SECTION 20

MECHANICAL SERVICES

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Version	Date	Authors	Summary of Changes
1	9 April 2013	Multitech for JCU	First Edition
2	30 September 2013	Manager, Infrastructure Services	Revised with JCU comments

20.0 MECHANICAL SERVICES

20.1 INTENT OF THE JAMES COOK UNVERSITY DESIGN GUIDELINES

James Cook University was established to pursue and encourage study and research, especially in subjects of importance to the people of the tropics. James Cook University is Queensland's second oldest university and through its research, graduates and industry links, is a major driver of economic growth and social change in northern Queensland.

Staff and students of JCU use its unique locations to conduct nationally significant and internationally-recognised research in areas such as marine sciences, biodiversity, tropical ecology and environments, global warming, tourism and in tropical medicine and public health care in underserved populations. Its network of specialist centres, institutes and research stations span a wide geographic area from marine islands to the outback and the students come from many backgrounds, promoting a rich cultural and experiential diversity on campus.

These design guidelines are the minimum acceptable standard and have been developed to ensure that projects delivered by JCU comply with the University's vision, are appropriate for the unique tropical environments and incorporate the lessons learnt from previous projects. The Deputy Director – Planning and Development is responsible to ensure these Design Guidelines achieve the best design outcomes for JCU.

20.2 COMPLIANCE AND APPROVALS

20.2.1 Compliance Requirements

All design and works are to comply with the latest versions of all Australian National, Queensland State, legislation and standards, as well as local council/authority requirements. Further details are provided in Section 20.6.

All other sections of these Guidelines are to be read for completeness as this document has been developed as a section of a suite of documents.

Where there is a discrepancy between requirements, legislation and regulation to take precedent over these Guidelines.

20.2.2 Non-Conformance Approvals

All project team members (for example Consultants, D&C Contractors, Principal Consultants, Internal/External project managers, subcontractors etc.) are responsible for delivering the project in accordance with the project brief, these guidelines, user group information and other contractual documents.

Where there are sound engineering reasons to deviate from these documents, a written non-conformance request is to be submitted to the Deputy Director – Planning and Development via the JCU Project Manager.

This could apply when the project involve aspects, scope, technologies, locations or other applications that are not specifically briefed or covered by the Design Guidelines, the non-conformance request will include clear information on:

- Technical Aspect that is not covered
- A range of options to address the issue
- Time and costs implications for each option
- Effect of the aspect on the design and on other trades

- Effects on users, maintenance, access, life of plant, energy efficiency, cost
- Effects on future re-allocation of the space / system etc.
- Recommended solution to the issue

A Non-Conformance register is to be maintained by the Consultant and the details of each request plus the outcome are to be recorded.

Before departures in design intent are approved for the successful consulting engineer, detailed energy modelling against the NABERs' scheme shall be required. Departures shall prove there is an advantage to JCU in terms of energy savings and operating cost savings.

20.2.3 Design Approvals

Irrespective of directions received from JCU, the Consultant remains fully responsible for the design solution developed.

All designs done for and on behalf of JCU require RPEQ certification, unless approved by the Manager, Infrastructure Services.

Form 15 Design Certification is to be obtained.

20.2.4 NCC Version to Apply

Confirm with JCU's Project Manager which version of the National Construction Code (NCC) that is applicable to the works.

20.2.5 Site Infrastructure Connection Approvals

The Manager, Infrastructure Services shall approve all connections to existing infrastructure, including the CDC reticulation. Specific requirements for the CDC are listed in 20.4.17.5.

20.3 DESIGN PROCESS REQUIREMENTS

20.3.1 Roles and Responsibilities

JCU does not wish to be separated from the design process, regardless of whether the project is traditionally delivered, delivered through Managing Contractor, D&C contractor or other.

20.3.1.1 Traditional Delivery

Where traditional delivery is chosen, the framework may be through a Principal Consultant (such as an Architect or Project Manager), or direct to JCU.

The Principal Consultant is to arrange workshops with the JCU Deputy Director – Planning and Development, Manager, Infrastructure Services, Manager, Asset Strategy and Maintenance and other technical staff as directed by these managers from initiation of schematic design.

20.3.1.2 Managing Contractor Framework

Arrange workshops and information issues throughout the design process with the JCU Deputy Director – Planning and Development, Manager, Infrastructure Services, Manager, Asset Strategy and Maintenance and other technical staff as directed by these managers (through the Managing Contractor and JCU's Project Manager).

20.3.1.3 Communication Arrangements

All communication with JCU is to be via the JCU Project Manager. Minutes of any design

review meetings etc. are to be provided to all participants via the JCU Project Manager.

20.3.2 Interfaces with Other Disciplines

Ensure that all works necessary for the complete installation and successful operation are advised to other consultants and specified as interface with other engineering disciplines, professions or specialists.

Ensure that information required to accurately design the services is obtained from other consultants as required. Additional information is available in section 20.6.3.

20.3.3 Schematic Design (SD) Report / Design Review

The Schematic Design (SD) report will give a high level understanding to University of the requirements for the project.

20.3.3.1 Report Content

- The drawing numbers and revisions the SD report is based upon e.g. Architectural, As Installed drawings etc.
- A detailed list of the mechanical scope of works for the project
- A detailed list of the applicable standards, regulations and local authority requirements that the project has to conform to
- Where existing plant is being utilised, whether this plant is being used, replaced, refurbished etc. with indication of associated issues and costs.
- A high level description of the method of servicing the various spaces in the project
- List of Ecological Sustainable Development (ESD) opportunities
- Non-Conformance Register listing any deviations from Legislation, Standards, Codes, Guidelines or Project Brief.
- List of Assumptions, Boundaries (battery limits or tie-in points) and Specific Exclusions
- Equipment List with estimated sizes/specifications
- Estimated services consumptions (chilled water, etc.)
- Proposed Drawing Register and Deliverables List
- Layout drawings showing any interfaces with existing services and structures including proposed services corridor/trenches.
- Investment Decision Report including Cost (Capex and Opex) and Schedule estimates, Lifecycle costs and indicating any areas of risk to the project delivery. This document to be resubmitted based on feedback from the SD review and approved by the JCU Deputy Director – Planning and Development prior to commencement of Detailed Design.
- Where option analysis was included, a recommendation on the option to take forward with supporting information/decision criteria.
- Outcomes and recommendations for safety in design, and design risk assessment workshops particularly responding to (or addressing) design elements which will limit liability under mould issues in HVAC systems, temperature control and upper limit humidity control
- List of proposed design development activities/milestone schedule and deliverables

20.3.3.2 Submission Format

This information is to be submitted to the JCU Project Manager as an A4 colour PDF file with A3 drawing attachments, in hard and electronic format. The Consultant may be requested to deliver a presentation (in person or via VC) to JCU stakeholders and decision makers.

20.3.3.3 Design Review

Submit SD drawings / report and non-conformance register to JCU's Project Manager in full size hard copies (1) and on CD for a full design review in accordance with the project schedule, allow a minimum of 2 weeks for design review.

Inform the JCU's Project Manager as soon as possible if the drawings are going to be delayed for any reason.

Following receipt of the design review comments from JCU, respond formally with

- Acknowledgement that changes will be actioned, and
- List any areas where the design review comments require additional discussion and proposed manner of resolution.

20.3.4 Developed Design (DD) Report / Design Review

The DD report will provide more detail on the design for the accepted option and design approaches.

20.3.4.1 Report Content

- Full return brief for the mechanical services
- The drawing numbers and revisions the DD report is based upon e.g. Architectural, As Installed drawings etc.
- Provide detailed information of all existing site services, their re-use, refurbishment, relocation or removal
- Detail on connections to infrastructure, CDC etc.
- Detail on any central plant being provided
- Detail on mechanical design approach for each type of system / area etc.
- In each case options investigated, reasons or supporting information for design choices,
- Detail on loads and consumptions to existing services, including chilled water (kWr connected, etc.)
- Statement on how the existing services will be impacted by these additional loads and specify any required upgrades
- Detail on special services such as laboratory / piped gases
- Detail on special measures for spaces with additional requirements (eg PC2, PC3, laboratories etc)
- ESD Opportunities Register
- Updated Non-Conformance Register listing any deviations from codes, standards, legislation, guidelines or project brief.
- Updated Assumptions, Boundaries (battery limits or tie-in points) and Specific Exclusions
- Final Equipment List with sizes/specifications
- Detailed equipment layouts including dimensions for all access doors/hatches and showing provision to remove/maintain all items in excess of 50kg.
- Drawing Register and Deliverables list
- All IFC drawings and design calculations
- Updated and finalised Investment Decision Report including Cost (Capex and Opex) and Schedule estimates, Lifecycle costs and indicating any areas of risk to the project delivery. This document to be resubmitted based on feedback from the DD review and approved by the JCU Deputy Director – Planning and Development prior to commencement of Construction.
- Updated outcomes and recommendations for safety in design, and design risk assessment workshops particularly responding to (or addressing) design elements

which will limit liability under mould issues in HVAC systems, temperature control and upper limit humidity control
- Finalised recommendations for preventative maintenance and list of critical spares on proposed equipment
- Risk Matrix for design methodology (i.e. n+1 where necessary)
- Areas of risk to the project during construction and commissioning
- List of construction activities/milestone schedule and deliverables, including construction and commissioning hold point/inspection/witness/approvals.

20.3.4.2 Submission Format

This information is to be submitted to the JCU Project Manager as an A4 colour PDF file with A3 drawing attachments, in hard and electronic format. The Consultant may be requested to deliver a presentation (in person or via VC) to JCU stakeholders and decision makers.

20.3.4.3 Supporting Documentation

- Maximum 1:500 site services drawings – e.g. CDC, showing tie-in points to existing
- Maximum 1:100 Mechanical services Floor Plans.
- Maximum 1:50 inserts on Floor and Roof plans
- Maximum 1:50 Details
- Schematic of airflows through laboratories, pressure controlled areas etc.
- Updated JCU chilled water schematic

20.3.4.4 Design Review

Submit DD drawings / report and non-conformance register to JCU's Project Manager in full size hard copies (1) and on CD for a full design review in accordance with the project schedule, allow a minimum of 2 weeks for design review.

Inform the JCU's Project Manager as soon as possible if the drawings are going to be delayed for any reason.

Following receipt of the design review comments from JCU, respond formally with

- Acknowledgement that changes will be actioned, and
- List any areas where the design review comments require additional discussion and proposed manner of resolution.

20.3.4.5 Developed Design JCU RPEQ Certification Schedule

This table shall be completed by the DD Design Engineer as below, or as modified by the Manager, Infrastructure Services, and submitted for confirmation.

Project		
Project Number		
Date		
Company		
RPEQ Design Engineer		
RPEQ Licence Number		
Building Area	sqm	
Total HVAC Plant Cooling Capacity	kWr	
Calculated Maximum Chilled Water Demand	l/s	
Calculated Summer Day, Thermal Energy Consumption	kWht	
Mechanical Services Estimated Capital Investment (ex GST)	$(ex GST)	
Total number of Pumps	No. Off	
Total number of Air Handling Units (AHU)	No. Off	
Total number of Fan Coil Units (FCU)	No. Off	
Total number of Fans	No. Off	
Total number of Fume Cupboards	No. Off	
Any other plant and equipment requiring routine inspections	No. Off	
	Manager Infrastructure Services	
Schematic Design & Report Approved	YES / NO	
Developed Design & Report Approved	YES / NO	
Construction Documentation Approved	YES / NO	
All specific design elements are included in the design	YES / NO	
Does the design comply with 20.4.17 “Campus District Cooling (CDC)” in full	YES / NO	
Does the SD Report include a target NABERs Rating	YES / NO	
Does the SD Report include Life Cycle Costing	YES / NO	

20.3.5 Construction Contract Document Requirements

20.3.5.1 Specification Requirements

A concise, project specific specification shall be produced that

- Clearly identifies the scope of works
- Clearly identifies the project nature
- Clearly identifies Interfaces with other disciplines
- Calls into effect the requirements of codes, standards, legislation etc.
- Calls into effect the requirements of these guidelines
- Does not contain excessive or spurious references to unrelated projects or unrequired works.
- Includes all performance requirements

- Includes schedules of all equipment requirements, capacities etc.
- Requires relevant price breakup information from the contractor
- Requires contractor confirmation of equipment, scope, documentation etc.
- Calls up required service, maintenance details etc. in an acceptable Operating and Maintenance Manual format complete with preventative maintenance schedules.

20.3.5.2 Drawing and Documentation requirements

Both Issued for Tender (IFT) and Issued for Construction (IFC) drawing and documentation will be required.

Drawings shall conform to Section 34 of JCU's Design Guidelines. Ensure:

- Use JCU Title block and include JCU Drawing Number (obtain from JCU Drawing register)
- All fonts and colours to be legible at A3 print colour or black and white
- Use Australian English throughout all documents
- Clearly identify the scope of works
- Are clear and legible and easily read
- Provide sections, elevations and the like to indicate heights, etc. Generally a minimum of two sections shall be provided for any project to enable the contractor to determine the work heights, co-ordination etc.
- Provide details for specific items such as riser layouts, fume cupboards, special exhaust systems etc.
- Include laboratory and piped services layouts and details
- Include piped services schematics
- Include chilled Water Schematics
- Include airside schematics with air balance and pressures

20.3.5.3 Number of Copies

Unless briefed / agreed otherwise, the contract documents shall be provided in electronic (.pdf and native) format and in hard copy as follows:

- Three full sized hardcopies of all drawings
- Three bound copies of specifications in A4

20.3.6 Handover Requirements

20.3.6.1 Requirements for Commissioning

Commissioning of all mechanical systems shall be undertaken by a firm certified by the National Environmental Balancing Bureau (NEBB), and testing and balancing shall be in accordance with NEBB Procedural Standards for Testing, Adjusting and Balancing of Environment Systems published by NEBB, Current Edition.

Specialist equipment (compressor plant, vacuum plant, chillers, BMS) shall be commissioned and signed off by the Manufacturer or their approved representative.

Commissioning must be carefully scheduled to enable the Mechanical Contractor to have closed possession of the building for the period required to prove key operating elements such as

- Temperature and Humidity Control
- Air flows, relief air, pressure control, differential pressures
- Stability of control operation

During this testing the building shall be closed as per design operation, with external and internal doors not wedged open etc. for building tasks or the like.

Provide Form 16 and any other certification required for the works.

20.3.6.2 Witnessing

Following commissioning, undertake a witness inspection of the operation. Ensure that the Consulting Engineer and JCU Manager, Asset Strategy and Maintenance (or representative) are present.

As a minimum, prove to their satisfaction:

- Air flows. Generally a sample of 10-20% of registers and duct air flows may be witnessed. For small systems or critical systems all airflows shall be witnessed.
- Laboratory containment requirements: for any PC2, PC3, SPF or other pressure or airflow directional space, all related aspects shall be witnessed (room pressure, room airflow in or out, air flows are registers and grilles, control and alarm operation)
- Fume hoods: Air flow and sash operation
- Laboratory Shutdown
- Fire mode operation of systems. Undertake end to end testing from tripping a field device to the correct response of the mechanical services
- Chilled water balance and flows
- Duty / Standby operation and changeover.
- Controls operation. Prove operation by amending set-points etc. and observing operation. Prove alarm functionality. Provide end to end testing from field

Rectify any defects identified. Should re-inspection be required, the cost of consultants reinspections will be deleted from the contract sum.

20.3.6.3 Records to be provided

Within 3 weeks of practical completion provide

- All commissioning data as finalised
- Defects lists signed out and complete
- Certification of any Fire Penetrations etc
- Commissioning sheets for any specialised equipment (e.g. fume cupboards, HEPA tests, Chiller commissioning, etc.)

20.3.6.4 Defects Liability

The Defects Liability period shall be a minimum of 12 months from the date of Practical completion or acceptance of the systems by the Manager, Asset Strategy and Maintenance or representative. The Manager, Asset Strategy and Maintenance may require longer periods of warranty for key/critical equipment and this should be tested on a project specific basis.

During this period the contractor must attend to and rectify all faults, defects etc. at their cost including all parts, labour, commissioning and associated costs. Should an item repeatedly fail during this period, JCU may require warranty in relation to that item to apply from the date of latest repair / replacement.

20.3.6.5 Maintenance Requirements

All construction/ installation contracts shall allow for the performance of regular preventive maintenance of the works during the period of the defects liability period

inclusive of all consumables (e.g. filters on Fan Coil Units e.g. v-belts).

Such maintenance shall be in accordance with the manufacturer's instructions and the requirements of the Work Health and Safety Act, Standards or other applicable regulations, legislation, or codes of practice.

AIRAH DA19 manual shall be the minimum maintenance provision/recording.

With respect to any mechanical or electrical service, fire alarms, hydraulic systems, lifts etc. maintenance shall be carried out not less frequently than monthly.

Life safety systems shall be maintained and recorded as a minimum to relevant requirements (e.g. AS1851)

Maintenance records to be forwarded to JCU's Project Manager within 5 days of completion of maintenance.

20.3.6.6 Operating and Maintenance Manuals

Operating and maintenance manuals must be issued as Preliminary documents prior to Practical Completion. Any amendments must be made and manuals issued within three weeks of Practical completion. Manuals must include as a minimum:

- Concise English description of the installation as a whole
- Concise English description of the each system
- Concise English description of BMS system and controls,
- Concise English description of the Fire Mode Operation of systems
- Equipment list for all mechanical equipment and systems
- Supplier / Support list for all mechanical equipment
- Manufacturer's Literature for all mechanical equipment
- List of recommended critical spares
- List of Contractors and Subcontractors
- List of As-Constructed drawings
- All finalised commissioning data
- Form 16
- Recommended Service and Maintenance procedures
- Service and Maintenance Schedule
- Fault finding and reporting procedures
- Emergency Contacts
- Defects lists signed out and complete, and warranties

Provide THREE hard copies of all manuals and "As Constructed" drawings plus electronic (.pdf and native) copies of all documents and drawings.

Consultants shall provide a statement that maintenance manuals and as constructed drawings are correct to the best of their knowledge.

20.4 MECHANICAL SERVICES DESIGN REQUIREMENTS

20.4.1 Design for project and future

A holistic approach shall be taken to any new or refurbishment design and the effect on the existing campus services and buildings shall be well understood.

All designs must consider how the project specific requirements and any additional areas served by systems serving the project areas (e.g. chilled water branches etc.) will impact on the existing services, possible future fitouts / reworking of the project area, and future expansion such as master plan items, items advised etc. These impacts are to be clearly articulated in the design documentation.

20.4.2 Design for Tropical Areas

JCU's campuses are located in a tropical environment. Particular care is required to ensure necessary measures are taken to prevent the formation of condensate on external or internal surfaces such as air conditioning units, pipework, ductwork, registers, ceilings, walls, windows etc. The design must specifically deter the growth of mould. For this reason, the internal humidity levels within the building shall not exceed 70% under any circumstance with upper limit control of 65% RH.

In particular, ensure that cold bridges are avoided. Ensure that all other parties are aware of the measures required to prevent condensation forming (e.g. on windows, building facades etc.)

Ensure that duct leakage is minimised, and that exhausts from conditioned or cold spaces traversing through ambient air are insulated as necessary to prevent condensation.

The design team shall work together to minimise moisture migration into buildings which can lead to adverse effects and lower energy efficiency of air conditioning system (e.g.: no louvre type windows are to be provided to air conditioned spaces or automatic doors positioned in locations which could allow for a breeze way within the building). Provide advice to other members of the design team regarding the location and requirement for vapour barriers, insulation requirements for building elements relating to the mechanical services requirements.

20.4.3 Passive Energy Efficiency

Design should take advantage of local climate / weather profiles. Consideration should be given to the reduced use of air conditioning, ventilation etc. by making advantageous use of shading, prevailing breezes and the like.

Where practical, atrium's etc. can be naturally vented with passive and active elements to enhance air movement and comfort.

Air movement should be enhanced (e.g. through large commercial ceiling fans etc.) to minimise the reliance on air conditioning or to enhance the environment.

Under natural ventilation conditions, the humidity within the building shall not exceed 70%RH or dewpoint conditions above adjacent air condition spaces.

20.4.4 Heat Recovery / Energy Efficiency

JCU is committed to both minimising life costs of ownership and being environmentally responsible. Areas with high fresh air requirements (due to occupancy, operation, etc.) should be provided with enthalpy recovery from relief air. Similarly in areas requiring large exhaust of conditioned air, energy recovery from such exhaust is desirable.

CO2 control of outdoor air ventilation rates can be utilised in conjunction with energy reduction strategies if room pressurisation is a key driver.

Under all ventilation demand strategies, the building shall remain under a positive pressure.

Systems shall be designed so that fans, pumps etc. are operating against modest pressures, whilst maintaining economy of installation (e.g. pipes are not excessively oversized etc.)

20.4.5 Free Cooling / Economy Cycles

Free cooling options / economy cycle operation is to be carefully considered and implemented where beneficial to the operation, energy reduction, indoor air quality improvement or such. For critically controlled spaces (eg critical temperature / humidity requirements, laboratories), free cooling may be excluded by permission of the Deputy Director – Planning and Development.

20.4.6 Design for Cyclone Prone Areas

JCU's campuses are located in a cyclone prone environment. Particular care is required to ensure necessary measures are taken to ensure that all plant, equipment etc. (particularly external plant) is securely fixed, of suitably rated cyclone area construction and constructed in a manner to withstand such events.

20.4.7 Corrosion Prevention and Protection

JCU campuses are generally located in coastal areas. The prevention of corrosion must be considered in the design. Plant should be located under cover in plantrooms. Exposed plant should be avoided (except external condensing units, chillers and the like where included in the design).

External exhausts etc. should be constructed of non-corroding elements (PVC / Stainless steel etc.). Fixings should be stainless steel. Dissimilar metals should be electrically separated.

Pay particular attention to elements such as switchboards, control panels etc. which should be stainless steel where exposed to weather.

Identify additional service recommendations to mitigate or minimise corrosion where the particulars of the installation may produce corrosion in the installation.

20.4.8 Equipment Quality and Support

All equipment and components shall have a proven track record of operation in Queensland and be of high quality and reliability, readily available, with a Queensland based agent for service / spare parts, with sufficient stock of spares to support JCU's operation.

Critical Spares requirements shall be listed in Operating and Maintenance Manuals.

20.4.9 Design for Maintenance

Ongoing service and maintenance must be facilitated in the installation. Measures at least will provide minimum service access spaces, easily workable arrangements, clear unencumbered walkways of minimum 1200mm.

In all cases mandatory clear access for electrical switchboards and the like is to be provided.

Where roof areas must be accessed for maintenance, suitable stairs, walkways, railings, fall protection measures etc. are to be provided. Take reasonable steps to minimise the amount of

equipment etc. requiring servicing from roof areas. Roof mounted supply and exhaust fans are not permitted.

Ductwork inspection and cleaning must be facilitated through suitable location of services and careful co-ordination with other services and building elements. Ductwork shall be externally insulated except for within plantrooms where perforated sheet metal faced internal insulation may be used for acoustic purposes. Sisalation facing for internally insulated duct is not acceptable. Acoustic measures must therefore be addressed in design.

Generally some internal insulation within accessible plantrooms up to attenuators at plantroom boundaries is a preferred approach. Internal insulation for supply ductwork in ceiling spaces will only be permitted when approved by the Deputy Director – Planning and Development.

20.4.10 AQIS / OGTR / Authorities

Where AQIS / OGTR / Federal Drug Administration or other requirements apply, the designer must fully address these requirements, and provide all information to allow JCU to inform these bodies and pass certification.

20.4.11 Arrangement of Services

Take particular care with arrangement of services and ensure full co-ordination of the project. A particular requirement is the separation of mechanical services from electrical services. Ensure any mechanical plant which can cause condensation or water damage is not located above or in the same riser as the electrical services.

20.4.12 Locating Existing Services

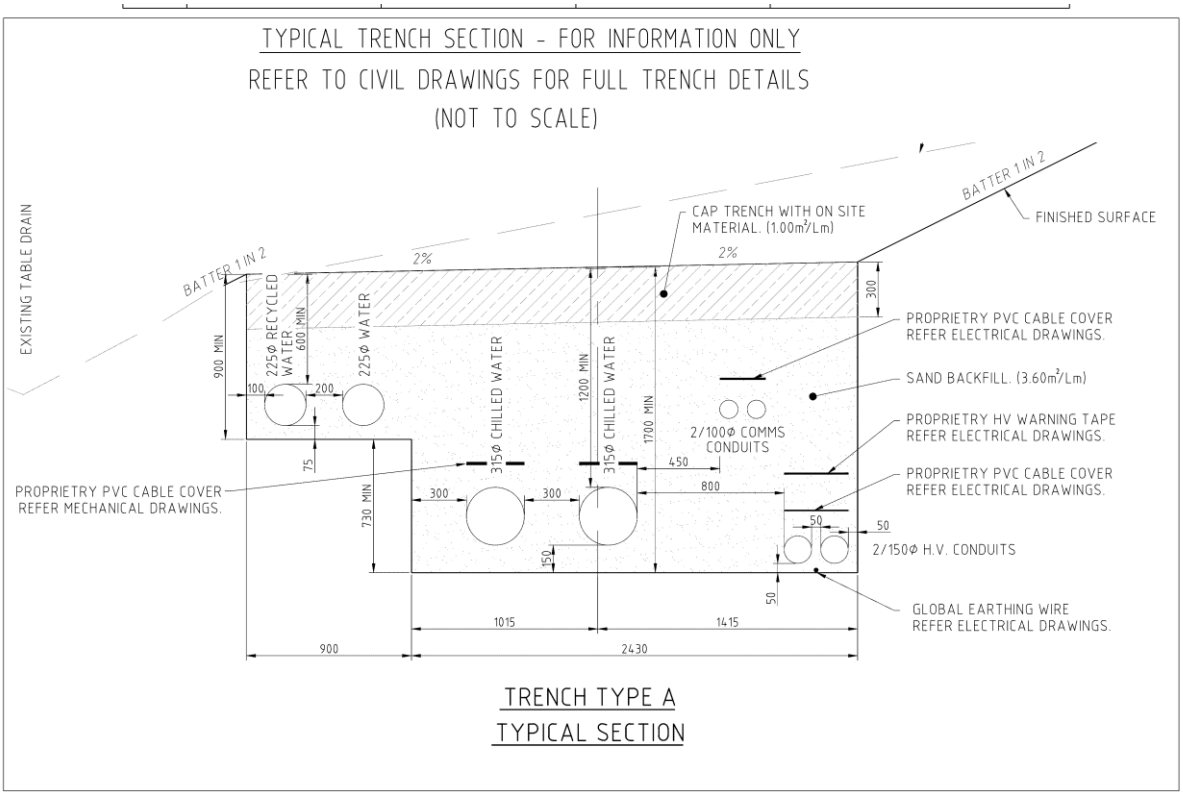
All existing services for the project shall be identified and confirmed onsite in accordance with the requirements identified through JCU's Permit to Work system.

20.4.13 Services Trench

The design shall provide for the connection to existing drinking, non-drinking water and sewer infrastructure within the site. Co-ordination with civil, electrical, communications, wet fire and mechanical services will be required to ensure that where ever possible common trenching of services is achieved.

All inground services shall have traceable identification tape installed above the service. All inground services shall be co-ordinated and common trenched where possible. All inground services shall be designed to suit the soil conditions as described by the geotechnical engineer.

Refer typical JCU common services trench detail below.



20.4.14 Safety in Design

Safety in design must be incorporated into the design of all new plant, buildings etc. In addition to legislated and briefed requirements, work closely with JCU Project Manager and keep the Deputy Director – Planning and Development, Manager, Infrastructure Services and Manager, Asset Strategy and Maintenance fully informed of installation, service and maintenance and access requirements.

Particular care must be taken to ensure that safe installation and service is inherent in the design. Generally any requirement for the use of Personal Protective Equipment (PPE) or protective measures (fall restraint systems etc.) should be avoided by design.

20.4.15 Diversity of Systems

Generally central systems, plant and infrastructure (chilled water pumps, pipes, central air handlers etc) shall be designed without diversity of load or spaces – i.e. they shall be capable of serving the full concurrent design loads.

Specific systems designed to accommodate load diversity (VAV systems etc.) may still be designed with appropriate diversity.

20.4.16 Specific Design Requirements

JCU owns, operates and maintains all infrastructure services and all academic buildings on and within the campuses. The RPEQ consulting engineer shall take a long term (whole of life) investment and maintenance decision strategy when designing the systems.

The design standards are provided with the intent that the default energy rating would be in the order of 4.5 star NABERs rating and previous maintenance or performance issues experienced with existing HVAC installations onsite are not repeated.

Where investment decisions on HVAC system options exceed $350,000, the schematic design report shall include a full financial evaluation. This shall include operating cost, life cycle cost and design elements which will achieve a 5 star or greater NABERs rating

The following shall be adopted in all new HVAC design solutions and where feasible on all refurbishment solutions, as required by the Deputy Director – Planning and Development.

Scope	**Reason**
Risk Assessment of HVAC design shall be in accordance with AS3666.4.	Risk Management
New buildings shall include NEBB 3rd Party certification on commissioning results. Should JCU engage independent commissioning agents / engineers (ICA), the requirement for NEBB is not required.	ICA is considered a higher standard of testing and would include witness certification of commissioned systems.
All systems shall have pre-conditioner plant included in the design to remove moisture content from the outdoor air before it is delivered to the building air handling units or room direct.	Condensation and Mould Control
HVAC plantrooms shall not be naturally ventilated or draw outdoor air through the plant areas. All outdoor air systems shall be ducted to external grilles. Outdoor air duct routes to filter plenums shall be kept to a minimum and include access panels.	Condensation and Mould Control
All air conditioning plant supplied with chilled water from the campus district cooling system shall have high temperature split cooling coils and pressure independent flow control valves. These can be at each air handling unit or a pressure flow regulating valve for the building.	Ensure no building is disadvantaged or takes more flow than designed.
Maintenance access to all HVAC plant shall include allowance to remove cooling coils, fans and major components. All internal components of the air handling units shall have service access for cleaning (hosing and the like) with adequate drainage and lighting. The RPEQ shall provide a description on component maintenance access in the schematic design report. All plant shall be located in floor mounted plantrooms (not in ceiling space or in areas which routine maintenance cannot be carried out)	Ability to clean system for longevity.
Air handling unit filter plenums shall be fabricated from the same material and form part of the manufacturers' scope.	Ability to clean filter plenums. Longevity of system.
Multizone air handling units are not accepted.	Inherent low return water issues which impact on the CDC plant.

Scope	Reason
Contact JCU PM for required manufactures of :- • Compressed Air Fume Cupboards • Fume Cupboards • Laminar Flow Cabinets • Specialist Ventilation Systems • Filters	Standing Maintenance agreements
BMS for Townsville shall be Satchwell & for Cairns shall be Tridium subject to a competitive market tender response.	Incumbent Supplier
Mechanical Services equipment shall have 10% margin (pipework, pumps, fans).	Future Flexibility
All AHU and pre-conditioner condensate drains shall be at least one size larger than the manufacturers socket connection and have a fall of 1:50 minimum.	Preventative Maintenance

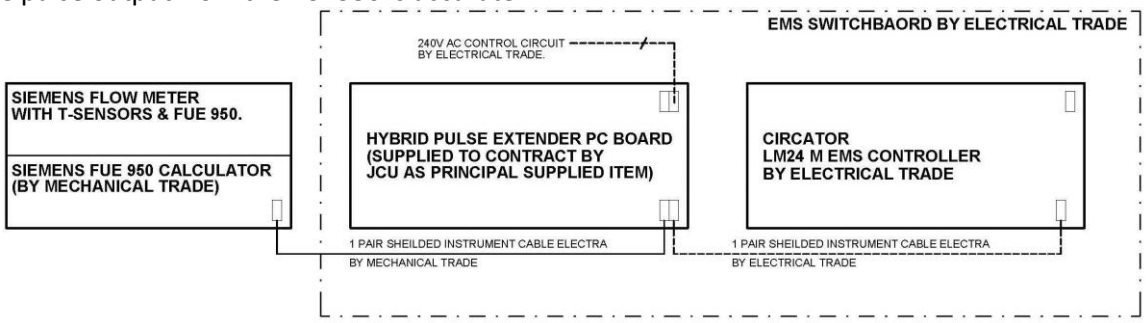
20.4.17 Campus District Cooling (CDC)

Both Townsville and Cairns campuses have a CDC reticulation and use a central energy plant (CEP) incorporating thermal energy storage (TES) to generate chilled water (CHW) for distribution to campus buildings through the chilled water piping reticulation. The Manager, Infrastructure Services approves new connections onto the CDC.

To maximise the benefits of the CEP/TES system, these provisions must be complied with;

- All air conditioning systems used in the building shall be chilled water type. Direct expansion systems shall not be used for any application unless specifically approved by the Manager, Infrastructure Services during SD.
- Chilled water cooling coil selections shall be based on the parameters scheduled below.
- “Duty” plus “100% Standby” variable speed tertiary pumping, operating in response to building chilled water flow and return differential pressure shall be provided. Selection shall be in accordance with the parameters scheduled below.
- Individual building CHW energy (kWr.hrs) metering shall be provided using magnetic flow meters and flow and return chilled water temperature monitoring. At each temperature sensor thermometer pocket (well), provide an adjacent binder fitting for testing and calibration purposes. A second set of thermometer pockets shall be provided for interface with the campus BMS.
- JCU standard for chilled water energy metering is Siemens MAG 5000/5100W mag-flow meter plus Siemens energy meter FUE950. This meter measures CHW mass flow rate plus flow and return water temperatures and has dual outputs, 4-20mA to the campus BMS and pulsed energy output from the FUE950 to the campus energy metering system (EMS). The pulse output from the FUE950 shall be coiled adjacent to the EMS panel which is provided by the electrical trade. The electrical trade shall connect the pulse input signal into the LM24 controller and provide all necessary programming. The mechanical services trade shall ensure

the pulse output from the FUE950 is accurate.



- Provide dedicated electrical power consumption metering (kWe.hrs) of the MSSB to capture only tertiary chilled water pumps and air conditioning air handling units serving each building or group of buildings. Separate metering of miscellaneous ventilation systems etc. shall be at the discretion of the JCU brief and/or Deputy Director – Planning and Development and shall be additional to that mentioned above.
- A dedicated pump room shall be provided to accommodate tertiary pump/s and control gear and flow meter. Two (2) pairs of double data points shall be provided for interface to the campus EMS (1pair) and campus BMS (1 pair).
- Two way chilled water control valves shall be used throughout. Three way valves or fixed or motorised flow/return bypass connections shall not be used under any circumstances.
- Coil control systems employing constant coil air off temperature (AOCT) control or similar control strategies which can result in fully open control valves at part load conditions shall not be used. AOCT control shall only be used in combination with set-point reset strategies to ensure that chilled water control valves respond to building load.

20.4.17.1 Interface with Reticulation System

The building shall be connected to the CEP site reticulation network at valved connection points located in a pit in a location approved by the Manager, Infrastructure Services during SD. All connections to the building shall have wafer butterfly valves which can isolate the building.

Tertiary pump/s shall be selected to satisfy building diversified flow against the system resistance of all pipework and equipment installed under the Building Contract. Include at least 10 percent allowance in pumps and piping design for future, or design allowance for known future stages of the building.

Designers shall analyse part load and after hours system flow requirements for the building and determine appropriate tertiary pumping configuration. In some applications a low load pump may be required, as per . Each building shall incorporate an air/dirt separator and strainer with a valved bypass across the air/dirt separator for cleaning.

For critical applications, systems are to be arranged to accommodate the temporary connection of JCU's mobile chiller, by provision of accessible branch valves and connections.

20.4.17.2 Design Parameters

The following design parameters apply to the CEP interface and shall be used for purposes of selecting pumps, pipework and fittings.

Parameter	Design Criteria
Available Flow/Return Differential Pressure	0 kPa
Available Flow Rate	As nominated by Building Designer
Delivery Temperature	7.0 ^{0}C
Static Pressure	300 kPa

20.4.17.3 Selection of Cooling Coils

It is important to maintain high building chilled water ΔTs during full and part load conditions to reduce pumping power and maximise TES capacities. Designers shall recognise this requirement and avoid any unnecessary system elements which compromise building ΔT. In particular, control systems shall be arranged to ensure that control valve positions respond to building load and flow/return bypasses shall be avoided.

Cooling coils shall be specified to achieve high ΔTs and designers should scrutinise manufacturer's technical data for cooling coils prior to accepting tenders.

20.4.17.4 Coil Selection Criteria – Design Parameters

Select all cooling coils using the following criteria.

Chilled Water Entering/Leaving Temperatures	7.0^{0}C / 17.0^{0}C
Maximum Coil Face Velocity	1.8 m/s
Max Coil Air Pressure Drop	80 Pa
Max Coil Water Pressure drop	40 kPa
Maximum Coil Height	950mm

Use the following coil construction.

General Air Handling Units	Copper tube aluminium fin
Outside Air Pre-Conditioners	Copper tube and copper fins electro-plated in brass frames

Cooling coils shall be fitted with drip trays. Drip trays shall be stainless steel and shall extend a minimum of 450mm beyond pre-cooling coils and chilled water coils on the downstream side of the coil and have sides and underside insulated with 12mm closed cell rubber. Install coils with sufficient space under for cleaning and fully flash around to prevent by-pass.

Coils shall have bleed and drain connections.

20.4.17.5 Approval request for CDC connection:

A single request for approval to connect to the CDC is to be sent to the Manager, Infrastructure Services, at least 3 working days before the connection is required. This document shall contain the following information;

From the RPEQ Design Engineer:

- Building Peak Load Chilled Water Flow Demand (l/s)
- Building Peak Load Chilled Water Design ΔT (°C)
- 24 hr Systems Peak Load Chilled Water Flow (l/s)
- 24 hr Systems Peak Load Chilled Design ΔT (°C)
- As built drawing of surveyed CHW in ground pipework, pit and connection point.
- Certificate of Design Compliance

From the commission team:

- Mechanical Services Commissioning Plan
- Certificate of Installation Compliance
- Water quality test result (pre-connection clean and passivation)
- Water pressure test results
- System commissioning test results

20.4.18 Low Load conditions to be considered

Generally the Campus District Cooling (CDC) provides designers the ability to address both low loads and peak loads. Consider the low load operating conditions and ensure that pump sets, controls etc., and the system design can accommodate low loads and small stand-alone loads (etc.). In some cases the CDC may provide sufficient low load flow without building pump operation.

Identify the requirements and strategy carefully and obtain approval from the Manager, Infrastructure Services.

20.4.19 Use of DX Air Conditioning

Direct Expansion / Split / VRV / VRF / Built up refrigerative systems etc. shall not be applied for HVAC duty without written permission of the Manager, Infrastructure Services. It is anticipated that such systems would only be at remote sites where CDC is not available, or alternatively for small / temporary applications.

20.4.20 CO_2 control to be considered

Areas with high fresh air proportions must be considered for energy reduction strategies such as CO_2 control / modulation. Provide design feedback to the Deputy Director – Planning and Development on the benefits and cost / return of the system on a case by case basis.

20.4.21 Ambient Design Conditions

Determine outside winter and summer dry-bulb design temperatures and other ambient conditions in accordance with AIRAH 4 published data included in DA9 Design Manual or CAMEL weather data.

Typically use “comfort” weather data for all general comfort air conditioning applications. “Critical” weather data should be considered for all process cooling, controlled environment spaces, data centres and particularly spaces with high fresh air loads. Confirm with the Deputy Director – Planning and Development that the design is to be based on Comfort or Critical weather data.

The design ambient air onto condensers condition (where permitted to be used) should be adjusted to account for local effects such as roof heating, partial recirculation etc. It is recommended that an uplift of between 3 and 5 degrees be used at the designer’s discretion to the design “Air on Condenser” conditions.

20.4.22 HVAC Zoning

Air conditioning zones shall be carefully arranged to permit accurate control of conditions and to avoid reheat, excessive zone throttling and such.

Heaters shall not be incorporated in VAV boxes unless approved by the Deputy Director – Planning and Development.

Air conditioning zones shall be carefully arranged to permit accurate control of conditions and to avoid reheat, excessive zone throttling and such. Zoning shall permit functionally separate systems to be turned off individually.

- Generally thermal / control zones on air handlers shall not exceed 150 m^2 for internal zones and 100 m^2 for perimeter zones (Guide). The zoning is acknowledged to have flexibility based on the RPEQ design engineer's experience.
- Zones displaying different usage patterns, solar aspects or load profiles must be served separately if a temperature swing of 1^0Cdb outside of normal temperature proportional control range is likely.
- Zones with different operating times must be served by separate plant
- Specific Zones requiring specialised humidity controls vs comfort conditioning must be by served separate plant
- Lecture theatres and intermittently loaded spaces must be served by separate plant.
- Areas with constant or 24/7 loads must be served by separate plant
- Laboratories requiring separate plant etc.

20.4.23 Internal Design Parameters

Generally for comfort

Summer: 22º C to 24 º C (at 55% relative nominal humidity – refer below)

Winter: 21º C to 23 º C (no humidity)

For special process areas, laboratories, physical activity areas, confirm the internal design conditions with the Deputy Director – Planning and Development.

20.4.24 Humidity Control / Requirements

JCU campuses are generally located in Tropical environments, in addition to which teaching and laboratory environments often include large fresh requirements. General comfort design required to produce approximately 55% RH @ 23 degrees internal temperature and external design conditions. Systems shall be designed to inherently limit space RH to below 65% under all conditions. The SD and DD reports shall specifically cover how space RH will be controlled.

20.4.24.1 Humidity Controlled Spaces

For particular areas, close humidity control may be required (e.g. Library spaces, laboratory spaces etc.)

Designers are required to produce energy efficient designs with inherently "improved" dehumidification over commercial norms. The use of additional energy to perform reheat dehumidification is to be avoided, and generally direct electric reheat will not be permitted for comfort dehumidification.

Dehumidification plant design shall accommodate part load conditions. Calculations should be verified by plotted psychometric charts (included in SD and DD reports).

20.4.24.2 Humidification

Generally humidification is not required. Where required for specific projects, ensure that the method is energy efficient, suitable for sustained operation, and suitable for the water supply available.

20.4.25 Heat load calculations

Formal heat load calculations are to be undertaken for all air conditioned spaces. The heat load must be calculated using software recognised by NCC (e.g. CAMEL)

Occupancy rates are to be taken from the project brief if provided, otherwise from the occupancy information provided in the NCC. If occupancy rates are not provided, the consulting engineer shall complete a return client brief for approval.

Activity levels used for heat loads shall match the usage of the space.

Initial calculations may be based on the allowances for lighting, equipment etc. provided in the brief or in this guide but shall be checked / amended before final design using information relevant to the specific project (e.g. specialist lighting etc.).

A modest safety factor should be applied (typically 5-15% at the discretion of the designer), however particular care must be exercised not to significantly oversize plant. Safety factors should be advised in SD and DD reports.

20.4.26 Population Densities

The following population densities are provided to assist with design where the design brief or architectural documents do not provide such detailed information. All room occupancies and loads are to be confirmed in writing with the room sheets to the Deputy Director – Planning and Development before Developed Design.

SPACE	Indicative Occupancy
Administration Spaces	One person per 10m^2
Postgraduate Spaces	One person per 4m^2
Conference Rooms	One person per 1.8m^2
Seminar / Tutorial Rooms	One person per 2.8m^2
Lecture Theatres	One person per 1.5m^2
Computer Teaching Laboratories	One person per 2.8m^2
Science / Laboratories	One person per 5m^2

20.4.27 Hours of Operation

Normal operating hours for the campuses are as follows:

20.4.27.1 Townsville:

Standard Operating hours 8:00am – 6:00pm, 5 to 7 days per week

20.4.27.2 Cairns:

Standard Operating Hours 7:30am – 7:00pm Monday to Friday

20.4.27.3 Data Centres:

24 hours per day, 7 days per week

Certain projects / areas may have special operating hour requirements. Confirm with the Deputy Director – Planning and Development via return brief.

20.4.28 Ventilation of Areas

20.4.28.1 Shower areas

Shower areas shall always be mechanically vented.

20.4.28.2 Toilets / Ablution areas

Wherever practical these shall be naturally vented. Natural ventilation openings etc. shall be a minimum of 200% of legislated requirements, otherwise mechanical ventilation should be applied.

20.4.29 Plantroom and Plant Locations and Platforms

All air handling plantrooms shall be fully enclosed and included within the building vapour barrier/insulation systems. Plantrooms shall be designed to limit internal temperature to under 26.0^0C, and this may require air conditioning of the plantroom space.

Generally plantrooms and the like shall not be located immediately bordering noise sensitive spaces (e.g. plant room backing on conference rooms and the like). Wherever possible, plantrooms shall be stacked above one another in multistorey buildings. AHU's to be a minimum of 600mm from the walls to allow for maintenance. The plantrooms shall be painted and floors finished with two part epoxy paint.

Plantrooms shall be carefully planned to facilitate all service and maintenance activities including (for example) motor changes, drive changes, filter access, coil and AHU cleaning, fan changes, and so on.

Safe permanent access is paramount. Where plant is located on external decks at height, permanent stairs, handrails etc. should be provided. Where ladders are used, these should only be for minor service items and must be less than 2.5m in height.

Plantrooms should be tanked / bunded and provided with drainage to address any free water (e.g. roof leakage, tray overflow etc.) Provide access panels to ducts immediately below roof penetrations to allow inspection for water ingress.

20.4.30 Noise & Vibration Control

Prior to finalising the design, provide an overall strategy for vibration isolation to all equipment with moving parts to the Deputy Director – Planning and Development for review and approval.

Pipework shall not be rigidly mounted to building structure. Ensure that hangers are arranged to accommodate thermal expansion, transient loads and conditions whilst maintaining isolation.

20.4.31 Design Sound Levels for Spaces

Noise level limits from Mechanical Services plant etc. shall be:

SPACE	Sound Power in dBA
Offices (enclosed)	37
Open Plan Offices, Administration spaces etc., Post graduate areas,	37
Teaching rooms	37
Accommodation rooms	32
Lecture Theatre / Auditoria	32
Library	40
Video Conferencing Areas	32
Corridors, Lobbies, Foyers	45
Laboratories etc.	40
Outside	5 dB above ambient @ 10 Metres

Take particular care to avoid tonal components, whistles, rattles etc. Avoid intrusive noises such as machinery start and stop characteristics. Generally allow VSD or soft starting.

20.4.32 Duct Design

Duct systems must be designed with velocity and pressure drop characteristics that permit full design flow to all points, do not create excess noise, do not contribute to noise bridges between areas and do not adversely affect comfort (e.g. draughts, stagnant areas etc.)

General design parameters:

Type	Velocity [m/s] (max)	Pressure [Pa/m] (max)
Supply Air Duct	8	0.8
Return air duct	5	0.8
Exhaust Ducts	7.5	0.8
Flexible duct	2.5	
Exposed Duct	4.0	0.8

Supply air duct risers may run at higher velocities than set out above.

20.4.32.1 Return Air Transfer Systems

Door grilles shall not be used without the approval of the Deputy Director – Planning and Development. Typically air conditioned rooms and toilets shall be provided with acoustic return air transfer systems sized to limit pressure drop to 10 Pa. Cascaded return air transfer systems shall not be used.

20.4.33 Ductwork

All air handling ductwork design and construction methods shall comply with AS4254 / SMACNA and shall be minimum 500pa pressure rating Class B, generally with external insulation as per clause 20.5.11.

20.4.33.1 Ductwork materials:

- Within concealed and plant spaces: Galvanised sheet metal
- Externally to buildings: stainless steel (including all fixings etc.)
- Exposed within spaces: fabric duct, spiral wound circular or oval duct, coloured to architect / Deputy Director – Planning and Development's direction
- For fume exhaust or in corrosive environments: Stainless steel / UPVC / PVC
- Fibreglass duct is not permitted
- All duct materials, sealants etc. shall meet the requirements of AS1530

20.4.33.2 Ductwork Arrangements:

- Ducts shall traverse with a minimum of bends, offsets, obstructions
- Penetrations through building elements shall match fire and acoustic properties of the wall.
- Prevent entry to the building through ducts / louvers and the like.
- Where external to buildings be constructed to be weatherproof and prevent ponding of water etc.
- Avoid multiple obstructions of changes of directions particularly in close proximity to each other.
- Volume dampers shall be located away from terminal devices to avoid noise.
- Duct connections to fresh air louvers etc. shall be provided with a drain section which drains any carried-in water back through the face of the building to the exterior.

20.5 MECHANICAL SERVICES EQUIPMENT REQUIREMENTS

20.5.1 Identification of Equipment / Services

Confirm the plant numbering sequence with JCU Deputy Director – Planning and Development prior to Contract Documentation. Prefix equipment with building number.

All items of equipment must be suitably identified with Traffolyte labels.

Generally all plant is to be numbered as follows:

- Chilled water entering building temperature sensor "T-1"
- Chilled water leaving building temperature sensor "T-2"
- Primary chilled water pumps "PCHWP-1"
- Secondary chilled water pumps "SCHWP-1"
- Tertiary chilled water pumps "TCHWP-1"
- Quad chilled water pumps "QCHWP-1"
- Fan coil unit ground floor "FCU 0-01", "FCU 0-02"
- Fan coil unit 1st floor "FCU 1-01", "FCU 1-02"
- Fan coil unit 2nd floor "FCU 2-01", "FCU 2-02"
- Air handling unit ground floor "AHU 0-01", "AHU 0-02"
- Air handling unit 1st floor "AHU 1-01", "AHU 1-02"
- Air handling unit 2nd floor "AHU 2-01", "AHU 2-02"
- Multi level AHU for VAV "AHU-1", "AHU-2"

- VAV; AHU number plus VAV number “1-01”
- Preconditioner “PCU-1”
- Exhaust fan “EF-1”
- Toilet exhaust fan “TEF-1”

Services shall be identified by laying continuous PVC marker tape on the sand bed 300mm above the pipe. The marker tape shall be colour coded, magnetic and be printed with the identification of the contents of the pipe and/or conduits and direction of flow. Provide brass engraved markers cast into any hard landscaping or cast into concrete markers, as approved by the Manager, Infrastructure Services.

20.5.2 Air handlers

20.5.2.1 Principles

All air handling equipment should be floor or plantroom mounted ducted equipment, readily serviceable without use of special platforms, lifting equipment etc.

All air handling equipment shall be non-cold tracking TB2 thermal rating.

In ceiling air handling equipment will not be allowed.

20.5.2.2 Arrangement and type

AHU equipment shall be built up sandwich panel or proprietary equipment manufactured by Modutherm, Carrier, GJ Walker or approved equivalent.

Drain trays in all instances shall be stainless steel and full width, depth condensate trays.

20.5.2.3 Cooling Coil Arrangements

Air handling equipment shall be designed to inherently provide enhanced dehumidification at low loads. Refer to 20.4.17.4 for coil requirements.

Provide isolation switches on power supply for AHU chilled water valve actuators.

All AHU’s serving Animal Facilities, PC2 / PC3 laboratories and preconditioner plant shall be fitted with UV lamps for coil sterilization e.g. Sterile Aire.

20.5.2.4 Casings and insulation

Air handlers and fan coil units shall be sandwich panel construction complying (at minimum) with NCC Section J Insulation and leakage requirements, displaying no cold tracking at supply air temperature of 12 degrees with ambient wet bulb of 28 degrees.

Cabinets shall be of sheet steel (external sheet minimum thickness 1.6mm, internal sheet minimum thickness 1.2mm), reinforced to prevent drumming. Casings shall be painted or powder coated internally and externally.

Where necessary for corrosion resistance or other requirements, casings may be Aluminium or Stainless Steel.

20.5.2.5 Coils and Condensate trays

Fin spacing shall not exceed 472 fins per meter. Water carryover from the cooling coil is not permitted. Refer to 20.4.17.4 for coil requirements.

In general, coils are to be aluminium fin, copper tube, mechanically bonded construction. Where additional corrosion resistance is required or for particular applications, coils may

be copper/copper or stainless steel.

Condensate drainage is to be gravity driven. The use of condensate pumps is not permitted without written acceptance from the Deputy Director – Planning and Development.

20.5.3 Tertiary CHW Pumps

Building chilled water pumps shall be provided in Duty and Standby arrangement (n+1), with independent VSDs. VSDs are to be powered at all times (do not remove control power on standby).

Pumps shall be Ajax or Wilo or other manufacturer approved by the Manager, Infrastructure Services.

Pumps shall be non-overloading and deliver required flow over all operating conditions and be free from cavitation. Generally pumps must be provided with Variable Speed Drives.

Pumps must not be selected at full size impellor.

VSD and electrical supply components are to be sized to suit full speed operation on full size impellor.

Each new pump set connected to any building / precinct / area shall be provided with Air/dirt separator.

Provide pumps and ancillaries as follows:

- End suction, single stage, back pullout pumps, vertical centreline discharge.
- Casings shall be spheroidal graphite cast iron with integral mounting feet. Bronze impellor, fitted to shaft with Stainless Steel or bronze nut, fine metric threaded.
- Stainless steel (316) shaft, with mechanical long life seals
- Deep groove long life bearings (>100,000 hours). Rear bearings shall be double row, and suitable for all thrust and load conditions.
- Provide suction diffusers or clear straight entry to pump in accordance with manufacturer's recommendations.
- Stainless steel drain tray, drained to condensate waste.
- Couplings suitable for continuous operation, guarded and capable of absorbing operational misalignment
- Pumps subject to high twisting (eg DOL) loads shall be provided with concrete filled inertia bases. Provide spring mounts for all pumps
- Pumps shall be vibration isolation mounted with flexible connections to pipe networks on inlet and discharge.

20.5.4 Fans

Ventilation fans shall be of Fantech, Fans Direct or other approved manufacture, and shall be carefully selected to match the system requirements.

- Fans handling moisture laden air or exposed to weather must be minimum IP55.
- Significant fans (generally fans above 1.1kW or where required for critical applications or control) are to be provided as three phase with VSD, however smaller fans may be three phase VSD if necessary.
- Fans are generally to be located within plantrooms etc. Avoid the installation of fans in ceiling spaces etc. unless specifically approved by the Deputy Director – Planning and Development.

20.5.5 Motors

Motors are to be high efficiency three phase units, IP56 minimum, tropic proof. Motors shall be non-overloading and selected to match full speed operation on full size impellor. Where VSD drives are used, motors shall be suitable for operation at low speed without overheating, and shall include an insulated bearing on the non-drive end.

20.5.6 Variable Speed Drives

Fan motors of 750Watts and below may be single phase direct drive with manual speed controllers (unless required to be variable speed or three phase to suit other requirements). Larger fans are to be multiple belt drives with adjustable pulleys or Variable Speed Drive.

Where air handlers serve systems with variable air flows, provide Variable Speed drive.

20.5.7 Filters

Plantrooms shall be provided with filters at the fresh air entry point. High efficiency filters minimum rating F5 shall protect all air handling equipment. These filters in turn shall be protected by pre-filters rated G4.

HEPA filters shall be carefully specified for the requirements of the space. For these systems ensure sufficient fan capacity and control. Fan assisted HEPA units may be used. As installed DOP testing and certification must be provided with each HEPA / NEPA install.

Provide Magnehelic gauges to all filters.

Where filters are of a critical nature to the operation or safety of a space (e.g. PC3 etc), provide filter differential pressure switches or air flow measurement and provide alarm function to alert users at the BMS front end and occupants within the building.

20.5.8 Fire Dampers

Fire Dampers shall be fully compliant to NCC, Australian standards (in particular AS1668.1) and the like in all aspects. Fire dampers shall be inspected and certified prior to practical completion.

Ensure that fire dampers are arranged to permit maintenance and inspection.

Fire dampers shall be carefully selected so that they do not adversely affect system air flows, pressure drops or noise levels. Avoid bends hard onto fire dampers.

Duct sections connected to fire dampers must be carefully constructed to be “drop away” as required by AS1668. Hangers, services etc. must not interfere with the dropping away of duct from the fire damper connection

20.5.8.1 Identification and Records

Provide permanent identification to all fire dampers. Where fire dampers are concealed, provide visible labelling to indicate their location. Ensure all installation, test and inspection records are provided to JCU Project Manager within 1 week of test.

20.5.9 Water Treatment

Pre-cleaning must be provided on all pipe systems, and only after successful pressure testing which has been signed off by JCU’s Commissioning Representative for witnessing purposes. Circulate non-foaming alkaline detergent solution for minimum 2 hours before removing this solution and flushing the system twice with fresh water. Immediately apply protective chemicals into the system.

Ensure all chemical treatments are suitable for use with those chemicals used in the CDC loop and have no detrimental effect on systems. Recommendations are to be submitted to the Manager, Infrastructure Services for approval, during DD.

The corrosion inhibitor dosage shall limit the corrosion to less than 3 mils per year (0.0762 mm) for steel and 1 mil per year (0.0254 mm) for copper.

20.5.10 Chilled Water Pipework

20.5.10.1 Dissimilar Metals

Provide full galvanic separation between dissimilar metals.

20.5.10.2 Air-Dirt Separators

OPTIVENT OVA-D air-dirt separators are to be provided to every new system installed. These are to be fully accessible for servicing, identified/numbered and valved for service isolation by providing a bypass line and valving arrangement to allow the unit to be taken out of circulation without impacting the entire system.

20.5.10.3 Headers

Where headers are provided, provide at least one spare pair of takeoffs for future use complete with isolation valves. Provide valves bypass line to avoid “dead-legs”

20.5.10.4 Pipe Materials – Above Ground

Chilled water pipework above ground and/or within buildings shall be AS1432 Type B Copper and shall be phosphorus de-oxidised non-arsenical copper.

Larger diameter pipe shall be stainless steel, spiral butt welded from minimum 2mm thick, grade 316 stainless steel sheet. Provide TIG full butt weld joints. Passivate weld areas following welding. Stainless steel pipe

20.5.10.5 Pipe Materials – Below Ground

Chilled water pipework below ground shall be HDPE or MDPE PE100 PN10 generally uninsulated and buried at 1200 fill and embedded in sand. Where thermal losses are considered an issue (shallow depth or creek crossing) pre-insulated system such as Insapipe (tm) is required.

20.5.10.6 Pipe Pits

Underground pipe transitions from one material to another, connections to CDC etc. shall be made within formed concrete pits with Gatic pit lids. Pits shall be drained and arranged to be fully accessible for service work on valves etc.

All bolts washers and fittings in pits shall be stainless steel. Thrust or mounting brackets shall be stainless steel or fully hot dip galvanised.

20.5.10.7 Valves: Balancing Valves

Option 1: Control valves for air handlers are generally pressure independent flow regulating self-balancing valves equal to Belimo PICCV or T&A Autoflow. Provide double regulating valves at each major branch take-off or takeoff to each floor, building etc., to allow balancing and measurement of respective branches equal to Tour and Andersson Sta-d / Sta-f type valves.

Option 2: Each AHU shall have double regulating valves equal to Tour and Andersson Sta-d / Sta-f type valves. If this option is adopted, the building CDC pipe connection shall have a pressure independent flow regulating device to ensure the building does not receive more flow than the design value at any time of the year.

20.5.10.8 Valves: Isolation Valves

Provide isolation valves to all air handling plant to enable service work / replacement of control valves, coils and the like.

Provide isolation valves at each major branch take-off, or takeoff to each floor etc. Provide isolation valves at each duty/standby piece of equipment to allow servicing etc.

Provide isolation valves at the CDC connection point.

Provide blanked isolation valves (150mm diameter) at suitable location adjacent the building chilled water connection point to allow connection of JCU's portable chiller.

Up to 50mm: Ball valve, Screwed BSP Bronze body, Stainless steel ball and stem

Over 50mm: Butterfly Valve (Gear type over 80mm), Lugged body to table E

20.5.10.9 Valves: Check valves

Check valves: Dual flap type, fully sealing, spring assisted.

20.5.10.10 Binder points

Provide binder test/measurement points across all operating elements of plant, including but not limited to:

- Each air handler cooling coil
- Every pump
- Any strainers or filters in the system
- Flow meters
- Adjacent any BMS sensing point (Pressure, temperature, sensing etc) to allow calibration and verification
- CDC connection point
- Temporary chiller connection point

20.5.10.11 Sensor Wells – Townsville Campus

For Townsville campus Sigma controls are to be provided with Telescopic STP660 type temperature sensors for chilled water; sensor wells to be fitted 30° below horizontal (120° from vertical).

20.5.10.12 Sensor Wells – Cairns Campus

For Cairns Campus, pipe sensors shall be thermowell with thermal contact with the bottom e.g. Invensys well-mounted temperature sensors TS-5721-853

20.5.10.13 Sensor Wells – Energy Calculator Wells

Energy Calculator wells may be fitted in the vertical position

20.5.10.14 Air Venting

Provide an Automatic air bleed at the top of each vertical riser and at all high points within the system. The automatic air bleed shall be fitted with an isolation valve and a permanent connection to a drain point complete with a section of clear hose.

20.5.10.15 Identification

Provide identification of all pipes in accordance with AS 1345 for the Identification of Piping, Conduits and Ducts and AS 1318, Industrial Accident Prevention Signs.

"Safetyman" adhesive labels are an acceptable method. Provide flow direction arrows to

all pipework at regular intervals (not exceeding 5m and at all connections)

All externally exposed pipework shall be fully painted in accordance with JCU's Colour Schedule, and colour standards shall be in accordance with AS2700.

20.5.11 Pipe Insulation

20.5.11.1 Insulation Material / Method

At hangers provide insulation blocks of high density polyurethane foam, except for pipes up to 25mm diameter where zinc annealed saddles may be used. For pipes larger than 25mm two rolled half sections of 1.2mm zincanneal shall be installed at the hanger to avoid damage to the phenol foam block. Where necessary to prevent crushing, provide extended saddle sections to support the pipe.

Compartmentalise insulation every 5m or at insulation blocks and adjacent to fittings and take-offs to prevent longitudinal moisture transfer along the pipe. Insulation shall be sealed to the pipes at these points.

Pipework from floor level to 2100mm above floor in plantrooms shall be metal sheathed, with colourbond or painted steel sheathing.

Where exposed to view, and where exposed to weather or the possibility of physical damage, all pipes shall be sheathed.

20.5.11.2 Chilled water Valve trains

Valves and strainers adjacent to fan coil units, air handlers, pumps are not be insulated but provided with drained insulated stainless steel safety tray. The condensate tray shall be insulated with minimum 25mmThermobreak applied to the base and sides.

Arrange for all such valves to be installed in the horizontal.

Insulation for other valves, flanges and fittings shall be arranged for easy removal for maintenance purposes, and shall have hinged and clipped (not screw fixed) casings. Pack penetrations for valve spindles etc. with white petroleum grease to provide a continuous vapour barrier.

20.5.12 Condensate Pipework

Provide insulated PVC condensate drains to all air handling equipment, pumps etc. The minimum pipe diameter is to be 32mm. Insulation shall be minimum 19mm wall thickness Thermobreak, or thicker as required to prevent condensation forming.

The insulation shall be carried vapour tight to within the air handler casing.

Provide a removable section of clear PVC pipe to inspect and service the drain

Safetrays are to be separately drained.

Condensate is to discharge to an approved tundish. Provide sufficient height to the unit to ensure satisfactory operation of the trap. Traps shall be sized to a height to accommodate the air side pressure differences of the air handler.

20.5.13 Duct Insulation

20.5.13.1 Ductwork Insulation Thermal

All Duct insulation shall be continuous and fully vapour sealed. Where required for thermal insulation, the minimum R value of the insulation shall be the greater of:

- As required by the version of NCC applicable to the project

- For refurbishments etc., as required by NCC
- As required in particular instances to prevent condensation etc.

20.5.13.2 Ductwork Insulation Thermal Material and Method

External insulation shall be Thermobreak, securely glued to the clean external surface of the duct. Where necessary apply multiple layers. Each layer shall be vapour taped and sealed fully.

Only where permitted by the Deputy Director – Planning and Development, external Bradford duct blanket may be used in lieu of Thermobreak. The duct-blanket shall meet or exceed all thermal property requirements, installed strictly to the Manufacturer's requirement.

20.5.13.3 Ductwork Insulation Acoustic

Where required for acoustic purposes, insulation shall be evaluated for the required performance. The mechanical engineer is required to undertake simple acoustic selection, however where an acoustic engineer is appointed, refer to the acoustic engineer for guidance.

Internal insulation should generally only be applied:

- Within the plantroom
- For plant located within spaces, the first 5-8m of duct and first two bends.
- Return air duct adjacent to plantrooms

20.5.13.4 Ductwork Insulation Acoustic Material and Method

Internal insulation applied for acoustic purposes shall also meet or exceed the thermal insulation requirements. Insulation shall generally be SuperTel or UltraTel installed strictly to Bradford insulation guidelines, and finished with:

Perforated 450 sisalation where not prone to moisture or grease

Unperforated sisalation where prone to light moisture

Unperforated sisalation or industrial Mylar where prone to heavy moisture, grease or chemicals.

20.5.13.5 Perforated Metal lining to internal insulation

Where insulation is accessible, provide perforated galvanised steel lining and protection to the insulation.

Where required for acoustic purposes, insulation shall be evaluated for the required performance.

20.5.14 Exhaust Systems

20.5.14.1 General

Ventilation systems must be suitable for the duty required. In particular, exhausts likely to handle contaminated air, moist air etc. must be specifically suitable. For moisture laden air or where condensation may occur within the duct, duct should be fully waterproof and appropriately drained. Install removable drain to allow service and inspection.

20.5.14.2 Exhaust Stacks / Flues

All exhaust stacks shall be fully drained with removable section to facilitate cleaning etc.

Exhausts shall be arranged to avoid adverse effects on intakes, other buildings, surfaces etc. For example, ensure kitchen exhausts are arranged so as not to cause excessive deposits of grease etc. on roofs.

Exhaust ductwork, fans and the like shall be concealed from view as practically possible. Fans from specialist exhaust systems (i.e. fume cupboards) shall be located in a separated ventilated plantroom and not on the roof. Plantroom shall have a roof and walls with adequate access for servicing.

20.5.14.3 Kitchen Exhaust

Kitchen exhaust shall be fully compliant to codes and regulations. Ensure kitchen exhaust systems in excess of 1000l/s are provided with user VSD control to NCC section J.

Kitchen exhaust hoods shall be 316 stainless steel.

Honeycomb (similar to Email GW) filters shall be provided with a full set of spares to allow cyclic cleaning.

High efficiency, low air volume hoods of self-cleaning type shall be Stoddart or similar.

Provide access panels to AS1668 for full cleaning access. Where discharges can admit water / weather, ensure that waterproof duct construction with accessible drain is provided.

20.5.14.4 Laboratory General Exhaust System

An independent laboratory exhaust is typically to be provided with intakes in each laboratory, independent of the building / laboratory room ventilation. Generally this system shall be 100mm PVC minimum diameter, terminated in PVC ball valves and stubs at accessible locations

20.5.15 Fume Cupboards / Systems

20.5.15.1 Overview

Fume cupboards shall be of Lab Systems or equal manufacture.

Fume cupboards, laminar flow cupboards, gloveboxes etc. are to be treated with particular care. Ensure all legislative requirements are met. Ensure a detailed briefing and confirmation with the Deputy Director – Planning and Development of exact requirements – preferably signed off in conjunction with the laboratory manager.

Ensure that makeup air is correctly provided. Generally fume cupboards may lead to high fresh air loads on air conditioning plant. Ensure that correct sizing is undertaken, humidity control is considered and that services are closely co-ordinated.

Recirculating fume cupboards are not the preferred solution and can only be used with the approval of the Deputy Director – Planning and Development.

Fume cupboards shall conform to the requirements of the latest version of AS2243.8, and AS 2982. Fume cupboards shall be variable air flow type. The Fume cupboard manufacturer shall be of a type that is currently operating at JCU with a proven record of operation, and shall be to the approval of the Deputy Director – Planning and Development.

The fume cupboards shall be either constructed from unplasticised UPVC or corrosion resistant Fibreglass (GRP) to AS1530 Part 3, depending on the client requirements. Provide infill panels above each fume cupboard to the ceiling line and cove the floor up the base to a minimum of 25mm.

Where the discharges from a fume cupboard or a group of fume cupboards could impact on intakes to buildings, undertake an analysis of the air discharge flow to determine the impact of the fumes. This should be undertaken prior to final review of the design and shall be presented as a brief report to the Deputy Director – Planning and Development.

Investigate the possibility of using energy saving automatic sash closing systems in all multiple fume cupboard set ups.

20.5.15.2 Specification of Services

Use the checklist below to obtain signoff from the Deputy Director – Planning and Development as to exact services required for each fume cupboard.

	Fume Cupboard Checklist		
	Location:		
	Feature	**Requirement**	**Comment**
1	Material Construction - PVC or Fibreglass		
2	External Dimensions WxHXD (mm)		
3	Sash Height (mm)		
4	Double GPO's - No. Required		
5	Sink required - Y/N		
6	Sink dimensions - WxLxH (mm)		
7	Suface Type - Tiles, SS, Epoxy, Trespa		
8	Aparatus Scaffold required - Y/N		
9	Lab Gas Services -Type & No.		
10	Lab Gas Services -Type & No.		
11	Lab Gas Services -Type & No.		
12	Lab Gas Services -Type & No.		
13	Compressed Air - No.		
14	Vacuum - No.		
15	Scrubber Required - Y/N		
16	Process Chilled water - Y/N		
17	Under bench Flammable DG3 Cabinet - Y/N		
18	Under bench Corrosive DG8 Cabinet - Y/N		
19	Solvent recovery System - Y/N		
20	Hi Vaccum cupboard and connection - Y/N		
21			
22			
23			

20.5.16 Flammable Materials Storage Cabinets

Class 3 dangerous goods cabinets shall be in accordance with AS1940 and shall not be provided with a ducted mechanical exhaust system. Pratt Safety systems are preferred.

20.5.17 Materials Storage Cabinets

Class specific goods cabinets shall be in accordance with codes and requirements. Pratt Safety Systems are preferred.

20.5.18 Laboratory & Piped Services

20.5.18.1 Gases Stores

Gases shall be supplied from bottles located within a lockable ventilated storage space

located external to the building which is easily accessible by the service road. Segregate gases as required, paying particular attention to Oxidizing and flammable gases, and segregation required between gases and other items (eg oxygen segregation from ductwork etc)

Cylinders shall be manifolded with non-return valves in such a way that any cylinder can be removed and still allow the effective operation of the pressure manifold. Identify whether manifolds are auto or manual changeover and provide alarms as necessary.

Bottle / Manifold regulators shall be provided to reticulate gas at required flow rate at the required pressure accounting for any line loses etc.

Where necessary, user point metering or pressure regulation shall be provided. Regulators shall be reliable and accurate – Broen by preference.

20.5.18.2 Terminations / Taps

Manufacture: Broen, Enware or Galvin Engineering (confirm user requirements)

20.5.18.3 High Purity Installations

High purity and Ultra-high purity installations should be orbitally welded stainless or SwageLok similar construction of appropriately clean materials and constructed in a manner to ensure the cleanliness is maintained. General welding / brazing in these systems is not permitted

20.5.18.4 LP Gas – refer Hydraulics Section of these Design Guidelines.

20.5.18.5 Compressed Air

Where possible utilise existing compressed air systems (e.g. in adjacent buildings) or link new installations with existing to provide backup.

Compressed air shall be reticulated in pressure grade appropriate copper pipe, terminated in SwageLok ½" / 12mm quick-connect, push-on barb or other to match requirements.

Air filters shall be provided and shall be substantially mounted. Unless otherwise specified, compressed air shall be reticulated at 700kPa and regulated at each laboratory.

Confirm type (e.g. reciprocating / rotary vane) of compressor required for the particular project.

Confirm the Oil / Water / Particulate aspects required for the particular project and ensure full compliance for compressor / distribution network to suite.

Receivers shall be provided to limit the number of starts per hour to manufacturer's recommendations. Receiver mounted compressors are acceptable in smaller sizes.

Compressors shall be silenced as necessary to meet the acoustic requirements of the project / guidelines.

Preferred Manufacture: Atlas Copco

20.5.18.6 Vacuum Pumps / Plant

Where vacuum is required confirm the full requirements (eg general suction, nature of contaminants, medical suction etc.) for the project.

Similarly to Compressed air services, where possible utilise existing plant in adjacent buildings, or link new plant to adjacent buildings to provide backup.

Ensure vacuum plant is capable of performing the duty under all operating conditions. Provide line filters etc to contain particulate items etc. Where biological material is present, provide Bacteria filters etc.

Vacuum pumps shall be capable of passing fluids from the system without damage to the pump (which shall be bronze impellor with bronze end plates.)

Pumps shall be mounted together with motor on integral base and shall be isolated from building services and structure.

Provide water seals with safety interlocks to each pump, with piping to the seals as recommended by the pump manufacturer.

Control systems shall be checked and commissioned by the pump manufacturer.

Preferred manufacture: Dynavac or Nash.

20.5.18.7 Vacuum Tanks

Vacuum tanks shall be provided to limit the number of starts per hour to manufacturer's recommendations. Provide gauges, safety valves and pressure regulation valves as required.

20.5.18.8 Vacuum Pipe

Vacuum services shall be reticulated in high pressure PVC or other to suit the particular application. All pipework shall rise in the direction of flow.

20.5.18.9 Distilled Water / Demineralised RO Water

Special water systems (such as deionised, demineralised, reverse osmosis or purified) where required should be accurately defined in terms of demand and water quality. Laboratories may provide their own water treatment/purification systems which may require pre-treated water, UV sterilisation, carbon filtration, storage tanks/vessels, recirculation pumps, special piping and avoidance of dead legs, and special metal-free tap ware.

Systems may be either stand-alone or recirculating depending on quality and quantity.

Systems shall be verified / commissioned and tested by the system manufacturer.

20.5.18.10 Isolation of Piped Services

Isolation shall be provided at

- all infrastructure connection points (e.g. main lines, main branches, plant),
- at the bottom (or top for top fed) of risers
- At each floor take-off
- At each major branch junction (example > 10 connected points)

20.5.19 Special Applications - Laboratories

Special applications and laboratories should be treated with particular care. Where air flow directionality is required (e.g. PC2 etc.), JCU prefers active control (e.g. pressure sensing, VSD control etc.) over relying on fixed air balance.

Laboratories should always be designed with appropriate control, safety and management measures addressed.

Laboratory design should always be undertaken by experienced specialists due to the diversity of requirements.

Exhausts etc. must be located so that contamination of fresh air, intake to buildings etc. is avoided.

20.5.20 PC2 / SPF Laboratories etc.

PC2 Laboratories are significantly controlled spaces. Ensure strict compliance with all Codes, Certifying bodies, and regulators.

PC2 laboratory areas must be provided with active pressure control to achieve the airflow requirements. Return air treatment must comply strictly with Code requirements and any specific requirements of the project.

PC2 Animal houses / Insect facilities etc. must be provided with Stainless steel access mesh to Code. Generally all instances of control mesh must be backed up by removable filters to allow removal of the mesh without concern for release of contaminants.

Take particular care with low level exhausts to ensure that inlets are filtered, easily removable for access and service and robust to suit the cleaning, maintenance and use of the facility.

For SPF facilities, pressure above surrounding spaces is to be actively controlled. The design must be conducive to the elimination of pathogens transgressing the SPF boundary.

All ventilation fans, air handler fans etc. should be provided with VSDs to enable rebalancing of systems, ensuring airflow regimes are met.

20.5.21 PC3 Laboratories

PC3 Laboratories are significantly controlled spaces. Ensure strict compliance with all Codes, Certifying bodies, regulators etc. Ensure that close communication is maintained from the instigation of the project to fully understand the operative requirements.

All secure duct and valves shall be strictly specified. Ensure careful co-ordination of gauge panels and alarm panels, fumigation ports etc. Ensure careful co-ordination throughout and especially for fumigation requirements.

Ensure that Pass through access areas is fully compliant and fully serviceable for the intended use.

All ventilation fans, air handler fans etc. should be provided with VSDs to enable rebalancing of systems, ensuring airflow regimes are met.

Design must only be undertaken by parties well experienced in these spaces.

20.6 USEFUL INFORMATION

20.6.1 National and State Legislation / Standards / Codes

As a minimum, the latest revisions or version of

- National Construction Code (revision as determined above)
- All applicable standards
- Queensland Development Codes
- Environmental Protection Act, Regulations
- Work Health and Safety Act
- JCU requirements as the local electricity provider
- QLD Electrical Safety Act and Regulations
- QLD Plumbing and Waste Water Code

- The Plumbing Code of Australia
- The Plumbing and Drainage Act
- The Plumbing and Drainage Regulations
- The Standard Plumbing and Drainage Regulations
- Local Authority's Plumbing and Drainage Department
- Local Authority's Trade Waste Department
- JCU requirements as the local sewer and water infrastructure owners
- QFRS
- These Design Guidelines
- JCU Policies and Procedures
- Any other regulation or local authority requirements applicable to the works

20.6.2 Discipline Specific Standards

AS 1029	Low voltage contactors
AS 1055	Acoustics - Description and measurement of environment noise
AS 1170.4	Minimum design loads on structures
AS 1132	Methods of test for air filters for use in air conditioning and general ventilation
AS 1210	Pressure vessels
AS 1318	Industrial safety colour code
AS 1324	Air filters for use in air conditioning and general ventilation
AS 1345	Identification of the contents of pipes, conduits and ducts
AS 1431	Copper tubes for plumbing, gasfitting and drainage applications
AS 1530	Methods of fire tests on building materials, components and structures
AS 1571	Copper - Seamless tubes for air conditioning and refrigeration
AS 1657	Fixed platforms, walkways, stairways and ladders — Design, construction and installation
AS 1668.1	The use of mechanical ventilation and air-conditioning in buildings – Fire and smoke control
AS 1668.2	The use of mechanical ventilation and air-conditioning in buildings – Mechanical ventilation for acceptable indoor-air quality
AS1668.3	The use of Ventilation and airconditioning in buildings – Smoke Control (large single)
AS 1668.4	Natural Ventilation in Buildings
AS 1677	Refrigerating systems
AS 1682	Fire Dampers - design and installation
AS 1716	Selection, use and maintenance of respiratory protective devices
AS 1775	Low voltage switchgear and control gear
AS 1851	Maintenance of fire protection systems and equipment
AS 2107	Acoustics — Recommended design sound levels and reverberation times for building interiors
AS 2243	Safety in Laboratories
AS 2639	Laminar Flow Cytotoxic drug safety cabinets – Installation and Use.

AS 2896	Medical Gas Systems
AS 2982	Laboratory Design and Construction
AS 3000	Wiring Rules
AS 3653	Boilers – Safety, Management, Combustion and other ancillary equipment
AS 3666	Air-handling and water systems of buildings - Microbial control
AS 4041	Australian Standard Pressure Piping
AS 4254	Ductwork for air-handling systems in buildings
AS 4426	Thermal insulation of pipework, ductwork and equipment – Selection, installation and finishes
AS 4508	Thermal Resistance of Insulation for Ductork used in building air conditioning
AS 4260	High Efficiency Particulate air (HEPA) filters
AS 60079	Electrical apparatus for explosive gas atmospheres

Regardless of the above, any applicable standard is to be considered in the design. The term "AS" shall also refer to "AS/NZS".

Any divergence from the above or other required provisions is to be listed on the Non-Conformance Register.

20.6.3 Interfaces

Further to 20.3.2, as a minimum:

20.6.3.1 General

Ensure that all works necessary for the complete installation and successful operation are advised to other consultants and specified as interface with other disciplines. Ensure that information required to accurately design the services is obtained from other consultants as required.

As a minimum:

20.6.3.2 Architectural Services

- Plantroom sizing (plan and height), access requirements, security, ventilation requirements etc.
- Duct and pipe special requirements and proposed zones
- Details of Fresh air louvers, relief air requirements,
- Riser spaces,
- Service clearances
- Penetrations, trenching, etc
- Indication of bunding requirements etc as applicable
- Clarification of building elements insulation
- Resolution of Glass types / performance (consider high performance glass etc)
- Shading of external windows
- Note: University preference is for white roofing throughout. Liaise with the architect.

20.6.3.3 Electrical Engineering

- Requirements for supplies (location, termination, size, phases) for each MSSB or separately supplied mechanical item of plant

example: 3phase + Earth + Neutral 40 Amp terminated in lockable weatherproof isolator at Adjacent AC 3.3, motor starting load
- Requirements for FIP interface, fire alarm indication / reticulation etc
- Requirements for plantroom and external plant deck lighting and service power points
- Requirements for data points for connection to BMS controls etc
- Interfaces to motion detectors etc for initiation of plant
- Electrical engineer to ensure interfaces and alignment of switchgear, protection, termination etc to suit mechanical requirements.

20.6.3.4 Acoustic Engineering

- Obtain the Acoustic report if relevant and address requirements
- Provide information of sound power / pressure etc and nature of devices
- Confirm internal and external noise constraints and design thereto.

20.6.3.5 Structural Engineering

- Location of plant including masses, any additional special items such as dynamic load etc
- Size of equipment to facilitate wind load calculations etc
- Size and mass of exhaust flues, requirements for stays and guy wire fixing points
- Special fixings as may be required
- Location of penetrations

20.6.3.6 Hydraulic Engineering

- Location and type of all tundishes (such as cold condensate, hot humidifier discharge etc), floor wastes, trade wastes and the like.
- Requirements for service taps
- Requirements for make-up water supplies
- Requirements water supplies such as RO water, supplies to equipment etc
- Ventilation requirements for pumps and equipment, fire pump rooms etc
- Control of associated mechanical plant (e.g. interlock with fire pump operation)
- Plenum plantrooms shall not incorporate floor wastes (Ref AS3500). Drainage to be taken to outside the plenum and then to air break and tundish.

20.6.3.7 Lifts

- Air conditioning or ventilation requirements for Lift Motor equipment and rooms
- BMS interfaces / alarm interfaces

20.6.3.8 Sprinklers

- Ventilation requirements for pump rooms
- Provide information on any exposed services (drawings, dimensions etc) to allow the sprinkler designer to evaluate where sprinkler patterns may be shrouded etc.

20.6.3.9 Hazardous Areas Design

- Review the Hazardous Area Classification for the space and address requirements (for example minimum ventilation rates, fresh air dilution etc)
- Where required, arrange for electrical design for Hazardous Areas
- Where potentially flammable or explosive liquids, gases, vapours or dusts are advised, advise the Deputy Director – Planning and Development of such presence and confirm whether a Hazardous Area Classification is required.