ELECTRICAL ENGINEERING

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

DESIGN STANDARDS

Document Register

Issue	Date	Description	Initials
Revision 1	18/10/2021	Project Use	P Saal (Aurecon)

Contents

Disclaimer

Refer to the Disclaimer within the UQ Design Standards.

Reference Documents

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

The designer is to coordinate between disciplines and standards.

01 Introduction

1.1 Introduction

1.1.1 Context

The University of Queensland (UQ) positively influences society by engaging in the pursuit of excellence through the creation, preservation, transfer and application of knowledge. UQ helps shape the future by bringing together and developing leaders in their fields to inspire the next generation and to advance ideas that benefit the world. UQ strives for the personal and professional success of its students, staff and alumni.

UQ operates over 1,670 hectares of real estate across three major campuses at St Lucia, Gatton and Herston; and other sites including research stations, centres of excellence, clinical units and satellite sites such as UQ Brisbane City and Customs House.

UQ's Property and Facilities (P&F) Division manages projects and initiatives across UQ's real estate portfolio that enhance and enrich the experience of UQ sites for students, staff and visitors.

1.1.2 Purpose

This Design Standard forms part of the University of Queensland's suite of Engineering Design Standards.

The purpose of this Design Standard is to define the University of Queensland's specific requirements for the design of electrical systems; and to assist designers, contractor and other professionals involved in the preparation of designs commissioned by UQ to understand the University context.

The purpose of this Design Standard is not to detract from designers' obligations to undertake stakeholder engagement to develop design briefs; follow good design practice; and produce designs that address project specific considerations.

The purpose of this Design Standard is not to detract from designers' obligations to seek endorsement of their design from UQ.

The purpose of this Design Standard is not to repeat the requirements of relevant legislation, regulations, codes and standards. Designers shall produce designs in accordance with the requirements of relevant references irrespective of the requirements of this Design Standard.

Where certain requirements are not addressed by this Design Standard, relevant industry-based design and construction standards should be adopted in consultation and agreement with UQ.

This document must be read and implemented in conjunction with project-specific documentation.

1.1.3 Departures

Departures from these guidelines shall be requested by designers in writing to the Contract Administrator. Departures must be approved in writing prior to being incorporated into project designs.

1.1.4 Contractors and consultants

Contractors shall read and comply with the requirements outlined in on the UQ Properties and Facilities Building Contractors and Consultants website, as follows:

https://coo.uq.edu.au/operational-areas/property-and-facilities/pf-staff-and-contractors/building-contractors-and-consultants

1.2 Objectives

The Electrical Design Standard sets out the University's requirements for the design, installation and testing for all Electrical services infrastructure across the University Campuses. The Design Standard shall assist designers, contractors and other professionals involved in the preparation of designs commissioned by UQ to understand the University context.

02 Abbreviations & definitions

For the purpose of interpreting this Design Standard, the abbreviations listed in Table 2–1 apply.

Table 2–1 Abbreviations

Abbreviation	Definition
AC	Alternating Current
ACB	Air Circuit Breaker
AS	Australian Standard
AS/NZS	Australian Standard / New Zealand Standard
BCA	Building Code of Australia, incorporating National Construction Code Series Volume 1: Building Code of Australia Class 2 to 9 Buildings; and Volume 2: Building Code of Australia Class 1 and Class 10 Buildings
BIPV	Building Integrated Photovoltaic
BMS	Building Management System
CAC	Connection Asset Customers (Tariff Class)
CCT	Correlated Colour Temperature
CEC	Clean Energy Council
CRI	Colour Rendering Index
CT	Current Transformer
DB	Distribution Board
DC	Direct Current
DPPC	Designated Pricing Proposal Charges
DRE	Demand Response Engine
DUOS	Distribution Use of System (DUOS) charges
EESS	Electrical Equipment Safety Scheme
ELV	Extra Low Voltage
EMC	Electromagnetic Compatibility
EMF	Electromagnetic Frequency
EMI	Electromagnetic Interference
EMS	Energy Management System
EN	European Norm (European Standard)

Abbreviation	Definition
ERAC	Electrical Regulatory Authorities Council
ESO	Electrical Safety Office (Queensland)
FF&E	Furniture, Fixtures (or Fittings) and Equipment
HRC	High Rupturing Capacity
HV	High Voltage
IP	Ingress Protection
LED	Light Emitting Diode
LSZH	Low Smoke Zero Halogen
LV	Low Voltage
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
MEN	Multiple Earthed Neutral (Earthing System)
MEPS	Minimum Energy Performance Standard
MOV	Metal Oxide Varistor
MSB	Main Switchboard
N/C	Normally Closed
N/O	Normally Open
NATA	National Association of Testing Authorities
NCC	National Construction Code
P&F	Property and Facilities (Division)
PLC	Programmable Logic Controller
PV	Photovoltaic
PVC	Polyvinyl Chloride
RCBO	Residual Current Breaker with Overload
RCCB	Residual Current Circuit Breaker
RCD	Residual Current Device
RCM	Regulatory Compliance Mark
REC	Renewable Energy Certificate, incorporating Small-scale Technology Certificates (STCs) and Large-scale Generation Certificates (LGCs)
RPEQ	Registered Professional Engineer of Queensland
SCADA	Supervisory Control and Data Acquisition (Control System)
SF6	Sulphur Hexafluoride (Gas)
SPD	Surge Protection Device
SSO	Switched Socket Outlet
STC	Small-scale Technology Certificate
TUOS	Transmission Use of System (TUOS) charges Now referred to as ‘Designated Pricing Proposal Charges’, refer ‘DPPC’
UPS	Uninterruptible Power Supply
UQ	The University of Queensland

Abbreviation	Definition
VOC	Volatile Organic Compound
WHS	Work Health and Safety

For the purpose of interpreting this Design Standard, the definitions listed in Table 2–2 apply.

Table 2–2 Definitions

Term	Definition
Access for Maintenance	Access required for safe maintenance, inspection, measurement, operation, adjustment, repair, replacement and other maintenance related tasks.
Accredited Testing Laboratory	➢ An organisation accredited by the National Association of Testing Authorities (NATA) to test in the relevant field; or ➢ An organisation outside of Australia accredited to undertake relevant tests by an authority recognised by NATA through a mutual recognition agreement; or ➢ An organisation recognised as an Accredited Testing Laboratory under legislation at the time that the test was undertaken
Consumer Mains	Those conductors between the point of supply and the main switchboard.
Contract Administrator	The University of Queensland's authorised representative for contractual matters, which may be a member of University staff, or a third-party representative appointed by the University.
Critical Electrical Supply	An electrical supply which is backed up by an alternative electrical supply from an Uninterruptible Power Supply. A Critical Electrical Supply may also be an Essential Electrical Supply.
Critical Service	A service requiring a Critical Electrical Supply. A Critical Service may also be an Essential Service. NB: This term has no bearing on the distinction between a General Service and a Safety Service.
Damp Conditions	Conditions as defined in Section 6 of AS/NZS 3000.
Design Life	The period during which a building component is expected by its designers to operate within its specified parameters, with only anticipated maintenance being carried out, and without the need for major repair or replacement.
Designer	Any person commissioned directly or indirectly by the University of Queensland to undertake design activities. Designers are the intended audience for this document.
Distribution Boards	Any low voltage switchboard other than the main switchboard.
Distribution Substation	A substation that receives a 11,000 Volt supply from a zone substation and transforms it to a voltage level suitable for commercial and household use.
Economic Life	The period during which a building component is the lowest cost alternative for satisfying its function, with only anticipated maintenance being carried out, and without the need for major repair or replacement.
Energex	The electrical Utility Authority / distributor in the majority of projects relating to UQ. For the purposes of this Design Standard, 'Energex' shall be synonymous with 'Energy Queensland'.
Essential Electrical Supply	An electrical supply which is backed up by an alternative electrical supply from an electricity generator or secondary low voltage distribution location (eg secondary main switchboard).

Term	Definition
Essential Service	A service requiring an Essential Electrical Supply. NB: This term has no bearing on the distinction between a General Service and a Safety Service.
Fire Safety and Rescue Authority	An operational entity in government, established for the purposes of providing fire, rescue and emergency services.
Floor Area	Measurement as defined in Volume 1 of the National Construction Code.
Full-sized Neutral Conductor	The neutral conductor of single-phase or multiphase circuits with a current-carrying capacity of not less than the current-carrying capacity of the largest associated active conductor.
Furnish	See 'Supply'.
General Service	A service which is not defined as a Safety Service.
High-level Interface	Transfer of complex information in a digital format using an open system protocol.
Hold Point	A point in time during the design period where design activities are paused, primarily allowing the Contract Administrator to conduct reviews with the client and other stakeholders; to provide feedback on the design; and to provide a direction for the design to proceed.
Ingress Protection	A rating describing the degree of protection provided by enclosures as defined in AS 60529.
Local (Government) Authority	An administrative entity in local government, established for the purposes of governing an area of the State or Territory.
Low-level Interface	Transfer of binary-type information via terminals and voltage-free contacts.
Main Contractor	See 'Principal Contractor'.
Main Switchboard	The first low voltage switchboard installed downstream of a distribution transformer.
Managing Contractor	See 'Principal Contractor'.
Manufacturer's Recommendations	Recommendations, instructions, specifications and similar expressions provided in written or other form by an equipment manufacturer and/or supplier, relating to the suitability, use, installation, storage, maintenance and/or handling of a product.
Network Coupling Point	The point at which the electrical supply for a new development is coupled with the existing electrical network, whether that be private or owned by the Utility Authority.
Non-essential Electrical Supply	An electrical supply which is not backed up by an alternative electrical supply.
Non-essential Service	A service requiring a Non-essential Electrical Supply.
Principal Contractor	The primary construction contractor who maintains overall control of a construction site, and who is usually required to engage specialist trade contractors to complete the construction works. For the purposes of this Design Standard, the term 'Principal Contractor' has the same meaning as 'Main Contractor' or 'Managing Contractor'.
Professional Engineer	A Registered Professional Engineer of Queensland (RPEQ).
Proprietary	Something that is used, produced, provided, installed, commissioned or marketed under exclusive legal right of the inventor, designer, owner, manufacturer or supplier.
Protective Device	A circuit breaker, fuse or other device intended to autonomously create a break in a circuit in response to certain electrical conditions.

Term	Definition
Prototype	A full-sized or scaled mock-up of components or systems to demonstrate or test construction methods, junctions and finishes, used to define or prove a minimum level of quality.
Referenced Documents	Documents referenced by this Design Standard in Section 03.
Renewable Energy Certificate	A form of renewable energy currency initiated by the Renewable Energy (Electricity) Act (Commonwealth), Renewable Energy Certificate, incorporating Small-scale Technology Certificates (STCs) and Large-scale Generation Certificates (LGCs).
Safety Report	A report satisfying the requirements of Section 295 of the Work Health and Safety Regulation (Queensland).
Safety Service	A service as defined in Section 7 of AS/NZS 3000.
Sample	A physical example of a component or system used to define or prove a minimum level of quality.
Statutory Authority	A public sector entity established under legislation, that is, a specific law of the Commonwealth, State, Territory or Local Government.
Supply	‘Supply’ shall mean to supply only.
Supply and Install	‘Supply and Install’ shall mean to supply, install, set to work, test, commission and warrant.
Supply Authority	See ‘Utility Authority’.
Trade Contractor	A secondary building contractor, usually engaged by the Principal Contractor to undertake a specialist portion of the construction works.
Utility Authority	An operational entity, usually in government, established for the purposes of governing supply of various services.
Zone Substation	A substation that receives electricity through powerlines or underground power cables from bulk supply substations and transforms it to 11,000 Volts for distribution along powerlines or underground cables to distribution substations.

03 Reference documents

3.1 UQ reference documents

This Design Standard shall be read in conjunction with relevant UQ reference documents, including but not limited to those listed in Table 3–1. The designer shall the source of the version of the reference document applicable to their design.

Table 3–1 UQ reference documents

Title / description
UQ Design Guidelines
Campuses on Country Design Framework
Sustainability Strategy
Space Planning Documents
Architecture Design Standard
FF&E Standard Documents
Landscape Design Standard
Structural Design Standard
Civil Design Standard
Hydraulic and Wet Fire Design Standard
Mechanical Design Standard
Electrical Design Standard
Dry Fire Design Standard
Fire Engineering Design Standard
Veridical Transportation Design Standard
Acoustic Design Standard
Security Standards Document
Information and Communications Technology Design Standards Documents
Wayfinding and Signage Design Standard
Teaching Standards Documents

3.2 Legislation, regulations, codes and standards

This design standard shall be read in conjunction with relevant legislation, regulations, codes and standards, including but not limited those listed in Table 3–2. The designer shall source the version of the reference document applicable to their design.

Table 3–2 Legislation, regulations, codes and standards

Reference	Title / description
Building Act (Queensland) and associated regulations	*An Act to regulate building development approvals, building work, building classification, building certifiers and pool safety inspectors, and to provide for particular matters about swimming pool safety and sustainable buildings, and for other purposes*
Work Health and Safety Act (Queensland) and associated regulations and explanatory notes	*An Act to provide comprehensively for work health and safety, to provide for a new definition of asbestos in particular legislation and for a work health and safety levy, to amend other legislation as a consequence, and to amend the Workers' Compensation and Rehabilitation Act 2003 for particular purposes*
Professional Engineers Act (Queensland) and associated regulations and explanatory notes	*An Act to provide for the registration of professional engineers, and for other purposes*
Electricity Act (Queensland) and associated regulations and explanatory notes	*An Act about the electricity industry and use of electricity, and for related purposes*
Electrical Safety Act (Queensland) and associated regulations, codes of practice notices and explanatory notes	*An Act about electrical safety, and for other purposes*
National Construction Code	*Incorporating National Construction Code Series Volume 1: Building Code of Australia Class 2 to 9 Buildings; Volume 2: Building Code of Australia Class 1 and Class 10 Buildings; and Volume 3: Plumbing Code of Australia*
Fire Safety and Rescue Authority Requirements	*Incorporating technical standards, guidelines and requirements published by the Fire Safety and Rescue Authority, as applicable to the project*
Local Authority Requirements	*Incorporating technical standards, guidelines and requirements published by the Local Authority, as applicable to the project*
Supply Authority Requirements	*Incorporating technical standards, guidelines and requirements published by the Supply Authority as applicable to the project*
-	NABERS, The Rules, Metering and Consumption
ANSI/IES LM-79	Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products
ANSI/IES LM-80	Approved Method: Measuring Luminous Flux and Colour Maintenance of LED Packages, Arrays, and Modules
IES LM-84	Approved Method: Measuring Luminous Flux and Colour Maintenance of LED Lamps, Light Engines and Luminaires
ANSI/IES LM-63	Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information
ANSI/IES TM-21	Technical Memorandum: Projecting Long Term Lumen, Photon and Radiant Flux Maintenance of LED Light Sources
ANSI/IES TM-30	Technical Memorandum: IES Method for Evaluating Light Source Colour Rendition

Reference	Title / description
AS 1158.3.1	Lighting for roads and public spaces Part 3.1 Pedestrian area (Category P) lighting – Performance and design requirements
AS 1170.4	Structural design actions Part 4: Earthquake actions in Australia
AS 1307.2	Surge arrestors – Metal-oxide surge arrestors without gaps for a.c. systems
AS 1319	Safety signs for the occupational environment
AS 1428.1	Design for access and mobility Part 1: General requirements for access – New building work
AS 1428.2	Design for access and mobility Part: Enhanced and additional requirements – Buildings and facilities
AS/NZS 1680 (set)	Interior lighting
AS/NZS 1768	Lightning protection
AS 1940	The storage and handling of flammable and combustible liquids
AS 2067	Substations and high voltage installations exceeding 1 kV a.c.
AS/NZS 2107	Acoustics – Recommended design sound levels and reverberation times for building interiors
AS/NZS 2293.1	Emergency escape lighting and exit signs for buildings Part 1: System design, installation and operation
AS/NZS 2293.2	Emergency escape lighting and exit signs for buildings Part 2: Inspection and maintenance
AS ISO 2631.2	Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration Part 2: Vibration in buildings (1 Hz to 80 Hz)
AS 2700	Colour standards for general purposes
AS/NZS 3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3008.1.1	Electrical installations – Selection of cables Part 1.1: Cable for alternating voltages up to and including 0.6/1 kV – Typical Australian installation conditions
AS/NZS 3010	Electrical installations – Generating sets
AS/NZS 3012	Electrical installations – Construction and demolition sites
AS/NZS 3017	Electrical installations – Verification guidelines
AS/NZS 3100	Approval and test specification – General requirements for electrical equipment
AS/NZS 3111	Approval and test specification – Miniature overcurrent circuit-breakers
AS/NZS 3175.1	Approval and test specification – Residual current-operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – General rules
AS/NZS 3820	Essential safety requirements for electrical equipment
AS 4086.1	Secondary batteries for use with stand-alone power systems Part 1: General requirements
AS/NZS 4282	Control of the obtrusive effects of outdoor lighting
AS/NZS 4509.1	Stand-alone safety systems Part 1: Safety and installation

Reference	Title / description
AS/NZS 4509.2	Stand-alone safety systems Part 2: System design
AS 4594 (set)	Internal combustion engines
AS/NZS 4777.1	Grid connection of energy systems via inverters Part 1: Installation requirements
AS/NZS 4777.2	Grid connection of energy systems via inverters Part 2: Inverter requirements
AS/NZS 4898	Approval and test specification – Circuit-breakers for overcurrent protection for household and similar installations
AS/NZS 5033	Installation and safety requirements for photovoltaic (PV) arrays
AS/NZS 5139	Electrical installations – Safety of battery systems for use with power conversion equipment
AS/NZS 60079 (set)	Explosive atmospheres
AS/NZS 60598 (set)	Luminaires
AS/NZS 60898 (set)	Circuit-breakers for overcurrent protection for household and similar installations
AS/NZS IEC 60947 (set)	Low-voltage switchgear and controlgear
AS/NZS 61000 (set)	Electromagnetic compatibility (EMC)
AS/NZS 61008.1	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs)
AS/NZS 61009.1	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)
AS/NZS 61386 (set)	Conduit systems for cable management
AS/NZS (IEC) 61439 (set)	Low-voltage switchgear and controlgear assemblies
AS/NZS IEC 62471	Photobiological safety of lamps and lamp systems
AS/CA S008	Requirements for Customer Cabling Products
AS/CA S009	Installation Requirements for Customer Cabling (Wiring Rules)
IEC 61730-1	Photovoltaic (PV) module safety qualification Part 1: Requirements for construction
IEC 61730-2	Photovoltaic (PV) module safety qualification Part 2: Requirements for testing

04 Design life

Building components and systems shall meet the requirements for design life as listed in Table 4–1.

Table 4–1 Design life

Element	Minimum design life
Batteries	10 years
Cable containment – above ground (trays, conduits, etc)	25 years
Cable containment – below ground (conduits, pits, etc)	50 years
Electricity generators, including back-up generators and photovoltaic installations	25 years
High voltage systems	25 years (generally) 40 years (cable)
Lightning protection	25 years
Low voltage and extra low voltage cables	25 years
Low voltage switchboards – indoors	25 years
Low voltage switchboards – outdoors	15 years
Programmable logic controllers	15 years
Uninterruptible power supplies	10 years

05 Design criteria

5.1 Health and safety

5.1.1 General

5.1.1.1 Legislated obligations

Designers shall meet their obligations under the Work Health and Safety Act (Queensland) and Work Health and Safety Regulation (Queensland).

Particular attention is drawn to Section 22 of the Work Health and Safety Act (Queensland) – *Duty of persons conducting businesses or undertakings that design plant, substances or structures*.

Particular attention is drawn to Section 295 of the Work Health and Safety Regulation (Queensland) – *Designer must give safety report to person who commissions design*.

Designers requiring additional information regarding their legislated obligations should contact the relevant Local Authority.

5.1.1.2 Safety in design

Irrespective of their legislated obligations, designers shall:

a. Consult with UQ and its nominated stakeholders throughout the design process about how to ensure that risks to health and safety arising from the design during the construction work are eliminated, so far as is reasonably practicable; or if it is not reasonably practicable to eliminate the risks, minimised so far as is reasonably practicable. This consultation shall occur not less than once during each separate design phase

b. Provide a Safety Report to UQ not less than once during each separate design phase

c. Provide a Safety Report to the Principal Contractor, when appointed

5.1.1.3 Electrical safety

The design of all electrical systems shall be configured to permit electrically isolated maintenance.

Under no circumstances is live maintenance permitted.

Main switchboards shall permit the isolation of general services for maintenance, including entire general services busbars, without requiring isolation of safety services.

Main switchboards shall permit the isolation of individual safety services for maintenance, without requiring isolation of any other safety services.

5.1.2 Access

All plant and equipment shall be positioned to allow safe and ready access.

Any access provisions for operation and maintenance of electrical plant and equipment requiring a ladder, platform or similar shall be approved by the Contract Administrator.

Electrical plant and equipment shall not be located behind the open position of any door or access cover.

Doors to electrical plant rooms, riser cupboards and similar shall be lockable in the open and closed position.

5.1.3 Safe working clearance

Safe working clearance shall be provided for all electrical plant and equipment as required by the reference documents listed in Table 3–2.

Required safe working clearances shall be documented on plan layout drawings.

Required safe working clearances shall be physically marked out on the floor during the installation of electrical plant and equipment.

Where floor marking is not practical, a sign is to be fitted to the front of electrical plant or equipment, or otherwise in plain view, to describe the required safe working clearance that is to be kept clear.

5.2 Quality

Documentation issued formally by designers for design milestones shall be reviewed and verified by an engineer independent of the design team.

Documentation issued formally by designers for design milestones shall be approved for issue by the relevant discipline RPEQ.

Documentation produced by designers shall indicate the RPEQ number of the engineer who has supervised the work. The same RPEQ shall provide Form 15 certification where contracted to do so.

Documentation issued informally for information by designers need not be formally verified, however shall be quality checked by the designer to ensure the documentation is free from errors and omissions.

5.3 Flexibility and robustness

The design of electrical services shall incorporate the following spare capacity for flexibility for future installations and/or modifications:

Table 5–1 Spare capacity

Element	Spare capacity type	Requirement	Design Standard reference
Transformers and generators	Load capacity	25% of estimated maximum demand	Section 6.1.7.1, 6.1.10.1
Main switchboards	Load capacity	25% of estimated maximum demand	Section 6.1.8.1
	Connection capacity	30% of total number of circuit breakers on all separate sections of the main switchboard – fitted with MCCBs with frame sizes no less than 400 A, complete with CTs, CT links and meters NB: All spare spaces must have circuit breakers fitted	Section 6.1.8.1
Consumer mains cabling and generator submains cabling	Load capacity	25% of estimated maximum demand	Section 6.1.9.1
Distribution boards	Load capacity	25% of estimated maximum demand	Section 6.3.2.1
	Connection capacity	30% of total number of consumed poles – fitted with 20 A, 30 mA RCBOs	Section 6.3.2.1
Submains cabling	Load capacity	25% of estimated demand	Section 6.3.5
Cable trays and ladders	Physical capacity	50% of maximum fill rate	Section 6.4.1.1
Skirting ducts	Physical capacity	50% of maximum fill rate	Section 6.4.2.1
Conduits – consumer mains cabling and major external runs	Physical capacity	The greater of 30% of total required cross-sectional area or 2no. 150mm conduits or minimum 4 conduits	Section 6.1.9.1
Conduits – other	Physical capacity	30% of total required cross-sectional area	Section 6.4.4.1

5.4 Sustainability

5.4.1 Demand response

UQ operates a Demand Response Engine (DRE) across some of its site and facilities. Integration with the DRE should be considered for all projects, and a respective strategy agreed with UQ.

5.4.2 Energy storage

UQ has a significant number of rooftop photovoltaic systems installed on campuses. The presence of rooftop solar is complemented by UQ's 68 MW Warrick Solar Farm installation.

Project-specific briefs will generally define the nature and extent of localised photovoltaic installations, and while rooftop photovoltaic installations should be considered on significant projects, this should generally only be considered when coupled with local energy storage to offset the building's local usage.

Battery and thermal storage should be considered as the primary forms of energy storage.

5.4.3 e-Mobility

As part of its overarching sustainability strategy, UQ is taking a step forward in its mission to create change by actively supporting and participating in the transition to a greener transport future. The university has been a pioneer in the provision of fast electrical vehicle charging infrastructure for the public in Queensland, and under its e-Mobility Plan, currently under development, it intends to achieve a zero-emissions passenger fleet by 2030. The university will also implement a workplace electric vehicle charging initiative in 2021, in a bid to facilitate the adoption of electric vehicles among university staff. As UQ works towards these goals, it will build the electric vehicle charging infrastructure and ecosystem to power this change.

Project-specific briefs will generally define the nature and extent of electric vehicle charging infrastructure to be incorporated in each project. Broad guidelines are provided here.

Projects shall generally:

d. Provide electric vehicle charging stations to parking bays as described in the project brief

e. Provide a mixture of 50 kW (fast chargers) and 10 kW capacity bays

f. Facilitate load management by charger communications and other UQ control systems to limit the instantaneous electric vehicle charging load

g. Integrate charging stations with the UQ Demand Response Engine (DRE) to shape electrical load to match UQ's load profile

h. At each bay, provide a double data outlet and isolator in a locked enclosure

i. Include within the contract works the procurement, installation and commissioning of charging stations, with charger make and model nominated by UQ

j. Coordinate the design of bays and charging locations with UQ's infrastructure and sustainability teams

Electric vehicle charging installations shall comply with AS/NZS 3000 Appendix P.

5.4.4 Materials

5.4.4.1 Equipment and components

All electrical equipment and components shall achieve RoHS compliance to minimise the presence of hazardous materials, including:

a. Lead (Pb): < 1,000 ppm

b. Mercury (Hg): < 1,000 ppm

c. Cadmium (Cd): < 100 ppm

d. Hexavalent Chromium (Cr VI): < 1,000 ppm

5.4.4.2 Cables

All consumer mains and submains cables shall be supplied to comply with Best Practice Guidelines for use of PVC in the Built Environment as published by the Green Building Council of Australia, or be supplied with low smoke, zero halogen insulation and sheaths.

5.5 Whole of life considerations

Project decisions relating to buildability, maintainability, plant and equipment selections, and system configurations shall be made with due consideration of whole of life impacts.

Designers shall prepare whole of life assessments for all major components as described in Table 7–2.

5.6 Tolerances

The tolerances required by all relevant Australian Standards and other reference documents shall be observed.

Specific to electrical services, all plant, equipment and components supplied on projects shall be suitable for operation in the expected electrical environment, nominally 230 Volts (+10%, -6%).

5.7 Acoustics

Refer to the Acoustic Design Standard for acoustic requirements and treatments required in connection with electrical services. This includes:

a. Noise levels and other acoustic criteria relating to the operation of electrical services and equipment

b. Mounting details for wall outlets to preserve acoustic ratings

c. Methods of sealing

d. Selection of sealants

06 Technical requirements

6.1 Electrical supply

6.1.1 Electrical supply topology

UQ has various types of connections to the utility authority network across its existing sites, as described in Table 6–1:

Table 6–1 Existing sites – customer types

Site	Customer type
St Lucia Campus St Lucia, Queensland 4072	➢ HV customer from St Lucia (STL) 33 kV / 11kV Energex zone substation ➢ Privately owned and operated 11 kV network throughout the campus
Gatton Campus 5391 Warrego Highway, Gatton, Queensland 4343	➢ HV customer from Gatton A (GTN) 33kV / 11 kV Energex zone substation, utilising primary feeder F377 (33 kV) and backup feeder GTN5B (11 kV) ➢ Privately owned and operated 11 kV network throughout the campus
Herston Campus 11 Wyndham Street, Herston, Queensland 4006	➢ HV customer from Victoria Park (VPK) 110 kV / 11 kV Energex zone substation ➢ Privately owned and operated 11 kV network distributed to Oral Health Centre (Building 883) ➢ All other campus distribution at low voltage
The Pharmacy Australia Centre of Excellence (PACE) 20 Cornwall Street, Woolloongabba, Queensland 4072	➢ HV customer from Annerley (ALY) 33 kV / 11 kV Energex zone substation ➢ Privately owned and operated 11 kV network distributed throughout the campus
Long Pocket Campus 80 Meiers Road, Indooroopilly, Queensland 4068	➢ HV customer from Taringa (BDA) 33 kV / 11 kV Energex zone substation ➢ Privately owned and operated 11 kV network distributed throughout the campus
Pinjarra Hills Research Facility Pinjarra Hills, Queensland 4069	➢ LV customer
Indooroopilly Experimental Mine Site Isles Road, Indooroopilly, Queensland 4068	➢ LV customer

Site	Customer type
Warrick Solar Farm	➢ 100% owned by UQ, the Warwick Solar Farm is a utility scale, grid connected renewable energy generation project that sells electricity to the National Energy Market. As UQ have moved to a spot market exposed electricity supply agreement, the Warrick Solar Farm acts as a physical hedge against electricity price increased for the approximate 160 GWh of energy generated each year
Other sites	➢ Confirm with Contract Administrator

For projects located at existing HV customer sites, individual projects shall be responsible for establishing and connecting a suitably sized supply to new developments in accordance with this Design Standard.

For projects located at new sites, individual projects shall be responsible for negotiating with UQ to agree on an appropriate connection type to the Utility Authority network, and then establishing and connecting a suitably sized supply to new developments in accordance with this Design Standard.

6.1.1.1 Existing high voltage customer sites

UQ utilises an underground ring main system across its major campuses for distribution of 11 kV supply.

New supplies required for projects shall entail:

a. A HV supply taken to a new substation, as an extension to an existing ring; or

b. A HV supply taken to a new substation, as a new ring; or

c. An LV supply taken from an existing privately owned and operated substation.

The network coupling point for the project shall be defined by the point of connection to the existing privately owned and operated network, whether that be at HV or LV.

6.1.1.2 New high voltage customer sites

New supplies for projects shall entail a HV supply taken from a Utility Authority owned and operated zone substation.

Designers shall provide a connection application to the Utility Authority as described in Table 7–2.

Design and installation of new HV supplies shall comply with the requirements of the Utility Authority.

The network coupling point for the project shall be determined by the Utility Authority and will typically be at the terminals of a HV circuit breaker in an existing Utility Authority owned and operated zone substation.

6.1.1.3 New low voltage customer sites

New supplies for projects shall entail an LV supply taken from a Utility Authority owned and operated distribution substation.

Designers shall provide a connection application to the Utility Authority as described in Table 7–2.

Design and installation of new LV supplies shall comply with the requirements of the Utility Authority.

Connections may require a new Utility Authority owned and operated substation to be established and connected as part of the project works. In this scenario, the demarcation of works between the project and the Utility Authority shall be in accordance with the requirements of the Utility Authority.

The network coupling point for the project shall be determined by the Utility Authority and will typically be at the LV terminals of the new or existing Utility Authority owned and operated distribution substation.

6.1.1.4 Maximum demand

For the purposes of planning new connections for projects, designers shall provide maximum demand calculations as described in Table 7–2.

6.1.1.5 Discrimination

Designers shall carry out a complete discrimination study, incorporating LV and HV protective devices.

Designers shall liaise with UQ (in the case of existing HV customer sites) or Utility Authority (in the case of new HV or LV customer sites) to confirm the prospective fault levels and protective device settings at the network coupling point.

Designers shall provide a report summarising the findings of the discrimination study for the electrical installation as described in Table 7–2.

6.1.2 Tariffs

6.1.2.1 General

UQ's major campuses are supplied under contestable electricity supply contracts.

The University is generally not contracted on a traditional peak / off-peak basis. This is due to the fact that the UQ has opted for a pool price pass through contract agreement with its energy retailer. The University is therefore exposed to spot prices in the National Electricity Market, where it actively manages its risks through financial hedges and demand response actions that seek to favourable shape electrical load. UQ's Warrick Solar Farm acts as a physical hedge to NEM price fluctuations throughout the day. This method of energy procurement is unlikely to changes in the foreseeable future.

6.1.3 Earthing

6.1.3.1 General

Earthing systems shall generally be standard TN-C-S systems.

A separate MEN connection shall be established at the main switchboard of each separate building. This connection shall include required earthing electrodes.

In the case of separated buildings with structurally continuous elements between them, the buildings shall bond to the MEN connection made at the distribution substation, to mitigate the risk of circulating currents between differing earth potentials.

6.1.4 High voltage distribution

6.1.4.1 General

All required HV cabling shall be installed underground. Aerial or overhead supplies are not permitted.

HV switchgear shall be free from oil and SF6.

High voltage switchrooms, and associated battery and SCADA rooms, shall be air conditioned.

6.1.4.2 Labelling

HV cables shall be permanently and durably labelled as follows: SXX-SZZ-AAA-YY, where:

a. XX is the source substation
b. ZZ is the destination substation
c. AAA is the conductor cross-sectional area in mm^2
d. YYYY is the year of installation

6.1.5 Substations

6.1.5.1 General

All new substations on HV customer sites shall be installed within a ring. Radial supplies to new substations are not permitted.

Designers shall engage the services of a specialist contractor to undertake earth resistance measurements at the proposed substation location, for incorporation into the design.

Designers shall provide an arc flash hazard severity assessment as described in Table 7–2.

Labels indicating prospective fault levels and safe approach distances shall be provided at each substation.

All HV equipment, including switchgear, installed within substations, shall be provided with auxiliary contacts and motorised spring charging mechanisms, or other means, to permit remote monitoring and operation, and connection to the BMS and SCADA control system (if present).

HV switchgear installed within substations shall incorporate circuit breaker tee-offs.

Protection relays shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

Protection relays shall be connected to the SCADA system (if present) by an RS-485 communications link, to permit remote monitoring.

6.1.6 Ring Main Units

6.1.6.1 Monitoring

Ring main units shall be provided with a full complement of auxiliary contacts for remote monitoring of switch and circuit breaker positions. Ring main units and protection relays shall be specified for 48 VDC operation.

Each ring main unit shall be provided with a gateway as described in Table 7–1 and within the shop drawing provided at Appendix B – Attachments, complete with the addition of expansion modules. The number of expansion modules provided shall suit the number of contacts being monitored (minimum 7).

All isolators, earth switches, selector switches and circuit breaker RMU auxiliary switches shall be wired to the input modules to provide comprehensive remote monitoring. For each item, both the ‘item open’ and ‘item closed’ contacts shall be wired to permit error checking. The specific elements to be monitored will be specified in the project brief developed by UQ.

Protection relays and DC supplies shall be connected via an RS-485 daisy chain to the relevant port on the gateway.

Ring main units shall be provided with dual DC power supplies. Power supplies shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator. The output of power supplies shall be bussed together to provide redundancy. Each DC power supply shall be fed from two dedicated circuits: one general and one essential.

6.1.7 Power transformers

6.1.7.1 General

Transformers shall be initially installed to provide spare capacity and flexibility as listed in Table 5–1.

Power transformers shall be dry type. Oil-type power transformers are not permitted.

Suitable thermostatically controlled ventilation shall be provided for dry type transformers. Ventilation systems shall incorporate means of achieving cooling in the event of failure of forced draft systems, which may be achieved by use of a secondary system.

The impedance of power transformers shall be determined in accordance with the allowable prospective fault levels at corresponding main switchboards, noting the requirement for each main switchboard to cater for parallel supply from two transformers during bus-tie switching.

All power transformers shall be provided with an alternate source of supply for maintenance purposes. The alternate source of supply:

a. May be achieved by way of an LV tie to another substation, or to a second transformer in the same substation.

b. Shall be capable of carrying the full load associated with essential services connected to the transformer.

The K factor of power transformers shall be selected to suit load the prospective load types.

Transformers shall meet the requirements of the Utility Authority, regardless or whether or not the installation is authority owned and operated.

6.1.8 Main switchboards

6.1.8.1 General

In buildings containing post-tensioned cables in the building structure, main switchboards shall be provided with signage as follows, with black text on a yellow background:

The concrete floor slabs and beams in this building contain post-tensioning cables critical to the building structural integrity, plus cast in concrete electrical services.

Accurate location of post-tensioning cables, reinforcement and building services by X-ray or scan is mandatory prior to any coring or drilling of the slabs and beams.

Under no circumstances shall any additional services be installed through the concrete floor slabs and beams without approval from UQ Property and Facilities Division. "As Built" drawings are available for information purposes only through PF Assist on 07 3365 2222 or pfassist@pf.uq.edu.au or https://www.pf.uq.edu.au/pfassist and do not remove the Contractors responsibility to X-ray or scan prior to any proposed work involving drilling or coring.

Main switchboards shall be initially installed to provide spare capacity and flexibility as listed in Table 5–1.

A common manufacturer shall be used to provide all main switchboards supplied on any single project.

Dedicated supplies from the main switchboard shall be provided to:

a. Building communications rooms

b. Mechanical equipment for building communications rooms

c. Consideration shall be given to other major electrical loads greater than 100 kVA

Workshop drawings for main switchboards shall be provided as described in Table 7–3.

Suitable thermostatically controlled mechanical ventilation shall be provided for main switchboards.

6.1.8.2 Arc flash hazard severity

Designers shall provide an arc flash hazard severity assessment as described in Table 7–2.

6.1.8.3 Enhanced protection mode

Enhanced protection functionality shall be provided to main switchboards to enhance operator safety during routine operation and maintenance. On activation, the protection curves on the incoming main switches / circuit breakers shall change to reduce the extent of let through energy as far as is practical. It is acknowledged that electrical discrimination may not be achieved when enhanced protection mode is active.

Enhanced protection mode shall be activated sing a switch on the remote operating panel or occupancy sensors in the main switchroom, complete with an indicating light wired to receive feedback from the affected circuit breakers.

6.1.8.4 Monitoring

Main switchboards shall be provided with a full complement of auxiliary contacts for remote monitoring of main switch circuit breaker positions.

Each main switchboard shall be provided with a gateway as described in Table 7–1 and within the shop drawing provided at Appendix B – Attachments, complete with the addition of expansion modules. The number of expansion modules provided shall suit the number of contacts being monitored (minimum 7).

All monitored circuit breakers, surge protection devices and energy meters shall be wired to the input modules to provide comprehensive remote monitoring. For each item, both the 'item open' and 'item closed' contacts shall be wired to permit checking. The specific elements to be monitored will be specified in the project brief developed by UQ.

Circuit breakers shall be connected via an RS-485 daisy chain to the relevant port on the gateway.

6.1.8.5 Control

Main switches and bus tie switches shall be configured to permit remote monitoring and operation.

On projects incorporating a SCADA control system, the status of main switches, bus tie switches and any motorised circuit breakers or transfer switches shall be reported to and monitored by the SCADA control system.

6.1.8.6 Construction

Main switchboards shall be freestanding, rear-connected, compartmented cubicle-type assemblies with provision for cables entering from above and below.

Main switchboards shall be extendable at either end.

Main switchboards shall incorporate an integral galvanised angle steel plinth 125 mm high.

Main switchboards shall have a maximum height of 2.1 m, including the main switchboard plinth.

Main switchboards incorporating doors or escutcheons fixed in place by screws are not permitted.

Doors and covers longer than 750 mm shall incorporate lifting handles.

Individual cable termination zones shall be provided for each circuit breaker to allow for termination of cabling to that circuit breaker while the remainder of the switchboard is live.

Main switchboards shall be coloured as follows:

a. Internal: White

b. External: Electric Orange X15

The construction of main switchboards shall incorporate the following specific elements:

a. Lift-off rear panels mounted using pintle-style hinges

b. Hinged front doors mounted using pintle-style hinges of staggered pin length for all compartments requiring ready access

c. Chrome quarter-turn slotted locks for all other compartments, including cable and busbar zones

d. Tinned copper busbars with phase bands visible at regular intervals

6.1.8.7 Technical parameters

Main switchboards shall be rated to withstand 120% of the expected prospective fault current for a period of 1 second.

Irrespective of other requirements of this Design Standard, or project specific considerations, main switchboards shall meet the minimum design criteria listed in Table 6–2.

NB: It may be necessary to exceed the minimum design criteria listed, based on project specific considerations.

Table 6–2 Main switchboards – minimum design criteria

Characteristic	Minimum design criteria
Environmental conditions	40 degree rise above 50 degrees Celsius ambient temperature at full rated load, in a ventilated space
Rating	To match full-load current of substation
Prospective fault level rating	43 kA for 1 second
Degree of protection	IP54
Form of separation	Form 4

The form of separation shall be consistent across all buses in a single main switchboard.

6.1.8.8 Bus sections and load arrangements

General services and safety services shall be supplied by separate bus sections.

Essential services and non-essential services shall be supplied by separate bus sections.

During normal operation, essential and non-essential bus sections shall be tied together.

During compromised operation, non-essential bus sections shall be load shed.

Renewable energy sources shall be connected to the essential bus section of main switchboards.

Loads shall be arranged on main switchboards to support separate metering of the following loads, using the minimum number possible of electrical meters:

a. Artificial lighting

b. Appliance power

c. Mechanical

d. Chillers (as separated from other mechanical loads)

e. Central hot water supply

f. Internal transport devices including lifts, escalators and moving walkways

g. Other major electrical loads greater than 150 kVA

6.1.8.9 Low voltage ties

Installations incorporating multiple main switchboards shall include LV bus ties between the essential sections of respective main switchboards, to permit backup of essential services in the event of an outage.

Installations incorporating three or more main switchboards shall include a wrap-around LV bus tie to link the end bus sections.

LV bus ties shall be normally open and shall not be relied upon to distribute electrical load across several transformers.

LV bus ties shall only be closed in support of temporary switching activities.

6.1.8.10 Parallel operation

Main switchboards shall be rated to withstand the prospective fault current associated with the parallel operation of transformers when the essential sections of the respective main switchboards are tied together.

A remote operation panel shall be located away from main switchboards to permit the remote opening and closing of main switches and bus tie switches.

The remote operation panel shall incorporate an interlocking system to permit the temporary paralleling of two or more transformers to carry out switching activities, such as to isolate an incoming supply for maintenance.

The interlocking system shall require the operation of a spring-return rotary switch (or similar digital control system) to provide a manual override to allow the paralleling action.

The interlocking system shall not allow the paralleling action if:

a. Both main switches on the associated main switchboards are closed; or

b. The manual override is not active.

6.1.8.11 Metering

All electrical meters for main switchboard elements shall be mounted on a separate, standalone metering panel.

Potential links and CT bridging links shall be provided in the metering panel and in the corresponding main switchboard(s).

Refer Section 6.2 for further details.

6.1.8.12 Power factor correction

Main switchboards shall incorporate spare circuit breakers to accommodate future installation of power factor correction units.

Circuit breakers shall be sized to accommodate the expected reactive power load presented by the power factor correction units.

6.1.8.13 Surge protection devices

Primary surge protection shall be provided at each main switchboard assuming a location category of ‘Category C’.

The subcategory shall be Category C3, requiring a device with I_{max} = 100 kA, unless otherwise agreed with UQ.

Surge protection devices shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

Surge protection devices shall be mounted in separate, independent compartments in main switchboards, complete with a viewing panel.

Surge protection devices shall be multi-stage units incorporate indicating lights showing the available capacity of the MOV unit.

The condition and state of all surge diverters shall be monitored using the BMS.

Surge protection devices shall have volt-free normally open and normally closed alarm contacts which operate when the device reaches 40% or 60% of its rated capacity.

Surge protection devices shall be located away from areas in main switchboards which may experience high ambient temperatures, eg areas incorporating busbars and other heat generating elements.

Circuit breakers protecting surge protection devices shall be mounted in a readily accessible position, allowing for ready reset without requiring exposure of live parts or isolation of any services.

6.1.8.14 Protective devices

Of the total number of outgoing circuit breakers provided in each main switchboard, 20% shall be provided with lock out devices. This shall incorporate at least one circuit breaker of each frame size.

Lock out devices shall be stored in the spare parts enclosure.

6.1.8.15 Cable entries / exits

All cables with a cross-sectional area greater than 10 mm^2 entering or exiting the switchboard shall be provided with cable glands using a non-metallic gland plate with a minimum thickness of 5 mm.

6.1.8.16 Labelling

Main switchboards shall be provided with labels to identify all components.

Main switchboards shall be provided with labels on the outside of the switchboard to indicate the positioning of equipment that is concealed or not readily apparent from the outside of the switchboard. This shall include control equipment.

All labelling shall be provided by way of machine engraved traffolyte labels screw fixed to exterior of the main switchboard.

Labels indicating prospective fault levels and safe approach distances shall be provided at each main switchboard.

Labels shall be provided as listed in Table 6–3.

Table 6–3 Main switchboards – labelling requirements

Component	Configuration	Lettering size	Colour	Example
MSB label for MSBs with single source of supply	Main switchboard name	12 mm	White lettering on black background	Refer Appendix A – Example labelling schemes
	Prospective fault current	6 mm		
	Safe approach distance	6 mm		
MSB label for MSBs with multiple sources of supply	Main switchboard name	12 mm	White lettering on black background	
	Prospective fault current	6 mm		
	Safe approach distance	6 mm		
	Warning text	12 mm	White lettering on red background	
Main switch	Component name	12 mm	Black lettering on white background	
	Trip setting / maximum trip setting	6 mm		
	Cable configuration, size and type	6 mm		
General services outgoing circuits with single source of supply	Circuit description	12 mm	Black lettering on white background	
	Trip setting / maximum trip setting	6 mm		
	Cable configuration, size and type	6 mm		
General services outgoing circuits with multiple sources of supply	Circuit description	12 mm	Black lettering on white background	
	Trip setting / maximum trip setting	6 mm		
	Cable configuration, size and type	6 mm		
	Warning text	12 mm	White lettering on red background	
Safety services outgoing circuits	Circuit description	12 mm	White lettering on red background	
	Trip setting / maximum trip setting	6 mm		
	Cable configuration, size and type	6 mm		
	Warning text	12 mm		
Lift outgoing circuits	Circuit description	12 mm	White lettering on red background	
	Trip setting / maximum trip setting	6 mm		
	Cable configuration, size and type	6 mm		
	Warning text	12 mm		
Electrical meters	Description of metered load	12 mm	White lettering on black background	
	CT ratio (if applicable)	6 mm		
	Meter identifier	6 mm		
	Modbus address	6 mm		
Concealed CTs and potential links	Equipment description and position description	12 mm	White lettering on background	
Accessories and other equipment	Equipment description	12 mm	White lettering on black background	

Component	Configuration	Lettering size	Colour	Example
Concealed accessories and other equipment	Equipment description and position description	12 mm	White lettering on black background	

A schematic wiring diagram shall be wall-mounted adjacent each main switchboard (in the main switchroom) into a frame with a non-reflective glass cover, depicting the schematic arrangement of the entire switchboard.

The schematic wiring diagram shall incorporate all details of incoming and outgoing circuits, including the details of cable types, cable sizes, protective device ratings, protective device settings and the make and model of all switchboard components, including protective devices.

6.1.8.17 Spare parts enclosure

A separate enclosure shall be wall-mounted adjacent in each main switchroom for storage of spare parts, tools and all spare fuses for the switchboard.

The spare parts enclosure shall be fabricated from sheet steel.

The spare parts enclosure shall be lockable.

The spare parts cabinet shall be labelled ‘Switchboard Tools and Spares’.

6.1.9 Consumer mains cabling

6.1.9.1 General

Consumer mains cabling shall be initially installed to provide spare capacity and flexibility as listed in Table 5–1.

All required consumer mains cabling shall be installed underground. Aerial or overhead supplies are not permitted.

Consumer mains cabling shall be reticulated to main switchboards at low level (underground or in cable trenches) to minimise EMF radiation into occupied areas.

All single core cables shall be arranged in trefoil formation to minimise electromagnetic emissions.

Service pits shall be installed at the exterior or all buildings provided with new incoming electrical supplies, to facilitate the drawing in of consumer mains cabling.

The locations and sizes of service pits and conduits shall be discussed and agreed with UQ.

6.1.10 Generator systems

6.1.10.1 General

Generators shall be initially installed to provide spare capacity and flexibility as listed in Table 5–1.

Generator systems shall operate in conjunction with other building electrical systems to provide essential power supplies to selected plant and equipment.

Generators with a continuous, prime or standby rating of 500 kVA or greater shall be configured for operation in parallel with the electricity grid.

Generators shall be classified by the designer as having a specific continuous, prime or standby rating.

The generator system shall generally be configured for zero export to the electricity grid.

Designers shall provide a project-specific generator submission as described in Table 7–2.

Designers shall provide an embedded generation application to the Utility Authority as described in Table 7–2.

6.1.10.2 Integration

Generator system(s) shall be connected to the essential bus section of main switchboards.

Main switchboards shall incorporate a separate generator bus, with outgoing

connections to individual automatic transfer switches to essential loads.

6.1.10.3 Parallel operation

Main switchboards shall be rated to withstand the prospective fault current associated with the parallel operation of generators when the essential sections of the respective main switchboards are tied together.

The generator system shall be programmed to evenly share the load between generators, or in the event that multiple generators are low-loaded, shutdown a generator.

6.1.10.4 Control

Generator systems shall be provided with a fully automated PLC-based control system that provides the following minimum functionality:

a. Remote, manual start, synchronise and shutdown of each generator
b. Remote, manual commencement of an on-load test
c. Adjustment of the duration of the on-load test
d. Remote monitoring of engine and alternator status
e. Remote monitoring of oil pressure and coolant temperature
f. Remote monitoring of fuel levels in bulk storage tanks
g. High level interface with the BMS and SCADA control system (if present)

6.1.10.5 Emergency shutdown buttons

Emergency shutdown buttons shall be installed adjacent each generator.

Operation of emergency shutdown buttons shall immediately shutdown all connected generators.

Reset of the generator system after the operation of an emergency shutdown button shall require manual intervention.

6.1.10.6 Mains loss

Upon a loss of mains power at any one or more automatic transfer switch, the generator system shall:

a. Start up the generator(s)
b. Automatically select master and slave generators, and synchronise
c. Signal the relevant automatic transfer switch(es) to preference the generator bus
d. Isolate (load shed) loads throughout the building if required
e. Close the generator(s) on to load
f. Progressively increase the load on the generator(s) in steps no greater than 250 kVA
g. Prioritise the re-energisation of safety services

6.1.10.7 Mains restoration

Upon restoration of mains power, the generator system shall:

a. Synchronise the generator(s) to the electricity grid
b. Restore essential building loads to the mains supply
c. Progressively restore all remaining loads to the mains supply.
d. Stop the generator(s)

6.1.10.8 On-load test

Upon the commencement of an on-load test, the generator system shall:

a. Start up the generator(s)
b. Synchronise the generator(s) with the electricity grid
c. Close the generator(s) on to load, running in parallel with the electricity grid
d. Reduce the load on the generator to maintain a minimum import on the associated mains supply
e. Monitor the generator parameters

f. Restore the building load to the mains supply

g. Stop the generator(s)

6.1.10.9 Fuel storage and reticulation

Generator systems shall be provided with inground bulk fuel storage with sufficient capacity for the generator(s) to operate for 24 hours at 80% of their rated output. For the purposes of this clause, the ‘rated output’ shall be the generator’s continuous, prime or standby rating as adopted by the project.

Generator systems shall be provided with 1,000 L day tanks adjacent to each generator.

Generator systems shall be provided with a fuel reticulation system between the bulk storage and day tanks.

Generator systems shall be provided with a fuelling point that is accessible by a bulk fuel carrier. The fuelling point may be remote from the bulk storage.

6.1.10.10 Acoustics, vibration and environment

Generator systems shall comply with the requirements of the acoustic and vibration brief, as will be developed specific to each project.

Generator systems shall be provided with control and treatment of reverberant noise, transmitted noise and vibrations.

Generator systems shall be provided with control and treatment of transmitted noise.

Generator systems shall be provided with silencers and treatment for exhaust systems if required by the Local Authority.

6.1.11 Uninterruptible power supply (UPS) systems

6.1.11.1 General

UPS systems shall operate in conjunction with other building electrical systems to provide critical power supplies to selected plant and equipment.

UPS systems shall also provide filtered power for critical services.

6.1.11.2 Components

All UPS systems shall consist of one or more of the following primary components:

a. UPS module, containing the rectifier, inverter, battery charger, internal static bypass switch and associated control and monitoring panel

b. Battery string(s) mounted in either internal or external cabinets

c. External maintenance bypass switch

Depending on the configuration of UPS systems, they may also contain one or more of the following components:

a. UPS input distribution board

b. UPS output distribution board

c. Parallel tie switch

6.1.11.3 Modes of operation

UPS systems shall operate as online, double conversion, fully automatic systems in the following modes:

a. Normal

   The UPS system is supplied by mains or standby power. Critical services are supplied by the UPS inverter. The UPS inverter regulates (filters) the voltage and frequency of critical power supplies. Simultaneously, the battery charger charges the batteries.

b. Battery

   The UPS system is supplied by batteries. Critical services are supplied by the UPS inverter. The UPS inverter regulates (filters) the voltage and frequency of critical power supplies. There shall be no interruption to critical power supplies during failure or restoration of the mains or standby power supply to the UPS system.

c. Recharge

   As for ‘Normal’.

d. Automatic static bypass

The UPS system is taken out of normal mode due to overload, load fault or another internal failure. The static bypass switch automatically transfers the supply of critical services to the mains or standby power supply. The voltage and frequency of critical power supplies is not regulated (filtered) by the UPS inverter. There shall be no interruption to critical power supplies when the UPS system is automatically put into, or taken out of, static bypass mode.

e. Manual maintenance bypass

The UPS system is manually taken out of normal mode for maintenance, replacement, etc. The manual external bypass switch automatically transfers the supply of critical services to the mains or standby power supply. The voltage and frequency of critical power supplies is not regulated (filtered) by the UPS inverter. The switching sequence of the external maintenance bypass switch is such that there shall be no interruption to critical power supplies when the UPS system is manually put into, or taken out of, maintenance bypass mode.

6.1.11.4 Control and monitoring

UPS systems shall be controlled and monitored using the following components integral to the UPS module:

a. Control panel: colour LCD, complete with touch sensitive interface and LED status indicators

b. Communication ports: ethernet, RS-232 and USB

UPS systems shall be provided with network management capability to permit communication with the Building Management System (BMS) and Power Control and Monitoring System (PMCS).

Network management capability shall be integral to the UPS module or provided by way of an add-on input/output network management card.

Network management capability shall permit remote monitoring of UPS systems via any standard internet browser.

Network management capability shall permit passing of alarms and notifications over email and SMS.

6.1.12 Photovoltaic systems

6.1.12.1 General

This Design Standard incorporates technical requirements for roof mounted photovoltaic systems. Ground mounted photovoltaic systems shall be subject to specific requirements determined by UQ.

Designers shall provide a project-specific photovoltaic system submission as described in Table 7–2.

Generally, UQ P&F will assist with applications to the Utility Authority for photovoltaic installations on the St Lucia, Gatton and Long Pocket Campuses. Designers shall provide an embedded generation application to the Utility Authority for all other sites as described in Table 7–2.

6.1.12.2 Roof construction

Roof structures intended to accommodate photovoltaic systems shall:

a. Be assessed by a structural engineer to confirm the ability of the structure to accommodate relevant structural loadings

b. Be of a construction that is suitable for photovoltaic module clamp footings

6.1.12.3 Access, egress and positioning

Roof mounted photovoltaic installations shall be safely accessible without the use of ladders.

Roof mounted photovoltaic installations shall be provided with safe access clearance around panels.

The positioning and layout of the photovoltaic installation shall minimise shading caused by adjacent roof plant and/or building elements.

Where significant shading exists, module-based optimisation systems, such as those listed in Table 7–1, should be considered.

6.1.12.4 Certificates

UQ will retain ownership of the Renewable Energy Certificates (RECs) for the photovoltaic system.

6.1.12.5 PV modules

Photovoltaic modules shall be sourced from Tier 1 manufacturers, as listed by the Bloomberg New Energy Finance Corporation.

Photovoltaic modules shall have an efficiency of not less than 12%.

Photovoltaic modules shall be provided with a material and workmanship warranty of not less than 10 years.

Photovoltaic modules shall be provided with a manufacturer's performance warranty guaranteeing no depreciation in the rated output of modules greater than 20% for 20 years.

Photovoltaic modules shall be rated at Fire Class C or better.

6.1.12.6 Inverters

Inverters shall be sourced from Tier 1 manufacturers, as listed by the Bloomberg New Energy Finance Corporation.

Inverters shall be provided with a material and workmanship warranty of not less than 10 years.

Inverters shall have an efficiency of not less than 90% (at 10% of rated load).

Inverters shall have a total output current harmonic distortion of not more than 4%.

Photovoltaic installations shall utilise centralised string inverters. The use of microinverters is not permitted.

6.1.12.7 Installation

Installers of photovoltaic systems shall be accredited by the Clean Energy Council (CEC).

Fixings associated with the installation of photovoltaic systems shall be certified to relevant Australian Standards, and shall be provided with a material and workmanship warranty of not less than 10 years.

The photovoltaic system structural supports shall be certified by a Professional Structural Engineer.

Photovoltaic module clamp footings shall be tested in situ on the building's roof, to ensure suitability, prior to commencement of the photovoltaic installation.

Photovoltaic modules shall be rail mounted.

All rooftop mounting structures shall be constructed from aluminium.

All rooftop fixings shall be made from stainless steel or aluminium, and wherever practical, shall be free from the need to penetrate building elements.

All penetrations to building elements are to be fire-sealed and waterproofed, including the installation of appropriate flashing.

Cable trays installed in exposed, rooftop areas shall be fitted with covers to provide protection of cabling from UV radiation.

Cable trays installed for photovoltaic installations shall be colour coded as follows:

a. Alternating current (AC) services: Orange

b. Direct current (DC) services: Yellow

c. Communications: White

Isolators and other electrical accessories installed in exposed, rooftop areas, shall be protected from UV radiation.

Isolators and other electrical accessories shall be housed in enclosures of stainless steel construction, with a minimum IP rating of IP 66.

DC cabling and connectors shall be secured properly to the mounting frame installed for photovoltaic modules. Installations where DC cabling and/or connectors dangle beneath modules will not be accepted.

6.1.12.8 Photovoltaic system output

Photovoltaic installations shall be provided with a dedicated output distribution board as described at Appendix B – Attachments.

Secondary protection relays shall be provided with all photovoltaic systems rated at 30 kW_p

or more. The standard design of the photovoltaic output distribution board, as provided at incorporates a protection relay and contactor to perform this function.

Secondary protection relays shall be configured and commissioned to meet the Utility Authority's requirements. A copy of the commissioning report shall be provided as described in Table 7–3.

6.1.12.9 Labelling

All labelling shall be provided by way of traffolyte labels which are machine engraved and screw fixed to exterior of components.

Labels shall be provided as listed in Table 7–4.

Table 6–4 Photovoltaic systems – labelling requirements

Component	Configuration	Lettering size	Colour	Example
At point of connection of strings to inverters	String identifier	6 mm	White lettering on black background	Refer Appendix A – Example labelling schemes
At point of connection of strings to DC isolators	String identifier	6 mm	White lettering on black background	
Inline surge protection devices and string fuses	String identifier	6 mm	White lettering on black background	
DC isolators	String identifier	6 mm	White lettering on black background	
	Distribution board and circuit designation	6 mm	White lettering on black background	
AC isolators	String identifier	6 mm	White lettering on black background	
	Distribution board and circuit designation	6 mm	White lettering on black background	
MSB label for MSBs with multiple sources of supply	Refer Table 6–3.			
DB label for DBs with multiple sources of supply **Located externally**	Refer Table 6–7.			

Component	Configuration	Lettering size	Colour	Example
DB label for DBs with multiple sources of supply **Located on escutcheon**	Refer Table 6–7.			

6.1.12.10 Commissioning

A schematic wiring diagram of the photovoltaic system shall be mounted in the inverter room, into a frame with a non-reflective glass cover, depicting the schematic arrangement of the entire system.

The schematic wiring diagram shall incorporate all details of modules, DC cabling, inverters, AC cabling, cable types, cable sizes, protective device ratings, protective device settings and the make and model of all components, including protective devices.

Inverters shall be configured for a 5 minute reconnection delay, as required by the Utility Authority.

Visible differences between photovoltaic modules (eg colour, etc) shall be investigated prior to or during commissioning, to determine whether these may affect the performance of the photovoltaic system.

Visibly similar photovoltaic modules shall be arranged together, provided that the performance of those panels is the same.

Photovoltaic modules from different manufacturer batches shall not be mixed in single strings.

Photovoltaic modules shall be cleaned prior to handover to UQ.

6.1.13 Lightning protection

6.1.13.1 General

All new buildings and significant renovations of existing buildings are to be assessed to the relevant reference documents listed in Table 3–2.

Designers shall provide a project-specific lightning protection system submission as described in Table 7–2.

Material selections shall be made in the context of eliminating galvanic corrosion in the use of incompatible metals.

Air terminals shall comprise dedicated metallic conductors to capture lightning strikes. The use of building elements, such as roof sheeting, handrails, antenna mounts and roof mounted plant is not permitted.

Impedance measurements shall be taken at various points of the completed lightning protection system installation.

6.2 Electrical metering

6.2.1 Energy Monitoring System (EMS)

6.2.1.1 General

UQ utilises an extensive inter-campus Energy Management System (EMS). The EMS is comprised of several digital power meters, which are networked and remotely monitored. Information from these meters are used to monitor loads, setup trends, generate alarms and send data to other software programs.

This section shall be applicable to all electrical metering devices, including those required for mechanical services switchboards.

Non-revenue meters shall be commissioned and validated in accordance with *NABERS, The Rules, Metering and Consumption*. Alternative protocols shall be approved by UQ prior to use.

Designers shall provide a project-specific electrical metering system submission as described in Table 7–2. This submission shall also cover the metering of mechanical services switchboards.

Contractors shall provide a project-specific electrical metering system submission as described in Table 7–3.

The EMS shall produce alerts if any inaccuracies are found within the meter network.

Meters shall be located in an area that permits regular access and maintenance.

The software tasks within the EMS, and data logging and gateway devices, do not fall within the scope of this Design Standard.

6.2.1.2 Metering structure

UQ utilises multiple layers of electrical metering to monitor power and energy consumption throughout its assets. These layers are defined as:

a. High voltage layer: metering undertaken at high voltage, within substations

b. Upstream layer: metering undertaken at the building main switchboard

c. Downstream layer: metering undertaken at distribution boards and mechanical services switchboards

d. Cost recovery layer: metering undertaken at any point in the electrical reticulation system, used for the recovery of energy costs, usually to be passed on to a third party

6.2.1.3 Metered loads

Meters shall be provisioned to meet the requirements of the reference documents listed in Table 3–2.

The energy consumption of general lighting and power, and on-floor mechanical systems, shall be metered in individual floor areas not greater than 500 m^2.

In addition to the minimum requirements set out by the reference documents listed in Table 3–2, meters shall also be provisioned specifically to record the electrical parameters associated with:

a. Low voltage supplies from each transformer (in the case of high voltage customer sites only)

b. The total electrical load across each building

c. The total general lighting and power load across each building

d. The total mechanical services load across each building

e. Large services, such as rising submains cables

f. Individual mechanical chillers

g. Cooling towers

h. Chilled water pumps

i. Condenser water pumps

j. Secondary chilled water pumps

k. Photovoltaic systems (input and output)

l. Battery storage systems (input and output)

m. Low voltage ties between main switchboards

n. Areas of the building nominated as high energy consumers

o. Common area lighting and power services, separated from services in tenanted areas

p. External services; and car park lighting and power services, separated from services in internal areas

q. Essential services, separated from non-essential services

r. All electrical equipment with a peak demand exceeding 10% of the total electricity supply to the site; or 100 kW, whichever is lower

6.2.2 Electrical meters

6.2.2.1 Product selections

Electrical meters shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

Departures from the list of approved proprietary products may be requested in writing to the Contract Administrator, provided the proposed product is of equal or better quality and performance. Requests shall be accompanied by a working sample, complete with necessary gateways, licence integration and EMS software, such that the product can be assessed by UQ. Due to the nature of interfaces to the existing EMS that may be in operation, such assessments may take an extended period of time.

Notwithstanding the approved proprietary products listed in Table 7–1, electrical meters shall be capable of measuring and recording the values listed in Table 6–5, to the specified level of accuracy. Three-phase meters shall be capable of measuring and recording the values individually per phase, and as totals.

All electrical meters shall be pattern approved revenue meters.

Table 6–5 Electrical metering – minimum performance requirements

Electrical parameter	Accuracy
Voltage (line to line) (V)	0.5%
Voltage (line to neutral) (V)	0.5%
Current (line) (A)	0.5%
Frequency (Hz)	0.1%
Power factor	0.01%
Real power (W)	1.0%
Reactive power (VAR)	1.0%
Apparent power (VA)	1.0%
Energy import (kWh, kVARh, kVAh)	1.0%
Energy export (kWh, kVARh, kVAh)	1.0%
Demand (VA)	1.0%
Total Harmonic Distortion (Voltage)	-
Total Harmonic Distortion (Current)	-

Electrical meters shall be provided with both RS485 and Ethernet TCP/IP communication options.

6.2.2.2 Installation

Electrical meters located at main switchboards shall be located within a dedicated cubicle.

Electrical meters located at main switchboards and mechanical services switchboards shall be mounted:

a. In the case of indoor switchboards, on the door of the switchboard cubicle; or

b. In the case of outdoor switchboards, on the escutcheon of the switchboard cubicle.

Electrical meters located at distribution boards shall be mounted on the escutcheon of the switchboard, adjacent the main switch.

Electrical meters located at mechanical services switchboards shall be designed by the mechanical designer, and shall be supplied and installed by the mechanical subcontractor.

Electrical meters located at mechanical services switchboards shall be installed in a

section of the switchboard that can be safely accessed, ie in a section of the switchboard where the meter's terminals are accessible without exposure to live conductors, satisfying a minimum IP2x rating.

Electrical meters located at mechanical services switchboards shall not be installed:

a. On the same door as the main isolator; or

b. On the same door as any other switch that requires isolation before opening; or

c. In a cubicle in close proximity to busbars.

Electrical meters shall be installed at a height no greater than 1,500 mm AFFL.

Safe and free access shall be available to the installed location of electrical meters and associated onboard controls without the need for a special tool to open or remove any covering elements.

Safe and free access shall be available to the terminals on the back of meters and to the standard metering terminals to allow safe removal of meters, shorting out of current transformers at the terminals, or to replace blow fuses.

Potential fuses at switchboards shall be accessible without the need to isolate the switchboard.

Electrical meters shall be installed with all required terminal strips for communications cabling, current transformer wiring and shorting links, power supplies, fuses and circuit breakers.

The auxiliary power supply for electrical meters shall be supplied from the line side of the isolator or circuit breaker of the circuit that the meter is measuring, and on the load side of the switchboard main isolator, to ensure the meter can be locally isolated, and to ensure continued reporting by the meter to the EMS.

The metering potentials for electrical meters shall be suppled from:

a. In the case of a single measured circuit, the load side of the isolator or circuit breaker of the circuit that the meter if measuring; or

b. In the case of multiple measured circuits, an appropriate position such that isolating any one of the circuits does not affect the meter measurement.

Where potential circuit wiring is not physically separated between busbars and fuse link assemblies, the maximum conductor size shall be 4 mm^2 with V-90 insulation and a PVC sheath, or clear sheathed cablese with phase colour identification. The maximum length of associated cabling is 500 mm.

Communications cabling for the connection of electrical meters shall be passed through glands at entries to switchboards and shall be concealed in corrugated conduit internally to the switchboard to the location of the connection port on the meter.

All wiring associated with electrical meters shall be boot laced crimped and number per the standard electrical meter schematics provided at Appendix B – Attachments.

All voltage multicore cable for remote meters shall be 1.5 mm^2. The sheath of such cabling shall be orange coloured.

All current multicore cabling for remote meters shall be 2.5 mm^2, except for the cabling from metering terminals to meters, where it shall be 1.5 mm^2. The sheath of such cabling shall be black coloured.

Internal switchboard wiring shall be flexible V90 insulated cable and shall be coloured to match the phase.

Electrical metering components shall be provided as the approved proprietary products listed in Table 7–1 or equivalents approved by the Contract Administrator.

An electrical metering installation checklist is provided at Appendix B – Attachments to assist contractors carrying out metering installations.

6.2.2.3 Current transformers

Current transformers shall be rated to match the rating of the main isolator or circuit breaker.

The secondaries of all current transformers shall be rated at 5 A.

Current transformer links and fused voltage connections shall be DIN rail mounted.

The current transformer ratio of at least one of the matched sets shall be visible.

The earthing of current transformers shall be carried out on the S2 leg at the switchboard terminals. Despite current transformers being earthed on one leg, they shall always be wired with both wires from the CT all the way through to the meter.

Remote meters shall be located as close as possible to their corresponding current transformers.

6.2.2.4 Communication requirements

The UQ EMS system utilises UQ's Local Area Network (LAN) infrastructure to communicate with electrical meters distributed across UQ sites.

The communication protocol between the EMS and electrical meters is Modbus / TCP via a gateway device. Gateway devices shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

The gateway devices shall be configured to operate at 9600 baud, 8 data bits, with no parity and one stop bit.

Gateway devices shall be provided with unique IP addresses to permit connection of meters to the EMS over the UQ LAN. IP addresses shall be supplied by UQ.

Electrical meters in a single location shall be daisy chained together via a local Modbus RS485 loop, connected to the gateway device. This connectivity shall be supplied and installed by the electrical trade contractor.

The free end of the RS485 network shall be terminated on a dedicated, labelled terminal strip.

Electrical meters on the same RS485 network shall be provided with unique Modbus addresses to allow the EMS to uniquely identify devices. Modbus addresses shall be supplied by UQ.

Each RS485 network shall be limited to supporting not more than 20 electrical meters, and a maximum of 1200 m of RS485 cabling. Permission may be sought from UQ to increase the number of electrical meters supported by a specific network to a maximum of 32.

RS485 cabling shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

A signal line surge protection device shall be installed on RS485 cabling that exits metering panels or switchboards to connect to external meters. Signal line surge protection devices shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

A data outlet shall be provided next to each metering panel and switchboard for the purposes of connectivity to the UQ EMS.

Segregation shall be maintained between low voltage and extra-low voltage (communications) cabling at all times. Suitable forms of separation shall be used when physical segregation is not possible.

6.2.2.5 Labelling

The auxiliary supply for each electrical meter shall be labelled to indicate the point of supply, for example, "SUPPLY FROM CB12".

In the scenario of more than one set of terminals in a metering panel, each set shall be labelled with the load description that reflects the meter label load description.

Each meter terminal strip shall have a label placed in a prominent location to indicate on which side the wiring from the CTs comes from and from which side the meter wiring goes to.

Each gateway device shall be labelled with its ID number and IP address.

Labelling shall be achieved using engraved traffolyte labels using non-metallic rivets or fasteners.

Labelling shall be provided to meters as described by the Standard Electrical Metering Labelling guidance document attached at Appendix B – Attachments.

6.2.2.6 Commissioning of the system

Metering installations shall be fully commissioned, including the networked communications to the relevant domain server.

Metering installations shall be commissioned in accordance with the Meter Commissioning Checklist attached at Appendix B – Attachments.

6.2.3 Documentation and approval process

6.2.3.1 General

The process for installation of electrical meters at the UQ shall be followed:

a. For each meter being installed, the installing contractor shall complete Section A of the Meter Data Form, as attached at Appendix B – Attachments, and shall forward it to UQ

b. UQ will assign a meter number and a corresponding Modbus address, and return the form to the installing contractor for final setup and commissioning

c. For each meter installed, the installing contractor shall complete the commissioning checklist, as attached at Appendix B – Attachments, and shall forward it to UQ

d. Upon completion of the installation, the installing contractor shall forward all documentation to UQ as part of the handover process

e. UQ will review and sign off the metering installation as complete

f. UQ will update electrical metering records and schematics to reflect changes

6.3 Low voltage distribution

6.3.1 Bus trunking and rising submains cabling

6.3.1.1 General

Tap-offs to bus trunking shall be providing using proprietary, modular ‘plug in’ units.

Tap-offs to rising submains cabling shall be protected by MCCB-type circuit breakers in an adjacent enclosure.

Bus trunking and rising submains cabling shall be arranged to provide sufficient spare capacity to permit future installation of additional tap-offs.

In the case of bus trunking, spare capacity shall be provided by way of additional ‘plug in’ positions for modular tap-offs.

In the case of rising submains cabling, spare capacity shall be provided by way of additional circuit breakers in an existing tap-off enclosure.

6.3.2 Distribution boards

6.3.2.1 General

Distribution boards shall be initially installed to provide spare capacity and flexibility as listed in Table 5–1.

Workshops drawings for distribution boards shall be provided as described in Table 7–3.

Distribution boards shall be:

a. Custom made enclosures with proprietary chassis; or

b. One of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

A common manufacturer shall be used to provide all distribution boards supplied on any single project.

Where essential supplies are required on projects, provide separate essential and non-essential distribution boards at each distribution riser cupboard or other distribution location.

6.3.2.2 Construction

Distribution boards shall be rated to withstand 120% of the expected prospective fault current for a period of 1 second.

Distribution boards shall have a minimum depth of 250 mm.

Escutcheons longer than 750 mm shall incorporate lifting handles.

Escutcheons shall be provided with neat cut outs for circuit breakers.

Proprietary pole fillers shall be installed for unused poles.

MCBs and RCBOs shall have a minimum clearance of 115 mm from the top, bottom and sides of the enclosure, and from accessories.

Distribution boards shall not have doors or escutcheons fixed in place by screws.

Distributing boards shall be coloured as follows:

a. Internal: White

b. External: Electric Orange X15

Irrespective of other requirements of this Design Standard, or project specific considerations, distribution boards shall meet the minimum design criteria listed in Table 6–2. NB: It may be necessary to exceed the minimum design criteria listed, based on project specifics considerations.

Table 6–6 Distribution boards – minimum design criteria

Characteristic	Minimum design criteria
Environmental conditions	40 degree rise above 50 degrees Celsius ambient temperature at full rated load, in a ventilated space
Rating	250 A
Prospective fault level rating	16 kA for 0.05 seconds
Degree of protection	IP65
Form of separation	Form 2

The form of separation shall be consistent across all buses in a single switchboard.

The construction of distribution boards shall incorporate the following elements:

a. An enclosure of unitary construction, fabricated from 1.6 mm minimum bright mild steel

b. All joints fully welded with continuous seam welds ground flush

c. Spot or tack welds or bolted or screwed construction is not permitted

d. Escutcheon shall be hinged using lift-off pintle-style hinges of staggered pin length

e. Escutcheon pintle-style hinges shall be arranged to permit the removal of the escutcheon when in the open position, and to permit 90-degree opening

f. Escutcheons shall be secured with chrome quarter-turn slotted locks

g. Doors shall be hinged using lift-off style pintle-style hinges of staggered length

h. Doors shall be provided to permit 135-degree opening

i. Doors shall be fitted with premium grade closed-cell door sealing gaskets with pressure sensitive adhesive

6.3.2.3 Locking

Where located in locked switchboard cupboards, distribution boards shall be provided with chrome plated lockable lever handles.

Where located outside of locked switchboard cupboards, distribution boards shall be provided with one of the approved proprietary products listed in Table 7–1.

Enclosures greater than 1200 mm in height shall be provided with two lever handles or three-point latching bars.

6.3.2.4 Main switch / isolator

Distribution board main switches / isolators shall be provided for each distribution board and shall be mounted at the top / centre of the distribution board.

Each chassis section shall be provided with a secondary section switch / isolator.

Main switch / isolator operating handles shall be integral with the main switch / isolator.

The escutcheon shall be neatly cut out around the isolator such that:

a. The escutcheon can be opened or removed with the main switch / isolation is in the ‘on’ position

b. The main switch / isolator can be operated with the escutcheon opened or removed

6.3.2.5 Neutral and earth bars

Locate neutral and earth bars at the base of distribution boards, spaced from the rear of the enclosure to provide sufficient clear termination access.

Provide double screw termination space on each bar for each pole position.

6.3.2.6 Cable management

For distribution boards up to 36 poles: provide minimum 60 mm wide and 80 mm deep slotted wiring duct for the full height of the chassis, on each side of the chassis, for sub-circuit wiring.

For distribution boards 48 poles and above: provide minimum 80 mm wide and 100 mm deep slotted wiring duct for the full height of the chassis, on each side of the chassis, for sub-circuit wiring.

6.3.2.7 Cables

All cables with a cross-sectional area greater than 10 mm^2 entering or exiting the switchboard shall be provided with cable glands using a non-metallic gland plate with a minimum thickness of 5 mm.

6.3.2.8 Controls

Distribution boards shall incorporate a separate section for control equipment and accessories.

The control equipment and accessories section shall have a minimum height of 400 mm and shall extend the full width of the distribution.

The control equipment and accessories section shall incorporate:

a. Two full width DIN rails, equally spaced

b. A metal segregation barrier between the mounting pan and the escutcheon to prevent inadvertent ingress of foreign material which may damage control equipment

c. Cable access for sub-circuits to pass through the section and exit through the bottom of the distribution board. This shall be achieved by extending the slotted wiring duct adjacent the chassis through this section

6.3.2.9 Surge protection devices

Secondary surge protection shall be provided at each distribution board assuming a location category of 'Category B'.

Circuit breakers protecting surge protection devices shall be mounted in a readily accessible position, allowing for ready reset without requiring exposure of live parts or isolation of any services.

6.3.2.10 Labelling

In buildings containing post-tensioned cables in the building structure, distribution boards shall be provided with signage as follows, with black text on a yellow background:

The concrete floor slabs and beams in this building contain post-tensioning cables critical to the building structural integrity, plus cast in concrete electrical services.

Accurate location of post-tensioning cables, reinforcement and building services by X-ray or scan is mandatory prior to any coring or drilling of the slabs and beams.

Under no circumstances shall any additional services be installed through the concrete floor slabs and beams without approval from UQ Property and Facilities Division. "As Built" drawings are available for information purposes only through PF Assist on 07 3365 2222 or pfassist@pf.uq.edu.au or https://www.pf.uq.edu.au/pfassist and do not remove the Contractors responsibility to X-ray or scan prior to any proposed work involving drilling or coring.

Distribution boards shall be provided with labels to identify all components.

Distribution boards shall be provided with labels on the outside of the switchboard to indicate the positioning of equipment that is concealed or not readily apparent from the outside of the switchboard. This shall include control equipment.

All labelling shall be provided by way of traffolyte labels which are machine engraved and screw fixed to exterior and/or escutcheon of the switchboard.

Distribution board labels installed on removable cable duct covers are not permitted.

Labelling shall be provided to distribution boards as listed in Table 6–7.

Table 6–7 Distribution boards – minimum design criteria

Component	Configuration	Lettering size	Colour	Example
DB label for DBs with single source of supply **Located externally and on escutcheon**	Distribution board name	12 mm	White lettering on black background	Refer Appendix A – Example labelling schemes
DB label for DBs with single source of supply **Located on escutcheon**	Distribution board name	12 mm	White lettering on black background	
DB label for DBs with multiple sources of supply **Located externally**	Distribution board name	12 mm	White lettering on black background	
	Warning text	12 mm	White lettering on red background	
DB label for DBs with multiple sources of supply **Located on escutcheon**	Distribution board name	12 mm	White lettering on black background	
	Warning text	12 mm	White lettering on red background	
Main switch **Located on escutcheon**	Component name	12 mm	Black lettering on white background	
	Rating (isolator); or Trip setting / maximum trip setting (circuit breaker)	6 mm		
	Cable configuration, size and type	6 mm		
Poles **Located on escutcheon**	Pole number	6 mm	Black lettering on white background	
Poles serving equipment with multiple sources of supply **Located on escutcheon**	Pole number	6 mm	Black lettering on white background	
	Warning text	6 mm	White lettering on red background	
Poles serving safety services **Located on escutcheon**	Pole number	6 mm	White lettering on red background	
	Circuit description	6 mm		
	Warning text	6 mm		

Component	Configuration	Lettering size	Colour	Example
Electrical meters **Located on escutcheon**	Description of metered load	12 mm	White lettering on black background	
	CT ratio (if applicable)	6 mm		
	Meter identifier	6 mm		
	Modbus address	6 mm		
Concealed CTs and potential links **Located on escutcheon**	Equipment description and position description	12 mm	White lettering on background	
Accessories, meters and other equipment **Located on escutcheon**	Equipment description	12 mm	White lettering on black background	
Concealed accessories meters and other equipment **Located on escutcheon**	Equipment description and position description	12 mm	White lettering on black background	

Labels indicating prospective fault levels and safe approach distances shall be provided at each main switchboard.

A type-written circuit schedule shall be mounted inside the door of each distribution board in a steel framed holder with a non-reflective plastic cover, describing the use of each circuit, its protective device type and rating, and sub-circuit cable size.

6.3.2.11 Non-essential distribution boards

Non-essential distribution boards are to be fed directly from non-essential submains cabling or a non-essential tap-off.

6.3.2.12 Essential distribution boards

Essential distribution boards are to be provided with a three-position changeover switch, with positions described as ‘essential’, ‘non-essential’ and ‘off’.

Putting the changeover switch in the ‘essential’ position shall supply the essential distribution board directly from essential submains cabling or an essential tap-off.

Putting the changeover switch in the ‘non-essential’ position shall supply the essential distribution board from a suitably rated supply in the adjacent non-essential distribution board.

Putting the changeover switch in the ‘off’ position shall isolate the essential distribution board.

6.3.2.13 Filtered power

Where filtered supplies are required on projects, the essential distribution board is to be sectioned into a filtered and non-filtered section.

The filtered section is to be supplied via a local mains power filter.

Mains power filters shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

6.3.3 Protective devices

6.3.3.1 General

A common manufacturer shall be used to provide all circuit breakers supplied on any single project.

All ACB-style and MCCB-style circuit breakers shall be installed with electronic trip units.

All circuits requiring earth leakage protection shall be protected using combined Residual Current Breakers with Overload (RCBOs). Use of standalone Residual Current Circuit Breakers (RCCBs) to protect several circuits is not permitted.

Circuit breakers installed in distribution boards shall be DIN rail mounted.

6.3.4 Cabling generally

6.3.4.1 General

Electrical cabling shall incorporate stranded copper conductors. The use of aluminium conductors is not permitted.

Irrespective of other requirements of this Design Standard, or project specific considerations, electrical cabling shall meet the minimum design criteria listed in Table 6–8.

Table 6–8 Electrical cabling – minimum design criteria

Conductor cross-sectional area	Service type	Conductor insulation	Conductor sheathing
All	Control cabling	V-75	PVC
≤ 4 mm^2	General services	V-90	PVC
	Safety services	X-HF-110	HFS-110-TP
> 4 mm^2	General services	X-90	PVC
	Safety services	X-HF-110	HFS-110-TP

Electrical cabling utilising Cross-linked Polyethylene (XLPE) insulation shall be rated to an operating temperature of 90 °C or higher.

Electrical cabling utilising Polyvinyl chloride (PVC) insulation shall be rated to an operating temperature of 75 °C or higher.

Consideration should be given to the use of Low Smoke Zero Halogen (LSZH) cabling insulation and sheaths in areas that facilitate evacuation in the case of an emergency.

All single core cables shall be arranged in trefoil formation to minimise electromagnetic emissions.

6.3.4.2 Joints

Joints in cables are not permitted under any circumstances.

6.3.4.3 Control cabling

Control cabling shall incorporate conductors with a minimum cross-sectional area of 1.5 mm^2.

Control cabling shall be identified by means of Z-type, full circle, slip-on ferrules fitted to both ends.

Where external connection is required, control cabling shall be terminated on terminal strips using one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

6.3.4.4 Colours

Distinctive and consistent colours shall be used for the insulation of all conductors throughout and installation.

Insulation of conductors shall be as listed in Table 7–9.

Table 6–9 Wiring colours

Wiring type	Insulation colour
Single-phase active wiring	Red
Three-phase active wiring	Red / white / blue
Neutral wiring	Black
Earth wiring	Green and yellow
Switch and control wiring	White with phase colour trace or number
Safety services, including fire services	Red

6.3.4.5 Terminations

Electrical cabling that is PVC insulated shall be fitted with crimp type lugs, fastened with the correct crimping tool, where they are to be connected to studs and switchboard terminals.

Electrical cabling shall be provided numbered ferrules, indicating circuit and neutral link numbers, to both the active and neutral conductors.

6.3.5 Submains cabling

6.3.5.1 General

Submains cabling shall be initially installed to provide spare capacity and flexibility as listed in Table 5–1.

Submains cabling shall incorporate conductors with a minimum cross-sectional area of 6 mm^2.

Irrespective of other requirements of this Design Standard, or project specific considerations, submains cabling shall meet the minimum design criteria listed in Table 6–10.

Table 6–10 Submains cabling – minimum design criteria

Conductor cross-sectional area	Cable configuration
≤ 50 mm^2	Multicore
> 50 mm^2	Single core

Consideration should be given to the use of busbar trunking systems for all submains rated at 1,200 Amps or more.

Where busbar trunking systems are utilised, they shall only be utilised for vertical portions of reticulation. Horizontal reticulation shall be undertaken using cable.

Full-sized neutral conductors shall be installed with each set of submains cabling. Half-sized and shared neutrals are not permitted.

6.3.5.2 Colour

Submains cabling colours shall be as listed in Table 6–11.

Table 6–11 Submains cabling – colours

Cabling type	Service type	Sheath colour
Single-core submains cabling	General services	Electric Orange X15
	Safety services	Red
Multi-core submains cabling	General services	Electric Orange X15
	Safety services	Red

Departures from these specified colours may be requested in writing to the Contract Administrator, however will only be approved in very specific circumstances at UQ's discretion.

6.3.5.3 Labelling

Labels for submains cabling shall be provided at the external point of entry and exit from associated switchboards / switchgear and in all cable pits.

Labels shall be provided at each end of each submains cable.

Labels shall be labelled to indicate conductor cross-sectional area, conductor material, insulation material, length, source and destination.

Labels shall be coloured as black text on yellow backgrounds.

Submains cabling labels shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

6.3.6 Sub-circuit cabling

6.3.6.1 General

Irrespective of other requirements of this Design Standard, or project specific considerations, sub-circuit cabling shall meet the minimum design criteria listed in Table 6–12.

Table 6–12 Sub-circuit cabling – minimum design criteria

Service type	Minimum conductor cross-sectional area	Load category	Conductor insulation	Conductor sheathing
Lighting	2.5 mm^2	General services	V-90	PVC
	2.5 mm^2	Safety services	X-HF-110	HFS-110-TP
General power	2.5 mm^2	General services	X-90	PVC
	2.5 mm^2	Safety services	X-HF-110	HFS-110-TP

Reticulation of sub-circuit cabling between floors of buildings is not permitted.

6.3.6.2 Colour

Sub-circuit cabling colours shall be as listed in Table 6–13.

Table 6–13 Sub-circuit cabling – colours

Cabling type	Service type	Sheath colour
Multicore sub-circuit cabling	General services	White
	Safety services	Red

Departures from these specified colours may be requested in writing to the Contract Administrator, however will only be approved in very specific circumstances at UQ's discretion.

6.3.7 Small power

6.3.7.1 General

All general power and lighting circuits shall be protected by an MCB with a minimum rating of 20 Amps.

All general power and lighting circuits shall be provided with earth leakage protection to meet the requirements of the reference documents listed in Table 3–2.

General power circuits shall service no more than six double socket outlets. Departures from this requirement may be requested in writing to the Contract Administrator, however will only be approved in very specific circumstances at UQ's discretion.

All general purpose socket outlets shall be manually switched, except in the case of auto switched soft wired outlets.

A common manufacturer shall be used to provide all of any one type of small power accessory supplied on any single project.

6.3.7.2 Provisioning and layout

Unless otherwise required by a specific project brief, socket outlets shall be provisioned as listed in Table 6–14.

Table 6–14 Socket outlets – provisioning

Space type	Minimum requirement
General	Two double socket outlets per 10 m^2 of floor area
Typical rooms	Three double socket outlets

Socket outlets shall be positioned to suit furniture and equipment layouts. This requires the Designer to consult with stakeholders prior to finalising their design.

Socket outlets shall be provisioned in amenities, locker rooms, cleaners' rooms, storerooms and plant rooms for general use.

Socket outlets shall be provided for cleaner's use, including within corridors, at a spacing of 12 m, to suit the trailing lead on cleaning equipment.

Socket outlets shall be provisioned in lecture theatres to facilitate laptop charging and other general use.

Socket outlets shall be provisioned in external spaces to facilitate laptop charging and other general use.

6.3.7.3 Internal socket outlets

Internal socket outlets shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

Double socket outlets shall be provided in all outlets that call for general socket outlets.

6.3.7.4 External socket outlets

Socket outlets in external spaces exposed to weather shall be rated at minimum IP 54, achieved by use of assemblies with a flap lid.

External socket outlets shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

6.3.7.5 USB charging

Socket outlets with integrated USB outlets shall be provisioned in meeting rooms, student rooms, library areas and lecture theatres.

Integral USB outlets shall be used for charging of electrical devices only, and are not intended for data transfer.

Integral USB outlets shall provide minimum 2.1 Amp charging current to permit charging of large electronic devices.

Integral USB outlets shall be provided as a combination of Type A and Type C USB outlet types.

6.3.7.6 Soft wiring

Soft wiring shall only be installed by qualified electricians, including within joinery or workstation systems. Installation by others is not permitted.

Soft wiring and softwired outlets shall be mechanically protected to prevent damage, and permanently secured within the installation.

Softwired outlets shall be auto switched, such that they are isolated until an electrical plug is fully inserted.

All extraneous conductive parts associated with a soft wiring installation, or workstation system, shall be earthed.

6.3.7.7 Mounting heights

Wall mounted general purpose socket outlets, which are not intended for use with specific equipment, and unless noted otherwise, shall be mounted at 300 mm above finished floor level (to the centre line of the accessory). This height shall be varied in the case of face brick walls, where the outlet shall be mounted in the centre of the brick nearest the indicated mounting position, and nearest to 300 mm above finished floor level.

6.3.7.8 Colour

Socket outlets shall be coloured as follows:

Table 6–15 Socket outlets – colours

Service type	Faceplate colour
Non-essential service	White
Essential service	Red
Critical service	Dark blue
Cleaner's outlets	Beige

Departures from these specified colours may be requested in writing to the Contract Administrator, specifically to integrate with the architectural aesthetic, however will only be approved at UQ's discretion.

6.3.7.9 Labelling

All socket outlets shall be marked to indicate the originating switchboard and circuit to which they are connected, including:

a. Details written on the accessory with indelible pen, beneath the faceplate and in a position where it is not visible when the faceplate is replaced

b. Brother-type label positioned at the top of the faceplate, in between outlets

Labelling to socket outlets shall be in the format of: <*distribution board identifier*>-<*circuit breaker number*>, eg “DB3-CB23”.

6.4 Cable containment

6.4.1 Cable trays and ladders

6.4.1.1 General

Cable trays and ladders shall be initially installed to provide spare capacity and flexibility as listed in Table 5–1.

Cable trays and ladders shall be heavy duty type.

Cable trays and ladders shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

Cable trays and ladders shall be pre-galvanised.

Consideration should be given to hot dip galvanised materials in environments prone to corrosion.

Cable trays and ladders shall be Electric Orange X15 powder coated.

Cable trays and ladders shall be rated to carry the weight of proposed conductors, including an allowance for spare capacity.

Fixers, fasteners and fixtures shall be of the same metallic type as cable ladders and trays to prevent galvanic corrosion.

Cable tray shall only be used up to and including 75mm wide. Cable ladder tray shall be used for cable containment greater than 75mm wide.

6.4.1.2 Routing

Cable trays and ladders shall be installed through corridors rather than through ceilings of adjacent rooms, wherever possible.

6.4.1.3 Earthing

All cable tray and cable ladder shall be earthed.

6.4.2 Cable ducts and skirting ducts

6.4.2.1 General

Cable ducts and skirting ducts shall be initially installed to provide spare capacity and flexibility as listed in Table 5–1.

6.4.2.2 Cable ducts

Cable ducts shall be constructed from minimum 1 mm thickness zinc anneal with a minimum of 14 mm on the front edges.

Cable ducts shall be provided with properly matching and fitting cover panels.

Cable duct cover panels shall be fixed to returns at intervals not exceeding 900 mm and shall be readily removable.

Cable ducts shall be electrically continuous.

Cable ducts shall be painted out to match surrounding wall colours unless specified otherwise.

6.4.2.3 Skirting ducts

Skirting ducts shall be three channel type, with the centre channel dedicated to fit off of all services outlets.

Skirting ducts shall have a minimum depth of 50 mm.

Services outlets shall be fitted to the body of skirting ducts.

The covers of skirting duct shall be removable without the removal of services outlets.

6.4.2.4 Earthing

All cable ducts and skirting ducts shall be earthed.

6.4.3 Catenary wire

6.4.3.1 General

Catenary wires shall support bundles of no more than six cables.

All circuits to be wired via looms and sockets within ceiling.

6.4.4 Conduit

6.4.4.1 General

Conduits shall be initially installed to provide spare capacity and flexibility as listed in Table 5–1.

Conduit runs longer than 50 m or that have in excess of three bends shall be further de-rated to 50% of the abovementioned capacity.

Conduits for electrical services shall be Electric Orange X15 coloured.

All conduits shall be installed with 6 mm blue/yellow poly draw ropes, regardless of whether the conduits have cabling installed.

6.4.4.2 Material

All conduits shall be rigid PVC type and shall be solid smooth walled.

All underground conduits shall be heavy duty rigid PVC type and shall be solid smooth walled.

Use of corrugated conduit is not permitted.

6.4.4.3 Sizing

Underground conduits shall meet the minimum sizing requirements as listed in Table 6–16.

Table 6–16 Conduit – sizing

Service type		Minimum conduit diameter
High voltage services		150 mm (nominal)
Low voltage services	Buried under slab or installed for future cabling access between blocks or buildings	100 mm (nominal)
	General services other than small power	100 mm (nominal)
	Street lighting and other minor services	32 mm (nominal), with appropriate reducers as necessary to facility entry of conduits to light poles

Above ground conduits shall meet the minimum sizing requirements as listed in Table 6–17.

Table 6–17 Conduit – sizing

Service type	Minimum conduit diameter
Low voltage services	25 mm (nominal)

6.4.4.4 Underground installations

Multiple conduits installed in a common trench shall be set out and spaced using conduit spacers.

The internal edge of conduits shall be chamfered to remove sharp edges, prior to joining bell ends of adjacent conduits.

All electrical conduits installed below the Defined Flood Level shall be sealed to prevent the ingress of floodwater.

6.4.4.5 Above ground installations

All conduits shall be concealed where possible.

6.4.4.6 Minimum Size

Indoor conduit shall be a minimum size of 25mm, class B. Plain conduit of class A will not be permitted.

6.4.5 Service pits

6.4.5.1 General

Service pits shall be provided to all cable pits and building entries

Service pits shall be arranged to provide a single continuous opening, consisting of single or multipart lids. Cantilevered tops shall be provided to adapt service the pit lid to the pit base where pits are wider than the lids.

Service pits shall be drained to stormwater via a dedicated 80 mm drain.

Service pits installed along multi-conduit runs shall provision for a 50 mm electrical conduit for lighting and ancillary services.

6.4.5.2 Construction

Service pits with multiple conduit entries shall be constructed from concrete and cast in situ, or be provided as precast products with concrete infill, gatic type lids.

The concrete infill of lids shall match the surrounding concrete.

Where installed in bitumen, the concrete infill of lids shall be black.

Service pits shall be constructed to be watertight. Particular care shall be taken when sealing pit lids to pit bases, to ensure the integrity of the waterproofing.

Support frames for service pit lids shall be mortar bedded on structural concrete. Reliance on unsupported frames, to support lids, is not permitted.

Service pit lids shall be selected for the required duty. Use of heavy-duty lids is to be restricted to areas of demonstratable need.

The use of brass trims is not permitted.

Where plastic pits are used, they shall be fitted with galvanised steel lids in gassed areas, and concrete or concrete infill lids for concrete and paved areas.

Galvanised steel lids shall be provided complete with underside return such that pit lids sit flush with the top pit surround.

A reinforced concrete mowing strip of minimum dimensions 200 mm wide by 400 mm deep shall be incorporated into all pits not installed in concrete surfaces.

6.4.5.3 Conduit entries

Conduit entries shall be positioned in the orientation of the long dimension of service pits.

Where a “T” junction service pit is require, the pit shall be extended in both the “straight through” and “T” directions to provide access for hauling, and to accommodate the bending radii of cables.

Where a right-angle change of direction is required, the pit shall be “L” shaped, and shall be extended in both directions to provide access for hauling, and to accommodate the bending radii of cables.

6.4.5.4 Dimensions

Service pits used for the hauling of electrical cables shall be of minimum dimensions 800 mm wide x 1,500 mm long x 900 mm deep.

6.4.5.5 Labelling

Service pits shall be labelled with brass labels. Labels shall be 27 mm high x 85 mm wide x 2 mm thick. Labels shall incorporate epoxy inkfill lettering with 15 mm high text. Labels shall be fixed to service pit lids using stainless screws into masonry plugs, and bedded in silicone, using 3 mm countersunk holes at 65 mm centres. Labels shall be recessed into service pit lids to create a flush surface.

A second identical label shall be fitted to the interior of the service pit.

Labels shall detail the service type, and a unique 3-digit code. For example, an electrical service pit labelled “E003” denotes:

a. “E” – electrical services

b. “003” – a number that is uniquely assigned to the site

6.5 Lighting

6.5.1.1 General

Designers shall provide a project-specific lighting submission as described in Table 7–2.

Luminaires shall incorporate LED lamp sources only or more efficient technologies as they are established. The use of incandescent, dichroic and fluorescent lamps is not permitted. NB: The requirements listed in this Design Standard are therefore focussed on luminaires that incorporated LED lamp sources. Luminaires incorporating other types of lamp sources should be individually assessed to meet the general intent of this Design Standard.

The Minimum Energy Performance Standards (MEPS) published by the Australian Government shall be observed for all luminaires.

6.5.1.2 Luminaire selection

Luminaires supplied on UQ projects shall be electrically safe and shall meet the requirements of the reference documents listed in Table 3–2.

Luminaires supplied on UQ projects that are in scope for the Australian / New Zealand Electrical Equipment Safety System (EESS) shall be:

a. Be marked with the Regulatory Compliance Mark (RCM)

b. Registered on the ERAC National Equipment Registration System for compliance with the Equipment Safety Rules (Level 2 and Level 3 equipment only)

c. Supplied by a responsible supplier registered on the ERAC National Equipment Registration System, as required under the Equipment Safety Rules

Luminaires supplied on UQ projects that are not in scope for the Australian / New Zealand Electrical Safety System (EESS) shall be:

a. Electrically safe, demonstrated by compliance with AS/NZS 3820

b. Registered on the ERAC National Equipment Registration System for compliance with relevant ACMA requirements

c. Supplied by a responsible supplier registered on the ERAC National Equipment Registration System, as required under the Equipment Safety Rules for an ACMA-only registration

Luminaires incorporating LED lamp sources shall utilise LED modules manufactured by one of the manufacturers listed in Table 7–1 or an equivalent approved by the Contract Administrator.

Diversity of luminaire selections on projects shall be minimised for ease of operation, maintenance and spares storage.

6.5.1.3 Maintenance factors

Maintenance factors shall be calculated using parameters as follows:

a. Elapsed time between luminaire cleaning, in years: 3.0

b. Lamp lumen maintenance factor (LLMF) (for luminaires incorporating LED lamp sources): to reflect the predicted lumen depreciation of the luminaire at 60,000 hours (maximum)

c. Lamp survival factor (LSF) (for luminaires incorporating LED lamp sources): 1.0, assuming immediate replacement upon failure

Other parameters shall be selected in accordance with AS/NZS 1680.4 or in accordance with manufacturer’s data.

6.5.1.4 Control gear

Luminaire control gear devices (drivers) shall be selected to provide flicker-free operation, defined as an output low frequency (< 120 Hz) current ripple of not greater than 5%, including for the full range of dimming. Such flicker shall not be observable by video or mobile phone camera.

Luminaire control gear devices (drivers) shall create a total harmonic distortion (voltage) not greater than 10%.

Where required, remote drivers shall be installed in accessible locations.

Remote drivers shall be provided with a descriptive label identifying the group of luminaires being controlled. A corresponding label shall be provided at the luminaires being controlled, to indicate the position of the remote driver(s).

6.5.1.5 Alternatives

Where alternative luminaires are put forward by contractors for consideration during or following a contract award, the proposed luminaires shall be accompanied by technical submissions as described in Table 7–3.

6.5.2 Internal lighting

6.5.2.1 Luminaire selection

Luminaires for internal lighting applications shall be selected to meet the minimum requirements listed in Table 7–18.

Table 6–18 Internal lighting – luminaire selection

Technical parameter	Minimum requirement
Operational ambient temperature range	0 °C – 35 °C
Configuration of LED modules	Zhaga certification preferred but not mandatory
Luminaire efficacy (NB: this is distinctly different to the efficacy of the installed LED modules)	≥ 80 lm/W
Correlated Colour Temperature (CCT)	4000 K unless otherwise approved by UQ
Colour Rendering Index (CRI)	$R_a \geq 80$, $R_9 \geq 50$
Colour consistency	3 MacAdam ellipses (Standard Deviation Colour Matching, SDCM)
Long-term projected lumen maintenance of individual LED chips or modules	L80 at 60,000 hours, as tested in accordance with ANSI/IES LM-80 and calculated in accordance with ANSI/IES TM-21
Long-term projected lumen maintenance of luminaires incorporating LED lamp sources	L80B10 at 60,000 hours, validated at operational temperatures derived from an In-Situ Thermal Management (ISTM) test in accordance with IES-84, AS/NZS 60598.1 and the relevant parts of AS/NZS 60598.2
Control gear lifetime	50,000 hours
Control gear surge protection, I_{max} (L/N – E)	2 kA
Product warranty, including luminaire, LED modules, LEDs and control gear	Five years, including labour required to repair or replace luminaires or components if failures are experienced, with no limit on the corresponding run time

Technical parameter	Minimum requirement
Flicker	All electric lights (except decorative lights, emergency lights and other special-purpose lighting) used in regularly occupied spaces meet at least one of the following requirements for flicker: ➢ A minimum frequency of 90 Hz at all 10% light output intervals from 10% to 100% light output ➢ LED products with a “low risk” level of flicker (light modulation) of less than 5%, especially below 90 Hz operation as defined by IEEE standard 1789-2015 LED Validation of flicker requirements shall be undertaken by a slow-motion video test.
Availability of documentation and test results	Other documentation: ➢ Registration and certification ➢ Photometric file provided in accordance with ANSI/IES LM-63 ➢ Warranty statement ➢ Test results: ➢ ANSI/IES LM-79 ➢ ANSI/IES LM-80 ➢ ANSI/IES LM-84 ➢ ANSI/IES TM-21 ➢ ANSI/IES TM-30 ➢ AS/NZS 60598.1 ➢ Relevant parts of AS/NZS 60598.2

6.5.2.2 Design

Internal lighting installations shall make provision for a basic grid of safe access lighting. Controls for safe access lighting shall be separate from controls for other parts of the lighting installation.

The calculated Unified Glare Rating (UGR) of internal lighting installations shall not exceed 19. To achieve this rating, the use of panel-type LED luminaires and LED downlights with shallow recessed light sources is generally not permitted.

The lighting power density, aggregated over an entire installation, shall not exceed 90% of the maximum calculated in accordance with Section J of the NCC.

Luminaires should generally be laid out in rows parallel to the longest window wall.

Consideration should be given to lighting installations incorporating tuneable white lamp sources to match human circadian rhythm cycles, especially in areas with minimal natural light penetration.

6.5.2.3 Controls

Automatic lighting control systems, incorporating occupant detection, absence detection, daylight harvesting, and time clock controls shall be provided to 95% of the floor area of all lighting installations.

The size of individually switched lighting zones in Class 5 and Class 9a spaces shall not exceed 100 m^2 for 95% of the floor area.

Internal lighting installations shall be programmed to hold on lighting during business hours. Business hours shall nominally be 7 am – 6 pm, however shall be

confirmed with UQ on a project by project basis.

6.5.2.4 Wiring

Luminaires installed into false ceilings shall be supplied by socket outlets securely mounted to the soffit immediately above each luminaire.

6.5.3 External lighting

6.5.3.1 Luminaire selection

Luminaires for external lighting installations shall be selected to meet the minimum requirements listed in Table 7–19.

Table 6–19 External lighting – luminaire selection

Technical parameter	Minimum requirement
Operational ambient temperature range	-20 °C – 50 °C
Ingress protection (IP rating)	IP 65 (maintained at front and rear of luminaire)
Impact resistance (IK rating)	IK 09 (for all luminaires mounted ≤ 2.5 m above the finished ground level)
Configuration of LED modules	Zhaga certification preferred but not mandatory
Luminaire efficacy (NB: this is distinctly different to the efficacy of the installed LED modules)	≥ 80 lm/W
Correlated Colour Temperature (CCT)	Security lighting: 4000 K Decorative / architectural lighting: 3000 K
Colour Rendering Index (CRI)	$R_a \geq 70$, $R_9 \geq 30$
Colour consistency	3 MacAdam ellipses (Standard Deviation Colour Matching, SDCM)
Long-term projected lumen maintenance of individual LED chips or modules	L80B10 at 60,000 hours, as tested in accordance with ANSI/IES LM-80 and calculated in accordance with ANSI/IES TM-21
Long-term projected lumen maintenance of luminaires incorporating LED lamp sources	L80B10 at 60,000 hours, validated at operational temperatures derived from an In-Situ Thermal Management (ISTM) test in accordance with IES-84, AS/NZS 60598.1 and the relevant parts of AS/NZS 60598.2
Control gear lifetime	50,000 hours
Control gear surge protection, I_{max} (L/N – E)	10 kA
Product warranty, including luminaire, LED modules, LEDs and control gear	Five years, including labour required to repair or replace luminaires or components if failures are experienced, with no limit on the corresponding run time

Technical parameter	Minimum requirement
Availability of documentation and test results	Other documentation: ➢ Registration and certification ➢ Photometric file provided in accordance with ANSI/IES LM-63 ➢ Warranty statement Test results: ➢ ANSI/IES LM-79 ➢ ANSI/IES LM-80 ➢ ANSI/IES LM-84 ➢ ANSI/IES TM-21 ➢ ANSI/IES TM-30 ➢ AS/NZS 60598.1 ➢ Relevant parts of AS/NZS 60598.2

Designers shall further consider the following parameters during selection of luminaires, to ensure suitability of selected products to their environment:

a. Optical performance

b. Suitability of light distribution for the application

c. Vandal resistance (IK rating)

d. Ingress protection (IP rating)

e. Ultraviolet stability

f. Corrosion resistance

g. Ease of access for maintenance

h. Energy management and associated controls

Luminaires for external lighting installations, mounted ≤ 2.5 m above the finished ground level, shall be provided with security screw fixings to access integral components of the luminaires and their mountings.

The use of bollard type luminaires will be subject to approval by UQ and shall not be relied upon as the primary source of external security lighting..

6.5.3.2 Design

New external lighting installations shall be designed giving strict regard to existing conditions. New luminaires, including appearance, effect, colour temperature, pole type, pole height, etc, shall be visually similar to existing luminaires and to the express approval of UQ, which shall be facilitated by submissions required by this Design Standard.

6.5.3.3 Controls

External lighting installations shall be controlled in separate groups, described as follows:

a. Architectural lighting

b. Security lighting

As a minimum, all external lighting shall be controlled via photoelectric cells driving a suitably rated contactor, with manual override at contactor in the local distribution board.

Photoelectric cells shall be provided as NEMA-based plug-in accessories, with a minimum rating of 16 A.

External security lighting shall be controlled via photoelectric cells only, to facilitate operation from dusk until dawn.

External architectural lighting shall be controlled via photoelectric cells with time clock override to observe lighting curfews. Time clock control shall be provided by the central BMS unless advised otherwise.

Use of time clock controllers without photoelectric cell override is not permitted.

6.5.3.4 Wiring

External lighting sub-circuits shall be copper, with V-90 conductor insulation and PVC conductor sheathing.

External lighting sub-circuits shall have a minimum cross-sectional area of 6 mm^2.

External lighting sub-circuit cabling, protective devices, switches and other accessories shall be rated to 150% of the expected electrical load.

External lighting circuits shall be protected by a residual current device (RCD), which may be a combined Residual Current Breaker with Overload (RCBO).

Luminaires mounted on poles shall be individually protected by a local protective device, such as an HRC fuse or MCB, and surge protection device.

In addition to the switched lighting supply, each light pole shall be provided with an unswitched supply to provision for CCTV cameras, WiFi repeaters, etc. Separate entries shall be provided for communications, security and other extra-low voltage services, to achieve the required segregation.

6.5.3.5 External emergency lighting

Emergency escape lighting and exit signs shall be provided to external areas to illuminate specific hazardous identified by the Designer, including external stairs. Such emergency escape lighting and exit signs shall be provided to meet statutory requirements, regardless of the statutory requirement to provide such lighting in an external space.

6.5.3.6 Light poles

Light poles shall be galvanised, powder coated black, or stainless steel, complete with rag bolt mounting and acorn nuts.

Light poles shall incorporate an inspection plate near ground level, to facilitate maintenance or new installations. The inspection plate shall conceal the required local protective device and surge protection device.

Underground conduits servicing light poles shall turn up within light poles a minimum of 100 mm above finished ground level.

Underground conduits servicing light poles shall be run into and out of each pole. Use of underground tees in conduits is not permitted.

An exit conduit, installed complete with draw wire, is to be provided at the last pole of each run, for ease of connection of future poles.

Light poles with heights greater than 4.5 m shall be provided with dedicated service pits to facilitate cable reticulation. Such service pits shall be positioned in line with the trunk conduit, with the spur / branch being directed to the light pole.

Light poles shall be wired using a loop-in, loop-out system. Cable terminations and joints in service pits are not permitted.

Light poles shall be selected to meet the design criteria listed in Table 6–20.

Table 6–20 Light poles – minimum design criteria

Category	Pole height	Pole outreach
Major streets	10.5 m	1.5 m – 3 m
Minor streets	9 m	1.5 m – 3 m
Carparks	9 m	1.5 m – 3 m (dual)
Walkways	4.5 m	Side entry or top entry

Switchboards or other enclosures, for example, control gear enclosures, shall be securely locked, using the proprietary product listed in Table 7–1 or an approved equivalent.

Where required and approved, external signs shall be illuminated using LED flood lights, which shall be selected for high energy efficiency, vandal resistance and minimisation of glare and associated light spill. Associated control gear shall be mounted above ground in an accessible location. All such installations must be approved by UQ.

6.5.3.7 Labelling

Light poles shall be marked to indicate the pole number, building number, distribution board identifier and circuit to which they are connected, including:

a. Details engraved on a narrow unbevelled brass plate, screw fixed to the pole in a vertical orientation on the kerb side of the pole

b. The mounting height of the label shall be approximately 1 m above finished ground level

c. Fixing screws shall be stainless steel vandal-proof type to prevent removal

Labelling to light poles shall be in the format of: <pole number>-<building number>-<distribution board identifier>-<circuit breaker number>, eg “P23-98B-DB3-CB23”.

Pole numbers shall be designated by UQ.

6.5.3.8 Light pollution

External lighting installations shall be designed to minimise the effects of obtrusive lighting on adjacent properties and roadways.

External lighting installations shall be designed to minimise pollution to the night sky. Light pollution to the night sky shall be limited through one of the following requirements:

a. Upward Light Output Ratio (ULOR) of all luminaires shall not exceed 5%; or

b. The direct contribution from an external lighting installation shall not exceed initial point illuminances of 0.5 lux at the site boundary, and 0.1 lux at 4.5 m into the night sky.

Designers shall take specific care in the design of façade lighting systems and note that previous installations have resulted in increased insect activity, and therefore increased cleaning requirements.

6.5.4 Lighting controls

6.5.4.1 General

Internal and external lighting installations shall be controlled using a lighting control system, which may comprise some or all of the following components:

a. Manual switches

b. Door limit switches

c. Lighting control panels

d. Occupancy and absence sensors, including for corridor hold functionality

e. Time clock controls

f. Photoelectric daylight sensors, including for daylight harvesting functionality

g. Intelligent, networked and addressable dimming systems, including user interfaces for commissioning, programming and operation

A common manufacturer shall be used to provide all of any one type of lighting control accessory supplied on any single project.

6.5.4.2 Manual switches

Manual switches shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

Manual switches shall be rated to 15 Amps.

Manual switches should generally be flush mounted and provided in white, except where otherwise required to integrate with architectural detailing.

Manual switches shall be grouped in logical locations and as listed in Table 6–21.

Table 6–21 Lighting control – switch grouping

Scenario	Switch grouping
Not more than four switches in the one location	Grouped under a single faceplate, using the nominated accessory
Five or more switches in the one location	Grouped under a single plate, using a satin finished stainless steel face plate, engraved to indicate the area controlled by each switch

Individual switch mechanisms for safe access lighting shall be red coloured.

Spaces controlled using occupancy and absence sensors shall be provided with manual override switches to permit luminaires to be overridden ‘off’.

Programmable time delay switches shall have an adjustable run on time, configurable between 1 – 120 minutes.

All manual switches shall be marked to indicate the originating switchboard and circuit to which they are connected, including:

a. Details written on the accessory with indelible pen, beneath the faceplate and in a position where it is not visible when the faceplate is replaced

b. Brother-type label positioned at the top of the faceplate

Labelling to manual switches shall be in the format of: <*distribution board identifier*>-<*circuit breaker number*>, eg “DB3-CB23”.

Wall mounted switches, unless noted otherwise, shall be mounted at 1100 mm above finished floor level (to the centre line of the accessory). This height shall be varied in the case of face brick walls, where the outlet shall be mounted in the centre of the brick nearest the indicated mounting position, and nearest to 1100 mm above finished floor level.

6.5.4.3 Door limit switches

Industrial quality door limit switches shall be provided to substation access doors, wired in parallel with manual light switches, to automatically turn on lighting upon entry to substations.

6.5.4.4 Occupancy and absence sensors

Occupancy and absence sensors shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

Occupancy and absence sensors should generally be provided with an ancillary relay output such that activation of a sensor in an open plan area, meeting room, etc will hold on adjacent corridor lighting while a space is occupied.

Occupancy and absence sensors shall be provided with an unswitched active supply to facilitate their function.

Occupancy and absence sensors shall have an adjustable run on time, configurable between 1 – 30 minutes. Sensors shall be set to a run on time of 10 minutes unless otherwise directed by UQ.

Spaces controlled using occupancy and absence sensors shall be provided with 24 hour, low powered LED luminaires corridors and other access ways to provide basic orientation lighting.

6.5.4.5 Time clock controls

Time clock controls shall be governed by the local BMS. Use of standalone time clock controllers is not permitted.

6.5.4.6 Photoelectric daylight sensors

Daylight harvesting functionality should be considered for external lighting applications only.

Daylight harvesting functionality should preferably drive the dimming of luminaires in response to the available natural daylight, as opposed to on / off switching, so as to avoid occupant agitation.

Photoelectric daylight sensors should be placed in areas where there is adequate, uninterrupted natural daylight, sufficient to reliably activate the sensors.

Photoelectric daylight sensors shall be provided in external lighting applications as listed in Table 6–22.

Table 6–22 Lighting control – photoelectric daylight sensors

Installation type	Sensitivity	Time delay	Trigger
External applications	Adjustable between 2 lux and 100 lux	2 minutes	Changes of greater than 50 lux

6.5.4.7 Intelligent, networked and addressable lighting control systems

Lighting control systems utilising a Digital Addressable Lighting Interface (DALI) protocol shall preferably operate in a broadcast fashion, allowing luminaire control gear to not require digital addressing. Use of DALI or similar protocols for individually addressing luminaire control gear shall be subject to approval by UQ.

6.5.4.8 Interfacing with audio visual systems

Spaces requiring lighting scenes to be interfaced with audio visual equipment (eg projection, video conferencing, presentations, etc) shall be provided with one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

The use of intelligent, networked and addressable lighting control systems should be considered in other areas for the benefits associated with ease of maintenance and reporting.

The audio visual and lighting control systems shall be interfaced by way of an ethernet gateway integration device.

In such areas:

a. The lighting control system shall not directly respond to commands received from user interfaces, including lighting control panels and lighting control sensors

b. Lighting controls shall primarily be available at the audio visual control panel, which shall call logical lighting areas, channels and dimming levels automatically dependent on which audio visual function is selected

c. Independent lighting control panels shall be provided at the entrances to each space, and shall be limited to basic on / off functionality

d. As for lighting control sensors, the lighting control panels shall call phantom preset scenes, which shall in turn trigger the audio visual control system to call the appropriate logical lighting areas, channels and dimming levels

e. Lighting control panels shall be one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator

Each teaching space shall be considered a single zone. Logically, each zone shall have at least one area assigned to it, with several corresponding logical lighting channels. Logical lighting areas and channels shall be standardised as far as practical across all spaces and systems as described in Table 6–23 and Table 6–24.

UQ does not typically programme fixed lighting presets. Instead, the audio visual control system shall call logical areas and channels with corresponding dimming levels.

The scope of the lighting control programmer shall be to confirm the correct operation of all fittings with the electrical contractor, then setup addressing with the audio visual contractor.

Where room joins are possible, each join shall have a base link area. All subsequent lighting calls in ‘join mode’ shall be routed via this area.

Table 6–23 Standardised logical lighting areas

Logical area	Address
Default base link area for joinable areas	10
First teaching area	11
Second teaching area	12
…and so on	…and so on
Phantom areas for lighting control panels	150+
Phantom areas for lighting control sensors	200+

Table 6–24 Standardised logical lighting channels

Logical channel	Address
Dimmable downlights	1
Dimmable presenter lights	2
Dimmable wall washing lights	3
Dimmable profile lights	4
Dimmable overhead lighting, or first bank of overhead lighting	5
Second bank of overhead lighting (if present)	6
Board lights	7
Step lights	8
Aisle lights	9
In use lighting	10

Refer also corresponding interface requirements of UQ's Audio Visual Design Standard.

6.5.5 Emergency escape lighting and exit signs

6.5.5.1 General

Emergency escape luminaires and exit signs shall be provided as self-contained single point units. The use of centralised battery systems is not permitted.

Emergency escape luminaires and exit signs shall be connected to the unswitched active supplies from the nearest local lighting circuit.

Emergency escape luminaires and exit signs shall incorporate:

a. LED lamp sources

b. Lithium iron phosphate or lithium nanophosphate batteries, with a minimum guaranteed warranty of 5 years with 6-monthly discharge tests

c. Ancillary LED indicator to provide a visual indication of the state of battery changing and the mains supply

d. Integral 'test' buttons

e. Integral 'reset' buttons

f. Communications interfaces to suit the systems listed in the following sections

Local distribution boards supplying emergency escape luminaires and exit signs shall incorporate an emergency test facility regardless of the presence of an automatic, computerised testing and monitoring system.

Emergency escape luminaires and exit signs shall be labelled with their own unique fixture identification number.

6.5.5.2 Emergency escape lighting

In addition to required locations, emergency escape lighting shall be provided to main switchrooms to illuminate the front and rear faces of main switchboards.

6.5.5.3 Exit signs

Exit signs in auditoriums, large lecture theatres and other presentation spaces shall be provided as theatre-types with a green pictograph on a black background.

Exit signs shall be integrally illuminated and maintained. The use of externally illuminated or photoluminescent exit signs is not permitted without the express permission of UQ.

6.5.6 Emergency escape lighting and exit sign systems

6.5.6.1 General

UQ operates two types of emergency lighting systems across its campuses, with variants for each, being:

a. Clevertronics Zoneworks LW

b. Clevertronics XT Powerline

c. Stanilite Nexus LX

d. Stanilite Nexus RF

The project brief will generally define which type of system is to be used on a particular project. Where this brief is absent, designers shall seek guidance from UQ prior to proceeding with design work.

Dedicated servers are provided for each system. UQ will provide access credentials to approved contractors on request.

6.5.6.2 Clevertronics systems

Clevertronics emergency escape lighting and exit signs shall be provided as the approved proprietary products listed in Table 7–1 or equivalents approved by the Contract Administrator.

Prior to completion of any project, the existing, central Clevertronics emergency lighting and exit sign database shall be updated to reflect the location and unique identifier of all new emergency escape luminaires and exit signs.

Required routers and injectors shall be installed in segregated sections of local distribution boards.

Required network devices (for example, iLons and SmartServers) shall be located in main switchrooms.

Emergency escape luminaires and exit signs shall be allocated to system routers in a logical manner, and always to the same router as other fixtures on the same building level.

The number of emergency escape luminaires and exit signs assigned to a single router shall not number more than 55.

Commissioning of Clevertronics installations shall be undertaken by the manufacturer's approved agent. Contractors shall engage the manufacturer's approved agent directly to test the installation, and certify that it is complete, functioning correctly, and that the existing, central database has been updated to reflect the new installation, including any associated demolition.

Certification provided by the manufacturer's approved agent shall form part of the acceptance of the emergency escape lighting and exit sign installation, which shall be required for the issue of practical completion of the project.

6.5.6.3 Stanilite systems

Stanilite emergency escape lighting and exit signs shall be provided as the approved proprietary products listed in Table 7–1 or equivalents approved by the Contract Administrator.

Prior to completion of any project, the existing, central Stanilite emergency lighting and exit sign database shall be updated to reflect the location and unique identifier of all new emergency escape luminaires and exit signs.

Required network devices (for example, iLons) shall be located in main switchrooms.

Emergency escape luminaires and exit signs shall be allocated to system routers in a logical manner, and always to the same router as other fixtures on the same building level.

The number of emergency escape luminaires and exit signs assigned to a single router shall not number more than 55.

Commissioning of Stanilite installations shall be undertaken by the manufacturer's approved agent. Contractors shall engage the manufacturer's approved agent directly to test the installation, and certify that it is complete, functioning correctly, and that the existing, central database has been updated to reflect the new installation, including any associated demolition.

Certification provided by the manufacturer's approved agent shall form part of the acceptance of the emergency escape lighting and exit sign installation, which shall be required for the issue of practical completion of the project.

6.6 Electromagnetic interference

Electrical installations shall be designed in accordance with the Australian Standards and other reference documents relevant to electromagnetic interference and compatibility. In addition of the requirements of the standards, electrical installations shall incorporate best practice design elements, for example:

a. Arrangement of consumer mains and major submains cables in trefoil to balance and negate generated electromagnetic fields

b. Reticulation of consumer mains cables underground

c. Separation of consumer mains and major submains cable reticulation from inhabited areas and equipment sensitive to electromagnetic interference

6.7 Spatial planning

Primary electrical services spaces, specifically including those supporting safety services, shall be positioned minimum 0.5 m above the 1% AEP flood level from the 2017 Brisbane River Catch Flood Study (for Brisbane-based sites), or 0.5 m above the Defined Flood Level (for other sites).

6.7.1 Substations and high voltage switchrooms

6.7.1.1 General

The spatial planning of substations shall meet the minimum criteria listed in Table 6–25.

Table 6–25 Substation spatial planning – minimum design criteria

Characteristic	Minimum criteria
Dimensions	➢ 16.6 m length x 6.8 m width x 3.6 m height ➢ This arrangement allows for equipment access along the 6.8 m side. Should individual access to transformers and other equipment be available along the 16.6 m, then the 6.8 m dimension can potentially be reduced
Personnel access and egress	➢ Two diagonally opposite or otherwise geographically diverse exits to unsecured, and preferably external areas ➢ Doors shall facilitate quick and unimpeded egress through use of panic exit devices
Equipment access	➢ Dual 2.4 m wide, weatherproof, louvered doors for equipment access ➢ Direct ramped access to vehicular service way

Substations should preferably be located adjacent main switchrooms and major plant centres, such as mechanical chillers.

Substations shall be provided with in-floor trenches for high voltage and low voltage cabling. Minimum trench dimensions shall be 1.2 m depth x 0.8 m width with length to suit switchgear, etc.

Substations shall be keyed using the B1 series from UQ's Abloy keying system.

6.7.2 Main switchrooms

6.7.2.1 General

The spatial planning of main switchrooms shall meet the minimum design criteria listed in Table 6–26.

Table 6–26 Main switchroom spatial planning – minimum design criteria

Characteristic	Minimum criteria
Dimensions	➢ 6 m length x 4 m width x 3 m height
Personnel access and egress	➢ Two diagonally opposite or otherwise geographically diverse exits to unsecured, and preferably external areas ➢ Doors shall facilitate quick and unimpeded egress through use of panic exit devices
Equipment access	➢ Single 0.9 m width x 2.2 m height door for equipment access

A cable trench shall be installed for the full width of main switchboards, extending 1 m beyond either side of the switchboard.

6.7.3 Electrical risers

6.7.3.1 General

Electrical risers and other instances of major submains cabling shall be positioned to minimise EMF radiation into occupied spaces.

Electrical risers shall be dedicated to electrical cabling.

6.7.3.2 Electrical riser cupboards

Electrical riser cupboards shall be sized to accommodate distribution boards, cable containment, tee-off boxes and other ancillary equipment such as emergency lighting controllers, lighting control system controllers, etc.

Building Distribution Board Cupboards - provide space as required to accommodate electrical services riser cable ladder, tee-off boxes (if applicable), distribution boards and ancillary equipment such as emergency lighting or dimmer controls and devices.

Electrical riser cupboards shall be keyed using the electrical services series from UQ's Abloy keying system.

Electrical riser cupboards shall be provided permanent lighting, emergency lighting, a double general use socket outlet and a double data outlet. Emergency lighting may be situated in the space directly in front of the riser cupboard so as to also service general areas.

Irrespective of other requirements of this Design Standard, or project specific considerations, the spatial planning of electrical risers and riser cupboards shall meet the minimum design criteria listed in Table 6–27.

Table 6–27 Electrical riser spatial planning – minimum design criteria

Characteristic	Minimum criteria
Dimensions	➢ 1800 mm length x 800 mm depth x full height
Equipment access	➢ Doors to provide access to the full width of the electrical riser ➢ Doors shall not be fitted automatic re-locking devices ➢ Doors shall be lockable in the open and closed positions

6.8 Special installations

In addition to other requirements in this Design Standard, special installations shall also meet the requirements set out in this section.

6.8.1 Laboratories

6.8.1.1 Power distribution

Laboratories shall be provided with separate and dedicated essential and non-essential distribution boards supplied by separate and dedicated submains cabling.

6.8.1.2 Set out of electrical accessories

Wall mounted general purpose socket outlets shall be mounted at 300 mm above the finished floor level, or above the adjacent surface (for example, benchtop, counter, cupboard) (to the centre line of the accessory.

NB: It may be necessary to alter the positions and mounting heights outlets to meet hazardous area classifications.

6.8.1.3 Emergency shutdown buttons

Emergency shutdown buttons shall be installed adjacent all entrances to laboratories.

Operation of emergency shutdown buttons shall immediately disconnect essential and non-essential supplies to distribution boards supplying services within the laboratory.

Operation of emergency shutdown buttons shall also immediately disconnect gas supplies within the laboratory.

Reset of electrical and gas supplies after the operation of an emergency shutdown button shall require manual intervention.

Temporary loss of electrical supply to a laboratory shall automatically disconnect gas supplies within the laboratory.

Reset of gas supplies after automatic disconnection due to a temporary loss of electrical supply shall require manual intervention.

6.8.2 Hazardous areas

Some buildings may house functions requiring hazardous areas assessment and zoning. Some examples may include chemical stores,

gas cylinder storage areas and dust extraction facilities.

In such instances, an expert with the appropriate hazardous area qualifications and competencies shall be engaged to undertake a hazardous areas assessment and zoning exercise.

An expert with the appropriate hazardous area qualifications and competencies shall also undertake an audit and certification of the completed installation. This audit and certification shall occur prior to energisation of electrical services.

In hazardous areas, the design and installation of electrical services shall be undertaken strictly in accordance with the outcomes of the hazardous areas assessment and zoning exercise.

6.8.3 Main communications rooms

6.8.3.1 Power distribution

Building communications rooms shall be provided with a dedicated essential distribution board supplied by dedicated submains cabling direct from the main switchboard.

Essential supplies to building communications rooms shall be filtered.

Mains power filters shall be provided as one of the approved proprietary products listed in Table 7–1 or an equivalent approved by the Contract Administrator.

07 Schedules

7.1 Nominated proprietary equipment specifications

Table 7–1 Nominated proprietary equipment specifications

Equipment type	Nominated specification	Design Standard reference
HV protection relays (without reverse power flow protection)	➢ Schneider Electric / Micom P121	Section 6.1.5.1
HV protection relays (with reverse power flow protection)	➢ Schneider Electric / Micom P127	Section 6.1.5.1
RMU / main switchboards gateway device	➢ Red Lion / TRZR, complete with Red Lion / CSDIO14R and Red Lion / XCRS0000	Section 6.1.6.1 & 6.1.8.4
RMU DC power supplies	➢ Schneider Electric / PS100 48 VDC	Section 6.1.6.1
Primary surge protection devices	➢ ERICO / Transient Discriminating MOVTEC Series ➢ Novaris / SDN3 Series ➢ Emerson / SolaHD 200/400K Series	Section 6.1.8.13
PV module optimisers	➢ Solar Edge / Power Optimiser	Section 6.1.12.3
Electrical meters – high voltage layer	➢ Schneider / PowerLogic ION9000	Section 6.2.2.1
Electrical meters – upstream layer	➢ Schneider Electric / PowerLogic PM5350	Section 6.2.2.1
Electrical meters – downstream layer	➢ Schneider Electric / PowerLogic PM5350	Section 6.2.2.1

Equipment type	Nominated specification	Design Standard reference
Electrical meters – cost recovery layer	➢ Schneider Electric / iEM 3350 (NMI approved)	Section 6.2.2.1
Electrical meters – components	End clamp ➢ Eaton / ES35PA 2 A circuit breaker ➢ Eaton / NT102C Beige terminal ➢ Eaton / RK6-10PA Beige end plate ➢ Eaton / AP2.5-10PA Fuse terminal ➢ Eaton / STKIPA 2 A fuse ➢ Eaton / SIK252A 4 mm test socket ➢ Eaton / STB14/4 Red terminal ➢ Eaton / RK6-10PAR Red end plate ➢ Eaton / AP2.5-A0PAR White terminal ➢ Eaton / RK6-10PAW White end plate ➢ Eaton / AP2.5-10PAW Blue terminal ➢ Eaton / RK6-10PAB Blue end plate ➢ Eaton / AP2.5-10PAB	Section 6.2.2.2
Electrical meters – gateways	➢ Red Lion Modular Controller / CSMSTRGT ➢ A WAGES hub will be coupled to these devices in certain instances	Section 6.2.2.4
Electrical meters – RS485 cabling	➢ Hartland Cables / 2 pair screened / HCY097	Section 6.2.2.4
Electrical meters – signal line surge protection devices	➢ Novaris / SL485/EC90	Section 6.2.2.4
Distribution boards	➢ Eaton / EWQ Plus Series ➢ NHP / Concept Premier UNIQ Series	Section 6.3.2.1

Equipment type	Nominated specification	Design Standard reference
Mains power filters	➢ ERICO / Surge Reduction Filter N-Series	Section 6.3.2.13, 6.8.3.1
Distribution board locks	➢ Abloy / University A2 Series, 'Garage Door' style	Section 6.3.2.3, 6.5.3.6
Control cabling – terminal strips	➢ Sprecher + Schuh	Section 6.3.4.3
Submains cabling labels	➢ Critchley / Z-type (up to 50 mm^2) ➢ Critchley / Permark (above 50 mm^2)	Section 6.3.5.3
Socket outlets – internal	➢ Clipsal / 2000 Series	Section 6.3.7.3
Socket outlets – external	➢ Clipsal / 56 Series	Section 6.3.7.4
Cable containment – cable tray	➢ Burndy ➢ EzyStrut	Section 6.4.1.1
Cable containment – cable ladder	➢ Burndy ➢ EzyStrut	Section 6.4.1.1
Luminaires – LED modules	➢ Philips ➢ CREE ➢ Tridonic ➢ Samsung	Section 6.5.1.2
Lighting control – manual switches	➢ Clipsal / 2000 series	Section 6.5.4.2
Lighting control – occupancy and absence detection	➢ iAutomation / BEG	Section 6.5.4.4
Lighting control – lighting control systems	➢ Philips Dynalite	Section 6.5.4.7
Lighting control – lighting control panels for audio visual controlled spaces	➢ Philips Dynalite / Antumbra PA2BPA-AA-L ➢ Order code (12NC): 913703035609 Finishes: ➢ American Style / 2-button / Aluminium Rim / Aluminium Button / Labels for 'on' and 'off' Finishes may be adjusted to suit architectural selections. Two-button panel preferred, however six-button panel acceptable to suit availability, in which case, four lower buttons remain unused.	Section 6.5.4.8

Equipment type	Nominated specification	Design Standard reference
Emergency escape lighting and exit signs – Clevertronics systems	System types: ➢ Clevertronics LW ➢ Clevertronics XT Powerline ➢ Clevertronics XT Hive Product types: ➢ L10 Lithium Nanophosphate	Section 6.5.6.2
Emergency escape lighting and exit signs – Stanilite systems	System types: ➢ Stanilite Nexus LX ➢ Stanilite Nexus RF Product types: ➢ Platinum	Section 6.5.6.3

7.2 Design submissions

The submissions listed in Table 7–2 may be undertaken by a consultant or contractor depending on the procurement methodology of the project.

The submission timing noted shall be adjusted as necessary to suit individual project programs.

Table 7–2 Design phase submissions

Submission	Description	Reviewer	Timing (to be aligned with PREM process)	Design Standard Reference
Whole of life assessments	Designers shall prepare whole of life assessments for all major components. Assessments shall include: ➢ Multi-criteria analysis across major components, to consider capital cost, operational costs, life expectancy and replacement, and sustainability ➢ Value of investment decisions in present day value for comparison	UQ	End of schematic design	Section 5.5
Utility Authority Connection Application	Designers shall provide a connection application to the Utility Authority as detailed by the Utility Authority: https://www.energex.com.au/home/our-services/connections/business/new-connections	Utility Authority	To suit the project program	Section 6.1.1.2, 6.1.1.3
Maximum demand calculations	For the purposes of planning new connections for projects, designers shall provide a maximum demand calculation for endorsement, calculated in accordance with Clause 2.2.2 of AS/NZS 3000. Distinguish between essential and non-essential loads. During preliminary design phases, the maximum demand shall detail the entire building load. During detailed design phases, the maximum demand shall detail the estimated demand at a distribution board level.	UQ (in the case of existing HV customer sites) or Utility Authority (in the case of new HV or LV customer sites)	End of schematic design. Calculation to be maintained and further detailed throughout later design phases	Section 6.1.1.4
Discrimination study report	a. Designers shall provide a report summarising the findings of the discrimination study for the electrical installation, including: i. Prospective three-phase and earth fault levels at each HV equipment site	UQ	Prior to submission of final construction documentation	Section 6.1.1.5

Submission	Description	Reviewer	Timing (to be aligned with PREM process)	Design Standard Reference
	ii. Prospective three-phase and earth fault levels at each distribution transformer iii. Time-current curves for each protection device in the long-time (overload) zone, overlaid on a single chart. In the case of ring main HV distribution, two charts are required; one for supply from each side of the ring iv. Time-current curves for each protection device in the short-time (short circuit) zone, overlaid on a single chart. In the case of ring main HV distribution, two charts are required; one for supply from each side of the ring v. Time-current curves for each protection device, overlaid on a single chart. In the case of ring main HV distribution, two charts are required; one for supply from each side of the ring vi. Required settings for all adjustable protection devices			
Arc flash hazard severity assessment	Designers shall provide a submission summarising the outcome of an arc flash hazard severity assessments The assessment shall include the qualification of arc flash energy in accordance with the Australian Energy Council Electrical Arc Flash Hazardous Management Guideline, which in turn is based on the international standard IEEE 1584 and Energy Network Australia's NENS 09 Guideline. The designer shall undertake all necessary power systems studies (eg fault level studies) and field investigations in order to determine arc fault hazard severity at the electrical location under consideration. The assessment shall summarise:	UQ	Prior to submission of final construction documentation	Section 6.1.5.1, 6.1.8.2

Submission	Description	Reviewer	Timing (to be aligned with PREM process)	Design Standard Reference
	a. The arc flash incident energy (cal/cm^2) at a pre-defined working distance away from exposed terminals b. The arc flash boundaries in a three-phase AC system to which workers may be exposed during their work or where near electrical equipment c. The rating of required Personal Protective Equipment (PPE) d. The minimum safe approach distances to exposed terminals without additional PPE			
Utility Authority Embedded Generation Application	Designers shall provide an embedded generation application to the Utility Authority as detailed by the Utility Authority: https://www.energex.com.au/home/our-services/connections/major-business/large-generation-and-batteries	Utility Authority	To suit the project program	Section 6.1.10.1
Generator system submission	Designers shall provide a submission summarising the make up and functionality of the generator system, including: a. Full functional description b. Control system description c. The intended make and model of the generator alternator and engine, and associated technical datasheets d. Plan layout of generator system Fuel consumption calculations.	UQ	Prior to submission of final construction documentation	Section 6.1.10.1
Photovoltaic system submission	Designers shall provide a submission summarising the make up and functionality of the photovoltaic system, including: a. Full functional description b. The intended make and model of PV panels, inverters and other system components	UQ	Prior to submission of final construction documentation	Section 6.1.12.1

Submission	Description	Reviewer	Timing (to be aligned with PREM process)	Design Standard Reference
	c. The effect on performance of the photovoltaic system due to shading by adjacent plant and equipment, and the building structure d. Details of electrical protection as required by the Utility Authority e. Shop drawings of the PV system, including: i. Site plan, indicating all adjoining streets and the magnetic north point) ii. Location of incoming electrical and communications lead in cables, and associated points of connections iii. Location of transformer (if applicable), site main switchboard, metering panel and all distribution boards on site iv. Electrical single line diagram for the complete photovoltaic system v. General arrangement for the complete photovoltaic system, including details of require access and maintenance clearances vi. Electrical single line diagram, indicating connection of photovoltaic system into the electrical reticulation system vii. Locations of inverters, data loggers and authority meters viii. Locations of all cable routes, including underground cabling, pits and conduits affected by the works ix. Parts schedule of all equipment x. Local Utility Authority contact details xi. Main switchboard spare load capacity			

Submission	Description	Reviewer	Timing (to be aligned with PREM process)	Design Standard Reference
	xii. Consumer mains spare load capacity xiii. Control diagrams xiv. Details for the support structure for photovoltaic modules			
Lighting protection system submission	Designers shall provide a submission summarising the make up and configuration of the lighting protection system, including: a. Lighting protection risk assessment b. Layout drawing indicating air terminal locations and heights c. Conductor type, size and protection requirements for all down conductors and other types of conductors d. Bonding requirements e. Details of any separating earthing systems (where applicable) f. Testing requirements	UQ	Prior to submission of final construction documentation	Section 6.1.13.1
Metering system submission	Designers shall provide a submission summarising the make up and configuration of the photovoltaic system, including: a. Full functional description b. List of electrical loads to be metered c. Make and model of meters proposed d. Electrical single line diagram indicating where the meter(s) fit into the electrical reticulation system, and how the meter(s) is/are connected to the metering communication network	UQ	Prior to submission of final construction documentation	Section 6.2.1.1
Lighting submission	Designers shall provide a submission summarising the make up and configuration of the lighting and lighting control system, including: a. Full functional description	UQ	Prior to submission of final construction documentation	Section 6.5.1.1

Submission	Description	Reviewer	Timing (to be aligned with PREM process)	Design Standard Reference
	b. Assessment of lighting technology options c. Optimisation of capital, operational and overall lifecycle costs d. Luminaire schedule, including the following characteristics for each luminaire: i. Luminaire mounting type (recessed, surface mounted, wall mounted, suspended, pole top, inground, etc) ii. Luminaire type (downlight, track light, spot light, linear extrusion, batten, high bay, area light, bollard,etc) iii. Lamp source (eg LED, fluorescent, etc) iv. Lamp wattage v. Luminaire wattage vi. Drive current vii. Lamp lumen output viii. Luminaire lumen output ix. Distribution (eg narrow spot, spot, flood, wide flood, oval flood, asymmetric, wall washing) x. Beam angle xi. Control gear type (eg electronic, DALI, etc) xii. Control gear location (eg integral, remote, etc) xiii. Correlated colour temperature xiv. Colour rendering index xv. TM-30 parameters xvi. Lifetime (in accordance with TM-21) xvii. IP rating xviii. IK rating xix. Dimensions			

Submission	Description	Reviewer	Timing (to be aligned with PREM process)	Design Standard Reference
	xx. Finish / colour xxi. Body material xxii. Diffuser material (if applicable) xxiii. Pole type (if applicable) xxiv. Pole height (if applicable) xxv. Supplier contact details			

7.3 Construction submissions

The submissions listed in Table 7–3 should be undertaken the project's Principal Contractor given the level of construction detailing required.

The submission timing noted shall be adjusted as necessary to suit individual project programs.

Table 7–3 Construction phase submissions

Submission	Description	Reviewer	Timing (to be aligned with PREM process)	Design Standard Reference
Photovoltaic system commissioning report	Contractors shall provide a photovoltaic system commissioning report, and coordinate a full connection agreement submission with the Utility Authority..	UQ	Prior to energisation	Section 6.1.12.8
Main switchboard workshop drawings	Contractors shall provide main switchboard workshop drawings, including: a. Drawn to a minimum scale of 1:10 b. Plan view c. Front, rear and side elevations d. Sectional views showing each variation of cubicle layout, form of separation and busbar arrangements e. Proposed labelling	UQ	Prior to procurement or fabrication	Section 6.1.8.1
Metering system submission	Contractors shall provide a submission summarising the configuration of the electrical metering system, including: a. Completed Meter Data Form for each proposed meter, as attached at Appendix B – Attachments	UQ	Prior to any related works being undertaken	Section 6.2.1.1

Submission	Description	Reviewer	Timing (to be aligned with PREM process)	Design Standard Reference
	b. Completed Meter Data Form for each meter replacement, meter relocation or change to metered load, as attached at Appendix B – Attachments Following approval by UQ, a unique identifier shall be given to each meter. This will permit the accurate tracking of each meter, in addition to identification on the EMS.			
Distribution board workshop drawings	Contractors shall provide distribution board drawings, including: a. Drawn to a minimum scale of 1:10 b. Plan view c. Front, rear and side elevations d. Sectional views showing each variation of cubicle layout, form of separation and busbar arrangements e. Proposed labelling	UQ	Prior to procurement or fabrication	Section 6.3.2.1
Luminaire alternatives	Where alternative luminaires are put forward by contractors following a contract award, they shall be accompanied by technical submissions, including: a. All items listed under 'Luminaire schedule', required as part of the design phase lighting submission (refer Table 7–2) b. Design calculations, completed in AGi or Elumtools modelling software, or an approved equivalent accepted by UQ c. Product and Responsible Supplier registration details as listed on the ERAC National Equipment Registration System d. Regulatory Compliance Mark (RCM) certification e. Photometric data (supplied in .cie and/or .ies formats, including polar curves) f. Test data, as described Table 6–18 in and Table 6–19 g. Physical samples	UQ	Prior to procurement	Section 6.5.1.5

Submission	Description	Reviewer	Timing (to be aligned with PREM process)	Design Standard Reference
Operation and maintenance manuals	As required by project specific specifications, but specifically including: **Cable containment** a. Luminaire warranties **Emergency escape lighting and exit signs** b. Layout drawings, indicating: i. Locations of all emergency escape luminaires and exit signs ii. Locations of all communication devices iii. Unique identifiers for all emergency escape luminaires and exit signs iv. Route of communications cabling between devices **Cable containment** a. Survey plan, indicating underground cable routes, produced by registered surveyor. The survey plan shall be provided in .dwg format to UQ's drawing standards, and shall include all pit label IDs b. Video taken for each conduit demonstrating complete, continuous, undamaged conduit runs between start and stop points **Photovoltaic system** a. Operation manuals b. Product data sheets c. Warranty information d. Record of commissioning e. Record of serial numbers f. PV system yield report **Control cabling**	UQ	At handover	-

Submission	Description	Reviewer	Timing (to be aligned with PREM process)	Design Standard Reference
	a. Provide comprehensive as-built drawings of all control cabling complete with associated wire numbering. **Lighting protection system** a. Impedance measurements.			

Appendix A – Example labelling schemes

Main switchboard

Design standard reference: Clause 6.1.8.16.

MSB label for MSBs with single source of supply:

MAIN SWITCHBOARD 1
Prospective fault current level: 37 kA
Safe approach distance: 2 metres

MSB label for MSBs with multiple sources of supply:

First label:

MAIN SWITCHBOARD 1
Prospective fault current level: 37 kA
Safe approach distance: 2 metres

Second label:

WARNING: MULTIPLE SOURCES OF SUPPLY
ISOLATE ALL SUPPLIES PRIOR TO CARRYING OUT WORK

Main switch:

MSB-1 MAIN SWITCH
800 A / 1000 A
2x4x1Cx150mmsq XLPE / PVC + E

General services outgoing circuits:

RISING SUBMAINS 1
250 A / 400 A
1x4x1Cx150mmsq XLPE / PVC + E

General services outgoing circuits with multiple sources of supply:

First label:

RISING SUBMAINS 2
250 A / 400 A
1x4x1Cx150mmsq XLPE / PVC + E

Second label:

WARNING: MULTIPLE SOURCES OF SUPPLY
ISOLATE ALL SUPPLIES PRIOR TO CARRYING OUT WORK

Safety services outgoing circuits:

FIRE INDICATOR PANEL
20 A / 100 A
1x1x2Cx4mmsq X-HF-110 / HFS-TP-110 + E
WARNING: SAFETY SERVICE – DO NOT SWITCH OFF

Lift outgoing circuits:

LIFT 1
80 A / 100 A
1x1x4Cx16mmsq X-HF-110 / HFS-TP-110 + E
WARNING: LIFT CIRCUIT – DO NOT SWITCH OFF

Electrical meters

BUILDING 5 LIGHT AND POWER
CT RATIO: 400 A / 5A
METER ID: 5A.02
MODBUS ADDRESS: 02

Concealed CTs and potential links

METER ID 5A.02 CTs & POTENTIAL LINKS MOUNTED BEHIND

Accessories and other equipment

SURGE DIVERTER

Concealed accessories and other equipment

FAULT CURRENT LIMITERS MOUNTED BEHIND

Distribution boards

Design standard reference: 6.3.2.10.

DB label for DBs with single source of supply (located externally and on escutcheon):

DISTRIBUTION BOARD 1

DB label for DBs with multiple sources of supply (located externally and on escutcheon):

First label:

DISTRIBUTION BOARD 1

Second label:

WARNING: MULTIPLE SOURCES OF SUPPLY ISOLATE ALL SUPPLIES PRIOR TO CARRYING OUT WORK

Main switch (located on escutcheon):

DB-1 MAIN SWITCH 250 A 2x4x1Cx95mmsq X-90

Poles (located on escutcheon):

P1

Poles serving equipment with multiple sources of supply (located on escutcheon):

First label:

P1

Second label:

WARNING: MULTIPLE SOURCES OF SUPPLY ISOLATE ALL SUPPLIES PRIOR TO CARRYING OUT WORK

Poles servicing safety services:

P1 FIRE INDICATOR PANEL WARNING: SAFETY SERVICE – DO NOT SWITCH OFF

Lift outgoing circuits:

LIFT 1 80 A / 100 A 1x4x1Cx16mmsq X-HF-110 WARNING: LIFT CIRCUIT – DO NOT SWITCH OFF

Electrical meters

BUILDING 5 LIGHT AND POWER CT RATIO: 400 A / 5A METER ID: 5A.02 MODBUS ADDRESS: 02

Concealed CTs and potential links

METER ID 5A.02 CTs & POTENTIAL LINKS MOUNTED BEHIND

Accessories and other equipment

SURGE DIVERTER

Concealed accessories and other equipment

CONTROL SECTION BEHIND

Photovoltaic system components

Design standard reference: 6.1.12.9.

At point of connection of strings to inverters

PV STRING A

At point of connection of strings to DC isolators

PV STRING A

Inline surge protection devices and string fuses

PV STRING A

DC isolators

DB-1 / P1

AC isolators

DB-1 / P1

Appendix B – Attachments

Shop Drawing – Red Lion Device-TRZT-Dual Port with I/O / Electricity Metering

Design standard reference: 6.1.6.1, 6.1.8.4

Shop Drawing – Photovoltaic Installation Output Distribution Board

Design Standard reference: Clause 6.1.12.8.

Shop Drawing – Standard Electrical Metering Schematics

Design Standard reference: Clause 6.2.2.2.

Form / Checklist – Electrical Metering Installation Checklist

Design Standard reference: Clause 6.2.2.2, 6.2.3.

Guidance Document – Standard Electrical Metering Labelling

Design Standard reference: Clause 6.2.2.5.

Form / Checklist – Electrical Metering Commissioning Checklist

Design Standard reference: Clause 6.2.2.6.

Shop Drawing – Emergency Shutdown Control Schematic

Design Standard reference: 6.8.1.3.

Form / Checklist – Meter Data Form

Design Standard reference: Table 7–3.

Appendix C – Project specific design standard deviations

This appendix will be supplied in a completed form to describe deviations from these standards that are permitted for specific projects.

Project name and number

Completed by: *name*

Dated: *date*

Design Standard Reference	Approved deviation