LABORATORIES

DESIGN STANDARDS

Document Register

Issue	Date	Description	Initials
Revision 1	18/10/2021	Project Use	MP

Contents

Disclaimer
Refer to the Disclaimer within the University Design Standards.

Reference Documents
Refer to the University 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.

1 General Principles

1 General Principles

The University space inventory lists laboratories as follows for space designation:

(a) Dry laboratories:

Computer laboratory, acoustic, laser, language laboratory, sports science, electronics, nanotechnology, imagery, microscope, occupational therapy and behavioural.

(b) Wet laboratories:

Chemistry, Biosciences, Dental, Pathology, Anatomy, Tissue culture, Plant Growth, Medical and Blood Typing.

(c) Special Security Laboratories:

PC1, PC2, PC3, Containment and Clean Rooms. Where relevant to type of laboratory then follow the guidelines provided by the Office of Gene Technology Regulator (OGTR). Special security laboratories not listed shall be individually briefed by the University

(d) Teaching and Research Laboratories:

These incorporate laboratories listed above, however, with altered focus to suit the laboratory use and occupancy.

(e) For spaces not listed refer the University for classification, special laboratories also fall into dry or wet categories and shall meet the relevant requirements and some laboratories will have a mix of these spaces. The workplace risk to occupants within laboratory spaces requires designers to minimise these risks and this shall be a focus of all design decisions

1.1 General Design Requirements

(a) For general space requirements within laboratories, refer the Architectural Design Standard. Generally comply with the following additional laboratory specific requirements:

i. Space planning of laboratories shall be based on standardised architectural, structural and services modules for flexibility and consistency. Planning shall incorporate safety and access provisions in accordance with relevant standards and equipment clearance requirements.

ii. Generally laboratory spaces require specialist equipment to be installed and will require experienced designers within the specific laboratory type for design and construction, experienced designers only shall be engaged to perform the design. Demonstrate relevant experience to the University prior to commencing the design phase for approval. Designers, if not suitably experienced as determined by the University will not be accepted. The University will, however, accept engagement of specialists to support designers and these shall be subject to approval by the University.

iii. For general laboratory spaces the designer shall obtain all relevant briefing information on proposed equipment and provide an assessment and project scope via return brief, for demonstration to the University that the proposed design

solutions meet equipment requirements for structure, services, cross contamination risk, environmental factors and architecture. Infrastructure and structural upgrade requirements shall be included in the assessment for existing buildings. The university has significant existing laboratory assets and generally requires consistency with other similar buildings and sites. Designers shall inspect other similar university sites or buildings for design guidance. Other laboratories are, however, for guidance only and do not negate any requirements for compliance and introduction of new technologies and solutions.

iv. Laboratory spaces shall comply with all relevant Australian and International standards applicable to the works, (whether referenced in the NCC (BCA) or not) and all University design standards. Return briefs shall include design standards that are utilised and will be complied with. Where University standards exceed legislated or relevant Australian or International design standards then the highest requirement shall be incorporated. Where the space is a modified existing laboratory, upgrading services to the current standards is to be provided, however, outline to the University any issues or excessive cost implications for a final decision before upgrading any existing services that may not be viable or warranted.

v. Laboratory systems shall have redundancy provided based on discussions with the University, this includes items such as dedicated cooling/heating plant, air compressors, standby ventilation, gases, power and controls. Each project shall have redundancy return briefed to the University for review.

vi. The University has a commitment to lowering greenhouse gas emissions and water use. Refer also the University Sustainability Strategy guideline. Laboratory spaces typically utilise large amounts of energy. Energy recovery measures shall be assessed for each project then presented to the University for a decision to proceed. The designer shall provide energy recovery options within a sustainability section of the return brief to the University, including highlighting benefits of sustainable elements added to the project. Laboratory design solutions shall be selected on a best for whole of life basis unless other selection factors are approved or advised by the University.

- Incorporate design and construction that meets laboratory equipment supplier requirements including factors such as low noise levels, low vibration spaces, specialist power, specialist environments and contamination removal.

vii. Laboratory designs shall incorporate the procedures and policies as outlined in the University Health Safety and Wellness Division, in particular laboratory safety training. The design and construction shall include the following:

- Designers shall review and undergo all University safety training in relation to laboratory spaces and their risks. Designers shall be aware of occupational health and safety responsibilities as a designer of a University facility. Designers are to be familiar with and incorporating the University Workplace Health and Safety governance procedures (available on-line). These guidelines are provided to assist users as well as designers to generate a safe working environment.
- Designers shall conduct a detailed laboratory risk assessment and submit to the University as part of the project requirements before proceeding with design development. This shall be updated and re-submitted before proceeding with finalised documentation to demonstrate control measures and resultant risk levels achieved. If not acceptable to the University then adjust the design to meet acceptable risk levels to the University.

- Sourcing all relevant information on risk items and subsequent minimisation or containment of these risks.
- Incorporate waste management design and installation provisions for safe disposal.
- Incorporate design elements that can accommodate incidents with a requirement to maximise protection of occupants and the environment (eg chemical spills contained).
- Incorporate design that maximises ability to safely and easily service equipment/plant and allows clean/tidy housekeeping.

2 Laboratory Types

2.1 Dry laboratories

(a) Provide the design and construction of the following systems/features if the these and similar services provisions are deemed by the university as required for the project or required by systems installed within the laboratories:

i. Multiple power outlets and control of power supply quality to meet equipment requirements.

ii. Specialist room treatment for acoustics. Engage a specialist acoustic designer for spaces requiring specific treatment to meet the projects acoustic design performance. Comply with the acoustic engineer's requirements and design and construct all recommendations. As a minimum all laboratory spaces shall have acoustic treatment to meet or exceed AS/NZS 2107 requirements internally and not exceed existing ambient external sound levels externally. For specialist laboratory spaces refer user requirements.

iii. High and low heating and cooling loads when varying occupancy or equipment loads exist. High occupancy spaces shall include variable outside air provisions.

iv. For specialist space conditions design cooling and heating plant that can accommodate high changes in room load profiles. Plant shall be selected for reliable equipment operation and meet equipment/user requirements, include relevant humidity, pressurisation, air movement and temperature control.

v. For specialist power supply laboratories serving high technology or sensitive equipment, provide a comprehensive review of power supplies and provide systems that adjust/control the power supply quality to suit the equipment manufacturers requirements.

2.2 Wet Laboratories

(a) Provide the design and construction of the following systems/features if the these and similar services provisions are deemed by the University as required for the project or required by systems installed within the laboratories:

i. Containment for biological and chemical experiments in accordance with relevant Australian Standards and authority requirements as well as specific University requirements.

ii. Specialist systems such as heating water, cooling water, deionized water (reverse osmosis) and filtered water.

iii. Waste and trade waste disposal with specialist treatment systems.

iv. Other specialist services relevant to the laboratory equipment or processes such as specialist gases with bottle storage, reticulated services, fire detection/suppression and specialist power supplies and power outlets.

v. Fume cupboards, Biohazard cabinets, equipment services provisions, safety showers/eye wash, laboratory sinks and wet benches.

vi. Sealed spaces with dedicated environmental controls. Generally cross contamination shall be assessed and the design must take into account provisions to prevent cross contamination to any other space, including during normal laboratory operation and spills.

vii. The suitability of the design solutions shall be presented to the University

and stakeholders. Include in the project high levels of stakeholder communication and discussion. Final approval of all stakeholder discussions shall be subject to approval by the University property and facilities manager and documented by the designers

viii. High structural loads where large equipment is installed, including structural penetrations for services

ix. For specialist laboratory spaces that require laboratory ratings, refer guidelines by the Office of Gene Technology Regulator (OGTR) for PC1, PC2 and PC3. For Biosecurity spaces (such as BC2 and BC3 spaces) comply with Department of Agriculture, Water and Environment (DAWE) guidelines and standards. The designers must have relevant recent experience in the laboratory rating proposed for the project and this must be demonstrated to the satisfaction of the University. If relevant designers do not have sufficient experience as determined by the University then engagement of specialist designers will be required. Laboratory certification shall be achieved to the nominated rating via the design solutions chosen. The University requires all spaces to be certified to meet space performance requirements. Certification requirements shall be included in the project works including all accreditation and documentation requirements.

x. For specialist high containment laboratories rated at PC3 and BC3, a specialist designer is shall be engaged or be present regularly within the design team to direct containment requirements to all team members and review final solutions. The final review shall be reported to the University.

xi. Engage dedicated specialist commissioning personnel experienced in relevant room ratings to test and adjust all systems.

2.3 Specialist Laboratories and Specialist Spaces within Laboratories

(a) Laboratories contain specialist spaces that require additional design experience. These spaces may be stand alone or incorporated within a larger laboratory

(b) Clean Rooms shall include:

i. Designers must be demonstrated as experienced in the proposed clean room grades and will be subject to University approval. If not approved the designers shall obtain alternate designers or advisers.

ii. The designers shall work collaboratively as a team to ensure the room design and particle levels are met along with room environmental conditions and pressures.

iii. The clean room grades and design shall be assessed by all trades to ensure all provisions (such as low level return/exhaust droppers, flush surfaces and specialist sealing to services penetrations) are incorporated. Final certification of room performance at completion shall be signed off via submission to the University by the original designers as well as the commissioning and accreditation teams.

iv. Tested environmental and particle level certification shall be provided for at rest ratings or in-use ratings as per relevant standards or as directed by the University.

v. Design solutions shall incorporate filtration, walls and ceilings with fire resisting composite panel (where utilised), such as PIR. Compliance with AS1530 shall be achieved for all construction.

vi. Clean rooms will normally be subject to independent review by the University and all comments received shall be addressed by the designers to achieve University and relevant standards performance requirements. The university shall review the design and provide comments, however, the design team and construction team shall be responsible for final room performance and addressing review comments.

vii. Composite panelling systems must be utilised for clean rooms that have a rating equal to ISO Class 7 or higher efficiency (or equal rating systems). Rooms may be prefabricated, custom built or from a specialist supplier, subject to University approval.

viii. Room detailing shall be comprehensive and outline all construction and sealing methods. All walls shall be flush and all services wipeable with no horizontal elements. All doors shall incorporate airtight seals and adjustable floor drop seals for pressure adjustment unless specifically not required by the University.

ix. Windows and door vision panels shall be included to maximise occupant safety and monitoring of clean room occupants. Walls shall incorporate windows for monitoring of spaces. All doors shall have viewing panels unless specifically not required by the University. Windows between two clean rooms shall be double glazed to achieve flush surfaces on each side.

(c) Specialist equipment rooms such as electron microscopes, magnetic field generating equipment, medical imaging equipment, laser generating equipment, radiation generating equipment will require specialist designers to be engaged. Design solutions shall incorporate all equipment and space requirements including:

i. Safety and risk assessments.

ii. Containment for electromagnetic fields.

iii. Materials and barrier selection to achieve safety for all occupants within or adjacent to the facility.

iv. Light proofing for laser use areas.

v. Specialist radiation shielding. Designers shall be engaged with relevant specific experience and all recommendations followed through to construction.

vi. Reporting of solutions as a return brief for approval by the University prior to design development through to construction. Include design and construction hold points for university review.

vii. High levels of supervision. Construction supervision methodology shall be demonstrated to the University and shall be subject to approval. During construction records shall be kept and at completion demonstrated to the University that all project requirements are met. If supervision is not sufficient, as determined by the University, then an independent reviewer is to be engaged by the designers to assess and report. The University also may engage separate independent reviewers and the recommendations provided shall be complied with.

(d) Anatomy Laboratories - Designers must be experienced in anatomy laboratory design, this shall be demonstrated to the University. Design shall demonstrate due consideration to achieving a high level of security and meeting specific University containment requirements as well as specific temperature and humidity levels, specialist briefing will be provided by the University. Designer and installation shall ensure strict adherence to providing high quality vapour barriers, demonstrated to the university during construction. The facility shall be constructed to contain odours and chemicals without affecting all adjacent spaces.

(e) Animal Houses/Facilities - Designers must be experienced in animal laboratory design, this shall be demonstrated to the University. Note that specific temperature and

humidity controls shall be provided as well as specialist ventilation systems installed. Refer animal house laboratory detailed descriptions within this document. The design shall meet all requirements relevant to animal ethics and welfare as per Australian and International guidelines and standards

(f) Hazardous areas - The designers shall engage all specialist designers to assess hazardous zones and risk generated by dust, chemicals, fluids and vapours. Provide design solutions to the University via a separate report that covers hazardous zones and hazardous goods within a single report. Reporting and design shall include risk levels, delivery paths, spill risk/containment, standards utilised and proposed design solutions. All report requirements shall be included within the design unless approved by the University.

(g) Corrosive and flammable stores and cupboards – Design to relevant standards. Individual flammable and corrosive cabinets shall not be vented unless specifically directed by the University. Preference shall be to provide smaller flammable cupboards in lieu of central stores to limit risk and infrastructure. For larger stores these may be provided if approved by the university, however, the designers shall co-ordinate solutions with the University and demonstrate the requirement for a central store. Central stores shall include fire isolation to Australian Standards and ventilation systems strictly in accordance with the relevant Australian standards. Works must include all requirements of hazardous/flammable zones assessors and reviewers engaged for the works.

(h) Dust producing rooms and equipment – The designers shall be experienced in dust extraction systems including those generating hazardous zones. A specialist designer or supplier with design experience shall be engaged if the systems are not fully deemed to comply with relevant standards. The use of dust capture exhaust systems shall be specified to be provided by a specialist supplier with local representation for maintenance. Design and installations shall include providing containment space pressures and airflow directions within rooms so that adjacent spaces are not affected or put at risk. Works must include all requirements of hazardous/explosive zones assessors and reviewers engaged for the works.

(i) Explosive vapour spaces and equipment - The designers shall be experienced in vapour removal systems. A specialist designer shall be engaged if the systems are not fully deemed to comply with relevant standards. The use of vapour capture exhaust systems shall be specified to be provided by a specialist supplier with local representation for maintenance.

(j) Teaching and Research laboratories - Teaching Laboratories provide facilities to cater for student classes and generally are larger and less specialised than Research Laboratories. These laboratories shall include:

i. Teaching and Research laboratories can contain wet and dry laboratory spaces and shall comply with these space requirements.

ii. Teaching and Research laboratories include PC1 and PC2 general laboratory spaces. PC1 spaces shall be designed as PC2 spaces. These rooms shall strictly comply with the relevant Australian Standards

iii. Academic Research Laboratories are used by the University academic research staff and post-graduate students and are normally located close to staff areas and away from general access to student groups. Security and safety aspects shall comply with the Security Design Standard. Research Laboratories may include wet or dry laboratory areas, commonly with specialist equipment within these spaces. These may include external parties

performing research. The requirements of the users should be defined for each project. Higher or alternate security levels and access provisions may be required and if so shall be incorporated. Compliance with the users requirements shall be assessed and included, however, any deviations from the University design standards shall be advised to the University

2.4 Laboratory Building Configuration

Provide buildings and spaces that meet the following general design requirements:

(a) Laboratory buildings shall comply with all University design standards and be configured with a focus to meet high levels of aesthetics without compromising the laboratory requirements and future flexibility of the building. Laboratory services and structural designers and stakeholders will have direct involvement with and shall assist building and space configuration. Laboratory configuration shall be performed as a team collaboration basis. This collaboration shall be recorded and demonstrated to the University.

(b) Laboratory spaces and buildings modularised for ease of construction. Laboratory space design shall have an ability to be easily refurbished for change of use.

(c) Prefabrication shall be utilised for ease of construction and modification. This shall include common services support systems.

(d) Designers shall outline the boundary of the laboratory spaces and the method for containment of contamination to other spaces. The works shall include for full height walls from floor to underside structure over sealed to form the laboratory boundary and fully isolate from adjacent spaces. Laboratories shall not connect concealed ceiling spaces to non-laboratory ceiling spaces.

(e) Consistency with existing University buildings laboratory spaces of similar use so that students and staff are familiar with the design and use of the spaces. Inspect existing similar use spaces and discuss with users.

(f) Flexibility for modification, including additional equipment and services for additions and new equipment to be installed in each laboratory, include the following:

i. Physical spare space for a minimum of 20% additional services space installed including risers, bulkheads and ceiling spaces for equipment such as future fume cupboards. When spare services space is provided, associated spare floor and plantroom space shall be allocated for cabling, switchboards, ductwork, equipment and exhaust or intake positions. All building modelling/drawings and as-built records shall provide a modelled green zone or area to indicate these future provision areas, so the University recognises these provisions in the future.

ii. Riser shafts and spare space within shafts shall include:

- Construction and fire isolation provisions with free access for maintenance and testing without obstructions.
- Accessibility provisions for future services installation that allow practical installation without altering existing services in shafts or demolition of shaft components.
- Spare space shall be as directed by the University with a minimum of 20% of the shaft area, this may increase for future provisions.

(g) Project by project assessment of future connections and design of these connections for additional future services, shell areas, fitouts or building extensions. This shall include power supply, water, drainage, plant and architectural provisions. Refer the University for proposed future use of each fitout space or extension. Provide all design and construction requirements for the future services connections for ease of connection. Provide all architectural access, riser

shaft and egress provisions for ease of fitout or extension construction. Document all future planning provisions for these areas.

(h) All future fitout and building extension areas shall be accessible and buildable without major building impacts, major services shut downs to University operations or major reconfiguration. The determination of major or minor impacts will be by the University and shall be presented to the University for review.

(i) Design for buildings with external services risers:

i. Ensure an open floor space serviced by external riser ducts branching off at each level, with accessible horizontally mounted services on the perimeter walls.

ii. Main service routes shall allow for future installation of services and flexibility for laboratory future refurbishment or re-planning.

iii. Concealment of services shall be agreed with the University.

(j) Design for buildings with Internal Core Service Ducts:

i. Provide central riser ducts in cores with branch services feeding out on each level.

ii. Access to shafts and for maintenance of plant shall not be via clean laboratory spaces.

iii. Provide access to allow for maintenance and for future changes.

2.5 Finishes and Materials

(a) Laboratory construction shall comply with the following general requirements for wet and dry laboratories:

i. Impervious materials shall be utilised on floors, walls, ceilings, shelves and benches. Joints in all finishes and surfaces shall be sealed and kept to a minimum.

ii. Inaccessible flat surfaces that may harbour dust shall not be installed. Voids shall be either fully sealed or openable and accessible for cleaning

iii. All furniture and fittings are to be sealed and cleanable with access to all areas of the room for cleaning, including under benches which shall be sealed cupboards or open cleanable spaces.

iv. Select and provide specialist materials for containment of impacts relating to radiation, electromagnetic fields, heat, cold, chemicals, fluids, vapours and moisture. Installation of these specialist materials shall be in accordance with manufacturers and University requirements. Containment into local areas for higher risk impacts shall be utilised in lieu of allowing exposure to general laboratory spaces.

v. Light colours are to be utilised for bench tops, walls and fittings unless required for alternate purposes. Provide a table or sample of colours and materials for review by the University.

vi. Materials shall be selected to optimise whole of life performance and durability under use.

vii. Materials shall be smooth and cleanable.

viii. Acoustically and thermally rated walls that allow spaces to operate 24hrs with adjacent areas not operational (no wall condensation or heat transfer) and to meet sound transfer requirements to adjacent spaces. Bounding walls of the laboratory space shall allow for 24hr use of the laboratory space set at the lowest design temperature and non-24hr use in adjacent areas with no airconditioning operational. This shall be in addition to all legislated code requirement insulation and vapour barriers.

ix. Vapour barriers, air sealing, pressure containment barriers and thermal barriers shall be documented and submitted to the University to demonstrate isolation of each laboratory space. Vapour barriers shall fully encompass the entire laboratory space including where bounding internal adjacent spaces, barriers shall be located on the highest vapour pressure side of the barriers. These barriers shall be

clearly documented for university approval. For higher level containment or risk laboratories include air leakage testing to ATTMA standards and recommended levels, refer the university for laboratories requiring air pressure testing.

x. Provide colour coded identification tags on suspended ceilings and access panels to describe access points to serviceable items in ceiling voids. Provide engraved labels on the ceiling highlighting equipment mounted above with the university equipment identifier

xi. Ceilings may be omitted only in spaces such as dry computing laboratories, subject to acoustic review and meeting room sound level requirements. Typically ceilings shall be provided for all laboratory spaces unless approved by the University. Where ceilings are cut or trimmed the edges shall be re-sealed to match the ceiling seal.

xii. Access panels shall be located to suit items served. If located to suit ceiling symmetry then adjust services locations so that safe full access can be achieved. Safe access to items in ceilings is a strict requirement and all serviceable items shall be accessed with typically a maximum of 300mm from ceiling to underside large serviceable items in ceiling voids. Service personnel shall not be required to access items at high level in ceiling spaces that do not allow 3 points of contact on ladders or platforms below the ceiling line. Access interrupted by benches or fixed equipment is not acceptable. When serviceable items are installed at high level in ceiling voids, then fixed ladders, walkways and access platforms shall be provided.

xiii. Design services serviceable items located outside laboratory spaces so that service personnel do not service systems from within laboratory spaces. This shall not occur unless specific approval from the University is sought and provided. Redesign shall be included in the works if this is submitted for review by the university.

xiv. Refer the Architectural Design Standard for further finishes and materials details.

(b) Wet Laboratories Specific Requirements:

i. Materials are rated to resist the physical loads and chemicals utilised within the laboratory. A table of finishes and materials resistance to proposed chemicals utilised in the laboratory shall be provided to the University to demonstrate suitability. Provide documentation of solutions and demonstrate final samples/colours of materials to be utilised for the laboratory design, for review by the University. Adjust selections if directed.

ii. Flush welded frames shall be utilised in lieu of bolted or screwed fixings, suitable for cleaning.

iii. Coving and smooth sealed finishes suitable for frequent cleaning shall be utilised throughout.

iv. Chemical resistance shall include ability to resist any neutralisation chemicals utilised for spills and cleaning.

v. Floors and doors, provide:

- Submit all floor finishes to the University for approval. Anti-static floors and materials are to be provided unless otherwise approved. Provide floor warranty for University approval.
- Sheet vinyl floors unless specifically required or nominated otherwise. Provide non-slip with welded joints and coved corners. Chemical resistance to accommodate all chemicals utilised within the laboratory.
- Floor vinyl shall be coved up all walls, upstands and plinths. Coving shall include beading of sealant between cut edge of vinyl and the wall or plinth finish
- Floor finishes shall be sealed to door jambs and thresholds
- Door jambs shall be sealed to adjacent walls and shall not include shadow lines

- Provide a slip resistance assessment for all floor coverings and select to suit the risk level in the laboratory. Submit as a return brief.

(c) Floor Finish Sealing:

i. All floors and penetrations in floors shall be sealed impervious to accommodate spills and overflows.

ii. Penetrations in floors shall be provided with upstands and floor finishes coved up the sides of upstands or an equivalent approved method as approved by the University. Services penetrations shall be provided with plinths to their perimeter unless approved otherwise.

iii. Provide flood testing of floors via flooding with water and testing/inspection for leaks at joints and penetrations. This shall be discussed with the University if factors such as doors, floor design, falls and joinery inhibit this being performed. Provide an alternate floor sealing testing method to demonstrate waterproofing if flood testing is not viable.

iv. Walls, provide:

- Painted (heavy duty acrylic finish) plasterboard. Chemical resistance to suit chemical use within the laboratoryWelded sheet vinyl for rooms with regular cleaning requirements such as animal rooms and operating theatres. This shall include partial or full wall coverage to suit room use.
- Laboratory perimeter walls shall extend to underside slab or roof over and air/vapour sealed to slab or roof over. Barriers shall completely encompass spaces at roof and wall joints. If this is not provided then justification shall be submitted and equivalent alternate containment solutions proposed.

v. Ceilings:

- Grid tiles ceilings with vinyl facing shall be the minimum standard for all laboratory spaces. Alternative ceiling types including non-moisture absorbing or damp wipeable acoustic tiles may be proposed to the University subject to approval. Refer the Architectural Design Standard for further details. Provide removable ceiling tiles (vinyl faced) in an exposed grid system. Cut vinyl tiles shall have edges re-sealed, cutting tiles without sealing cut edges will not be accepted by the University
- Flush set ceilings to be provided for laboratories with a PC3 rating, insect and animal house buildings and laboratories with specific risk if vinyl tiles are utilised. Provide a risk assessment and select ceiling to suit. For flush set ceilings minimise the use of access panels and co-locate services. Minimise serviceable items in these ceiling spaces. Cooling and heating plant normally serviced regularly shall not be located above these spaces.
- Comply with special requirements outlined in relevant Australian Standards for containment laboratories such as outlined within OGTR Guidelines

(d) Bench Tops:

i. Provide modular standard sizes suitable for future adjustment of laboratory layouts. Assess against similar University laboratories for consistency.

ii. Post formed edges and upstands preferred. Utilise two part Epoxy finish, chemical resistant laminate or stainless steel. The final finish shall be agreed with the users and shall provide durable performance for the proposed laboratory chemicals. Designers shall assess chemicals and select finishes then present suitability to the University

iii. Stainless steel where chosen shall be type 316 Grade within laboratory spaces

iv. For laminates, select chemical resistant laminates from a specialist supplier

v. Radiation laboratory surfaces required special attention as set out in AS 2243.4.

(e) Dry Laboratories specific requirements:

i. Floors, provide:

- Anti-static finishes to suit equipment installed. Select carpet or resilient sealed flooring. Submit for approval to achieve the University requirements for each space
- Carpet - Provide the University Architectural Design Standard.

ii. Walls, provide:

- Painted plasterboard. Insulated and with vapour barriers if 24hrs. This shall include internal walls if adjacent spaces are turned off after hours.
- Acoustic fabrics suitable for laboratory environment

(f) Ceilings, provide:

- A ceiling system that complements the architecture, room acoustics and room pressure/cleanliness requirements. Ceilings may be exposed without drop ceiling, grid system without ceiling tiles or grid ceiling system with ceiling tiles installed. Where a ceiling is not provided then the design shall minimise dust build-up on top of services at high level and address acoustic performance of the space.

(g) Benchtops, provide:

- Min 25min thick waterproof plywood plastic laminates or as approved by the University as an alternative solution.
- Where laminates are utilised they shall be heavy duty abrasive resistant.

2.6 Built-in Furniture and Services Supports

(a) General - refer also Furniture Fittings and Equipment Standard. This section applies to all laboratory types unless noted

(b) Laboratory Benches:

i. Provide modular standard sizes suitable for future adjustment of laboratory layouts.

ii. Provide clear span under benches to allow lab attendants to work at benches in a seated position, and for wheelchair users in all locations. Where required for storage provide benches with cupboards.

iii. Provide shelves and service ducting over.

iv. Unobstructed Worktops - Clear unobstructed work benches are required with all services and outlets fitted above and well clear of wet surfaces, for code compliance, safety and accessibility.

v. Wet laboratory services support system – Provide a system of standardised exhaust, gases, power and data supports. This system shall be a modular system supported from the structure over or from the bench structure. These support systems shall be agreed with the University users, overhead services typically apply to research laboratories. For teaching laboratories the services support systems shall allow for line of site requirements.

vi. Factory laminate finished panels shall be utilised unless other systems are required for specific resistance to chemicals.

vii. Carcass Material – Utilise high moisture resistance (HMR) craft wood for carcass construction. Ensure water resistance and sealing for all furniture. In particular for built-in furniture all materials utilised for all components of the furniture shall be 100% non-moisture absorbing and this shall be demonstrated to the University. If alternate materials are proposed, then submit for University approval.

viii. Penetrations and cutouts in joinery, cupboards, shelving – Provide sealing flanges to each side of each penetration. Provide sealing of penetrations and cutouts, so that no exposed timber, composite or similar surfaces are exposed to laboratory air.

ix. Under Bench Units - Two types may be utilised:

- Type 1 - Suspended under bench cupboard units on structural support system. Construction to match benches and chemically resistant in wet laboratories.
- Type 2 - Standard free standing unit on castors. Construction to match benches and chemically resistant in wet laboratories.
- Top of all bench units shall be made chemically resistant in wet laboratories with extended front drip edge.
- Cupboards not under bench (including overhead) shall have the same performance as general floor mounted benches and shall be chemically resistant in wet laboratories if containing chemicals or equipment. Provide glazed safety panels to cupboard doors where agreed with the University for visualisation of cupboard contents.

x. Bench Heights:

- 930mm for normal working height - allow for some benches to be adjustable for wheelchair users. Provide adjustable levelling to benches.
- 720mm for writing

xi. Laboratory Sinks and Hand Basins- refer the University and users for direction on sink types required and include these within the project design. Standardisation with other University laboratory fitouts shall be utilised unless agreed otherwise for specialist purposes. Laboratory sinks shall be type 316 stainless steel laboratory sinks typically, unless for a specialist purpose.

xii. High risk floor spill provisions - For floor waste requirements at fume cupboards and high strength chemical use areas (such as for perchloric or hydrofluoric acid use), provide a risk assessment and include additional chemical spill containment locally, including additional local floor waste requirements to contain potential high risk acid spills from fume cupboards and scubbers.

xiii. Storage Space – Provide shelves and/or cupboards for the storage of both equipment and consumables with spare storage expansion space of 20% unless agreed otherwise with the University. There is a high demand for storage in many laboratories (such as biosciences) for consumable items in large cardboard boxes, include these storage areas. Storage provisions shall not require large or heavy items to be stored above shoulder height. Storage and shelving shall match construction as outlined under built in furniture. Standardised shelves are utilised throughout the University and these shall be inspected on site with the University and incorporated unless approved otherwise.

(c) Computer and Office Facilities serving laboratories shall include:

i. Provide offices in separated rooms from associated laboratories. In some instances local single offices may be accepted opening to laboratory spaces. If utilised these shall be located and agreed with the University. Office facilities shall comply with the University Furniture Fittings and Equipment Standard

ii. Where it is necessary for a computer to be housed in the laboratory itself and this computer is to be operated for several hours at a time, the following shall apply unless approved otherwise:

- Bench Depth - a bench depth of 900mm provided, except where it is demonstrated narrow monitors and sufficient workspace is available, then 750mm deep benches can be provided.
- Visual Obstructions - avoid overhead obstructions and background glare which will prevent the computer screen being placed at the horizontal eye height of the operator or affect use of monitors.

2.7 Laboratory Equipment and Fume Cupboards/Containment Cabinets

(a) General design and installation requirements shall comply with:

i. During the design process a brief must be obtained from the users to demonstrate to the University that service requirements are met for all items of laboratory equipment to be installed during design and future allowances are included. This assessment shall be returned to the University in the form of a return brief. The document shall list equipment and provisions required, including how future provisions will be met with the services infrastructure provided within the project works.

ii. General laboratory equipment requires a comprehensive assessment. Items requiring assessment are at a minimum:

- Power (single, three phase, special voltages). Check requirement for quantity.
- Data and building management system connections to equipment. For building management and data refer the university for existing suppliers to be utilised.
- Cooling and heating water connections to equipment. Equipment requiring dedicated cooling or heating circuits. These systems shall be independent of the main building cooling and heating plant. Specific University approval must be obtained before connecting to the base building cooling or heating plant. If base build systems are to be designed as part of the works then space shall be allocated for areas that anticipate future use of an independent cooling or heating circuit to serve laboratory equipment. Refer the University for direction.
- Lighting method, including specialist colours, intensity, higher luminosity and local task lighting for equipment.
- Services connection points and capacity for future laboratory equipment (gases, power, liquids, water, cooling/heating, exhaust). Refer the University for anticipated future equipment and make provisions in the design in accessible locations that do not require building works to make connections.
- Potable and non-potable water supply type, flows, pressure capability and connection points.
- Local fire risk and hazardous zones around equipment.
- Room pressure control requirements for containment or equipment protection purposes.
- Trade and house drainage connection points and capacity. This shall include trade waste treatment pits and future equipment loading capability.
- Structural floor loadings for average floor load and point load, include any high or low load areas.
- Safety provisions and safety barriers.
- Locating hazardous equipment in dedicated spaces.
- Access for safe maintenance and use.
- Noise impacts.
- Heat rejection and environmental conditions, including 24hr use and impacts on adjacent areas which are not 24hr.
- Discharge of dust, vapours, gases and chemicals that require specialist ventilation solutions.
- Waste disposal - The University chemical store shall be consulted for disposal advice for waste that cannot be discharged into sewer or trade waste and design provisions required.
- Clinical and cytotoxic waste – Provide design to allow waste removal in accordance with the University clinical and related waste operating procedure and Cytotoxic

Drugs and related waste Operating Procedure.

- Animal waste shall be disposed of in accordance with the University operating procedure with design provisions included to allow seamless removal.
- Spill kit locations.
- Area containment around equipment including walls and barriers.

(b) Specialist laboratory areas or Equipment - In addition to the general equipment and space installation design and construction provisions the following items shall be assessed and incorporated within designs by experienced designers approved by the University. If not listed then agree solutions with the University.

- Electron microscopes – Provide dedicated environmental controls in a dedicated space, use of low air movement airflow design is required. Provide clean power design to manufacturers requirements.
- Particle accelerator or large vacuum chambers – Provide dedicated environmental controls in a dedicated space. Provide clean power design to manufacturers requirements.
- Metallurgy Labs – Provide dedicated environmental controls in a dedicated space, use of specialist exhausts required.
- Psychology Laboratories – Provide lighting to complement one-way observation mirrors.
- Biosecurity containment devices (such as high containment class cabinets) – Engage an independent accredited auditor to review and provide advice for containment of biosecurity risk. Advice shall be followed and submitted to the University.
- Autoclaves/Sterlilizers/Steam Humidifiers – Steam generation design shall be included if generated independent of the equipment. It is University requirement to provide local packaged steam generation within equipment if available and within the building power supply capability, or local packaged steam generators in lieu of larger central steam plant. Design provisions shall be included to accommodate safety and high temperature steam or water discharges from this equipment such as to drainage from blow down modes.
- Piped Gas Cylinders – Provide in accordance with relevant Australian Standards. Location of stores shall be to the University approval and shall include an assessment of delivery methods and access pathways to storage areas. Bottle storage of gases within laboratory spaces is not acceptable to any level and if proposed a separate submission is to be provided to justify storage, including risk assessments. Bottle storage will be subject to the University approval if proposed and if rejected shall be redesigned. Final storage volumes and a risk assessment is to be provided to the University for all storage solutions including externally. Where stored externally provide all design requirements for physical protection, security, enclosures, delivery methods and pipework pathways to the laboratory spaces. Refer the University Mechanical Design Standard for piped gases system design.

(c) Fume Cupboards, Laminar Flow Cabinets and Recirculating Safety Cabinets and Toxic Exhausts. Refer the University Mechanical Design Standard for cupboard specific requirements, in addition to this standard provide the following for laboratory spaces:

i. Recirculating fume cupboards shall not be provided or utilised without specific University approval. The use of recirculating cupboards is not approved for general use.

ii. Provide water scrubbers as briefed and as required to meet trade waste discharge treatment requirements for

fume cupboard sink discharges. Provide as outlined within the Mechanical Design Standard, including drain point requirements

iii. Ganged or manifolded fume cupboards may be utilised subject to assessment of risk and solutions by the designers and approval from the University. The designers shall document a risk assessment in accordance with relevant standards and engage with all stakeholders to document the design process including organising meetings and documenting records. The final design shall incorporate a comprehensive analysis, report and risk assessment included in the design. Only specific equipment suppliers with local representation may be utilised and this will vary depending on market conditions, refer the University for direction on potential suppliers for specialist equipment.

iv. Recirculating safety cabinets shall be exhausted based on a risk assessment by the designer, submit the risk assessment to the University. Design shall include a thimble or equal exhaust method. Typically, the University cabinets are recirculating and exhausted cabinets shall be provided for higher risk procedures only. The designers shall co-ordinate solutions and make recommendations to the University.

v. Make-up air for exhaust for cabinets and fume cupboards shall be treated to room conditions and strictly comply with relevant Australian Standards for air turbulence (ambient air will not be accepted and if present shall be modified for existing sites). The use of heat exchangers shall be included if whole of life costs demonstrate benefits (without excessive maintenance) for the University and room pressures are not compromised.

vi. Exhaust air discharges for fume cupboards and toxic exhaust systems shall be risk assessed for adjacent buildings and spaces. CFD modelling shall be provided for all toxic air, containment cabinet and fume cupboard discharges. CFD modelling shall be performed by a specialist consultant with a University approved experience level and include relevant engineering design certification. CFD modelling can be removed by risk assessment and (subject to University approval) be omitted only if the risk is deemed to be low by the University. This would typically be in a smaller system with general use exhausts and located remote from outside air intakes and close by buildings.

vii. Provide 20% spare space for additional fume cupboard ductwork and fans as a minimum, or additional as directed by the University for future fitout.

2.8 Sustainability

(a) Laboratory design and construction shall assess and include the following general design principles in addition to the University Sustainability design guideline requirements, provide:

i. Modular construction to minimise impacts for purchasing new systems during future laboratory reconfiguration.

ii. Chemical waste minimisation methods assessed and included.

iii. Reduction in chemical use methods assessed and included.

iv. High efficiency plant selection without compromising plant reliability.

v. Design to ensure minimal use of cleaning and decontamination chemicals/gases.

vi. Laboratory equipment and heating/cooling plant with low energy use and automatic energy saving modes.

vii. High level of controls and monitoring including reset of internal environmental conditions to save energy.

viii. Re-use of existing laboratory equipment and services including all design provisions and assessment of these provisions compared to utilising new equipment and services.

ix. Heat recovery equipment (water or air) where whole of life assessment indicates a benefit to the University and reliable operation without excessive maintenance.

2.9 Safety Features

(a) Generally include all safety design provisions as outlined in all University Design guidelines including additional laboratory requirements, provide as follows:

i. Safety Showers and eyewashes to all wet laboratories.

ii. Waste containment systems.

iii. Specialist task lighting to meet user or manufacturer requirements for safe operation of equipment, ensure laboratory processes meet user requirements or processes in addition to legislated lighting levels.

iv. Design shall allow for spills to occur for chemicals utilised in the laboratory, demonstrate to the University the safety of the spaces during a spill. Spill kit locations and sizing shall be included to suit the laboratory type.

v. First aid stations with additional provisions to reflect the safety risks in the specific laboratory space.

vi. Safety signage relevant to the equipment, chemicals, gases and power supplies, in addition to authority requirements and to highlight any risks to occupants.

vii. Use of cryogenic materials such as liquid nitrogen may be required. Include in the design delivery pathways and safety provisions in case of a cryogenic gas spill. Provide an assessment to the University for approval and provide all design requirements for safe movement.

viii. Use of gases including high risk gases that asphyxiate or are explosive. Include in the design delivery pathways and safety provisions in case of gas leaks or an explosion occurs. Provide an assessment to the University for approval and provide all design requirements for safe movement and containment.

ix. PPE equipment provisions or cupboards near entry points to laboratories.

2.10 Standards Compliance

(a) Provide designs that comply with all relevant codes and standards. Provide standards compliance clauses within the return briefing as follows:

i. Applicable and relevant Australian and International standards that the University deems covers the systems installed shall be utilised for laboratory spaces whether legislated or not by the NCC. The intent is to maintain a suitable compliance pathway for all systems and spaces that minimise risks to occupants and the laboratory equipment.

ii. The NCC (BCA) current version shall be utilised to select appropriate legislated standards to be utilised even on refurbished or altered buildings built to earlier standards.

iii. Provide a list of relevant Australian and international standards that will be incorporated within the design.

iv. Provide the hierarchy of standards outlined where standards rely on each other.

v. International standards shall be utilised when not covered by Australian Standards

vi. Highlight any non-compliance or alternate solutions

2.11 Mechanical Services

(a) Provide design and construction that complies with the Mechanical Design Standard. Additional to these requirements include the following for laboratories:

i. The mechanical services trade shall, inform and direct the implementation of wall and roof air seals and vapour barriers. These shall be implemented architecturally.

ii. Laboratory plantrooms shall be separated from general air handling plantrooms. Laboratory fume exhaust fans shall not be located in general air handling plantrooms.

iii. Where future ventilation is provided this shall be capped off and sealed at the laboratory boundary with wall penetration sealed. Future ducts installed shall be pressure tested for leaks and results provided to the University.

iv. Heat loads shall allow for equipment actually installed, plus 10% safety factor on sensible and latent loads, sqm rates shall not be utilised for final equipment loads.

v. Each laboratory shall be provided with a dedicated PVC or HDPE wet moist general laboratory equipment exhaust system where laboratory equipment will require exhaust or future equipment will require exhaust, provide 25% spare airflow capacity and spare connections.

vi. Each laboratory shall be provided with a dedicated dry warm air general laboratory equipment exhaust system where laboratory equipment will require exhaust or future equipment will require exhaust, provide 25% spare airflow capacity and spare connections.

vii. Air changes and outside air shall dilute air to levels that meet workplace health and safety recommendations for additional dilution of airborne contaminants. Submit provisions and expected results within a return brief. The air change rates shall meet minimum levels as set by the university for each project, refer the University for specific briefing requirements.

viii. Building management system architecture and devices shall be installed for high speed reaction to space contaminent levels or other critical control signals to maintain space safety or equipment operation. Install local controllers and high speed devices to ensure fast acting systems.

ix. For pressure controlled spaces install visible pressure indication and BMS alarms. For pressure controlled spaces provide active space pressure sensing and control of space airflows, including automatic adjustment to compensate for filter loading and maintain space pressures

x. For fire mode operation, meet the requirements of the fire systems without compromising occupant safety in test modes.

xi. For PVC ducts penetrating fire resisting riser elements, provide a deemed to comply or engineered solution to University approval that reflects similar installations on the site.

xii. Emergency air flush modes in all laboratories with chemical spill use.

xiii. Latching emergency isolation to gases combined with power on one switch located at laboratory entry as a minimum shut down requirement.

xiv. All air shall be ducted, plenum ceilings shall not be utilised in wet laboratories.

xv. All ductwork systems shall be designed to allow for an element of leakage risk from the ductwork to the plantrooms and ceiling spaces so that if this occurs there is no risk to other systems or occupants in the building.

xvi. All sheetmetal ductwork shall be to a minimum pressure class serving wet laboratories of 750Pa medium pressure seal class A to AS4254. A minimum of 20% of ductwork shall be pressure tested for leakage to a recognised international testing standard.

xvii. All sheetmetal exhaust ductwork carrying fumes or dust shall be 750Pa medium pressure seal class A to AS4254. A minimum of 20% of ductwork shall be pressure tested for leakage to a recognised international testing standard. All duct longitudinal and cross joints shall be externally mastic sealed in addition to AS4254 requirements.

xviii. Toxic cabinets shall be separately ventilated with individual ducts.

xix. Fume and toxic exhaust systems shall not have positive pressure ductwork located inside the building.

xx. A number of exhaust systems are typically required in laboratory

spaces. Provide in accordance with relevant standards and the manufacturers requirements. These exhaust systems shall be individual exhaust systems unless serving equipment in a common room and similar equipment.

xxi. Exhaust systems shall be individually ducted to relevant Australian Standards whether legislated or not. Include design solutions to minimise odour risk to external areas. Common exhaust plenums, if proposed, shall utilise dividers to ensure systems are fully isolated to the discharge points. Systems with a risk of chemicals or dust reacting in any manner shall have separate exhaust systems.

xxii. Directional airflow shall be from clean to dirty.

xxiii. Direct humidity control shall be assessed for each laboratory and only provided if required for specific purposes including laboratory work performed, condensation risk, equipment requirements or occupant comfort. Each laboratory shall be assessed for dehumidification only, humidification plus dehumidification or inherent dehumidification only via the cooling process. The design shall ensure laboratory spaces do not exceed 60%RH at laboratory indoor and outdoor peak summer design conditions for non-direct humidity controlled laboratories. Use of electric reheat is not permitted without University approval. If approved (for example minor reheat purposes where other heating methods are not possible) then electric heating shall be minimised. The designer shall demonstrate that other methods could not be utilised. Use of dessicant based dehumidification will be limited by odour and contamination risk in wet laboratories.

xxiv. All direct humidity control spaces shall be designed and installed to achieve 50 %RH +/-10%RH and not exceeded for more than 5 minutes, unless briefed otherwise by the University or required by specific laboratory erquipment. Confirm all humidity level requirements with the University and users then design and construct as directed for all specialist spaces.

xxv. Air movement shall be selected to suit specialist equipment and for dilution of odours and contaminants.

xxvi. Temperature set points shall be selected in consultation with the University, make all associated building design then construction provisions for insulation, sealing and barriers for low or high temperature spaces so that adjacent spaces are not impacted from these rooms/spaces and condensation does not occur.

xxvii. Humidity control spaces shall not be open to non-humidity controlled spaces

xxviii. All laboratories shall have dual cooling coils with dual control valves when above 20kWr in total cooling capacity for inherent dehumidification.

xxix. All heating for spaces above 15% of airflow being outside air shall utilise heating methods that are not electric resistance or gas driven. Heating shall be discussed and agreed with the University, in particular high outside air spaces with fume cupboards.

xxx. Acoustic treatment of ductwork or use of sound attenuators. For wet laboratories sound attenuators shall have impervious lining.

xxxi. For spaces with freezers containing samples, provide backup mechanical ventilation to allow shut down or failure of laboratory airconditioning systems.

xxxii. External insulation only for ductwork in wet laboratory spaces.

xxxiii. For vibration, temperature and air movement sensitive equipment engage a specialist designer to assess the services impacts and implement recommendations.

xxxiv. All low temperature storage equipment such as freezers with samples shall include BMS temperature and alarm monitoring.

xxxv. Implement filtration levels to user requirements for air quality and space particle levels. All filters shall be deep bed and if rated at F9 or better shall have G4 pre-filters. For HEPA filtered spaces utilise F7 pre-filters to protect HEPA filters. This includes supply air HEPA filtration and exhaust HEPA filtration.

xxxvi. Louvred windows or natural ventilation openings shall not be utilised in laboratories. If existing louvred windows (including glass pane adjustable louvres) are part of a laboratory design then the windows shall be replaced with a sealed solution.

xxxvii. For dedicated laboratory equipment cooling refer users for requirements of cooling plant, heat exchangers and pumps. Provide a criticality and assessment review to the University and the users. Major critical laboratory equipment may incur a highly critical loss of data or equipment, provide N+1 cooling plant including local dedicated chiller, pumps, heat exchangers and local power supplies/controls, unless directed otherwise by the university. The designers shall assess and provide systems on the basis of the University project requirements.

xxxviii. Heating hot water systems for laboratories that require specialist heating, these shall be selected to the University Hydraulic and Mechanical design guidelines. Use of LP gas is not acceptable as a heating water energy source. Use of natural gas is not acceptable unless approved by the University. Natural gas as an energy source can only utilised if high temperature water cannot be achieved by another method. Provide heating water methods to the University for approval in a return brief.

xxxix. It is a strict requirement to seal all roof, wall and floor penetrations airtight and to meet containment requirements of laboratory spaces. Packed gaps and mastic sealed sheetmetal angles must be utilised to each side of each service penetration.

xl. Sensors and exposed services in laboratory spaces shall be sealed and wipeable with no horizontal surfaces to harbour dust.

xli. All materials (including those within ductwork and plant) utilised shall be compatible with the room chemicals/fluids/vapours used or stored so that no corrosion occurs during the life span of the services under normal use.

xlii. Stainless steel ductwork shall be utilised for ductwork that may impact or be impacted by electromagnetic fields.

xliii. All non-teaching wet laboratories and specialist laboratory spaces shall have space air leak testing performed to a recognised international testing standard such as ATTMA in accordance with the standards class of space, unless approved to be removed from the scope of works by the University. Refer associated University Design Standards for testing methodology and leakage rate required to be achieved. The works shall be specified and provided under the mechanical trade.

2.12 Electrical Services

(a) Provide design and construction that complies with the Electrical Design Standard and additional to these requirements include the following:

i. Provide a harmonic and interference assessment impact report for sensitive electrical equipment. Implement provisions such as filtration and screening to ensure reliable operation of equipment.

ii. It is a strict requirement to seal all wall and floor penetrations airtight and to meet containment requirements of laboratory spaces.

iii. Provide an assessment of standby power and report to the University. Include assessment of UPS provisions and generators. Implement the design and construction of these systems to ensure reliable laboratory equipment operation. Provide a detailed power and controls resilience report for

University review. Standby power shall be provided as directed by the University.

iv. Power outlets and Power Ducts - sufficient power points shall be installed to operate (without the use of adaptors or extension leads) all the electrical appliances and instruments to be installed in the laboratory with an allowance for future equipment provided as agreed with the University. In instrument rooms and laboratories use ducted cabling above the bench tops or overhead services ducting to ensure flexibility for locating outlets.

v. Power outlets for cleaning purposes - Provide a labelled and coloured power outlet on the end of bench closest to corridor to provide cleaning staff easy access to power and throughout the laboratory in clearly visible locations away from laboratory equipment to suit cleaning equipment utilised.

vi. All outlets shall be fully sealed and wipeable, IP rating and hazardous zone rating shall be assessed and included for outlet selection. All laboratory spaces shall have sealed outlets for power, communications and audiovisual systems. unless specifically approved otherwise by the University. For highly contained sealing spaces such as PC2, PC3, plant and insect spaces then all sealing of outlets shall be strictly air and watertight. Wall boxes behind outlets or equivalent sealing shall be utilised.

vii. Lighting shall be flush and wipeable with no horizontal lips or edges.

viii. All wall outlets in wet laboratory spaces shall include wall boxes behind, sealed airtight.

ix. Provide a common resettable labelled emergency shut down to each individual laboratory for emergency isolation of general power outlets and, if installed, combustible laboratory gas supplies. For specific alternate gases refer the University for inclusion or not on shut downs.

x. Provide a minimum of 20% spare space within switchboards for future circuits.

2.13 Dry Fire Services

(a) Provide design and construction that complies with the Dry Fire Design Standard and additional to these requirements include the following:

i. Provide a fire suppression options report or engineering advice to assess impacts and options on suppression methods for sensitive laboratory equipment. Make recommendations and implement design and construction of systems.

ii. It is a strict requirement to seal all wall and floor penetrations airtight and to meet containment requirements of laboratory spaces.

2.14 Hydraulic Services

(a) Provide design and construction that complies with the Hydraulic and Wet Fire Design Standard and additional to these requirements include the following:

i. Backflow prevention RPZ valves to each laboratory or group of the same use laboratory spaces. Include provision of engineering advice to the University outlining backflow cross contamination risk impacts for each laboratory. Backflow prevention shall be fully accessible and discharges drained to a tundish below the valves. Backflow prevention shall include cold and hot water systems.

ii. Provide spare connections or access to install connections to stacks and water supplies for future fitout changes. Document provisions.

iii. Hot water (tempered) and cold water shall be supplied to all wash hand basins, each laboratory shall utilise a wash hand basin at or near the laboratory entry.

iv. Each laboratory shall have safety shower and eye wash bowl provisions to code requirements if chemicals/fluids are utilised. Locate additional safety provisions close to high risk items of equipment. Provide

charged floor waste provisions to each safety shower, unless approved by the University not to provide for alternate reasons such as containment. Floor wastes shall not have graded falls within laboratory spaces unless outside of a circulation zone and approved by the University to include falls. Provide a flow measurement mechanism for testing each safety shower, the plumbing trade shall demonstrate to the University use of the measurement method. The methodology shall strictly comply with relevant Australian standards and meet flow requirements.

v. All floor wastes in laboratory spaces shall have charging to maintain the water seal. Resolve with the University alternate solutions for specialist containment spaces that cannot accommodate floor wastes. All floor wastes shall be clamped ring type with vinyl turned down into the waste outlet.

vi. Trade waste shall be in accordance with the University guidelines and shall be assessed by the designers for each project. Submit all trade waste discharge calculations for review and utilise within trade waste applications. The designer shall include to design all treatment systems to achieve the site trade waste discharge compliance requirements to meet local authority requirements and trade waste agreements with the University. Provide all submissions for trade waste approval.

vii. It is a strict requirement to seal all wall and floor penetrations airtight and to meet containment requirements of laboratory spaces.

2.15 Physical Containment Laboratory (PC1, 2 and 3) Requirements

(a) Provide the following additional laboratory allowances in addition to briefed requirements, relevant standards, legislated requirements and the University general guidelines:

i. Airconditioning and/or Ventilation - provide a dedicated air conditioning unit to each containment laboratory, this shall include pressure controls, filtration and assessment against Australian design standards compliance submitted to the University. Install as per the Mechanical Design Standard requirements and this guideline.

ii. Room design shall include double skin fire resistant wall and ceiling panelling for PC3 rooms (PIR panels or approved equal).

iii. Engagement of specialist experienced designers are required for PC3 containment facilities to provide advice on classification levels, air change rates, pressurisation, containment method. Design will be subject to University approval and may be independently reviewed by the University. All University review recommended alterations shall be included in the design and construction. A detailed design review shall be performed and documented at each phase of the design to limit redesign risk.

iv. BMS monitoring and automatic adjustment of systems shall be provided to maintain room pressures, including allowances for filter loading.

v. Hands Free Taps - provide at least one dedicated set of taps to wash hands to serve each containment area or room.

vi. Refer the University for provision of fume cupboards and their features within the project scope. The designers shall include all design provisions within the project design documents including all associated works.

vii. Refer the University for provision of biohazard cabinets within the project scope. The designers shall include cabinets within the project design documents including all associated works. the University may also choose to supply biohazard cabinets or relocate cabinets for installation under the project scope.

viii. Provide gowning areas with separate airflow and pressure gradients.

2.16 General Items

(a) Provide all final connections and terminations to all laboratory equipment and systems nominated under the project scope, including but not limited to fume cupboards, biohazard cabinets and major laboratory plant. This shall include power, data, BMS, piped gases, cooling, heating, waste and exhaust connections. All systems and equipment installed within the works shall be complete and fully operational at completion. Practical completion of the works shall be subject to satisfactory performance as deemed by the University for the spaces and equipment.

(b) For laboratory items supplied by the University for installation, take possession and install in accordance with the suppliers recommendations. Take full responsibility for all works performed including installation method, insurances, movement methods and provide all services provisions.

(c) Colour and aesthetics of the laboratory fitout and supporting building shall be presented to the University including images of proposed solutions. Where major laboratory equipment is installed, the architecture shall highlight the plant for demonstration purposes if required by the University. This may be in the form of additional signage and viewing windows.

(d) For University spaces where external parties take possession of the laboratory or spaces in the laboratory or the building, refer to the University for direction and implement additional user design standards or guidelines as directed/required by the University. Standards shall include those required by alternate users taking possession of a University building (such as for commercial partner research). Where standards are not advised by users then the University standards shall be utilised. Where a conflict of design and construction standards exists then the highest standard is to be applied and the University consulted for further direction.

3 Animal Facilities

3.1 General Requirements

(a) This design guideline refers to a single room or a group of rooms and refers to both animal houses and animal holding rooms. The facility may be a standalone building with all the necessary staff amenities or part of a larger building.

(b) Comply with all laboratory requirements within the Design Standard laboratories, including additional items listed under this clause animal houses. The facility shall comply with AS/NZS2982, latest version.

(c) Siting and General layout - Animal Facilities (either building of spaces within a building) shall be carefully considered to comply with the following requirements:

i. Safety of animals from non-approved university staff shall be provided. Security for staff and animals from threats of operational disruption is essential and shall be in the form of both physical barriers and electronic security systems. The facility designs shall reflect respectful and sympathetic treatment of animals to other parties.

ii. Unpleasant odours from exhaust air shall be directed away from adjacent occupied areas and or treated to reduce impacts. Provide an assessment of odour risk for approval by the University.

iii. Easy access for delivery vehicles to load and dispose of animal wastes.

iv. Vermin and insect proofing of the animal spaces without voids and spaces for vermin and insects to access, including full height airtight sealed walls to the perimeter of the laboratory.

v. 24hr cooling and heating of the animal spaces therefore vapour barriers and insulation to the complete perimeter of the spaces.

vi. Acoustic separation of animal areas from all adjacent areas and to outside.

(d) Room Layouts - a summary of the space requirements for Animal Houses is as follows:

i. Provide separate rooms for staff offices, staff tearoom, staff showers and toilets, animal housing, manipulative procedures (injection, bleeding, surgery, testing, and euthanasia), food storage rooms, quarantine and plant rooms.

ii. Provide separate areas for cage storage, cage cleaning/washing and garbage handling/storage. A loading dock shall be provided.

iii. A large capacity Autoclave near the cage cleaning area shall be provided.

iv. Incorporate separate delivery access and lifts to avoid mixing movements of animals and cages with building occupants and visitors, particularly in a mixed use building.

3.2 Finishes

(a) Walls:

i. Walls shall be impervious, washable and resistant to chemical attack from animal wastes. Finishes shall be smooth to facilitate cleaning.

ii. Material options are:

- Laminated panels with sealed joints, on waterproof substrate.
- Up to 1200mm above the floor, special industrial coatings.
- For new and existing animal rooms high quality chemical resistant full gloss enamel paint utilised above 1200mm.

(b) Floors:

i. Floor materials shall be low maintenance, impact resistant, durable for heavy trolleys and require minimum cleaning. All corners shall be smooth and coved. Floor finishes can vary between different usage spaces. Submit details for the University review, options are:

- Special non-slip 2 pack epoxy paints applied to new well cured concrete.
- Welded sheet vinyl. Animal faeces and urine may affect vinyl condition, hence assessment shall be performed by the designers for suitability. Extended manufacturer's warranty is required if this option is chosen.
- High quality non-slip floor tiles with special jointing, Use of tiles is however not preferred due to ability to withstand impact and shall not be normally provided unless approved by the University for a specific use.

ii. Provide coved skirting at corners of wall and floor.

(c) Ceilings:

i. Provide flush, cleanable, impervious materials with matching finish to walls.

ii. False ceiling voids are to be avoided where possible

(d) Buffer Rails and Corner Guards - install type 316 stainless steel rails in corridors to protect walls from damage by mobile cages and trollies. Stainless steel corner guards are to be utilised in trolley route areas. This protection shall apply to all trolley pathways.

3.3 Plumbing and Hygiene

(a) Floor Wastes - consult with users on their method of cleaning, before considering the need for floor wastes. Floor drains are not required where a totally dry husbandry system is utilised i.e. wood shavings in cages. If required by the users, special floor wastes are to be fitted with removable grates and stainless steel litter baskets to prevent sawdust and faeces entering and blocking drains. Animal faeces are not to go to the sewer. If there is a risk of this occurring there must be regular inspection points for cleanout provided and at all changes of plumbing direction. Sewerage drain size must be a minimum of 150mm where risk of waste to house drainage occurs. If rubbish is picked up in the room then the drain grate shall have stainless steel close mesh grilles prior to the floor baskets.

(b) Vermin Proof Grease Trap - if required by users, provide accessible grease traps nearby. These will need cleaning out regularly therefore shall have free and easy access.

(c) Well Drained Floors - ensure adequate slope to floors to drain excess water from wash down. Consider angle and direction of slope so that animal cages remain stable and level. Refer the University where wash down is not required as in some instances this is not required.

(d) Wash down provisions shall be included for spill and clean-up including hose connections and power outlets located to suit.

(e) Wash/Hand Basins - provide hands free stainless steel hand and/or wash basins at convenient locations outside or inside the animal rooms (depending on users). Supply tempered hot and cold water to each hand basin. A hose cock shall also be provided in each animal cage area. All benches and hand basins shall cantilever from the wall to maintain a clear floor for cleaning. Soap dispenser, paper towel dispenser and plastic coated wire baskets shall be provided to each animal housing space or laboratory.

(f) Provide tempered hot and cold water backflow prevention to each individual laboratory area independent of the main building.

(g) Hot Water System - provide a storage type large capacity quick recovery unit, with drip tray. Pipework shall be kept to a minimum and be fully insulated.

(h) Vermin - provide fully exposed surfaces and accessible fittings to assist quick hose cleaning of the total room surfaces. Avoid recesses and gaps that provide breeding grounds for cockroaches, insects and other vermin.

(i) Air Lock - provide a pressurised airlock to separate animal odours from other areas. Ensure both airlock doors are not opened at the same

time if the animal room is adjacent a sensitive or public space.

(j) Foot Bath - depending on the particular user requirements, a foot bath and/or special foot protective covering will be necessary. Refer users for location and configuration.

(k) False Ceilings – shall be fully sealed and designed out if possible. Vermin proofing and airtight sealing shall be utilised.

(l) Steam Cleaning - provide steam cleaning facilities for cage washing including water supplies and power, applicable to larger projects. Small facilities shall be provided with a laboratory sink to be to hold the largest cage size for cleaning. Refer users for final requirements.

(m) Vacuum Cleaning - Provide a central industrial vacuum system with outlets to each area and vacuum unit mounted in an acoustically isolated space with cleaner access. The system shall minimise noise transfer to animal cage areas and is provided for bedding cleaning.

(n) Backflow prevention - Provide backflow prevention to isolate all laboratory areas in the form of RPZ valves with drain and accessible for inspection.

(o) Cages:

i. Cages shall not be mounted permanently on floors to assist floor cleaning. Cage heights shall be adjustable for levelling if the supporting floor has a fall.

ii. Materials shall be corrosion resistant and fully cleanable, stainless steel and mounted on sturdy lockable castors shall be utilised.

iii. Design shall ensure the cage size and door width (minimum door shall be 900mm wide) will provide easy movement throughout corridors and rooms for cages. Corridors shall accommodate large turning radius and adequate spare clearances when accommodating large cages.

(p) Cage Rooms - cages are to be typically placed along the 2 long walls of a room with bench, wash hand basin and drainers at one end near the exit.

(q) Animal Waste Disposal - all wastes are manually collected by specialist contractors. Discuss waste storage and management with users and provide suitable design and construction inclusions for seamless waste removal.

(r) Fumigation - Animal rooms require pest control treatment from time to time, provide external control of the room air conditioning supply and exhaust to isolate the room fully from all other spaces and allow the introduction of fumigants Once fumigated the ventilation systems shall then exhaust the room for a predetermined period. The specialist contractor working for the University shall be consulted and design requirements included for fumigation chemicals, discharges, intakes and methodology.

3.4 Doors

(a) Refer Architectural Design Standard for general door requirements and meet the following requirements as well:

i. Solid Core - Provide solid core water proof materials fitted with stainless steel rubbing strips at the bottom and seals.

ii. Finish - finishes shall be chemical resistant epoxy type coatings for new work. Use gloss enamel paint for existing doors. Ensure that doors are properly primed and painted on both top and bottom edges to prevent moisture entering and generating warping.

iii. Stainless Steel Kickplate - fix a one piece full width stainless steel panel 200mm high on one side underneath, and then up the other side of each laboratory access door.

iv. Vision Panel - provide vision panels to provide observation of animals. A window shutter shall be provided to prevent line of sight for all vision panels.

v. Hinges - provide stainless steel fixed pin butt type, minimum 3 off per leaf.

vi. Locks and Door Closers – (refer users plus the University Property and Facilities division for locking solutions, all doors shall have electronic security and electronic latching provided to laboratory and animal rooms to approval of the University. This shall include tracking of door access via security Hardware and Accessories. Doors shall be openable at all times from inside rooms for egress.

vii. Door Seals – provide adjustable heavy duty drop type door seals to ensure air tight enclosures. Seals shall be adjusted to suit room pressure requirements. Door seals fixed to floor in any manner are not acceptable.

viii. Direction of Door Opening - all doors to animal rooms must open outwards into corridor. Allow sufficient corridor width for doors to be left open for cage movement, provide door closers that allow doors to hold open until released.

3.5 Air Conditioning

(a) Generally install in accordance with the Mechanical Design Standard and general laboratory requirements unless listed in this section.

(b) Design Loads - determine the number and type of animals kept in each room to establish heat loads for the system.

(c) Once Through Air - provide 100% clean outdoor air to all animal rooms. Air shall not be recycled.

(d) Air Change Rate to animal rooms – Provide in accordance with the American Society of Heating, Refrigerating and Air-Conditioning Engineers. (ASHRAE) Handbook for animal rooms, latest version. Minimum air change rates are:

Species	Minimum Room Air Changes per Hour (utilise 100% Outside Air)
Mouse, Hamster, Rat, Guinea Pig	15
Rabbit, Cat and Dog	10
Non-Human Primate	Refer the University

(e) Exhaust System - provide dedicated animal room exhaust with fine stainless steel insect mesh screen at air inlets. Provide prefiltration to exhaust system intakes in addition to the screen filters. Screens and prefilters shall be easily removable. Refer also AS 2243. Provide exhaust systems that cannot be contaminated or clogged during steam cleaning of cages. A dedicated cage 'knock out' cleaning bench under strong negative exhaust pressure shall be provided with access to a wheelie bin or similar below the bench. Refer users for requirements. Provide a cleaning bench exhaust separate to the general room exhaust.

(f) Exhaust Grills - exhaust grills shall be removable, wipeable and cleanable. Dampers shall not be located at grilles for cages.

(g) Air movement and Noise – Ensure sound levels are met for the space for all grilles and air velocities measured within 500 of all grilles. Air movement shall flush the space fully with no dead pockets of air, ensure cages are not influenced by supply air drafts that exceed room air movement rates.

(h) Effluent Air - discharge of effluent air shall be in accordance with AS/NZS 1668.2 with provisions for direct odour management. Assess external odour risk and provide odour control filtration. All ductwork within the building shall be held under negative pressure to limit risk of air leakage into the building, including plantrooms and service spaces (critical requirement). Service of the exhaust systems or fans shall not allow odours into the building general spaces.

(i) Vermin Proof Ducts and Pipes - seal all ducts and pipes to prevent vermin access. Inlets and outlets shall be insect, bird and rodent proofed.

(j) Air Pressure - animal rooms are to be kept at negative pressure at minimum 10Pa below surrounding areas, except Specific Pathogen Free areas e.g. SPF mice rooms, which shall be positive pressure. Refer users for requirements. Provide a method for pressure indication to users and BMS alarm indication.

(k) Staff Offices and Tea Rooms - provide a separate recycled comfort air conditioning system at positive pressure.

(l) Filtration - all exhaust air shall be rough filtered prior to discharge with deep bed filters. Where there is a risk of zoonotic diseases being discharged, High Efficiency Particle arresting (HEPA) filters shall be installed at terminal inlets to the exhaust system.

(m) Room Conditions - For the University animal rooms conditions are to be set to control to an adjustable range of 18 – 26 Deg C +/- 1.5 Deg C at the set point chosen within this range or as directed, adjustable via the BMS system Humidity levels are to be adjustable from 40% to 60% and shall achieve 50%RH +/- 10% RH at the full range of internal temperature adjustment at external design conditions. Humidifiers with direct packaged steam injection shall be provided. Direct dehumidification shall be provide to each individual animal room. External design conditions – Animal rooms shall be designed to AIRAH critical 24Hr design conditions for the location. Example conditions required are below and shall be confirmed.

Species	Deg C	% RH
Mouse, Hamster, Rat, Guinea Pig	18-26	40-60
Rabbit	16-21	40-60

(n) For air change rates utilise AS/NZS2982 and if not covered then ASHRAE Handbook recommendations. Utilise latest versions, these may be reviewed and discussed however the systems shall achieve the previously nominated room space conditions at the required air change rates for nominated room design conditions. Refer users for final briefing requirements.

3.6 Electrical Requirements

(a) Provide design and construction that complies with the Electrical Design Standard and additional to these requirements include the following items in this section.

(b) Waterproof Fittings - all GPOs, light switches and light fittings shall be waterproof minimum IP66 rated outlets. Consult with users for mounting height - nominally 1200 mm above floor. Design shall include risk assessment of all outlets and include use of IP66 rated plugs to outlets.

(c) Animal rooms shall have direct simulated controlled day/night conditions with automatic dimmed level controls. Animal rooms shall have separately switched red light modes for supervision of animals out of hours, for minimisation of animal disturbance.

(d) Animal room, shall have CCTV to monitor animal welfare remotely by an approved method by the University for viewing the CCTV images.

(e) Time Clocks – Refer Electrical Design Standard, provide standard digital type.

3.7 Other Design Features

(a) General - National animal welfare guidelines shall be consulted and followed for further information.

(b) Natural Light - Animal rooms shall have direct simulated controlled day/night conditions in addition to any natural lighting provisions. Skylights and windows shall only be installed in the staff spaces. Natural daylight shall be provided if available and shall be provided for dogs, cats and primates with the ability to close

off the natural lighting and shall not be visible from outside the building. Refer users for final briefing.

(c) Security:

i. All animal houses to be fitted with a University approved access control and security alarm system connected back to the University security network

ii. All openings and grilles accessible via personnel to outside shall be fitted with welded and security fixed security bars.

(d) Colours in the Work Environment:

i. Animal houses can be introspective buildings isolated from the outside world and with strong odours. A well chosen interior colour scheme shall be included to create a more pleasant workplace for staff and visitors. Attention shall be given by designers for high aesthetic comfort levels.

3.8 Storage

(a) Dry Space - provide a dry storage space for feed and animal cages on a platform 500mm above the floor and as briefed or discussed with users for the particular facility. Garbage shall be kept separately sealed in a separately exhausted space and close to a loading dock.

(a) Flammable and Toxic Materials - consult with Occupational Health and Safety Office for safe storage of chemicals and the Fire Officer at Security Section for advice on fire protection equipment and fire alarm systems.

(b) First Aid:

i. Provide an up to date first aid kit located in the staff space near the entrance doorway and clearly signed.

ii. The potential for infection from working in animal houses is relatively low but still requires additional safety precautions. Personal protective equipment (PPE) enclosures and provisions shall be provided for all animal rooms or outside, In the event of an injury, first aid will be sought immediately. The area of greatest risk is to those working on active animal house waste discharges. For air handling units, fans, filters and drains. Provide physical precautions stating no sharp edges in this plant and warning signage to wear PPE during plant service.

3.9 Important Issues

(a) Electrical, Plant and Filters – Access to equipment and plant must be from outside laboratory and animal rooms for maintenance.

(b) For PC3 spaces with animal rooms, PC3 laboratory requirements must also be followed in addition to animal room requirements.

(c) Plant and equipment must not be located above research equipment or cages.

(d) RO water must be located outside or in a dedicated plant space.

(e) Specific Pathogen Free spaces (PC2 rated positive pressure) may be considered as cage base controls, refer users and provide a proposal if considered as part of the design. If not adopted then adopt the PC rating to user requirements.

(f) The University Animal Ethics Officer shall be consulted during the design process to input into the proposed solutions.

3.10 Precedent Buildings For Reference Designs

(a) GBP Biovarium 80.

(b) AIBN Level 6 animal facility.

3.11 Abbreviations

ASHRAE	The American Society of Heating, Refrigerating and Air-Conditioning Engineers
SSO	Switched Socket Outlet
HEPA	High Efficient Particle Air
OGTR	Office of Gene Technology Regulator
RO	Reverse Osmosis
the University	The University of Queensland
EC	Animal Experimentation Ethics Committee

4 Materials/Equipment/Product Schedule

5 Contacts Schedule

Reason for Contact	Organisation/Group	Name	Contact Number