HAZARDOUS CHEMICALS STORAGE AND HAZARDOUS AREA CLASSIFICATION

DESIGN STANDARDS

DS-25

Contents

Disclaimer

Refer to the Disclaimer within the UQ Design Standards.

Reference Documents

Refer to the UQ Design Standards for the list of documents and associated standards to be referenced for design work.

The designer is to coordinate between disciplines and standards.

UQ design standards are to be complied with in addition to the NCC and Australian Standards requirements.

Document Register

Issue	Date	Description	Prepared By	Reviewed By
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1 Hazardous Chemicals Storage Policy

1 – Hazardous Chemicals Storage Policy

Hazardous chemicals, including nanomaterials storage, at the University of Queensland consists of both storage in laboratories and their associated separate storerooms, as well as storage external to laboratories.

a) The purpose of this standard is to ensure that a safe minimum practical volume of hazardous chemicals are stored in laboratories, consistent with the purpose of the laboratory usage (i.e. research or teaching).

b) This standard is intended to provide for the required broad range of chemical compounds in small quantities for laboratory workers to facilitate effective teaching and research.

c) Packages (i.e. Winchesters etc) used in the laboratory to store chemical compounds are to be of the smallest practical capacity to minimise the effects of loss of containment.

d) A ‘Just in Time’ delivery methodology is preferred for the replenishment of hazardous chemical stock rather than maintaining a larger manifest of hazardous chemicals.

e) Separate storerooms associated with the laboratory are intended to provide a storage buffer for chemicals that are delivered to the facility prior to their decanting into smaller size packages for laboratory usage.

f) In some situations, hazardous chemicals are not permitted to be stored in laboratories due to their type or volume. For example, gases in cylinders are required to be stored external to the laboratory, within or external to the building.

1.1 - Minimum Design Criteria

a) Hazardous chemicals in laboratories are required to be stored in compliant chemical storage cabinets specific to the Class and Safety Data Sheet (SDS) requirements of the chemicals stored.

b) Incompatible chemicals of the same dangerous goods Class must be stored is separate compliant chemical storage cabinets (e.g. Class 8 Corrosive liquids (Acids) may not be stored in the same cabinet with Class 8 Corrosive liquids (Bases), Class 4.1, 4.2 and 4.3 must be stored in separate chemical storage cabinets).

c) Chemical storage cabinet ventilation is required where highly flammable or highly noxious/toxic hazardous chemicals are stored (e.g. typically Packing Group I). Designers must ensure through their design, however, that no person at the workplace is exposed to a substance or mixture in an airborne concentration that exceeds the exposure standard for the substance or mixture.

d) Where refrigerated laboratory storage is required, storage units must be appropriate for use with the stored hazardous chemical.

e) Where flammable substances (e.g. Class 3, Class 4) are stored, the refrigeration units must be certified for use with respect to the flammable atmosphere associated with the

chemicals stored. (Also see Section 2 – 'Hazardous Area Classification')

f) The minimum design criteria associated with the storage of hazardous chemicals external to laboratories or associated laboratory storerooms, will be the applicable dangerous goods (hazardous chemicals) Australian Standard for the Class of hazardous chemicals stored (e.g. AS4332 [1] – The storage and handling of gases in cylinders).

g) Designers are to ensure that where there is a risk from a spill or a leak of a hazardous chemical in liquid form, provision is made in each part of the workplace where the hazardous chemical is used, handled, generated or stored - for a spill containment system that contains within the workplace, any part of the hazardous chemical that spills or leaks, and any resulting effluent.

1.2 – Purpose

The purpose of this design standard is to specify the requirements for hazardous chemicals storage at the University of Queensland, such that the 'Person in Control of the Business or Undertaking' (PCBU) can manage risks to health and safety associated with the use, handling, generating or storing of hazardous chemicals at the university or any of its associated facilities.

1.3 – Design Conditions

a) Internal spaces used for the storage of hazardous chemicals must be provided with continuous mechanical ventilation.

b) Internal spaces, where temperature sensitive hazardous chemicals require refrigerated storage, must be provided with continuous air conditioning suitable for the storage of the hazardous chemicals.

1.3 - Designers Responsibilities

The hazardous chemicals storage designer/consultant shall be responsible for providing the following:

a) The overall conceptual method of hazardous chemical storage.

b) An initial hazardous chemicals (aka. Dangerous Goods) storage report detailing hazardous chemicals information, a volumes stored summary of hazardous chemicals by Class and Packing Group, package sizes of each hazardous chemical stored, storage requirements by chemical storage cabinet, cabinet capacities and locations of cabinets, information in relation to ventilation of cabinets and all other requirements of the applicable Australian Standard relating to the storage of the hazardous chemicals. This must detail compliance of the proposed installation for client review and feedback.

c) Final hazardous chemicals report/s incorporating client feedback to the satisfaction of the **UQ P&F Director Infrastructure and Sustainability.**

d) Suitability of the hazardous chemicals storage report, to inform the University of Queensland and project team consultants and designers (e.g. mechanical consultants, architects, electrical consultants, laboratory user groups, gas piping consultants, D&C contractors etc.) of hazardous chemical storage issues potentially impacting their design.

e) Hazardous chemicals storage reports and drawings shall contain Australasian Institute of Dangerous Goods Consultants (AIDGC) Consulting Member/s registration number and Registered Professional Engineer of Queensland (RPEQ) number.

f) The hazardous chemicals storage consultant shall provide advice to the EM during all phases of the project.

g) The hazardous chemicals storage consultant shall provide advice to the architect in relation to the required separation and segregation distances associated with hazardous chemicals storage, including limitations on chemical storage cabinet sizes and number of cabinets per unit area.

h) Ensure compliance with all relevant sections of Acts, Regulations, Codes and Australian Standards and the University of Queensland Design Standards. Specific clarification requests, if required, may be directed to the EM. Some Australian and Australian/New Zealand Standards are called up in this Design Standard (See Section 3).

i) Design certification (Form 15) is to be provided by the RPEQ / AIDGC consulting member.

1.5 – Storage of chemicals and gas cylinders in laboratories

The following information in this design standard outlines the requirements for consultants in order to design hazardous chemicals storage for laboratories.

1.6 – Chemical packages – maximum package volume in a laboratory

a) The maximum volume of any chemical package brought into a laboratory for decanting or dispensing must not exceed 25L or 25 kg.

b) Packages used for the purpose of collecting chemical wastes shall not exceed 25L, however, should not be larger than necessary for the task.

1.7 – Maximum laboratory storage quantities

a) The minimum volume and range of chemicals consistent with the laboratory operations are only permitted within the laboratory

b) The volume of mixed class hazardous chemicals that may be stored in a University of Queensland laboratory may not exceed 250L or 250kg , with the following conditions:

c) No greater than 25kg of PGI;

d) Class 3 flammable liquid storage shall not exceed:

   a. 50L per 50m^2 of floor space in a room up to 50m^2 of floor space for PGI and PGII.

   b. 100L per 50m^2 of floor space for PGIII

   c. 200L total for C1 or C2 combustible liquids

e) The limit of any manufactured product is the same as for a liquid of the same Packing Group

f) The volume of mixed class hazardous chemicals that may be stored in a University of Queensland separate storeroom may not exceed 250L or 250kg, with the following conditions:

a) No greater than 25kg of PGI;

b) Class 3 flammable liquids storage must not exceed Minor Storage provisions as defined in AS1940 [2].

c) The volume of hazardous chemicals that may be stored in chemical storage cabinets must not exceed 50L or 50 kg for Classes 3, 4.1, 4.3, 5, 6.1 and 8, with a maximum of 3 cabinets at 3m apart per 250m^2 area.

d) The maximum volume of Class 3 Flammable liquid that may be stored in a storage cabinet under a bench is 30L.

e) Where more than one type of hazardous chemical are stored in a chemical storage cabinet, the chemicals must be compatible with each other such that dangerous reactions do not occur if they come into contact with each other.

f) Class 3 and Class 4.1 may be kept within the same cabinet.

g) Note: The above laboratory limitations are intended to cater for the daily working stock of a University of Queensland laboratory.

h) In an internal fire rated store, 2,000kg or 2,000L of mixed class hazardous chemicals may be stored with segregation based on AS/NZS 3833 [3].

i) Class 3 flammable liquids may only be stored in an internal store where the store is fully compliant to the requirements of AS1940 [2] with a maximum storage volume of 500L.

j) External stores must be compliant to AS/NZS 3833 [3] or the specific applicable dangerous goods standard where only one (1) dangerous goods class applies (e.g. AS4332 [1] for Gas Cylinder storage).

k) Materials being analysed, used, mixed, blended or reacted upon on laboratory benches, or in fume cabinets are exempt from the above limitations.

l) Recommendations on storage of the following high risk hazardous chemicals requires approval from the UQ EM prior to draft report preparation:

a. Scheduled drugs, poisons and controlled substances, e.g. cyanide;

b. Scheduled carcinogens;

c. Illicit drug precursors;

d. Chemicals of security concern;

e. Hydrofluoric acid;

f. Nitric acid etchant blends e.g., Nital; and

g. Perchloric acid.

1.8 - Storage in cabinets and cupboards in laboratories

a) Flammable liquids storage in cabinets under benches shall not exceed 30L [3].

b) The aggregate volume of flammable liquids storage in a cabinet shall not exceed 250L [2].

c) Where hazardous chemical vapours cannot be eliminated by storing materials in appropriately sealed packages, at least one (1) ventilated cabinet is required for the storage of these chemicals. Compatibility of the chemicals must be assure based on Safety Data Sheet requirements.

d) Cabinet ventilation, where required, is to be compliant with AS1940 [2] and AS2243.2 [4].

e) Cabinet storage capacity in a laboratory for Classes 4.1, 4.2, 4.3, 5.1 or 5.2 shall not exceed 50L. Other hazardous chemicals Classes shall not exceed a cabinet capacity of 250L.

f) From any one cabinet, the aggregate storage volume of hazardous chemicals shall not exceed 250L or 250kg.

g) From any one cabinet, the aggregate storage volume of PGI hazardous chemicals of Classes 4.1, 4.2, 4.3, 5.1 or 5.2 shall not exceed 10L or 10kg.

h) The radius for (f) and (g) shall be measured horizontally through intervening walls, unless the walls are fire rated to an appropriate level to prevent fire spread between compartments. Refer [2].

i) Compliance with AS/NZS 3833 – Clause 5.10.1 [3] is required where more than one type of dangerous good are stored in a cabinet.

j) Where compatibility of the hazardous chemicals being stored cannot be fully determined, separate storage cabinets shall be provided.

1.9 – Storage on racks and shelves in laboratories

a) The primary means of enclosed storage for all laboratory chemicals at the University of Queensland is by means of compliant dedicated hazardous chemicals storage cabinets.

b) Chemicals kept on racks and shelves (i.e. solvent racks, specimens etc) shall meet the following requirements:-

a. Chemicals shall not be stored on shelves over benches at a height exceeding 1.5m from the floor.

b. Compatibility between chemicals stored shall be met by providing shelves and fixtures compatible with the hazardous chemicals or suitable protection between the shelves and the hazardous chemicals.

c. The maximum loading of the shelves shall not be exceeded.

d. Shelves used for chemical storage shall be restrained from lateral movement.

e. Compactus type shelving is not permitted for the storage of any chemicals at the University of Queensland.

f. Burettes used for gravity feed experiments may be stored on shelves or stands higher than 1.5m above ground with the shelves being consistent with the operational requirements, however spill containment must be provided.

1.10 - Management of the opening and decanting of hazardous chemicals

a) Spill control and adequate ventilation, consistent with the hazardous chemicals being opened, decanted and closed shall be provided for each laboratory space.

b) For smaller procedures, spill control may be achieved by means of bench

design, chemically resistant trays and spill control kits.

c) For larger procedures, a dedicated decanting/preparation room, or a suitably compliant and required capacity fume cabinet shall be specified.

1.11 – Adequacy of ventilation

a) Adequate ventilation shall be provided to meet the requirements of the Hazardous Area Classification (HAC) for the specific laboratory or storage cabinet.

b) Adequate ventilation shall be provided to meet the toxicological health requirements for the specific laboratory or cabinet.

c) Displacement ventilation is required for the management of Nano-Objects and their Aggregate and Agglomerates (NOAA).

1.12 – Segregation of incompatible chemicals on racks and shelves in laboratories

a) Where potentially incompatible hazardous chemicals are to be stored on shelves or racks, catchments are required to segregate the incompatible chemicals to prevent their mixing.

1.13 – Segregation of incompatible chemicals in chemical storage cabinets

a) Chemical storage cabinets or cupboards must be selected or designed to prevent incompatible chemicals coming into contact with each other within the cabinet/s.

The following specific requirements exist for University of Queensland laboratories and separate storerooms:-

a. Dedicated cabinets are required for the storage of Class 3 flammable liquids and/or combustible liquids.

b. Dedicated cabinets are required for the storage of Class 4.1 flammable solids.

c. Dedicated cabinets are required for the storage of Class 4.2 flammable solids.

d. Dedicated cabinets are required for the storage of Class 4.3 flammable solids.

e. Dedicated cabinets or refrigerators are required for the storage of Class 5.1 oxidising substances.

f. Dedicated cabinets or refrigerators are required for the storage of Class 5.2 organic peroxides.

b) Toxic substances – Class 6.1 storage requirements must be agreed by the EM prior to its storage assessment by the dangerous goods consultant and inclusion in the draft dangerous goods report, as specific regulatory requirements may exist.

c) Dedicated cabinets are required for Class 8 Corrosive liquids (Acids) and Class 8 Corrosive liquids (Bases) in accordance with their Safety Data Sheets.

d) Class 8 Corrosive liquids must be stored to prevent reactions between:-

a. Acids and hypochlorite.

b. Acids and cyanides.

c. Acids and Class 4.3 flammable solids.

d. Oxidising acids and combustible materials, and

e. Incompatible acids.

e) Suitable and compliant storage shall be specified for Class 9 Miscellaneous dangerous goods and articles in accordance with AS/NZS 4681 [5]. NOTE: Some manufacturers provide Class 9 Cabinets.

1.15 - Compressed gases in laboratories

a) Gas cylinders shall **not** be stored in laboratory compartments.

b) Cylinders may be kept connected in a laboratory compartment for the duration of an experiment only if no practical suitable alternative location is available.

c) The consultant is to undertake analytical assessment calculations to the satisfaction of the EM to address the potential risk of asphyxiation, oxygen-enrichment, flammable atmosphere development or any other potential hazardous effects of gases

lost from containment within the laboratory or separate storage room.

d) LP Gas cylinders storage must be designed in accordance with AS/NZS1596 [6].

e) Class 2.3 toxic gases shall **not** be kept in any University of Queensland laboratory, unless as part of an experiment. Signage must be designed for such instances that clearly signpost the nature of the gas and its associated hazards in use at laboratory entrances.

1.16 - Cryogenic gases in laboratories

a) Cryogenic flammable or toxic gas Dewars shall not exceed 5L in any laboratory at the University of Queensland.

b) Ventilated storage enclosures must be designed to store such packages, which may not be located within a laboratory.

c) Cryogenic storage containers for gases that are neither flammable nor toxic, shall not exceed 250L.

d) Cryogenic liquids may not be stored in unventilated rooms, such as cold rooms, due to the risk of oxygen depletion and asphyxiation.

e) The dangerous goods consultant is to facilitate a risk assessment to determine ventilation, oxygen monitoring, fail safe mechanisms and associated alarms.

f) Where basement laboratories or basement storage areas are being proposed, dual ventilation systems shall be provided with primary and back-up ventilation with oxygen monitoring and alarms.

g) Gas cylinders used for experiments in laboratories shall be the minimum capacity available consistent with the operations of the laboratory, however, may not exceed 70L.

h) Gas cylinder storage shall comply with the relevant Standard for the particular gas.

1.17 – Chemicals Stored in a Separate Storeroom

Two (2) types of separate storeroom apply to this Design Standard:-

a) Internal Separate Storerooms; and

b) External Separate Storerooms.

1.17.1 – Internal Storerooms

Internal Separate Storerooms may be either:-

a) Attached to a laboratory, or

b) Attached to any other room.

A maximum of 2,000kg or 2,000L of hazardous chemicals is permitted in an internal store.

A maximum volume of 500L of Class 3 flammable liquid is permitted and must be in a separate compartment within the Storeroom.

1.17.2 – External Storerooms

External Separate Storerooms are either:-

a) A separate freestanding building or structure; or

b) A structure attached to a building but separated by 240/240/240 construction.

External stores must be separated from on-site protected places, protected places and public places, by a minimum distance of:-

a) 3m for a storage capacity not exceeding 1,000kg or 1000L; or

b) 5m for a storage capacity of hazardous chemicals between 1,000L or kg and 1,000 and 4,500L or kg.

c) Or by the use of firewalls/vapour screen in accordance with AS1940.

Gas cylinders and cryogenic liquids are not permitted in this store.

1.18 – Storeroom requirements - General

Laboratory stores are required to be designed for the storage of hazardous chemicals, excluding gases, intended for laboratory use: -

a) Where the required quantity exceeds the volume allowed to be stored on laboratory shelves or in hazardous chemicals storage cabinets in the laboratory; or

b) Where chemicals are infrequently used.

Generally, the storeroom is required to be designed to meet the requirements of:-

a) AS 1940 [2] where the volume of hazardous chemicals stored does not exceed the aggregate maximums of 2,000 kg or 2,000L of mixed dangerous goods for an internal storeroom or 4,500 kg or 4,500L for an external storeroom; and

b) Does not exceed 500L of flammable liquids in a separate fire rated compartment of the storeroom; or

c) The Australian Standard specific to the particular class/es of dangerous goods for an external store; or

d) AS/NZS 3833 [3] for the storage of mixed classes of packaged dangerous goods.

1.19 - Storeroom requirements – Construction

a) For both internal and external stores, compliance to AS2243.2 [1] is required.

b) Stores must be designed to eliminate the effects of direct sunlight or the effects of ambient temperature.

1.20 – Ventilation

a) The AS1940 [2] option for natural ventilation is **not** permitted in University of Queensland hazardous chemical storerooms.

b) Ventilation shall be designed to accommodate highly volatile, toxic or corrosive substances.

c) Main supply with backup supply ventilation must be considered where highly volatile, toxic or corrosive substances are stored. Automatic activation through vapor detection must be considered.

d) Cooled storerooms must be designed to take into account the effects and risks associated with recycled air in relation to airborne vapours.

1.21 – Environmental control – Storeroom heating and cooling

a) Cooled storerooms must be designed to comply with Hazardous Area Classification (HAC) associated with stored flammable hazardous chemicals. (See Part 2)

b) Heating for heated hazardous chemicals storerooms shall be provided by indirect heating, such as hot air or hot water based circulation system. Compliance with AS2243.2 [4] is required.

1.22 – Management of ignition sources

Hazardous Area Classification (HAC) is required for all storerooms where flammable substances are stored or handled, including flammable gases, flammable liquids, flammable solids and combustible dusts. Refer to Part 2 of this Design Standard.

1.23 – Management of Spillage

Storerooms for the storage and handling of hazardous chemicals must be designed with a suitable bund for the management of spilled liquids.

The design must provide for the following:-

a) The bund must be impervious to the hazardous chemicals stored in the facility. Consultants are to ensure Safety Data Sheets (SDS) of hazardous chemicals stored are reviewed and acceptable for any construction or sealing materials used in the bund.

b) Where the potential for reactions between incompatible chemicals spilled into the bund may occur, the bund shall be designed to prevent these hazardous chemicals from coming into contact with each other.

c) In addition to providing the bund outlined in a) and b), liquid hazardous chemicals shall be stored in compliant chemical storage cabinets within the storeroom.

d) Storerooms not provided with automatic water or foam sprinklers are not permitted on levels above Ground Floor and must have readily available Queensland Fire and Emergency Services (QFES) access.

e) For Ground Floor storerooms where automatic water or foam sprinklers are not provided, the bund capacity must be designed to accommodate discharge from a fire hydrant located external to the storeroom. Either within the bund or in an external containment chamber, 20 minutes of firefighting effluent in addition to 110% of the stored volume of liquid hazardous chemicals must be contained.

f) Where the storeroom is provided with automatic water or foam sprinklers, the design is required to accommodate either, within the bund or in an external containment chamber, 20 minutes of firefighting effluent in addition to 110% of the stored volume of liquid hazardous chemicals.

1.24 – Storeroom hazardous chemical storage methods

a) Hazardous chemicals storage cabinets shall be specified for use within both internal and external storerooms for the storage of incompatible dangerous goods and to reduce the risk of fire spread.

b) The maximum volume of hazardous chemicals per storage cabinet is 250L or 250 kg.

c) Further limitations exist for chemical storage cabinets in storerooms in accordance with this design standard. (See 1.18 and AS2243.2 [4]).

d) Under no circumstances shall cabinet separation be less than 300mm.

e) Chemicals stored outside hazardous chemicals storage cabinets (i.e. non-flammable solids etc) shall be stored on shelves designed in accordance with 1.9.

1.25 - Movement of chemicals within, to and from the storeroom

a) Access to and within the storeroom must be designed so that it is adequate to enable the safe movement of personnel and mechanical handling equipment that may be used to handle packages.

b) Storerooms shall be designed to eliminate the risk of incompatible chemicals coming into contact with each other as a result of spillage during transport to and within storerooms.

1.26 - Cryogenic liquids and compressed gases in a separate storeroom

Two (2) types of separate gas cylinder and/or cryogenic liquids storerooms are covered under this Design Standard:-

a) Internal Separate Storerooms; and

b) External Separate Storerooms.

1.26.1 – Internal Storerooms

Internal cryogenic liquids and compressed gas storerooms may be either:-

a) Attached to a laboratory, or

b) Attached to any other room.

1.26.2 – External Storerooms

External cryogenic liquids and compressed gas storerooms may be either:-

a) A separate freestanding building or structure; or

b) In the open.

1.27 - Storeroom requirements – General

a) The storeroom may only be used for the storage of gas cylinders or cryogenic liquids (or both).

b) Design must allow for the storage of empty gas cylinder storage to be classified as full cylinders or Dewars.

c) Separation distances are to be consistent with the requirements of the specific gas type dangerous goods Standard (e.g. AS4332 [1].)

d) Design of storage requirements for specific gas types addressed under Australian Standards must be allowed for. (e.g. Ammonia – AS2022 [7] etc)

1.28 – Ventilation

a) One side of the gas cylinder and cryogenic liquid store must be open to atmosphere.

b) Open stores are not required to have a roof, however protection from sunlight and weather conditions must be considered in design.

c) Ventilation in accordance with AS4332 [1] is required in this Design Standard.

d) Internal storerooms used for flammable cryogenic liquids and flammable compressed gas must be mechanically ventilated.

e) External storerooms used for flammable cryogenic liquids and flammable compressed gas must be fitted with vents at high points in the structure to allow the removal of positively buoyant gas and to relieve any explosion. Refer to AS1375 [8]

and NFPA 68 [9] for explosion venting requirements.

f) All gas cylinder and cryogenic liquid storerooms must be ventilated at both low level and at high level, whether mechanically or naturally ventilated.

1.29 – Management of ignition sources

a) Hazardous Area Classification (HAC) is required for all gas cylinder and cryogenic liquid storerooms where flammable gases are stored or handled. Refer to Part 2 of this Design Standard.

1.30 – Storeroom gas storage methods

Design shall allow for the following gas storage methods, as applicable:-

a) Gas cylinders or cryogenic liquid storage packages must be located such that they are not subject to physical damage, tampering or excessive temperature rise whether stored externally or internally.

b) Gas cylinder storage must not be located within 1m from any building opening. (Also refer HAC).

c) All cylinders are to be restrained from falling in storage and handling.

d) Cylinder storage design shall allow for upright storage of cylinders only.

1.31 - Gas Cylinder Segregation

a) Class 2.3 gas storage design shall allow for a segregation distance of 3m from other gases.

b) Class 2.1 gas storage design shall allow for a segregation distance of 3m from Class 2.2/5.1 gases.

1.32 - Gas cylinder and cryogenic liquid storage separation

a) Separation distance for gas cylinders or cryogenic liquid storerooms to other areas or structures must be compliant with the requirements of AS4332 [1].

b) For mixed gas cylinders or cryogenic liquid storerooms, the separation distance between Classes must be compliant with the requirements of AS4332 [1].

2 Hazardous Area Classification Policy

2 – Hazardous Area Classification Policy

A hazardous area means an area in which:-

a) An explosive gas or vapour is present in the atmosphere in a quantity that requires special precautions to be taken for the construction, installation and use of plant; or

b) A combustible dust is present, or could reasonably be expected to be present, in the atmosphere in a quantity that requires special precautions to be taken for the construction, installation and use of plant.

Designers and consultants must undertake a Hazardous Area Classification (HAC) for laboratory or associated separate storerooms or storage facilities (e.g. External flammable gas cylinder stores) where flammable gases or liquids or combustible dusts are stored or used.

For smaller projects within the University of Queensland, only those staff competent and accredited to carry out HAC should undertake this work.

HAC does not address situations of oxygen enrichment or oxygen depletion, and as such, is not addressed under this design standard.

Where a hazardous area consultant is not directly engaged by the University of Queensland, engagement of a separate dedicated hazardous area and/or dangerous goods consultant will be decided by the lead consultant or project manager and determined on a project by project basis, based on discussions with UQ.

It is the University of Queensland's preference that hazardous area and dangerous goods advice be provided by the same accredited consultant (AIDGC Consulting Member / RPEQ).

2.1 - Minimum Design Criteria

Design compliance with Australian Standards AS/NZS 60079.10.1 [10] for flammable gases and vapours and with AS/NZS 60079.10.2 [11] for combustible dusts is required by this design standard.

AS/NZS 60079.10.1 Supplement 1 [16] provides typical industry examples of hazardous area classifications.

If these examples are applied, they must be supported using analytical assessment or numerical (CFD) from [10] to justify their application to ensure that under the conditions they are applied at the University of Queensland, it is safe to do so.

AS/NZS 60079.10.2 [11] provides industry examples of combustible dust hazardous areas and provides methodology for assessing hazardous areas associated with combustible dusts. Refer to AS/NZS 60079.10.2 [11] 'Area Classification Procedure for Dust Atmospheres'.

Alternative approaches to HAC are permitted, such as 'Risk Based HAC', as agreed with the EM.

2.2 – Purpose

The purpose of this design standard is to specify the requirements for HAC, such that the PCBU can manage risks to health and safety associated with hazardous atmosphere involving flammable gases, vapours or combustible dusts at the university or any of its associated facilities.

HAC scope includes, but is not limited to: -

a) Laboratories.

b) Flammable storage facilities, including separate storerooms and external storage depots (e.g. flammable gas cages located outside laboratory buildings).

c) Major chemical and gas stores.

d) Gas meter and gas distribution rooms.

e) Raw materials stockpiles involving combustible dusts.

2.3 – Design Conditions

a) Both internal and external spaces used for the storage of flammable hazardous chemicals and combustible dusts must be assessed against the range of flammable substances that may be released potentially forming a flammable atmosphere.

b) All flammable compounds will have their Temperature Class (or T Max. for dusts) and Gas Group included in the HAC. The worst-case Temperature Class and Gas Group for each storage will define the minimum safety thresholds of the zone/s.

c) All spaces impacted by the flammable atmosphere shall be considered in the HAC, including but not limited to:-

   a. Ductwork.
   b. Refrigerators.
   c. Freezers.
   d. Cool rooms.
   e. Laboratories.
   f. Gas cages.
   g. Separate storerooms (i.e. Package stores).
   h. Gas stores.
   i. Gas meter rooms.
   j. Flammable substance storage cabinets.
   k. Workshops.
   l. Gas taps on or near benches.
   m. Dust bag filters.
   n. Silos.
   o. Exhaust outlets.
   p. Non AS2243.8 [12] compliant Fume Cabinets.

2.4 - Designers Responsibilities

The hazardous area classification designer/consultant shall be responsible for providing the following:

a) The overall conceptual method of the HAC.

b) Engagement with other stakeholders associated with the design team where applicable throughout the development of the HAC.

c) Development of a briefing document to cover all associated design standards and applicable Australian Standards seeking approval and feedback from University of Queensland stakeholders, including Facilities Management and the EM. Note: Where the Hazardous Area Engineer is a subconsultant, the lead consultant is to inform the University of Queensland on design compliance.

d) The HAC consultant is to work closely with trade contractors, as applicable.

e) The HAC consultant is to provide the University of Queensland user groups with a survey document to facilitate the design of the HAC in relation to the flammable substances, their characteristics, spillage potential to inform the HAC.

f) The HAC consultant is to engage with the mechanical consultant to provide adequate ventilation requirements to meet HAC requirements.

g) The HAC consultant is to engage with the electrical consultant to ensure the proper selection of electrical equipment and wiring in hazardous areas, or elimination of ‘electrical work’ in hazardous areas.

h) Where applicable, the HAC consultant is to facilitate risk workshops associated with HAC, particularly in relation to HAZOPs associated with determining Equipment Protection Level (EPL) assessments.

i) A HAC draft zone classification report detailing zone delineation and classification information with zone characteristics, such as Temperature Class and gas Group.

j) Final HAC report/s incorporating client feedback to the satisfaction of the **UQ**

P&F Director Infrastructure and Sustainability (DIS).

k) Suitability of the HAC report to inform the University of Queensland and project team consultants and designers (e.g. mechanical consultants, architects, electrical consultants, laboratory user groups, gas piping consultants, D&C contractors etc.) of hazardous area issues potentially impacting their design.

l) HAC reports and drawings shall contain Australasian Institute of Dangerous Goods Consultants (AIDGC) consulting membership registration number and Registered Professional Engineer of Queensland (RPEQ) number.

m) HAC consultant shall provide advice to the EM during all phases of the project.

n) HAC consultant shall provide advice to the architect in relation to the required exclusion zones associated with flammable hazardous chemicals storage, including limitations on Flammable Liquids Storage Cabinets (FLSCs), laboratory floor zones etc.

o) Ensure and or facilitate compliance with all relevant sections of Acts, Regulations, Codes and Australian Standards and the University of Queensland Design Standards. Specific clarification, if required, may be directed to the EM. Some Australian and Australian/New Zealand Standards are called up in this design standard.

p) Design certification (Form 15) is to be provided by the RPEQ and the AIDGC registered consulting member/s.

q) The HAC consultant must emphasise in their HAC report the Electrical Safety Regulation [13] requirement for the development of a Hazardous Area Verification Dossier in accordance with AS/NZS 60079.14 [14].

r) The HAC consultant must emphasise in their HAC report the Electrical Safety Regulation [13] requirement for the auditing of 'electrical work' located within a hazardous area. This must be carried out by a Queensland Government Accredited Hazardous Area Auditor, ensuring compliance of the installation **prior to** its energisation.

2.5 - Laboratory Hazardous Areas

Hazardous area design associated with laboratories where flammable substances are stored and handled includes, but is not limited to the following:-

a. Laboratory floors.

b. Laboratory flammable liquids storage cabinets.

c. Laboratory flammable solids storage cabinets.

d. Laboratory flammable gas outlets.

e. Laboratory miscellaneous hazardous areas, and

f. Laboratory combustible dust hazards.

2.5.1 – Laboratory Floors

a) The HAC consultant shall clearly define the methodology applied to assess the hazardous area.

b) The HAC consultant is to source a complete flammable hazardous chemicals manifest from the university for the location to determine potential Loss of Containment (floor spill) event characteristics for each compound.

c) The HAC consultant is to source ventilation parameters from the mechanical consultant to determine flammable liquid evaporation characteristics.

d) The HAC consultant shall assess the potential formation of the flammable vapour (or gas) and undertake a HAC in accordance with AS/NZS 60079.10.1 [10].

e) The HAC consultant shall define the most significant case extent of the hazardous area, its most significant case Temperature Class and most significant case Gas Group, which will form the overall minimum safety threshold for the laboratory floor.

f) If the HAC consultant's method applies an industry example from AS/NZS 60079.10.1 Supplement 1 [16], the outcome of item d) will be compared with the industry example to ensure that the application of the industry example provides a safe outcome for the laboratory floor under

assessment and is not exceeded by the result of item d).

2.5.2 - Laboratory Flammable Liquids Storage Cabinets (FLSC)

a) The HAC consultant shall clearly define the methodology applied to assess the hazardous area.

b) The HAC consultant is to source a complete flammable hazardous chemicals manifest from the university for the location to determine potential Loss of Containment event characteristics for each compound within the FLSC.

c) The HAC consultant is to source room and FLSC ventilation parameters from the mechanical consultant to determine flammable liquid evaporation characteristics within the FLSC.

d) The HAC consultant shall assess the potential formation of the flammable vapour and undertake a HAC in accordance with AS/NZS 60079.10.1 [10].

e) The HAC consultant shall define the most significant case extent of the hazardous area, its most significant case Temperature Class and most significant case Gas Group, which will form the overall minimum safety threshold for the FLSC.

f) If the HAC consultant's method applies an industry example from AS/NZS 60079.10.1 [10], the outcome of item d) will be compared with the industry example to ensure that the application of the industry example provides a safe outcome for the FLSC under assessment and is not exceeded by the result of item d).

2.5.3 – Laboratory Flammable Solids Storage Cabinets (FSSC)

a) HAC applies to FSSCs storing dangerous goods Class 4.3 'Flammable When Wet' compounds.

b) AS5026 [15] recommends a 3m separation distance to ignition sources from FSSCs storing Class 4.3 flammable solids.

c) The type of Class 4.3 flammable solid (i.e. Category A, B or C) is indicative of the volume of potentially flammable gas that may be produced when the flammable solid comes in contact with water.

d) The HAC consultant is to assess the category and amount of Class 4.3 compound stored in the FSSC and from this, determine the volume of flammable gas likely to be produced.

e) A HAC is subsequently required based on AS/NZS 60079.10.1 [10].

f) Typical reaction gases produced from a reaction of Class 4.3 with water include hydrogen and acetylene.

2.5.4 – Laboratory Flammable Gas Outlets

a) AS/NZS 60079.10.1 Supplement 1 [16] addresses Gas Industry codes and where applicable, systems designed and installed strictly in compliance with AS/NZS 5601.1 [17] may be considered Non-Hazardous. The HAC consultant must determine if the installed system complies with AS/NZS 5601.1 prior to allocating a HAC.

b) The HAC consultant shall clearly define the methodology applied to assess the hazardous area.

c) The HAC consultant shall assess the potential formation of the flammable gas and undertake a HAC in accordance with AS/NZS 60079.10.1 [10].

d) The HAC consultant shall define the Temperature Class and Gas Group for the hazardous area.

e) If the HAC consultant's method applies an industry example from AS/NZS 60079.10.1 Supplement 1 [16], the outcome of item b) will be compared with the industry example to ensure application of the industry example provides a safe outcome for the gas outlets under assessment and is not exceeded by the result of item b).

2.5.5 – Laboratory Miscellaneous Hazardous Areas

Laboratory miscellaneous hazardous areas include, but are not limited to the following:-

a) Ventilation ductwork.

b) Niederman Arms.

c) Gas connections associated with laboratory equipment, such as Gas Chromatography units.

d) Flammable liquid Decanting Sinks and benches.

e) Equipment with onboard flammable liquid supplies i.e. Tissue Processing equipment.

The consultant shall apply HAC for each situation and location in accordance with the steps outlined in items 2.5.1 to 2.5.4 of this design standard.

2.5.6 – Laboratory Combustible Dust Hazardous Areas

Where combustible dust hazards exist in University of Queensland laboratories, HAC must be carried out in accordance with the requirements of AS/NZS 60079.10.2 [11].

a) The HAC consultant is to coordinate with the mechanical consultant to determine whether the potential dust hazardous area can be eliminated through ventilation design.

b) If the dust hazardous area cannot be eliminated through design, the HAC consultant shall assess the potential formation of the hazardous atmosphere and undertake a HAC in accordance with AS/NZS 60079.10.2 [11].

c) The HAC consultant shall define the Temperature Class (and Temp. Max.) and Equipment Group for the hazardous area.

2.6 – Separate Storeroom Hazardous Areas

To allow maximum flexibility in separate storeroom design, it is the University of Queensland's preference to apply the industry examples as detailed in AS/NZS 60079.10.1 Supplement 1 [16] and AS/NZS 60079.10.2 [11], however the HAC consultant is to undertake an analytical assessment to the satisfaction of the EM to prove that the industry examples may be safely applied in each circumstance.

2.7 – Flammable gas and flammable cryogenic liquid hazardous areas

Flammable gas and flammable cryogenic liquid hazardous areas are to be assessed in compliance with AS/NZS 60079.10.1 [10] and AS/NZS 60079.10.1 Supplement 1 [16], where applicable.

The HAC consultant is to undertake an analytical assessment to the satisfaction of the EM to prove that the industry examples may be safely applied in each circumstance.

3 Referenced Australian and International Standards

[1] AS4332 - The storage and handling of gases in cylinders, SAI Global, Sydney Australia.

[2] AS1940 - The storage and handling of flammable and combustible liquids, SAI Global, Sydney Australia.

[3] AS/NZS 3833 - The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers, SAI Global, Sydney Australia.

[4] AS2243.2 - Safety in laboratories Chemical aspects and storage, SAI Global, Sydney Australia.

[5] AS/NZS 4681 - The storage and handling of Class 9 (miscellaneous) dangerous goods and articles, SAI Global, Sydney Australia.

[6] AS/NZS1596 - The Storage and Handling of LP Gas, SAI Global, Sydney Australia.

[7] AS2022 - Anhydrous ammonia - Storage and handling, SAI Global, Sydney Australia.

[8] AS1375 - Rules for industrial fuel fired appliances (Industrial Fuel Fired Appliances Code), SAI Global, Sydney Australia.

[9] NFPA 68 - Standard on Explosion Protection by Deflagration Venting, National Fire Protection Association, Bethesda, USA.

[10] AS/NZS IEC 60079.10.1 - Explosive atmospheres, Part 10.1: Classification of areas — Explosive gas atmospheres, SAI Global, Sydney Australia.

[11] AS/NZS 60079.10.2 - Explosive atmospheres Classification of areas - Explosive dust atmospheres, SAI Global, Sydney Australia.

[12] AS2243.8 - Safety in laboratories Fume cupboards, SAI Global, Sydney Australia.

[13] Electrical Safety Regulation Qld (2013), Queensland Government Printers, Brisbane, Australia.

[14] AS/NZS 60079.14 - Explosive atmospheres, Part 14: Design selection, erection and initial inspection (IEC 60079-14:2013 (ED.5.0) MOD) , SAI Global, Sydney Australia.

[15] AS5026 - The storage and handling of Class 4 dangerous goods, SAI Global, Sydney Australia.

[16] AS/NZS 60079.10.1 (Supplement 1) - Explosive atmospheres — Classification of areas — Explosive gas atmospheres — Commentary (Supplement 1 to AS/NZS IEC 60079.10.1:2022), SAI Global, Sydney Australia.

[17] AS/NZS 5601.1 AS/NZS 5601.1 Gas Installations - Part 1: General installations, SAI Global, Sydney Australia.