Capacity	Storage Capacity	Total (L)
Class 2.1 - Flammable	10% Methane in Argon	G	1 x cylinder manifold (50 L)	2 x spare / empty (100 L)	500 L
	5% Hydrogen in Argon	G	1 x cylinder manifold (50 L)	No spare / empty allocation.	
	Difluoromethane (CH <sub>2</sub> F <sub>2</sub> )	G	1 x cylinder manifold (50 L)	No spare / empty allocation.	
	Forming Gas (5% Hydrogen in Nitrogen)	G	1 x cylinder manifold (50 L)	No spare / empty allocation.	
	Hydrogen	G	1 x 1 cylinder manifold (100 L)	2 x spare / empty (100 L)	
	Silane	G	1 x cylinder manifold (50 L)	No spare / empty allocation.	
Class 2.2 - Inert	Argon (UHP)	G	1 x 1 cylinder manifold (100 L)	2 x spare / empty (100 L)	1,050 L
	Carbon Dioxide	G	1 x cylinder manifold (50 L)	1 x spare / empty (50 L)	
	Carbon Tetrafluoride (CF <sub>4</sub> )	G	1 x cylinder manifold (50 L)	1 x spare / empty (50 L)	
	Helium	G	1 x 1 cylinder manifold (100 L)	2 x spare / empty (100 L)	
	Hexafluoroethane (C <sub>2</sub> F <sub>6</sub> )	G	1 x cylinder manifold (50 L)	No spare / empty allocation.	
	Nitrogen (UHP)	G	1 x 1 cylinder manifold (100 L)	2 x spare / empty (100 L)	
	Octafluorocyclobutane (C <sub>4</sub> F <sub>8</sub> )	G	1 x cylinder manifold (50 L)	No spare / empty allocation.	
	Sulfur Hexafluoride	G	1 x cylinder manifold (50 L)	1 x spare / empty (50 L)	
	Trifluoromethane (CHF <sub>3</sub> )	G	1 x cylinder manifold (50 L)	No spare / empty allocation.	
Class 2.2(5.1) - Oxidising	Nitrogen Trifluoride	G	1 x cylinder manifold (50 L)	1 x spare / empty (50 L)	2,600 L
	Nitrous Oxide	G	1 x cylinder manifold (50 L)	1 x spare / empty (50 L)	
	Oxygen	G	2 x 2 manpack manifold - 4 packs of 12 cylinders (2,400 L)	No spare / empty allocation.	
Class 2.3 - Toxic	Ammonia	G	1 x cylinder manifold (50 L)	No spare / empty allocation.	148 L
	Chlorine	G	1 x cylinder manifold (50 L)	No spare / empty allocation.	
	Hexafluoro-1,3-Butadiene (C <sub>4</sub> F <sub>6</sub> )	E	1 x cylinder manifold (24 L)	No spare / empty allocation.	
	Hydrogen Bromide	E	1 x cylinder manifold (24 L)	No spare / empty allocation.	

#### 4.3.1 Gas Cabinet Storage

All highly flammable (percentage of flammable gas > 5% by volume) and toxic gases must be stored inside a gas cabinet or equivalent ventilated enclosure. An example of a gas cabinet is shown in Figure 11. All gas cabinets installed must comply with the construction, fire protection and ventilation requirements of:

- Toxic Gas Ordinance 2017
- SEMI™ S2 Safety Guidelines for Semiconductor Manufacturing Equipment

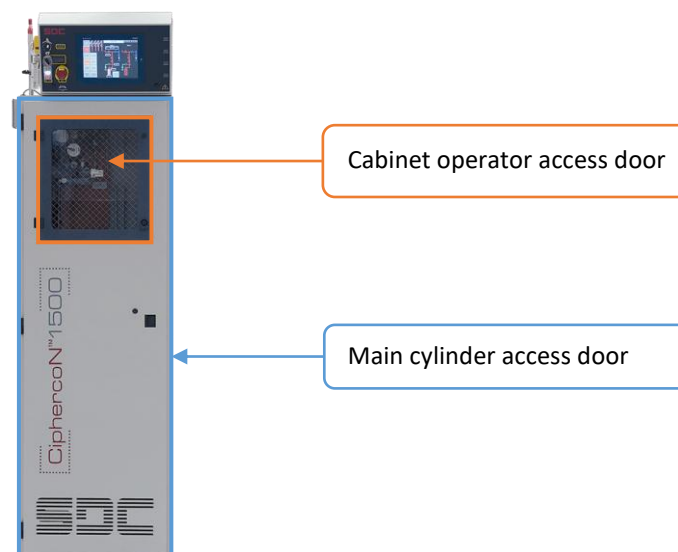


Figure 11 - Example of a gas cabinet for indoor storage of flammable and toxic gases

The typical utilities provided to a gas cabinet include:

- Enclosure exhaust to achieve 1.0-1.3 m/s face velocity across the cabinet operator access door monitored to trigger isolation of the gas supply if ventilation failure occurs
- Exhaust pressure switch that monitors exhaust from the cabinet with an interlock to shut-off gas supply in case of ventilation failure
- Fire sprinkler to cool cylinder in the event of a facility fire and prevent over pressure

These utilities are provided to accomplish the following design and safety objectives:

- Ventilation achieves High Dilution and is monitored (Good availability as per definition in AS 60079 10.1 – Classification of areas – Explosive gas atmospheres), enabling the Hazardous Area resulting from Class 2.1 flammable gases to be contained within the enclosure
- Face velocity across the cabinet operator access door prevents gas leaks from escaping the enclosure and protects operator during cylinder changes

- Storage in a continuously exhausted enclosure provided with ventilation pressure monitoring and exhaust gas sampling mitigates interaction between incompatible gases and achieves the objectives of the segregation requirements of AS 4332 without physical separation distances
- Gases classified as incompatible according to AS 4332 Clause 4.4.3 may not be stored in the same gas cabinet, this includes the following combinations of gas:
  - Class 2.1 flammable gases are incompatible with Class 2.3 toxic gases and Class 2.2(5.1) oxidising gases
  - Class 2.3 toxic gases are incompatible with Class 2.1 flammable gases and Class 2.2(5.1) oxidising gases

A total of 8 gas cabinets will be installed in the main gas store. A summary of the type and quantity of gases stored in these cabinets is presented in Table 24.

Table 24 - Gas cabinet storage inventory

Cabinet ID	Gas	DG Class (Subs.)	Cylinder Size	Storage Capacity	
				No. of cylinders	Total volume (L)
1	10% Methane in Argon	2.1	G	1	50
2	Ammonia	2.3 (8)	G	2	100
3	Chlorine	2.3 (5.1, 8)	G	1	50
4	Difluoromethane (CH <sub>2</sub> F <sub>2</sub> )	2.1	E	1	24
5	Hexafluoro-1,3-Butadiene (C <sub>4</sub> F <sub>6</sub> )	2.3 (2.1)	E	1	24
6	Hydrogen	2.1	G	2	100
7	Hydrogen Bromide	2.3 (8)	E	1	24
8	Silane	2.1	G	1	50

#### 4.3.2 Separation and Segregation

Section 4.4 of the gas cylinder storage standard (AS 4332) describes requirements for the separation distances that must be maintained between gas stores and specified locations on / off the storage premises. Table 4.1 of AS 4332 defines the minimum separation distances for cylinder stores based on the Classes stored and their stored aggregate water capacity.

According to Clause 4.4.2.1 b), where mixed classes of gases are kept the greatest separation distance for any of the classes stored shall apply. For the main gas store, the greatest separation distances are triggered by the stored quantity of Class 2.2(5.1) oxidising gases (greater than 2,000 L of aggregate volume). Therefore, the separation distances from Table 4.1 that apply to the gas store are shown in Figure 12.

In addition, Section 4.4.3 describes segregation requirements for incompatible Divisions of gases that are stored within the same gas store. The majority of the segregation requirements applying to the main gas store are achieved through storage of all highly flammable and toxic gases in ventilated gas cabinets. However, where Class 2.1 flammable gases (percentage of flammable gas < 5% by volume) are stored outside of gas cabinets, they must be segregated from Class 2.2(5.1) oxidising gases by at least 3 m (also shown in Figure 12).

**AS 4332 Table 4.1 – Item 2**

Oxidising gases of Class 2.2(5.1) stored in quantities >2,000 L must be separated from on site protected places by at least 5 m. Intervening wall must have a FRL of 240/240/240 to the extent that separation is achieved.

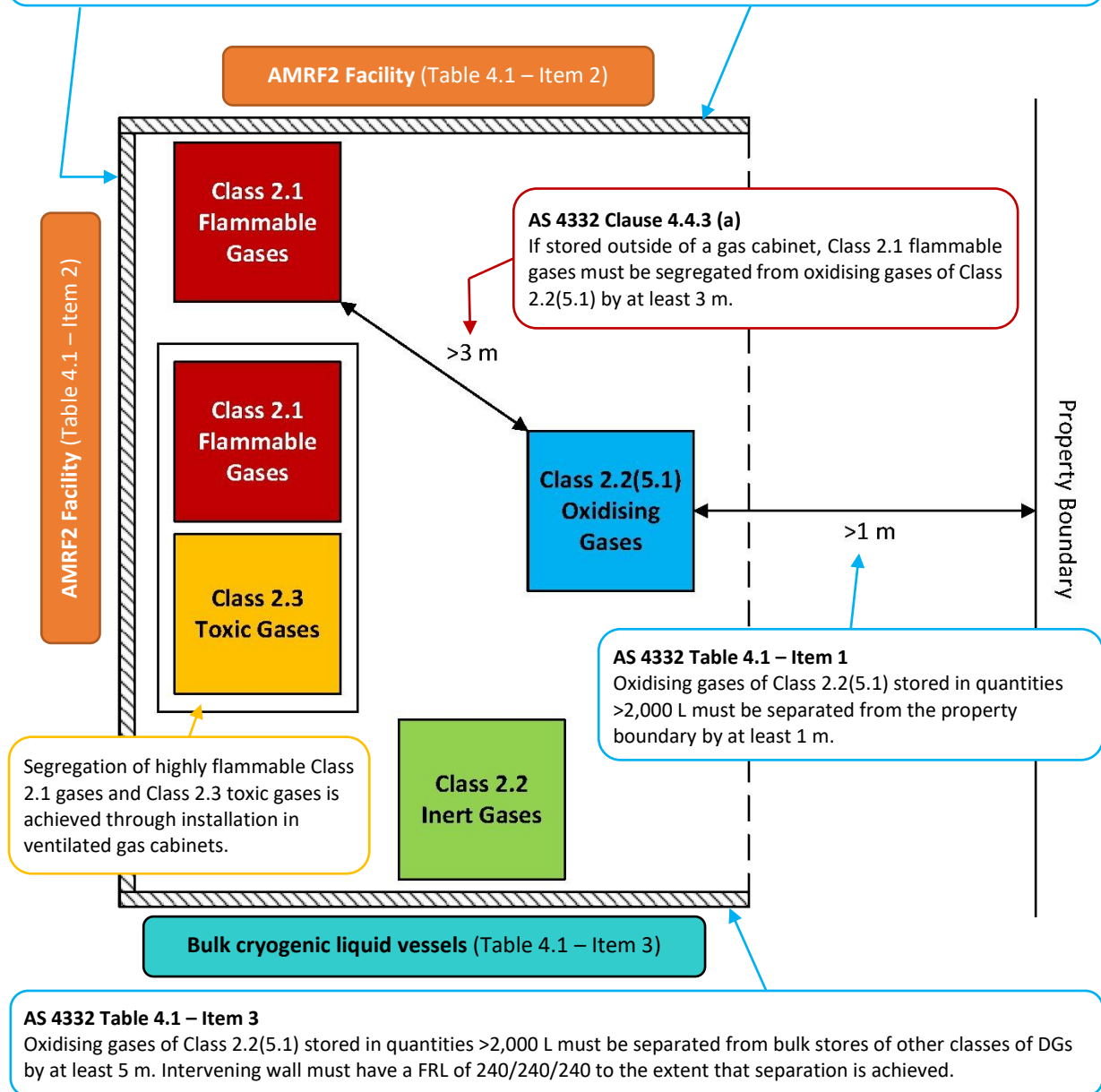


Figure 12 - Separation and segregation requirements of main gas store according to AS 4332

### 4.3.3 Construction

The construction of the store must comply with all relevant provisions of Clause 4.2 of the gas cylinder storage standard (AS 4332). Because the store is located internally, Clause 4.2.1 of AS 4332 specifies that the store must be separated from the remainder of the building by walls achieving a FRL of not less than 240/240/240. The floor above the gas store must also be constructed of materials having an FRL of not less than 180/180/180. This passive fire protection is also required to achieve the required separation and segregation distances between the store and on site protected places, as shown in Figure 12 above.

The construction of the store should also adhere to the following additional requirements:

1. The store flooring must be level and constructed of non-combustible materials.
2. The possible generation of static electricity in a store containing flammable gases shall be controlled in accordance with AS/NZS 1020.
3. Where any penetrations through a wall or barrier are required, the fire resistance level of the wall or barrier shall not be compromised. Any openings shall be vapour tight.

Access doors to the store will open externally to a services laneway, as indicated in Figure 13 below. The access strategy for the store is as follows:

- Personnel will enter / exit the gas store from the laneway through a standard single-leaf door. This door must swing outwards in accordance with Clause 4.2.1 of AS 4332.
- Two ventilated roller type doors are also provided for movement of gas cylinders in and out of the store. The doors are sized to accommodate fork lift access required for delivery of oxygen manpacks.

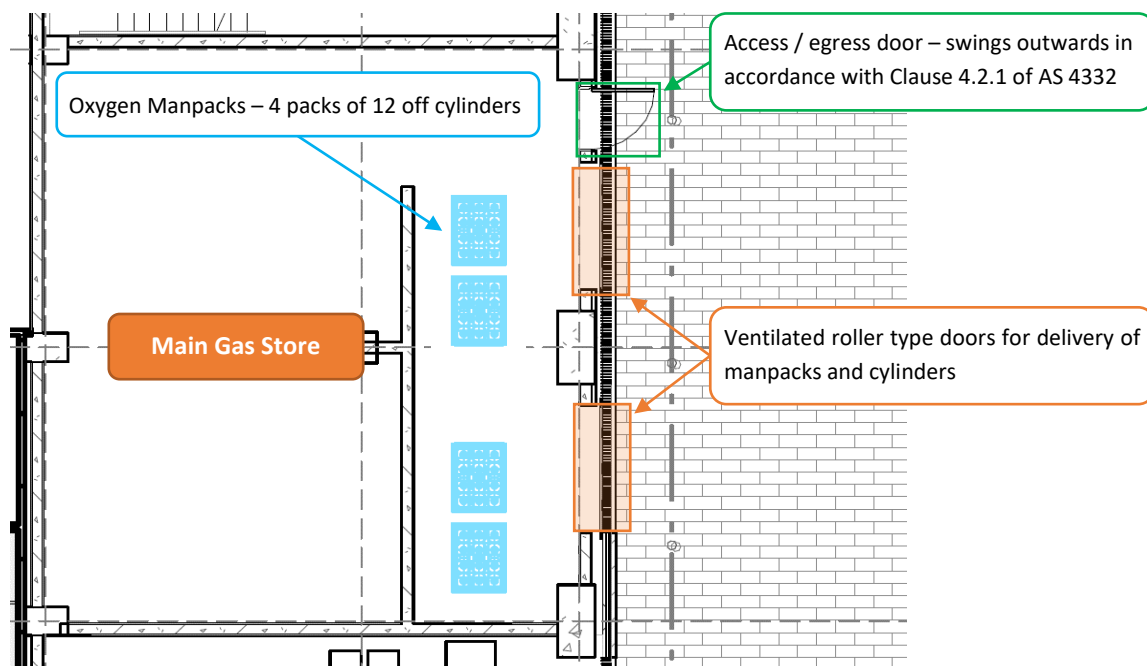


Figure 13 - Main gas store access provisions

#### 4.3.4 Ventilation and Ignition Control

Section 4.3 of AS 4332 describes the requirements for ventilation of gas cylinder stores. The main Gas Store will be mechanically ventilated in accordance with Clause 4.3.3, which includes the performance standards described in Table 25 below.

Table 25 – Gas store ventilation requirements

AS 4332 Clause	Parameter	Requirement
4.3.3 (a)	System capacity	For stores where gases are transferred, the exhaust system must provide 0.0075 m <sup>3</sup> /s of exhaust for every square meter of floor space.
4.3.3 (c)	Air velocity	The air velocity at the air entry register shall be at least 5 m/s.
4.3.3 (f)	Intake / exhaust location	Any air intake / exhaust duct must terminate in the open air, at distances of at least: <ul style="list-style-type: none"> <li>• 2 m from any opening to a building;</li> <li>• 3 m from the outlet of any chimney or flue</li> <li>• 3 m above the ground</li> </ul>
4.3.2.2	Intake / exhaust location	High-level extraction shall be provided where lighter-than-air gases are present.

The ventilation strategy proposed to achieve these performance requirements is as follows:

- Extraction at low level shall be provided via exhaust from the 8 off gas cabinets installed in the store.
- Two extraction points shall be provided at high level with an exhaust capacity of at least 0.08 m<sup>3</sup>/s per point.
- To provide make-up air into the store, a span of the external-facing wall of the gas store must be constructed from one of the following:
  - Wire mesh or grill
  - Louvres
  - Chequered brickwork, vent bricks, slotted roller doors or equivalent

The reticulation and storage of Class 2.1 Flammable Gases will result in Hazardous Areas that must be considered in the design of electrical equipment to be installed in the gas store, including the lighting. A Hazardous Area classification as per AS 60079.10.1 Classification of Areas – Explosive Gas Atmospheres must be undertaken as part of the detailed design of the gas reticulation system in the store and compliant mitigation measures must be implemented.

#### 4.3.5 Fire Protection

Section 7 of the gas cylinder storage standard describes the fire protection that must be provided to gas stores based on their aggregate capacity. The requirements that apply to the main gas store are summarised in the table below.

Table 26 - Fire protection requirements of main Gas Store

Aggregate storage capacity of gas store	Storage threshold (Table 7.2 AS 4332)	Requirements
4,298 L	2000 to ≤12 000	At least one hose reel and one fire extinguisher.

#### 4.4 Class 2.3 Toxic Gas – Minor Storage

Etching tools proposed for installation in the Level 2 Cleanroom require Boron Trichloride, which is a low vapour pressure gas that is prone to condensation in long piping runs. Therefore, the Boron Trichloride must be stored in Sub-Fab on Level 1, close to the point of use, to minimize the length of the reticulation piping.

As shown in Table 27, a maximum of one G-sized cylinder of Boron Trichloride may be stored without exceeding the threshold for minor storage.

Table 27 - Class 2.3 Toxic Compressed Gases Minor Storage Thresholds

Location	Storage ID (Table 14)	Class of Gas	Max. Minor Storage Capacity (L)	Quantity Stored (L)
Sub-Fab	GC1	2.2	50	24 (1 x E cylinder)
		Total mixed aggregate	2,000	24 (1 x E cylinder)

There is no Australian Standard that specifically addresses requirements for installations of gases with acute toxicity risks. In the absence of a local standard, the storage requirements for the Boron Trichloride have been specified based on international standards developed for the semiconductor industry.

The Toxic Gas Ordinance (TGO) summarises the installation guidelines for hazardous toxic gases typically used in semiconductor processes. According to the class rating system established by the TGO, Boron Trichloride is a Class II Toxic Gas (medium lethal concentration (LC<sub>50</sub>) in air between 200 – 2,000 ppm). In accordance with the General Requirements described by the TGO for indoor installations of Class II Toxic Gases, the Boron Trichloride must be stored inside a gas cabinet or equivalent ventilated enclosure.

The gas cabinet and gas supply infrastructure must comply with all construction, fire protection and ventilation requirements of:

- Toxic Gas Ordinance 2017
- SEMI™ S2 Safety Guidelines for Semiconductor Manufacturing Equipment

## 4.5 Liquid Nitrogen / Argon Bulk Vessels

A store for bulk quantities of cryogenic liquid is located on the Ground Floor of AMRF2. The store houses the following vessels and ancillary equipment:

1. 5,000 L Liquid Argon tank installed in the single-height, northern end of the store
2. 25,000 L Liquid Nitrogen tank installed in the double-height, southern end of the store
3. 1 off Liquid Argon vaporizer and 2 off Liquid Nitrogen Vaporizers
4. A Liquid Nitrogen Fill Station for transfer of LN2 from the bulk vessel into portable dewers

Requirements for the storage of cryogenic liquids are described in AS 1894 - The storage and handling of non-flammable cryogenic and refrigerated liquids. The following sections of the cryogenic liquids standard (AS 1894) are applicable to these installations:

- Section 3 - Storage Vessels and Ancillary Equipment
- Section 5 – Special Requirements for Nitrogen, Argon, Helium and Carbon Dioxide

### 4.5.1 Location and Separation

Section 6.4 of the cryogenic liquids storage standard (AS 1894) describes requirements for the separation distances that must be maintained between the cryogenic liquid storage vessels and specified locations on / off the storage premises. Table 6.4.1 of AS 1894 defines the minimum separation distances for cryogenic liquid stores based on the aggregate water capacity of the storage vessels.

*Table 28 - Separation distances for bulk liquid argon and nitrogen vessels*

Aggregate water capacity of storage vessels (L)	Location from which separation is required	Minimum separation distance (m)
30,000 L	Property boundary	2
	Fixed installations of gases in cylinders	
	Openings to underground drains, pits, ducts, surface water drains, or openings or systems below ground level	
	Areas where personnel can congregate (e.g. offices, lunchrooms)	

A drain must be provided in the vessel store for run-off from the vaporizers. In accordance with Table 6.4.1 of AS 1894, this drain must be located at least 2.0 m from the cryogenic storage vessels. Therefore, the separation distances from Table 6.4.1 that apply to the cryogenic liquids store are shown in the indicative schematic in Figure 14.

**AS 4332 Table 4.1 – Item 3**

Intervening wall between gas store and bulk stores of other classes of DGs must have a FRL of 240/240/240 to the extent that separation is achieved.

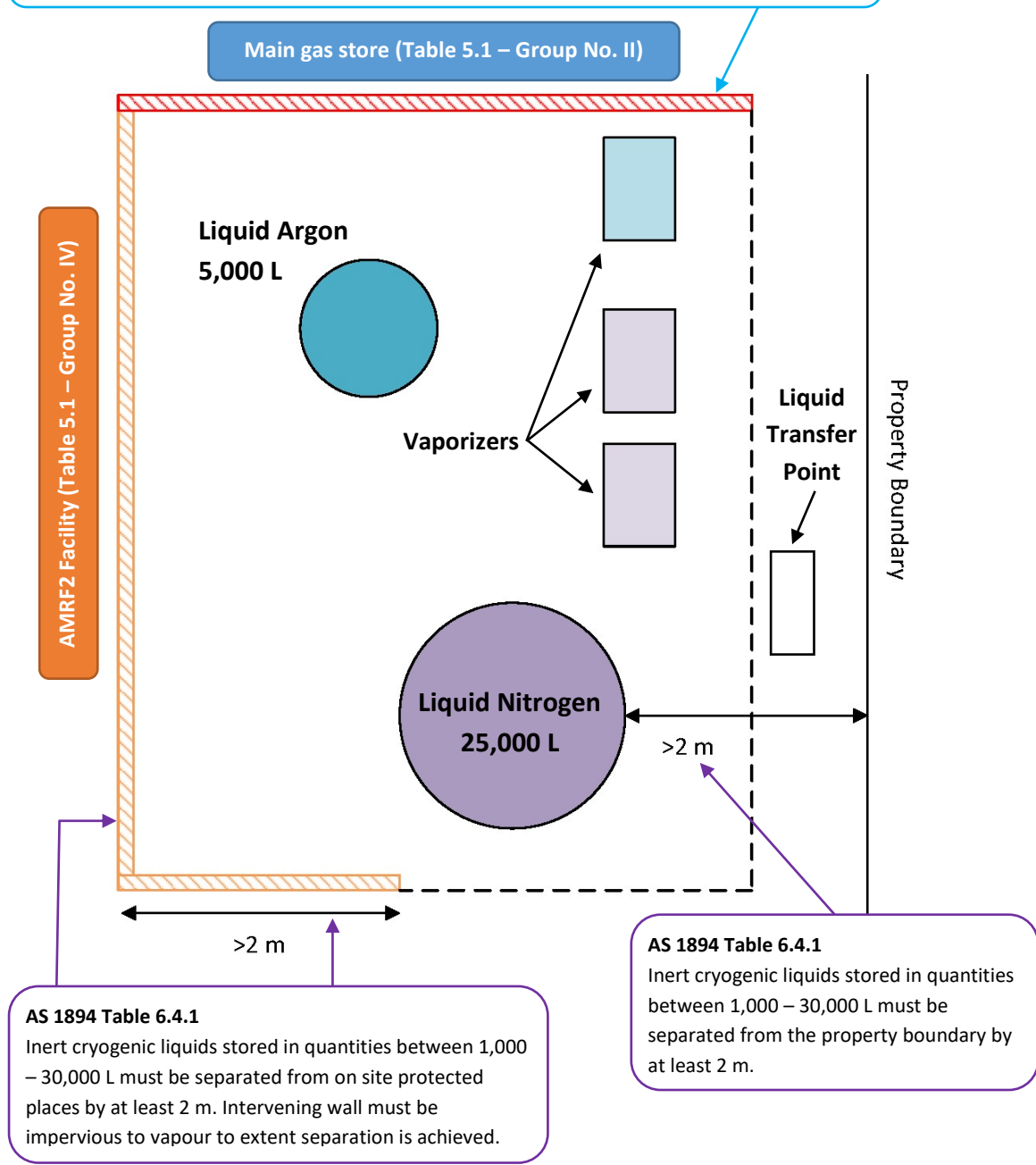


Figure 14 - Separation requirements of bulk cryogenic liquids store according to AS 1894

#### 4.5.2 Construction

As shown in Figure 14, passive fire protection is required to achieve the required separation between the store and on site protected places. This will apply to the separation between the vessels and the occupied areas of the AMRF2 building and the main gas store.

The notes to Table 6.4.1 of AS 1894 specify that a wall may be used to provide separation between installations of cryogenic liquids and protected places if it functions as a vapour barrier (impervious to vapour with no openings within the required separation distance). Because the cryogenic liquids requiring separation are inert, this wall does not require a FRL.

However, the gas cylinder storage standard (AS 4332) specifies that walls used to provide separation from a gas store must achieve a FRL of not less than 240/240/240. Therefore, the wall between the main gas store and the cryogenic vessel store must adhere to this requirement of AS 4332.

### 4.5.3 Ventilation

Clause 3.4.3.3 of the cryogenic liquids storage standard (AS 1894) describes the ventilation that must be provided to areas where bulk vessels of cryogenic liquids are stored indoors. The main requirements are as follow:

- Any vents or relief valves from the vessels must be piped to an external atmosphere.
- Ventilation must be provided to the space that is adequate to disperse the gas / vapour from any liquid spill (other than total loss of contents) without resulting in oxygen depletion in the room below 19.5%.

The store will be mechanically ventilated in accordance with the requirements of Clause 3.4.3.3 of AS 1894, which specifies that 10 m<sup>3</sup>/min of continuous forced exhaust ventilation must be provided per 1000 m<sup>3</sup> of vessel full gas volume. The design of the mechanical exhaust system shall comply with all relevant provisions of AS 1668.2.

The full gas volume of the vessel refers to the total volume that the gas in a nominally full vessel will occupy when expanded at 15°C and 101.325 kPa. The full gas volume of the cryogenic liquid storage has been calculated based on the expansion ratio of the stored gases given in Appendix B of AS 1894 and the water capacity of the vessels. Based on the results of this calculation (Table 29), at least 220 m<sup>3</sup>/min of exhaust must be provided to the cryogenic liquid store to comply with the requirements of AS 1894.

*Table 29 - Required ventilation capacity of cryogenic liquid store*

Cryogenic Liquid	Vessel water capacity (m <sup>3</sup> )	Expansion Ratio (Appendix B – AS 1894)	Vessel full gas volume (m <sup>3</sup> )	Required ventilation (m <sup>3</sup> /min)
Liquid Nitrogen	25	1:682	17,050	220 m <sup>3</sup> /min
Liquid Argon	5	1:824	4,120	

To provide make-up air into the store, a span of the Eastern external-facing wall of the store must be constructed from one of the following:

- Wire mesh or grill
- Louvres
- Chequered brickwork, vent bricks, slotted roller doors or equivalent

#### 4.5.4 Transfer Area

An appropriate transfer area must be provided in proximity to the vessels to enable refilling from a cryogenic liquid tanker. The only vehicular access to the cryogenic liquid store is a public laneway that runs along the Eastern side of the AMRF2 facility.

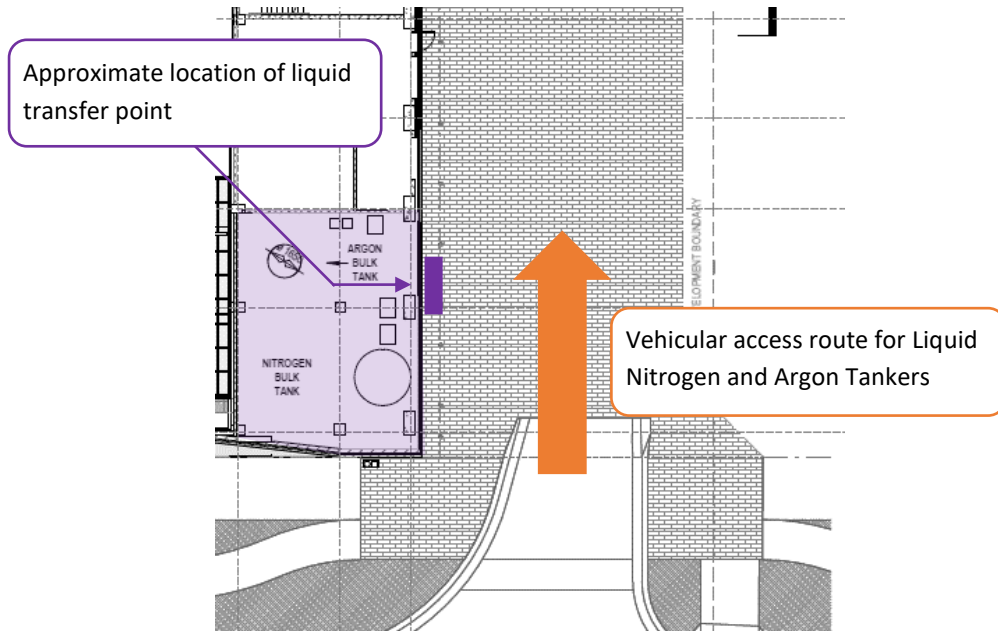


Figure 15 – Cryogenic liquid vessel refilling transfer area

Because of this constraint, cryogenic liquid transfer to the vessels must occur while the tanker is standing on public property against the recommendations of AS 1894. Where this configuration is unavoidable, AS 1894 specifies that the following management procedures must be implemented during the transfer operation:

- Clear definition of the hazard area by suitable warning signs
- Strict control of the area around the filling point

The detailed arrangement of the transfer area will depend on the requirements of the gas supplier nominated to provide the vessels and ongoing gas deliveries.

A remote filling point may be required if the supplier determines that the distance between transfer area and the vessel is too great for a fill operator to maintain clear visibility of the vessel's controls and instrumentation. If a remote filling point is required, repeater vessel fill controls and instrumentation must be provided at the remote location.

## 4.6 Diesel Storage

Three diesel back-up generators will be provided in the open plant area of the facility roof. Diesel fuel for the generators will be stored in the following configuration:

- 3 off 1,000L day tanks connected to the fuel supply pumps of each of the generators, located in the open roof plant on Level 4.
- 1 off 3,000L bulk storage tank which supplies the day tanks, located in the Basement of the Southern section of the AMRF2 building.

Diesel is a Class C1 combustible liquid and therefore, the installation must comply with all relevant provisions of Section 5 of the flammable liquids standard (AS 1940) which applies to storage and handling in tanks. The key Clauses of Section 5 that apply to the tanks are as follow:

- Clause 5.2.6 – Tanks on or above a roof
- Clause 5.6 – Location and capacity of indoor tanks
- Clause 5.9 - Requirements for above-ground tanks with integral secondary containment
- Clause 5.13 – Installation methods for tanks in tank chambers

### 4.6.1 Location, Construction and Separation

Because the bulk 3,000L Diesel tank will be installed indoors, it must be located at the lowest level within the building. Within the tank chamber, there shall be a clear space of at least 450 mm between any tank and any wall or roof of the chamber, or any other tank in the chamber.

The construction of the tank chamber shall comply with all provisions of Clause 5.13 of AS 1940 applying to above-ground tanks, including:

- The walls shall have an FRL of 240/240/240.
- The roof shall be reinforced concrete at least 150 mm thick.
- Where a tank chamber is subject to superimposed loads, the thickness of the roof or walls, or both, shall be increased appropriately.
- The floor shall be of masonry or reinforced concrete, or of material of equivalent strength, excluding earth and asphalt.
- Any doorway or other access opening in any wall shall be protected by a fire door or cover having an FRL of at least –/120/30. Such a door or cover shall be designed to normally be closed.
- The sill of any doorway shall be raised to provide a liquid-tight compound capable of sustaining the hydrostatic load and having a net capacity at least that of the largest tank (2,000L).

- The tank chamber shall not have an automatic pump-out system. If spills could accumulate in the tank chamber, a manually operated low-point sump or pump-away facility should be installed.

The three 1,000L day tanks installed in the open roof plant must be installed in accordance with Clause 5.2.6 of AS 1940 which states that tanks installed on or above a roof must be of double-walled construction. The installation method for the day tanks shall comply with all relevant parts of Clause 5.11 of AS 1940 regarding the structural adequacy of the tank foundations and supporting structures.

#### 4.6.2 Spillage Containment

Spillage containment must be provided to prevent any leaks or spills of Diesel from draining to the sewage system or contaminating surrounding soil / waterways. This may consist of:

- A bunded compound in accordance with Clause 5.8 of AS 1940, or;
- Integral secondary containment in accordance with Clause 5.9 of AS 1940.

All of the tanks proposed for installation at AMRF2 will be provided with integral secondary containment, and therefore must comply with Clause 5.9. This includes the following key provisions:

- The primary (inner) tank shall be constructed to AS 1692.
- The secondary containment shall be adequately designed and constructed, to contain the entire contents of the primary tank.
- Means shall be provided to establish and monitor the integrity of the primary tank.

The design and construction of the external secondary containment must comply with Clause 5.8.3 of AS 1940.

In addition, because the day tanks are installed on or above a roof, Clause 5.2.6 includes the following requirements for overflow piping from the tanks / integral containment:

- The outer shell overflow pipe shall be directed to a remote tank, sump or compound having a capacity at least equal to the tank capacity.
- A tank overflow pipe shall be provided with sufficient capacity to return the full capacity of the filling pump to the remote tank, sump or compound without spillage.
- An overflow alarm shall be fitted, audible at the filling point.

In accordance with these requirements, all necessary overflow piping from the day tanks will be directed back to the bulk storage tank, which is sized to accommodate the full capacity of any day tank.

#### 4.6.3 Ventilation and Ignition Control

Venting of vapour from the tanks must comply with Clause 5.4 of AS 1940. This includes the following requirements:

- Vent pipes shall fall consistently back to the tank at a slope of at least 1 in 100.
- Where vent piping penetrates a fire-rated wall, it shall be installed so as to ensure that the fire resistance of the wall is maintained.
- The vent pipe and terminal shall be located or protected so that they are not liable to damage resulting from normal activities.
- The vent discharge point shall be located laterally at least 2 m from any opening into a building, e.g. window, door, ventilator, air conditioner or a mechanical vent intake to reduce the possibility of the entry of nuisance vapour.
- The vent discharge point shall be located at least 4 m above ground level.
- The vent shall be located such that the opening into a building shall be outside the hazardous area to AS/NZS 60079.10.1.
- The discharge end of a vent shall be protected from the ingress of foreign material by means of a protective cage or fitting.

A Hazardous Area classification as per AS 60079.10.1 Classification of Areas – Explosive Gas Atmospheres must also be undertaken as part of the detailed design of the Diesel store and reticulation piping and compliant mitigation measures must be implemented.

#### 4.6.4 Fill Point

A location on Ground level shown in Figure 16 on the following page has been proposed for the fill point of the bulk Diesel storage tank (3,000L capacity). The proposed location is accessible from Central Loop West, a public laneway that runs along the Western side of the AMRF2 facility.

The fill point must comply with all relevant parts of Clause 5.3 of AS 1940, including the following:

- The fill connection to a storage tank that is filled from a tank vehicle shall incorporate a liquid-tight connection unless the filling method employs a hand-held trigger nozzle with a non-latching feature. A cap or cover shall be provided for the fill point.
- The fill point shall be protected from accidental damage.
- The areas around the tank fill point and the vehicle hose connection point shall be impervious to the product.
- Each fill point shall be clearly identified. For petroleum products, fill points shall comply with AS 4977.

- The fill point shall be provided with spill containment having a minimum capacity of 15L to contain any minor spill during product delivery to the tank.
- Appropriate controls and tank level indicators are to be located at the fill point to indicate to the person filling the tank the level at which the diesel is within the tank. Because the tank is out of direct sight of the attendant monitoring filling flow controls, this must include:
  - A contents gauge or monitoring device, and;
  - A suitable high level alarm (LAH) set at a maximum of 97% of tank capacity. This alarm shall not be used to control the filling, and;
  - A physically and electrically independent high-high level alarm (LAHH) set at or below the tank rated capacity.

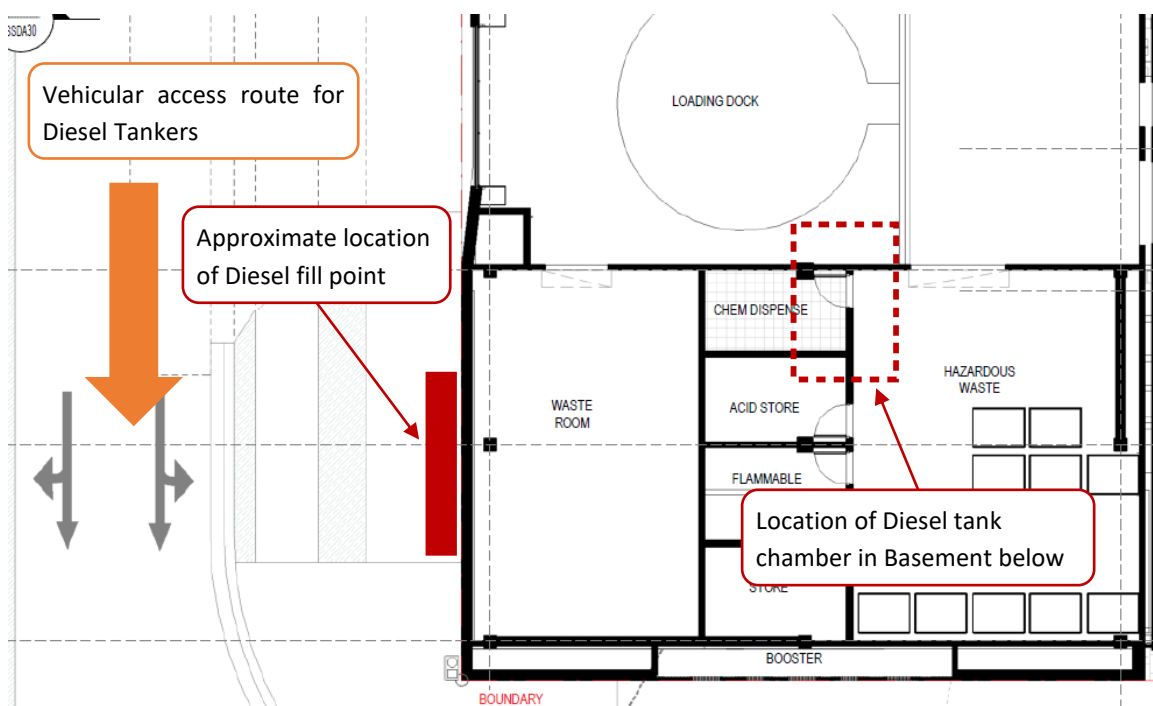


Figure 16 – Diesel fill point

Because Diesel is a Class C1 combustible liquid (rather than a Class 3 flammable liquid), AS 1940 / the ADG Code does not explicitly prohibit fill points that require the tanker to stand on a public road during filling. However, appropriate management procedures should still be implemented during the transfer operation, including:

- Clear definition of the hazard area by suitable warning signs
- Strict control of the area around the filling point

## 4.7 Waste Storage and Disposal

Any waste produced in the facility that meets the criteria of the ADG Code for classification as a Dangerous Good must be stored in accordance with all the requirements of the applicable standard (ie. AS 1940 – Flammable liquids/AS 3780 – Corrosive substances etc.). No chemical waste may be disposed of to the sewage system. Therefore, all hazardous waste produced by the facility must be:

- Collected and disposed of appropriately by a licensed hazardous waste disposal company, or;
- Treated using an appropriate pre-treatment method until the concentration of controlled substances is below the acceptance standards for trade wastewater specified by Sydney Water.

When it is stored awaiting collection, all chemical waste must be kept in appropriate containers and labelled in accordance with WHS 2011 guidelines. This includes labelling of the:

- Type of waste
- GHS information (signal words, hazard statements and pictograms)
- Relevant Dangerous Goods Class diamond symbol

The management strategies proposed for the main categories of chemical waste produced by the facility are summarised in Table 30.

Table 30 – AMRF2 waste management strategy

Waste Category	DG Class	Source	Management Method
Acid	8 – Corrosive substances	Wet benches and etching processes	Treated in Neutralisation Plant until pH meets acceptance standard for release as trade wastewater.
Alkaline	8 – Corrosive substances	Wet benches and etching processes	<ul style="list-style-type: none"> <li>• Piped from waste sources into IBCs located in the hazardous waste store on Ground Floor.</li> <li>• Stored in hazardous waste store until collection.</li> </ul>
Metallic	9 – Environmentally hazardous substances	Copper and Nickel Sulfate used in plating baths	
Solids	N/A	Chemical Mechanical Planarization (CMP) and other grinding or cutting operations	
Solvent	3 – Flammable liquids	Wafer treatment and cleaning	<ul style="list-style-type: none"> <li>• Collected in small containers (&lt;25 L) at each waste source.</li> <li>• Full containers are removed from tools and stored in flammable liquids store until collection.</li> </ul>

#### 4.7.1 Hazardous Waste Store

An area on Ground Floor directly adjacent to the main chemical store has been allocated for hazardous waste storage. The hazardous waste store has been designed with space allocation for a total of seven 1,000L waste IBCs, including:

- 1 off metallic waste IBC – Class 9 Environmentally hazardous substance
- 1 off alkaline waste IBC – Class 8 Corrosive substance
- 3 off solid waste IBCs – Non-Dangerous Good
- 2 off spare IBCs – Non-Dangerous Good

Paths of travel in the store must accommodate a standard forklift to enable full IBCs to be removed for collection by a hazardous waste disposal contractor. Beyond the IBCs allocated for waste storage, a further three 1,000L IBCs of dosing chemicals required for the Acid Waste Neutralisation Plant will also be located in the store. These consist of:

- 2 off caustic (Sodium Hydroxide) IBCs - Class 8 Corrosive substance
- 1 off acidic (Sulfuric Acid) IBC – Class 8 Corrosive substance

The chemicals will be pumped from the IBCs in the hazardous waste store down to the Neutralisation Plant located in the Basement below.

Because the four IBCs of Class 8 corrosive substances in the store are filled and emptied in situ, they are classified as portable tanks (rather than packages) according to the corrosive substances standard (AS 3780). Therefore, the IBCs of Class 8 corrosive substances must comply with Section 6 of AS 3780, which describes the requirements for storage and handling in tanks.

The single IBC of metallic waste (Class 9 Environmentally hazardous substance) must comply with the provisions for bulk storage described in Section 4 of the Class 9 storage standard, AS 4681.

##### 4.7.1.1 General Requirements

In accordance with Clause 6.5.7 of the corrosive substances standard (AS 3780), the following must be provided within 7 m of any point for transfer of Class 8 corrosive substances into a tank:

- A safety shower conforming to AS 4775.
- Eye-wash facilities conforming to AS 4775.
- Water for washing of the hands.

#### 4.7.1.2 Location, Separation and Segregation

The IBCs containing Dangerous Goods (alkaline waste, dosing caustic / acid and metallic waste) must be located according to the requirements of the applicable storage standard. The separation distances applying to the IBCs are defined in:

- Clause 6.3.2 of the corrosive substances standard (AS 3780) for the alkaline waste and dosing caustic / acid, and;
- Clause 4.8 of the Class 9 storage standard (AS 4681) for the metallic waste.

In accordance with both AS 3780 and AS 4681, a minimum of 0.6 m of clear space must be provided between adjacent IBCs to allow access for activities such as inspections. For tanks (IBCs) with a capacity of 1,000 L, the separation distances applying to protected places and boundaries are summarised in Table 31.

Table 31 - Separation distances for IBCs of Class 8 and Class 9 hazardous waste

IBC	DG Class	Location from which separation is required	Minimum separation distance (m)
Alkaline Waste	8	Protected places and boundaries	3
Sodium Hydroxide			
Sulfuric Acid			
Metallic Waste	9		

The corrosive substances standard (AS 3780) defines additional requirements for segregation of corrosive substances that are incompatible or may react dangerously. Based on the definition in AS 3780, the chemical incompatibilities that have been considered are as follow:

- Acids (Sulfuric Acid) may react dangerously with caustics (Sodium Hydroxide / Alkaline Waste)
- Metallic Waste (Copper Sulfate / Nickel Sulfate) is incompatible with caustics (Sodium Hydroxide / Alkaline Waste)

The segregation of these chemicals must be as per Clause 6.3.3, which states that substances that are incompatible must:

1. Be segregated by a distance of not less than 5 m, or;
2. Not be kept with the same compound, or in compounds that share a common drainage system.

Where substances may react dangerously, both provisions of Clause 6.3.3 must be met (segregation distance and spillage containment).

Clause 6.3.3.1 of the corrosive substances standard states that segregation distances between tanks may be measured around an intervening screen wall that:

1. Extends a distance at least equal to the height of the higher store, and;

- Has a FRL of at least 120/120/120 if any of the goods being segregated are of Classes or Divisions 2.1, 3, 4 or 5.

The segregation strategy proposed to achieve compliance with these Clauses is as follows:

- IBCs containing Alkaline Waste or Sodium Hydroxide may not share a spillage containment compound with the Metallic Waste or the Sulfuric Acid.
- A screen wall must be erected between the Sodium Hydroxide and Sulfuric Acid IBCs, constructed from corrosion resistant materials. This wall does not require an FRL because the goods being segregated are not of Classes or Divisions 2.1, 3, 4 or 5.

Based on these provisions and the separation distances described above, that separation and segregation requirements that apply to the hazardous waste store are shown in Figure 17.

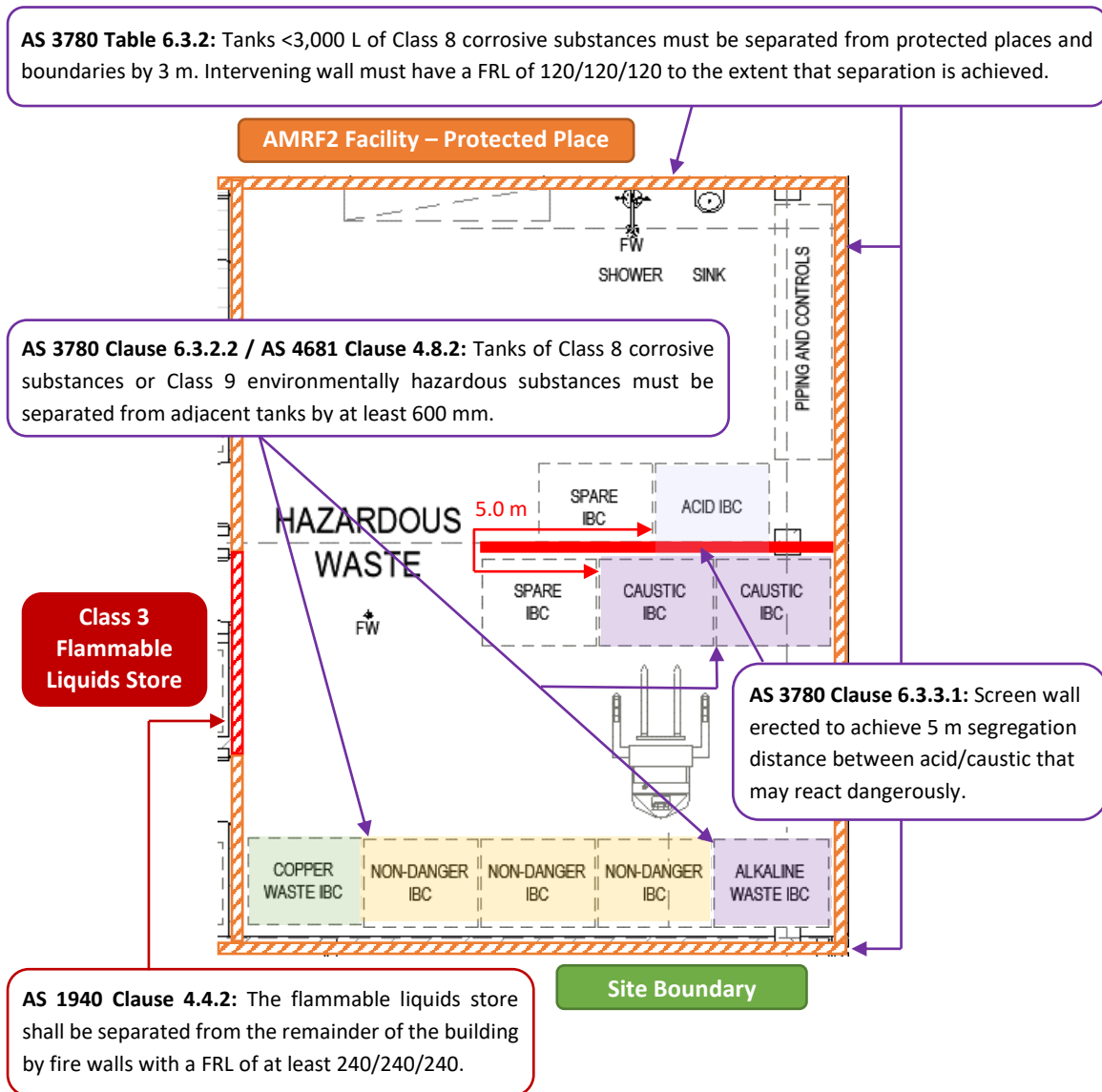


Figure 17 - Separation / segregation requirements of hazardous waste store to AS 3780 and AS 4681

#### 4.7.1.3 Construction

Clause 6.3.2.3 of the corrosive substances standard (AS 3780) states that segregation and separation distances may be measured laterally around an intervening screen wall if the wall:

1. Extends at least 1 m above the highest item in the store;
2. Is marked to indicate the maximum permissible storage height; and
3. Has a FRL (fire resistance level) of at least 120/120/120

Clause 3.2.2.2 of the Class 9 storage standard (AS 4681) requires a FRL of 60/60/60 to achieve the same separation. Therefore, to achieve the required separation and segregation distances described in Section 4.7.1.1, the walls of the hazardous waste store must have a FRL of 120/120/120. Fire-rating should extend to the full height of the walls.

All materials of construction used in the hazardous waste store shall have a corrosion resistance appropriate to the type of chemicals being stored. Typically, this is achieved through chemically resistant coatings that can be applied to concrete to form an impermeable barrier.

#### 4.7.1.4 Spillage Containment

All IBCs in the hazardous waste store must be installed on banded spill containment pallets or the like. The capacity of the spill containment compound provided to each IBC must adhere to the requirements of the storage standard applying to the material stored, as summarised in Table 32. This includes spill containment for the IBCs used for Non-Dangerous Good waste storage.

Table 32 – IBC spill containment compound requirements, hazardous waste store

IBC	DG Class	AS Standard / Clause	Description	Bund Capacity
Alkaline waste	8	AS 3780 / Clause 6.4.2	The net capacity of the compound shall be not less than 110% of the capacity of the largest tank located within the compound.	1,100 L of capacity per IBC
Dosing caustic				
Dosing acid				
Metallic waste	9	AS 4681 / Clause 4.7.2		
Solid waste	N/A	N/A		

The construction of the spill containment must adhere to the following requirements:

- The bund must be entirely fabricated from corrosion resistant materials appropriate to the type of materials stored.
- Spill containment pallets must be permanently affixed to the ground to prevent them from being moved to an unsuitable location.
- The point at which any pipe passes through the wall of spillage containment shall be provided with an appropriate seal to prevent leakage from the compound.

#### 4.7.1.5 Disposal Frequency

The frequency of hazardous waste collection must be considered in the design of the Dangerous Goods handling provisions for the facility. The volume of liquid waste production has been estimated based on the maximum throughput of the full suite of tools proposed for installation in the facility.

Based on this estimate of the production, the anticipated disposal frequency was determined for each Class of chemical waste that will be stored on site (Table 33).

Table 33 - Hazardous waste disposal frequency

Waste Category	Waste Production (L per day)	Available Storage	Disposal Frequency
Alkaline	50	1,000L IBC	Once per 20 days
Metallic	50	1,000L IBC	
Solids	250	3 off 1,000L IBC	Once per 12 days
Solvent	32.5	250L Flammable Liquids Cabinet	Once per 7 days

As shown in Table 33, a significantly lower volume of Class 3 flammable liquids waste storage has been provided compared to the other Classes, in line with its relative hazard level. At peak usage, weekly collection of solvent waste may be required in lieu of accumulation of larger volumes of Class 3 flammable liquids on site.

#### 4.7.2 Acid Waste Neutralisation Plant

Liquid acid waste is expected to be the largest volume of hazardous waste produced by the AMRF2 facility. Because of the rate of waste production, collection and disposal of the acidic waste would require excessive onsite storage and / or an impractical disposal frequency. Therefore, a Neutralisation Plant will be provided to enable the acid waste to be treated on site and released as trade wastewater.

The Neutralisation Plant will consist of the following main components:

1. 1 off 1,000 L IBC installed in a sunken pit to enable gravity-fed collection of acid waste from both the Bay and Chase (Basement) and Ballroom / Sub-Fab (Level 1/Level 2) Cleanroom areas.
2. 3 off 3,000 L Neutralisation Tanks, each containing an agitator and appropriate instrumentation including pH control.
3. Pumps for transfer of acid waste between the collection IBC and Neutralisation Tanks.
4. Pumps for dosing of pH adjustment chemicals (Sulfuric Acid and Sodium Hydroxide) from IBCs stored in Ground Floor hazardous waste store.

Wastewater cascades between the three Neutralisation Tanks, achieving a progressively higher pH in each tank. The wastewater from the third and final tank is released as trade wastewater when pH monitoring confirms that it is within the Sydney Water acceptance standard.

Because the process involves Class 8 corrosive substances (acids and caustics), the area where the plant will be located must comply with Section 6 of AS 3780, which describes the requirements for storage and handling of corrosive substances in tanks.

#### *4.7.2.1 Location, Separation and Segregation*

Clause 6.3.2 of the corrosive substances standard (AS 3780) describes the separation distances that must be maintained between tanks of Class 8 corrosive substances and protected places / boundaries. Given that the volume of each individual tank is less than or equal to 3,000 L the following separation distances must be maintained:

- 3.0 m from any protected places (on-site / off-site / public places), including other stores of Dangerous Goods in quantities exceeding the threshold for minor storage.

#### *4.7.2.2 Construction*

Clause 6.3.2.3 of the corrosive substances standard (AS 3780) states that segregation and separation distances may be measured laterally around an intervening screen wall if the wall:

1. Extends at least 1 m above the highest item in the store;
2. Is marked to indicate the maximum permissible storage height; and
3. Has a FRL (fire resistance level) of at least 120/120/120

Therefore, to achieve the required separation and segregation distances described in Section 4.7.2.1 the walls of the Neutralisation Plant must have a FRL of 120/120/120. Fire-rating should extend to the full height of the walls.

All materials of construction used in the plant room shall have a corrosion resistance appropriate to the type of chemicals being stored. Typically, this is achieved through chemically resistant coatings that can be applied to concrete to form an impermeable barrier.

#### *4.7.2.3 Spillage Containment*

The Neutralisation Plant must be bunded in accordance with the requirements of AS 3780 Clause 6.4.1. The capacity of the bund must satisfy Clause 6.4.2, which specifies that the capacity must be the larger between:

- 110% of the capacity of the largest tank in the compound or;
- 25% of the total capacity of all tanks within the compound.

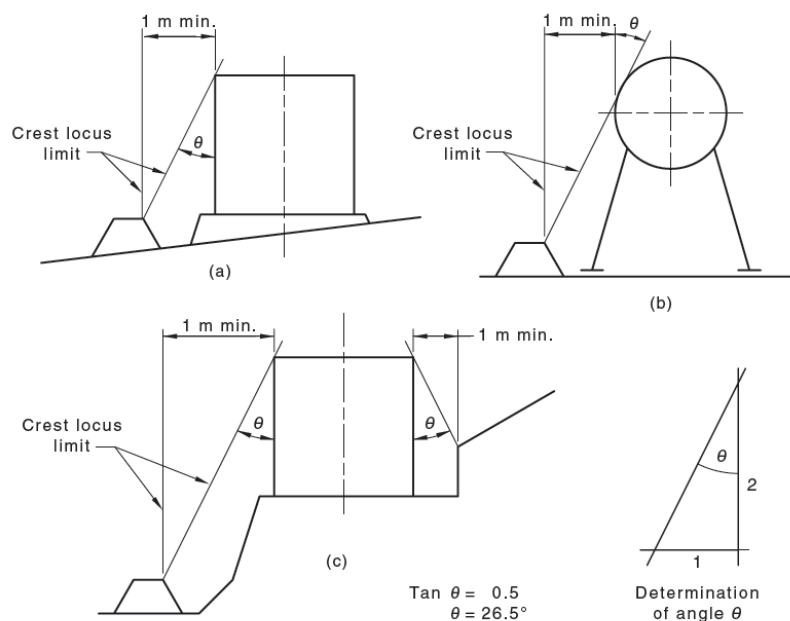
To meet this requirement, the following spill containment will be provided:

- The 1,000 L acid waste collection IBC will be installed on a spill containment pallet with a minimum sump volume of 1,100 L.

- The three Neutralisation Tanks will be contained in a bunded compound with a minimum capacity of 3,300 L (110% of the largest tank > 25% of the total capacity of all tanks).

The construction of the bunded compound containing the three Neutralisation Tanks must adhere to the following requirements:

1. The materials of construction shall be substantially immune to the corrosive substance they are required to contain (acidic waste).
2. The compound must be impervious and designed to retain and enable recovery of any spillage.
3. Any point where a pipe passes through the wall of a bund or floor shall be provided with a waterstop or other appropriate seal to prevent leakage from the compound.
4. Provision shall be made for the safe operation of valves and critical items that may be required to manage a leak event. They must be able to be operated safely, from outside the bunded area/from above the top of the bund wall.
5. The location of a bund relative to the closest tank shall be such that the top inside perimeter of the bund is not inside the crest locus limit specified in the Figure 6.4.3 of the corrosive substances standard (see below).



**Figure 6.4.3 — Bund location limits**

*Figure 18 – Bund location limits as per Figure 6.4.3 of AS 3780*

The following provisions are required for drainage of the spill containment:

1. The drainage point should slope away from any tank to a sump which is drained from the lowest practicable level.

2. Substances that might react dangerously must not be directed into a common compound.
3. Any valve controlling drainage must be located outside the bunded compound. The valve must have a visually obvious distinction between the open and shut positions and must be resistant to the material contained in the tank.
4. Drainage valves shall be kept closed except during supervised activities.
5. If drainage is achieved by pumping, the pump shall be manually controlled.

Assuming a bunded area that encompasses the entire plant room (~57 m<sup>2</sup> floor area), a bund height of approximately 60 mm will be required.

#### *4.7.2.4 Ventilation*

Section 6 of AS 3780 does not include any explicit requirements for the ventilation of indoor spaces where tanks of Class 8 corrosives are installed. From a performance perspective, it is recommended that ventilation is provided to achieve approximately 6 ACH to control humidity in the room and prevent long-term corrosion issues.

## 5.0 Summary of Outcomes

The AMRF (Advanced Manufacturing Readiness Facility) is an advanced manufacturing and research precinct located in the Bradfield City Centre at 215 Badgerys Creek Road, Bradfield. Stage 2 (Building Two – AMRF2) of the AMRF will be a specialized facility built to house semiconductor / micro-electronic fabrication and packaging resources. In this report, the provisions required for handling and storage of Dangerous Goods at the AMRF2 facility have been summarised.

These include, but are not limited to, the following findings:

- The chemical inventory of the AMRF2 facility includes the following classes of Dangerous Goods: Class 2.1 flammable gases, Class 2.2 compressed gases, Class 2.2(5.1) oxidising gases, Class 2.3 toxic gases, Class 3 flammable liquids, Class 5.1 oxidising substances, Class 6.1 toxic substances, Class 8 corrosive substances and Class 9 environmentally hazardous substances.
- The majority of chemical storage on the site will be located on Ground Floor in the following areas:
  - a. Main chemical store, which is divided into three areas for segregated storage of Class 3 flammable liquids, Class 8 acids and Class 8 caustics
  - b. Main gas store for storage of gases in cylinders
  - c. Liquid Nitrogen / Liquid Argon bulk vessels
- The AMRF2 facility will be classified as a Manifest Quantity Workplace (MQW) based on the quantity of the following chemicals stored on site:
  - a. Gases under pressure (due to bulk cryogenic liquid storage)
  - b. Skin Corrosion (Category 1A)
- The following hazard categories may require Placarding in accordance with Schedule 13 of the Work Health and Safety Regulation 2011:
  - a. Flammable gases
  - b. Flammable liquids (Category 2)
  - c. Gases under pressure with acute toxicity, categories 1, 2, 3 or 4
  - d. Gases under pressure
  - e. Skin Corrosion (Category 1A and 1B)
  - f. Oxidising Liquids (Category 2)
- A hazardous waste store is provided on Ground Floor with space allocation for a total of seven 1,000L waste IBCs, including:

- a. 1 off metallic waste IBC – Class 9 Environmentally hazardous substance
  - b. 1 off alkaline waste IBC – Class 8 Corrosive substance
- Acidic waste produced by the facility will be treated in a Neutralisation Plant located in the facility Basement until the pH meets Sydney Water’s acceptance standard for release as trade wastewater.
  - The quantity of Dangerous Goods stored at the AMRF2 facility does not exceed any threshold defined in the Hazardous and Offensive Development Application Guideline “Applying SEPP 33” published by the NSW Department of Planning and Environment. Therefore, the development is not considered potentially hazardous and will not require a PHA report.
  - Any areas where Class 2.1 Flammable Gases or Class 3 flammable liquids are stored or reticulated will be subject to a hazardous area assessment as per AS 60079.10.1 Classification of Areas – Explosive Gas Atmospheres. This includes the flammable liquids store in the main chemical store and the main gas store.
  - In areas that are classified as hazardous according to AS 60079.10.1, all electrical equipment must comply with AS/NZS 60079.14 (be certified IEC Ex).
  - The type and quantity of Dangerous Goods stored at the facility may not be increased beyond their current levels without undertaking further assessment.

## Appendix A – Manifest of Dangerous Goods

SUBSTANCE OVERVIEW				ADG CODE 2022, EDITION 7.8					WHS REGULATION 2017, SCHEDULE 11				STORAGE OVERVIEW					
NAME	CAS NUMBER	UN PROPER SHIPPING NAME	UN NO.	FORM	DG CLASS	DESCRIPTION	SUBSIDIARY RISK	PACKING GROUP	HAZARD CODES	SCHEDULE 11 HAZARD	CATEGORY	CYLINDER SIZE	PACK SIZE	UNITS	STORAGE LOCATION	# OF PACKS	STORED QUANTITY	UNITS
2-Propanol	67-63-0	ISOPROPANOL	1219	Liquid	3	Flammable Liquids	N/A	II	H225, H319, H336	H225	2	N/A	25	L	FLAM1	8	200	L
10% Methane in Argon	7440-37-1 (Ar), 1333-74-0 (H2)	COMPRESSED GAS, FLAMMABLE, N.O.S (Argon and Hydrogen)	1954	Gas	2.1	Flammable Gases	N/A	N/A	H220, H280	H220	1A	G	50	L	GAS1	2	100	L
5% Hydrogen in Argon	7440-59-7 (He), 1333-74-0 (H2)	COMPRESSED GAS, FLAMMABLE, N.O.S (Helium and Hydrogen)	1954	Gas	2.1	Flammable Gases	N/A	N/A	H220, H280	H220	1A	G	50	L	GAS1	1	50	L
Acetone	67-64-1	ACETONE	1090	Liquid	3	Flammable Liquids	N/A	II	H225, H319, H336	H225	2	N/A	25	L	FLAM1	2	50	L
Alkaline Waste	N/A	CORROSIVE LIQUID, N.O.S	1760	Liquid	8	Corrosive Substances	N/A	III	H314, H290	H314	1B	N/A	1000	L	HAZW	1	1000	L
Acid Waste	N/A	CORROSIVE LIQUID, N.O.S	1760	Liquid	8	Corrosive Substances	N/A	III	H314, H290	H314	1B	N/A	1000	L	AWNP	1	1000	L
Ammonia	7664-41-7	AMMONIA, ANHYDROUS	1005	Liquefied Gas	2.3	Toxic Gases	8	N/A	H221, H280, H331, H314, H318, H400, H411	H331	3	G	50	L	GAS1	1	50	L
Ammonium hydroxide (30-50%)	1336-21-6	AMMONIA SOLUTION	2672	Liquid	8	Corrosive Substances	N/A	III	H314, H335, H400, H411	H314	1A	N/A	25	L	DECANT	4	100	L
Argon (UHP)	7440-37-1	ARGON, COMPRESSED	1006	Gas	2.2	Compressed Gases	N/A	N/A	H280	H280	N/A	G	50	L	GAS1	4	200	L
Boron Trichloride	10294-34-5	BORON TRICHLORIDE	1741	Liquefied Gas	2.3	Toxic Gases	8	N/A	H280, H300, H330, H314, H335, H360	H330	2	E	24	L	GC1	1	24	L
Buffered oxide etchant (4:1)	7664-39-3 (HF), 12125-01-8 (NH4F)	CORROSIVE LIQUID, TOXIC, N.O.S. (ammonium fluoride, hydrofluoric acid)	2922	Liquid	8	Corrosive Substances	6.1	II	H301, H331, H310, H314	H314	1A	N/A	25	L	ACID1	8	200	L
Carbon Dioxide	124-38-9	CARBON DIOXIDE	1013	Liquefied Gas	2.2	Compressed Gases	N/A	N/A	H280	H280	N/A	G	50	L	GAS1	2	100	L
Carbon Tetrafluoride (CF4)	75-73-0	TETRAFLUOROMETHANE	1982	Gas	2.2	Compressed Gases	N/A	N/A	H280	H280	N/A	G	50	L	GAS1	2	100	L
Chlorine	7782-50-5	CHLORINE	1017	Liquefied Gas	2.3	Toxic Gases	5.1, 8	N/A	H270, H280, H314, H330, H400	H330	2	G	50	L	GAS1	1	50	L
Copper(II) Sulfate	7758-99-8	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (CUPRIC (II) SULFATE PENTAHYDRATE)	3077	Solid	9	Environmentally Hazardous Substance	N/A	III	H302, H318, H400, H410	N/A	N/A	N/A	5	kg	DECANT	1	5	kg
Diesel	68334-30-5	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.. Marine pollutant (Fuels, diesel)	3032	Liquid	9	Environmentally Hazardous Substance	C1	III	H227, H304, H315, H332, H351, H373	N/A	N/A	N/A	3000	L	DIESEL	1	3000	L
													1000	L	DSLDAY	3	3000	L
Difluoromethane (CH2F2)	75-10-5	DIFLUOROMETHANE	3252	Liquefied Gas	2.1	Flammable Gases	N/A	N/A	H220, H280	H280	N/A	G	50	L	GAS1	1	50	L
EKC265 post-etch residue remover	Proprietary mixture	CORROSIVE LIQUID, BASIC, ORGANIC, N.O.S (2-(2-aminoethoxy) ethanol)	3267	Liquid	8	Corrosive Substances	N/A	II	H314, H318	H314	1B	N/A	25	L	BASE1	4	100	L
Forming Gas (5% H2 in N2)	7727-37-9 (N2), 1333-74-0 (H2)	COMPRESSED GAS, NON-FLAMMABLE, N.O.S (Nitrogen and Hydrogen)	1956	Gas	2.1	Flammable Gases	N/A	N/A	H280	H280	N/A	G	50	L	GAS1	1	50	L
Helium	7440-59-7	HELIUM, COMPRESSED	1046	Gas	2.2	Compressed Gases	N/A	N/A	H280	H280	N/A	G	50	L	GAS1	4	200	L
Hexafluoro-1,3-Butadiene (C4F6)	685-63-2	LIQUEFIED GAS TOXIC, FLAMMABLE, N.O.S. (1,1,2,3,4,4-HEXAFLUOROBUTA1,3-DIENE)	3160	Liquefied Gas	2.3	Toxic Gases	2.1	N/A	H280, H331, H412, H220, H373	H331	3	E	24	L	GAS1	1	24	L
Hexafluoroethane (C2F6)	76-16-4	HEXAFLUROETHANE, OR REFRIGERANT GAS R 116	2193	Gas	2.2	Compressed Gases	N/A	N/A	H280	H280	N/A	G	50	L	GAS1	1	50	L
Hexamethyldisilazane (HMDS)	999-97-3	FLAMMABLE LIQUID, TOXIC, N.O.S. (1,1,1,3,3,3-hexamethyldisilazane)	1992	Liquid	3	Flammable Liquids	6.1	II	H225, H302, H332, H311	H225	2	N/A	0.5	L	FLAM1	2	1	L
Hydrochloric Acid (>51%)	7647-01-0	HYDROCHLORIC ACID	1789	Liquid	8	Corrosive Substances	N/A	II	H290, H314, H318, H335	H314	1B	N/A	25	L	ACID1	4	100	L
Hydrofluoric Acid (<60%)	7664-39-3	HYDROFLUORIC ACID	1790	Liquid	8	Corrosive Substances	6.1	II	H300, H330, H310, H314, H318	H314	1A	N/A	25	L	ACID1	4	100	L
Hydrogen	1333-74-0	HYDROGEN, COMPRESSED	1049	Gas	2.1	Flammable Gases	N/A	N/A	H220, H280	H220	1A	G	50	L	GAS1	4	200	L
Hydrogen Bromide	10035-10-6	HYDROGEN BROMIDE, ANHYDROUS	1048	Liquefied Gas	2.3	Toxic Gases	8	N/A	H280, H314, H318, H331, H335	H331	3	E	24	L	GAS1	1	24	L
Hydrogen Peroxide (30%)	7722-84-1	HYDROGEN PEROXIDE, AQUEOUS SOLUTIONS	2014	Liquid	5.1	Oxidising Substance	8	II	H272, H302, H314, H332, H335	H272	2	N/A	25	L	DECANT	10	250	L
Liquid Argon	7440-37-1	ARGON, RERIGERATED LIQUID	1006	Cryogenic Liquid	2.2	Compressed Gases	N/A	N/A	H281	H281	N/A	N/A	3000	L	CRYO	1	5000	L

SUBSTANCE OVERVIEW				ADG CODE 2022, EDITION 7.8					WHS REGULATION 2017, SCHEDULE 11				STORAGE OVERVIEW					
NAME	CAS NUMBER	UN PROPER SHIPPING NAME	UN NO.	FORM	DG CLASS	DESCRIPTION	SUBSIDIARY RISK	PACKING GROUP	HAZARD CODES	SCHEDULE 11 HAZARD	CATEGORY	CYLINDER SIZE	PACK SIZE	UNITS	STORAGE LOCATION	# OF PACKS	STORED QUANTITY	UNITS
Liquid Nitrogen	7727-37-9	NITROGEN, RERIGERATED LIQUID	1977	Cryogenic Liquid	2.2	Compressed Gases	N/A	N/A	H281	H281	N/A	N/A	25000	L	CRYO	1	25000	L
Metallic Waste	N/A	HAZARDOUS WASTE, N.O.S.	3082	Liquid	9	Environmentally Hazardous Substance	N/A	III	H302, H318, H400, H410	N/A	N/A	N/A	1000	L	HAZW	1	1000	L
Methanesulfonic Acid	75-75-2	CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S. (METHANESULFONIC ACID)	3265	Liquid	8	Corrosive Substances	N/A	II	H290, H302, H314, H318, H335	H314	1B	N/A	5	L	ACID1	2	10	L
Nickel(II) Sulfate	7786-81-4	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (nickel sulphate)	3077	Solid	9	Environmentally Hazardous Substance	N/A	III	H302, H332, H315, H334, H317, H341, H350, H360, H372, H410	N/A	N/A	N/A	5	kg	DECANT	1	5	L
Nitric Acid (<65%)	7697-37-2	NITRIC ACID, other than red fuming, with less than 65% nitric acid	2031	Liquid	8	Corrosive Substances	5.1	II	H272, H290, H314, H331	H314	1A	N/A	25	L	ACID1	2	50	L
Nitrogen (UHP)	7727-37-9	NITROGEN, COMPRESSED	1066	Gas	2.2	Compressed Gases	N/A	N/A	H280	H280	N/A	G	50	L	GAS1	4	200	L
Nitrogen Trifluoride	7783-54-2	NITROGEN TRIFLUORIDE	2451	Liquefied Gas	2.2	Compressed Gases	5.1	N/A	H270, H280, H332, H373	H280	N/A	G	50	L	GAS1	2	100	L
Nitrous Oxide	10024-97-2	NITROUS OXIDE	1070	Gas	2.2	Compressed Gases	5.1	N/A	H270, H280, H336	H280	N/A	G	50	L	GAS1	2	100	L
Octafluorocyclobutane (C4F8)	115-25-3	OCTAFLUOROCYCLOBUTANE (REFRIGERANT GAS RC 318)	1976	Gas	2.2	Compressed Gases	N/A	N/A	H280	H280	N/A	G	50	L	GAS1	1	50	L
Oxygen	7782-44-7	OXYGEN, COMPRESSED	1072	Gas	2.2	Compressed Gases	5.1	N/A	H270, H280	H280	N/A	G	50	L	GAS1	48	2400	L
PGMEA (Propylene Glycol Monomethyl Ether Acetate)	108-65-6	ETHERS, N.O.S. (2-Methoxy-1-methylethyl acetate)	3271	Liquid	3	Flammable Liquids	N/A	III	H226, H336	H226	3	N/A	25	L	FLAM1	4	100	L
Phosphoric Acid (25-85%)	7664-38-2	PHOSPHORIC ACID SOLUTION	1805	Liquid	8	Corrosive Substances	N/A	III	H314, H290	H314	1B	N/A	25	L	ACID1	2	50	L
Photoresist	Proprietary mixture	RESIN SOLUTION	1866	Liquid	3	Flammable Liquids	N/A	III	H226, H315, H317, H319, H400, H410	H226	3	N/A	1	L	FLAM1	2	2	L
Potassium Dicyanoaurate(I)	13967-50-5	CYANIDES, INORGANIC, SOLID, N.O.S. (Potassium dicyanoaurate(I))	1588	Solid	6.1	Toxic Substances	N/A	I	H300, H330, H310, H400, H410	H300	1	N/A	1	kg	DECANT	1	1	kg
Potassium Hydroxide	1310-58-3	POTASSIUM HYDROXIDE SOLUTION	1814	Liquid	8	Corrosive Substances	N/A	II	H290, H302, H314, H318, H402	H314	1A	N/A	25	L	BASE1	2	50	L
Silane	7803-62-5	SILANE	2203	Gas	2.1	Flammable Gases	N/A	N/A	H220, H280, H332	H220	1A	G	50	L	GAS1	1	50	L
Sodium Hydroxide	1310-73-2	SODIUM HYDROXIDE, SOLID	1823	Solid	8	Corrosive Substances	N/A	II	H290, H314, H318	H314	1A	N/A	1	kg	BASE1	2	2	kg
Sodium Hydroxide	1310-73-2	SODIUM HYDROXIDE, SOLUTION	1824	Liquid								N/A	1000	L	HAZW	1	1000	L
Solvent / Flammable Liquid Waste	N/A	FLAMMABLE LIQUID, N.O.S.	1993	Liquid	3	Flammable Liquids	N/A	III	H225, H319, H336	H226	3	N/A	25	L	FLAM1	10	250	L
Sulfur Hexafluoride	2551-62-4	SULPHUR HEXAFLUORIDE	1080	Gas	2.2	Compressed Gases	N/A	N/A	H280	H280	N/A	G	50	L	GAS1	2	100	L
Sulfuric Acid (>51%)	7664-93-9	SULPHURIC ACID with more than 51% acid	1830	Liquid	8	Corrosive Substances	N/A	II	H290, H314, H318, H335	H314	1A	N/A	25	L	ACID1	8	200	L
													1000	L	HAZW	1	1000	L
Tetramethylammonium hydroxide pentahydrate (TMAH)	10424-65-4	TETRAMETHYLAMMONIUM HYDROXIDE SOLUTION	1835	Liquid	8	Corrosive Substances	N/A	II	H300, H301, H310, H311, H312, H314, H318, H370, H371, H372, H373	H314	1B	N/A	25	L	BASE1	8	200	L
Trifluoromethane (CHF3)	75-46-7	TRIFLUOROMETHANE	1984	Gas	2.2	Compressed Gases	N/A	N/A	H280	H280	N/A	G	50	L	GAS1	1	50	L

**Appendix B – Site Plan**

revision	purpose of issue	date
T01	FOR TENDER	27.09.24



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Lab Design Consultant: **Jacobs**

Project  
**FULL SCALE AMRF BUILDING 2**

215 BADGERYS CREEK ROAD, BRADFIELD

Drawing  
**LOCATION PLAN**

Scale 1 : 20000 @B1 Project no 220479

Drawing No. **AMRFB2-ARC-DRW-AR-020000**

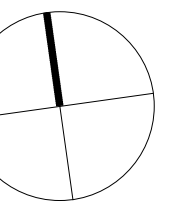
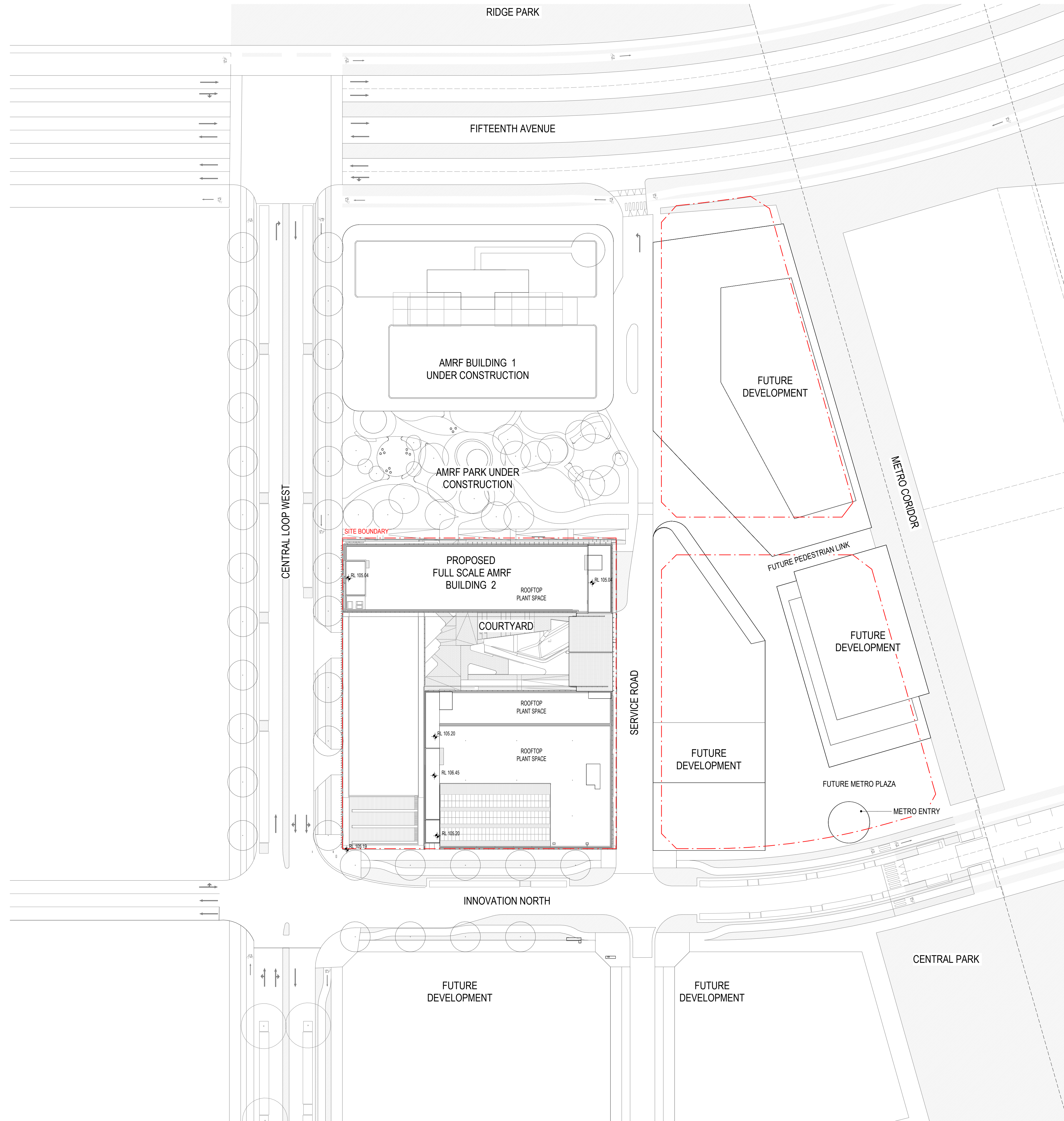
Prepared LRJ revision

Approved BR **T01**

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**TENDER**

revision	purpose of issue	date
T01	FOR TENDER	27.09.24



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Project: **FULL SCALE AMRF BUILDING 2**

215 BADGERYS CREEK ROAD, BRADFIELD  
Drawing: **SITE PLAN**

Scale: 1 : 500 @B1 Project no: 220479

Drawing No: **AMRFB2-ARC-DRW-AR-020010**

Prepared: LRJ revision

Approved: BR **T01**

**TENDER**