SECTION 37

SPECIAL REQUIREMENTS FOR LABORATORIES

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37.0 SPECIAL REQUIREMENTS FOR LABORATORIES

37.1 Design Issues

37.1.1 Laboratory Definition

This section deals with the spaces used for research or teaching activities with a technical or scientific function, in which there is a potential risk or hazard to users are described as 'Laboratories'. Non-hazardous spaces often called 'Dry Laboratories', which may include computer facilities and language laboratories are not covered in this section.

Laboratories may be required in areas such as Biosciences, Medical Research, Physics, or Chemistry and may include teaching, research, quality control, testing or analysis. These activities may require the usage of chemicals, including dangerous goods, hazardous substances, electrical or radiation hazards, pathogens, quarantine materials or work processes which could also be hazardous.

Special Hazard Laboratories are areas within laboratories (or whole laboratories) in which particularly hazardous substances are used or specific hazardous processes are required which necessitate the requirement to conform with specific standards and legislation in their design and operation. The standards relating to these special hazard laboratories will be over and above the regulatory requirements which are listed in the following section. These special hazard laboratories may include microbiological laboratories, vivariums, cytotoxic chemical preparation rooms, clean rooms and radiological laboratories to cite examples.

The designated laboratory area should include, or have access to, all support spaces required, such as; instrument and preparation labs, laboratory stores, sample stores,, chemical stores, wash up, media prep, sterilization facilities, waste storage and waste treatment facilities. Administration and office accommodation should not be within the laboratory boundary but should ideally be in close physically proximity to the laboratories they serve. Write up areas are permitted within the laboratory boundary however, these should be separated from areas where hazardous materials are stored or processes undertaken and should only be used on a temporary basis to support the scientific activities.

These design requirements are for research and teaching laboratories within the University environment only and do not encompass larger scale pilot plant production and manufacturing. Specialist advice on regulatory requirements associated with such facilities should be sought and applicable risk assessment carried out, should they be under consideration.

37.1.2 Regulatory Requirements

Laboratory spaces must be designed to comply with latest version / amendment of all relevant legislation and standards and referenced and related documents, which include as a minimum:

- AS/NZS 2982 – Laboratory Design and Construction
- AS/NZS 2243 Parts 1-10 inclusive – Safety in Laboratories
- AS 1940 – The Storage and Handling of Flammable and Combustible Liquids
- AS 60079 – The Storage and Handling of Gases in Cylinders
- AS/NZS 2430 – Classification of Hazardous Areas

- The Building Code of Australia (NCC)
- DAFF – Biosecurity policy and risk management guidelines and animal ethics
- Electrical Safety Act 2002 incorporating all amendments
- Animal Ethics Committee – Animal Care and Protection Act 2001
- Australian Code of Practice for the Care and Use of Animals for Scientific Purposes
- Queensland Work Health and Safety Act 2011 (WHS Act) including regulation of dangerous goods in QLD.
- Queensland Work Health and Safety Regulations 2011 & Codes of Practice 2011
- Queensland Health State legislation and advisory standards where relevant
- OGTR – Commonwealth Gene Technology Act 2000
- OGTR Regulation 2001 incorporating all amendments
- Hazardous Substances Advisory Standard 2003
- Queensland Health (Drugs and Poisons) Regulations 1996
- Radiation Safety Act 1999
- Radiation Safety Regulation 2010
- Radiation Safety Standards published by Queensland Health which set out requirements for licensing radiation source in use (e.g. PR100, HR001 & NM001.)

Where there is a discrepancy between requirements, legislation and regulation to take precedent over Guidelines. Refer all current amendments and latest versions.

37.2 The Laboratory Design Brief - the Generic Laboratory

The laboratory design brief must identify the requirements of the laboratory and associated spaces in order for them to operate as intended. The type of laboratories must be determined; whether they are for research or teaching, the relationship requirements to other facilities and support spaces and the degree of future flexibility required.

37.2.1 The Laboratory Design Brief should identify the:

37.2.1.1 Full range of laboratory types and support spaces

37.2.1.2 Expected staff numbers and hours of operation

37.2.1.3 Potential hazards (e.g. chemical, flammable, toxic, biological, infectious, radioactive, odour) related with the laboratory's operation

37.2.1.4 Quantities and classifications of chemicals to be used and stored in the facility. Identify special code requirements applying to storage, handling and waste of chemicals subject to classification and hazard type, segregation and quantities allowed. Laboratory users to supply hazardous substances register.

37.2.1.5 Storage and delivery requirements for
- Chemicals
- Equipment
- Consumables

37.2.1.6 Waste types likely to be generated – solid, liquid and gaseous

37.2.1.7 Implications of disposal of waste types, including identification of relevant environmental protection legislation

37.2.1.8 Equipment lists to be provided for all spaces with all services and space requirements, equipment weight, environmental housing and operational requirements and any potential risk associated with the use of such equipment to be provided.

37.2.1.9 Degree of flexibility for future change required if possible

37.2.1.10 Special structural, anti-vibration, insulation or shielding requirements

37.2.1.11 Future extension or expansion needs
37.2.1.12 Code requirements for provisions such as safety shower and eyewash locations, electrical exclusion zones, services isolation provision and bench clearances
37.2.1.13 Security requirements and access control
37.2.1.14 Environmental operating conditions – temperature and relative humidity where required for containment or clean room projects, relative air pressures should also be defined
37.2.1.15 Specialised containment or fume exhaust requirements
37.2.1.16 After hours emergency alert systems for occupant safety and for maintenance of preservation of important research material, samples and processes
37.2.1.17 Backup systems for essential building services
37.2.1.18 Equipment requiring essential power and monitoring systems and a functional description of what the protocols are to alert security and laboratory staff should equipment or laboratory processes become faulty.
37.2.1.19 Assessment of 'Business Continuity Capability' requirements during a Cyclone or other natural disaster emergency.
37.2.1.20 Audio Visual requirements, especially those required for teaching and including any disability access requirements

37.3 Laboratory Design

Consideration of the design layout of the laboratory is paramount to satisfying both the needs of the users and to enable flexibility for future use, and requires a services strategy which reinforces these requirements. Wherever possible a generic laboratory model, should be the basis of the laboratory design. This is particularly suited to both research and teaching laboratories in new buildings, but can also be incorporated into refurbishments of existing facilities.

37.3.1 The Generic Research Laboratory

A flexible and adaptable generic laboratory floor plate provides the basis for exceptional scientific research and teaching environments within the university, allowing for growth and sustaining dynamic change, fostering interaction and team based research and facilitating linkages with other institutions, providing flexibility for periodic co-location.

The open laboratory is a basic unit of laboratory space, which can be shared by multiple user groups, allowing flexing of group sizes over time. Separation of laboratory space is ideally only provided if functionally justified by; environmental control requirements (e.g. containment lab or clean room), security requirements, hazard classification, smell noise or regulatory requirements. Furniture should preferably be modular and loose to enable users to modify their environment to suit particular needs.
Support spaces should open off the main laboratories with more particular functions that require separation to meet performance criteria, including equipment rooms, instrument rooms, cold rooms, balance and chemical storage, -80 freezer rooms, store rooms, dark rooms and the like.

The key attributes required for adaptability of the laboratory environments include the following design criteria:
37.3.1.1 The generic laboratory planning utilises a structural grid of 6.6m or setout grid of 3.3 or 3.4m for new builds. Structural spans should then match the lab planning

grid and have minimum impact on flexibility of floor layout and future services penetrations.

37.3.1.2 A lab planning grid of 3.3m allows flexibility in bench depth and maintains equity and lab code access requirements. Laboratory modules may be 33m^2 (10 x 3.3m) or 40m^2 (12 x 3.3m) with laboratory support modules of 24m^2 (7.2 x 3.3m) and should be used wherever possible to facilitate efficient and rational planning.

37.3.1.3 A 4.5m floor to floor height in laboratory areas will allow future services accessibility and reticulation.

37.3.1.4 Laboratories should be optimised in large open configurations to support re-distribution of group populations to maximise sharing of laboratory space and access to laboratory support facilities.

37.3.1.5 Laboratory support rooms should ideally be located off one wall of the main lab space, accessed by a 'ghost corridor'; i.e. a circulation zone open to the main laboratory space.

37.3.1.6 The 'ghost corridor' system should connect through the main lab to the central goods lift service node allowing staff to circulate vertically between the labs without having to enter non-laboratory and office areas. This is particularly important for movement of hazardous goods. A 'ghost corridor' is a highly efficient system of movement as it passes through functional space and allows for open visibility to each end of the laboratory.

37.3.1.7 The main laboratory space is to be separated from adjacent office and non-laboratory areas by full height glazed walls to allow for maximum visibility between the laboratory and non-laboratory environment.

37.3.1.8 Locate risers and stairs at each end of the main laboratory space to optimise air handling and egress efficiently whilst minimising impact on flexibility. Provide accessible supply and exhaust risers to allow future services additions and maintenance access.

37.3.1.9 Fume cupboards are to be grouped at end walls of main laboratories to enable flexibility of laboratory floor plate. Install additional fume cupboard exhaust penetrations in building fabric, with ductwork and reticulated services within ceiling and risers to agreed locations for future fume cupboards.

37.3.1.10 Provide a generic exhaust system to each end of main open plan laboratories and with outlets located in each support room to enable future exhaust capability to the support laboratory. Refer to Mechanical Services section 20.3.60.4 for further information.

37.3.1.11 Provide services reticulation within the ceiling of floor served (except drainage services) so that any future modifications only disturb the floor served. All services, including RO water, to benches in laboratories (except drainage waste) to be reticulated from above.

37.3.1.12 Floor by floor configuration of air-handling systems is to allow the isolation of a floor for future reconfiguration without disturbing other floors of the building.

37.3.1.13 Laboratory benching should be a module based wherever possible with standardized sizing to suit the building grid layout. Modules of 1800mm or 2400mm long x 750mm wide, 930mm high are a suitable benchmark. Bench top and framing materials shall be suitable for the application.

37.3.2 The Generic Teaching Laboratory

More flexible teaching arrangements are required to cope with the demands and multiplicity of uses that are now a significant part of academic programmes. Adaptable teaching

environments need to adjust to allow for smaller work group models, formalised practical classes and other events and displays.

Changing teaching methodology has affected the layout and design of tertiary teaching laboratories which need to be adaptive and flexible environments that can respond to a number of functional requirements and teaching styles.

The key attributes required for adaptability of the teaching laboratory environments include the following design criteria:

37.3.2.1 International guidelines for calculating area requirements for Teaching Laboratories for advanced science and engineering subjects recommend an area per student of 5.0m2 with an additional 20% set aside for preparation rooms and laboratory storage.

37.3.2.2 Support spaces and specialised equipment should be accessed off the main teaching laboratory, along with more particular functions that may require separation to meet performance criteria. These functions may include preparation rooms, equipment rooms, instrument rooms, cold rooms, balance and chemical storage, -80 freezer rooms, store rooms and dark rooms.

37.3.2.3 Provision of adaptable services which can be capable of being expanded and changed with relative ease in order to cope with rapidly changing technology.

37.3.2.4 Services reticulation shall occur within the ceiling of the floor served except for waste so that any future modifications can only disturb the floor served. All services to benches in laboratories except waste to then be reticulated from above. This allows for ease of access and provides opportunity for maximising the flexibility of the design.

37.3.2.5 Equipment with high servicing needs e.g. fume cupboards should be consolidated into centralised locations to allow for efficient design of mechanical services.

37.3.2.6 Traditional 'lecture' type operation should be provided, along with smaller group sizes / tutorial spaces, in order to cater for a range of class sizes and configurations and the possibility of multiple users at one time.

37.3.2.7 Where appropriate, mobile modular furniture should be used instead of or in conjunction with fixed furniture.

37.3.2.8 Provide storage space for individual lab groups to lock expensive items.

37.3.2.9 Teaching labs rely on line of sight observation between staff and students i.e. generally no overhead shelving.

37.3.2.10 Minimise movement of students in laboratory i.e. rationalise movement of students between bench and specialist equipment.

37.3.2.11 Design layout needs to take into account the provision of technology for audio visual requirements and the necessary screen sizes and sight lines.

37.3.3 Laboratory Refurbishment and Fitout

When renovating existing buildings for laboratory use, particular care should be taken to consider the effects on the buildings' occupants during construction. Liaise with building occupants and provide an assessment of possible disruption to building access (pedestrian and vehicular), building services; and likely impacts from noise, vibration and dust.

37.3.4 Risk Assessment

Carry out a detailed risk assessment (analogous to HAZOP procedures) using the design brief. This should engage all key stakeholders and must be completed in order to record recognised risks and responses in accordance with the Queensland Work Health and Safety Act and Regulations requirements.

37.3.5 Hazardous Zone Assessment

An accredited auditor shall be provided (as part of the Principal Consultancy Service) to identify and zone any hazardous areas to ensure unsuitable electrical equipment is not used where there is potential for creating fire or explosion through ignition of flammable vapours and gases. Maximum allowable quantities and their storage locations are to be documented, and will be used to inform the continued safe operation of the laboratory. Scientific User Groups shall provide an inventory of all intended hazardous substances under the ChemWatch Gold system which maintains a hazardous substance register for compliance with the Queensland Fire and Rescue Service requirements.

37.3.6 Consultation

To ensure compliance with the design guidelines there shall be close collaboration and coordination between the consultants and the University's Estate Office. Close liaison with the University Workplace Health and Safety Coordinator is also required.

37.4 Laboratory Furniture

The needs of the particular laboratory activities should influence the design of the laboratory furniture whilst maintaining a flexible loose furniture layout in the general laboratories. Benching should be loose where possible, but may also need to be fixed in certain circumstances, and may consist of wall, peninsular or island benching. Fixed benching should incorporate splashbacks to wall junctions and may incorporate shelving, or shelving may be wall mounted. Ergonomics, function, equipment dimensional requirements, as well as a modular approach to the flexible laboratory shall be taken account of when determining bench dimensions.

Loose laboratory furniture, such as under bench units storage and tables shall be generally be bespoke in order to coordinate with the laboratory benching in both form and function. These items should be included with the construction budget. Details shall be determined in conjunction with the University. Loose lab furniture shall be constructed using similar materials and detailing as per fixed laboratory benching and shall incorporate detailing similar in design and function to fixed benching.

All fixed and loose benching shall incorporate the following:

37.4.1 Bench Tops

Bench tops within laboratories shall be designed to suit the use of the laboratory in which they are to be installed. Joints in fixed bench tops are to be minimised.

Performance testing of 4 minimum options for the finish material from a range of suppliers or different products within a suppliers range the surface shall be carried out with respect to likely chemicals used and is described in section 37.6

Bench top surface material selection shall take into account the anticipated laboratory activities, including risks of staining, scratching and burning and the texture / pattern of the material.

All bench tops should include an appropriate drip mould to University approval with integral front edges to be an extension of the surface top material, whether it be either of the material options stated below.

Bench surface material options:

37.4.1.1 Cellulose fibre, homogeneously reinforced phenolic thermosetting resin core - Trespa Toplab Plus (typically 16mm)

37.4.1.2 "Chemical resistant" Laminate post formed over high moisture resistant (HMR) structural MDF, typically 32mm. Upstands preferred. All faces are laminated, including underside of benchtop.

37.4.1.3 Stainless Steel Grade 316 – Solid Cores. All fabricated sinks and benches, including shelving, shall be solid core construction with moisture resistant structural ply core edged with stainless steel sheet and fully backed. Shape core to provide falls where required. All stainless steel bench tops and below bench shelving shall be backed and encapsulated on the underside with 0.4mm Galvabond sheeting silicone sealed to the stainless steel top sheeting.

37.4.2 Bench Framing

Bench framing should be fully welded powder coated mild steel or Grade 316 stainless steel depending on the application. Powder coat should be corrosion resistant where required. Use either epoxy powder coats or modified polyester / epoxy powder coatings where corrosion resistance is required. Otherwise, use polyester powder coatings.

Framing is to be engineered to suit the potential loads, including heavy loose equipment such as bio-hazard or laminar flow cabinets.

Bench leg spacing should be modular where possible and should suit the type of activity and number of people working at each bench and should accommodate under bench units.

Benches frames should typically include adjustable feet, or castors if on loose furniture.

37.4.3 Bench Heights

Generally 930mm for normal working height is preferred for laboratory benching. Refer to section 37.12 for requirements regarding adjustable height benching within laboratories. 760mm is the preferred height for writing benches.

37.4.4 Overhead Bench Shelving

In laboratories and support spaces, overhead bench shelving may be incorporated, providing servicing flexibility by reticulating services and their distribution from overhead. The overhead structure can also support adjustable and removable shelving and lab bench task lighting.

Sizing: Modules of shelving should be to match the benches below. Removable sections should be of a size to enable easy removal and transportation out of the laboratories via doorways and service lifts.

This shelving should comprise of the following elements:

37.4.4.1 Hangers: Suspend the droppers from the underside of concrete slab over via a system of steel plates, hangers and structural bracing, using the fixings and the plates for alignment.

37.4.4.2 Droppers: Two compartment segregated service droppers for reticulation of gases, power & data.

Droppers should be extruded, powder coated aluminium and provide removable access cover plates to two opposing faces

Venting: Provide pre-drilled ventilation slots in droppers containing gases

37.4.4.3 Central bracing and support shelving frames and horizontal self- spanning power duct: Between the droppers, provide a removable arrangement of horizontal power and data reticulation duct, pre-slotted powder coated shelving bracing frame and shelves.

37.4.4.4 Power & Data: Unless otherwise noted, power and data should be provided every 900mm for a 180mm shelf module, or 1200mm for a 2400mm shelf module. Sufficient power should be installed to meet user objectives. GPO for cleaners to be provided on end of each laboratory.

37.4.4.5 Shelving: Location - generally per dropper, 2 no. per frame to each side. Ensure uppermost shelf does not exceed recommended height above floor c. 1650mm.

37.4.4.6 Lighting: Refer Section 25: Electrical Services. Provide task bench lighting required to underside of lower adjustable shelf to each module. Consider issues of glare and wiring implications of hard or soft wiring to underside of shelf.

37.5 Special Laboratory Equipment

Installation of special laboratory equipment may be necessary depending on the type of equipment which may be either free standing (floor mounted) or bench mounted.
The user supplied equipment list shall incorporate all service and location requirements and identify any possible risks associated with the installation and use of the equipment. The list shall also clarify who is supplying the equipment, whether it is a client supplied item or to be supplied as part of the building works. If it is a client supplied item, identify where installation by the building contractor is required.

37.5.1 Briefing Process

The design consultant during the briefing process shall ascertain from the users at minimum the following requirements for each piece of equipment, whether to be included at Practical Completion, or envisaged in the future:

- Size
- Power (single, 3 phase). Check requirement for quantity.
- Lighting
- Water supply and waster
- Floor loadings

- Safety
- Access
- Noise Interference

Possible equipment may include the following items which are typically to be included in either the main construction budget, or allowed for within the University's Furniture, Fixtures and Equipment Budget (FF&E). The items are listed according to which budget they should be apportioned:

37.5.2 Equipment Typically in Construction Budget

37.5.2.1 Autoclave

Commercial quality autoclave / steam steriliser provision may be required. Check servicing ability in area and check for existing service contracts. Service requirements should be verified with the equipment manufacturer but would typically include power, water and drainage at the minimum. Large pass through style autoclaves may also require compressed air, exhaust, BMS connection, chilled water and drainage resistant to the discharge of hot liquids.
Allow space for maintenance access and for the steam generator if necessary. Establish whether specific exhaust for odour elimination is needed in the operation of the steriliser, specifically when opening. In the case of large pass through autoclaves, determine if a floor set-down is required.

37.5.2.2 Biosafety or Laminar Flow Cabinets for PC3 Areas

Provision for Biosafety or laminar flow cabinets may be required. Ensure that sufficient space is maintained to accommodate these large appliances. Services required may include power, gases, water and drainage. Determine type & quality of each. To be installed in accordance with regulatory requirements.

37.5.2.3 Glass Washer

Services which may be required for a commercial laboratory glass washer:

- Power supply to suit the load of the glass washer (3phase, 10A or 15A).
- Hot and cold water and possibly RO water terminating in an appropriately sized and type of valve.

Ensure that sufficient storage near glass washers is provided for accessory trays which may be used in the machine.

37.5.2.4 Ice Machine

Provide sufficient space for maintenance access and provision for the following services: water (check quality required), 240v power, drainage (for ice melt from cabinet – check tundish / drain height / location)

37.5.2.5 Cold Rooms

Installation of purpose built cold rooms may be required. Check requirements for power (typically 15A or 20A with potential essential power and/or CO2 backup systems, temperature alarms (both local and remote). Floor set downs for cold rooms shall be provided in new building applications. Provide floor wastes outside the doorways of cold rooms in accordance with regulatory requirements. Allow for walk-in freezers in preference to -20degC freezers

37.5.2.6 Vibration Isolation / Balance Benches

Balance benches may be required for measuring or microscopic work. Verify the type of vibration-isolation required. Balance Benches may consist of fully welded steel framed rigid benching, terrazzo-topped steel benching which should be included in the construction budget.

37.5.3 Equipment Typically in FF&E Budget

37.5.3.1 Furnace or Drying Oven
Provide heavy duty benching, non-combustible adjacent surfaces and sufficient power to suit these heavy, high temperature pieces of equipment. Special ventilation or exhaust may be necessary.

37.5.3.2 Microwave Ovens
Provide appropriate benching and power to suit the appliance. Individual ventilation or exhaust may be required. Locate to minimise explosion risk to operator and other laboratory staff / students.

37.5.3.3 Biosafety or Laminar Flow Cabinets for non-PC3 Areas
Provision for Biosafety or laminar flow cabinets may be required. Ensure that sufficient space is maintained to accommodate these large appliances. Services required may include power, gases, water and drainage. Determine type & quality of each. To be installed in accordance with regulatory requirements.

37.5.3.4 Vibration Isolation / Balance Benches
Balance benches may be required for measuring or microscopic work. Verify the type of vibration-isolation required. Balance Benches may consist of proprietary airbag suspended furniture depending on requirements which would be from FF&E budget.

37.5.3.5 Custom made or proprietary chemical storage cabinets.
Cupboards for chemical storage may be custom made or special proprietary types with internal bunding, lockable closing doors and made of various materials (typically steel or polypropylene). Note that special code requirements apply to classification, and hazard type (flammability, toxicity, corrosive), segregation by classification, and quantity.
Note that the stated (theoretical) capacities of proprietary storage cabinets do not reflect the realistic / practical storage capacity when storage container sizes are taken into account.
Flammables cabinets should be non-vented type. Refer to Mechanical Services Section 20.3.62 Flammables Cabinets for detailed description.

37.5.3.6 Low Temperature Freezers
Installation of proprietary low temperature (typically -20, -50 or -80 deg C) freezers may be required. Check requirements for power (typically 15A or 20A with potential essential power and/or CO2 backup systems, temperature alarms (both local and remote). Consider co-locating -80 deg C freezers in a dedicated room to enable efficiency of air conditioning.

37.6 Finishes

Code requirements shall be met with regard to selected finishes; Factors which may be applicable include slip resistance, ease of cleaning (smoothness, sealed joints, provision of coves, avoidance of construction joints), resistance to chemicals and / or cleaning / decontamination agents, flammability. Impervious materials shall be used on walls, floors and benches.
In wet laboratories where there is the potential for water spills and flooding, the optimal flood containment and minimal risk of leakage to lower floors is required. Appropriate detailing and construction sequence of these spaces is vital.

37.6.1 Floors

Check requirement for anti-static conditions with welded joints.
Generally sheet vinyl is to be used in laboratories unless specifically required for other purpose (such as epoxy coated floors for hose down areas). Rubber flooring may also be considered if appropriate to the application.
Electrical exclusion zones, including at safety shower and eyewash locations, should be marked in contrasting colours on floor.

37.6.2 Walls

Generally painted (heavy duty, washable acrylic) plasterboard is suitable unless other requirements for impervious finish, washability and airtightness are paramount. E.g. clean rooms, animal holding facilities, surgical areas etc. In such cases sandwich panelling, sheet vinyl or epoxy coatings may be required.

37.6.3 Ceilings

Vinyl faced removable ceiling tiles are appropriate for use in laboratories unless special requirements for containment are an issue. Ceilings may be omitted in some situations, however accumulation of dust on exposed surfaces must be addressed. Provide colour coded identification tags on suspended ceilings to locate access points to service pipes.

37.6.4 Colour Selection

Colour selection within the laboratories shall generally be neutral. Feature colours shall be used on paintable surfaces only, and not for example in joinery finishes such as laminates. Colour selection shall also take into account the anticipated laboratory activities, including risks of staining, scratching and burning and the texture / pattern of the material.

37.6.5 Materials Testing

All selected finishes and colours to be used within the laboratory environment on floors, bench tops, fume cupboard work surfaces, shelving and splashbacks shall be fully evaluated by the users with respect to their performance and suitability with all specific types and concentrations of chemicals which are likely to be encountered in each laboratory. This will enable the final selections of colour and material type to be determined. A test of how each material performs with respect to its chemical and stain resistance shall be performed over a period of up to 24 hours.

The primary purpose of this is to assess the chemical resistance to staining and damage of the proposed finishes against the specific chemicals that will be used in the particular spaces in question. While the proposed finishes should be selected for their known general high level of chemical resistance, particular chemicals can have different effects on otherwise seemingly similar finishes and colours.

For each finish type and colour, material samples form 4 sets of alternative suppliers should be distributed to the user groups of each building / laboratory. Provide plans showing allocation of finishes types to the various spaces, to assist in deciding which chemicals need to be tested on which finishes. The codes for each finish should also be marked on the matching samples for ease of identification. User groups should undertake testing along the following lines:

- Users should set up a grid on each of the samples, and record the chemicals on a matching grid drawn up on a sheet of paper.
- Testing for all chemicals for periods of time similar to how long a spill might be left for, but also up to 24 hours to simulate repeated staining over time.

37.7 Hydraulics

Refer Section 24 Hydraulic Services and Section 20 Mechanical Services for Special Laboratory Water Systems

Wet laboratories typically require laboratory process sinks and hand wash basins which are located near entry / exit points and are potentially dedicated to a particular activity. Provide both hot and cold water as required.

37.7.1 Laboratory Fixtures and Fittings

Laboratory sinks are typically fabricated from certified Grade 316 stainless steel and can either be single or double bowl sinks. These typically have integral drainers and splashbacks, minimum 300mm high and are either inset or pot sink type. Fabrication from other materials may be necessary, such as under bench mounted porcelain for use with corrosive chemicals or self draining PVC runnel sinks where required by the laboratory process. Height adjustable sinks may be required for access by people with disabilities.
Refer to Hydraulics Section 24.2.15 for other requirements.

37.7.2 Water Supply

Potable water supply must be provided to safety equipment (hand wash basins, eyewash and safety showers).

37.7.3 Safety Showers and Eye Wash

Refer to Hydraulics Section 24.2.15 Laboratory Hydraulic Services for emergency Eyewash and safety showers requirements, which should be provided in accordance with AS/NZS 2982 and AS 4775.

Eyewash and safety showers are to be provided in accordance with AS/NZS 2982. Their location should not constitute a slip hazard for users and they should not be located in the main exit from the laboratory.

Ensure selection of model is suitable also for use of people in wheelchairs i.e.safety shower spray covers diameter of wheelchair and control mechanism is accessible from wheelchair.

Eyewash stations shall be plumbed to waste.

37.7.3.1 Drainage: Floor waste drains should be avoided within wet laboratory spaces classified under AS2243.3 as containment laboratories. They constitute a potential source of biological contamination and leakage path in the event of a biological spill. Consider provision of floor wastes to safety showers in non-containment teaching laboratories.

37.7.4 Special Laboratory Water Systems

Special water systems may be required (such as deionised, reverse osmosis (RO), purified or process chilled water). Refer to Mechanical Section 20.3.64.11.

37.7.4.1 Salt Water Systems

Consideration of the following issues and requirements regarding salt water systems:

- Sink types
- Bench types with respect to corrosion issues
- Effect of corrosive environments on surrounding structure and enclosure
- Odour control
- Waste treatment

37.7.5 Waste Water

Refer to Hydraulics Section 24.2.15

37.8 Air-Conditioning and Ventilation

Refer Section 20 Mechanical Services

Provision of fume cupboards, specialised ventilation or local exhaust systems are all potential requirements for laboratories. The impact of these on air-conditioning loads, and requirements for fresh or tempered air make-up should be taken into account.

Some experimental processes necessitate irregular or extended operational hours and may require air-conditioning over 24 hours. These requirements should be identified in briefing. Humidity levels and control requirements must also be understood and clearly identified by the users, particularly for specific equipment or processes, with absolute humidity limits (high or low) or acceptable ranges specified.

PC2 facilities are to be equipped to measure and display the pressure difference between the facility and adjacent areas. The display must be able to be read before entering the facility.

The roof and/or ceiling space for each laboratory is to be tested for airtightness to enable complete pressure and humidity control of the space. Pay particular attention to the design of ceiling spaces below lightweight roof construction, to ensure adequate air-tightness for both humidity control, and potential effect on the pressure control of internal spaces below.

37.8.1 Fume Cupboards

Refer to Mechanical Services Section 20.3.61
Provide the space necessary to accommodate these large appliances, to be installed in accordance with regulatory requirements, which should be fully integrated into the design of the laboratory fixtures and furniture. Services required would typically include power, gases, water, drainage. Determine type and quality required for each. Code requirements for space clearances to fume cupboards must be satisfied, consider the location of fume cupboard in relation to access in the laboratory, adjacent walls and columns, other items of equipment.

Refer to 37.3.1 for requirements to provide exhaust and reticulated services to anticipated (future fume cupboard) locations.

The requirements for fume scrubbing must be determined. Consideration of the visual impact, location and dimensions of exhaust flues in terms of their aerodynamic effectiveness taking account of prevailing wind directions, proximity to adjacent ventilation openings or windows, proximity to adjacent structures as causes of turbulence. In challenging locations or to fulfil EPA conditions, a comprehensive air flow / dispersion study may be required.

37.9 Lighting and Power

Refer Section 25 Electrical Services and 37.13 Health and Safety Provisions further below.
Services Isolation is required to each laboratory. Refer to Electrical Services section 25.4.20.1 for details.

Adhere to code requirements for outlet locations above benches, services isolation and proximity to flammable liquids cabinets and other sources of ignition.

Determine requirements for essential power, the processes and equipment that are to depend on essential power, and the appropriate combination of standby power generation and uninterrupted power supply (UPS) applicable to each facility.

37.10 Communications, Data and Security

Refer Section 26 Communications Services
Identify the users' specific requirements for communications and equipment alarms, security systems, access control, AV requirements and data provision.
All laboratories whether new or undergoing refurbishment are to be provided with proximity card security control.

An emergency alert system (duress style alarm) is to be provided for the safety of laboratory staff , particularly relevant for after hours occupation. PC3 or other hazardous laboratories with spaces that cannot be viewed by occupants through glazing shall have cameras connected to security and

another designated monitoring station. Liaise with stakeholders to determine requirements for monitoring of essential equipment such as fridges and freezers.

37.11 Audio Visual

Refer Section 27 AV Standards

Based on the pedagogy to be employed (in teaching laboratories) or the specific users' requirements (in research laboratories) determine the facilities needed for source equipment (including PCs and cameras), video display equipment and audio equipment (including hearing assistance).

Special provision should be made for the installation of AV equipment in laboratories so that it is clear of any hazards, including electrical hazard that may be caused by spills or ingress of fumes or residue from chemicals.

All equipment installed should conform to the specifications set out in Section 27. Approval for equipment types should be referred to JCU Videoconferencing and Audio Visual Services (VAVS). Screen sizes and sightlines must conform to appropriate standards including the AETM Audio Visual Design Guidelines as set out in section 27.

For multi-use teaching laboratories consideration should be given to the provision of a tutor station at the end of each bench (or pair of benches) with an associated large screen display monitor. If so provided, the AV system should provide the ability to group benches together to allow multiple classes to be taught at once. Where voice reinforcement systems are included, provision must also be made for a hearing assistance system. (See also section 37.15.6 below.)

37.12 Fume Exhaust Systems

Refer Section 20 Mechanical Services

37.13 Gas Reticulation:

Refer: Mechanical Section 20.3.64
Laboratory gases shall be reticulated through each floor of the laboratory building and usage of gas bottles within the laboratory is to be minimised. Where there is a requirement for specialist gas types not provided by the building reticulation system then individual gas bottles may be provided in accordance with the relevant standards and codes. Such bottles should be kept to a minimum. Where there is a requirement for specific bottles, e.g. Liquid Nitrogen dewars, they should be located in laboratories in a ground floor location wherever possible in order to minimise the amount of travelling required through the building.

37.13.1 Gases Stores

Refer Mechanical section 20.3.64.3. Consideration shall be given to:

37.12.1.1 Ensure adequate Ventilation is provided.
37.12.1.2 Refilling points for permanent bulk vessels should have a direct line of sight from the refilling vehicle.

37.14 Health & Safety Provisions

Refer to AS/NZS 2982.1 for typical safety provisions for laboratories. These may include hand washing facilities, safety showers and eye wash, safety and evacuation signage, noticeboards, chemical storage placarding and storage of safety equipment and data records such as MSDS.

37.14.1 Signage

Provide all statutory and safety signage as per relevant legislation and codes and standards. This signage is to be included in the construction budget.

37.14.2 Radiation Safety

Liaise with the University's Radiation Safety Officer for particular design requirements related to the use and storage of isotopic or ionising radiation sources.

37.14.3 Safety Showers and Eyewash

Refer to subheading 37.6 above.

37.14.4 Safety Isolators for services Isolation

Provide the appropriate safety isolators for power, water, gas and other services as called for by the applicable regulations and standards. Isolation not applicable to emergency safety equipment, for example, eye wash and safety showers. Attention should be given to the location of shutdown isolator switches, ease of identification and accessibility. Generally locate isolators at all exits from the laboratory zone. Consult with the University to determine the extent of laboratory zones to be isolated. Position isolators adjacent to doors and away from light switches if possible. The use of a combined isolating device addressing all reticulated services in one action is preferred.

37.14.5 Services Outlets

All laboratory service outlets and systems for reticulated services including, but not limited to, water, demineralised water, LP gas, vacuum, compressed air and special gases, shall be approved types. Laboratory fittings shall be epoxy coated and should be colour coded as per the DIN Standard. The preferred manufacturer of laboratory tapware is BROEN. Other brands will be subject to approval. The preferred manufacturer of specialised quick-connect couplings and fittings is Swagelok. Other brands will be subject to approval.

37.15 Access to Laboratories for People with Disabilities

Access for people with disabilities is required within both teaching and research laboratories and recommendations for accessible laboratory design are set out below. Liaise with the University's Accessibility Services and the Laboratory Manager.
Generally, each laboratory should contain at least one workspace which is adaptable to enable use by a person with a disability, some guidelines for which are outlined here:

37.15.1 Location

Within teaching laboratories, a position near the front of the laboratory is appropriate to enable lip reading for hearing impaired students.

37.15.2 Working Heights and adequacy of space below the working surface

Laboratory benches are generally intended for standing work unless specifically briefed for sitting. This restricts their use by those in wheelchairs.

Providing benches which are flexible and adjustable in height enables a variety of users access to the working surface to suit their particular need. An average of one workspace per 40 users / students should be readily adjustable by the user to provide a full range of bench heights whilst giving access to all services required. Other equipment and items such as fume cupboards and sinks should be designed so that at least one of each per laboratory space is accessible to people with disabilities.
Refer to AS 1428.2 Section 24 'Furniture & Fitments' for standards for tables, counters and worktops and unobstructed space requirements below them to enable wheelchair access.

37.15.3 Access

Access between benches should be at minimum those set out in AS 1428.1

37.15.4 Reach Distances

Reach distances should conform with the requirements listed in Section 22 of AS 1428.2

37.15.5 Laboratory Services

Location of services and controls for water, gas, power etc. should be located in a position accessible to people with disabilities at each accessible workstation. Reference should be made to Section 12 of AS 1428.1 for details, whilst adhering to the placement and separation of services that are governed by regulation, usually above the bench top and away from possible hazards.

37.15.6 Hearing Augmentation – Listening System

Provision of an audio-frequency loop system in accordance with AS 1428.2 for persons with impaired hearing in laboratories is required in teaching laboratories. This shall comprise a low impedance coil recessed into the floor and a suitable amplifier mounted in an equipment rack in an adjacent Comms Room.

37.15.7 Emergency Equipment

Those items of emergency equipment which are required by code, including emergency showers, shall be accessible for people with disabilities.

37.16 Special Hazard Laboratories

Special Hazard Laboratories are spaces in which hazardous substances may be used, and must be designed and operated to conform with specific standards and state legislation or international best practice if no legislation exists.
Examples of Special Hazard laboratories include:

- Microbiological containment laboratories dealing with infectious microorganisms categorised as either risk group 1, 2, 3 or 4 and kept in physical containment conditions categorised as either PC1, PC2 PC3 or PC4
- Genetically modified organisms kept in physical containment conditions categorised as either PC1, PC2, PC3 or PC4 under OGTR (Office of Gene Technology Regulator) guidelines.
- Animal houses, categorised as either PC1, PC2, PC3 or PC4
- Plant houses, categorised as either PC1, PC2, PC3 or PC4
- Cleanroom laboratories
- Radiological laboratories
- Cryogenic laboratories
- Radiological or X-Ray laboratories

- Laboratories dealing with and containing AQIS materials, categorised as either QC1, QC2, QC3 or QC4 facilities.
- NMR facilities (Nuclear magnetic resonance)
- Electron microscopy

37.16.1 Potential issues

Potential issues to be addressed include but are not limited to the following:

37.15.1.1 Containment strategies. Refer to section 20.3.6 for Mechanical air containment guidelines.

37.15.1.2 Clean Room and Animal Room construction, and specialised mechanical installations for high quality particulate air filtration. Refer to section 37.15.2 below for guidelines.

37.15.1.3 Hazardous Goods handling (e.g cryogens – very low temperatures, oxygen displacement, delivery by lifts, special storage)

37.15.1.4 Non- ionising radiation exposure (magnetic, laser, RF, IR and UV) and ionising radiation exposure (X-Ray, gamma rays, alpha particles, beta particles) and their specific shielding and operational issues and certification.

37.15.1.5 Mechanical vibration or freedom from vibration

37.15.1.6 Security

37.15.1.7 Waste treatment and disposal methods of contaminated materials.

37.16.2 Animal / SPF Laboratories

Reference should be made to regulatory standards for laboratory areas and to the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes. Refer to Section 20.3.6 Mechanical Section: PC2 / SPF Laboratories.

37.15.2.1 Typical Construction: Typically wall construction may incorporate the use of a sandwich panel. The intention is to minimise the possibility of vermin entry and egress and maintain as clean an environment as possible. Construction must exclude any voids where insects can conceal themselves e.g. power points, conduits and the like.

37.15.2.2 Finishes: Finishes should facilitate the cleanability of all spaces, including sealed coving to all wall / ceiling / floor junctions. All rooms must have painted or pre-finished surfaces that are able to be decontaminated using 'wipe down' procedures.

37.15.2.3 Floors: Floors should be chemical resistant welded sheet vinyl throughout. All skirtings must be integrally coved. In wash-down areas anti-slip finishes (R10 or R11) must be used. Where floor drains are provided (and these should be severely limited behind the SPF barrier), they must be sealed according to PC2 regulations and OGTR guidelines.

37.15.2.4 Walls & Ceilings: The construction of the facility must be impervious to all walls and ceilings. Vinyl dado must be provided to 1200 high minimum in high traffic areas. Acoustic insulation and control must be provided in accordance with acceptable practice and NH&MRC Guidelines.

37.15.2.5 Fixings: Wall fixings to be avoided where practicable. All ceiling fixtures must be flush fitting including: lights, mechanical registers, sprinkler fittings, etc.

37.15.2.6 Access: Accessible ceiling space is required for service access.

37.15.2.7 Doors: Doors must be fitted with the following:

- Containment seals appropriate to the barrier control selected

- Vision panels with 'black out' flaps
- Rodent barriers
- Doors to the outer perimeter of the facility must be access controlled
- Internal glazing must be provided with 'black out' blinds between animal holding areas provided that the blinds are not in the animal holding rooms themselves and are cleanable and accessible from the access corridors
- External glazing, if any may be provided but should address any concerns regarding security and malicious intent by anti-vivisectionists.

37.15.2.8 Day Night Cycles: Animal holding rooms must be capable of reverse cycle light control under blackout conditions and controlled light cycles with dawn/dusk sequence.

37.15.2.9 Muzac Systems: Provide Muzac AV system to all animal holding rooms (audio only), controlled from access corridors.

37.15.2.10 Cage Systems: Evaluate in each case which cage systems would be most appropriate. Provide evaluation background for all options including space requirements, suitability to particular animals, size of autoclave required. Provide all information to user group at 70% of Schematic Design stage in order that the user group can make an informed decision regarding which cage system to choose.

37.15.2.11 Fumigation: Consider whether fumigation of the facility to leakage testing of AS2243.3 is a requirement.