



201 Kent Street
Sydney NSW 2000
P: (02) 9299 6605 M: 0411 659 309
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Mr. Tino Ucchino
Brookfield Multiplex
Level 22, 135 King Street,
Sydney NSW 2001

Attention: Mr. Tino Ucchino

Dear Tino,

Subject: Dangerous Goods Preliminary Review

I have reviewed the details of the conceptual design, with regards to the Dangerous Goods (DGs) component of the project, and in summary, the proposed DG storage quantities, layouts and storage design can be configured to comply with the requirements of the NSW Work Health and Safety Regulation 2011, the governing legislation for the storage and handling of DGs in NSW.

Please find attached a DG Report on the proposed storage configurations within the building, indicating how compliance can be achieved, based on the proposed configuration and storage quantities.

Should you have any queries regarding the attached document, please give me a call on 9299 6605.

Yours faithfully,

Steve Sylvester

Associate Director – Risk Engineering
D +61 2 9299 6605 M +61 411 659 309
steve@rawrisk.com



UNIVERSITY OF NEW SOUTH WALES

BIOLOGICAL SCIENCES PROJECT

DANGEROUS GOODS STORAGE

CONCEPTUAL DESIGN DG REPORT

1. INTRODUCTION

1.2 Background

Brookfield Multiplex Constructions (BMC) has been commissioned by the University of New South Wales (UNSW) to design additional facilities for the Biological Sciences precinct, known as the Biological Sciences Project. As part of the Biological Sciences operations, it will be necessary to store and handle a number of Dangerous Goods (DGs), the storage of which must comply with the requirements of the NSW Work Health and Safety Regulation – 2001 (the Regulation). To assist in reviewing the proposed DG storage and handling facilities, BMC has engaged RAWRISK Engineering Pty Ltd (RAWRISK) to provide advice on compliance of the proposed design with the Regulation.

The project is in the second design phase and therefore BMC has requested RAWRISK to provide a preliminary assessment of the proposed DG storage facilities at the Schematic Design Review (SDR) to confirm that compliance can be achieved based on the DG storage Schematic Design configuration.

1.3 Objectives

The objective of the review is to confirm to BMC that the proposed DG storage facilities configuration can achieve compliance with the regulation.

1.4 Scope of Work

The scope of work for this report/study is for a review of the proposed DG storage facilities configuration at the Biological Sciences project, UNSW. The study involves the assessment of the conceptual designs, layouts and configurations for the proposed DG storage areas within the Biological Sciences project only and does not include any other DG storage facilities within the Biological Sciences precinct.

1.5 Qualifications of the Assessors

Steve Sylvester is a mechanical engineer (BEng.mech.hons) with over 40 years engineering experience, including 20 years in plant operation and over 20 years in risk engineering consultancy. Steve has conducted over 500 risk engineering studies in a wide range of industries including oil and gas (up and downstream), chemical and petrochemical facilities, mining and mineral processing, nuclear, aerospace, marine, warehousing and water/sewage treatment plants. He has conducted over 100 DG related projects (including 10 DG projects at the UNSW). Steve is also an accredited Functional Safety Engineer (TUV 2203/10) and a founding member of the Australasian Institute of Dangerous Goods Consultants (www.AIDGC.org.au). As a member of the AIDGC, he is considered by WorkCover NSW as a “Competent Person” under the Work Health and Safety Act 2011 to assess and report on compliance of DG storage facilities in NSW.



Julia Hasche will be assisting Steve Sylvester. Julia is a mining engineer (BEng mining) who is currently being mentored by Steve Sylvester. Julia has completed several Dangerous Goods assessments under Steve's guidance. Relevant projects include the following;

- SRG Brendale;
- MotorActive;
- Rust-Oleum; and
- Wildbreads.

2. CONCEPTUAL REVIEW OF DG STORAGE FACILITIES AT THE BIOLOGICAL SCIENCES PROJECT

A list of proposed room fit out equipment was provided by BMC for review and assessment with regards to the DG storage requirements. **Appendix A** contains a summary of the DG components contained within the Biological Sciences Project on a room by room basis. A review of the proposed equipment and materials to be stored in the facilities the Biological Sciences Project indicated that the following classes of DGs will be stored and handled at the project:

- Class 2.2 Gases (Liquid Nitrogen, Carbon Dioxide, Argon, Helium, Oxygen);
- Class 3 Flammable Liquids;
- Class C1 combustible liquids (diesel fuel);
- Class 8 Corrosive Liquids;
- Class 6 Biohazard Material; and
- Class 7 Radioactive wastes.

Appendix B lists the DG type with its type of storage, Class, location and quantity.

The predominant method of storage of these materials will be in Dangerous Goods Cabinets, located within the various laboratories and preparation rooms throughout the Biological Sciences Project building. However, there will also be a number of gas cylinders, bulk tanks (nitrogen, carbon dioxide, diesel fuel) and acid baths located within specific areas of the facility.

Each storage configuration has been assessed in the following sub-sections.

2.1 DG Storage Cabinets (Flammable Liquids/Corrosive Liquids)

As noted above, the predominant storage method for DGs is within DG storage cabinets. These range from 30 L cabinets to 250 L cabinets. It is understood that DG cabinets will be supplied by manufacturers who provide certification of cabinets with the relevant sections of the Australian Standard relating to the material (DG) stored. Hence, cabinets will comply with the requirement of the relevant standard and would therefore be considered to comply with the requirements of the Regulation. All Class 3 Flammable Liquid cabinets will require ventilation in order to eliminate the requirement for a 3m hazardous zone (ignition source exclusion) surrounding the cabinet. Although the standard does not require Class 8 Corrosive cabinets to have ventilation, it would be prudent to consider such ventilation to provide adequate control of corrosive vapours within cabinets (predominantly for Work Health and Safety reasons). The cabinets are also provided with bunding; hence, it is not necessary to provide bunding for the whole room.



In addition to the DG Cabinet design, the cabinet location must also be considered, taking account of the quantity of DGs stored in each cabinet and the cabinet location with regards to the adjacent DG storages (i.e. other cabinets, cylinders, tanks, etc.). A review of the proposed storage locations indicates that all cabinets can be located such that the requirements of the Regulation are met.

DG Storage Cabinets will be stored in the following rooms:

- RSS Research Shared Support – Tissue Culture 01/Negative Pressure-Ionising Radiation (Levels 3 and 5)
- RSS Research Shared Support – SSBA Room (Level 2)
- RSS Research Shared Support – Negative Pressure_Chemistry 01 (Levels 4 and 5)
- RSS Research Shared Support – Equipment Room-Clean/Instruments (Levels 3,4, and 5)
- PML Precinct – Management labs – Main Stores (Level LG)
- CCA Core – Cell Analysis – Preparation Las-Specimen Lab (Level 2)
- CGE Core – Genomics – Pre-Prep Amplification (Level 2)
- CGE Core – Genomics –Prep-Post Amplification (Level 2)
- CPT Core – Proteomics – Preparation & Biophysical Analysis Lab (Level 2)
- CFS Core – Fieldwork Support – Field gear Store (Level LG)
- CSH Core – Sample Handling – Petrological Prep Laboratory (Level LG)
- CSH Core – Sample Handling – Palaeontological Prep – Sample Sorting/Prep (Level LG)
- TAL Teaching & Learning – WET Teaching Prep 01 (Level G)
- TAL Teaching & Learning – WET Teaching Prep 02 (Level 1)

In addition to the cabinet design and construction requirements, Class 3 flammable liquid cabinets must be compliant with other aspects of AS 1940 Clause 4.9 – Storage in Storage Cabinets. As noted earlier, it is understood that cabinets will be supplied with certification documents for compliance with AS1940 this will ensure the following requirements are met:

AS 1940 Clause 4.9.2 – Cabinet Construction

- a) The walls, floor, door and roof shall be of double-walled sheet steel construction, with a space of at least 40 mm between the walls.

NOTE: This space may be either an air space or filled with non-combustible insulation.

- b) Any gaps around the doors and into the space between the walls shall be sealed as far as is necessary to prevent the spread of flame or heat radiation.
- c) The inner base of the cabinet shall form a liquid-tight compound at least 150 mm deep, and shall be designed to prevent the compound from being used as a storage space.
- d) Any shelves shall be perforated to permit free air movement, and shall be capable of carrying the maximum possible load.
- e) All leakage shall be directed into the lower compound.
- f) All cabinet doors shall be self-closing, close-fitting and held shut automatically by catches at two or more points.
- g) Where doors are equipped with a device to hold them open when necessary, they shall be released automatically the temperature exceeds a nominal 80°C.
- h) The materials of any components that are critical to the cabinet's structural integrity shall not melt at temperatures less than 850°C. Seals or gaskets are excepted, but their use should be avoided if their failure could affect the protective function of the cabinet.



AS 1940 Clause 4.9.4 – Cabinet Marking

Each cabinet shall be marked with -

- a) the name and address of the manufacturer or, for imported cabinets, the distributor within Australia;
- b) the maximum storage capacity;
- c) a Class 3 dangerous goods label with sides of at least 250 mm nominal length; and
- d) Note that where extraction ventilation is provided to Class 3 flammable liquids cabinets, there is no requirement for an ignition source exclusion zone, hence, 3m exclusion zone marking is not required.

All signs and markings shall be clearly visible when the cabinet doors' are closed.

AS 1940 Clause 4.9.5 – Ventilation Provisions

Where ventilation is installed, it shall be designed so that vapours are prevented from escaping into any room. Any ventilation exhaust shall be to the outside atmosphere and in a location which allows the safe dispersal of vapours and is away from any ignition sources.

AS 1940 Clause 4.9.6 – Cabinet Location

The following requirements apply to the location of cabinets for flammable and combustible liquids:

- a) Cabinets shall be located so that they do not impede escape in an emergency.
- b) Cabinets having a capacity **greater** than 250 L shall not be installed in residential or accommodation buildings, commercial buildings, hospitals, aged care buildings or school buildings.
- c) Cabinets having a capacity **greater** than 250 L shall only be installed on floors that have direct access from street or ground level.
- d) Cabinets having a capacity **greater** than 250 L shall not be placed nearer than 3 m to any wall that is common with another room, unless that wall is constructed of concrete or masonry to ceiling height or 3 m above the top of the cabinet (whichever is less) and 3 m to either side of the cabinet.
- e) The aggregate capacity of cabinets shall not be greater than 250 L per 250 m² on any floors.
- f) Each aggregate quantity given in Item (e) shall be separated by at least 10 m.
- g) A storage cabinet may be used for outdoor storage, provided that adequate protection against weather, corrosion and traffic damage is provided.

It is noted that the proposed storage areas at the Biological Sciences Project can be configured to comply with the above requirements

AS 1940 Clause 4.9.7 – Exclusion of Ignition Sources

There shall be no ignition sources within the cabinet. Where flammable liquids are stored, ignition sources shall be excluded from the area outside the cabinet to a distance of 3 m measured laterally, and from floor level to a height of 1 m above any opening in the cabinet, including the door.

Note that were extraction ventilation is provided to Class 3 flammable liquids cabinets, there is no requirement for an ignition source exclusion zone, hence, this clause would not apply. This complies with the provisions of AS60079.0-2012, Explosive Atmospheres Part 0: Equipment – General requirements (Standards Association of Australia).



AS 1940 Clause 4.9.8 – Storage in Storage Cabinets

The following operational requirements and recommendations apply:

- (a) Persons shall be prevented from entering the cabinet.
- (b) Drums shall not be stacked more than two high if they are greater than 60 L capacity.
- (c) Only one drum of more than 60 L capacity should be kept in a horizontal (decanting) position at any time.
- (d) Only closed packages, or those fitted with a tap, should be stored in the cabinet.

Operational requirements can be configured to comply with these clauses.

AS 3780 Clause 2.3 – Precautions for Minor Storage

Class 8 corrosive cabinets must be compliant with AS 3780 Section 2 (Minor Storage) and Clause 4.6 (Requirements Specifically for Indoor Storage Cabinets):

- (a) A supply of water shall be available at a nearby location.
- (b) Adequate ventilation shall be provided for package storage and handling areas
- (c) Packages shall not be kept near incompatible substances.
- (d) Packages shall be kept away from sources of heat.
- (e) Packages shall be kept securely closed when not in use.
- (f) Packages shall be kept in such a manner as to avoid spillage.
- (g) Packages shall be kept on surfaces which, in the event of spillage, are resistant to damage by the contents of the packages.
- (h) Appropriate spillage-retention measures shall be provided at locations where packages are likely to be opened or their contents transferred.
- (i) The contents of a package shall not be transferred to any other container for storage unless the latter is suitable for the storage of the corrosive substance and is clearly and marked to indicate the identity and hazard potential of that substance.

NOTE: Where the contents of a package have been transferred into another container, the resultant package, if it is to be used for transportation, is required by the relevant regulatory authority to comply with the ADG Code.

- (j) Appropriate personal protective equipment shall be worn by any person involved in product transfer operations.
- (k) Any spills or leaks shall be cleaned up immediately, and disposed of in accordance with Section 9.
- (l) Wastes shall be disposed of in accordance with Section 9.
- (m) Storage areas shall be secured against unauthorized entry.

The proposed cabinet storages can be configured to comply with these requirements.

AS 3780 Clause 4.6.1 – Application of Clause

In addition to the requirements of this Clause (4.6), the requirements of Section 2 only, apply to the storage of corrosive substances in indoor storage cabinets.

NOTE: The maximum quantities specified in Clause 4.6.3 always apply to any one storage cabinet.



AS 3780 Clause 4.6.2 - Types of Substances Kept

Cabinets designated for the storage of packages of corrosive substances shall not be used for the storage of incompatible goods or goods with which they might react dangerously.

To comply with this clause, incompatible substances can be stored in separate "tubs" within the cabinet. However, such an operational requirement has no bearing on the facility design and cabinet location.

AS 3780 Clause 4.6.3 – Maximum Quantities to be kept

The maximum quantity of corrosive substances kept in a single cabinet shall not exceed 1000 kg or L, of which not more than 250 kg or L shall be of Packing Group II and not more than 50 kg or L shall be of Packing Group I.

NOTE: Units of kilograms are applicable to solids and units of litres to liquids.

Note that all cabinets are less than 250L.

AS 3780 Clause 4.6.4 – Cabinet Design

As noted earlier, it is understood that cabinets will be supplied with compliance certificates from the manufacturer, hence, all cabinets will comply with the design provisions of the standard.

The following requirements apply to the design of cabinets, which will be certified by the manufacturer:

- (a) Cabinets shall be provided with a self-closing, close-fitting door, held shut by catches at no fewer than two points. The door shall not open inwards, and shall be capable of being opened from inside the cabinet.
- (b) The cabinet bottom shall form a liquid-tight compound at least 150 mm deep and capable of containing at least 25% of the maximum storage capacity.
- (c) Any shelves within cabinets shall be such as will permit free air movement.

AS 3780 Clause 4.6.5 – Materials of Cabinet Construction

The walls, floor, doors and roof of a cabinet shall either be constructed of corrosion-resistant materials or be protected by a corrosion-resistant lining or coating.

AS 3780 Clause 4.6.6 –Cabinet Location

The following requirements apply to the location of cabinets:

- (a) Cabinets shall be located so that they will not impede the escape of persons in the event of fire.
- (b) Cabinets shall be located near to a provision for the washing of hands.
- (c) Where there is more than one cabinet in any building or area, either –
 - i. the aggregate quantity of corrosive substances kept in all such cabinets shall not exceed the quantities specified in Clause 4.6.3; or
 - ii. the cabinets shall be separated from each other by at least 5 m.

AS 3780 Clause 4.6.7 –Cabinet Marking

Cabinets shall be marked in accordance with regulatory requirements.

Where there are no such requirements, each cabinet shall be marked with -

- (a) the name and address of the manufacturer or, for imported cabinets, the distributor within Australia;
- (b) the maximum storage capacity; and
- (c) a Class 8 dangerous goods label with sides of at least 100 mm nominal length.



All signs and markings shall be clearly visible when the cabinet doors are closed.

2.2 Gas Cylinders (Argon, Helium and Oxygen)

Information provided by BMC, regarding gas cylinder storage, indicates that the total number of cylinders stored is 14 x G size cylinders (i.e. 1 G size cylinder = 50 L Water Capacity or WC). Based on this, the total water capacity of cylinders is 700 L (100L of Class 2.1 gases, and 600 L of Class 2.2 gases). Noting that all gases are Class 2.1 or 2.2, AS4332-2008 (Ref.1) indicates that Class 2.1 gases stored below 500 L and Class 2.2 gases stored below 2,000 L WC of cylinders are classified as minor storage. Hence, the proposed gas storages would be classified as minor storage.

Compliance with AS4332 (Ref.1) requires a number of minor precautions that are readily achievable in the proposed storage locations, including ventilation. Hence, compliance of the gas cylinder stores with the regulation is considered to be achievable, based on the proposed quantity of gases and storage locations/configurations.

Gas Cylinders will be stored in the following rooms:

- RSS Research Shared Support (Levels 2,3,4, and 5)
- RSS Research Shared Support – SSBA Room (Level 2)
- PML Precinct – Management Labs – Bulk Gas Store (Level LG)

The following “precautions” should also be observed when storing and handling gases of minor quantities in cylinders:

AS4332 Clause 2.5 – Precautions for the Storage of Gases in Minor Quantities

- a) Areas in which cylinders are kept shall be –
 - i. away from any artificial sources of heat; and
 - ii. kept clear of combustible materials, vegetation and refuse for a distance of not less than 3 m from any cylinder.
- b) All cylinder stores shall be provided with adequate ventilation at all times.

NOTES:

- 1 Ventilation should be adequate to maintain exposure levels to any gases in the store below recommended workplace exposure standards and lower explosive limits, and to maintain safe oxygen levels.
- 2 Reference should be made to AS 1668.2 for requirements for mechanical ventilation of enclosures. [*Note: ventilation in smaller rooms may require review under the provisions of the Work Health and Safety Regulation (2011)*]
- c) The precautions stated in Clause 5.2 and training described in Clause 5.3 shall apply to the storage of gases in cylinders in minor quantities, as appropriate to the types of gases being stored.
- d) Classes of gases shall be segregated within the store, but need not be separated.

Precautions and training listed in Clauses 5.2 & 5.3 are operational issues and do not affect the design, construction and location of cylinders.

NOTE: Appendix D provides guidance on dealing with leaks.

- e) The floor should be flat, solid, and constructed from non-combustible materials. It should drain away from the cylinders. Concrete flooring is preferred (see also Clause 4.2.1(b)).



AS4332 Clause 2.6 Outdoor Minor Storage

Outdoor minor stores of Class 2 gases in cylinders shall be separated from other dangerous goods stores by a minimum distance of 3 m. They shall be located not less than 1 m from any door, window, air vent or duct.

AS4332 Clause 2.7 Indoor Minor Storage

Clause 2.7.1 General

The indoor use and storage of gas cylinders should be avoided wherever possible. Where it is impractical to provide an outdoor cylinder store, the keeping of cylinders indoors shall be restricted as follows:

- a) The total capacity of gas in cylinders allowed for any particular indoor location shall include cylinders in use, spare cylinders not in use, and used cylinders awaiting removal.
- b) The total capacity of the gases kept shall not exceed one minor storage quantity per 200 m² of floor area. Where the floor area exceeds 200 m² any arrangement that could result in an undue concentration of cylinders shall be avoided.
- c) Indoor minor stores of gases in cylinders shall be separated from other minor stores of gases or other dangerous goods stores by a minimum distance of 5 m.
- d) Except for Class 2.2 gases having no subsidiary risks, there shall be no minor storage in basements.
- e) Where cylinders are kept inside a building or a confined area, e.g. a shipping container, that building or area shall be adequately ventilated. Such ventilation shall be achieved by natural air movement or equivalent.

A review of the proposed storage locations for gas cylinders indicates that the storage areas can be configured to comply with the majority of requirements of the standard and that risk assessment may be used, in accordance with the Work health and Safety Regulation (2011) where minor non-compliances may exist. In summary, the proposed cylinder storage designs can be configured to comply with the provisions of the NSW Work Health and Safety Regulation 2011.

2.3 Bulk Gas Tanks (Liquid Nitrogen, Carbon Dioxide)

Liquid nitrogen will be stored at lower ground level in a 6,000 L cryogenic vessel.

Section 3 (Storage Vessels and Ancillary Equipment) of AS 1894 is applicable to the storage of liquid nitrogen and carbon dioxide in bulk gas tanks. This Section sets out requirements and recommendations for the location, marking, installing and commissioning of storage vessels and ancillary equipment for non-flammable cryogenic or refrigerated liquids. The 6,000 L cryogenic vessel will be supplied by the gas provider (e.g. BOC, Linde, Coregas, etc.) and will be provided with a compliance certificate to the relevant Australian Standard for the storage of cryogenic gas (AS1894, Ref.2). The storage of gas within a “room”, open to atmosphere is permitted within the provisions of the standard (AS1894), however, room dimensions are critical in controlling the potential hazards. Where pipework is used to reticulate nitrogen gas within the Biomedical Sciences building, if joints on the pipes are not welded, a method of detecting nitrogen release will be required (e.g. oxygen depletion), this will be provided by the Life Safety System (LSS) within the facility and is outside the scope of this document.

Hence, the main requirement for the gas storage will be compliance with the location requirements (Section 3.5 – Location of Storage Vessels) of the Australian Standard to demonstrate compliance with



the relevant sections of the Regulation. This Section sets out requirements and recommendations for the location of storage vessels and ancillary equipment for non-flammable cryogenic or refrigerated liquids.

The bulk gas tank will be stored in the PML Precinct – Management Labs – Bulk Gas Store (Level LG). A review of the location provision detailed within the Australian Standard, for liquid nitrogen, indicates that the proposed storage locations can be configured to comply with the requirements of the standard and therefore the Regulation.

AS1894 Clause 3.5.1 - General

The installation shall be located so as to minimize the risk to personnel, local population and property. Consideration shall also be given to the location of any potentially hazardous processes in the vicinity which might jeopardize the integrity of the storage, or on which the storage might impact. The requirements of the relevant regulatory authority shall also be met.

The location chosen for the installation shall be acceptable to both the gas supplier and the user of the cryogenic or refrigerated liquids and shall be such that it is readily retrievable or accessible for maintenance purposes.

Vessels containing inert cryogenic or refrigerated liquids (defined in the standard as non-flammable, non-toxic gases i.e. class 2.2 gases) shall be located in accordance with the requirements of Section 5 (Special Requirements for Nitrogen, Argon, Helium, and Carbon Dioxide).

AS1894 Clause 3.5.2 - Protection against Vehicular Damage

Storage vessels shall be protected against accidental damage from vehicles and forklift trucks by a guardrail or traffic bollards. Where a guardrail is installed, it shall be of heavy construction and installed so as to provide a clear floor area of at least 1 m all around the vessel.

Filling points shall be similarly protected.

A review of the proposed location of the cryogenic gas tank indicates that the location could be configured to comply with the requirements of the standard and therefore meet the requirements of the Work Health and Safety Regulation (2011).

AS1894 Clause 3.5.4 - Indoor Installations for Inert Cryogenic and Refrigerated Liquids

3.5.4.1 Location

Internal siting shall only be considered after exhaustive investigation has shown that there is no suitable outdoor location. If this is the case, the vessel shall be placed on a level floor, preferably above ground level, as far away from normal work locations as is practicable.

Oxidizing fluids shall not be stored indoors.

The proposed location for the bulk nitrogen tank is not considered an indoor location.

3.5.4.2 Ventilation

Areas where cryogenic or refrigerated liquids are stored and or used shall be ventilated to prevent the accumulation of gas or vapour which could evaporate from the liquid.

The vessel's location shall be adequately ventilated so as to disperse the gas or vapour evaporating from any liquid spill without reducing the oxygen content of the surrounding air below 18%. This shall be provided by one of the following:



- a) Siting the vessel against an external wall and incorporating into that wall a wire mesh, lattice or louvered opening equivalent in size to the width of the vessel being installed, and of a height from floor level to the vessel fill point. The opening shall not incorporate any means of being sealed, nor allow discharge to areas of public congregation or into any basements, pits or trenches.
- b) Providing natural cross-ventilation by means of permanent openings of not less than 10 m² inlet and 10 m² outlet per 1000 m³ of vessel full gas volume, in close proximity to the vessel.
- c) Providing continuous forced exhaust ventilation of a capacity not less than 10 m³/min per 1000 m³ of vessel full gas volume.
- d) The total free space of the building shall be sufficient to ensure that the oxygen content in the atmosphere will not be reduced below 18% in the event of total evaporation of entire vessel contents. Based on the assumptions that –
 - i. the initial oxygen content is 20%; and
 - ii. the inert gas will displace an equivalent volume of air from the building (making no allowance for ventilation);

the total free space air volume in the building shall be at least 10 times the total full gas volume of the contents of the vessel.

Where the above ventilation requirements cannot be met, the space in which the vessel is kept shall be well ventilated prior to entry

Where the vessel is located in a confined space, AS 2865 (Safe Working in a Confined Space) shall be referred to.

It is noted that the proposed bulk nitrogen tank would comply with sub-clause (a) above.

3.5.4.3 Vents and Relief Valves

Pressurized vessels for cryogenic or refrigerated liquids which are located inside a building that does not meet the ventilation requirements of Clause 3.5.4.2 shall have any vents or relief valves piped to an external atmosphere or to an external recovery system.

It will be necessary to ensure the pressure relief vents are piped to an external location.

3.5.4.4 Mechanical Ventilation

When processes that generate large amounts of gas are conducted indoors, the gas produced shall be vented by mechanical means into the atmosphere away from areas where people work or congregate, in order to ensure an acceptable atmosphere for human occupation. To prevent icing-up of the mechanical ventilation system, the exhaust gas should be mixed with ambient air or heated to a temperature above 0°C.

The following Section sets out additional requirements for the storage and handling of inert, non-oxidizing cryogenic and refrigerated liquids.

This section would not be applicable to the Biological Sciences Project.

AS1894 Clause 5.2 - General

The special hazards associated with inert cryogenic and refrigerated liquids stem from the possibility of the creation of oxygen-deficient atmospheres in the work area, owing to displacement of the atmosphere by inert gas evaporating from the liquid.



AS1894 Clause 5.3 - Oxygen Enrichment

The boiling point of nitrogen is significantly lower than the boiling point of oxygen. If liquid nitrogen is exposed to the atmosphere, atmospheric oxygen will condense into the liquid. If this is allowed to continue for any length of time, the oxygen content of the liquid can become appreciable and the same precautions as those for liquid oxygen will be required.

Due to the possibility of oxygen enrichment, inert cryogenic or refrigerated liquids should not be stored for long periods in an open system, e.g. in a flask. An indication of oxygen enrichment is a blue tinge in the liquid. Any oxygen impurity in nitrogen or helium will concentrate in time due to the lower volatility of the oxygen.

This section is not considered applicable to the Biological Sciences Project. Incidents involving accidental release will be covered in the building emergency plan and will not affect the design/construction phase of the project.

AS1894 Clause 5.4 Location of Storage Vessels

Storage vessels shall be located in accordance with Figure 5.1 and Table 5.1 from AS1894 (**Figure 2-1** and **Figure 2-2** respectively).

AS1894 Clause 5.6 Special Precautions for Carbon Dioxide

A carbon dioxide-enriched atmosphere is especially hazardous because carbon dioxide has toxic properties at high concentrations, even when there is adequate oxygen for life support.

For poorly ventilated installations, a carbon dioxide monitor should be installed, with detector displays or warning signs located so that they are clearly visible to persons entering the affected area. The site shall be assessed to establish where the carbon dioxide (which is heavier than air) might accumulate, and the detector measurement head located in that area.

NOTE: It is recommended that detector displays or warning signs be located outside the affected area.

It is noted that the Biological Sciences Project LSS will be installed to cater for potential gas release and detection of oxygen deficient atmospheres, this is not within the scope of this document.

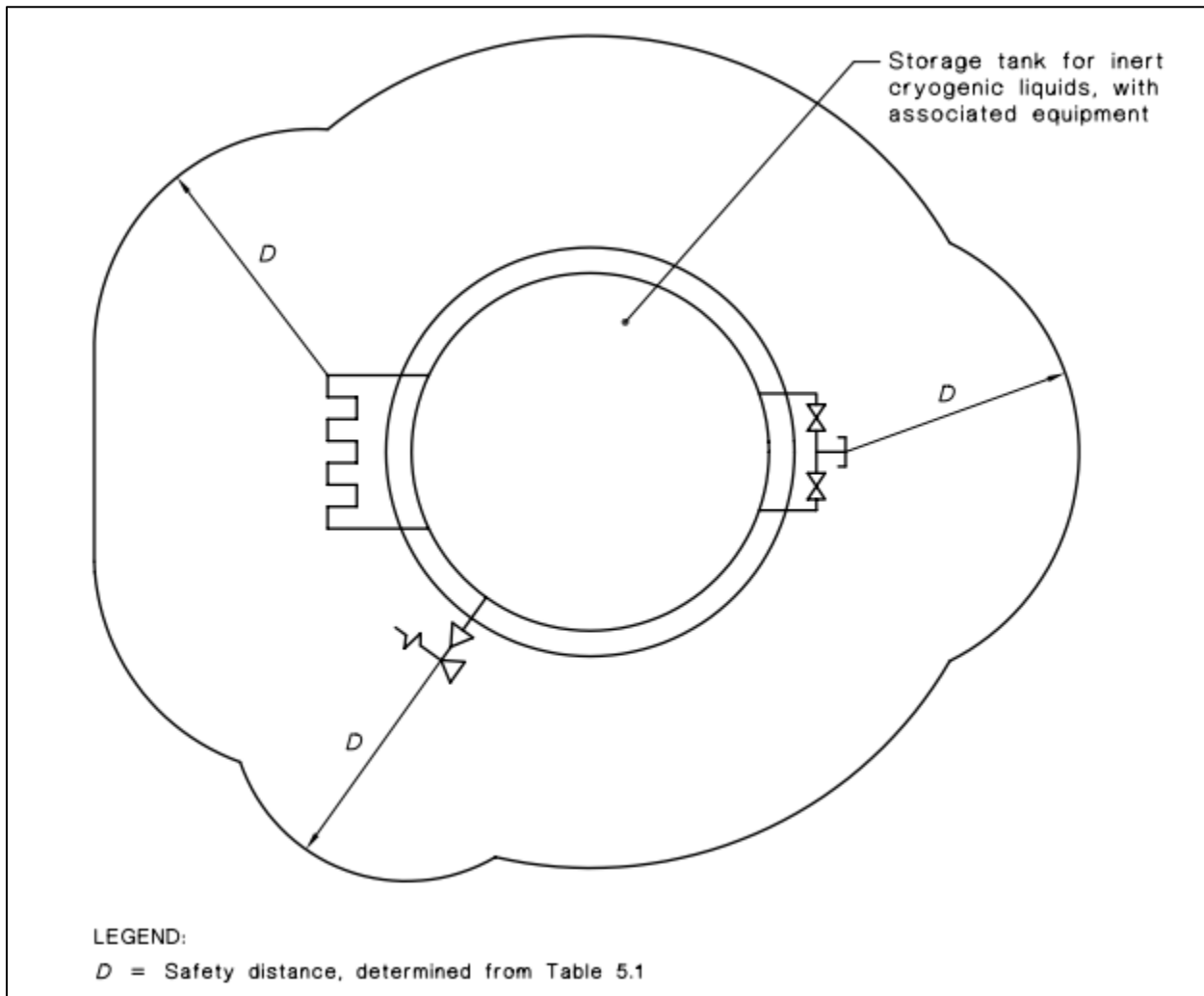


Figure 2-1: Safety Distances Definition for Storage Vessel for Inert Cryogenic or Refrigerated Liquid with Associated Equipment (Figure 5.1 from AS 1894)



Group No.	Item(s) from which separation is required	Aggregate water capacity of storage vessels, L	Minimum distance, 'D', m
I	<ul style="list-style-type: none"> Continuous section of pipeline containing flammable gas or liquid, not interrupted by fittings, e.g. valves, unions, flanges Building or structure with non-combustible exterior, or sprinklered building of other construction (see Notes 8 and 9) 	≥ 50 $\leq 1\ 000$	1
		$>1\ 000$ $\leq 30\ 000$	1
		$>30\ 000$ $\leq 200\ 000$	1
II	<ul style="list-style-type: none"> Property boundary (see Note 2) Street, road boundary or car park, other than for authorized vehicles (see Notes 3 and 4) Areas where open flames, smoking or sources of ignition are permitted Fixed installations of gases in cylinders* (see Note 8 and 9) Other dangerous goods stores of other classes or subsidiary risks† 	≥ 50 $\leq 1\ 000$	1
		$>1\ 000$ $\leq 30\ 000$	2
		$>30\ 000$ $\leq 200\ 000$	3
III	<ul style="list-style-type: none"> Medium or high voltage electrical equipment greater than 415 volts, e.g. substations, transformers or motor control centres (see Notes 3 and 4) Building or structure with combustible exterior (see Note 9) Process equipment and machinery that is not part of the installation** Fittings, e.g. valves, unions, flanges, in pipeline containing flammable gas or liquid Openings to underground drains, pits, ducts, surface water drains, or openings or systems below ground level Openings in walls of adjacent buildings or structures (see Notes 3 and 4) 	≥ 50 $\leq 1\ 000$	1
		$>1\ 000$ $\leq 30\ 000$	2
		$>30\ 000$ $\leq 200\ 000$	3
IV	<ul style="list-style-type: none"> Areas where personnel can congregate, e.g. offices, lunchrooms (see Notes 3 and 4) Compressor or ventilator air intakes 	≥ 50 $\leq 1\ 000$	2
		$>1\ 000$ $\leq 30\ 000$	2
		$>30\ 000$ $\leq 200\ 000$	3
V	<ul style="list-style-type: none"> Places of public assembly (see Notes 3 and 4) Areas of buildings where patients are confined to bed (see Notes 3 and 4) Solid combustible material (see Notes 4, 5 and 7) 	≥ 50 $\leq 1\ 000$	3
		$>1\ 000$ $\leq 30\ 000$	3
		$>30\ 000$ $\leq 200\ 000$	3

* For separation from stores of gas cylinders, see AS 4332.

** Where these separation distances cannot otherwise be achieved, they may be reduced subject to the satisfactory outcome of a risk assessment.

† Greater separation distances may be required by the Australian Standards for the other dangerous goods, or by regulations.

NOTES TO TABLE 5.1:

1 For vessels having a water capacity greater than 200 000 L, the separation distances are subject to the requirements of the relevant regulatory authority.

2 The separation distance given in this Table assumes that any structure on the adjoining property does not dictate a greater separation distance. Subsequent construction on the adjoining property could alter this requirement.

3 This separation distance may be measured around a vapour barrier (see Clause 1.5.32), which may be a screen wall (see Clause 1.5.26).

4 This separation distance is measured horizontally. To obtain a vertical separation, the horizontal distance shall be multiplied by a factor of 0.6.

5 These separation distances may be halved if the combustible material is slow-burning, e.g. coal or heavy timber.

6 Separation distances shall be measured horizontally in accordance with Figure 5.1.

7 'Combustible materials' refers to such things as used boxes or cartons, waste paper, firewood, tyres, or the like, but not materials in structures such as timber in a fence or building wall.

8 Alternatively, separation may be achieved by the use of a non-combustible splash-guard that is as high as any pipework connected to the vessel, or extends at least 500 mm above the uppermost point of any cylinder, whichever is the higher. Cylinders shall be kept at least 50 mm above the ground.

9 For vessels having a water capacity of 750 L or less, this distance may be reduced to zero.

Figure 2-2: Minimum Separation Distances for Inert Cryogenic or Refrigerated Liquid with Associated Equipment (Table 5.1 from AS 1894)

2.4 Portable Nitrogen Dewars

100 L Nitrogen dewars will be stored in the following rooms:

- RSS Research Shared Support – Tissue Culture (Levels 1, 3 and 4)
- RSS Research Shared Support – Negative Pressure_QC2 (Level 4)
- CCA Core – Cell Analysis – Preparation Las-Specimen Lab (Level 2)

Section 2 (Portable Dewars and Portable Pressure Flasks) of AS 1894 is applicable to the storage of the portable nitrogen dewars. The following lists requirements and recommendations for the storage and handling of Class 2.2 cryogenic or refrigerated liquids in dewars.

AS1894 Clause 2.2.1 – General

Only flasks that have been specifically designed for cryogenic and refrigerated liquids shall be used. Special care shall be taken to avoid bumping and jarring when using and handling the flasks (see Clause 2.2.3).

It is understood that the flasks used by the University are appropriate for the use of liquid nitrogen storage, hence, no further assessment is conducted in relation to this clause.

AS1894 Clause 2.2.2 – Formation of Frozen Plug

If a plug of frozen material forms beneath the lowest vent in a flask containing cryogenic liquid, it is unlikely that the vessel will be able to withstand the pressure that can build up. The formation of a frozen plug can be indicated by -

- (a) a disconnected transfer line which is known to have been connected;



- (b) an inability to insert the transfer line;
- (c) a lack of detectable boil-off; or
- (d) ice formation around the neck of the flask.

The flask should be disconnected and personnel evacuated. Any attempt to remove the plug shall only be made by a person skilled in the procedure.

This clause is related to operational requirements of flasks and cryogenic Dewars and does not impact on the design/construction of the facility.

AS1894 Clause 2.2.3 – Handling

The following precautions shall be observed:

- (a) Do not drop the container.
- (b) Surround any external pipework and control valves with a structure to prevent damage during handling. Where necessary, provide an additional structure to prevent damage to the outer vessel during handling.
- (c) Lift only at designated slinging points or at specifically provided tine pockets.
- (d) 'Tie down' the container at designated points. Do not 'tie down' around the outer vessel.
- (e) Only containers that have been specifically designed for transportation shall be used.
- (f) Only trolleys that are specifically designed for moving these containers shall be used.
- (g) Cryogenic or refrigerated liquids that have a Subsidiary Risk of Class 5.1 shall not be stored or transported in open-necked dewar flasks.
- (h) Any cap supplied with the flask shall be
 - i. fitted when the contents of the flask are not in use; and
 - ii. sufficiently loose-fitting so as to prevent pressure build-up.

This clause is related to operational requirements of flasks and cryogenic Dewars and does not impact on the design/construction of the facility.

2.4 Bulk Acid Tanks (Large & Small)

Two bulk acid tanks will be used for acid baths (1,000 L and 500 L). Tanks will be located within CSH Core Sample Handling area on level LG. The baths will require spill retention and ventilation, both of which can be provided within the area proposed. Options are to provide "double skin" tanks to eliminate the requirement for a bunded area within the specific room in which the tanks are installed. Alternately, a false fibre-glass grated floor can be installed and a large floor area bund constructed to contain any spillage. Ventilation can be provided at the tank/liquid surface to extract vapours and minimise accumulation of harmful releases.

Section 5 (Storage and Handling in Bulk) sets out requirements and recommendations applicable to the storage and handling of corrosive substances in tanks and other bulk containers.

Any tank that is intended for the storage of corrosive liquid shall comply with AS3780 or other appropriate specification.

AS3780 Clause 5.3 - Location of Bulk Containers

5.3.1 General

Bulk containers for corrosive substances shall not be wholly or partly buried. Tanks will be above ground and therefore satisfactory.



5.3.2.2 Separation Distances

Bulk containers shall be separated in accordance with the following requirements:

- a) The minimum separation distance between containers shall be 0.6 m (see also Clause 7.2.1(a)).
- b) The minimum separation distances for bulk containers from protected places and the boundaries of the premises shall be as set out in Table 5.1 of the standard.
- c) Where a bund is provided, subject to the concession in the Note to Table 5.1 of the standard, the minimum distance between the top inside perimeter of the bund and any protected place or boundary shall be 3 m (see also Clause 7.2.1(a)).
- d) Where a double-walled tank has an FRL of at least 240/240/240, the following separation distances apply (see also Clause 5.7.8):
 - i. To on-site and off-site protected places, the distances given in Table 5.1 may be halved (as both acid tanks stored at the UNSW Biological Sciences facility will be less than or equal to 3,000 L, this equates to a separation distance of 1.5 m if the tank is doubled walled and has an FRL of 240/240/240).
 - ii. To boundaries and protected places - 2 m.
 - iii. To any security fence - 1 m. up to here

Container capacity kg or L		Separation distance, m			
		Packing Group I		Packing Groups II and III	
		Solid	Liquid	Solid	Liquid
>3000	≤3000	3	3	3*	3*
	≤50000	5	8	3	5
	>50000	10	15	5	8

Figure 2-3: Minimum Separation Distances for Bulk Containers from Protected Places and Boundaries (Table 5.1 of AS3780)

Based on the proposed location, it is considered that the bulk tanks can be arranged to meet the requirements of the standard.

5.3.3 Segregation

Corrosive substances that are kept in bulk shall be segregated from incompatible goods and goods with which they might react dangerously in accordance with the following:

- a) Where the substances being kept are incompatible, they shall be –
 - i. kept in separate compounds; or
 - ii. segregated by a distance of not less than 5 m, except that, where both of the incompatible substances are solids, the minimum segregation distance may be reduced to 3 m.
- b) Where the substances being kept react dangerously, they shall –
 - i. be segregated by a distance of not less than 5 m; and
 - ii. not be kept within the same compound, or in compounds that share a common drainage system.

It is understood that the substances within the tanks are compatible, hence, no segregation will be required.



AS3780 Clause 5.4 – Bunds and Compounds

5.4.1 General

All above-ground tanks for corrosive substances shall be provided with a compound complying with the requirements of this Clause (5.4).

5.4.2 Capacity of Compounds

The net capacity of a compound shall be not less than 100% of the capacity of the largest container located within the compound.

NOTE: In order to facilitate the management of emergencies, it is recommended that compound capacities be about 10% greater than the minimum values specified above.

5.4.3 Design and Construction

Compounds and, where they are provided, bunds shall comply with the following requirements:

- a) The materials of construction shall be substantially immune to attack by any corrosive substance that they may be required to contain.
- b) They shall be sufficiently impervious to retain and to enable the recovery of any spillage.
- c) Except where the containers are double-skinned, the minimum separation distance between a container and the bund shall be as shown in Figure 5.1, i.e. the top inside edge of the bund shall not be inside the crest locus limit. If, at any time, the container is to be held under pressure, the so-determined minimum separation distance between the bund and the container shall be increased appropriately.

The distance between the tank and the band may be less than 1 m where the tanks have a capacity not greater than 3000 L.

- d) For containers that are double-walled, and where the secondary containment has an FRL of at least 240/240/240, Clause 5.3.2.2(d) shall apply.
- e) They shall be designed to withstand the hydrostatic pressure expected to be exerted on them when they are full.
- f) The point at which any pipe passes through the wall of a bund shall be sealed to prevent leakage from the compound.
- g) Provision shall be made such that entry and exit by personnel into and out of the compound, under both normal conditions and emergency conditions, shall be ergonomically safe.



Figure 2-4: Bund Location Limits (Figure 5.1 from AS3780)

5.4.4 Compound Drainage

A compound shall be drained in accordance with the following requirements:

- a) Substances that might react dangerously shall not be directed into a common compound.
- b) Any valve controlling the drainage from a compound shall be located outside the bund. The valve shall be of a type for which the distinction between the open and shut positions is obvious, and shall be resistant to the material contained in the tank and to any possible mixtures resulting from a spill into the compound.
- c) Except during the supervised drainage of water, any compound drain valve shall be kept closed.

The drainage provision for the compound should slope away from any bulk container to a sump which, in turn, is drained from the lowest practicable level. Where drainage is achieved by gravity, a manually-controlled, normally-closed valve shall be provided. Where drainage is achieved by pumping, the pump shall be manually controlled.

NOTE: Drainage by gravity, and the subsequent disposal of the waste, may require consultation with the relevant regulatory authority.

In summary, the acid baths within the CHS Core Sample Handling areas rooms can be configured to comply with the requirements of AS3780-2008 (Ref.4).

Based on the proposed tank design and location it is considered that the spill retention can be configured to meet the requirements of the standard.



2.5 Bulk Diesel Tank (Combustible Liquid)

The bulk diesel fuel tank (combustible liquid Class C1) will be located in a dedicated diesel tank room on Lower Ground floor (accessible from street level). The design brief indicates that the tank capacity will be required to maintain continuous diesel generator operation for 48 hours. Based on this, the design brief indicates a diesel tank capacity of 35m³. In addition to the bulk fuel storage, a diesel fuel day tank will be located in the generator room. This tank capacity will be decided based in the diesel engine selection and supply, however, this is anticipated to be in the order of around 1,000 L.

Diesel tank storage will be required to comply with the relevant sections of the Work Health and Safety Regulation (2011), and relevant Australian Standard (AS1940-2004, Clause 5.7.2, Ref.3). The storage of 35 m³ of combustible liquids Class C1 is classified as bulk storage and 1000 L of Class C1 combustible liquids is classified as a minor store, under the provisions of AS1940.

In summary, the storage of bulk combustible liquids (in tanks within rooms) requires the tank to be a double skin tank (i.e. integral secondary containment, with the room walls having and FRL 240/240/240 (Clause 5.6.3.2 of AS1940). The tank filling point will require a tank level indicator so that the filling operator will have a clear indication of the tank level when filling. The use of an integrally bunded tank will provide the required spill containment and no bunding will be required within the room. Tank vents will be required to extend to the exterior of the building and will be required to discharge at least 4m above ground level.

Compliance with the Regulation and Australian Standard for minor storage requires a number of minor precautions (predominantly operations with little impact on design and construction). These precautions are readily achievable in the proposed storage location (i.e. adjacent to the diesel engine).

Based on the above requirements, it is considered that compliance of the diesel fuel storage with the regulation & standard can be achieved in the proposed location and configuration. A detailed requirement for tanks in rooms is provided in the following sections.

AS1940 Clause 5.6.3.1 Class C1 Liquids

Tanks having a capacity of 1,000 L or less may be installed anywhere within the building, provided that -

- a) such tanks are not interconnected;
- b) provision is made to contain the spread of any small leak or spill; and
- c) such tanks are separated from each other, and from any other tanks, by at least 3 m.

AS1940 Clause 5.7.2 Separation distance from tank to protected places, security fences or to on-site protected places

A tank or tanks shall be located so that the following minimum separation distances are maintained:

- a) To security fences and on-site protected places, Table 5.3.
- b) To a protected place beyond the site boundary, Table 5.4.
- c) Except where provided with cooling water in accordance with Appendix J, the layout of tanks storing flammable liquids (or combustible liquids within the same compound as flammable liquids) shall be such that any tank is accessible on at least two sides from an access road outside the bund.

The separation distance to a protected place on an adjacent property may be measured across the property boundary as if the boundary did not exist.



Note also, separation may be measured around a fire wall (FRL 240/240/240). Hence the fire wall discussed above provides the appropriate separation for the tank.

Separation required from tank to:	Minimum distance, m*		
	Flammable liquid	Combustible liquid	
		C1	C2
Fill points†, platforms or package storage	Diameter of the tank or 15 m, whichever less, but not less than 6 m	Diameter of the tank or 7.5 m, whichever is less, but at least 3 m	Unrestricted, determined by the compound
Office buildings, warehouses, manufacturing and processing areas, workshops or amenities blocks on the same premises	Distance required by Table 5.4, but need not exceed 15 m	Distance required by Table 5.4 but need not exceed 7.5 m	
Security fence‡	Diameter of the tank or 15 m, whichever is less, but not less than 6 m or the distance obtained from Table 5.4 whichever is the lesser	Diameter of the tank or 7.5 m whichever is less, but at least 3 m	

* Refer to the various rules for alternative distances when vapour barriers are used.
 † Points for filling packages, drums or tank vehicles and not the fill point into the storage. Where the liquid being transferred and the liquid in the adjacent storage under consideration are of different classes, determine the separation as if both were of the lower flash point of the two.
 ‡ For distance to boundaries, see Clause 3.2.5.2.

Figure 2-5: Separation Distances for Tanks to Security Fences and On-site Protected Places (Table 5.3 of AS1940)



Maximum capacity of any tank, m ³ (kL)				Minimum distance m
Flammable liquids		Combustible liquids		
PG I, PG II	PG III	C1	C2	
0.25	0.5	2.5	5	Unrestricted
1	4	10	20	3
2	8	20	40	4
4	16	40	80	5
7	28	70	140	6
10	40	100	200	7
14	56	140	280	8
20	80	200	400	9
26	104	260	520	10
34	136	340	680	11
42	168	420	840	12
52	208	520	1 040	13
64	256	640	1 280	14
77	306	770	≥1 540	15
170	680	1 700		20
310	1 240	≥3 100		25
500	2 000			30
750	≥3 000			35
1 100				40
1 500				45
≥2 000				50

Figure 2-6: Separation Distances for Tanks to Protected Places (Table 5.4 of AS1940)

AS1940 Clause 5.8 Bunds and Compounds

5.8.1 Requirements

Provision shall be made to contain any leakage or spillage from the tank storage facility and to prevent it from contaminating the surrounding soil or from entering any watercourse or water drainage system.

Any above-ground tank shall be installed within a compound, except where the quantity of liquid stored is in a tank which has integral secondary containment complying with Clause 5.9.

Consideration should be given to the installation of an integrally bunded tank. This would provide compliance with many of the requirements in the standard, minimising the construction requirements for bunds. However, a fire wall would still be required around the tank.

5.8.2 Capacity

The net capacity of a compound shall be at least the capacity of the largest tank. The capacity of on-site containment shall be increased to include the output of any fire water over a 20 min period. If two or more tanks are operated as a single unit, then the capacity of all such tanks shall be used when calculating the capacity of the compound.

Note: if an integrally bunded tank is provided, then the requirements for bunding and fire water containment is negated.



5.8.3 Design and Construction

A compound and its associated bund shall comply with the following requirements:

- a) It shall be sufficiently impervious to retain spillage and to enable recovery of any such spillage.
- b) In a fire situation, the bund shall retain the structural integrity
- c) Any bund or compound floor shall be designed to withstand the hydrostatic head when full.

5.9.2 Requirements for all Tanks having Integral Secondary Containment (AS1940)

The following requirements apply to tanks with integral secondary containment:

- (a) The tank shall not be used for the storage of PG I flammable liquids.
- (b) The capacity of the tank shall not exceed—
 - (i) 55 000 L for PG II liquids;
 - (ii) 110 000 L for PG III liquids; or
 - (iii) 110 000 L for combustible liquids.
- (c) The primary (inner) tank shall be constructed to AS 1692 or equivalent Standard.
- (d) The secondary containment shall be adequately designed and constructed, to contain the entire contents of the primary tank.
- (e) Means shall be provided to establish and monitor the integrity of the primary tank.
- (f) The tank shall be installed in accordance with Clause 5.11 or 5.12.6 as appropriate.
- (g) Where flammable liquid or vapour could escape from the interstitial space of a tank, the tank shall be separated by at least 3 m from any ignition source, including vehicles being refuelled.
- (h) Spacing between adjacent tanks shall be at least 600 mm.
- (i) The tank shall be capable of resisting damage from the impact of a motor vehicle, or suitable collision protection shall be provided.
- (j) Means shall be provided to prevent release of liquid by siphon flow from the tank.
- (k) The tank shall be fitted with a means of determining the level of its contents. Such means shall be available to the delivery operator.
- (l) All piping connections to the tank shall be above the normal maximum fill level.
- (m) Tanks shall not be manifolded unless provisions are made to prevent their being overfilled.
- (n) Overfill protection shall be provided by an alarm sounding and the flow of liquid being stopped, before the tank overflows. If the tank is designed to contain overflow, such an alarm is the minimum provision necessary to achieve this objective. If the overflow is to be discharged outside the secondary containment, an automatic shut-off shall be provided. These provisions shall not restrict or interfere with the proper functioning of the normal vent or the emergency vent.
- (o) Each fill point shall be provided with spill containment having a minimum capacity of 15 L per fill point. Such a device shall be fitted to a tank in order to catch and contain any minor spill during product delivery to the tank.



- (p) Where a tank having multiple compartments is installed, the separation distance to protected places shall be based on the aggregate volume of the compartments and the lowest flash point of the liquid in any tank compartment.
- (q) Venting shall comply with Clause 5.4. Venting of compartments of a multiple-compartment tank shall be based on the lowest flash point product in any of the compartments.
- (r) Where the interstitial space is enclosed, it shall be provided with venting in accordance with this Standard or with a UL approved method.

Many of the above requirements are provided as part of the basic tank specification, design and construction by the tank manufacturer. Hence, the provision of an appropriate specification will cover the majority of the above requirements.

A review of the proposed location of the tank on the lower ground floor (accessible from street level) and the provision of fire walls (FRL 240/240/240) surrounding the tank will meet the remaining requirements. The venting provisions can be readily achieved and therefore in summary, the proposed location would be suitable and configuration can be provided to meet the requirements of the standard (AS1940).

2.6 Radioactive Waste (packages)

It is understood that the existing radioactive waste will be stored in “packages” within an existing dedicated room on level LG. The storage of radioactive materials is normally approved by the Australian Nuclear Science and Technology Organisation (Ansto), however, key factors in the storage of waste radioactive materials relate to spill containment, radiation control (shielding) and security. A review of the proposed storage location indicates that these factors can be readily controlled as part of the facility design.

No further design or construction is required to this dedicated room.

2.7 Biohazard Material

Biohazard (assumed Class 6.2) storage cabinets will be located in the following rooms:

- RSS Research Shared Support – Negative Pressure, QC2 (Level 4)
- RSS Research Shared Support – SSBA Room (Level 2)

It is understood that the Class 6.2 cabinets will be provided from manufacturers that will supply appropriate certificates of compliance with the relevant sections of the Australian Standards. Based on this, the DG cabinets can be configured to meet the location requirements of the standards.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions

Based on the conceptual design for the proposed Dangerous Goods storage at the Biological Sciences Project, UNSW, it is concluded that the proposed storage facilities can be designed and configured to comply with the requirements of the relevant Australian Standards and the Work health and Safety Regulation.



3.2 Recommendations

Notwithstanding the conclusion reached in **Section 3.1**, it is recommended that BMC maintain close liaison with the Dangerous Goods consultant to ensure any changes or design modifications to the DG storages can be assessed and confirmed that they do not affect compliance with the Regulation.

4. REFERENCES

1. AS4332-2004 ,The storage and handling of gases in cylinder, Standards Association of Australia., Sydney
2. AS1894-1997, “The storage and handling of non-flammable cryogenic and refrigerated liquids”, Standards Association of Australia, Sydney
3. AS1940-2004, The storage and handling of flammable and combustible liquids, Standards Association of Australia., Sydney
4. AS3780-2008, The storage and handling of corrosive substances, Standards Association of Australia., Sydney

APPENDIX A

LIST OF DG COMPONENTS WITHIN THE BIOLOGICAL SCIENCES PROJECT, UNSW

1. RSS Research Shared Support – Tissue Culture 01
 - Dewar (small) – Liquid Nitrogen – 100LDewars filled from liquid nitrogen cryogenic tanks (3 x 6000 L each tank)

2. RSS Research Shared Support – Tissue Culture 01
 - Negative Pressure-Ionising RadiationClass 8 Corrosive Liquids (30 L Cabinet) – UN No. of corrosives stored
Class 3 Flammable Liquids (30 L Cabinet) – UN No. of flammables stored

3. RSS Research Shared Support 0 Negative Pressure-Ionising Radiation
 - Class 8 Corrosive Liquids (250 L Cabinet) - UN No of corrosives stored
 - Class 3 Flammable Liquids (250 L Cabinet) – UN No. of flammables stored

4. RSS Research Shared Support
 - Gas Manifold Cupboard - 2xGas Cylinders – “G” size cylinders Class 2.2 non-flammable/non-toxic gas (argon, helium, oxygen)

5. RSS Research Shared Support - Negative Pressure_QC2
 - Biohazard Cabinet – Assumed Class 6.2 Dangerous Good (100 L Cabinet)
 - Dewar (small) – Liquid Nitrogen – 100 L Quantity held in the dewarDewars filled from liquid nitrogen cryogenic tanks (3 x 6000 L each tank)

6. RSS Research Shared Support – SSBA Room
 - Biohazard Cabinet – assumed Class 6.2 Dangerous Good (100 L Cabinet)
 - Class 8 Corrosive Liquids (250 L Cabinet) - UN No of corrosives stored
 - Class 3 Flammable Liquids (250 L Cabinet) – UN No. of flammables stored
 - Dewar (small) – Liquid Nitrogen – 100 L Quantity held in the dewarDewars filled from liquid nitrogen cryogenic tanks (3 x 6000 L each tank)

7. RSS Research Shared Support – Negative Pressure_Chemistry 01
 - Class 8 Corrosive Liquids (250 L Cabinet) - UN No of corrosives stored
 - Class 3 Flammable Liquids (250 L Cabinet) – UN No. of flammables stored

8. RSS Research Shared Support – Equipment Room-Clean/Instruments-Large
 - Class 8 Corrosive Liquids (250 L Cabinet) - UN No of corrosives stored
 - Class 3 Flammable Liquids (250 L Cabinet) – UN No. of flammables stored

9. RSS Research Shared Support – Equipment Room-Clean/Instruments-Small
 - Class 8 Corrosive Liquids (250 L Cabinet) - UN No of corrosives stored
 - Class 3 Flammable Liquids (250 L Cabinet) – UN No. of flammables stored

10. PML Precinct – Management Labs – Main Stores
 - Class 8 Corrosive Liquids Acid (120 L Cabinet) - UN No of corrosives stored
 - Class 8 Corrosive Liquids Alkali (120 L Cabinet) – UN No. of flammables stored

- Class 8 Corrosive Liquids General (120 L Cabinet) - UN No of corrosives stored
11. PML Precinct – Management Labs – Store-Bulk Gas & Cylinder
 - Gas Vessels – 3x6,000 L liquid nitrogen, 4,500 L Carbon Dioxide
 - Gas Manifold Cupboard - 2xGas Cylinders – “G” size cylinders Class 2.2 non-flammable/non-toxic gas (argon, helium, oxygen)
 12. CCA Core – Cell Analysis – Preparation Las-Specimen Lab
 - Class 8 Corrosive Liquids (30 L Cabinet) - UN No of corrosives stored
 - Class 3 Flammable Liquids (30 L Cabinet) – UN No. of flammables stored
 - Dewar (small) – Liquid Nitrogen – 100 L Quantity held in the dewar
Dewars filled from liquid nitrogen cryogenic tanks (3 x 6000 L each tank)
 13. CGE Core – Genomics – Pre-Prep Amplification
 - Class 8 Corrosive Liquids (30 L Cabinet) - UN No of corrosives stored
 - Class 3 Flammable Liquids (30 L Cabinet) – UN No. of flammables stored
 14. CGE Core – Genomics – Prep-Post Amplification
 - Class 8 Corrosive Liquids (30 L Cabinet) - UN No of corrosives stored
 - Class 3 Flammable Liquids (30 L Cabinet) – UN No. of flammables stored
 15. CPT Core – Proteomics – Preparation & Biophysical Analysis Lab
 - Class 3 Flammable Liquids (30 L Cabinet) – UN No. of flammables stored
 16. CFS Core – FieldWork Support – Field gear Store
 - Battery Charge Area – Type of batteries charged (e.g. lithium, metal hydride, lead/acid?)
 17. CFS Core – FieldWork Support – Field gear Store
 - Class 3 Flammable Liquids – Cabinet capacity (120L), UN No. of flammables stored
 18. CSH Core – Sample Handling – Petrological Prep Laboratory
 - Class 8 Corrosives Liquids General (120 L Cabinet) – UN No. of corrosives stored
 19. CSH Core – Sample Handling – Palaeontological Prep – Acid Baths
 - Acid bath Large – 3,000 L of acid
 - Acid bath Small – 1,500 L of acid
 20. CSH Core – Sample Handling – Palaeontological Prep – Sample Sorting/Prep
 - Class 8 Corrosives Liquids Cabinet – Cabinet capacity (120L), UN No. of corrosives stored
 - Class 3 Flammable Liquids Cabinet – Cabinet capacity (120L), UN No. of flammables stored
 21. TAL Teaching & Learning – WET Teaching Prep 02
 - Class 8 Corrosive Liquids (30 L Cabinet) - UN No of corrosives stored
 - Class 3 Flammable Liquids (30 L Cabinet) – UN No. of flammables stored
 22. TAL Teaching & Learning – WET Teaching Prep 01
 - Class 8 Corrosive Liquids (30 L Cabinet) - UN No of corrosives stored
 - Class 3 Flammable Liquids (30 L Cabinet) – UN No. of flammables stored

23. Ground Floor Waste Areas – Chemical and Radioactive Wastes

24. Diesel Fuel Tank – 1,000 L (part of emergency generator frame).

APPENDIX B

DG STORAGE DETAILS - BIOLOGICAL SCIENCES PROJECT, UNSW

PRODUCT NAME	TYPE OF STORAGE	CLASS	LOCATION	QUANTITY
Methane	2 x "G" size gas cylinders	2.1	RSS Research Shared Support	13 kg
TOTAL Class 2.1 Storage				13 kg
Carbon Dioxide	Tank (x1)	2.2	PML Precinct – Management Labs – Bulk Gas Store	4,500 L
Nitrogen	Tank (3 x 3000 L)	2.2	PML Precinct – Management Labs – Bulk Gas Store	9,000 L
Nitrogen	Dewar	2.2	RSS Research Shared Support – Tissue Culture	100 L
Nitrogen	Dewar	2.2	RSS Research Shared Support – Neg. Press, QC2	100 L
Nitrogen	Dewar	2.2	RSS Research Shared Support – SSBA Room	100 L
Nitrogen	Dewar	2.2	CCA Core – Cell Analysis – Preparation Las-Specimen Lab	100 L
Argon	Gas Cylinder (2 x "G" size)	2.2	CCA 04 Lab	100 L [#]
Argon	Gas Cylinder (2 x "G" size)	2.2	CCA 08 Lab	100 L [#]
Argon	Gas Cylinder (2 x "G" size)	2.2	CCA 02 Lab	100 L [#]
Helium	Gas Cylinder (2 x "G" size)	2.2	CPT 02 Lab	100 L [#]
Oxygen (Medical)	Gas Cylinder (2 x "G" size)	2.2	CCA 07 Lab	100 L [#]
Oxygen (Medical)	Gas Cylinder (2 x "G" size)	2.2	CCA 08 Lab	100 L [#]
TOTAL Class 2.2 Storage				23, 500 L
Class 3 Flammable Liquid	DG Cabinet (30L)	3	RSS Research Shared Support – Tissue Culture	25 kg
Class 3 Flammable Liquid	DG Cabinet (250L)	3	RSS Research Shared Support - Negative Pressure-Ionising Radiation	200 kg
Class 3 Flammable	DG Cabinet	3	RSS Research Shared Support –	200 kg

PRODUCT NAME	TYPE OF STORAGE	CLASS	LOCATION	QUANTITY
Liquid	(250L)		SSBA Room	
Class 3 Flammable Liquid	DG Cabinet (250L)	3	RSS Research Shared Support – Negative Pressure-Chemistry	200 kg
Class 3 Flammable Liquid	DG Cabinet (250L)	3	RSS Research Shared Support – Equipment Room-Clean/ Instruments-Large	200 kg
Class 3 Flammable Liquid	DG Cabinet (250L)	3	RSS Research Shared Support – Equipment Room-Clean/ Instruments-Large	200 kg
Class 3 Flammable Liquid	DG Cabinet (30L)	3	CCA Core – Cell Analysis – Preparation Las-Specimen Lab	25 kg
Class 3 Flammable Liquid	DG Cabinet (30L)	3	CGE Core – Genomics – Pre-Prep Amplification	25 kg
Class 3 Flammable Liquid	DG Cabinet (30L)	3	CGE Core – Genomics – Prep-Post Amplification	25 kg
Class 3 Flammable Liquid	DG Cabinet (30L)	3	CPT Core – Proteomics – Preparation & Biophysical Analysis Lab	25 kg
Class 3 Flammable Liquid	DG Cabinet (100L)	3	CFS Core – Fieldwork Support – Field gear Store	80 kg
Class 3 Flammable Liquid	DG Cabinet (100L)	3	CSH Core – Sample Handling – Palaeontological Prep – Sample Sorting/Prep	80 kg
Class 3 Flammable Liquid	DG Cabinet (30L)	3	TAL Teaching & Learning – WET Teaching Prep 02	25 kg
Class 3 Flammable Liquid	DG Cabinet (30L)	3	TAL Teaching & Learning – WET Teaching Prep 01	25 kg
TOTAL Class 3 Storage				1,335 kg
Class 6.2 Infectious Substance	Biohazard Cabinet (100 kg)	6.2	RSS Research Shared Support - Negative Pressure_QC2	100 kg
Class 6.2 Infectious	Biohazard Cabinet (100 kg)	6.2	RSS Research Shared Support – SSBA Room	100 kg

PRODUCT NAME	TYPE OF STORAGE	CLASS	LOCATION	QUANTITY
Substance				
TOTAL Class 6.2 Storage				200 kg
Class 8 Corrosive (PGII)	DG Cabinet (250L)	8	RSS Research Shared Support – Tissue Culture	50 kg
Class 8 Corrosive (PGII)	DG Cabinet (250L)	8	RSS Research Shared Support - Negative Pressure-Ionising Radiation	400 kg
Class 8 Corrosive (PGII)	DG Cabinet (250L)	8	RSS Research Shared Support – SSBA Room	400 kg
Class 8 Corrosive (PGII)	DG Cabinet (250L)	8	RSS Research Shared Support – Negative Pressure-Chemistry	400 kg
Class 8 Corrosive (PGII)	DG Cabinet (250L)	8	RSS Research Shared Support – Equipment Room-Clean/ Instruments-Large	400 kg
Class 8 Corrosive (PGII)	DG Cabinet (250L)	8	RSS Research Shared Support – Equipment Room-Clean/ Instruments-Large	400 kg
Class 8 Corrosive (PGII)	DG Cabinet (120L)	8	PML Precinct – Management Labs – Main Stores	180 kg
Class 8 Corrosive (PGII)	DG Cabinet (120L)	8	PML Precinct – Management Labs – Main Stores	180 kg
Class 8 Corrosive (PGII)	DG Cabinet (120L)	8	PML Precinct – Management Labs – Main Stores	180 kg
Class 8 Corrosive (PGII)	DG Cabinet (30L)	8	CCA Core – Cell Analysis – Preparation Las-Specimen Lab	45 kg
Class 8 Corrosive (PGII)	DG Cabinet (30L)	8	CGE Core – Genomics – Pre-Prep Amplification	45 kg
Class 8 Corrosive (PGII)	DG Cabinet (30L)	8	CGE Core – Genomics – Prep-Post Amplification	45 kg
Class 8 Corrosive (PGII)	DG Cabinet (120L)	8	CSH Core – Sample Handling – Petrological Prep Laboratory	180 kg
Class 8 Corrosive (PGII)	Tank	8	CSH Core – Sample Handling – Palaeontological Prep – Acid Baths	2,400 kg

PRODUCT NAME	TYPE OF STORAGE	CLASS	LOCATION	QUANTITY
Class 8 Corrosive (PGII)	Tank	8	CSH Core – Sample Handling – Palaeontological Prep – Acid Baths	1350 kg
Class 8 Corrosive (PGII)	DG Cabinet (100L)	8	CSH Core – Sample Handling – Palaeontological Prep – Sample Sorting/Prep	150 kg
Class 8 Corrosive (PGII)	DG Cabinet (30L)	8	TAL Teaching & Learning – WET Teaching Prep 02	45 kg
Class 8 Corrosive (PGII)	DG Cabinet (30L)	8	TAL Teaching & Learning – WET Teaching Prep 01	45 kg
TOTAL Class 8 Storage				7,255 kg
Lithium Batteries	Battery Charge Area	9	CFS Core – Fieldwork Support – Field gear Store	20 kg
TOTAL Class 9 Storage				20 kg