SECTION 25

ELECTRICAL SERVICES INCLUDING DRY FIRE

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Version	Date	Authors	Summary of Changes
1	10 April 2013	Multitech for JCU	First Edition
2	30 September 2013	Manager, Infrastructure Services	Revised with JCU comments
3	30 October 2013	Manager, Infrastructure Services	Metering information updated to reflect legislation requirements
	10/03/15	Manager, Infrastructure Services	Cross referenced with new sections
V4	02/07/18	Infrastructure Electrical Engineer and Manager, Infrastructure Services	2018 general review update

25.0 ELECTRICAL SERVICES

This document is a sub-section of the James Cook University (JCU) Design Guidelines and is not to be read in isolation. Consultants and Contractors are required to comply with all sections of the JCU Design Guidelines.

25.1 Design Process Requirements

The consultant shall be held responsible / liable for ensuring that all works necessary for the complete installation and successful operation are included in the design and specifications. Specific deliverables are required at the end of each project stage, namely:

25.1.1 Approvals Required during Design

Approval shall be obtained from the JCU Estate Directorate, Deputy Director, Planning and Development in SD for the:

- Equipment numbering sequence,
- An energy rating not in the order of 4.5 star NABERs, and the
- Reuse of any existing services or equipment.

Approval shall be obtained from the JCU Estate Directorate, Manager, Infrastructure Services in SD for the:

- Engineering designs not completed by RPEQ Engineers,
- Any power outages or disruption to power supplies to accommodate the new installation,
- Any HV switchgear and transformers not conforming to the Australian Standards or to the Ergon Energy installation guidelines,
- Any HV motors,
- Any surge diverters not inline type or based on MOV technology manufactured by Novaris,
- Single insulated cables,
- Any design not utilising a system of “essential” and “non-essential” submains,
- Lightning protection risk assessment as per AS1768 with the risk index and a recommendation, and the
- The actual category of external lighting including parking spaces, aisles, roadways and pathways.

25.1.2 Site Infrastructure Connection Approvals

The Manager, Infrastructure Services shall approve all connections to existing infrastructure, including the HV and LV reticulation.

Specific HV requirements; a single request for approval to connect to the HV network is to be sent to the Manager, Infrastructure Services, at least 10 working days before the connection is required. This document shall contain the following information;

- Form 15 or statement from electrical designer that design meets code requirements
- Form 16 or statement from electrical installer that installation done in accordance with design
- Electrical design criteria issued to electrical designers, especially protection criteria
- Details of electrical design, cable sizes, loads, impact on JCU protection settings, etc.
- Confirmation of fault levels - and impact on our network
- Confirmation that electrical design is within current protection envelope and comments on any expected impact on our reticulation
- Electrical commissioning plan and comment on progress to date
- HV Auditors report with all supporting documentation
- Names of persons visually inspecting cable connections at Transformers and GMS, confirming methodology, labelling, locking, earthing.
- Report from electrical consultant, photos taken, Earth mat readings with witness signatures and dates of tests, Earth mat design and construction details, confirming CADWeld connections below ground and CADWeld or C Crimp connections above ground, as agreed with the Manager, Infrastructure Services.
- Witnessed (signed and name and position and company represented) impedance values to earth and then same for global earth connection to main bar
- Updated HV Schematic for approval
- Schematic of final LV connection including expected maximum load
- Certificate of testing and compliance from electrical installation contractor

25.1.3 Schematic Design (SD) Report / Design Review

Report Content in addition to requirements of Section 30:

- BCA/NCC Light Calculations Sheet
- Preliminary Findings from the Building Energy Model
- Equipment List with estimated sizes/specifications
- Concept cable and motor schedules
- Proposed cable and equipment numbering system
- Estimated services consumptions (maximum demand, etc.).
- Updated HV Protection Study

- Preliminary fire interface matrix and baseline data

25.1.4 Developed Design (DD) Report / Design Review

Report Content in addition to requirements of Section 30:

- Project specific building energy study derived from the Building Energy Model
- BCA/NCC Light Calculations Sheet
- Detail on maximum demand calculations including design calculations for all cables and equipment to verify sizing and showing design allowances and safety margin used
- Detail on switchboard sizes and location
- Detail on loads and consumptions to existing services, including preliminary assessment of effect on existing HV network including fault level and protection settings LV fault level, switchboard fault ratings and protection settings.
- Statement on how the existing services will be impacted by these additional loads and any specify any required upgrades
- Preliminary indication of changes to HV switching protocols
- Preliminary lighting and power design
- Preliminary single line diagrams
- Details of all connection points to existing site HV, LV, Telecommunications, Fire and Security Services etc.
- Details – Plans and Elevations of all in-building/cast in structure/concealed services layouts including floor plans
- Final fire interface matrix and baseline data.

The Developed Design JCU RPEQ Certification Schedule below shall be completed by the DD Design Engineer and submitted for confirmation.

Project Name		
Project Number		
Date		
Company		
RPEQ Design Engineer Name		
RPEQ Licence Number		
Building Area (GFA)	sqm	
Building Area (UFA)	sqm	
Calculated Maximum Demand	kW	
Transformer Size	kVA	
Length of HV cable installed	m	
Total number of Transformers	No. Off	
Total number of Ring Main Units (RMU)	No. Off	
Fault Level	kA	
Length of LV cable installed	m	
Electrical Services Estimated Capital Investment	$	
Any other plant and equipment requiring routine inspections	No. Off	
		Manager Infrastructure Services
Recommended change to protection settings	YES / NO	
Does the SD Report include Life Cycle Costing	YES / NO	

25.1.5 Construction Contract Document Requirements

In addition to requirements of Section 30, include an updated Certification Schedule as per 25.1.4 completed by the CD RPEQ Design Engineer.

25.1.6 Commissioning, Testing and Handover Requirements

The entire installation shall be thoroughly tested by an approved independent tester prior to being energised. These tests shall verify all functions and test that all protective devices are operating correctly. Testing shall include all mandatory tests as per Australian legislation, standards and codes.

Calibration and maintenance of all instruments shall be in accordance with NATA standard. Where required by the project or specification, instruments shall be NATA certified and calibrated.

All new installations shall be provided with independent testing and all test results will be submitted and included in the Operation & Maintenance Manuals.

All new work to comply with QLD Electrical Acts and Regulations.

The Design Consultant (RPEQ) as a minimum shall perform regular inspections during construction to perform the role of 'Certifying Consultant' to ensure that the Design is actually being installed and provide Certification (Form 16) that the works are as per the design.

After Commissioning and Testing, Provide Form 16 and any other certification required for the works,

including an electrical certificate of test for the electrical works completed. The certificate must certify the following:

- that the electrical installation, to the extent that it is affected by the work, has been tested to ensure it is electrically safe and is in accordance with the requirements of the wiring rules, contract documentation, and any other standard applying to the electrical installation under the Electrical Safety Act & Regulations 2002.

The certificate of test must include the following information:

- details of the person who performed the work,
- the extent of works (include drawing numbers and specification the electrical equipment tested),
- the date that the equipment was tested, and
- the contractor's licence number.

Provide an AS1670 Installers Statement for Fire Services

Following installation and commissioning, undertake a witness inspection of the operation. Ensure that the Consulting Engineer, Manager, Infrastructure Services (HV) and Manager, Asset Strategy and Maintenance (LV) or their nominated representatives are present.

Requirements for each test are included in relevant sections of this section.

As a minimum, prove to their satisfaction:

- Cabling rough in prior to sheeting
- Generator site load test
- Functional test of installed fire-fighting equipment

Provide as built fire interface matrix, baseline data and full fire panel database. In addition to the general requirements for record drawings the Fire Services As-Constructed Drawings are to show all zones, detector and manual call points locations with addresses, cable routes, interface matrix, baseline data and an electronic copy of the fire panel database.

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

25.1.7 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 electrical installations onsite are not repeated.

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

25.1.8 Disruption of Power

Any power outages or disruption to power supplies to accommodate the new installation shall be arranged with, and approved by, the Manager, Infrastructure Services. Where critical power supplies are disrupted, alternate power supplies e.g. generator, will have to be arranged by the project.

Minimum notice: 14 days

25.1.9 Solar Power

Consideration is to be given to the use of photovoltaic panels to generate solar power for use in new buildings.

This is to be on a project by project basis and for the approval of the Manager, Infrastructure Services, who will manage the required embedded generation enquiries and liaison with Ergon Energy Network.

25.1.10 Reuse of Existing Services or Equipment

There shall be no reuse of existing services or equipment unless prior approval is granted from the JCU Estate Directorate, Deputy Director, Planning and Development.

For refurbishment projects, reuse of existing services or equipment may be permitted however approval is to be sought from the JCU Estate Directorate, Deputy Director, Planning and Development.

25.1.11 Redundant Services

Where services or equipment or cabling is made redundant, they must be removed in their entirety and disposed of off-site.

25.1.12 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 (xxx) for Townsville, the Cairns building number is an integral part of the sequence.

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 “xxx-T-1” Townsville or “T-xxx-1” Cairns
- Chilled water leaving building temperature sensor “xxx-T-2” Townsville or “T-xxx-2” Cairns

25.2 High Voltage Electrical Equipment Requirements

25.2.1 HV Interfaces with Existing Infrastructure

JCU is the owner of the high voltage reticulation equipment and cables on both the Cairns and Townsville campuses. The high voltage (HV) supply is different at each campus: Townsville campus supply voltage is 11kV and the Cairns campus supply voltage is 22kV.

The design shall provide for the connection of the electrical services to the existing campus infrastructure and shall be determined in conjunction with the Manager, Infrastructure Services during the schematic design stage. All works are to be in accordance with the JCU HV Access and Operating procedures.

Note that JCU has Network Connection Agreements in place with Ergon Energy for both the Townsville and Cairns campuses the following information should be noted and/or utilised for any HV design works at either campus.

25.2.1.1 JCU Cairns

Feeders 1 and 2 connect to Ergon Energy 22kV Cook 3 Feeder (2CO3) (Interconnect Feeder between Kamerunga Zone Substation and Kerwarra Switching Station and can be supplied from either end).

Feeder 1 terminates at HV Hut 1 via underground connection from Macgregor Road

Feeder 2 terminates at HV Hut 2 via underground connection from Panguna Lane.

Upstream Protection

KAMERUNGA ZONE SUBSTATION

Overcurrent	300A SI TMS 0.5 INST 2400A
Earth Fault	102A SI TMS 0.65 INST 1650
Sensitive Earth Fault	15A 12 sec
Automatic Reclose	Enabled

KEWARRA SWITCHING STATION

Over Current	300A SI TMS 0.1 INST = OFF
Earth Fault	78A SI TMS 0.15 INST = OFF
Sensitive Earth Fault	2A 10 sec

Prospective Fault Level at HV Hut1 Feeder 1 and HV Hut 2 Feeder 2
3 Phase Fault – 5.8kA

Phase – Ground Fault 4.3kA

25.2.1.2 JCU Townsville

Ergon Energy 3 x 11kV Feeders – At Ergon Energy Peter Arlett Zone Substation - Feeder 1 JCU ABS25 U60, 11kV James Cook University Feeder 2 JCU ABS26 U54, and 11kV James Cook University Feeder 3 JCU GMS2.

All 3 Feeders have the same upstream protection settings

Overcurrent Setting:
300 Amp Trip
Standard Inverse Curve
0.25 Time Lever
Instantaneous Trip at 6 kA with 0.0 sec delay

Earth Fault Setting:
54 Amp Trip
Standard Inverse Curve
0.3 Time Lever
Instantaneous Trip at 3 kA with 0.0 sec delay

Sensitive Earth Fault Setting:
6 Amp Trip
5 sec delay on trip

Prospective Fault Level at JCU 11kV Feeder connection points:
3 Phase Fault – 16.27kA

Phase – Ground Fault 17.7kA

The services shall be installed in a defined services corridor and agreement be obtained from Manager, Infrastructure Services on proposed electrical services routes.

Under Section 153 of the Electrical Safety Regulation 2002, the Contractor must not connect or reconnect a high voltage electrical installation to a source of electricity, after electrical work has been performed on the installation, unless the electrical work has been inspected by an accredited auditor and found to be electrically safe and compliant with the Wiring Rules (AS/NZS 3000) and other relevant Australian standards, such as AS 2067.

The Contractor is to engage an independent accredited auditor to perform the auditor's role as required by the Electrical Safety Act and Regulations 2002.

All high voltage detailed design and installation works carried out by the Contractor shall be reviewed and checked by the accredited auditor.

25.2.2 HV Protection Study – RMU's and Transformers

Noting the campus fault levels above, a HV protection study is to be completed at early design stage to ensure correct earth mat design, appropriately chosen fault rated cable, step and touch potentials and the like. This study is to co-ordinate with and be of similar format for easy transfer into the existing site wide fault and protection study.

Note that the RMU and Substation earth mats are to comply stand alone and not rely on the Global earth to achieve compliance with AS2067.

Note: Earth Mat Design – parameters – Earth grids for JCU Townsville must be designed utilising CDEGS software provided by Safe Engineering Services & Technologies Ltd and form part of and be co-ordinated with the campus HV Protection Study. The actual design inputs for the grid are determined by its location. Protech Power International have completed extensive earth grid design works including HV Protection Study updates on the Townsville campus and should be considered for the design and documentation aspect of this work.

Note: Earth Mat Design – parameters – Earth grids for JCU Cairns must be designed utilising CDEGS software provided by Safe Engineering Services & Technologies Ltd (preferred) OR SKM Power Tools for Windows provided by SKM Systems Analysis, Inc. The earth grid design must form part of and be co-ordinated with the campus HV Protection Study. The actual design inputs for the grid are determined by its location. SEQUAL Consultants Cairns have completed an extensive design check of the JCU Cairns Campus HV Network and should be considered for the design and documentation aspect of this work.

25.2.3 Ring Main Units and Transformers (Substation)

New buildings projects are required to provide an HV Ring Main Unit (RMU) at the connection point to the existing network, a high voltage transformer to supply the low voltage infrastructure of the building, and any buried HV cable and earths. A report is to be submitted to the Manager, Infrastructure Services during SD, including recommendations based on the maximum demand calculations.

Note that transformers are not procured under the building contract - they are supplied separately through JCU. However the installation, connection to the high voltage system and provision of the required transformer capacity shall be included in the design, including associated impact studies.

Ensure that all RMU's, transformers and substations are connected to the global earth system.

Ground mount transformers are to be installed in a transformer room generally in accordance with the Ergon Energy installation manual(s). Noting that where transformers are provided within buildings also requires specialist design for matters pertaining to earthing, bonding, maximum EMF limits of 4mG etc.

Padmount transformers are to be generally installed in accordance with the Ergon Undergound Installation manual, where there is a conflict (such as JCU require all earth connections to be CADWeld type) the JCU Design Guidelines take precedence. Additionally for padmounted transformers and remote externall RMU's provide a paved area (ie 6m x 4m for the std rectangular padmount) utilising Besser "Interlock" pavers or approved equal secured via a concrete barrier kerb. Install this paver system over the earth mat high risk "step and touch" potential area – this is to be co-ordinated with the fault and protection study above.

IMPORTANT NOTE – the consultant is to confirm the extent of the existing Global Earth prior to design as the nearest Global Earth connection point may be remote from the project site.

All doors/panels that provide HV access, including substation doors and equipment panels will be clearly labelled with a sign, or signs, reading:

DANGER
High Voltage
Unauthorised Entry Prohibited

Low voltage doors will have similar signs prohibiting entry.

25.2.4 Underground HV Electrical Services

Underground sand filled "earth turning pits" shall be provided to allow for reticulation of underground conduits for the HV reticulation. Two spare conduits are to be provided to these pits for future use. Spare conduits are to be capped and be provided with nylon draw wires.

All HV cables are to be installed in 150mm HV Orange PVC Conduit.

All HV cables will have sheath protection, as per 25.2.7.

All underground HV services to be installed at a minimum depth of 1200mm cover and to have marker tape irrespective of final depth. Provide a polymeric HV cover over all HV conduits.

At least 2 spare conduits to be installed

Allowance to be made for minimum 2 x 100mm Dia White PVC Communications Conduits for IT&R fibre optic bundle to be installed in services trench

25.2.5 HV Earthing and Global Earth Connection

Provide dedicated earthing at each ring main unit and each transformer. Provide minimum of 4 earth rods, connected via conductor (120mm SQ Cu Bare Earth Cable) in ring configuration, with two connections between the earth grid and the RMU earth bar. Design the system and size the components in accordance with AS3000 and AS2067.

Provide an earthing bar in each RMU with each earthing cable terminated separately and individually labelled at the termination bar. Provide engraved traffolyte labels fixed with cable ties, to match the labelling system utilised at either campus.

All earthmats RMU and/or Transformer are to comply “stand alone” without a fault current split factor taken into account , the prospective fault level at the proposed location being agreed to first by the Manager Infrastructure Services. All earth grids require connection to the site wide/global earthing system. Two design reports are required for the same earthmat configuration ; 1) at the Prospective Fault Level without split factor and 2) at the Prospective Fault Level with the calculated split factor for the location.

Earth cable joins and earth cable to earthing rod connections shall be made utilising CADWeld joining kits only.

Both the Townsville and Cairns have a “Global” HV earthing system where all HV equipment is interconnected via bare earth conductor installed in every HV cabling trench. Connect the Global earth to the Earth Bar in the HV Equipment as a separate connection to allow for future earth mat testing. Refer 25.2.7 for size of “sitewide” Global Earth.

25.2.6 HV Switchgear

JCU has had a preference in the past for all new high voltage works to be provided in accordance with the current version of Ergon Energy’s External Sales Price Book. This enabled JCU to procure equipment locally from Ergon Energy for maintenance in an emergency situation or equipment failure. This clause applied when the equipment when the equipment in the above price book was largely static, however, the reality today is that the equipment can change with each issue of the price book which is unsatisfactory to JCU.

Generally all HV switchgear and transformers are to conform to the Australian Standards and to the Ergon Energy installation guidelines (refer to sections below where JCU guidelines differ from Ergon Energy guidelines). The equipment specified within the contract documentation is to comply with these requirements. If alternative equipment is proposed, a full technical submission complying with these requirements must be provided to the Manager, Infrastructure Services for approval.

The HV switchgear shall be of type tested, factory built, metal encapsulated SF_6 insulated, modular type. Modular assemblies of switchgear shall be expandable at each end. For side by side fitting of modules, each side of the SF_6 gas tank shall have inner cone plug in systems for the busbar connection. Provide blanking plates at each end to conceal busbar plug in points.

HV switchgear shall be provided with interlock facility (location specific) and earthing switch with spring operated ON and OFF.

All switches, circuit breakers and earth switches are to be able to be pad locked in the on and in the off position, provide a “DNOB” – Do Not Operate Board for each switch. Also provide at least one “N/O” – Normally Open Board.

25.2.6.1 JCU Cairns

The site HV switchgear shall be type: Ormazabal 24kV rated switchgear to match existing switchgear on site GAE Type Internal Switch-room – GAC Type External RMU or approved equal by Manager, Infrastructure Services.

25.2.6.2 JCU Townsville

The site HV switchgear shall be type: Ormazabal 12kV rated switchgear to match existing switchgear on site GAE Type Internal Switch-room – GAE Type External RMU or approved equal by Manager, Infrastructure Services.

25.2.6.3 RMU/Switchgear Construction

Switchgear to be housed in external RMU's shall have suitable dust and moisture ingress protection. For alternative equipment, provide a full technical submission to the Manager, Infrastructure Services for approval.

SF_6 insulation: The switchgear shall have hermetically sealed SF_6 pressurised containers. Provide gas leak indication. Ensure containers are fully charged with SF_6 to levels in accordance with the manufacturer's recommendations prior to energising.

HV compartment: All live parts, including busbars shall be included in a gas-tight welded stainless steel tank. The incoming and outgoing power feeders shall be led through cast resin bushings. Each HV compartment shall have a stainless steel bursting membrane.

Cable connection compartment: Front covers shall be interlocked against the corresponding earthing switch. The front cover can be opened only with the earthing switch switched on.

Pressure relief: The switchgear shall have "bottom open" arrangement to allow for pressure relief of hot gases in the event of an internal arc fault. The area of the floor opening shall be the same as the switchgear pressure relief opening to enable hot gases to be vented into the cable trench below.

Front panel: The switchgear shall have a front panel with: mimic diagram; switch position indication; operator surface for the actuators; capacitive voltage indicators; gas leakage indication; short circuit indicators; padlocking facility; drive sealed against dust, sand and insects; and min IP44 housing.

Earth connection: Provide a common earthing bar for the full width of each modular assembly. The earthing bar shall be connected to the equipotential earth.

Operation: The mechanisms shall be operated via the external drive shafts that are included in the mimic diagram on the front panel. They include operating lever, 1 x load break switch, and 1 x earthing switch.

Key interlocking Cairns: There are no "castell" or "fortress" or equal integrated key interlocking systems on the JCU owned and operated HV Cairns network. The "interlocking" is achieved via padlocks, network open points, DNOB's and procedures alone.

Key interlocking Townsville: A system of integrated key interlocking exists only at CDC HV switch-room only. For the remainder of the JCU owned and operated HV Townsville network the "interlocking" is achieved via padlocks, network open points, DNOB's and procedures alone.

Labelling: Provide labelling to the front of each switchgear item and to individual cable cores, including the cable description including feeder identification, size, conductor and insulation type, voltage, cable origin and length. The actual labels are campus specific to comply with the existing HV labelling system on site.

Provide engraved traffolyte labelling permanently fixed to the front panels or fixed to individual cable cores with cable ties.

Installation: Install all high voltage switchgear strictly in accordance with the manufacturer's recommendations. Ensure modular systems are accurately aligned.

Tools: Provide one set of required tools required for operation or maintenance of the switchgear prior to practical completion.

25.2.7 HV Cables

25.2.7.1 HV Underground Cables for Cairns 22kV

Ergon Stock Code 2429934 - 12.7/22kV, 3 x 1 Core Triplex, 185mm^2 Al, TR-XLPE Insulated 48/1.35mm Cu Wire Screen, Semi Conductive, Water Blocking Tape Polylaminate Al

25.2.7.2 HV Underground Cables for Townsville 11kV

6.35/11kV, 3 x 1 Core Triplex, 240mm^2 Al, TR-XLPE Insulated 48/1.35mm Cu Wire Screen, Water Blocking Tape Polylaminate Al, PVC/HDPE Sheathed, with Nylon Termite Barrier/Insect Screen.

IMPORTANT NOTES:
1) this cable is no longer stocked by Ergon Energy and
2) due to the JCU Townsville Calculated Fault Level, extreme care is to be taken during design phase to provide the correct cable specification and arrangement.

A suitable supplier for the above HV Cable for JCU Townsville is Prysmian Cables

Product Code – 14278365.01

Prysmian Group

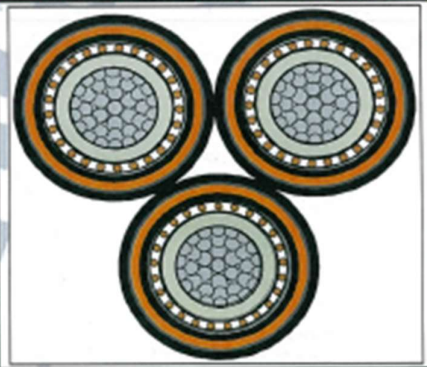
CABLE DESCRIPTION

6.35/11kV 3 x 1core 240mm² compacted aluminium conductor, Semi conductive XLPE conductor screen, Tree Retardant XLPE insulated, Semi conductive XLPE insulation Screen, plain annealed copper wire screen, semi-conductive water swellable taped, aluminium moisture barrier tape, MDPE Sheathed, PVC Inner Sheath, Nylon Jacket, HDPE Outer Sheathed, Lay up only. Triplex Cable.

STANDARD	AS/NZS 1429.1	PRODUCT CODE	14278365.01

PHYSICAL CHARACTERISTICS			
Conductor Diameter	Nominal	(mm)	18.1
Insulation Thickness (Nominal)		(mm)	3.4
Diameter Over Insulation	Nominal	(mm)	26.1
Diameter of Phase Cable	Nominal	(mm)	43.8
Overall Cable Diameter (Circumscribing Circle)	Nominal	(mm)	94.4
Cable Mass (Approx.)		(kg/km)	7930
Minimum Bending Radius	During Installation	(mm)	1885
	Installed	(mm)	1415
Max. Pulling Tension	Stocking (f)	(kN)	25
	Conductor (f)	(kN)	25

CROSS-SECTIONAL DRAWING (NTS) (g)



ELECTRICAL CHARACTERISTICS (a)

25.2.7.3 HV Underground global earth for both JCU Townsville and Cairns Campus'

Size: 120 mm^2 Cu Bare Earthing Conductor installed in location as per service trenching detail

25.2.8 HV Motors and other HV Equipment (Loads)

25.2.8.1 JCU Cairns

At 22kV supply, there are no existing HV Motors or other Loads operating at High Voltage at this campus.

25.2.8.2 JCU Townsville

There are 4 x HV (11kV) powered chillers installed and operational at the CDC operating at this campus.

Due to the highly specialised design nature of HV motors and loads should any project specific information need to be provided about any existing HV loads or JCU proposed HV loads these will be provided by the Manager, Infrastructure Services for approval.

25.3 Low Voltage Electrical Services

25.3.1 Maximum demand calculations

Maximum demand calculations shall be undertaken for all new buildings and submitted for design review at SD. Calculations shall be in accordance with Method A only, as prescribed in AS3000. This is important in determining the size of the transformer required.

25.3.2 LV Supply

All incoming mains or consumers mains shall be sized for the maximum demand plus 30%. Submains shall be generally be XLPE/PVC and installed from the LV point of supply - generally the substation fuses/CFS or isolator. All underground submains shall be nylon sheathed to protect against termite damage.

Each building shall be metered at the mains and separate meters shall be provided for mechanical services, lift services and hydraulic services. Meters shall be Circuitor CVM96-ITF-RS485-C2. Metering and supply equipment should have adequate capacity to allow a minimum 50% increase over initial load requirements for future expansion. All meters above must be linked to the University's EMS (Energy Monitoring System) refer separate section for details.

Additional meters are to be provided as per the requirements of the BCA/NCC Part J8 refer to MSB and DB sections

25.3.3 Main Switchboard

The Main Switchboard (MSB) shall be designed for ease of maintenance and future upgrades or modifications. MSB shall be construction of 2mm zinc anneal steel and be IP56 rated if located externally or IP54 for indoor use. MSBs in corrosive environments shall be constructed in marine grade stainless steel (316L) and be IP56 rated.

The (main) switch-room shall be designed to allow sufficient access and clearance for a safe working environment. There shall be a minimum of 1.2m clearance around a main switchboard unless located in a cupboard where the clearance will be 1.2m to the front of the MSB.

At least 30% spare space and capacity in the MSB and busbar shall be provided as a minimum. Spare spaces shall be distributed across each section of the MSB and each section shall contain at least two off spare spaces. Cubicles shall not exceed 900mm in width. No equipment is to be mounted less than 300mm above the floor. In addition to the JCU EMS metering requirements provide Circuitor CVM96-ITF-RS485-C2 meters to each individual bus section.

The switchboard shall be type tested to (a minimum of) Form 2 or Form 3B construction or as applicable not to be “bih” style. The MSB shall be floor mounted on a steel plinth below, free standing cubicle style construction with bottom entry and top or bottom exits (for external switchboards only

bottom entry is permitted). Fault levels shall be appropriate for each application and to suit the size proximity to of the point of supply (transformer). All sections on the MSB shall be modular type to allow ease of upgrade. Provision shall be made to extend the busbars in either direction. MSB's shall be provided with a hot dipped galvanised steel channel (min 75mm) for mounting.

Each cubicle shall have a hinged escutcheon secured via slotted quarter turn locks. Escutcheons shall be painted white and the external finish for the MSB shall be electric orange. Escutcheons are to be able to be opened without the necessity to turn off the associated switch(s) or circuit breaker(s) or in lieu the switches and circuit breakers are to be fitted with defeat mechanisms. Door handles shall flush swing chrome type and fitted with L&F 92268 locks.

No NEMA type tested switchboards are to be installed. Noting that careful fault current design will be required to be carried out to ensure that cascading breakers provide equal to "enhanced" selectivity.

The MSB shall be designed such that fitting a new circuit breaker or (switch fuse) should take less than 60 minutes.

Non-fading laminated prints of the 'As Constructed' line diagram schematic drawings of the main switchboard and the building electrical reticulation shall be installed on a wall within the Main Switchroom showing as a minimum all outgoing cables and the rating, model and manufacture of all switchgear installed in the switchboard.

Control sections shall be located within its own compartment with a separate escutcheon and door.

Thermo-scans shall be undertaken under load on all MSB's at completion and six months into the defects liability period.

25.3.4 Distribution Boards

Distribution boards shall be strategically located and consideration for factors such as voltage drop, fault loop impedance and flexibility.

Minimum Fault rating: 10kA

Maximum Current rating for the DB shall be 250A.

All lighting and power circuits are to be loaded to less than 75% of their rated capacity. All DBs shall be sized large enough to cater for all incoming submains and outgoing cables. Positioning of terminal blocks, contactors, time clocks and other accessories shall be done in a neat and tidy manner. A separate controls section that is segregated from the main section shall be provided. All cables supplying circuit breakers shall be via ducting complete with easily removable lids.

The minimum depth of DBs shall be 150mm and minimum clearance between circuit breakers and the edge of the DB shall be 115mm.

Distribution boards (DB) shall be custom made switchboards or panel boards based on Form 1 folded and welded construction and constructed of 1.6mm zinc anneal steel. DBs are to be IP54 rated and finished in electric orange. Escutcheons are to be hinged via lift off pintle hinges and fitted with slotted quarter turn locks. Escutcheons are to be able to be opened without the necessity to turn off the associated switch(s) or circuit breaker(s) or in lieu the switches and circuit breakers are to be fitted with defeat mechanisms.

Distribution boards are to be accessed via L&F 31R key blank 92268. Fault current limiting is to be provided for each circuit according to its rating. A full mounting chassis is to be provided for circuit breakers.

In addition to any JCU EMS requirements provide Circuitor CVM96-ITF-RS485-C2 meters to each separate bus section.

Main DBs shall have a minimum of 30% spare current carrying capacity and 30% spare pole space or min 15 spare poles/5 three phase spaces (whichever the greater) and floor DB's shall have a minimum of 30% spare current carrying capacity and 50% spare poles or a minimum of 15 spare poles (whichever the greater) for future expansions. Acceptable DB makes or manufacturers are NHP, Schneider-MG, Heinemann or Eaton Cutler-Hammer.

All subcircuits shall be installed with Residual Current Device (RCD) protection which includes all power subcircuits supplying socket outlets and lighting circuits, unless otherwise stated. Each circuit shall be individually protected. Where power outlets cannot be RCD protected they shall be prominently labelled 'OUTLET NOT RCD PROTECTED' and the circuit cabling labelled "NON RCD CAPABLE CIRCUIT" every metre along its length.

Separate dedicated circuits are to be provided for computers and server rooms. This power shall be filtered power.

Circuit schedule cards are to be provided in each DB – provide information as a minimum:

DB - Fault Rating, Fault Level (Without Upstream Cascade protection taken into account),
Submains, Size, Length of Run, Origin (where fed from), Upstream Protection (rating and settings to achieve "enhanced selectivity")
Final Subcircuits, Designation inc. Identifying Room Number, and general location in the space; ie. "Room 124 Power, Eastern Wall", Circuit Protection, Cable Size, Neutral Number, Earth Number.

Where electrical tee off boxes are used, they shall be accessible, painted electric orange and labelled on the front to indicate the switchboard served by the box and origin of supply. If a fused tee off box is used, then fuses shall be easily replaced without disrupting other circuits.

25.3.5 Surge Diverters

Surge diverters are to be provided on all MSBs and distribution boards. Surge diverters are to be inline type and based on MOV technology manufactured by Novaris or approved equal by Manager, Infrastructure Services, The I_n (Nominal) rating shall be used to size Surge Diverts not the I_{max} rating. Surge diverters shall be installed on the line side of incoming functional units and upstream of RCDs. A perspex panel shall be provided such that the indicators (showing device status and life) are visible from the external/through the escutcheon.

25.3.6 Switchgear

25.3.6.1 Circuit Breakers

Miniature circuit breakers (MCBs) shall comply to AS3111. All lighting and power subcircuits shall be RCD protected refer above.

Residual current devices (RCDs) shall be Type II with a maximum tripping current of 30mA complying with AS 61009.1 and AS 3190. Residual current devices shall be incorporated to provide earth leakage protection of nominated circuits and equipment for general use. The residual current protection shall be integral with MCBs. RCD/MCBs shall occupy the same number of pole spaces as per standard MCBs within an MCB chassis.

MCBs and RCDs shall be of NHP, Schneider-MG, Heinemann - CBI or Eaton Cutler-Hammer manufacture.

Duplex type circuit breakers shall not be used under any circumstance. Any existing duplex circuit breakers are to be replaced with any new works.

25.3.6.2 Contactors

Contactors shall comply with AS3947.4 and be of the compact, block type with auxiliary contacts as required by control circuitry. Contactors shall be rated for enclosed uninterrupted duty with a utilisation category of AC3.

Selection of contactors shall be such that co-ordination with protective devices is type 'C'.

Contactors shall have a mechanical life rated at a minimum of one million no-load operating cycles and an electrical life rated at a minimum of twenty percent of this value

Provide Man/Off/Auto switches on the escutcheon for all controlled circuits

25.3.7 Electrical Riser Cupboard

A dedicated electrical services riser shall be provided for the reticulation of electrical services throughout the building. The minimum size of the electrical riser shall be 1000mm x 500mm. Each electrical riser shall have lighting and a double 10A switched socket outlet per floor.

Ensure that the fire rating between floors is maintained and that all cable penetrations are fire-stopped in an approved manner - fire pillows are not acceptable.

25.3.8 Cable Supports

Any cable support systems eg conduits, trays, trunking, cable pits, ducting etc shall be provided with a minimum 50% space for future expansions. Cable supports in corrosive areas or areas with a high salt contamination in the atmosphere shall be manufactured of 316L stainless steel. Note all metallic cable supports are to be earthed.

All cable support systems are to be designed and co-ordinated between disciplines to ensure each discipline has adequate space to install and maintain their respective service and provide absolute minimum mandatory segregation requirements. It is expected that a minimum segregation of 300mm be used a starting point for example with common types of cables that require mandatory segregation distances – segregation is horizontal and vertical and at crossovers.

LV cabling and Fire Detector Cabling	300mm
LV cabling and Fire BOWS/EWS Cabling	300mm
LV Cabling and ELV cabling	300mm
LV cabling and Telecommunications cabling	300mm
LV cabling and Security cabling	300mm
LV cabling and BMS cabling	300mm
LV and other specialist cabling	300mm

Cable pits shall be polycrete and installed in 100mm steel reinforced concrete or cast in situ concrete type with galvanised steel lids. The pits shall be drained to the nearest stormwater connection – preferred, or to adjacent rubble drain – note that the top of the rubble drain cannot be higher than the base of the pit.

Colour coding for cable supports shall be:

Orange - electrical

White – comms

Red - fire

25.3.9 Underground LV Electrical Services

All underground electrical services shall be installed in conduit and in accordance with the requirements of AS3000 and shall be laid in sand with depth of (min) 75mm below and 150mm above and to sides (min 50mm sand between conduits side by side) and shall be identified by laying an approved continuous PVC marker tape 300mm min above the conduits.

At least two spare conduits are required with the design of the underground conduits/services.

Only selected backfill shall be used and shall be compacted in layers not exceeding 200mm to a density of 90%. The minimum cover shall be in accordance with AS3000 and in any case, not less than 600mm to top of conduit.

Minimum size of underground conduit shall be 32mm. Underground cable shall be double insulated cable, not less than 2.5mm^2. All underground submains shall have nylon sheaths to prevent termite damage. All spare ground conduits to be fitted with a nylon polypropylene cable as a draw wire.

Underground cable joints shall not be permitted.

Maximum distance between pits on underground cable runs shall be 60m.

All underground pits shall have their lids marked with a brass/aluminium/stainless steel plate indicating the service installed and the route from the pit, and shall be adequately drained. Brass marker plated shall be installed at kerbs and road crossing and any changes in direction. The lettering shall be minimum 15mm high engraved with black infill.

Joint services trenches can be considered if suitable for a particular application.

All buried cables will be armoured/have sheath protection

Allowance to be made for 2 x 100mm Dia White Communications Conduits for the installation IT&R fibre optic bundle/fibre tubes to be installed in services trench

25.3.10 Motors and VSDs

Refer to JCU Design Guidelines Section 20 for Mechanical Services for minimum requirements.

25.3.11 Wiring

25.3.11.1 General

Total voltage drop shall not be more than 5% if there is a transformer supplying the building.

Single insulated cables shall not be used unless approved by the Manager, Infrastructure Services. All cables shall be PVC/PVC, TPS or XLPE/PVC type and voltage drop shall not exceed 2% for final subcircuits.

Cabling serving each level of occupied space remains within that occupied space, i.e. power cabling is not to reticulate via the ceiling space below. Horizontal main runs of cabling shall generally be reticulated via accessible ceiling spaces on trays (when grouped), minor runs are to be via catenaries with vertical runs routed via wall cavities and discretely positioned vertical runs of perimeter cable duct.

Careful design co-ordination to ensure that subcircuit cabling is not run in the vicinity of extraneous conductive materials which cannot be effectively earthed such as conductive building papers – foil insulation. Where this applies the subcircuit cabling must be RCD protected and installed in PVC conduit.

Local distribution to SSOs (in low concentrations) shall be via wall and stud-partition cavities, and for heavier concentrations or where flexibility is required, via multi-compartment perimeter skirting duct.

PVC conduits to be provided in all blockwork walls and walls containing bulk insulation this aids in maintenance, building re-wiring and refurbishment works.

Cabling made redundant by a refurbishment must be removed in their entirety.

Cables must not be supported on the TBar ceiling grid, tiles or supports.

25.3.11.2 Power and lighting cables

Minimum subcircuit cabling shall not be less than 2.5mm^2 stranded copper conductors (PVC/PVC or TPS). Field control wiring shall be not less than 1.5mm^2 stranded copper. Control wiring within a switchboard can be 1.5mm^2 but once these cables leave the board they are to be 2.5mm^2 and leave via a terminal block. Loop in and loop out principles shall be used for subcircuit cabling.

25.3.11.3 Cable Entries

Entries to switchboards or equipment via gland plates or through panels shall be made using circular, orange-sheathed, cable and suitable compression glands. Double insulated flat cable may be used if entering through ducts or conduits. Non-metallic gland plates (type X bakelite) shall be used when the cable rating exceeds 125A.

25.3.11.4 Fault Loop Impedance – all circuits are to be designed with maximum circuit lengths to meet the Fault Loop Impedance requirements of AS3000 inherently first then with added protection of RCD's.

25.3.12 Generator Supply

Where required (by the RDS or project/design brief), an auto start emergency diesel generator with sufficient capacity to service items nominated in the brief is to be provided. The generator shall have sufficient capacity/fuel to run at full load for 36 hours as a minimum – refer project brief for the specific project requirements. Generators are to be sized for operation between a minimum of 60% and a maximum of 80% of design load. Additionally it is commonly expected for generator power to be provided for all fire safety equipment and services, Uninteruptible Power Supplies, Data Racks/Telecommunications equipment, BMS, 100% building lighting, lighting and power outlets in plantrooms, security panels, coldrooms, refrigerators and freezers in laboratories.

Generators shall be the encapsulated, weatherproof acoustic enclosure/canopy style with acoustic louvres (sound pressure level to be agreed at early design stage) with base mounted self bunded day fuel tank. Generally the units will be skid mounted and installed on a slab adjacent to the new buildings, while maintaining separation to allow free air flow and not be roofed.

Refer below for bulk fuel tank requirements.

The set shall start automatically and only connect to load after running up to speed and frequency. The load shall be connected automatically through the automatic transfer switch on the site main

switchboard. The generator set shall be capable of accepting full load within ten (10) seconds of receiving a start signal. The set is to also have a “Manual” mode.

The Generator shall have electronic controlled governing

Upon restoration of normal supply, the set shall have a predetermined shut down procedure.

For smaller sets/installations it is permissible for the Starting/Cranking batteries to also form part of the controls function.

Provide a separate float/trickle battery charger for all batteries (Starting/Cranking and Control System) to maintain battery life and state of charge – Battery Charger(s) to be connected to essential supply on a separate circuit from the site MSB.

The generator control panel shall be complete with all necessary controls for start-up and shutdown as well as monitoring and interface with logic controls on the Building main switchboard. The control systems and circuitry shall interface with the main switchboard manufacturer to ensure proper operation of the system.

Subject to specific project requirements acceptable manufacturers of generators that have proven after sales service and maintenance locally in the Cairns and Townsville Regions are :

Cummins South Pacific 39 - 53 Ron Boyle Cres Carole Park, Qld 4300 Australia Phone: 61 7 3710 4766 Mobile: 0408 280 074 Fax: 61 7 3375 3520 www.cummins.com	Penske Power Systems (MTU, Kohler) 196 Viking Drive, Wacol Queensland 4076 Phone: 61 7 3877 6060 Mobile: Fax: 61 7 3877 6092 www.mtudda.com.au	Caterpillar – Energy Power System 50 Arc Place, Larapinta (Brisbane), QLD, 4110. Phone: 61 7 3722 1425 Mobile: 0409 604 613 Fax: 61 7 3722 1495 www.energypower.com.au

The diesel generator shall be “prime” rated for tropical and humid conditions applicable to the location of the installation, minimum ambient rating is 50 degres Celcius. A load bank shall also be provided for the testing and on load tests of the generator (for new buildings). Minimum Site testing is: (note this is to be one continuous test)

100% of for 4 hours
110% for 1 hour
Stepped Cool-down for 1 hour as per manufacturers requirements

All relevant engine parameters to be monitored and recorded for the above test at 15 min intervals:

. Generator kW and kVAr output.
. Generator output voltage.
. Generator output current.
. Generator output frequency.
. Power factor.
. Oil pressure and water temperature.
. Electrical power requirements of continuously running electric motor driven ancillaries.

. Each battery charger current and voltage readings.
. Noise level.

DBs that are supplied with generator supply shall have 2 x chassis - normal and essential (generator) supply to allow for load shedding when the generator is operating.

The design utilising a system of “essential” and “non-essential” submains makes for easier regular generator testing utilising actual site load. This aspect is to be considered at the early design stage and report submitted to Manager, Infrastructure Services for consideration.

Generators also required for areas of critical research.

No single “split” chassis to be incorporated into the design

25.3.12.1 Bulk Fuel Tank

Where the project essential power demand exceeds the capacity of the day tank an above ground self bunded bulk fuel tank is to be provided. The bulk fuel tank is to have the following minimum requirements:

Comply to all relevant Australian Standards and EPA requirements
Be self bunded type minimum 110%
Concrete Plinth Mounted/Skid Type with a system of rag bolt cage mounted bollards
Have curved roof to prevent ponding of water
Tank to be supplied with in-built water drain off point
To have Interstitial space monitoring and venting
Mechanical overfill protection and overfill alarm
Suction Line to have Anti-Syphon Valve
Full undertank visibility to facilitate airflow an eliminate corrosion of the floor of the tank
Front Bunded Pump Bay with full frontal access – tank size permitting
WeatherProof Heavy Duty Roller Door – only applicable to tanks with a pump bay.
Be protected with a paint/coating system not inferior to Inorganic zinc silicate to AS/NZS 3750.15, followed by polyurethane to AS/NZS 3750.6.

Dipsticks: Form from brass section or anodised aluminium extrusion, with the bottom 100 mm coated with nylon or equivalent non-conducting coating. Stamp or engrave calibrations at intervals of not more than 5% of nominal tank capacity.

25.3.12.2 Fuel Distribution System

Provide a duty/standby fuel distribution from the bulk fuel storage tank to the base mounted day tank of the Generator. Provide manual bypass valves and a panel to control the pumps.

Type: Self priming positive displacement internal gear type pumps with mechanical seal and direct driven by totally enclosed motor.

Bypass: Provide an automatic built-in overpressure bypass with adjustable spring relief.

Mounting: Mount the motor and pump on a common base plate.

Material - Casing and rotor: Cast iron or cast steel.

Material - Shaft: Hardened steel.

Drip tray: Provide a 50 mm deep drip tray under each pump to be minimum 1.6 mm thick copper with brazed joints with rolled edges.

25.3.13 Uninterruptable Power Supply (UPS)

A UPS is to be provided where specified on room data sheets or brief. The battery cabinet will be housed in the same enclosure. A built in static bypass is to be provided. The UPS shall have a minimum backup of 30 min and shall be located in a dedicated UPS room where required by the BCA.

25.3.14 Power Factor Correction

A PFC cubicle is to be provided in accordance with the university's standard drawing which is connected at one end of the MSB. This PFC installation shall ensure a unity power factor applicable to the completed building.

25.3.15 Lightning and Surge Protection

Lightning protection shall be provided to buildings if recommended, using the risk assessment criteria as specified by AS1767. Undertake a lightning protection risk assessment as per AS1768 and submit the risk index and a recommendation on this – for approval, to the Manager, Infrastructure Services.

Lightning and transient protection in the form surge arrestors or similar shall be provided to all Electrical Switchboards, Fire indicator panels, Security panels and Telecommunications Equipment power supplies. Manufacturers for these products include Novaris and Erico.

Notwithstanding the above, it is a requirement for all buildings that all electrically conductive construction materials are electrically continuous and bonded to earth this includes; all structural steelwork such as Footings, Columns and Beams, re-bar, concrete wall or slab steel reinforcing mesh, metal roofing and the like.

25.3.16 Small Power

Generally, the number of SSOs shall be in accordance to room data sheets or brief.

All switched socket outlets (SSOs) shall be 230V type and be RCD protected. SSOs shall also generally be 10A unless otherwise noted in the room data sheets. SSOs shall be Clipsal C2025I system (or equivalent dual outlet as approved by the Manager, Asset Strategy and Maintenance) with an ID windows all other fittings. Typed circuit identification numbers must be located on each power outlet (Circuit number and distribution board origin eg DB2A-15) with matching number system at each sub-board. ID window labels shall be typed NOT hand written. Labelling of all outlets are also to be undertaken on the inside with an indelible pen.

Power outlet faceplates shall match the University's existing practice as follows:

- RED Generator
- GREEN Filtered Power (marked as computer only)
- BLACK UPS
- WHITE Normal Power
- BEIGE Cleaning power

A minimum allowance of 3 double SSO shall be provided for each office and workstation - 2 double SSOs below bench and 1 double SSO above bench. SSOs are to be flush mounted. Cleaning outlets shall be single 10A SSO and mounted at 300mm AFL. A cleaner's outlet shall be allocated every 20m.

Special purpose outlets shall be 'Clipsal IP56' or similar.

Special purpose outlets shall be 'Clipsal IP56' or similar.

Three-phase outlets shall be 'Clipsal' and shall have 5 round pins. These outlets shall be identified by means of circuit identification 'Brother P/Touch' labels or equivalent.

Suspended outlets – Suspended GPOs shall be 'Clipsal SS15' or approved equal complete with metal suspension chain supported via building structure

Power for Audio Visual Equipment - A separate power circuit must be provided for all audio visual equipment in all projects. Where possible projectors and audio visual equipment shall be on the same circuit.

'Softwiring' for power is permissible provided the quantities of outlets comply with the above criteria. Ducted skirting (min size 150x50mm 3 channel aluminium type with covers that positively clip in place - ECD or Moduline) at floor level shall be provided for all perimeter walls.

SSOs in the communications rooms shall be installed on separate surge protected and filtered power circuits.

Ensure that where there are conductive building materials in the vicinity of live parts that an earth tail from the socket outlet is connected to the adjacent conductive item – eg; metal stud. This is required in each case the situation occurs and studs cannot be grouped together under one single earth tail. Insulation shrouds fixed to the rear of the socket outlet are not permitted.

25.3.17 Emergency Lighting

Emergency and exit evacuation lighting shall be supplied and installed, conforming to AS2293.1 for computerised monitored type. The fittings shall be compatible with the existing manufacturer on campus which is Stanilite Nexus models.

In addition to being computer monitored and connected to the site-wide emergency lighting monitoring system, separate manual test facilities to be provided in each DB supplying circuits with emergency lighting connected.

Luminaires shall be self-contained, maintained or non-maintained fittings surface and recessed type. The installation shall be arranged in accordance with AS2293 with luminaires automatically connected to their emergency power source upon failure of the electrical supply to the normal lighting in the designated area.

In buildings supplied with essential power and subject to the Manager, Asset Strategy and Maintenance's approval the sensing for an emergency or emergency exit light may not actually be from the un- switched active of the adjacent light fitting if that luminaire is not connected to essential power. (this is to prevent the emergency or emergency light fitting running down on battery and not charging when the generator is running)

All emergency and exit lights shall be LED type.

On completion, provide certification of installation compliance with relevant codes (i.e. BCA/NCC and AS2293.1). As part of commissioning, contractors will be required to complete the Nexus electronic network records with all information. The "As Constructed" drawings, all individual light fitting addresses and locations as well as all router addresses and locations must be clearly shown. A completed log book (to AS2293-2/1995) will also be required on handover.

During the defects maintenance period, tests shall be recorded in a hard bound log book and handed over at the end of the maintenance period. Maintenance procedures including full discharge tests shall be carried out at six (6) monthly intervals to AS2293.2. Circuit breakers controlling emergency and exit lighting circuits shall be labelled: "WARNING - Interrupting supply will discharge emergency lighting batteries"

All batteries shall be high temperature Li-ON type.

ILON 600 communications interface devices shall be provided to connect to the campus data network as required along with any required power supply. Connect and commission the card(s) to the existing communications network and existing University exit/emergency light computer system. Wireless communicating models are not to be used at this time. In addition to AS requirements, provide an emergency light in each toilet area and conference room, except where two way glass is installed.

Stanilite (Thomas & Betts) should be engaged as the commissioning agents for each system installation and the commissioning report should be submitted as part of the Operation & Maintenance Manuals.

25.3.18 Lighting

25.3.18.1 General

Generally, only energy efficient lamps such as LEDs, shall be used for internal applications. LED lamps shall be used for external applications. Mercury vapour, Incandescent, Fluorescent, Metal Halide and HPS (SON) shall not be used.

Preference is to be given to luminaires manufactured from Australian made components where possible.

Glare and obtrusive lighting shall be minimised. LED lighting shall be used for all lighting applications within all buildings. All lighting shall be designed in accordance with AS1680 and the following lighting levels:

Offices:	320 lux
Labs:	400 lux
Seminar & teaching rooms:	320 lux
Drafting rooms:	550 lux

For all other areas the lighting criteria shall be to the recommendations of AS1680.

Where practical recessed troffers are to be used.

Indirect lighting is preferred where possible.

High Light Output Ratio (LOR) >= 87% single lamp luminaires generally shall be installed, however dual lamp luminaires may be where high ceilings occur or high lighting levels are required.

All light fittings are to be located / positioned to allow maintenance by a 3m step ladder max, EWP or scissor lift. Luminaires shall not be mounted above stairs and ramps or where access to the luminaires for maintenance cannot be achieved in a safe manner without the need for scaffolding. Where this is not practical then a maintenance strategy is to be provided by the electrical engineer or designer.

25.3.18.2 Standard Fittings

All fittings shall be provided with fused terminal block and electronic control gear.

LED luminaires shall be used in plantrooms and weatherproof LED luminaires shall be used in plant decks.

25.3.18.3 LED Lighting

LED lighting shall be used for the conservation of energy and architectural enhancement of areas. Where LEDs are used the following minimum requirements shall apply:

- Have specially designed heat dissipation to ensure the junction temperature of any LED does not exceed the manufacturer's recommended maximum operating temperature. Heat dissipation shall be designed for the installation conditions and wattage of the unit.
- Be purpose built LED fittings designed for use with an integral LED module unless a retrofit style lamp is specified
- Be photometered by a NATA approved laboratory as a complete luminaire including the driver and all attachments, at operating temperatures consistent with its intended installation with resultant photometric data available.
- LED modules shall be manufactured by a reputable manufacturer with proven experience in LED production such as Philips, Osram, CREE, Lumileds or Samsung

25.3.18.4 Task Lighting

Task lighting is to be used wherever high localised levels of illuminance are required. The background lighting shall provide ambience lighting and the task lighting shall provide the lighting levels over the working plane as per recommendations of AS1680.

Task lighting is to be on a separate circuit (from the background lighting) and provided with a master switch/ timeclock and override switch to control all task lights.

25.3.18.5 External Lighting

All external lighting including parking spaces, aisles, roadways and pathways shall be vandal proof, weatherproof, sealed against entry by insects and vermin, and to be designed to avoid damage and discoloration to the body, glass and lamp to comply with AS1158 Lighting for roads and public spaces. The actual category applicable is to be determined at early design stage with inclusion of the Manager, Infrastructure Services.

External lighting fittings shall use LED lamps. Lighting levels are to be designed and calculated for each individual application with the applicable design criteria.

Provide lighting to ensure full coverage of external landscaped and seating areas. Co-ordinate with Electrical Engineer to ensure minimum lighting levels achieved.

JCU has a preference not to use low height Bollard type luminaires refer "Lighting Poles" below.

The following are the University's standard fittings used externally.

- Roadway - Advance Lighting LEDway Type 3 in 80-120 led
- Pathway - Advance Lighting LEDway Type 2 in 20-30 led
- Carpark - Advance Lighting LEDway Type 3 or 4 in 40-120 led
- Carpark - Advance Lighting The Edge Area Round

25.3.18.6 Lighting Poles

Lighting poles shall be galvanised steel complete with rag bolt mounting. All poles shall have an inspection plate located 600mm above ground level. All wiring shall be loop in loop out of the base of the pole and all lighting poles shall have terminals and fuses/circuit breaker located in the base.

Where the design requires "tee offs" these are only permitted to be completed in small

above ground pillars not via underground cable pits and only to the permission of the Manager Infrastructure Services.

Generally, luminaire heights shall be 8m for car parks and roadways and 4.5m for walkways.

The final design of the pole and the footing arrangement shall be subject to site investigation and wind loading and engineering certification by a qualified geo-technical engineer is required.

25.3.18.7 Spares

Where non standard or unusual lamps are specified 10% of lamps as spares shall be specified.

25.3.18.8 Switching

Light switches shall be suitable for controlling indoor lighting and be rated at 15A (Fluorescent type switch mechanisms) Clipsal 2000 series outlets with ID (Circuit identification label) windows shall be used.

Circuit details shall be printed using Clipsal label software and be inserted in the ID window. In addition circuit details shall be written on the lighting plate, with permanent marker pen in a position where it is not visible when surround is replaced. As a minimum circuit details shall include distribution board reference, circuit number and circuit breaker number.

Switching shall be provided to control lighting fittings in rows running parallel to the windows. Each row of luminaires next to windows shall be separately switched. Additionally in teaching spaces the row of lighting fittings parallel to the white board or projection wall/screen shall also be independently switched.

All lighting switches shall be at centre line 1100mm above finished floor level.

Where four or less switches are grouped in the one location they shall be mounted behind the one face plate. Where more than four switches are grouped in the one location they shall be mounted behind a satin finished stainless steel face plate which shall be engraved to indicate the area controlled by each switch.

25.3.18.9 Wiring

Lighting circuits shall be wired in not less than 2.5mm^2 stranded copper cables. The circuits shall be designed to no more than 70% of capacity and shall be protected by 16A RCD circuit breaker. Also refer to “Fault Loop Impedance”.

Ensure that where there are conductive building materials in the vicinity of live parts that an earth tail from the light switch is connected to the adjacent conductive item – eg; metal stud. This is required in each case the situation occurs and studs cannot be grouped together under one single earth tail. Insulation shrouds fixed to the rear of the light switch are not permitted. Should there already be an earth tail to the same stud via a socket outlet then a second earth tail from the light switch is not required.

25.3.18.10 Design

Where false ceilings exist all luminaires shall be provided with a 3 pin plug and 1500mm of flexible lead. Connect luminaires to a lighting (socket) outlet securely fixed in the ceiling space (concrete ceiling, structural supports catenary wires and the like). Lighting Socket Outlets shall be clearly circuit numbered and marked with permanent marker the Sub Board No. and Circuit Breaker No.

Layout of luminaries should be preferably in rows parallel to the longest window wall and

should provide an even illuminance.

25.3.19 Lighting Controls - Generally

Lighting control systems shall be used to control lighting in all buildings.

JCU has a preference that Clipsal C-Bus lighting control systems shall be used where ever possible and be connected to the University C-Bus network. This will enable monitoring and control by JCU management/JCU Estate Directorate. A Network Interface shall be used to separate the building networks from the Campus Network.

25.3.19.1 General Areas

One light fitting outside lifts and escape stairs shall be on '24 hours' for security. Light fittings in stairwells shall be on 24 hours. The 24 hour lights shall be LED only.

Plantrooms shall utilise PIR occupancy / motion sensor with manual switch override to control the luminaires.

25.3.19.2 Offices/Corridors/Store rooms

The lighting will be switched on via a wall switch that will activate the luminaires and the PIR occupancy sensors if applicable to the project.

25.3.19.3 Seminars and Teaching Rooms

Multiple circuit 4 programmable scene setting control panels to control the lighting environment. The control panels shall be C-Bus. The control system shall provide single or combination control of rooms with removable / sliding partitions.

Panels shall incorporate 6 buttons i.e. OFF, 25% on, 50% on 100% on , raise and lower controls. The dimming control panel shall have an interface for connection to an AV system

25.3.19.4 Auditorium Lighting

Lighting within the Auditorium will be controlled via a dimming control panels utilising a C-Bus network that will have an interface to the AV system AMX.

25.3.19.5 Motion Sensors

Lighting control motion sensors shall be equal to BEG PIR detection type and programmed to 30 min before switching off. The detectors shall be capable of detecting finger movement within the space installed.

Connection to the BMS shall be considered to allow for the control of the air conditioning.

A one off remote control IR-PD devices is to be provided for remote setting of detectors. This is to be passed to JCU Project Manager when commissioning is complete.

The contractor shall demonstrate the correct operation of the system for JCU Manager, Asset Strategy and Maintenance approval.

25.3.19.6 External Lighting

External lighting shall be controlled via photocell with digital timeclock and have manual override controls and to be connected to the campus wide C-BUS or BMS lighting control.

The installation of C-bus systems on Campus must comply with the Clipsal Integrated Systems (CIS) Approved Installer Program. A copy of all relevant programming documentation, software files, drawings and wiring diagrams must be supplied to the Estate Directorate together with the CIS Approved Site Status registered Certificate. A copy

of the data files MUST be supplied upon hand over of the site.

25.3.20 Lecture Theatre Lighting

Designers shall discuss requirements with JCU's Video-Conferencing and Audio Visual Services (VAVS) team and read the requirements in Section 27 of these Design Guidelines .

25.3.21 Laboratories – Specific Occupancy Requirements

25.3.21.1 General

Dedicated lab panels or lab switchboards shall be located on each laboratory, complete with local emergency shutdown facility. The switchboard shall be used only for the supply of power subcircuits within the lab.

Power to lab areas shall be controlled by an emergency shut-off system. The shut down button shall isolate all reticulated services including power and gasses only. Power shut off shall not affect the operation of fume cupboards or bio-safety cabinets.

All exit points from the laboratory area shall have an emergency shutdown button. This shall be a red mushroom head button mounted on a stainless steel panel engraved with the list of services shutdown, the reset procedure and a map of the area to be shut down. The power shut off button shall be shrouded to prevent accidental operation. Operation of an emergency shutdown push button shall require manual resetting of both the electricity and gas and associated services. Gas services shall not be automatically reconnected in the event of a temporary loss of electrical supply due to a black out etc.

25.3.21.2 PC3 Laboratory

An electronic access control system shall be used to control the access into the facility. Airlock doors shall be interlocked. A communication system and a backup system shall be provided inside the facility.

The electrical services i.e. luminaires, services trunking shall be constructed to enable decontamination to occur easily and quickly, including fumigation of all spaces in the facility.

Where SSOs are required as part of the fumigation process these should be controlled by remote switches. If a dedicated building management system (BMS) control panel is employed to manage the fumigation zones then the fumigation power outlets shall be controlled by the BMS.

All cable penetrations into the PC3 facility are to be sealed to prevent the ingress of air and water. The penetration shall be tested during commissioning of the facility and any defects shall be rectified.

All contact points between services and surfaces shall be sealed to prevent dust traps.

Emergency stop buttons shall be used as Services Isolation Points to isolate all reticulated services into the facility except supplies to lighting, fridges, freezers, fume cupboards and bio-safety cabinets where isolation of these services could lead to further risks.

Specific services shall be provided to suit the use of the facility. This shall comply with AS/NZS 2243.

25.3.22 Videoconferencing Facilities

Details are provided in Section 27 and Section 36 of these guidelines.

25.4 Electronic Fire Services – Dry Fire

Buildings that have a client requirement for or are deemed (as in Deemed to Satisfy BCA/NCC) to require the installation of an automatic smoke detection system. The entire system is to be provided in accordance to the BCA/NCC and AS 1670 and shall be an electronic analogue addressable automatic fire detection system comprising of Building Fire Indicator Panel (FIP), Sub FIP's (project specific), detectors, manual call points and building occupant warning system / EWS / BOWS as required.

The Building FIP shall be in a protected location, preferably inside the building close to the main entry - preferred. If located externally, the FIP shall be housed in an IP65 cabinet and located out of direct sunlight.

To be compatible with the JCU Fire System - The FIP shall be a Notifier 3030 series panel with 16AT annunciation device.

For the Townsville campus, the system shall connect to the campus main fire indicator panel located in Building 003 (until relocation – confirm requirement with the JCU Project Manager) via a Fibre Optic network card installed in the new building FIP and dedicated Fire Rated Fire Fibre (min 8 core Single Mode) installed in ICT Infrastructure Conduits(as determined by project design) – there are to be two, fire rated, underground, dedicated runs of fibre from two different locations (for redundancy in the event one fibre path is damaged) as per the Design Guidelines for ICT.

For Townsville campus buildings connected to the existing campus (main) fire alarm panel the system shall automatically indicate an alarm to the local fire authority upon detection of a fire by a thermal or smoke detector or any other fire detection device or manually operated alarm. Ensure that connection to, programming and labelling of the main fire panel is included in the design.

On the Cairns campus, new buildings will be connected to an existing ASE or will require the installation of an new ASE which will automatically indicate an alarm to the local fire authority upon detection of a fire by a thermal or smoke detector or any other fire detection device or manually operated alarm. For connection to an existing ASE, allowance must be made to connect to an adjacent building. Ensure that connection to, programming and labelling of the ASE is included in the design.

The new building FIP shall incorporate all alarm zone facilities, ancillary control facilities, master alarm facilities, auto testing facilities, and indicators and isolators grouped in logical order. Clearly labelled manually operated switches to isolate door holders, bells and relays (for maintenance), air-conditioning shutdown, and the paging evacuation system are to be included. Allow for 30% spare capacity for future expansions. All panel keys are to be to the standard pattern 003 key already in use at the University.

Zone diagrams shall be colour coded, plastic, back engraved and show all relevant information and update existing diagrams when alterations take place. These diagrams shall be provided as a practical completion requirement.

In addition to the general requirements for record drawings the Fire Services As-Constructed Drawings are to show all zones, detector and manual call points locations with addresses, cable routes, interface matrix, baseline data and an electronic copy of the fire panel database.

All detectors shall be fit for purpose and types to be in accordance to AS1670. Detectors shall be fully addressable and be compatible for use with the Notifier FIP. Locate all detectors in accordance to AS1670. Remote detectors shall be provided with mounting bracket to allow for ease of testing and maintenance. Thermals shall be provided in showers and kitchens to minimise false alarms. In accommodation buildings, multi-criteria detectors shall be used. Thermal detectors shall also be used

in external areas and public access areas around buildings. Thermal detectors are preferred over smoke detectors for use in concealed spaces such as ceiling and roof spaces.

Provide Duct Probe Detectors for all dedicated Return Air Ducts.

Any structure or building used for student accommodation shall be provided with fire services complying with the requirements of a Class 3 structure or building, regardless of the building classification. The installation must pass the QFES “Pragmatic cooking” test.

The BOWS/EWS system shall be Notifier and integrated with the FIP. Speakers shall be 100mm diameter recessed type where installed in accessible ceilings or surface mounted type where installed on concrete soffits. Horn speakers are to be used in plantrooms and other services equipment rooms. The amplifier shall be sized to suit all devices.

Ensure that adequate inspections are planned at cabling rough in and after installation that the QFES inspection is arranged for acceptance.

25.5 EMS – Energy Monitoring System

An EMS is to be provided for all new buildings, additional to mains supply. All energy used for cooling is to be metered, and connected to the University’s site-wide EMS.

The following equipment is to be provided where there is no chilled water connection to the Campus District Cooling (CDC) system:

- Power Quality: 1x Schneider ION9000 power quality analyser (supplied with JCU template by Hexeis)
- Mains: 1x Circutor CVM-C10-ITF-485-ICT2 (M55911), (where utility metering (revenue) is required specify Schneider iEM3255-NMI)
- MSSB: 1x Circutor CVM-C10-ITF-485-ICT2 (M55911)
- 1x Backup generator meter, Circutor CVM-B100 (M56011) plus M-CVM-B-DATALOGGER (M56E06),
- 0.5% accuracy C/T’s and potential take offs wired to terminals in close proximity to all meters
    - 1x Circutor LM25-M (M31567) or LM4I-4O-M (M31563) DI Controller, the model depending on required number of DI inputs
- 1x Moxa Mgate MB3180 Gateway connected to meters via RS485 and to JCU network via data point
- 1x GPO per gateway
- 1x Network data point per Gateway

Preferably meters should be mounted in their own cubicle, but in any case must be accessible without isolating the main switch

All wiring to devices connected to the RS-485 bus (meters, gateway, DI Controller etc. should be screened instrument cable, Electra EAS730 or equivalent. EMS meters must be accessible without the need to isolate the power supply, they shall be mounted in their own cubicle/enclosure but are to be accessible without isolating the main switch. See attached schematic for the wiring details and interfacing to BMS and UC50.

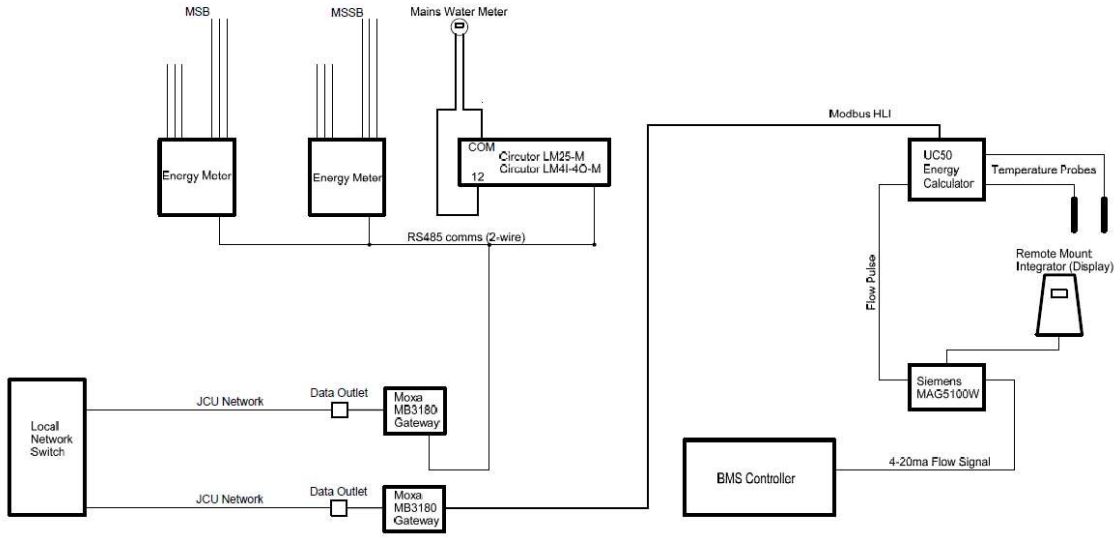
All buildings shall have the mains water meter fitted with a pulse output and wired into channel 12 of the LM-25 pulse input Controller, or channel 1 if LM-4

Where a connection to the Campus District Cooling (CDC) system will be made, in addition to the

above requirements, provide the following to measure the amount of energy the building/facility has used from the chilled water supply:

- 1x Siemens MAG 5000/5100W Magflow plus accessories (1x Magflo Integrator 24VAC 100623899, 1x Remote Mount Kit 100623900, 1x Electrode Cable)
- 1x Siemens UC50 Energy Calculator (wired to additional Moxa gateway via Modbus HLI), Sensors (10M) and Pockets
- 1x additional Moxa Mgate MB3180 Gateway connected to the UC50 via RS485 and to JCU network via data point.

All field wiring is to be terminated in terminals in close proximity to the mains meter including the digital input from Energy Meter (UC50).



Water Meter

- All buildings shall have the mains water meter (Prefer Elster with electronic reed switch) and wired into Circutor LM25-M (M31567) or LM4I-4O-M (M31563) DI Controller