

PROJECT: 1 (LOT 181) GLENBURNIE TERRACE, PLYMPTON (APARTMENTS)

ELECTRICAL SPECIFICATION

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0901 ELECTRICAL SYSTEMS

1 GENERAL

1.1 AIMS

Responsibilities

General: Provide electrical systems as documented.

Design Criteria

Design criteria associated with the installation are listed below:

Item	Design Criteria
Extreme ambient conditions under which all services and systems shall operate	50.0°C dry bulb maximum 24.0°C wet bulb maximum Full solar load -2.0°C dry bulb minimum.
Ambient conditions within air conditioned spaces under which all services and systems shall achieve full load performance	24.0°C dry bulb maximum 60% relative humidity maximum with humidity varying dependent on ambient and internal loads 20.0°C dry bulb minimum.
Ambient conditions within ventilated non air conditioned spaces under which all services and systems shall achieve full load performance	39.0°C dry bulb maximum 21.0°C wet bulb maximum 4.0°C dry bulb minimum.
Earth resistivity	100 ohm - metres nominal.
Earthing	2m earth stake, minimum, within poly pit
Hours of operation - general	24 hour operation 7 days
Maximum noise levels at adjoining property boundaries	Not to exceed levels specified for commercial properties and residential properties in the Environmental Protection Act.
Earthing systems:	
Protective earthing system	MEN earthing system in accordance with Australian Standard 3000 - Electrical installations (known as the Australian/New Zealand Wiring Rules)
Electricity supply	400/230 volts, +10%, -6%, 3 phase, 4 wire, 50 Hz in accordance with SA Power Networks Service Rules and Conditions of Supply. Design and utilise only systems and equipment to be capable of guaranteed rated performance on both present and future supply voltages.
Consumers mains	400/230 volt, 3 phase, 50 Hz supplies from the SA Power Networks transformer.
Metering	Retailer metering to minimise operating costs.

Item	Design Criteria
Electrical reticulation	In accordance with AS/NZS 3000 - Electrical installations (known as the Australian/New Zealand Wiring Rules)
Electrical capacities	Equipment and cable capacities calculated to achieve 30% spare capacity.
Electrical and communications Pits and Lid	In accordance with Australian Standard AS3996 Access covers and grates. Class B Covers, Grates and pit/lid combinations minimum in non-vehicle trafficable areas, Class D otherwise.
Automatic fire detection and alarm system	In accordance with AS 1670 – Fire detection, warning, control and intercom systems – System design, installation and commissioning.
Voltage drop	Voltage drop at switchboards limited to 2.5% (maximum) of nominal LV supply voltage of 400 volt, 3 phase. Voltage drop at final distribution points limited to 5% (maximum) of nominal LV supply voltage of 400 volt, 3 phase.
Electromagnetic emission and immunity	In accordance with AS/NZS 61000.
Degree of protection (IP Code)	In accordance with AS/NZS 60529.
Illuminance levels	In accordance with the minimum requirements of the following:
Building interiors	AS/NZS 1680.1 Interior and workplace lighting - General principles and recommendations AS/NZS 1680.2.1 Interior and workplace lighting - Specific applications - Circulation spaces and other general areas
Exit and emergency lighting	AS 2293.1 Emergency escape lighting and exit signs for buildings - System design, installation and operation AS/NZS 2293.2 Emergency evacuation lighting for buildings - Inspection and maintenance AS 2293.3 Emergency escape lighting and exit signs for buildings - Emergency escape luminaires and exit signs
Master antennae television system	AS/NZS 1367 Coaxial cable and optical fibre systems for the RF distribution of digital television and sound signals in single and multiple dwelling installations

Item	Design Criteria
Voice/data cabling	AS/NZS 3080 Telecommunications installations - Generic cabling for commercial premises (ISO/IEC 11801:2002, MOD)

1.2 RESPONSIBILITIES

General

Requirement: Provide the electrical services, as documented. Items not included in the specification but shown on the drawings or vice versa shall be included:-

Power Reticulation

- Liaise, make application, coordinate and pay all fees for SA Power Networks to supply and install a new pad mount transformer.
- Liaise with SA Power Networks and energy retailer for supply and installation of kilowatt hour meter in the main switchboard.
- Supply and install a custom-made Main Switchboard (MSB), Main Distribution Boards (MDB) and Distribution Boards (DSB) including all associated switchgear, control gear and earthing system.
- Supply and install consumer mains and submains including underground conduits and cable pits.
- Supply and install power and lighting sub-circuits protected by MCB's and RCB's

Accessories

- Provide light switches and pushbutton dimmer switches where nominated on drawings, and install no closer than 500mm from internal wall corner in accordance with DA requirements.
- Supply and install power outlets.
- Supply and install cooktop and oven function isolators.
- Supply and install power supplies to all Hydraulic, Mechanical and all other equipment. Isolators mounted externally to be weatherproof.
- Provide RCD protection for all power outlets and lighting circuits.
- Supply and install fire rated wall boxes for all accessories where mounted on fire rated walls.

Luminaires

- Supply and install artificial lighting in accordance with Section J of the NCC including all associated trimmers, fixings, suspension kits, brackets and supports as required.
- Supply and install PIR occupancy sensors installed in series with light switch and luminaires.
- Supply and install car park lighting including control circuits and cabling.
- Supply and install photo electric cells and time clocks to control all external lighting.

Emergency Evacuation Lighting

- Supply and install exit and emergency lighting in accordance with AS/NZS2293 including automatic test facility to each distribution board.
- Upon failure of the electrical supply to the normal lighting in an area, irrespective of whether or not it is illuminated, each relevant emergency escape luminaire and exit sign shall be energized from its emergency supply in accordance with AS/NZS 2293, Clause 2.3.2.

Telecommunications System

- Supply and install NBN compliant lead-in conduit and cable pit from street to building in accordance with NBN/Telstra requirements.
- Supply and install a structured cabling system comprising comms outlets and UTP horizontal cabling from a single vendor connected to NBN services.

Intercom System

- Design, supply and install an intercom system complete with entry door intercom station and door intercom panel (per apartment).

Fire Detection and Alarm system

- Supply and install AS3786 compliant fire detection system within apartments.
- Supply and install an AS1670 fully monitored and addressable system to all common areas with occupant warning throughout the building.
- Provide an ASE with a primary and secondary 4G mobile dialer c/w high gain antenna, and connect to SAMFS services, as required. Allow to lodge applications with SAMFS and Telstra.
- Supply and install new fire bells/strobes, fire speaker, manual call points, smoke and thermal detectors.
- Install connection to sprinkler system for valve monitoring and connection to smoke exhaust systems to provide shutdown upon fire detection.
- Allow for an extra 15 detectors for beams, concealed spaces and other voids to ensure compliance with AS1670.
- Provide a block plan for the fire indicator panel.
- Commissioning and testing of the complete system including SAMFS final site inspection.
- Allow to program the FIP, as required.

Digital FTA TV System

- Design, supply and install a digital FTA TV system including antenna, amplifiers, splitters, cabling and outlets.

General

- Programming, testing and commissioning of the above systems.
- Supply and install cable tray and catenary wiring systems.
- Wall, ceiling and floor penetrations and access for installation of electrical cables and equipment.
- Earthing system to all accessories, power outlets, luminaires, isolators, building structure and switchboard.
- Colours of all electrical equipment, i.e. switchboards, isolators, top hat covers, switches, power and communication outlets, conduits, access hatches, luminaire trims, etc, to Architects selection. Submit samples for approval prior to ordering.
- Submit shop drawings for review and approval.
- Seal all penetrations (fire proof at fire barriers).
- Provision of all hoisting and scaffolding to install the above systems.
- Coordination with other trades.
- Confirm all trenching routes and allow to coordinate with other new and existing underground services. Allow reinstatement of trenches and make good to match surrounding existing surfaces and conditions.
- Maintenance, service, defects liability and warranty for 12 months from date of practical completion.
- Operating and maintenance manuals (bound), refer to later specification section for requirements.

Performance

Requirement: 400 V, 3-phase, 4-wire, 50 Hz system.

Performance criteria: Meet the performance criteria, as documented.

Fault level protection: To withstand the prospective fault level of the incoming supply at the equipment location.

Site electricity supply

Responsibilities: Provide site electricity supplies as documented. Connect project electrical facilities to the network distributor's external site electricity supply.

Low voltage supplies

Low voltage transformer output supply: To AS/NZS 3000 and the network distributor's requirements.

Low voltage protection: Provide low voltage short circuit and overload protection at the transformer secondary supply using fault current limiting circuit breakers with adjustable overload and short circuit current setting features. Alternatively, if approved by the network distributor, where no secondary output protection is provided, provide appropriate sized high voltage protection on the incoming supply to transformers.

Low voltage circuit breakers: Include full discrimination and cascade protection and grade with the incoming transformer supply protection system and the downstream site protection devices.

Switchboards

Responsibilities: Provide main switchboard(s) and local distribution boards as documented and to the requirements of the following worksections:

- 0942 *Switchboards – custom-built*.

Electrical protection equipment: Include all necessary electrical protection equipment, electrical components and the local network distributor's tariff metering equipment to the requirements of the 0943 *Switchboard components* worksection.

Large switchboards: Manufacture switchboards of module sizes to allow access and manoeuvrability through the project site and into switchrooms.

Overload and fault protection on all submains: Provide circuit breaker protection equipment coordinated to allow cascade and discrimination protection between upstream and downstream cable protection devices to AS/NZS 3000.

Electricity distributor's low voltage service protective device: To AS/NZS 3000, the network distributor's requirements and the supply authority Service and Installation rules.

For service protective devices > 100 A: Provide fault current limiting circuit breakers with adjustable overload and short circuit current facilities and full discrimination and cascade protection between the incoming supply protection systems and the downstream protection systems, if required.

Electrical cable systems

Responsibilities: Provide the following cabling systems:

- Power cables: Provide cable systems as documented and to the requirements of the 0921 *Low voltage power systems* worksection.
- Communications cables: Provide cable systems as documented and to the requirements of Australian Communications and Media Authority (ACMA) and the 0961 *Telecommunications cabling* worksection.

Provide separate cable systems for communications and sound systems. Do not use any part of the power system cable support systems.

Lighting

Responsibilities: Provide lighting systems as documented and to the requirements of the following worksections:

- 0951 *Lighting*.
- 0971 *Emergency evacuation lighting*.

Proprietary equipment: If proprietary equipment is selected by the contractor, the requirements of this specification override the specifications inherent in the selection of a particular make and model of accessory.

Fire safety systems

Responsibilities: Provide fire safety systems as documented and to the requirements of the following worksections:

- 0972 *Fire detection and alarms*.

Communications systems

Responsibilities: Provide communication systems as documented and to the requirements of the 0961 *Telecommunications cabling* worksection.

Door intercom systems

Responsibilities: Provide security systems as documented and to the requirements of the 0981 *Electronic security* worksection.

Lightning protection

Responsibilities: Provide lightning protection as documented and to the requirements of the 0979 *Lightning protection worksection*.

1.3 DESIGN**Design for durability and maintainability**

Design for durability: Develop the design so the systems achieve the documented performance, reliability, service life, energy efficiency and safety requirements, and are easily maintainable.

Access for maintenance: Develop the design so the systems conform to **ACCESS FOR MAINTENANCE** in the *General requirements worksection*.

1.4 PRECEDENCE**General**

Worksections and referenced documents:

- The requirements of other worksections of the specification override conflicting requirements of this worksection.
- The requirements of the worksections override conflicting requirements of their referenced documents.
- The requirements of the referenced documents are minimum requirements.

1.5 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

- 0911 *Cable support and duct systems*.
- 0921 *Low voltage power systems*.
- 0942 *Switchboards – custom-built*.
- 0961 *Telecommunications cabling*.
- 0951 *Lighting*.
- 0971 *Emergency evacuation lighting*.
- 0972 *Fire detection and alarms*.
- 0973 *Emergency warning and intercommunication*.
- 0981 *Electronic security*.
- 0991 *Electrical maintenance*.

1.6 STANDARDS**General**

Electrical services: To AS/NZS 3000, unless otherwise documented.

Electrical installations

Electrical design guide: To SAA HB 301.

Selection of cables: To AS/NZS 3008.1.1.

Degrees of protection (IP code): To AS 60529.

Electromagnetic compatibility (EMC): To AS/NZS 61000.

Telecommunications systems: To AS/CA S008, AS/CA S009 and AS/NZS 3008.

1.7 CONTRACT DOCUMENTS**General**

Requirement: Conform to the 0171 *General requirements worksection*.

1.8 PERMITS NOTICES AND INSPECTIONS

Make applications, obtain all permits, and arrange testing, all as necessary for the installation and placing into operation of the works where required by any Authority including:

- Department of Premier and Cabinet – Safe Work SA
- Department of State Development (DSD) - The Office of the Technical Regulator.

- Australian Communications Authority.
- Site Telecommunications Carrier.
- National Broadband Network (NBN Co).
- SA Power Networks (formerly ETSA Utilities).
- SA Fire Services.
- Energy retailer.

Provide all associated documentation required for the applications.

Pay all associated fees.

1.9 SUBMISSIONS

Certification

Requirement: Submit certification that the plant and equipment submitted meets the requirements and capacities of the contract documents except for departures that are identified in the submission.

Technical data

Submissions: Submit technical data for all items of plant and equipment.

Data to be submitted: Include at least the following information in technical submissions:

- Assumptions.
- Calculations.
- Model name, designation and number.
- Capacity of all system elements.
- Country of origin and manufacture.
- Materials used in the construction.
- Size, including required clearances for installation.
- Certification of compliance with the applicable code or standard.
- Technical data schedules corresponding to the equipment schedules in the contract documents. If there is a discrepancy between the two, substantiate the change.
- Manufacturers' technical literature.
- Type-test reports.
- Single line diagram(s), including fault levels at switchboards, cable size and type.
- Switchboard layouts.

1.10 INSPECTION

General

Provide 7 day's notice so that inspection may be made at the following stages:-

- 1st Fix – At completion of first fix cabling and conduits works but prior to being covered up.
- PC – At completion of PC works prior to handover.

2 PRODUCTS ---

2.1 ELECTRICAL ACCESSORIES

General

Responsibilities: Provide accessories as documented and to the requirements of the *0921 Low voltage power systems* worksection.

Proprietary equipment: If proprietary equipment is selected by the contractor, the requirements of this specification over-ride the specifications inherent in the selection of a particular make and model of accessory.

Uniformity: Provide all accessories and outlets located in close proximity of the same manufacture, size, finish and material.

Default finish: Select from the manufacturers' standard range.

3 EXECUTION

3.1 ALTERNATIVES

Electrical equipment

Unless otherwise specified, alternatives will not generally be accepted where equipment has been nominated.

Where alternatives are proposed, the Contractor is to provide adequate information including technical data, fully revised shop and/or installation drawings, manufacturer & supply chain profile, warranty, local after-sales support and calculations which demonstrate that the alternatives are “equal” to the products and/or equipment that have been specified,

Where proposed alternatives relate to luminaires, a fully coordinated luminaire drawing shall accompany the proposal, along with lux/lumen plots, clearly showing compliance to the original project design criteria and the AS/NZS-1680 suite of Standards.

Unapproved alternatives found to be installed shall be removed at the Contractor’s cost and the nominated product(s)/equipment shall be installed. Making good of adjacent surfaces shall also be at the Contractor’s cost.

3.2 SWITCHBOARDS

General

Fixing wall mounted switchboards: Fix direct to wall framing for framed wall constructed walls and to masonry or concrete walls.

Fixing floor/wall mounted switchboards: Fix to floor plinths and direct wall framing for framed wall constructed walls and to masonry or concrete walls by suitable fasteners.

Seismic sensitive projects

Fixing wall and wall/floor mounted switchboards: Fix only to building structural elements or to steel framing fixed to structural elements. Do not fix to masonry infill panels.

3.3 SUPPORT OF PLANT AND EQUIPMENT

Support of roof mounted plant and equipment

Platforms: If a horizontal platform is required, or the area of the plant and equipment is extensive, obtain the advice of a professional engineer for the documentation of a suitable platform.

Balustrades: If balustrades or screening are required, obtain the advice of a registered architect.

Roof level support: If any of the following apply to roof level support, obtain the advice of a professional engineer:

- The total load from any unit of plant or equipment exceeds 500 kg.
- The load from a unit of plant or equipment to any single support point exceeds 100 kg.
- The average loading of plant and equipment over the area extending 1 m on all sides beyond the plant and equipment exceeds 25 kg/m².

Sloping roofs:

- Roof slope $\geq 10^\circ$: Adopt the roof material manufacturer’s documented installation procedures, or seek the advice of a professional engineer.
- Roof slope $< 10^\circ$: Provide appropriate continuous supporting members, compatible with the roof material, laid parallel to the span of the roof sheeting. Extend the continuous support members in both directions to the first purlin or joist that is > 1 m from the face of the plant or equipment it supports.

Support of ground level plant and equipment

Ground level:

- If the ground slope is $\geq 15^\circ$ or the area of the plant and equipment is extensive, obtain the advice of a professional engineer for the documentation of a suitable slab or platform.
- In all other cases, provide proprietary plastic or concrete supports installed with falls that achieve a raised, impervious and water shedding bearing surface.

Balustrades: If balustrades or screening are required, obtain the advice of a registered architect.

Support of equipment mounted into suspended ceilings

General: all equipment must be adequately supported, considering its own weight the capacity of what it is installed into and also the environment it is in.

Installation of surface-mount equipment using only "wall mate" or toggle bolts into flush plasterboard, without additional bracing, would not be acceptable in an environment where vandalism is likely, eg schools, correctional or mental health installations,

3.4 CONCRETE PLINTHS**Construction**

General: Provide plinths conforming to the

- For all floor mounted equipment. Hot dipped or galvanised..
- Concrete: Grade N25
- Finish: Steel float flush with the surround.
- Reinforcement: Single layer of F72 mesh.
- Surround: Provide galvanized steel surround at least 75 mm high and 1.6 mm thick. Fix to the floor with masonry anchors. Fill with concrete.
- Minimum height: 100mm for main switchboard.

3.5 PLANT AND EQUIPMENT ACCESS**General**

Services and equipment: Locate and arrange all services and equipment so that:

- They comply with the relevant requirements of the appropriate Occupational Health and Safety regulations.
- Failure of plant and equipment (including leaks) does not create a hazard for the building occupants.
- Failure of plant and equipment (including leaks) cause a minimum or no damage to the building, its finishes and contents.
- Inspection and maintenance operations can be arranged to minimise inconvenience and disruption to building occupants or damage to the building structure or finishes.
- Services and equipment are readily accessible for inspection and maintenance and arranged so that inspection and maintenance can be carried out in a safe and efficient manner. Include the following:
 - Conform to the relevant requirements of AS 1470, AS 1657, AS/NZS 1892.1 and AS/NZS 2865.
 - If parts of the plant require regular inspection and maintenance either locate plant so it is safely accessible from floor level or provide permanent access platforms and ladders.
 - In false ceilings locate items of equipment that require inspection and maintenance above tiled parts where possible. If this is not possible (for example if above set plaster or other inaccessible ceilings) provide access panels. Arrange services and plant locations to reduce the number of access panels. Coordinate with other trades to use common access panels where feasible.
 - Modify manufacturer's standard equipment when necessary to provide the plant access in the contract documents, to manufacturer's instructions.

3.6 PAINTING AND FINISHES**General**

General: If exposed to view (including in plant rooms) paint new services and equipment.

Surfaces painted or finished off-site: Conform to *Metals and prefinishes*.

Exceptions: Do not paint chromium or nickel plating, anodised aluminium, GRP, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Surfaces with finishes applied off-site need not be re-painted on-site provided the corrosion resistance of the finish is not less than that of the respective finish in this clause.

Standard

General: Conform to the recommendations of AS/NZS 2311 Sections 3, 6 and 7 or AS/NZS 2312 Sections 5, 8 and 10, as applicable.

Low VOC emitting paints

Provide the following low odour/low environmental impact paint types with the following VOC limits:

- Primers and undercoats: < 5 g/litre.
- Low gloss white or light coloured latex paints for broadwall areas: < 5 g/litre.
- Coloured low gloss latex paints: < 85 g/litre.
- Gloss latex paints: < 90 g/litre.

Painting systems

New unpainted interior surfaces: To AS/NZS 2311 Table 5.1.

New unpainted exterior surfaces: To AS/NZS 2311 Table 5.2.

Paint application

Coats: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Ensure each coat of paint or clear finish is uniform in colour, gloss, thickness and texture and free of runs, sags, blisters or other discontinuities.

Combinations: Do not combine paints from different manufacturers in a paint system.

Protection: Remove fixtures before starting to paint and refix in position undamaged on completion.

3.7 MARKING AND LABELLING**General**

General: Mark services and equipment to provide a ready means of identification.

- Locations exposed to weather or direct sunlight (UV): Provide durable materials.
- Pipes, conduits and ducts: Identify and label to AS 1345.
- Cables: Label at each end to indicate the origin and destination of the cable.

Consistency: Label and mark equipment using a consistent scheme across all services elements of the project and to suit any existing site services naming conventions, in consultation with site management as necessary.

Operating and maintenance manuals: Provide marking and labelling text, identical to the text and terminology used in operating and maintenance manuals, and all as-built drawings.

Accessories

Label isolating switches and outlets to identify circuit origin and label communications outlets to identify data port.

Fixing: Securely fixed.

Label Types

General: Select from the following materials:

- For indoor applications only, engraved two-colour laminated plastic.
- Stainless steel or brass ≥ 1 mm thick with black filled engraved lettering.
- IPA studs for low voltage accessories
- Not accepted: Proprietary pre-printed self-adhesive flexible plastic labels

Emergency functions: To AS 1319.

Colours: Generally in conformance with AS 1345 as appropriate, otherwise black lettering on white background except as follows.

- Danger, warning labels: White lettering on red background.
- Main switch and caution labels: Red lettering on white background.

Edges: If labels exceed 1.5 mm thickness, radius or bevel the edges.

Fixing: Fix labels securely using screws, rivets, proprietary self-adhesive labels or double-sided adhesive tape.

- If labels are mounted in extruded aluminium sections, use rivets or countersunk screws to fix the extrusions.
- Use aluminium or monel rivets for aluminium labels.

Label locations: Locate labels so that they are easily seen and are either attached to, below or next to the item being marked.

Lettering heights:

- Danger, warning and caution notices: ≥ 10 mm for main heading, ≥ 5 mm for remainder.
- Equipment labels within cabinets: ≥ 3.5 mm.

- Identifying labels on outside of cabinets: ≥ 5 mm.
- Other locations: ≥ 3 mm.

Operable devices: Mark to provide a ready means of identification. Include the following:

- Controls.
- Indicators, gauges, meters and the like.
- Isolating switches.
- Outlets.

Underground cable routes

Survey: Accurately record the routes of underground cables before backfilling. Include on the record drawings.

Records: Provide digital photographic records of underground cable routes before backfilling. Include in operation and maintenance manual.

Location marking: Accurately mark the location of underground cables with route markers consisting of a metal marker plate complete with securely fixed direction arrows, set flush in a concrete base.

Marker plates and/or their fixings must not be a trip hazard, and must be finished flush with adjacent surfaces.

Markers: Place markers shall be placed at, building entry/exit points, inground cable joints, route junction, change of direction, termination and building entry point and in straight runs at intervals of not more than 300 m.

Marker bases: 200 mm diameter x 200 mm deep, minimum concrete.

Direction marking: Show the direction of the cable run by means of direction arrows on the marker plate. Indicate distance to the next marker.

Plates: Brass, aluminium or mild steel hot-dipped galvanized, minimum size 75 x 75 x 2 mm thick.

Plate fixing: Waterproof adhesive and secure stainless steel fixings.

Marker height: Set the marker plate flush with paved surfaces, and 25 mm above other surfaces.

Marker tape: Underground wiring: provide a 150 mm wide marker tape bearing the words 'WARNING – electric cable buried below', laid in the trench 150 mm below ground level.

Marker tape to be Orange for Electrical, and/or White for Data/Comms/Security and the like.

Draw wire: provide 5mm poly rope for all spare conduits.

Spare conduits must be capped off at all cable pits (and the like) and building entry points with propriety (typically PVC) caps. Expanding foam filler will not be acceptable.

Fire Rating and vermin sealing of building cable entries: Propriety (and removable) fire-rated filler must be provided to all conduit and like entries entering and exiting buildings. Filler material to be (typically) 50mm to 150mm (Maximum) in thickness/depth, Contractors need to provide a sectional detail clearly showing how and with what product they intend to seal such cable entries. Final approval shall be from Superintendents representative approval.

Failure to seek approval, and use of non-approved sealing products, will necessitate complete removal of sealant installed, and the detail/approval/re-sealing of said cable entries will need to be undertaken.

3.8 OPERATION AND MAINTENANCE MANUALS

Manuals

General: Conform to the **OPERATION AND MAINTENANCE MANUALS** clause in the *0991 Electrical Maintenance* worksection.

3.9 RECORD DRAWINGS

General

General: Show dimensions, types and location of the services in relation to permanent site features and other underground services. Show the spatial relationship to building structure and other services. Include all changes made during commissioning and the maintenance period.

Drawings: Include all documented shop drawings.

3.10 COMMISSIONING

Circuit protection

General: Confirm that circuit protective devices are sized and adjusted to protect installed circuits.

Controls

General: Calibrate, set and adjust control instruments, control systems and safety controls.

Notice

General: Give sufficient notice for inspection to be made of the commissioning of the installation.

Reports

General: Submit reports indicating observations and results of tests and compliance or non-compliance with requirements.

3.11 CLEANING

General

Practical completion: At practical completion, clean the following:

- Insides of switchgear and control gear assemblies.
- Luminaires.
- Switchgear and contactors, and other electrical contacts. Adjust as necessary.
- Switchboards.

3.12 COMPLETION TESTS

General

General: Test the works under the contract to demonstrate compliance with the documented performance requirements.

Functional checks

General: Carry out functional and operational checks on energised equipment and circuits and make final adjustments for the correct operation of safety devices and control functions.

Proprietary equipment

General: Submit type test reports confirming compliance of proprietary equipment.

Sound pressure level measurements

Correction for background noise: To AS/NZS 2107 Table B1.

External: To AS 1055.1.

Internal: To AS/NZS 2107.

Measurement positions: If a test position is designated only by reference to a room or space, do not take measurements less than 1 m from the floor, ground or walls.

Sound pressure level analysis: Measure the sound pressure level and the background sound pressure level over the full range of octave band centre frequencies from 31.5 Hz to 8 kHz at the designated positions.

Sound pressure levels: Measure the A-weighted sound pressure levels and the A-weighted background sound pressure levels at the designated positions.

Test instruments

General: Use instruments calibrated by a registered testing authority. Ensure equipment test parameters meet all current standards.

3.13 TRAINING

General

Duration: Instruction to be available for the whole of the commissioning and running-in periods.

Format: Conduct training at agreed times, at system or equipment location. Also provide seminar instruction to cover all major components.

Operation and maintenance manuals: Use items and procedures listed in the final draft operation and maintenance manuals as the basis for instruction. Review contents in detail with the principal's staff.

Certification: Provide written certification of attendance and participation in training for each attendee. Provide register of certificates issued.

Demonstrators

General: Use only qualified manufacturer's representatives who are knowledgeable about the installations.

Maintenance

General: Explain and demonstrate to the principal's staff the purpose, function and maintenance of the installations.

Operation

General: Explain and demonstrate to the principal's staff the purpose, function and operation of the installations.

3.14 MAINTENANCE**General**

General: During the maintenance and defects liability periods, carry out periodic inspections and maintenance work as approved. Refer to the 0991 *Electrical Maintenance* worksection for further requirements.

Emergencies: Attend emergency calls promptly (within 24 hours).

Servicing Access

Arrange all plant and equipment to provide minimum access and maintenance requirements in accordance with the equipment manufacturers' recommendations and the requirements of the Occupational Health, Safety and Welfare Act and Regulations.

Maintenance program

General: Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.

The program shall meet all of the requirements from:

- 1) the equipment manufacturers
- 2) applicable Australian Standards
- 3) applicable OH&S & supply authority regulations

Maintenance records

General: Submit, in binders which match the manuals, loose leaf log book pages designed for recording completion activities including operational and maintenance procedures, materials used, test results, comments for future maintenance actions and notes covering the condition of the installation. Include completed log book pages recording the operational and maintenance activities performed up to the time of Final Completion.

Existing binders: Update all binders with the relevant information

Certificates: Include test and approval certificates.

Certification: On satisfactory Final Completion of the installation, submit certificates stating that each installation is operating correctly.

Number of pages: The greater of 100 pages or enough pages for the maintenance period and a further 12 months.

Referenced documents: If referenced documents or technical worksection s require that log books or records be submitted, include this material in the maintenance records.

Service visits: Record comments on the functioning of the systems, work carried out, items requiring corrective action, adjustments made and name of service operator. Obtain the signature of the principal's designated representative.

Site control

General: Report to the principal's designated representative on arriving at and before leaving the site.

0911 CABLE SUPPORT AND DUCT SYSTEMS**1 GENERAL****1.1 RESPONSIBILITIES****General**

Requirement: Provide cable support and duct systems, as documented.

1.2 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

- 0901 *Electrical systems*.

1.3 INTERPRETATION**Definitions**

General: For the purposes of this worksection the following definitions apply:

- Cable support: Cable tray, cable ladder and cable mesh cable support systems.

1.4 SUBMISSIONS**Operation and maintenance manuals**

Requirement: Submit all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

Technical data

General: Submit technical data for the following:

- Ducted wiring enclosure systems.
- Cable support systems.
- Proprietary pits.

2 PRODUCTS**2.1 MARKING****Identification**

General: Deliver materials to the site in the manufacturer's original sealed containers or packaging, legibly marked to show the following:

- Manufacturer's identification.
- Product brand name.
- Product type.
- Quantity.
- Product reference code and batch number.
- Date of manufacture.
- Material composition and characteristics such as volatility, flash point, light fastness, colour and pattern. Provide technical data sheets if not shown on labels.
- Handling and installation instructions.
- Safety data sheets.

2.2 CONDUITS**General**

Standards: To AS/NZS 2053.3, AS/NZS 61386.1, AS/NZS 61386.21, AS/NZS 61386.22 and AS/NZS 61386.23.

Communications cabling: To AS/NZS ISO/IEC 14763.2.

Type

General: Rigid.

Sizes

Requirement: Conform to the following:

- Underground: ≥ 32 mm.
- Telecommunications: ≥ 25 mm.
- Other locations: ≥ 20 mm.

Fixings

Surface mounted: Double sided fixed/saddled.

In concrete slabs: Tie to structural steel or provide separate fixing system, to Superintendent's approval.

Colour

Electrical: Light orange (in plant rooms) or grey (other areas).

Telecommunications systems conduits: White.

Galvanized water pipe

Medium or heavy: To AS 1074.

2.3 METALLIC CONDUITS AND FITTINGS**General**

Standards: To AS/NZS 61386.21 and AS/NZS 61386.23.

Type

General: Steel conduit with medium protection outside and inside to AS/NZS 61386.21.

Exposed to dampness or moisture: Steel conduit with high protection outside and inside to AS/NZS 61386.21.

Laid underground: Steel water pipe with protection outside and inside to AS/NZS 61386.21.

Joining

Steel conduit: Screwed joints and ends.

Fixings

Saddles: Conform to the following:

- Internal: Zinc plated.
- External: Hot-dipped galvanized.

Corrosion protection

Steel conduits: Paint ends and joint threads with zinc rich organic primer to AS/NZS 3750.9.

2.4 NON-METALLIC CONDUITS AND FITTINGS**General**

Standards: To AS/NZS 2053.3, AS/NZS 61386.21, AS/NZS 61386.22 or AS/NZS 61386.23.

Solar radiation protection: Required for conduits and fittings exposed to sunlight.

Flexible conduit

Requirement: Provide flexible conduit to connect with equipment and plant subjected to vibration. If required, provide for adjustment or ease of maintenance. Use the minimum possible length.

Associated fittings

Type and material: Same as the conduit.

Wall boxes on PVC-U conduits: Provide prefabricated earthed metal boxes, for special size wall boxes not available in PVC-U. Allow for fire-rated or acoustically rated boxes as applicable.

Inspection-type fittings

Requirement: Use only in accessible locations and where exposed to view.

Joints

Type: Cemented or snap-on joints.

UV protection

General: All plastic conduit (and accessories) exposed to direct Sunlight shall be Black HFT conduit. All other exterior conduit (and accessories) not exposed to direct sunlight, may also be UV rated medium Duty Grey conduit. Unpainted PVC conduits exposed to view will not be accepted.

Fixings and Supports

Type: In any accessible locations, particularly in vandalism prone locations, fixings are to be securely fixed to/with double-side metal saddles. Zinc plated for internal use and hot dipped galvanised for external use or where exposed.

2.5 CABLE DUCT**General**

Standards: To AS/NZS 4296.

Communications cabling: To AS/NZS ISO/IEC 14763.2.

Cable duct

Material: Metal.

Material finish: Metallic-coated to AS 1397 Grade G2, Coating Class Z275.

Construction: Solid.

Covers for accessible locations: Screw-fixed or clip-on type removable only with the use of tools.

Accessories: Purpose-made to match the duct system.

Cable support: Except for horizontal runs where the covers are on top, support wiring with retaining clips at intervals of not more than 1000 mm.

2.6 CABLE SUPPORT SYSTEMS**General**

Standard: To NEMA VE-1.

Type tests: To NEMA VE-1.

Manufacture: Provide proprietary cable support, fittings and accessories from a single manufacturer for the same support system.

Selection: Select cable supports in conjunction with support system installation to achieve the loading and deflection requirements.

Spare capacity: Minimum 50%.

Support

Power cables: Conform to the following:

- Overhead suspension: Trapeze or centre rail structure.
- Wall supported: Wall bracket with full access from one side of the cable support.

Communications cables: Conform to the following:

- Overhead suspension: Single sided.
- Wall supported: Wall bracket with full access from one side of the cable support.

Dimensions: To the preferred dimensions nominated in NEMA VE-1.

Material finish: Metallic-coated to AS 1397, Grade G2, Coating Class Z275. All cut ends to be deburred and painted with cold galvanising paint.

Alternatives include aluminium, stainless steel, or fibreglass.

Covers: Ventilated flat covers to cable support systems installed in open to view and/or accessible locations. All cable trays exposed to direct sunlight shall be covered.

2.7 CATENARY SYSTEMS**General**

Catenary systems: May be used within suspended ceiling spaces instead of cable tray and ladder systems. Catenary system must be tied/strung off the building structure, and not from lightweight ceiling and/or wall, or their framing.

Wire: Stainless steel or coated galvanized cable and couplings.

2.8 CABLE PITS

General

Cable draw-in pits: Provide cable draw-in pits as documented. Sizes given are internal dimensions.

Requirement: Installation in accordance with Australian Standard AS3996 Access covers and grates, as a combined installation, and the manufacturers written installation instructions.

Pits must be installed higher than the wider surrounding ground to prevent the entry of surface water, ramping down over to the surrounding area not to become a trip hazard.

Provide drainage/soakage drains to the bottom of the pit. Pits must not be installed so that they become inevitable low lying sumps. Pit/Lid combinations found to be installed too low compared to their surrounding environs, shall be rectified at the contractors cost.

Class "B" load rated Pit / lid combinations to non-vehicle accessed areas, typically garden beds, where there is no risk of the pit being exposed to any vehicle.

Class "D" load rated Pit / lid combination to all vehicle accessible areas ie: paved (vehicle and pedestrian), grassed and open areas.

In general, all lid and their frame assemblies, shall be of ductile iron manufacture.

All pits shall be installed to the manufacturers written installation instructions with drainage and necessary strengthening treatments, such as concrete base, sides and collar, in order to obtain the appropriate load and sealing ratings.

Proprietary cable pits

Pits $\leq 1200 \times 1200$ mm: Proprietary concrete or polymer moulded pits encased in concrete.

Pit covers

General: Provide pit covers to suit external loads. Fit flush with the top of the pit.

Standard: To AS 3996.

Lids must be greased around their frame, to allow easy access when required.

Provide one set of cable pit lid lifters per project, to be handed over to the client at the end of the project.

Weight: < 40 kg for any section of the cover.

Evidence will be required that this has been done.

Drainage

General: Provide drainage from the bottom of cable pits, with minimum 50mm PVC pipe to absorption trenches filled with rubble, formed of 16mm aggregate and geotextile barrier..

Absorption trenches: Minimum size $300 \times 300 \times 2000$ mm. Provide photographic evidence that this has been completed on request.

This is to make sure that pits and conduits remain dry and that storm water does not overflow through the conduits into the switchboards or occupied spaces. The drainage of pits should be coordinated with the stormwater designer.

3 EXECUTION

3.1 GENERAL

Installation of cables

General: To be supported where possible.

Internal: Unsupported cables resting on ceiling are not acceptable.

Provide propriety cable tray system for all consumer mains and sub-mains cabling over 70mm^2 .

External: To be concealed. Provide mechanical protection to approval. Minimum thickness shall be 3mm, galvanised and/or powder coated to approval. Exposed cables are not permitted. Cables in PVC conduit on roof tops is not acceptable.

Inaccessible concealed spaces: Cable in UPVC conduit, or tied to catenary systems is permitted.

Face, plastered or rendered masonry surfaces: Cable in UPVC conduit for their full length for this type of cable installation..

Stud walls with or without bulk thermal insulation: All data and communications cabling shall be "re-wireable" and thus installed in PVC conduit. All light and power cabling can be run within the stud wall

in compliance to AS/NZS3000 and AS/NZS3008. All cabling shall be protected with PVC conduit at locations where cabling is in contact with unbushed metal studwork. Under no circumstances will any unprotected cabling be accepted, where it is run in the gap located/formed where metal studwork meets metal noggins, metal floor/bottom-track, metal head/top-track and the like.

Fire isolation

Requirement: Provide fire-stop sealing where electrical services pass through fire-resisting walls, floors or ceilings. Additionally, the cable support system must not penetrate the fire rated wall, but rather stop 50-100mm from the wall, and then continue again on the other side. Only the cables themselves are to pass through the fire wall, and be appropriately fire sealed to control/minimise the spread of fire.

Fire Sealant:

Provide propriety fire-rated sealant and/or propriety fire stop pillows themselves firmly fixed in place with propriety fire-rated sealant.

Expanding foam type fire sealing, shall only be used as a temporary measure for sealing of plasterboard walls only.

Wall boxes in fire rated walls: Provide wall boxes containing intumescent fire control medium, and/or fire-resisting barriers behind wall boxes in fire-resisting walls if the integrity of the fire-resistance level has been altered. Consideration shall be given to acoustics between rooms, where electrical accessories and/or equipment has been mounted on walls/ceilings.

3.2 UNSHEATHED CABLES – INSTALLATION

General

Requirement:

Not permitted underground.

Provide permanently fixed enclosure systems/conduits, assembled before installing wiring. All conduits shall be glued.

Draw wires: Provide draw wires to pull in conductor groups from outlet to outlet, or provide ducts with removable covers.

3.3 CONDUIT SYSTEMS – INSTALLATION

Set out

General: If exposed to view, install conduits in parallel runs with right angle changes of direction.

Bends

General: Install conduits with the equivalent of ≤ 2 right angled bends per cable draw-in run.

Approval: Superintendent approval required for > 2 bends.

Conduits $> 80\text{mm}$ to have bellmouth cable guides at both ends to minimise damage to cable insulation.

Underground conduit bends must use Large Sweep Bends, Clipsal 247L or 247P series, or approved equivalents

Conduits in roof spaces

General: Locate below roof insulation and sarking. In accessible roof spaces, provide mechanical protection for light-duty conduits. Solar Photovoltaic DC cabling to be meet requirements of AS/NZS5033.

Roof Penetrations

All roof penetrations to be certified and warranted by the roofing contractor for new installations.

Penetration through a high-point of the roofing material profile. Penetrations through low point or pan of the roofing material not accepted. Any penetrations found penetrating the low points or the pan of the roofing deck, will necessitate repair/replacement of the roofing material, and thus be re-wired.

$< 50\text{mm}$ – use a proprietary penetration flashing, eg “Dektite” or similar. Only one cable or conduit per Dektite, to maintain seal.

$> 50\text{mm}$ – through an upstand and overflashing.

Inspection fittings

Location: Locate in accessible positions.

Draw cords

General: Provide 5 mm² polypropylene draw cords in conduits not in use.

Spare conduits

Provide spare conduits in underground conduit runs, as documented. These are to be left unused, with draw-cords. Perform mandrel testing to prove suitability and then seal all ends with propriety PVC type caps. Submit test results to Superintendent for review and included in the O&M manuals.

Draw-in boxes

General: For conduits in accessible locations provide draw-in boxes as follows:

- In straight runs at > 30 m: Spacing ≤ 28 m.
- At changes of level or direction.

Underground draw-in boxes: Provide gasketed covers and seal against moisture. Install in accessible pits.

Expansion

General: Allow for thermal expansion/contraction of conduits and fittings due to changes in ambient temperature conditions. Provide expansion couplings as required.

Rigid conduits

General: Install in straight long runs, smooth and free from rags, burrs and sharp edges. Set conduits to minimise the number of fittings.

Routes

Set out: If exposed to view, install conduits in parallel runs with right angle changes of direction.

Bends: Install conduits with no more than 2 right angled bends per cable draw-in run.

Concealed conduits: Run conduits concealed in wall chases, embedded in floor slabs or installed in inaccessible locations directly between points of termination, minimising the number of sets. Do not provide inspection fittings. Use large radius bends or elbows.

Overhead conduits in mechanical plant rooms: If overhead conduits service mechanical equipment installed on plinths in plant rooms, provide support and protection. Alternatively use cable support system.

Painting

Conduits exposed to view: Paint to match surrounds as documented. Unpainted PVC conduits exposed to view, will not be accepted.

Conduits in concrete slabs

Where in-ground conduits are protruding up through concrete slabs during the construction period, they shall be effectively sealed with propriety PVC conduit/pipe caps. Leaving them open, or taped over is not acceptable.

Route: Do not run conduits in concrete toppings. Do not run within close proximity of pre/post-tensioning cable zones. Cross pre/post-tensioning cable zones at right angles. Route to avoid crossovers and minimise the number of conduits in any location.

Parallel conduit spacing: ≥ 50 mm apart.

Conduits in mechanical plant room slabs: Avoid installation of conduits in plant room slabs (boiler rooms, mechanical plant rooms and tank rooms) if conduits and cables are likely to experience high temperatures, or be subject to core hole drilling, or the drilling of large anchor bolt points or where exact plant locations are unknown at time slab is poured. For this reason, surface mounted conduits, cable trays and the like are the preference.

Minimum cover: The greater of the conduit diameter and 20 mm.

Construction joints: Provide sleeving over conduit to allow movement of the conduit across the joint due to any slab movement.

Fixing: Fix directly to the top of the bottom layer of reinforcing.

3.4 CABLE SUPPORT SYSTEMS – INSTALLATION**General**

Standard: To NEMA VE-2.

Design: Support cable support systems as follows:

- Horizontal runs:

- . Concealed cable support system: At spacing which is less than length of cable support section.
- . Visible cable support: Loaded deflection \leq span/200.
- Vertical runs: To manufacturer's recommendation, taking into account the weight of cables installed.

Fixing to building structure

General: Fix supports to the building structure or fabric with >10mm threaded rod hangers (hot-dipped galvanised within 1km of the sea, or zinc plated for other areas) attached to hot-dipped galvanized U-brackets, or by means of proprietary brackets.

Cut ends: De-burred and painted with cold galvanised paint.

Seismic restraint to AS1170.4.

Fixings must be independent of any other building services (eg mechanical ducts or pipes) or suspended ceiling.

Cable fixing

General: Provide strapping or saddles suitable for fixing cable ties.

Plastic cable ties shall be premium type long life and UV stabilised black cable ties. Where other colours are required (typically for securing white flexible cabling down a pendant or similar), these shall be by approval.

Fire Rated services:

Fire-Rated cable system installations are to be engineered and installed as a complete "System", comprising of:

- (1) The Fire-Rated Cable.
- (2) The Fire-Rated Cable support system (cable tray, brackets, suspensions, fixing bolts, metal cable ties and anchors etc.)
- (3) The completion of Fire-Rating of penetrations, where Fire-Rated cabling passes through and/or via Fire-Rated penetrations, building envelopes, fire and/or smoke baffles and the like.

Certificates of Conformity for the Fire Rated Cable Systems shall be provided on request, and in Operation & Maintenance Manuals at project completion, and/or as staged completion occurs.

Inside bend radius

Requirement: At least 12 times the outside diameter of the largest diameter cable carried.

Cable protection

General: Provide rounded support surfaces under cables where they leave trays or ladders. All cut ends to be de-burred and painted with cold galvanising paint.

Clearances

Access requirement: At least 150 mm free space above and at least 600 mm free space on at least one side of cable tray and ladders.

From hot water pipes: > 200 mm.

From hot water units: > 500 mm.

Electromagnetic interference (EMI): Locate support systems for electrical power cabling and communication cabling to minimise electromagnetic interference.

3.5 CATENARY SYSTEMS – INSTALLATION

General

Anchoring: Anchor catenary systems to the structure. Do not fix to any part of a suspended ceiling system or any other building services (eg mechanical ducts or pipes) .

Design loads: Design catenary systems to support the proposed load of the cables with a spare capacity of 50% loading.

Fixing: Fix cables to the catenary system so that no cable is under stress due to tension or compression. Use proprietary fasteners that allow cables to be added or removed without destroying the integrity of the system.

No more than 5 sub-circuit cables per catenary is permitted.

No more than 25 data/communications cables per catenary is permitted.

No more than 25 security cables per catenary is permitted.

No more than 25 fire cables per catenary is permitted.

No more than 25 MATV per catenary is permitted.

3.6 CABLES IN TRENCHES – INSTALLATION

General

General: Conform to Civil Engineers Specification.

Sand bed and surround

Sand bed and surrounds: Provide at least 150 mm clean sharp sand around cables and conduits installed underground.

Sealing ducts and conduits

General: Seal buried entries to ducts and conduits with waterproof and vermin-proof removable seals as follows:

- Spare ducts and conduits: Immediately after installation.
- Other ducts and conduits: After cable installation.
- Application of sealant to a maximum of 50mm from the duct/conduit end such that the sealant is easily removable as required. This can be facilitated by putting solid foam or a rolled up cloth in the duct/conduit end to a depth of <50mm first before applying the sealant.

0921 LOW VOLTAGE POWER SYSTEMS**1 GENERAL****1.1 RESPONSIBILITIES****General**

Requirement: Provide low voltage power systems, as documented.

Design

Fault protection: Automatic disconnection to AS/NZS 3000 clause 2.4.

Maximum demand: Calculation method to AS/NZS 3000 Appendix C.

1.2 PERFORMANCE**Network supply**

General: Liaise with the electricity distributor and provide network connection, as documented.

Program: Schedule the works and statutory inspections to suit the construction program.

Prospective fault current: Determine, from the electricity distributor, the prospective fault current and fault protection requirements.

Supply system: 400 V, 3-phase, 4-wire, 50 Hz, MEN system.

Distribution system

General: Provide power distribution system elements, as documented.

Metering

Retail: Provide metering to the requirements of the principal, the selected electricity retailer and the electricity distributor.

Private: Provide private metering, as documented.

Surge protection devices (SPD)

General: Provide surge protection as documented.

1.3 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

- 0901 *Electrical systems*.
- 0911 *Cable support and duct systems*.

1.4 STANDARDS**General**

Electrical design: To SAA HB 301.

Electrical equipment: To AS/NZS 3100.

Fire and mechanical performance classification: To AS/NZS 3013.

Selection of cables: To AS/NZS 3008.1.1.

Distribution cables: To AS/NZS 4961.

Communications cabling: To AS/NZS ISO/IEC 14763.2.

Testing

Standard: To AS/NZS 3017.

1.5 INTERPRETATION**Abbreviations**

General: For the purposes of this worksection the following abbreviations apply:

- RCD: Residual current device.
- SPD: Surge protection device.

Definitions

General: For the purposes of this worksection the following definitions apply:

- Extra-low voltage: Not exceeding 50 V a.c. or 120 V ripple-free d.c.
- Low voltage: Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.

1.6 SUBMISSIONS

Operation and maintenance manuals

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the systems installed.

Samples

General: Submit samples of all visible accessories and equipment.

Cabling accessories: Submit switched socket outlets, light switch plates and other accessories.

Technical data

General: On request, submit the following information for each main, submain and final sub-circuit for which calculation is the responsibility of the contractor:

- Single line diagram.
- Fault levels at switchboards.
- Maximum demand calculations.
- Cable and conductor cross sectional area and insulation type.
- Cable operating temperature at design load conditions.
- Voltage drop calculations at design load conditions.
- Protective device characteristics.
- Discrimination and grading of protective devices.
- Prospective short circuit current automatic disconnection times.
- Earth fault loop impedance calculations for testing and verification.
- Certification of conformance to AS/NZS 3000, for electrical services.
- Stringing calculations for aerial cables.

Final sub-circuits: May be treated as typical for common route lengths, loads and cable sizes. Final sub-circuit minimum loading shall be calculated from:

- Connected load, or
- 50% of the circuit breaker rated current,
- and being whichever load profile is the greater one of the above two dot points.

Tests

Other tests: Submit results as follows:

- Installation: To AS/NZS 3000 Section 8 using the methods outlined in AS/NZS 3017.
- Connections to electricity networks: To AS 4741.

2 PRODUCTS ---

2.1 SITE ELECTRICITY SUPPLY

LV supplies from dedicated substations

LV transformer output supply: To AS/NZS 3000 and the electricity distributor's Service and Installation Rules.

Requirements: Provide short circuit and overload protection at the transformer secondary supply using fault current limiting circuit breakers with adjustable overload and short circuit current setting features, if secondary output supply protection is required.

Circuit breakers: Include full discrimination and cascade protection and grade with the electricity distributor's incoming supply protection system and the downstream site protection devices.

Consumers mains

Requirement: Provide consumers mains, associated services and all necessary fault and overload current protection equipment to AS/NZS 3000 Section 3, the electricity distributor's standards and the local Service and Installation Rules.

Protected consumers mains: Provide short circuit and overload protection, where required by the electricity distributor.

2.2 WIRING SYSTEMS

General

Requirement: Provide wiring and site cable reticulation systems appropriate to the installation conditions and the function of the load. Include the following:

- Underground services.
- Above-ground services.
- In-building services.

Type: Re-wireable system.

Neutral Conductors: Same size as the corresponding active conductors. Rate the neutral conductor size for the maximum harmonic currents.

Cable support system: Conform to the *0911 Cable support and duct systems* worksection.

2.3 POWER CABLES

Standards

Polymeric insulated cables: To AS/NZS 5000.1.

Aerial cables: To AS 1746.

Cable

General: Select multi-stranded copper cables.

Default insulation: V-75.

Default sheathing: 4V-75.

Minimum size: Conform to the following:

- Lighting sub-circuits: 2.5 mm².
- Power sub-circuits: 4 mm².
- Sub-mains: 6 mm² with (minimum) 6mm² earthing conductors.

Voltage drop: Select final sub-circuit cables within the voltage drop parameters dictated by the route length and load.

Fault loop impedance: Provide final sub-circuit cables to satisfy the requirements for automatic disconnection under short circuit and earth fault/touch voltage conditions.

Distribution cables: To AS/NZS 4961.

Colours

Fixed wiring cables: Coloured conductor insulation or at least 150 mm of close fitting coloured sleeving at the termination points of each conductor.

Active conductors in single phase circuits: Red.

Active conductors in polyphase circuits:

- A phase: Red.
- B phase: White.
- C phase: Blue.

Sheath: White.

2.4 ELECTRICAL ACCESSORIES

General

Style: Provide accessories of the same style and from the same manufacture across all trades and disciplines. Electrical contractor is to lead the coordination process with other trades via the lead construction contractor(s).

Accessory selection and locations require approval to ensure that each item is compatible with the final interior design of the space. Refer to the table below for Site Specific requirements.

Quality Assurance

Implement a quality system for the works in accordance with Australian/New Zealand ISO 9000.1 - Quality management and quality assurance Standards - Guidelines for selection and use and

Australian/New Zealand ISO 9001 - Quality systems - Model for quality assurance in design, development, production, installation and servicing.

Socket outlets

Standards:

- General: To AS/NZS 3112.
- Industrial: To AS/NZS 3123.

Plastic switched socket outlets

Type: Integral switched socket outlet.

Material: High impact plastic.

Size: refer to table below.

Colour: refer to table below.

Current rating: 10 A.

Pin arrangement: Mount outlets with the earth pins at the 6 o'clock position.

Mounting configuration: Horizontal.

Weatherproof socket outlets

Type: Integral switched socket outlet.

Material: High impact plastic.

Size: Standard single gang.

Colour: Grey.

Current rating: 10 A.

Pin arrangement: Mount outlets with the earth pins, at the 6 o'clock position.

Plugs – 230 volt

Requirement: Insulated type to AS/NZS 3112 with integral pins.

230 volt combination switch and permanently connected cord outlet

Type: Three terminal flush mounted switch and flex-lock insert assembly.

Material: High impact plastic.

Size: Standard single gang.

Colour: White electrical.

Current rating: 10 A.

Neon Indicator: Provide neon indicator to match existing.

Flex-lock assembly: Match and securely grip the size and type of flexible cable used.

Mounting configuration: Horizontal.

Installation couplers

Standard: to AS/NZS 61535.

Permanently connected equipment

General: Provide final sub-circuit to permanently connected equipment, as documented.

Isolating switch: Locate adjacent to equipment.

Coordination: Coordinate with equipment supplier.

Wall/ceiling mounted equipment: Conceal final cable connection to equipment.

Isolating switches

Standard: To AS/NZS 3133.

Selection: Clipsal WHT series, Clipsal 56 series, NHP ISO series, IPD W66 series, Wilco A series or Superintendent approved equal

Cable entries to be bottom-entry only and sealed to maintain IP rating

Light Switches

- Provide 15 A minimum rated rocker switch mechanisms suitable for fluorescent lighting loads equal to "Clipsal 30USM" or "HPM 770/15" and flush wall mount generally. Mechanism must be screw-fixed within the retaining plate

- Provide multi switch positions ganged under one cover plate, arranged in ganged boxes similar in plan to the lighting points controlled. Where more than 6 switches are required at the one location, install mechanisms on a flush mounted multi-gang lighting control panel.
- Install at 1000mm AFFL to centre of the plate, to AS1428.1

Appliances & other hard-wired equipment

General:

- Provide all appliances internally wired and complete with control switches, controllers and connecting links.
- Unless stated otherwise provide an isolating switch adjacent all direct connected appliances and equipment. The Isolation device, shall not be immediately behind the equipment, but be readily accessible adjacent to it.
- Connect each three phase appliance with a separate full size neutral and earth.
- Install the final connection to any equipment installed away from, but within 600mm of, a wall or column in flexible PVC conduit. PVC clad flexible steel conduit shall be used for machinery and in workshop type environments.
- Where any equipment is located at greater than 600mm from the wall, provide cabling installed within concealed conduit, in-floor ducting cast into the slab/flooring or by securely fixed metallic service pole (minimum 3mm thickness).
- Due consideration will be required for the environment of the installation to include but not be limited to:
 - . Chemical/corrosive resistance may be important in commercial kitchen and laundry environments
 - . Plastic-coated flexible metal conduits, eg "Anaconda" or similar, where mechanical damage is likely.
 - . Type of environment/product selected to provide a longevity of in-service installation.

Cross check immediately all equipment arriving on site for its electrical loading and phase connections. Advise Design team and Superintendent in writing, where equipment is found/deemed to be unsuitable for connection to the documented/designated building supply.

Connection: Shorten lead to minimum length for plug connections.

Isolating Switches: To AS/NZS 3000.

Air Conditioning (Mechanical Services) Isolating Switches:

Air conditioning electrical isolation switches shall not be mounted on equipment. These isolation switches shall be either wall mounted (if adjacent a wall/building), or be mounted on a secure metallic Hot dipped Galvanised bracket, adjacent to the piece of equipment it is serving.

Ovens and hot plates

General: functional switch

Single phase: 20amp isolator, minimum

Isolator switch is to be installed maintaining a minimum of 300mm clearance from the appliance, and not immediately behind it, to ensure it can be accessed in the event of an emergency with that appliance.

Dedicated appliance outlets

Outlets that are dedicated for individual appliances, eg fridge, dishwasher, microwave, rangehood etc, shall be installed on a circuit separate away from other general purpose outlets in the area.

TV outlets:

Provide flush wall mounted plates to TV points of the same manufacture as switches complete with 75 ohm F-type crimp connect TV antennae socket suitable for connection to an RG6 quad shield cable.

Provide one propriety fly lead (black) F-type male to 75ohm PAL, for each TV point. Length to be 1.5 meter minimum.

Notes to Site Specific requirements table

- Standard Plate: fixed accessory plate with no removable fascia, eg Clipsal 2000 series or approved equivalent
- Weather Proof: with IP rating of 55 minimum

3 EXECUTION

3.1 SITE ELECTRICITY SUPPLY

General

Electrical systems: Connect to the electricity distributor's supply, as documented and provide all equipment necessary to meet the electricity distributor's requirements.

3.2 EARTHING

Earthing systems

Protective earthing system with a multiple earth neutral (MEN) connection: To AS/NZS 3000 and as documented.

Earth electrodes

General: Provide electrodes to AS/NZS 3000 clause 5.3.6.

Length: 2 metres minimum

Type: Copper clad metal (Minimum requirement).

Electrode pit

Material: Non-ferrous

Earth electrode pit to be provided. Pit to be non-conductive, and be encased in 100mm concrete surround (200mm depth) to provide secure installation. Internally the earth connection, shall be well wrapped in Petrolatum type tape (as 'Denso Tape') or Self-amalgamating tape.

Bonding

General: Provide equipotential bonding to AS/NZS 3000 clause 5.6.

Earth and bonding clamps

General: Provide proprietary earthing and bonding clamps.

Standard: To AS 1882.

3.3 POWER CABLES

Cable installation

Classifications: To AS/NZS 3013.

Handling cables: Report damage to cable insulation, serving or sheathing.

Stress: Do not use installation methods that exceed the cable's pulling tension. Use cable rollers for cable installed on tray/ladders or in underground enclosures.

Straight-through joints: Unless unavoidable due to length or difficult installation conditions, run cables without intermediate straight-through joints.

Cable joints: Locate in accessible positions in junction boxes and/or in pits.

Individual wiring of extra-low voltage circuits: Tie together at regular intervals.

Circuit loading

Lighting: 1800VA at 240Vac, 1725VA at 230Vac, on a 10amp circuit breaker.

General Power: 6 off double power socket outlets (i.e. 12 single outlets maximum), on a 16amp circuit breaker, or 10 off double power socket outlets (i.e. 20 single outlets maximum) on a 20 amp circuit for circuits in a permanently air-conditioned environment. For this latter option, strict adherence to AS3008.1 will be required. Provide calculations of compliance on request.

Tagging

General: Identify multicore cables and trefoil groups at each end with stamped non-ferrous tags clipped around each cable or trefoil group.

Marking

General: Identify the origin of all wiring by legible indelible marking, at the final termination.

Submains and final sub-circuits

Installation: Provide the following:

- Cables with conductor size of less than or equal to 35mm²: Run in conduit, cable ducts or support on cable trays, catenary wire or ladders. Cables larger than 35mm² must be supported by cable tray

or ladders. Conduits, ducts, trays & ladders must be sized to allow 30% spare capacity for future additions.

- Cables for lighting systems: Run in conduit, cable ducts, suspend on catenary systems or support on cable trays or ladders.
- Inaccessible concealed spaces: Install cable in PVC-U conduit to allow for re-wiring if necessary.
- Roof spaces: Install cable below thermal insulation and sarking. If not protected from high ambient roof space temperatures by thermal insulation, derate the cables, to AS/NZS 3008.1.1 Table 27, for an assumed ambient temperature of 55°C.
- Accessible ceiling voids: Support or enclose cables in conduit on ceiling surfaces or on catenary systems if run adjacent to ceiling suspension systems. Cables within ceiling voids installed on catenary systems, shall be PVC cable tied at (minimum) 600mm intervals.
- Plastered or rendered masonry: Install cable in PVC-U conduit.
- Double sided face brick partition: Install cable in PVC-U conduit installed within the brick wall by slotting bricks or using any pathways provided in the brick.
- Walls filled with bulk thermal insulation: Install cables in PVC-U conduit, or if walls are timber stud, clip to the stud. Final sub-circuits may be run loose in stud walls where compliance (by calculation) to AS3008.1 has been achieved.
- Metal stud framed walls: Install cable using TPS cable allowing rewirability. Bush all knock-outs in steel framing to prevent cable damage. Earth bond (minimum 4mm²) metal stud frames to the electrical earthing system, to achieve a mechanical continuous framing installation.
- Horizontal cable trays or ladders: Fix cables using premium quality and durable proprietary nylon cable ties or straps, cable saddles or clips at 2000 mm intervals. Metal cable ties required for fire-rated cable systems.
- Vertical cable risers: Fix cables using proprietary nylon cable ties or straps, cable saddles or clips at 1000 mm intervals. Metal cable ties required for fire-rated cable systems.
- Plant rooms, Store rooms, and other rooms and the like without ceilings: Install cable in heavy duty PVC-U conduit or on tray, cable ladder or in duct.
- All cabling below 2100,, to be in steel conduit (earthed), or on cable tray with metallic protection covers. If internal cable tray(s) is accessible to any other than pedestrian traffic, metallic protection covers shall be equal to 3mm. Otherwise 1mm (nominal) or as otherwise approved.

3.4 FIRE-RESISTANT CABLES

Protection

General: If exposed to mechanical damage, provide protection to AS/NZS 3013.

Fire-Rated cable system installations are to be engineered and installed as a complete "System", comprising of:

- (1) The Fire-Rated Cable.
- (2) The Fire-Rated Cable support system (cable tray, brackets, suspensions, fixing bolts, metal cable ties and anchors etc.)
- (3) The completion of Fire-Rating of penetrations, where Fire-Rated cabling passes through and/or via Fire-Rated penetrations, building envelopes, fire and/or smoke baffles and the like.

Certificates of Conformity for the Fire Rated Cable System shall be provided to the Superintendents Representative on request, and also be included in O&M Manuals at project completion, and/or as staged completion occurs.

3.5 COPPER CONDUCTOR TERMINATIONS

General

General: Other than for small accessory and luminaire terminals, terminate copper conductors to equipment, with compression-type lugs of the correct size for the conductor. Compress using the manufacturers specified crimping method/tool.

Within assemblies and equipment

General: Loom and tie together conductors from within the same cable or conduit from the terminal block to the point of cable sheath or conduit termination. Neatly bend each conductor to enter directly

into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

Alternative: Run cables in PVC-U cable duct with fitted cover.

Identification: Provide durable numbered ferrules fitted to each core, and permanently marked with numbers, letters or both to suit the connection diagrams.

Spare cores: Identify spare cores and terminate into spare terminals, if available. Otherwise, neatly insulate and neatly bind the spare cores to the terminated cores.

3.6 ACCESSORIES

Installation

General: Install accessories and conceal cabling in walls in conformance with the following:

- Site specific requirements as per table in section 2.5 above
- Rendered masonry partition: Flush wall box, with PVC rigid conduit chased into wall.
Depth: maintain a clearance depth to the top edge of the conduit to the finished wall surface with 15mm clearance. Expanded metal lathe (mesh) to be fixed over chases prior to rendering.
Expanded mesh to finish a (minimum) of 50mm to each side of the primary chase/conduit.
- Refer to the specification on solid plastering for further details as applicable,
- Double sided face brick partition: Vertically mounted flush wall box, with conduit concealed in cut bricks. If retrofitting an existing installation, surface mounted duct/conduit to design team approval.
- Face brick external cavity wall: Flush wall box, with thermoplastic insulated cables in conduit run in cavity and tied against inner brick surface, or thermoplastic sheathed cables run in cavity.
- Data and/or Communications cabling shall be run in PVC conduit in the walls to enable future rewiring. Minimum size conduit = 25mm.
- Stud partition: Flush stud plate secured to proprietary support bracket or wall box. Rewireable, earth and shroud all metal frame partitions at each accessory location.
- The use of retro fitted wall plates (eg "C-Clips") is only approved where electrical accessories are being installed on existing walls, etc..
- Fire walls: Flush wall box, with conduit built into wall. Provide additional fire protection around wall boxes, where necessary to maintain fire-resistance rating.

Location: Confirm final location of all outlets and equipment on site, before installation.

Spacing from adjacent horizontal surface: ≥ 75 mm to the centre of accessory socket.

Default mounting heights to centre of accessory plate:

- Outlets: 300 mm or 150mm above bench height when at a workstation.
- Switches and controls: 1000 mm to the centre of the faceplate/primary switch mechanism.

Accessories: Flush mounted, except in plant rooms/and other rooms not provided with ceilings and the like, where surface mounted is acceptable.

Common face plates: Mount adjacent flush mounted accessories under a common faceplate.

Restricted locations:

- Do not install any electrical accessories across junctions of wall finishes.
- Coordinate electrical accessories where proposed/documented to be installed on Pin Board type wall finishes, with architectural documents, to avoid installing accessories on such substrates.
Where this is not possible contractors are to provide shop drawings (clearly showing elevations) where accessories clash with pin boards and the like., to the design team for final approval.

Surface mounting: Proprietary mounting blocks (minimum 4 secure fixings) may be used.

Installation of ceiling mounted accessories

Connections for appliances: Flush mounted outlets on the ceiling next to support brackets. The installation must be electrical insulated above the ceiling, in accordance with AS/NZS3000.

Mounting: Mount appliances independent of ceiling tiles and suspended ceiling suspension system. Fix directly to concrete slab or to structure above ceiling.

Lightweight ceilings, acoustic flush plasterboard ceilings, metallic and acoustic ceiling tiles: Electrical accessories and/or luminaire fixtures installed on such ceilings, shall be provided with additional backing boards to fully transfer the weight of the accessory to the primary ceiling rail system.

Connections for fixed equipment: Provide concealed permanent connections.

Fixing: For equipment and appliances heavier than five (5) kilograms, provide support through the suspended ceiling to the building structure. Brace appliances that have excessive bending moments, are heavy or vibrate, to prevent horizontal movement, e.g. operating theatre shadowless lights.

3.7 TESTING

Site tests

Inspection: Visually inspect the installation to AS/NZS 3000 before testing. Submit record on a checklist.

Ventilation: Test and verify the installation to AS/NZS 3000 Section 8 using the methods outlined in AS/NZS 3017.

Electricity networks: Test and verify the connections to electricity networks to AS 4741 and SA Power Networks Service & Installation Rules. Record and submit the results of all tests.

Dummy load tests

General: If electrical tests are required and the actual load is not available, provide a dummy load equal to at least 75% of the design load and appropriate resistive & inductive components to approximately simulate the expected power factor of the actual installation.

0942 SWITCHBOARDS – CUSTOM-BUILT**1 GENERAL****1.1 RESPONSIBILITIES****General**

Requirement: Provide switchboards, as documented.

1.2 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

- 0901 *Electrical systems.*
- 0921 *Low voltage power systems.*
- 0943 *Switchboard components.*

1.3 STANDARD**General**

Standards: To AS/NZS 3000 and AS/NZS 3439.1.

1.4 INTERPRETATION**Abbreviations**

General: For the purposes of this worksection the following abbreviations apply:

- TTA: Type-tested assemblies.
- NTTA: Non type-tested assemblies.
- PTTA: Partially type-tested assemblies.

Definitions

General: For the purposes of this worksection the following definitions apply:

- Custom-built assemblies: Low voltage switchgear and controlgear assemblies manufactured to order and incorporating either purpose-built or proprietary components or purpose-built or proprietary busbar assemblies.
- Fault current limiters: Circuit opening devices designed or selected to limit the instantaneous fault current.
- Incoming busbars: Busbars connecting incoming terminals to line side terminals of main switches.
- Main circuit supply busbars: Busbars connecting incoming functional unit terminals, or incoming busbars where no main switches are included, to outgoing functional unit terminals or outgoing functional unit tee-offs.
- Rated currents: Rated currents are continuous uninterrupted current ratings within the assembly environment under in-service operating conditions.
- Rated short-circuit currents: Maximum prospective symmetrical root mean square (r.m.s.) current values at rated operational voltage, at each assembly incoming supply terminal.
- Tee-off busbars: Busbars connecting main busbars to incoming terminals of outgoing functional units.

1.5 SUBMISSIONS**Calculations**

General: Submit detailed certified calculations verifying design characteristics.

Standard: To AS 3865 and AS 60890.

Operation and maintenance manuals

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

Routine tests

Standard: To AS/NZS 3439.1.

General: Submit reports.

Assemblies: Electrical and mechanical routine function tests at the factory using externally connected simulated circuits and equipment.

Dielectric testing: NTTAs: 2.5 kV r.m.s. for 15 s.

Shop drawings

General: Submit shop drawings showing:

- Types, model numbers and ratings of assemblies.
- Component details, functional units and transient protection.
- Detailed dimensions.
- Shipping sections, general arrangement, plan view, front elevations and cross-section of each compartment.
- Projections from the assembly that may affect clearances or inadvertent operation, such as handles, knobs, arcing-fault venting flaps and withdrawable components.
- Fault level and rated short circuit capacity characteristics.
- IP rating.
- Fixing details for floor or wall mounting.
- Front and back equipment connections and top and bottom cable entries.
- Door swings.
- External and internal paint colours and paint systems.
- Quantity, brand name, type and rating of control and protection equipment.
- Construction and plinth details, ventilation openings, internal arcing-fault venting and gland plate details.
- Terminal block layouts and control circuit identification.
- Single line power and circuit diagrams for all new and modified switchboards.
- Details of mains and submain routes within assemblies.
- Busbar arrangements, links and supports, spacing between busbar phases and spacing between assemblies, the enclosure and other equipment and clearances to earthed metals.
- Dimensions of busbars and interconnecting cables in sufficient detail for calculations to be performed.
- Form of separation and details of shrouding of terminals.
- Labels and engraving schedules.

Technical data

Calculations: Submit design calculations of non-type-tested and non-proprietary busbar assemblies.

Tests

Standard: To AS/NZS 3439.1.

Type tests: Submit certificates for components, functional units and assemblies. Verify that type tests and internal arcing-fault tests, if any, were carried out at not less than the designated fault currents at rated operational voltage.

Alterations to TTAs: Submit records of alterations made to assemblies since the tests.

Testing facility: Accredited by a NATA registered testing authority.

2 PRODUCTS

2.1 CUSTOM-BUILT SWITCHBOARD CONSTRUCTION

General

Requirement: Provide custom-built switchboards as documented.

Minimum width of all switchboards shall be >700mm per section.

Location

Where required: General: Internal switchboard locations are preferred. Where external installation is necessary, a weather proof canopy is required to approval.

External: Provide anti-condensation heaters to all externally mounted/installed electrical distribution boards and the like. Provide a minimum of 1 per switchboard cubical. Sizing to be calculated to a minimum of 20 W/m² of the total Height multiplied by Width of the enclosure.

Switchboard manufacturer

General: Use only switchboard manufacturers employing experienced switchboard personnel with more than 5 years' experience in the design of switchboards.

Separation

Default: Form 1.

Metering

General: Conform to the 0921 *Low voltage power systems* worksection.

Spare capacity

Default spare poles: Minimum 30% spare poles.

Surge protection

General: Provide surge protection as documented.

Earthing

General: Make provision for connection of communication systems CET at switchboard earth bar to AS/CA S009.

IP rating

Default rating: IP52 minimum.

Weatherproof: IP56 minimum.

Fire exits & egress paths: IP56 minimum (or enclosed in cupboard).

Supporting structure

Assemblies:

- Wall mounted: Maximum 2 m².
- Floor mounted: Greater than 2 m².

Ventilation

General: Required to maintain design operating temperatures at full load.

Layout

General: Position equipment to provide safe and easy access for operation and maintenance. Group devices according to function.

Connection: Front connected.

Compartments: Separate shipping sections, subsections, cable and busbar zones, functional unit modules and low voltage equipment compartments by means of vertical and horizontal steel partitions which suit the layout and form of separation.

Form 1 enclosures: Separate into compartments with partitions at 1.8 m maximum centres.

Equipment on doors: Set out in functional unit groups and to provide access without the use of tools or keys.

Segregation

General: Segregate BCA emergency equipment from non-emergency equipment with metal partitions designed to prevent the spread of a fault from non-emergency equipment to emergency equipment.

Enclosure materials

General: Fabricate from sheet metal of rigid folded and welded construction. Obtain approval for non-welded forms of construction.

Material: Metallic-coated sheet steel to AS 1397.

Material thickness:

- Diagonal dimension:
 - . < 900 mm: Minimum 1.6 mm.
 - . ≥ 900 mm: Minimum 2.0 mm.

Coating class:

- Indoor assemblies: Z200.
- Outdoor assemblies: Z450.

- Stainless steel construction: Refer to 'Materials and Components' section of General Requirements for stainless steel selection criteria.

Insect proofing

General: Cover ventilation openings with non-combustible and corrosion resistant 1 mm mesh.

Equipment mounting panels

General: To support the weight of mounted equipment.

Metallic panels: Construct from metal greater than or equal to 3 mm thick with heavy metal angle supports or plates bolted or welded to enclosure sides.

Non-metallic panels: Provide non-metallic to support the weight of the mounted equipment and design the mounting structure for stability and stiffness.

Non-metallic boards: To IEC 60893-1.

Equipment fixing

Spacing: Provide 50 mm minimum clearance between busbars for the following:

- Lifts, fire services and building emergency services.
- General installation services busbars.
- Equipment.

Mounting: Bolts, set screws fitted into tapped holes in metal mounting panels, studs or proprietary attachment clips. Provide accessible equipment fixings which allow equipment changes after assembly commissioning.

Installation: For lightweight equipment, provide combination rails and proprietary clips.

Earth continuity

General: Strip painted surfaces and coat with corrosion resistant material immediately before bolting to the earth bar. Provide serrated washers under bolt heads and nuts at painted, structural metal-to-metal joints.

Construction

Lifting provisions: For assemblies with shipping dimensions exceeding 1800 mm high x 600 mm wide, provide fixings in the supporting structure and removable attachments for lifting.

Supporting structure: Provide concealed fixings or brackets to allow mounting and fixing of assemblies in position without removing equipment.

Floor-mounting: Provide mild steel channel plinth, galvanized to class Z600, with toe-out profile, nominal 75 mm high x 40 mm wide x 6 mm thick, for mounting complete assemblies on site. Drill M12 clearance holes in assembly and channel and bolt assemblies to channel. Prime drilled holes with zinc rich organic primer to AS/NZS 3750.9.

Ventilation: Provide ventilation to maintain design operating temperatures at full load.

2.2 CABLE ENTRIES**General**

General: Provide cable entry facilities within assembly cable zones for incoming and outgoing power and control cabling. Provide sufficient clear space within each enclosure next to cable entries to allow incoming and outgoing cables and wiring to be neatly run and terminated, without unnecessary bunching or sharp bends.

Cover and gland plates

Cover plates: Provide 150 mm maximum width cover plates butted together and covering the continuous cable entry slot.

Gland plates: Provide removable gland plates fitted with gaskets to maintain the degree of protection.

Materials: Conform to the following:

Generally: 3mm Aluminium Gland Plates shall be provided to all switchboard cable entries.

Steel (ferrous metal) gland plates are not acceptable.

All cable entries shall strictly comply with AS/NZS3000, Fire rated measures clause (currently Clause 2.9.7).

Provide the minimum number of entry plates to leave spare capacity for 30% future cable entries.

Do not run cables into the top of weatherproof assemblies. These shall be bottom entry only.

Single core cables: Pass separately through propriety Plastic Glands and via the 3mm Aluminium cable gland plates. Provide Metal glands for Fire Rated cables.

2.3 DOORS AND COVERS

General

Requirement: Provide lockable doors with a circuit card holder unless enclosed in cupboards.

Door layout

Maximum width: 900 mm.

Minimum swing: At least 90° and 600mm clearance, as per AS3000.

Door stays: Provide stays to outdoor assembly doors.

Adjacent doors: Space adjacent doors to allow both to open to 90° at the same time.

Door construction

Protection: Provide single right angle return on all sides and fit suitable resilient sealing rubber to provide the documented IP rating and prevent damage to paintwork.

Hinges: Provide the following:

- Generally: Corrosion-resistant pintle hinges or integrally constructed hinges to support doors.
- For removable doors: Staggered pin lengths to achieve progressive engagement as doors are fitted.
- For doors higher than 1000 mm: 3 hinges.
- For non lift-off doors: Restraining devices and opposed hinges.

Door hardware: Provide the following:

- Corrosion resistant lever-type handles, operating a latching system with latching bar and guides strong enough to withstand explosive force resulting from fault conditions within the assembly.
- Dual, edge mounted, corrosion resistant T handles with provision for key locking cylinder.
- Captive, corrosion resistant knurled thumb screws as an alternative to handles.

Locking: Incorporate cylinder locks in the latching system. 604 Key, 2 keys per assembly.

Door mounted equipment: Protect or shroud door mounted equipment and terminals to prevent inadvertent contact with live terminals, wiring, or both.

Earthing: Maintain earth continuity to door mounted indicating or control equipment with multi-stranded, flexible earth wire, or braid of equal cross-sectional area, bonded to the door.

Covers

Maximum dimensions: 900 mm wide and 1.2 m² surface area.

Fixing: Fix to frames with at least 4 fixings, using corrosion-resistant acorn nuts with serrated washers.

Rest cover edges on the cubicle body or on mullions. Do not provide interlocked covers.

Handles: Provide corrosion-resistant D type handles.

Gland Plates

All cable entry points shall be via (minimum) 3mm Aluminium or Brass Gland plates. Steel Gland Plates will not be permitted.

Escutcheons

General: For doors enclosing circuit breakers, provide escutcheon plates as barriers between operating mechanisms and live parts. Hinged and removable

Escutcheon plates

General: Provide plates or removable covers with neat circuit breaker toggle cut-outs allowing interchangeability of 1, 2 and 3 pole circuit breakers. Provide corrosion-resistant lifting handles or knobs. Provide unused circuit breaker toggle cut-outs with blanking in-fill pole covers.

Maximum dimensions: 900 mm wide and 1.2 m² surface area.

2.4 FACTORY FINISHES

General

Standard: To AS 2700.

Extent: Apply protective coatings to internal and external metal surfaces of assembly cabinets including covers, except to stainless steel, galvanized, electroplated, or anodised surfaces and to ventilation mesh covers.

Finish coats: Thermoset powder coating to AS 4506 or two-pack liquid coating of AS/NZS 3750.13 primer and proprietary or epoxy acrylic full gloss spray finish.

Factory finish colours

Mounting structure (brackets): To match enclosure.

Enclosure - indoor: To Architects colour schedule, otherwise

Indoor assemblies: to match wall surface

Otherwise:

- Indoor assemblies: Orange X15.
- Assembly interior: Gloss White.

Enclosure - outdoor:

Outdoor assemblies: to match wall surface, to Architect's colour schedule, otherwise

- Outdoor assemblies: Avocado green G34.
- Assembly interior: Gloss White.

Escutcheons - removable equipment panels:

- Internal assemblies: Gloss White.
- External assemblies: Off white Y35.

Doors: To match enclosure.

Plinths: Hot-dipped galvanised.

2.5 BUSBARS**General**

General: Provide main circuit supply busbars within assemblies, extending from incoming supply terminals to the line side of protective equipment for outgoing functional units and for future functional units.

Standards: To AS 3768, AS 3865 and AS 60890.

Protection: All unused terminals to be protected.

Custom-built busbar construction

Material: Hard-drawn high-conductivity electrolytic tough pitched copper alloy bars, designation 110.

Temperature rise limits - active and neutral conductors:

- Maximum rated current temperature rise limits: $65 \pm 1.5^\circ\text{C}$ above ambient temperature by type test or calculation to AS 3768 or AS 60890.
- Maximum short-circuit withstand current temperature rise limits: 160°C by calculation to AS 3865.

Cross section: Rectangular. Remove sharp edges of rectangular busbar by filing the edge or use radiused edges.

Supports: Sufficient to withstand thermal and magnetic stresses due to maximum prospective fault currents.

Support material: Non-hygroscopic insulation capable of holding busbars at 105°C .

Proprietary busbars

Type: Multi-pole proprietary insulated busbar assemblies or busbar systems, verified for short circuit capacity and temperature rise-limits by type tests.

Phase sequence

General: For main busbars and connections to switching devices, set-out phase sequence for phases A, B and C, from left-to-right, top-to-bottom and front-to-back when viewed from the front of the assembly.

Colour coding

General: Provide 25 mm minimum width colour bands permanently applied to busbars at 500 mm maximum intervals with at least one colour band for each busbar section within each compartment.

Active busbars: Red, white and blue respectively for the A, B and C phases.

Neutral busbar: Black.

MEN link: Green-yellow and black.

Protective earth busbar: Green-yellow.

Restrictions: Do not provide adhesive type colour bands.

Current carrying capacity

Active conductors: Take into account thermal stresses due to short circuit current, assuming magnetic material enclosures located indoors in well-ventilated rooms and 90°C final temperature.

Neutral conductors: Size to match incoming neutral conductor current carrying capacity.

Protective earth conductors: Size for at least 50% of the rated short circuit withstand current for 100% of the time duration.

Tee-off busbars current rating

For individual outgoing functional units: Equal to maximum frame size rating of the functional unit.

For multiple functional units: Equal to the diversity factors of AS/NZS 3439.1, based on frame size rating.

MEN links

MEN links > 10 mm² in cross-section: Bolted removable busbar links stamped MEN LINK, located in the incoming compartment, between neutral and earth busbars.

Amend to suit the supply authority or project specific requirements.

Fault current limiters

General: Rate busbars connected to fault current limiters to 100% of the indicated fault current limiter circuit breaker frame size or fuse base rating.

Busbar links

General: For current transformers, provide removable busbar links less than or equal to 450 mm long.

Cable connection flags

General: Provide and support busbar flags for equipment with main terminals too small for cable lugs. Provide flags sized to suit cable lug termination, with current rating of at least the maximum equipment frame size.

Phase isolation: Provide phase isolation or barriers between flags where the minimum clearance distances phase-to-phase and phase-to-earth are below the component terminal spacing.

Future extensions

General: Pre-drill the main circuit supply busbar for future extensions and extend busbar droppers into future functional unit locations.

Jointing

General: Use multiple bolted joints on all overlapping busbars with a minimum of two bolts per joint.

Type: High tensile steel bolts, washers and nuts, with lock nuts or spring washers. Do not use tapped holes and studs or the like for jointing current carrying sections.

Custom-built busbar insulation

Active and neutral busbars and joints: Select from the following:

- Polyethylene: At least 0.4 µm thick with dielectric strength of 2.5 kV r.m.s for 1 minute, applied by a fluidised bed process in which the material is phase coloured and directly cured onto the bars.
- Close fitting busbar insulation mouldings at least 1 mm thick.
- Heat shrink material: Only on rounded edge busbars.

Taped joints: Apply non-adhesive stop-off type tape, coloured to match adjacent insulation and half lapped to achieve a thickness at least that of the solid insulation to the manufacturer's instructions.

Damaged insulation: Replace/repair damaged insulation before energising.

2.6 NEUTRAL LINKS AND EARTH BARS**Terminals**

General: Provide terminals for future circuits. 2 screw cable tunnel per circuit.

Earth bar: Provide dedicated earth bar for all RCD units

Links

Assembly capacity > 36 poles: Provide neutral links and earth bars at the top and bottom of the circuit breaker section.

Assembly capacity ≤ 36 poles: Provide links and bars at the point of entry of incoming supply cables.

Mounting: Mount neutral links on an insulated base.

Control circuits: Provide separate neutral links and earth bars.

Labels: Provide labels for neutral and earth terminals.

Cables > 10 mm²: Provide bolts or studs.

Communications earth: Make provision for connection of communications systems earth at switchboard earth bar to AS/CA S009.

2.7 INTERNAL WIRING

Wiring

General: Cable type: 0.6/1 kV copper cables. Provide V-90HT insulation where directly connected to active and neutral busbars.

Cable interconnections

General: For the main circuit supply, provide cable interconnections as follows:

- ≥ 1.5 mm² internal cables, with minimum V75 insulation rating with stranded copper conductors rated to AS/NZS 3008.1.1. Provide cables with current ratings suitable for the internal assembly ambient air temperature and for temperature rise limits of equipment within the assembly.
- Run cables clear of busbars and metal edges.
- Provide cables capable of withstanding maximum thermal and magnetic stresses associated with relevant fault level and duration.
- Run cables neatly. Provide slotted trunking sized for future cables or tie at 150 mm maximum intervals with ties strong enough to withstand magnetic stresses created at the specified fault current. Do not provide adhesive supports.
- Provide for installation of wiring for future equipment without removal of existing equipment.
- Identify power and control cables at both ends with neat fitting ring type ferrules agreeing with record circuit diagrams. Mark to AS/NZS 4383 series.
- Terminate control cables and motor control circuits in tunnel terminals or, if necessary, provide suitable palm type lugs and correct crimp tool.
- For equipment mounted on hinged doors run cables on the hinge side to avoid restricting the door opening. Bundle cables with spiral wrap PVC or split conduit and secure to door.
- If recommended by device manufacturers, provide shielded wiring.

Linking of adjacent circuit breakers: Not permitted.

Cables > 6 mm²

Terminations:

- Tunnel terminals: Single cables.
- Other connection points or terminals: ≤ 2 cables.

Doors: Do not run cables to hinged doors or removable panels.

Supports:

- Spacing at enclosure: ≤ 200 mm from a termination.
- Spacing generally: ≤ 400 mm.
- Strength: Capable of withstanding forces exerted during fault conditions.

Single core cables rated ≥ 300 A: Do not provide ferrous type metal cable saddles.

Terminals marking: Terminate marked cables for connection to external controls in correspondingly marked terminals within the assembly.

Control and indication circuits

General: Provide conductors sized to suit the current carrying capacity of the particular circuit.

Minimum size: 1 mm² with 32/0.2 stranding.

Cable colours

General: Colour code wiring as follows:

- A phase: Red.
- B phase: White.
- C phase: Blue.
- Neutral: Black.
- Earthing: Green-yellow.

2.8 TERMINATIONS

Submains, light and power circuits

General: Connect direct to the control equipment terminals.

Shipping breaks: Provide terminal blocks for interconnecting wiring on each side of shipping breaks.

3 EXECUTION ---

3.1 ASSEMBLY INSTALLATION

Location

All external Switchboard's shall be provided with full weather protection to enable 24/7 maintenance access at all times. Switchboards shall have covering to a minimum of 1000mm past the open door of the front of the switchboard and typically 500mm to each other side of the switchboard.

Emergency Lighting

Install an AS2293 compliant emergency lighting luminaire in of the front of the board to provide adequate lighting in emergency conditions

Fixing

General: Before making inter-panel connections, fix assemblies and metering equipment enclosures into position, level and plumb. Ensure adequate seismic bracing to AS1170.4

3.2 ASSEMBLY ENTRIES

Cable entries

General: Neatly adapt one or more cable entry plates, if fitted, to accept incoming cable enclosure. Provide the minimum number of entry plates to leave spare capacity for future cable entries. Do not run cables into the top of weatherproof assemblies.

Single core cables rated > 300 A: Pass separately through non-ferrous gland plates. Do not use ferrous metal saddles.

Cable enclosures

General: Continue cable enclosures to or into assemblies and fit cable entry plates so that the IP rating of the assembly and the fire rating of the cable are maintained.

Cable supports

General: Support or tie mains and submains cables within 200 mm of terminations. Provide cable supports suitable for stresses resulting from short circuit conditions.

3.3 MARKING AND LABELLING

General

Switchboard assembly: Label in conformance with AS/NZS 3439.1 including the following:

- Size and type of all incoming and outgoing mains and submains.
- Emergency operating procedures.

3.4 MAINTENANCE

General

Standard: To AS 2467.

Requirement: Carry out the following:

- Rectify faults, make adjustments and replace consumable and faulty materials and equipment within 24 hours of notification.
- Monthly inspections and maintenance work to maintain the assembly, including battery systems.

0943 SWITCHBOARD COMPONENTS**1 GENERAL****1.1 RESPONSIBILITIES****General**

Requirement: Provide switchboard components, as documented.

1.2 DESIGN**Statutory authority's equipment**

General: Liaise with the electricity distributor about the installation and coordinate with their protective and control equipment.

1.3 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

- 0901 *Electrical systems.*
- 0942 *Switchboards – custom-built.*

1.4 INTERPRETATION**Abbreviations**

General: For the purposes of this worksection the following abbreviations apply:

- MSB: Main switchboard
- DB: Distribution board
- SPD: Surge protection device.

1.5 SUBMISSIONS**Operation and maintenance manuals**

Requirement: Submit all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

Technical data

General: Submit technical data for all components.

2 PRODUCTS**2.1 REQUIREMENTS****General**

Selection: Conform to AS/NZS 3000 clause 1.7 and Section 2.

Rated duty: Uninterrupted.

Rated making capacity (peak): $\geq 2.1 \times$ fault level (r.m.s.) at assembly incoming terminals.

Utilisation category: To AS/NZS IEC 60947.1 clause 4.4 and the recommendations of Annex A.

- Circuits consisting of motors or other highly inductive loads: At least AC-23.
- Other circuits: At least AC-22.

Coordination: Select and adjust protective devices to discriminate under overload, fault current, and earth fault conditions.

Enclosure: IP4X minimum.

2.2 SWITCH-ISOLATOR**General**

Standard: To AS/NZS IEC 60947.1 and AS/NZS 3947.3.

Poles: 3.

Operation: Independent manual operation including positive ON/OFF indicator.

Shrouding: Effective over range of switch positions.

Fault make/fault break switch-isolators

Rated breaking capacity: To AS/NZS 3947.3 Table 3.

Rated short-time withstand current: As defined in AS/NZS IEC 60947.1 clause 4.3.6.1 and the manufacturer's recommendation for the prospective fault current conditions.

Rated short-circuit making capacity: As defined in AS/NZS IEC 60947.1 clause 4.3.6.2, to conform to the manufacturer's recommendation for the prospective fault current conditions.

Rated short-circuit breaking capacity: To AS/NZS IEC 60947.1 clause 4.3.6.3 and the manufacturer's recommendation for the prospective fault current conditions.

Load make/load break switch-isolators

Rated making and breaking capacity: As defined in AS/NZS IEC 60947.1 clause 4.3.5 to conform to AS/NZS 3947.3 Table 3 and the manufacturer's recommendations for the prospective fault current conditions.

Rated short-time withstand current: As defined in AS/NZS IEC 60947.1 clause 4.3.5, to conform to the manufacturer's recommendation for the current conditions.

2.3 OVERLOAD AND FAULT PROTECTION GENERALLY

General

Requirement: Provide overload and fault protection devices, including full discrimination and cascade protection, and grade with the electricity distributor's incoming supply protection system and the downstream site protection devices.

2.4 MOULDED CASE AND MINIATURE CIRCUIT BREAKERS

General

Moulded case breakers: To AS/NZS IEC 60947.1, AS 2184 and AS/NZS IEC 60947.2.

Miniature circuit breakers: Interrupting capacity classification to AS/NZS 60898.1 or AS/NZS 3111.

- For general building services: Type C.
- For motor protection: Type D.

Operation: Independent manual operation including positive ON/OFF indicator.

Trip type: Conform to the following:

- Moulded case breakers: Adjustable thermal, fixed magnetic.
- Miniature circuit breakers: Fixed thermal and fixed magnetic.

Isolation facility: Required.

Mounting: Mount circuit breakers so that the ON/OFF and current rating indications are clearly visible with covers or escutcheons in position. Align operating toggles of each circuit breaker in the same plane.

Utilisation category: Moulded case breakers:

- Final sub-circuits category: Category A.
- Mains and submains: Category B.

Trip settings: Set as documented, seal, and label.

Interchangeable trip units: Connect trip units so that trip units are not live when circuit breaker contacts are open.

Fault current limiting circuit breakers: Select breaker frame sizes from one manufacturer's tested range of breakers to give cascade and discrimination protection within the switchboard and downstream switchboards as required.

2.5 ELECTRICITY DISTRIBUTOR'S SERVICE PROTECTIVE DEVICES

General

Low voltage service protective devices: To AS/NZS 3000, the electricity distributor's requirements and the supply authority Service and Installation rules.

Service protective devices > 100 A: Provide fault current limiting circuit breakers with adjustable overload and short circuit current facilities with full discrimination and cascade protection between the incoming supply protection systems and the downstream protection systems.

2.6 RESIDUAL CURRENT OPERATED CIRCUIT BREAKERS (RCBO)

General

Standard: To AS/NZS 3190.

Integral non-overload protection type: To AS/NZS 61008.1.

Integral overload protection type: To AS/NZS 61009.1.

Modular type: To AS/NZS IEC 60947.2.

- Type II.

Default tripping current: 30 mA generally, 10mA for body and cardiac protection to AS/NZS3003

Do not install an RCD in the Distribution Board on a Body- or Cardiac- protected circuit, only a MCB.

For Cleaners Circuits in a AS/NZS3003 area, install the RCD/LPD adjacent to first Cleaner outlet in the circuit and only a MCB in the switch board.

Enclosure mounting: Din rail mounted.

2.7 CURRENT TRANSFORMERS (PROTECTION)

General

Standard: To AS 60044.1 class 10P.

Type: Cast resin encapsulated window type with busbar clamping devices.

Rated short time current: At least the short time current equivalent to the assembly fault level.

Rated short-time: At least the maximum time setting of the related protective relay. Minimum 1 s.

Rated primary current: Equal to assigned current rating of the associated functional unit.

Rated secondary current: 5 A. Connect star point to earth.

Interposing transformers: Provide to the protective relay manufacturer's recommendations.

Characteristics: Conform to the protective relay manufacturer's recommendations.

Test links: Provide test terminals and current transformer secondary shorting links in accessible positions within instrument panels. Provide a set of DIN-type rail mounted test links, consisting of screw clamped slide links and earth links, for each current transformer group.

Installation: Install transformers to permit easy removal.

Removable links: Provide removable links of minimum lengths for transformers fitted on busbar systems.

Markings: Mount transformers in the assembly enclosure, so that polarity markings and nameplate details are readily viewed right side up without removing the transformers.

2.8 SURGE PROTECTION DEVICES (SPD)

General

Standard: To IEC 61643-11 and IEC 61643-12.

Installation: To AS/NZS 3000 Appendix F.

Primary protection

General: Provide shunt connected metal oxide varistor based SPDs between each phase and neutral at assembly incoming supply terminals, on the load side of incoming functional units.

Type I SPD

Surge Rating: $I_{\max} \geq 150$ kA per phase to neutral.

Surge Rating: $I_{\max} \geq 100$ kA neutral to earth if remote from the MEN earthing system.

Residual Voltage: $U_p < 800$ V @ 3 kA.

Visual indicator: Provide visual indication of SPD status and life visible from the switchboard front panel.

Alarm contacts: Provide one set of normally closed dry contacts indicating status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker or 63A HRC fuse.

Type II SPD

Surge Rating: $I_{\max} \geq 100$ kA per phase to neutral.

Surge Rating: $I_{\max} \geq 100$ kA neutral to earth if remote from the MEN earthing system.

Nominal discharge current: 40 kA (8/20 μ s).

Residual Voltage: $U_p < 800$ V @ 3 kA.

Visual indicator: Provide visual indication of SPD status and life visible from the switchboard front panel.

Alarm contacts: Provide one set of normally closed dry contacts indicating status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker or 63A HRC fuse.

Secondary protection

General: Provide shunt connected metal oxide varistor based SPDs between each phase and neutral and a gas discharge tube between neutral and earth at assembly incoming supply terminals, on the load side of incoming functional units and upstream of RCD devices.

NOTE: All Data and communications cabinets shall be provided with Secondary Surge Protection.

Type III SPD

Surge Rating: $I_{\max} \geq 50$ kA per phase to neutral.

Surge Rating: $I_{\max} \geq 20$ kA neutral to earth.

Residual Voltage: $U_p < 800$ V @ 3 kA.

Visual indicator: Provide visual indication of SPD status and life.

Alarm contacts: Provide one set of normally closed dry contacts indicating status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker or 32A HRC fuse. Connecting lead lengths should not exceed 300 mm.

Combined primary and secondary surge reduction filter protection

General: Provide series connected surge reduction filter comprising metal oxide varistor or triggered spark gap based primary SPDs, a low pass LC filter and secondary metal oxide varistor based SPDs.

Surge Rating: $I_{\max} \geq 100$ kA per phase to neutral primary protection.

Surge Rating: $I_{\max} \geq 100$ kA neutral to earth if remote from the MEN earthing system.

Residual Voltage: $U_p < 600$ V @ 20 kA.

Visual indicator: Provide visual indication of SPD status and life.

Alarm contacts: Provide one set of normally closed dry contacts indicating status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker equal to or less than the load current rating of the SPD.

Protection of final sub-circuits

General: Provide series connected surge filter comprising metal oxide varistor based primary SPDs, a low pass LC filter and secondary metal oxide varistor based SPDs.

Type: ERICO TDF 20A240V surge reduction filters TD technologies.

Operating voltage: $U_n = 220 - 240$ V at 50 Hz.

Maximum discharge current: $I_{\max} = 20$ kA (8/20 μ s) phase to neutral and 10 kA neutral to earth.

Voltage protection level: $U_p < 600$ V at 3 kA and < 700 V at 500 A.

Visual indicator: Provide visual indication of SPD status.

Maximum continuous operating voltage: $U_c = 340$ V a.c.

Enclosure and installation: House SPD in electrical switchboard or panel.

Enclosure mounting: Din rail mounted.

2.9 CURRENT TRANSFORMERS (METERING)**Standard**

Measurement current transformers: To AS 60044.1.

Test links

General: Provide test links for connection of calibration instruments and meters and for shorting of current transformer secondaries.

Energy meters, maximum demand meters, ammeters and protection relays: Provide with rail-mounted links consisting of screw-clamped slide links and an earth link.

Test studs

General: For energy and demand meters provide rail-mounted potential test studs or plug connections next to associated current transformer links. Provide at least one set of test studs for each compartment.

Accuracy classification

Energy measurements: Class 0.5.

Indicating instruments: Class 3.

Ratings

Rated short time current: At least the short time withstand current equivalent of the circuit in which the transformer is installed.

Rated primary current: At least equal to the current rating of the functional unit.

Secondary windings: Rated at 5 A, burden of 0.4 Ω (10 VA) with star point earthed.

Type

General: If practicable, cast resin encapsulated window-type with busbar clamping devices. Otherwise wound-primary type with mounting feet.

Installation

General: Install transformers to permit easy removal.

Removable links: Provide removable links of minimum length for transformers fitted on busbar systems.

2.10 CONTACTORS**General**

Standard: To AS/NZS IEC 60947.4.1.

Type: Enclosed, block type, air break, electro-magnetic.

Poles: 3.

Rated operational current: The greater of:

- Full load current of the load controlled.
- 16 A.

Mechanical durability: 10 million cycles to AS/NZS IEC 60947.4.1.

Electric durability: ≥ 1 million operations at AC-22 to AS/NZS IEC 60947.4.1.

Mounting: Mount with sufficient clearance to allow full access for maintenance, removal and replacement of coils and contacts, without the need to disconnect wiring or remove other equipment.

Auxiliary contacts: Provide auxiliary contacts with at least one normally-open and one normally-closed separate contacts with rating of 6 A at 230 V a.c., utilisation category: AC-1.

Slave relay: If the number of auxiliary contacts exceeds the number which can be accommodated, provide separate slave relays.

NOTE: Contactors shall be failsafe to on (may need to be Normally Closed, where used for General Lighting and Power provisions), so that in the event of failure of the contactor or its coil, the facility remains functional.

2.11 CONTROL DEVICES AND SWITCHING ELEMENTS**Standards**

General: To AS/NZS IEC 60947.1 and AS/NZS IEC 60947.5.1.

Time switches

Type: 7 day fully programmable with holiday override function. The override switch must be accessible without the use of a tool or a key and have "Off – Auto – On" facility.

Daylight saving switch: Required.

Mains failure operation: 100 hour minimum operating capacity.

Contact rating: ≥ 16 A at 230 V a.c. resistive load.

Construction: Provide readily accessible means of adjustment. Provide operational settings which are clearly visible when switch cover is fitted.

Dial: Digital with hour and minute display.

Override switch (manual): Required.

Control relays

Standard: To AS/NZS IEC 60947.5.1.

Operation: Suitable for continuous operation.

Construction: Plug-in types. Receptacle bases with captive clips which can be operated without using tools.

General: Provide heavy duty fixed mounted type 3 relays.

Type: Modular block.

Contact elements: Electrically separate, double break with silver alloy, non-welding contacts.

Configuration: For standard relays, provide assemblies with ≥ 2 sets of contacts and expandable to 8 sets of contacts in the same assembly. Provide at least one normally-open and one normally-closed contact.

Plug-in types: If required provide the following:

- Receptacle bases with captive clips which can be operated without using tools.
- Changeover type contacts to allow either normally-open or one normally-closed configuration.

Control relay selection table

Relay type	Minimum mechanical life (million operations)	Base	Minimum contact rating	Inter-changeable	Minimum number of contact elements
1	5	Plug-in	1.25I _L	Yes	2
2	10	Plug-in	5 A at 240 V	Yes	2
3	10	Fixed mounting	5 A at 240 V	Yes	4

Time delay relays

Adjustable range: Adjustable over the full timing range with timing repeatability within $\pm 12.5\%$ of nominal setting.

Electronic relays: Incorporate light emitting diodes indicating energisation states of relays.

2.12 ANTI-CONDENSATION HEATERS

General

Anti-condensation heaters shall be provided to all external switchboards, except in Domestic installations.

Rating: Provide heaters rated at not less than 20 W/m² of total external area including top of weatherproof enclosure.

Type: Black heat type with surface temperature less than or equal to 50°C, mechanically protected and thermostatically controlled.

3 EXECUTION

3.1 MARKING AND LABELLING

General

General: Provide labels including control and circuit equipment ratings, functional units, notices for operational and maintenance personnel, incoming and outgoing circuit rating, sizes and origin of supply and kW ratings of motor starters.

Labels on assembly exteriors

Manufacturer's name: Required.

Assemblies: Label with essential markings.

Designation labels: For other than main assemblies, provide designation label stating source of electrical supply. Identify separate sections of enclosures.

Assembly controls: Label controls and fault current limiters, including the following:

- Circuit designation for main switches, main controls and submains controls.
- Details of consumer's mains and submains.
- Use different colours on labels to distinguish operational requirements such as normal operation, operation under fire or emergency conditions.
- Incoming busbar or cable rating to first tee-off.
- Fuse link size.

Labels on assembly interiors

General: Provide labels for equipment within assemblies. Locate so that it is clear which equipment is referred to, and so that lettering is not obscured by equipment or wiring.

Moulded case circuit breakers: If circuit breaker manufacturer's markings are obscured by operating handle mechanisms or motor operators, provide additional markings open to view on, or next to, the circuit breaker.

Arrestors: Label each group of primary arrestors, stating their purpose and the necessary characteristics.

Danger, warning and caution notices

Busbars: If polymer membrane coating is used without further insulation, provide warning notices on the front cover near the main switch or local main switch and on rear covers, indicating that busbars are not insulated.

Fault current limiters: In assembly sections containing fault current limiter fuses provide caution notices fixed next to the fault current limiters, stating that replacement fuse links are to match the installed fuse link ratings, make and characteristics. Provide separate label stating make and fault current limiting fuse ratings.

Externally controlled equipment: To prevent accidental contact with live parts, provide warning notices for equipment on assemblies not isolated by main switch or local main switch.

Stand-by power: Provide warning notices stating that assemblies may be energised from the stand-by supply at any time.

Anti-condensation heaters: To prevent accidental switching off, provide caution notices for anti-condensation heaters.

Insulation and shrouding: For insulation or shrouding requiring removal during normal assembly maintenance, provide danger notices with appropriate wording for replacement of insulation shrouding before re-energising assemblies.

Positioning: Locate notices so that they can be readily seen, next to or, if impracticable, on busbar chamber covers of functional units and behind the front cover of functional units. Provide circuit identification labels in the cabling chamber of each functional unit, located next to external terminations.

Schedule cards

General: For general light and power distribution assemblies, provide schedule cards of minimum A4 size, with typewritten text showing the following as-installed information:

- Submain designation, rating and short-circuit protective device.
- Light and power circuit numbers and current ratings, cable sizes and type and areas supplied.
- Mounting: Mount schedule cards in holders firmly fixed to the inside of the assembly or cupboard door, next to the distribution circuit switches, stick on type, not acceptable. One schedule card per holder. Protect with hard plastic transparent covers.

Single-line diagrams

Main switchboards and distribution switchboard assemblies: Provide single-line diagrams wall mounted adjacent to all Main Switchboards and Main Distribution Switchboards.

Format: Non-fading print, at least A3 size, showing the system as installed.

Mounting: Enclose in a non-reflective frame and wall mount close to assembly.

Marking cables

General: Identify the origin and cable size of wiring with legible indelible marking.

Identification labels: Provide durable labels fitted to each core and sheath, permanently marked with numbers, letters or both to suit the connection diagrams.

Multicore cables and trefoil groups: Identify multicore cables and trefoil groups at each end with durable non-ferrous tags clipped around each cable or trefoil group.

3.2 MAINTENANCE

General

Standard: To AS 2467.

0951 LIGHTING**1 GENERAL****1.1 RESPONSIBILITIES****General**

Requirement: Provide lighting and control systems, as documented.

1.2 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

- 0901 *Electrical systems.*
- 0911 *Cable support and duct systems.*
- 0921 *Low voltage power systems.*
- 0943 *Switchboard components.*

1.3 STANDARDS**General**

AS/NZS 1680.0: Interior lighting - Safe movement

AS/NZS 1680.1: Interior and workplace lighting - General principles and recommendations

AS/NZS 1680.2.1: Interior and workplace lighting - Specific applications - Circulation spaces and other general areas

AS 1680.3 Interior lighting - Measurement, calculation and presentation of photometric data

AS/NZS 1680.4: Interior lighting - Maintenance of electric lighting systems

EMC compliance: To AS/NZS CISPR 15.

Fixed general purpose luminaires: To AS/NZS 60598.2.1.

Luminaires, general requirements and tests: To AS/NZS 60598.1.

Luminaires: To AS/NZS 60598.1.

Recessed luminaires: To AS/NZS 60598.2.2.

1.4 INTERPRETATION**Abbreviations**

General: For the purposes of this worksection the following abbreviations apply:

- CCT: Correlated colour temperature.
- CRI: Colour rendering index.
- DALI: Digital addressable lighting interface.
- EEL: Energy efficiency index.
- ELV: Extra low voltage.
- EMC: Electromagnetic compatibility.
- HID: High intensity discharge.
- ILCOS: International lamp coding system.
- LED: Light-emitting diode.
- PIR: Passive infra-red.
- PLC: Programmable logic controllers.
- RCD: Residual current device.
- UPS: Uninterruptable power supply.

Definitions

General: For the purposes of this worksection the definitions given below apply.

- Control system: A lighting control system comprising a combination of some or all of the following:

- . Timers.
- . Manual overrides.
- . Dimming systems.
- . Motion detection sensors (Occupancy sensors).
- Proprietary luminaires: Luminaires available as a catalogue item.

1.5 SUBMISSIONS

Operation and maintenance manuals

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

Samples

General: Submit samples of all luminaires and accessories complete with lamp, control gear and three core flex and plug.

Technical data

General: Submit technical data of the following:

- Luminaires.
- Drivers.
- Lighting control equipment.
- All accessories.

Tests

Lighting efficacy: Confirm the efficacy of the following by a photometric test, carried out for the applicable CCT, from a NATA approved laboratory:

- Light-emitting diode luminaires.

2 PRODUCTS

2.1 LIGHT-EMITTING DIODES (LEDs) LUMINAIRES

General

Requirement: Provide light emitting diode (LED) luminaires, as documented.

Light-emitting diode luminaires

General: Light-emitting diode luminaires include integral LEDs, reflectors, lenses, heatsinks and drivers.

Performance: Provide LED luminous efficacy of the LED luminaire at normal operating temperature in its normal position and enclosure of > 60 lumens per watt.

Life of the LED in the complete luminaire: L70 to IES LM-80-2008, unless documented.

LED modules shall not be connected with a higher forward voltage than declared, otherwise the LED control gear will be over loaded and the expected nominal life time will be reduced. This issue is not covered by warranties. Installation contractor to verify with luminaire manufacturer to ascertain and set the correct light sources' input mA setting. Provide evidence of same on request, and also provide this data in the final operation and maintenance manual.

Colour Temperature: Typically to be 4000 K.

Residential CCT: 3000 K

CCT: >5000 K is not acceptable.

Colour rendering: for all internal areas (unless industrial storage type areas) shall not be less than CRI 80

Light-emitting diode lamp replacement modules

Performance: Conform to the following:

- Reflector lamps: Provide luminous efficacy of the LED replacement modules at operating temperature in normal position and enclosure of > 80 lumens per watt where the quoted beam angle is the angle between the points of 50% of maximum luminous intensity.

2.2 CONTROL GEAR ENCLOSURE

General

Requirement: Provide controlgear support enclosure within the body of the luminaire, except where remotely mounted controlgear is documented or required by the manufacturer.

Enclosures and controlgear mounting assemblies: Provide heat dissipation facilities to dissipate heat from the luminaire.

Controlgear enclosure: Form a barrier against direct contact with live parts of the controlgear and the area of the luminaire containing the lamp and lamp support holders.

2.3 WIRING

External flexible cords

Recessed luminaires: Provide flexible cord in conformance with the following:

- Length: ≥ 1.5 m.
- Cross sectional area: 0.75 mm^2 .
- Type: 3-core V75 (minimum) PVC/PVC, connected to a 10 A 3-pin moulded plug to AS/NZS 3112 or multi-pin plug, as documented.

Other fittings: Provide external flexible cord in conformance with the following:

- Cross sectional area: $\geq 1 \text{ mm}^2$.
- Terminal blocks
- All luminaires: Large terminal blocks, suitable for 3 X 2.5 mm^2 conductors shall be provided in all luminaires

2.4 LIGHTING CONTROL

General

Requirement: Provide the following as documented:

- Lighting switches.
- Dimmers.
- Occupancy sensors.

Preference for any luminaires that require dimming is for LED (Light Emitting Diode type).

Manual controls

General: Provide manual control of luminaires into groups, zones and to individual devices, as documented.

Dimming

Dimming of LED luminaires shall be strictly in accordance to the luminaire and control gear manufacturers installation requirements eg, comply with Master/Slave interconnecting syncing of control gear assemblies, where multiple luminaires are connected for 1-10V or potentiometer control/dimming, or Touch/Push dimming (also typically called 2-wire or Push dimming), interconnecting cabling methodology shall be as Master/Slave syncing interconnection.

Dimming shall typically be provided in all Boardrooms, training rooms and all sleeping quarters. For all other areas, the design teams shall consult with the respective client agency to ascertain functional requirements.

Digital signal DALI

As the control input is non-polar. These control signal are generally not SELV. Control cable has to be installed in accordance to the requirements of low voltage installations as called for in AS/NZS3000. (eg), Double insulated cabling in approved junction boxes.

2.5 ACCESSORIES

General

Manufacturer: If of a similar finish, provide electrical accessories from the same manufacturer throughout the project and for interchangeability of subcomponents such as switch modules in wall plates. Electrical contractor shall lead this coordination, and the primary Construction Contractor shall facilitate all other trades to follow this direction/requirement.

Lighting outlets

Pin arrangement: Conform to the following:

- Standard: 3 flat pin with looping terminal.
- Luminaires with integral emergency light or special switching: If required, a 4 or 5 pin plug or a second lighting outlet plug of alternative pin configuration to differential the functions or supply.

Lighting switches

General: Provide light switches as documented.

Standard: To AS/NZS 3133.

Minimum: 15 A, 230 V a.c.

Mechanism retaining screws: Provide mechanism retaining screws for all light switches, including electronic switches and rotary potentiometers and the like.

Dimmer switches

General: Provide integral dimmer/switch units as documented.

Daylight switches

General: Provide integral photo electric switch units as documented.

Performance: Adjustable between 50 and 1000 lux in internal applications and 2 to 100 lux in external applications

Time delay: > 2 minutes.

Illumination differential: > 50 lux.

Where typical security and amenity external lighting is provided to a facility, the lighting shall be configured that it will shut down in daylight hours.

An appropriately labelled override/test switch shall be fitted externally to the originating switchboard, and be accessible without opening the switchboard or its escutcheon panel.

All external lighting circuits also incorporate a 7 day analogue time clock, set in the full bypass mode at Practical Completion, to allow the Client Agency to simply program "to off" exterior lighting, should the need arise.

Occupancy sensors

General: Provide motion detection sensors which cover designated areas as documented. Detection devices are to be located and adjusted, so that they are not subject to unnecessarily false tripping from a person walking past in a corridor, without entering the room.

Timer: Incorporate ON timers adjustable between 1 and 5 minutes minimum and 30 minutes and 2 hours maximum, typically set at 20 minutes.

Control function: As a minimum provide OFF/Automatic control override switching in each room. The Client agency is to be consulted, in relation to further providing manual/OFF/automatic control switching. Where manual light switches are used in association with motion sensors, wire the switch so that it can turn the lights OFF but not override the motion switch to turn the lights ON.

Where located in a toilet or similar, provide auxiliary contacts and run-on timer (set at a minimum of 20 minutes) to control a toilet exhaust fan.

BCA Section J has specific performance criteria for the operation of motion sensors for energy saving.

Standard: To AS 2201.3.

Type: Passive infra-red (PIR).

3 EXECUTION**3.1 SUPPORTS****General**

Requirement: Install luminaires on proprietary supports by means of battens, trims, noggings, roses and packing material. See also work section 0901, clause 3.5 Support of Plant and Equipment.

Surface mounted luminaires

General: Fit packing pieces to level luminaires and prevent distortion of luminaire bodies. Provide packing strips to align end to end luminaires.

Fixing: Conform to the following:

- Generally: Provide 2 fixings at each end of fluorescent luminaires.
- Luminaires less than 150 mm: A single fixing at each end in conjunction with 1.6 mm backing plates may be used. In vandalism-prone locations, provide minimum 4 fixings in any case.
- Provide battens and support for the fitting.
- Do not direct fix into plasterboard or ceiling tile – additional structural support is required.

Recessed luminaires

General: Install recessed luminaires in trimmed openings in the suspended ceiling.

Diffuser to be hinged frame type

Standard: To AS 2946.

3.2 WIRING CONNECTION

Remote Control Gear: must not sit solely on top of a ceiling tile, instead shall be firmly attached to the luminaire or the nearby ceiling support system.

Recessed luminaires

General: Connect all recessed luminaires to a plug socket outlet.

3.3 ACCESSORIES**Installation**

General: Install accessories and conceal cabling to the *0921 Low voltage power systems* worksection.

3.4 COMPLETION**General**

Requirement: Before the date of practical completion carry out the following:

- Verify the operation of all luminaires.
- Adjust aiming and controls for all luminaires under night time conditions.
- Replace lamps which have been in service for a period greater than 50% of the lamp life as published by the lamp manufacturer.

0961 TELECOMMUNICATIONS CABLING**1 GENERAL****1.1 RESPONSIBILITIES****General**

Requirement: Provide an NBN and passive telecommunications cabling system, as documented.

1.2 PERFORMANCE**General**

Application class: To AS/NZS 3080 clause 6.3 Class E.

Balanced system: To AS/NZS 3080 clause 7 (data/voice) Category 6A.

1.3 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

- 0901 *Electrical systems.*
- 0911 *Cable support and duct systems.*
- 0921 *Low voltage power systems.*

1.4 STANDARDS**General**

Authorities: To the requirements of the Australian Communications and Media Authority (ACMA).

Cabling products: To AS/CA S008 and AS/NZS 3080.

Installation of cabling: To AS/CA S009, AS/NZS 3080, AS/NZS 3084, SAA HB 252 and AS/NZS ISO/IEC 14763.2.

Electromagnetic compatibility (EMC): To AS/NZS 3080.

1.5 INTERPRETATION**Abbreviations**

General: For the purposes of this worksection the following abbreviations apply:

- EMI: Electromagnetic interference.
- EMR: Electromagnetic radiation.
- IDC: Insulation displacement connection.
- TRC: Telecommunications reference conductor.
- UTP: Unscreened twisted pair.

1.6 SUBMISSIONS**Certification**

Requirement: Submit certification for product and installation.

Copper cable termination distributors: Provide vendor certification (including the warranty period) for the integrated voice/data copper cabling systems.

Operation and maintenance manuals

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

Samples

Product data and samples: Submit for the telecommunications outlet.

Technical data

Requirement: Submit technical data including the following:

- System design parameters: Performance.
- Voice and/or data transfer rate.

- Cable type and characteristics.
- Segregation requirements for EMI/EMR.
- Maximum length of cables.

Warranties

Requirement: Submit the following:

Installation warranty: 15 years.

Provide hard copy of warranty statement in final operating and maintenance manuals

Interconnections with other systems

- NBN Services

2 PRODUCTS

2.1 NETWORK CONNECTION**External Network**

Requirement: Liaise with NBN and determine the services and site access requirements for the network connection.

2.2 BUILDING ENTRANCE FACILITIES**External communications' carrier network termination device**

Requirement: Provide NBN network termination device for the termination of external carrier cables and facilities. Provide separate frames as required.

2.3 DISTRIBUTORS**General**

Requirement: Provide NBN Floor Distributors (FD) for voice and data to AS/NZS 3080 and as documented for the termination of building NBN backbone cable systems and the horizontal cable distribution systems.

2.4 CABLES**Copper**

Standard: To AS/CA S008, AS/CA S009, AS/NZS 3080 and AS/NZS ISO/IEC 14763.2.

Minimum Requirements:

Horizontal cabling voice and data: Category 6 UTP cabling to each floor outlet.

Balanced system cables: UTP.

Cable end length: Provide a 5 m cable loop at each end of the cable.

2.5 TELECOMMUNICATIONS OUTLETS**General**

Outlets: Provide RJ45 8 way modular jacks, mounted on 6-way faceplate. Provide for up to three modular voice or data outlets on the each faceplate with three spaces for identification inserts.

Style, material and colour of plates: To match adjacent power and switch plates, as documented.

Provide mechanism retaining screws for fixing of outlets on faceplates.

Refer to the Electrical Accessories part of 0921 Low Voltage Power Systems work-section for further details on specific requirements for different site types.

Colour: Electric white or as documented.

Standard: To AS/CA S008.

Pinouts: T568A to AS/NZS 3080.

Modular socket outlets: Provide an 8-position conductor, no keyed RJ 45 compatible modular jack with centre locking latch in conformance with AS/NZS 3080.

2.6 FLY LEADS**General**

Type: Stranded.

Length: 1200 mm.

Quantity: Provide fly leads to 100% of outlets installed.

2.7 TESTS

General

Production tests: Complete as follows:

- Balanced cabling systems: To AS/NZS IEC 61935.1.
- Patch cords: To AS/NZS IEC 61935.2.
- Solder less connections: To AS/NZS 3080 Annexure C.
- Free and fixed connections: To AS/NZS 3080 Annexure C.
- Other connecting hardware: To AS/NZS 3080 Annexure C.

3 EXECUTION ---

3.1 GENERAL

Installation

Standard: To AS/NZS 3080, AS/NZS 3084, AS/CA S009 and AS/NZS ISO/IEC 14763.2.

Precedence: The space requirements as documented take precedence over the specific space requirements of AS/NZS 3084.

3.2 CABLES

Installation

Requirement: To manufacturers' recommendations.

Crossover: Install cables neatly and without crossovers between cables.

Stud-partition walls with bulk insulation: install cabling within conduit to allow cables to be pulled back and rewired to outlet locations without the need to demolish the wall, for future repairs and upgrades.

Cable separation

Separation for safety: To AS/CA S009, and by at least 150 mm.

LV power services: Maintain a clearance of more than 100 mm.

External cables

Requirement: To ACIF C524.

3.3 TELECOMMUNICATIONS OUTLETS

Installation

Mounting: Flush mount.

Flushplate layout: Provide two- or three-way standard flushplate, as specified on layout drawings, capable of accepting the installation of three individual modular sockets along the top horizontal axis and three identification labels, engraved. Printed plastic or hand marked labels not accepted. Unused socket positions to be filled with blank inserts. Arrange the modular sockets with the locking latch in the bottom position, i.e. pins at the top.

Horizontal cabling termination: Terminate Category 6A cabling to the rear of the outlet modular jack with insulation displacement connections forming a gas tight joint. Arrange cable pairs at each jack conforming to AS/NZS 3080 Fig 15.

Refer to the Electrical Accessories part of 0921 Low Voltage Power Systems work-section for further details on specific requirements for mounting on different wall types.

3.4 LABELS

General

Telecommunications facilities: To AS/NZS ISO/IEC 14763.2.

Cross connects and outlets: To AS/NZS 3080.

Cables: Label with the origin and destination of the cable.

Outlets: Label with the origin of the cross-connect, the workstation or outlet number and the port designation.

Label type table

Component	Label scheme	Type
Cables	Origin and destination	Self-adhesive, wrap on

3.5 TESTING**General**

General: Carry out 100% channel tests.

Site tests

Standard: To AS/NZS 3080 Annexure B. Include the following:

- Basic Link and Channel transmission tests including the following:
 - . Wire map.
 - . Length.
 - . Attenuation.
 - . NEXT.
 - . ACR.
 - . Propagation delay.
 - . Delay skew.
 - . Power sum NEXT.
 - . Power sum ACR.
 - . ELFEXT.
 - . Power sum ELFEXT.
 - . Return loss.
- Optical fibre cable: Carry out Basic link transmission tests including the following:
 - . Length.
 - . Attenuation.

0962 TELEVISION DISTRIBUTION SYSTEMS**1 GENERAL****1.1 RESPONSIBILITIES****General**

Requirement: Provide a system suitable for the reception and distribution of digital television, video, radio and sound signals, as documented.

Network connection: Arrange with the network operator(s) for the connection of their network. Comply with the network operators' requirements.

Designer: Network operator's Approved Design Partner.

Survey: Confirm location and height of Free-to-air (FTA) antenna by on-site measurements.

1.2 PERFORMANCE**System type**

Type: As documented.

Performance requirements

General: To AS/NZS 1367.

Capacity: Provide the distribution system with the installed capacity to accommodate 30% additional outlets.

Signal sources

Free-to-air (FTA) antennae system: Provide FTA antennae system terminating at the premises cabling interface.

Network operator: Provide for the connection of the network operator's system terminating at the premises cabling interface as documented.

Local signal source: Provide television input sockets at the premises cabling head-end for the distribution of in-house television channels on separate channels of the network.

Service entry

General: Provide service entry facilities to suit signal sources, head end equipment and distribution systems.

Location: As documented.

Head end equipment

General: Provide head end equipment to suit signal sources, distribution systems and documented performance.

Location: As documented.

Surge protection devices (SPD)

General: Provide all mode metal oxide varistor based series connected SPD to protect final equipment in racks and cabinets.

Standard: To AS 4262.1 and AS 4262.2.

Surge Rating: $I_{\max} \geq 20$ kA per phase.

Residual Voltage: $U_p < 600$ V.

Visual indicator: Provide visual indication of SPD status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker equal to or less than the load current rating of the SPD.

Distribution system

General: Provide a cabling distribution network from the head end equipment to each network distribution tap.

FTA distribution taps: Provide FTA distribution taps.

Network distribution taps: For systems designed for more than one network operator provide individual distribution taps for each network operator. Co-locate the taps with FTA taps in groups to facilitate selected connection or changes to outlet feeders.

Location: Group all equipment as documented.

Outlets

General: Provide outlets and feeders from distribution tap(s) as documented.

Quantity: Provide separate sockets for each source and service.

1.3 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

- 0901 *Electrical systems.*
- 0911 *Cable support and duct systems.*
- 0921 *Low voltage power systems.*

1.4 STANDARDS**General**

System design and performance: To AS/NZS 1367.

Application: For the purposes of this worksection, AS/NZS 1367 applies to all building types.

Earthing and segregation: To AS/NZS 3000.

Safety requirements: To AS/NZS 1367 Section 2.

Electromagnetic compatibility: To AS/NZS 1367 Section 3.

1.5 INTERPRETATION**Abbreviations**

General: For the purposes of this worksection the following abbreviations apply:

- BER: Bit error ratio.
- MER: Modulation Error Ratio.
- COFDM: Coded Orthogonal Frequency Division Multiplexing.
- QAM: Quadrature Amplitude Modulation.
- QPSK: Quadrature Phase Shift Keying.
- PAL: Phase Alternating Line.
- MATV: Master Antenna Television.
- SMATV: Satellite Master Antenna Television.

Definitions

General: For the purposes of this worksection the following definitions apply:

- MATV: System that primarily provides access to terrestrial television signals but may also carry radio services. Terrestrial signals may be distributed at their original frequency or shifted to a more convenient frequency. In-house services may also be provided by modulating base band signals from an appropriate source.
- SMATV – L Band: MATV system where satellite signals are distributed in native L-Band QPSK at the Intermediate Frequency delivered by the LNB.
- SMATV – QAM: MATV system where satellite signals received at the dish are transmodulated at the headend and distributed as QAM at frequencies below 860 MHz.

1.6 SUBMISSIONS**Certification**

Designer: Network operator's Approved Design Partner approval.

Drawings

Record drawings: Include minimum and maximum signal frequency (channel) and their levels at the input and output of amplifiers, splitters, taps, tap ports and outlets.

Documentation

Standard: To AS/NZS 1367 Appendix D.

Operation and maintenance manuals

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

Products

Product data: Submit for all system components.

Records

Correspondence with network operators: Submit copies of correspondence and notes of meetings with all subscription network operators.

Service agreements: Arrange for each service provider to submit service agreements for execution by the principal.

Samples

System components: Submit samples that are visible after installation, including but not limited to:

- Outlets.
- Labelling.

Shop drawings

General: Before commencing the work submit the following in accordance with AS/NZS 1367 clause D3 and D4:

- Schematic diagram, proposed location of all components and interconnecting cabling.
- Antennae types and their method of mounting.

Technical data

General: Before commencing the work submit the following:

- Design frequencies.
- Free-to-air reception quality report, citing methods used for determination. Address all signals that the system is to receive.
- Calculations of signal levels at outlets and at the input and output of amplifiers, splitters and taps.

Tests

Other tests: Submit results of system testing.

2 PRODUCTS

2.1 FREE-TO-AIR ANTENNA**General**

Standard: To AS 1417.1 (Int).

Material:

- Boom: Heavy Duty Galvanized steel.
- Elements: Aluminium ≥ 12 mm.

Connection: F type to IEC 60169-24.

Mounting hardware: Proprietary to suit antenna. Must be designed and installed to suit expected wind loads of the installed location.

2.2 ACTIVE EQUIPMENT**Masthead amplifier(s)**

Selection: To meet system performance requirements.

Head end amplifier(s)

Selection: To meet system performance requirements.

Distribution amplifiers

Selection: To meet system performance requirements.

2.3 PASSIVE EQUIPMENT**Splitters**

Selection: To meet system performance requirements.

Couplers

Selection: To meet system performance requirements.

Taps

Selection: To meet system performance requirements.

2.4 COAXIAL CABLE**Types**

Standard: To AS/NZS 1367 clause 5.11.

General: Minimum RG6QS quad shield.

Underground: Flooded type.

Connectors

Coaxial: F type to IEC 60169-24.

2.5 OUTLETS**General**

Outlet type:

- PAL type socket on the front and F type socket on the rear for terrestrial FTA services and down converted satellite services.
- PAL type on the front and F type on the rear for terrestrial FTA services and an F type on the front and on the rear for satellite services.
- F type socket on the rear and on the front for satellite services.
- F type socket on the rear and on the front for cable services.
- PAL type on the front and F type on the rear for terrestrial FTA services and an F type on the front and on the rear for cable services.
- PAL type socket on the front for FM radio services.

Outlet plate: Style, material and colour to match adjacent power and switch plates.

Provide mechanism retaining screws for fixing of outlets on faceplates.

Refer to the Electrical Accessories part of 0921 Low Voltage Power Systems work-section for further details on specific requirements for different site types.

2.6 EXTERNAL COMPONENTS**General**

Degree of weather protection: IPX4 to AS 60529.

3 EXECUTION**3.1 GENERAL****Free-to-air antennae**

Installation: To AS 1417.1 (Int).

Roof penetrations: all penetrations for screw-fixings and cable entries must be done to the satisfaction of the roofing-subcontractor and not void the roofing warranty. Generally: all penetrations must not go through the low-points of the roof corrugation profile, For "Klip-lok" roofing sheets or similar, the use of proprietary clamps is required to avoid roof penetrations for screw-fixings.

3.2 DISTRIBUTION EQUIPMENT**General**

Enclosure: Locate all active and passive distribution equipment in proprietary purpose built enclosures, located as documented.

3.3 COAXIAL CABLE**General**

Standard: To AS/NZS 1367 Appendix G.

Conduit: Install coaxial cable in conduit or ducting as follows:

Coaxial cable table

Cables	Conduit (minimum)
1 No. RG6QS quad shield	25 mm
1 No. double shielded RG11	32 mm

Bending radius: Conform to the minimum bending radius manufacturer's recommendations for the size of cable.

3.4 OUTLETS**Installation**

Mounting: Flush mount.

Screening: Fully screen all outlets.

Refer to the Electrical Accessories part of 0921 Low Voltage Power Systems work-section for further details on specific requirements for mounting on different wall types.

Outlet fly leads

General: Following commissioning of the system, provide 1500 mm fly leads to all outlets.

3.5 TESTING**General**

Extent: Test 100% of the system to demonstrate compliance with all documented requirements.

Setup: Use locally generated test signals to provide static conditions for level measurements.

Carrier-to-noise measurements: Required.

0971 EMERGENCY EVACUATION LIGHTING**1 GENERAL****1.1 RESPONSIBILITIES****General**

Requirement: Provide single point monitored emergency lighting (non-maintained) and exit signs (maintained), as documented.

Use LED technology and NiMH or Li Ion batteries. Fluorescent and halogen lamps and Ni CAD batteries are not acceptable unless matching to existing fittings is required. Sealed Lead Acid ("maintenance free") batteries are acceptable but not preferred

1.2 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

- 0901 *Electrical systems.*
- 0921 *Low voltage power systems.*
- 0951 *Lighting.*

1.3 STANDARDS**General**

System design, installation and operation: AS 2293.1.

Inspection and maintenance: To AS/NZS 2293.2.

Emergency escape luminaires and exit signs: To AS 2293.3.

1.4 SUBMISSIONS**Operation and maintenance manual**

Standard: To AS 2293.1, Section 8.

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the systems installed.

Samples

General: Submit samples of all luminaires and exit signs.

Shop drawings

General: For each custom-built luminaire and exit sign, submit the following:

- Construction details.
- Overall dimensions.
- Wiring arrangement.

Technical data

General: Submit technical data for each type of luminaire and exit sign including the following:

- Maximum luminaire spacing for a given mounting height.
- Luminaire classification to AS 2293.3.

Tests

General: Submit type test data.

2 PRODUCTS**2.1 SINGLE-POINT SYSTEM LUMINAIRES****General**

Visual indicator lights: Provide a red indicator, readily visible when the luminaire is in its operating location, which indicates that the battery is being charged.

Inverter system: Provide protection of the inverter system against damage in the event of failure, removal or replacement of the lamp, while in normal operation.

Local test switches: Provide a momentary action test switch, accessible from below the ceiling, on each luminaire to temporarily disconnect the mains supply and connect the battery to the lamp.

Common test switches: Provide a common test switch on the local distribution board which disconnects main supply to the luminaires and tests for discharge performance and automatically reverts to normal operating mode after testing.

Batteries

Type: Provide lithium ion (preferred) or nickel metal hydride (acceptable) batteries capable of operating each lamp at its rated output continuously for at least 2 hours during commissioning tests and 1.5 hours during subsequent tests. Lead-acid batteries only accepted to match existing fittings in the same area. Nickel-cadmium batteries will not be accepted.

Battery life: At least 3 years when operating under normal conditions at an ambient temperature of between 10°C and 40°C and subject to charging and discharging at 6 monthly intervals.

Marking: Indelibly mark each battery with its date of manufacture.

3 EXECUTION

3.1 SINGLE POINT SYSTEM

Power supply

General: Provide an unswitched active supply to each luminaire and exit sign, originating from the test switch control panel.

Test switch

General: Provide a timed test switch at each distribution board.

Function: To energise emergency lights and exit signs and then to automatically reset controls after a maximum of 2 hours.

Sensing of Supply Failure

Type: final sub-circuit sensing shall be provided. Individual phase sensing alone is not acceptable. Maintain compliance to AS2293 where Discharge type lighting is installed, and in particular to the Clause(s) relating to "*Normal lighting requiring cool-down*".

3.2 INSTALLATION

As per requirements of work section 0901, clause 3.5 Support of Plant and Equipment

Remote Control Gear or battery packs: must not sit solely on top of a ceiling tile, instead be firmly attached to the ceiling grid supports.

3.3 MARKING AND LABELLING

Labelling

General: Label each luminaire with a unique identifying number. Provide a label which is permanently fixed, indelible and readable from a standing position at Ground level. Handwritten text is not acceptable..

Emergency evacuation lighting schedule: Record the number and luminaire location in an emergency evacuation lighting schedule included in the operation and maintenance manual.

If applicable, update existing maintenance manual, drawings and the Site Emergency Lighting Log Book / register on all existing sites, when and where Emergency lighting systems are being altered, repaired, and/or installed.

3.4 TESTS

General

Requirement: Carry out tests, including out-of-hours tests, to demonstrate the emergency and evacuation system's performance. Include the following:

- Test components for correct function and operation.
- Demonstrate illumination performance on site, to at least the level stated in the manufacturer's recommendations for performance for that device.

- Test operation of battery discharge test and control test switch functions, including discharge and restoration.
- Demonstrate system functions under mains fail and local sub-circuit trip condition.
- Demonstrate system functions and re-sets under RCD tripping condition
- Demonstrate compliance to AS2293 where Discharge type lighting is installed, with reference to the Clause(s) relating to "*Normal lighting requiring cool-down*".
- Demonstrate operation of the battery and charger including a full discharge/recharge over the designated time.

Mains supply

General: Before commissioning, make sure mains supply has been continuously connected for at least 24 hours.

Maintenance during Defects Liability Period

Carry out all procedures within 1 week prior to the date of Practical Completion and again before the end of the Defects Liability Period stated in the *General requirements* worksection.

Record test results in logbook and locate in maintenance manual.

0972 FIRE DETECTION AND ALARMS**1 GENERAL****1.1 RESPONSIBILITIES****General**

Requirement: Provide an AS1670 fire detection and alarm systems, as documented.

1.2 SYSTEM**General**

System type: Addressable.

Surge protection devices (SPD)

General: Provide all mode metal oxide varistor based series connected SPD to protect final equipment in racks and cabinets.

Standard: To AS 4262.1 and AS 4262.2.

Surge Rating: $I_{max} \geq 20$ kA per phase.

Residual Voltage: $U_p < 600V$.

Visual indicator: Provide visual indication of SPD status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker equal to or less than the load current rating of the SPD.

1.3 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

- 0901 *Electrical systems.*
- 0911 *Cable support and duct systems.*
- 0921 *Low voltage power systems.*
- 0973 *Emergency warning and intercommunication.*

1.4 STANDARDS**General**

Standard: To AS 1670.1, AS 4428.1 and AS 7240.13.

1.5 SUBMISSIONS**Operation and maintenance manual**

Standard: To AS 4428.4, Section 3.

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the systems installed.

Samples

Requirement: Submit for the following:

- Detectors.
- Fire speakers
- Fire audio visual alarms.

Shop drawings

General: Submit showing the following:

- Fire detector layout.
- Dimensions and details of control and indicating equipment.
- Location.
- Circuit identification.
- Labelling details.

Technical data

Product data: Submit for the following:

- Fire indicating panel.
- Detectors.
- Fire speakers
- Fire audio visual alarms.

2 PRODUCTS

2.1 AUTHORISED PRODUCTS**General**

Equipment: Provide equipment listed in the ActivFire Register of Fire Protection Equipment.

2.2 CONTROL AND INDICATING EQUIPMENT**Standards**

General: To AS 7240.2.

Alarm investigation facility (AIF): To AS 4428.10.

Alarm signalling equipment: To AS 4428.6.

Power supply units: To AS 4428.5.

Fire brigade panel: To AS 4428.3.

Routing equipment: To AS 7240.21.

Fire indicator panels

General: Provide metal cubicle-type enclosures.

Isolation

Isolating facilities: Provide on fire indicator panels to enable testing without the transmission of alarm signals to the fire brigade.

Capacity

Spare zones: 50% minimum.

2.3 DETECTORS**Type**

Areas generally: Optical beam smoke detectors. Ionisation type detectors not accepted

Hot areas: Fixed temperature integral heat detector/alarm unit type.

Power supply: From the fire indicator panel battery power supply.

Standards

Smoke alarms: To BCA Spec E2.2a.

Heat detectors: To AS 7240.5.

Point type smoke detectors: To AS 7240.7 and AS 1603.2.

Integral smoke detector/alarm units: To AS 3786.

Optical beam smoke detectors: To AS 1603.7.

Remote indicators: To AS 1603.15.

Visual warning devices: To AS 1603.11.

Self-indicating detectors

General: Provide a light emitting diode mounted in a clearly visible position, which illuminates whenever detector operation causes an alarm condition to register on the fire indicator panel. Provide self-indicating devices which, if faulty, will not render the detector inoperative under fire conditions.

Mounting positions of light emitting diodes: Conform to the following:

- Visible detectors: On the outside of the detector or its base.
- Detectors concealed above ceilings: On the underside of the ceiling immediately below the detector.
- Detectors in other concealed spaces: On a visible panel close to the entry to the concealed space housing the detector.

- Remote indicators: To AS 1603.15.

2.4 MANUAL CALL POINTS

General

Standard: To AS 1603.5 and AS 7240.11.

2.5 EXTERNAL ALARM INDICATION

Standards

Bell circuits: To AS 4428.1.

Strobe lights: To AS 1603.11.

Power supply

To the strobe light and ≤ 2 others: From the fire indicator panel battery power supply.

To additional strobe lights: From the mains supply. Provide appropriate interface relays, operated by the fire indicator panel.

2.6 WARNING SYSTEM

General

Occupant warning system: To AS 1670.1 Section 3.22.

2.7 POWER SUPPLY

General

Surge protection: Ensure that normal operation is maintained and that voltage surges in the power source do not damage the control and indicating equipment.

Sealed batteries: Cycle the batteries before practical completion so that greater than or equal to 100% of nominal capacity is available at practical completion.

3 EXECUTION

3.1 FIRE ALARM MONITORING

General

General: Provide an AS1670.3 compliant monitoring service and connect to the SAMFS.

Connection: Connect using a an ASE with a primary and secondary 4G mobile dialer c/w high gain antenna (as required). Allow to lodge applications with SAMFS and Telstra, as required.

3.2 DETECTORS

Installation

General: Install detectors so they can be easily inspected and tested in situ, and readily withdrawn from service.

Ceiling mounting: As per requirements of work section 0901, clause 3.5 Support of Plant and Equipment

Integral smoke detector/alarm units: To AS 1670.6.

3.3 INSTALLATION WIRING

General

To AS 1670.1 Section 3.24.

3.4 TESTING

General

Tests: Carry out tests, including out-of-hours tests, to demonstrate the automatic fire detection and alarm system's performance to AS 1670.1 Section 7 and the compliance Sections of the relevant parts of the AS 1603 series. Include the following:

- Test components for correct function and operation.
- Demonstrate detection and alarm performance on site, to at least the level stated in the manufacturer's performance specification for that device.
- Test alarm zone identification.

- Demonstrate air sampling system operation for 14 days with data logger to verify stability of detectors and devices.
- Demonstrate addressable device operation for 14 days with data logger to verify stability of detectors and devices.
- Test interface to interconnected systems.
- Demonstrate correct shutdown sequences during fire mode.
- In situ testers: To AS 1603.16.

3.5 MAINTENANCE

Baseline data

Requirement: Provide baseline data to AS 1851, clause 1.8.

0981 ELECTRONIC SECURITY**1 GENERAL****1.1 RESPONSIBILITIES****General**

Requirement: Provide electronic security systems as documented and as follows:

- Intercom system.

1.2 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

- 0901 *Electrical systems.*
- 0911 *Cable support and duct systems.*
- 0921 *Low voltage power systems.*
- 0961 *Telecommunications cabling.*

1.3 STANDARDS**Intruder alarm systems**

General: To AS/NZS 2201.1.

1.4 SUBMISSIONS**Operation and maintenance manuals**

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

Technical data

General: Submit data showing dimensions and space requirements for the following:

- Intercom stations.
- Electric door strikes and door release devices.

2 PRODUCTS**2.1 INTERCOM****General**

Base station: Provide intercom base station at front entry door (audio and camera), interconnected with the individual local stations within each apartment (audio and visual).

Entry station construction: Wall mounted flush stainless steel panel.

Weatherproofing: IP56.

Dial: Digital push-button type.

Schedule: Provide a weatherproof (IP56) schedule holder and card identifying individual local stations. Locate next to the base station intercom panel.

Local station: Provide wall mounted intercom local stations, interconnected with the base stations and external entry points.

Internal station type: Surface mounted, colour display, pushbutton type.

Operation: Provide an audible tone device to indicate that the individual station is being called, and a press-to-talk switch so that the entry station can communicate with the internal station only when the switch is held down.

Door control: Provide integral momentary action door release switches to operate the door release or opening mechanisms at each external entry point, where remote door unlocking is provided.

Door control devices

General: Provide electric strikes, or similar devices as documented to suit door construction and hardware.

Monitoring: Provide lock status and door position monitoring of door control devices.

Fail-safe: Connect door control devices in a fail-safe mode to permit egress in the event of power failure. Propose method of implementation to Superintendent's approval.

Authorised products: Provide equipment listed in the ActivFire Register of Fire Protection Equipment.

3 EXECUTION**3.1 GENERAL**

Installation: As per requirements of work section 0901, clause 3.5 Support of Plant and Equipment
Mains supplies

Permanent power supply: Provide permanent power supply with dedicated circuits to the following:

- Intercom stations.
- Electric door strike local panels or control equipment.

Marking: Label the switchboard circuit breaker from which power for the security systems is obtained as follows:

Completion tests

General: Carry out tests, including out-of-hours tests, to demonstrate the security system's performance. Include the following:

- Test components for correct function and operation.
- Demonstrate that devices perform on site, to at least the level stated in the manufacturer's performance specification for that device.

3.2 MAINTENANCE**General**

Standard: To AS/NZS 2201.1.

Breakdown call outs: Attend (arrive) on site within 24 hours of notification. Rectify faults, and replace faulty materials and equipment.

Frequency of routine visits: ≤ 6 monthly.

0991 ELECTRICAL MAINTENANCE**1 GENERAL****1.1 RESPONSIBILITIES****General**

Requirement: Maintain the electrical systems for the documented maintenance period so that the performance, reliability, efficiency and safety of the system is the same or better than that at the beginning of the maintenance period, including:

- Periodic maintenance and replacement.
- Emergency repairs.
- Cleaning.

Maintenance period: As documented.

1.2 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

- *General requirements.*
- *0911 Cable support and duct systems.*
- *0921 Low voltage power systems.*
- *0942 Switchboards – custom-built.*
- *0961 Telecommunications cabling.*
- *0951 Lighting.*
- *0971 Emergency evacuation lighting.*
- *0972 Fire detection and alarms.*
- *0981 Electronic security.*

1.3 STANDARD**General**

Meet all of the requirements from:

- (1) the equipment manufacturers
- (2) applicable Australian Standards
- (3) applicable WH&S & supply authority regulations

1.4 INSPECTION**Notice**

Inspection: Give notice so that an inspection may be held simultaneously with the last programmed maintenance visit.

1.5 SUBMISSIONS**Certification**

Annual certification: Inspect and certify all items required to be inspected annually under statutory requirements including, but not limited to, fire detection and alarms, and emergency evacuation lighting. Submit certification to the principal.

Maintenance program

General: Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.

Maintenance records

General: Submit records of maintenance undertaken. If available, record in the schedules provided as part of the maintenance manuals.

Records: As a minimum, record the following:

- Date, time and name of person undertaking the task.
- Activities completed including operational and maintenance procedures.
- Materials used.
- Test results.
- Comments for future maintenance actions and notes covering the condition of the installation.

Mandatory maintenance records: Include mandatory maintenance record forms with completed project specific information.

Service visits: Record comments on the functioning of the systems, work carried out, items requiring corrective action, adjustments made and name of service operator. Obtain the signature of the principal's designated representative.

Log books: Record maintenance in the log book pages provided in the Operation and maintenance manuals to *General requirements*.

Periodic maintenance and performance report

General: Provide a report summarising the maintenance performed and the performance of the electrical services in the preceding period. Set out the report in a form that permits comparison with previous reports. Include the following as minimum requirements:

- Dates and number of site labour hours for programmed maintenance. Exclude travelling time.
- Dates, number of site labour hours and nature of work for corrective maintenance. Exclude travelling time.
- Dates and number of site labour hours for defects liability rectification if within the defects liability period. Exclude travelling time.
- Peak load and load profile for electrical power consumed, where metering equipment allows. Where no appropriate metering equipment exists, provide copies of electricity accounts from the electricity service provider.
- Results of recommissioning if scheduled for the period.

2 PRODUCTS

2.1 GENERAL

Selections

Proprietary items: Select products, as replacement items, of the same make, model and type as those being replaced.

Substitutions: Where the existing product is no longer available, provide products with at least the same performance, energy profile and construction characteristics.

3 EXECUTION

3.1 MAINTENANCE REQUIREMENTS

General

Requirements: Provide all labour and material necessary to maintain the electrical installation, including all items commonly referred to as consumable.

Site control

General: Report to the principal's designated representative on arriving at, and before leaving the site.

3.2 CLEANING

General: Progressively clean the interior of components as they are installed. Inspect the interior of components on installation and remove obstructions.

Lighting fittings: Clean the interior of luminaires, including diffusers and louvers, annually for non-air conditioned buildings and every three years for air conditioned buildings. For large air conditioning buildings schedule areas of the building where a third of the fittings are cleaned each year.

3.3 CORRECTIVE MAINTENANCE

General

Requirement: Respond to call outs for breakdowns or other faults requiring corrective maintenance. Rectify faults and replace faulty materials and equipment.

Remedial work: Carry out any remedial work, including temporary work, necessary to restore the systems to safe and satisfactory operation. Do not leave site until correct operation has been proven. Do not leave the plant in an unsafe condition.

Temporary work: Promptly replace temporary work with permanent rectification.

Response time

Period: Attend site for emergency service within the documented time period.

Calculation of response period: Response period starts at the time of notification to the contactor's nominated contact point.

Emergencies: Attend emergency calls promptly (within 24 hours).

Failure to respond

General: Should the contractor fail to respond to site within the period documented, the principal may, without incurring any liability or obligation and without limiting any other redress, engage persons other than the contractor to undertake emergency work on the systems. Fully reimburse the principal.

3.4 REGULAR MAINTENANCE

General

Requirement: Make routine service visits. Service items of equipment in accordance with the maintenance schedules in the operation and maintenance manuals.

Notification of defects

Requirement: When defects in the installation are identified, notify the principal in writing.

All systems

General: Provide maintenance work including, but not limited to, the following:

- The procedures set out in the operational and maintenance manuals provided.
- Attend to reported defects and complaints.
- Check for and repair corrosion.
- Remove rubbish and clean equipment.
- Thoroughly check for and rectify any unsafe conditions.
- Replace faulty or damaged parts and consumable components.
- Check anti-vibration supports, brackets and clamps, holding down bolts and flexible connections, for deterioration and for freedom of movement of assembly.
- Safety signs maintenance: To AS 1319.

Electrical general

Tasks: Perform the following tasks:

- The procedures set out in the operational and maintenance manuals provided.
- Check for hot joints, burnt insulation and burnt contacts.
- Check electrical connections for tightness.
- Check operation of all electrical components and systems.
- Check indicating lights and replace defective lamps.
- Check overload settings.
- Check and report any changes to controls and wiring.
- Provide maintenance in accordance with manufacturer's recommended maintenance program.

Standards:

- Electrical equipment generally: To AS/NZS 3760.
- Switchboards: To AS 2467.

Switchboards

Standard: To AS 2467.

General: Carry out the following:

- The procedures set out in the operational and maintenance manuals provided.
- Check for hot joints and burnt insulation. Carry out a thermal scan of joints and cable terminations by use of an infrared temperature detector or cameras and repair any joints showing high temperatures.
- Rectify faults, make adjustments and replace consumable and faulty materials and equipment within 24 hours of notification.
- Monthly inspections and maintenance work to maintain the assembly, including battery systems.

Emergency evacuation lighting

General: Perform the following tasks:

- Inspect and maintain to AS/NZS 2293.2, Sections 2 and 3.
- Clean luminaires as set out in clause 3.2 Cleaning.
- Follow procedures as set out in the operational and maintenance manuals provided.

Interval: Carry out the 6-monthly procedures before practical completion and again before the end of the maintenance period.

Fire detection and alarms

General: Perform the following tasks:

- Inspect and maintain to AS 1851 and to the operational and maintenance manual.

Maintenance records: To AS 1851.

Electronic security

Standard: To AS/NZS 2201.1.

Requirement: Maintain the system as set out in the operational and maintenance manuals provided.

Breakdown call outs: Attend on site within 24 hours of notification. Rectify faults, and replace faulty materials and equipment.

Frequency of routine visits: ≤ 3 monthly.

3.5 END OF MAINTENANCE PERIOD SERVICE

General

General: Within a month of the end of the maintenance period, undertake all work scheduled to be carried out on an annual basis.

4 OPERATING AND MAINTENANCE MANUALS

4.1 SUBMISSION

General

Prior to Practical Completion submit for approval one (1) copy of the Operating and Maintenance Instructions. Following submission and approval of draft copies, prepare three (3) copies of the approved manual.

Folder format

The manuals shall be written in clear concise English, printed or typed on durable printing A4 size paper with each page consecutively numbered.

Folders shall be 3 ring, hardback binders complete with plastic covered label tags between sections.

Folder colour: White.

Title page layout

<p>The front cover to include the following wording:-</p> <p>1 (LOT 181) GLENBURNIE TERRACE, PLYMPTON (APARTMENTS)</p> <p>Electrical Services</p> <p>Secon Consulting Engineers</p> <p>"Company name of electrical contractor"</p>	<p>The spine to include the following wording:-</p> <p>1 (LOT 181) GLENBURNIE TERRACE, PLYMPTON (APARTMENTS)</p> <p>Electrical Services</p>
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Folder content

The content of the manuals shall include the following sections:-

Title Page

- Title page to include the following wording:
 - . "Project name"
 - . Operating and maintenance manual
 - . Electrical Services
 - . "Company name of electrical contractor"

Index/ table of contents

- Index / table of contents to display each section as listed below in numeric order.
 - . Section 1 – Introduction
 - . Section 2 – Maintenance
 - . Section 3 – Accessories
 - . Section 4 – Cabling, Conduits and Cable Supports
 - . Section 5 – Lighting System
 - . Section 6 – Switchboards
 - . Section 7 – Telecommunications System
 - . Section 8 – Intercom System
 - . Section 9 – Fire Detection and Alarm System
 - . Section 10 – MATV System
 - . Section 11 – Certificates, Commissioning Reports and Test Results
 - . Section 12 – As-Installed Drawings

Section 1 - Introduction

- General Description of the electrical services installed including:
 - . Scope of works
 - . Main Switchboard location and ampere rating
 - . Main Distribution Board location and ampere rating
 - . Distribution board locations and ampere ratings
 - . Consumer mains and earth conductor sizes and installation details
 - . Submain and earth conductor sizes and installation details
 - . Earthing system including equipotential bonding and communications earthing.
 - . Sub-circuit cable type, size and installation details
 - . Cable support system details.
- Contact details for the Builder, Electrical Consultant and Electrical Contractor including:
 - . Company name
 - . Company address
 - . Contact number (working hours)
 - . Contact number (after hours)
 - . 24hrs emergency contact number
 - . Company website address
 - . Electrical contractor warranty statement including date of practical completion.

Section 2 - Maintenance

- Recommended maintenance program (general, monthly, quarterly, annually and end of warranty).
- Schedule of inspection and preventative maintenance and repair instructions for each item of equipment.
- Schedule of lamps and accessory replacements including:
 - . Item designation symbol
 - . Make and model
 - . Description of item
- Safety in maintenance issues

Section 3 - Accessories

- Index/ table of contents.
- Schedule of technical data including:
 - . Manufacturer
 - . Product code
 - . Description of item
- Technical data sheets and all other relevant manufacturers' literature.

Section 4 – Cabling, Conduits and Cable Supports

- Index/ table of contents.
- Schedule of technical data including:
 - . Manufacturer
 - . Product code
 - . Description of item
- Technical data sheets and all other relevant manufacturers' literature.

Section 5 – Lighting System

- Index/ table of contents.
- Schedule of technical data including:
 - . Item designation symbol
 - . Manufacturer
 - . Product code
 - . Description of item
- Technical data sheets marked with the corresponding item designation symbol and displayed in alphabetical order.
- All other relevant manufacturers' literature.
- Lighting column shop drawings and certification documentation.

Section 6 – Switchboards

- Index/ table of contents.
- As-installed shop drawings.
- Typed sub-circuit legend for each switchboard installed.

Section 7 – Telecommunications System

- Index/ table of contents.
- Schedule of technical data including:
 - . Manufacturer
 - . Product code

- . Description of item
- Technical data sheets and all other relevant manufacturers' literature.
- As-installed drawings with outlet ID's and main cable routes.

Section 8 – Door Intercom System

- Index/ table of contents.
- Schedule of technical data including:
 - . Manufacturer
 - . Product code
 - . Description of item
- Technical data sheets and all other relevant manufacturers' literature.
- As-installed drawings in AutoCAD format.
- Technical specification identifying the operation of the system to the client.
- Copy of devices inputs/ outputs.
- Manufacturer certification and warranty documentation.

Section 9 – Fire Detection and Alarm System

- Index/ table of contents.
- Schedule of technical data including:
 - . Manufacturer
 - . Product code
 - . Description of item
- Technical data sheets and all other relevant manufacturers' literature.
- Fire block plan.
- Include maintenance of fire protection equipment documentation – AS 1851.8 Part 8 Automatic fire detection and alarm systems.
- Appendix E – Commissioning test report.
- Appendix F – Standard form of installer's statement for fire alarm system.
- Manufacturer certification and warranty documentation.

Section 10 – MATV System

- Index/ table of contents.
- Schedule of technical data including:
 - . Manufacturer
 - . Product code
 - . Description of item
- Technical data sheets and all other relevant manufacturers' literature.
- As-installed schematic.
- Signal survey report.
- Manufacturer certification and warranty documentation.

Section 11 – Certificates, Commissioning Reports and Test Results

- Index/ table of contents.
- Provide the following Certificates:
 - . Certificate of compliance (CoC).
 - . Form 2.
 - . TCA1 Form.
 - . UTP cabling testing equipment: Calibration certificates

- . Switchboards: Manufacturer's Inspection and test report.
- . Telstra/NBN lead-in conduit – Mandrel test findings form.
- . Certificate of training completion for all systems installed.
- Provide the following Commissioning Report and Test Results:
 - . LV system as per AS3000, clause 8.3.
 - . Exit and emergency lighting: Initially 120min duration testing.
 - . Telecommunications System: UTP cable test results.
 - . Intercom System.
 - . Fire Detection and Alarm System: Fire detection: AS1670 Appendix E – Commissioning test report & Fire detection: AS1670 Appendix F – Standard form of installer's statement for fire alarm system.
 - . MATV System

Section 12 – As-Installed Drawings

- Index/ table of contents.
- Hard and soft copy A1-A3 AutoCAD drawings.
- Record during the progress of the project all changes to cable runs, fixture positions, etc. Prepare using AutoCAD 2016 (or later) drafting format. Where errors, discrepancies or omissions are identified, they will be returned to the Contractor for correction.
- The review of Contractor's installed drawings is not intended to be a checking process, and the Contractor remains responsible at all times for the content, accuracy and scope of submitted documents.
- Provide hard copy and soft copy of all As-Installed drawings. Include the following minimum information:-
 - . Actual locations of installed equipment
 - . Interface points with other trades
 - . Circuit numbers and phase for all final sub-circuits
 - . Actual cable tray and communication cable routes
 - . Location depths of all underground conduits and pits dimensioned from permanent landmarks

Electronic Copy

- Provide an electronic copy of the manual on USB stick and securely store within the folder.
- Provide and attach a key tag to USB stick and label with project name.

APPENDIX A

ACCESSORIES SCHEDULE

Item	Make and model	Colour	Mounting	Comments
10A single SSO (internal use)	CLIPSAL '2000 series' 'standard series'	White	Wall Flush mount	c/w fire rated wall box, as required
10A double SSO (internal use)	CLIPSAL '2000 series' 'standard series'	White	Wall Flush mount	c/w fire rated wall box, as required
10A single SSO (external use)	HPM LEGRAND 'soliroc'	Grey	Wall Surface mount	Min IP55
Special Group 1 outlets 'SG1'	CLIPSAL '2000 series' 'standard series'	White	Wall Flush mount	- 1x 10A double SSO - 1x RJ45, Cat 6 / 6A comms outlet
Special Group 2 outlets 'SG2'	CLIPSAL '2000 series' 'standard series'	White	Wall Flush mount	- 2x 10A double SSO - 2x RJ45, Cat 6 / 6A comms outlet
Television outlets 'TV'	CLIPSAL '2000 series' 'standard series'	White	Wall Flush mount	- 1x 10A double SSO, - 2x RJ45, Cat 6 / 6A comms outlet - 1x FTA, MATV outlet - 1x Blank faceplate
1ph isolator	CLIPSAL '56 series'	White or grey	Wall Surface mount	c/w traffolyte label
3ph isolator	CLIPSAL '56 series'	White or grey	Wall Surface mount	c/w traffolyte label
1ph, 40A functional isolator	CLIPSAL '.....'	White	Wall Flush mount	c/w engraved faceplate label
15A light switch	CLIPSAL '2000 series' 'standard series'	White	Wall Flush mount	Number of gangs as shown on drawings. c/w mech retaining screws
PIR occupancy sensor (Type A)	Steinel Professional 'IR QUATTRO HD'	White	Ceiling Surface / Flush mount	PIR and 360deg detection. 2-Pole version (pole #1 = lighting, pole #2 = mech plant) Default setting =15mins (to client approval) Wiring of sensor, lighting, switch and mech plant to manufacturers requirements.
PIR occupancy sensor (Type B)	Steinel Professional 'IR QUATTRO SLIM'	White	Ceiling Flush mount	PIR and 360deg detection. 2-Pole version (pole #1 = lighting, pole #2 = mech plant) Default setting =15mins (to client approval) Wiring of sensor, lighting, switch and mech plant to manufacturers requirements.

Item	Make and model	Colour	Mounting	Comments
PIR occupancy sensor (Type C)	Steinel Professional 'DUAL US'	White	Ceiling Surface / Flush mount	Ultrasonic and rectangular detection 1-Pole version Default setting =15mins (to client approval) Wiring of sensor, lighting and switch to manufacturers requirements
PE cell	HPM Legrand 'Sunset switch'	White or grey	Wall Surface	

CONDUIT, CABLE TRAY AND PITS SCHEDULE

Item	Manufacturer	Colour	Mounting	Comments
Power conduit	Generic	Orange	Underground	HD, uPVC type
Power conduit	Generic	Grey	Above ground	HD, Corrugated type
Comms conduit	Generic	White	Underground	MD, uPVC type
Comms conduit	Generic	White / Grey	Above ground	MD, Corrugated type
Power cable tray	Generic	Grey	Ceiling void / wall Surface mount Suspended by unistrut	150 / 300 / 450 / 600mm wide
Comms cable tray	Generic	Grey	Ceiling void / wall Surface mount Suspended by unistrut	150 / 300 / 450 / 600mm wide
NBN conduit	NBN approved	NBN approved	Underground / Above ground	MD, PVC type (NBN approved)
Power pit and lid (type P1)	ACO	n/a	Ground Flush mount	Min. 500mm(L) x 500mm(W) x 900mm(D). Classification type as noted in specification
NBN pit and lid (Class E)	NBN approved	n/a	Ground Flush mount	NBN approved

DOOR INTERCOM SYSTEM SCHEDULE

Item	Make and model	Colour	Mounting	Comments
Door intercom station (entry door)	AI Phone	Grey / Black	Wall Surface / Recessed	IP65 rating
Door intercom panel (apartment)	AI Phone	White / Black	Wall Surface / Recessed	c/w remote pushbutton for entry door release
Electronic door strike	Generic	Generic	Door hardware Recessed	Monitored

FIRE DETECTION SYSTEM SCHEDULE

Item	Manufacturer	Colour	Mounting	Comments
Fire indicator panel	Ampac	Generic	Wall Surface / Recessed mount	c/w occupant warning system
Smoke detector	Ampac	White	Ceiling / Concealed Surface mount	Addressable
Thermal detector	Ampac	White	Ceiling / Concealed Surface mount	Addressable

Smoke alarm	Ampac	White	Ceiling Surface mount	Hard-wired to local switchboard
Fire audio visual alarm	Ampac	White base	Ceiling / Wall Surface mount	C/w traffolyte label "FIRE"
Fire speaker	Ampac	White	Ceiling / Wall Surface / Recessed mount	
Fire horn speaker	Ampac	White or grey	Ceiling / Wall Surface mount	
Void fire detector holder	Ampac -	generic	Ceiling Recessed mount	c/w ceiling plate (white)

LIGHTING SCHEDULE

Type	Supplier, make & model	Comment	Finish	Diffuser	Wattage	Colour temp	Driver	Mounting type
DL1		Downlight			LED	3000k 4000k	Non-dim Switch-dim	Ceiling Recessed / Surface mount
DL2		Downlight			LED	3000k 4000k	Non-dim Switch-dim	Ceiling Recessed / Surface mount
EM1	Clevertronics	Emergency Light Non-maintained L10 version	White / Black	n/a	LED	4000k	n/a	Ceiling Recessed / Surface mount
EX1	Clevertronics	Exit Light Maintained Runningman pictogram L10 version	White / Black	n/a	LED	4000k	n/a	Ceiling Recessed / Surface mount
SL1		Surface Light			LED	3000k 4000k	Non-dim Switch-dim	Ceiling Surface mount
SL1/ EM		Surface Light c/w emergency battery back-up			LED	3000k 4000k	Non-dim Switch-dim	Ceiling Surface mount
SL2		Surface Light			LED	3000k 4000k	Non-dim Switch-dim	Ceiling Surface mount
WL1		Wall Light			LED	3000k 4000k	Non-dim Switch-dim	Wall Recessed / Surface mount

MATV SYSTEM SCHEDULE

Item	Make and model	Colour	Mounting	Comments
Antenna	Design, supply and install			
Amplifier	Design, supply and install			c/w 10A power outlet
Splitter	Design, supply and install			c/w 10A power outlet
FTA, MATV outlet	CLIPSAL '2000 series' 'standard series'	White	Wall Flush mount	c/w fire rated wall box, as required

SWITCHBOARD SCHEDULE

Item	Manufacturer	Colour	Mounting	Comments
Main Switchboard (MSB)	Be Switchcraft Or equal and approved	To Architects approval	Floor mount Concrete plinth	c/w anti-condensation heater.
Distribution Board (DSB)	Be Switchcraft Or equal and approved	To Architects approval	Wall mount Surface	
Load Center (LC)	Clipsal Or equal and approved	To Architects approval	Wall mount Recessed	
Switchboard components	Generic			

NBN / TELECOMMUNICATIONS SYSTEM SCHEDULE

Item	Make and model	Colour	Mounting	Comments
Cable Transition Loop	Generic		Minimum 400mm height, maximum 1000mm	
Floor Distribution Terminal	Generic		Minimum 400mm height, maximum 1000mm	
Network Termination Device	Generic		Minimum 400mm height, maximum 1000mm	
Comms outlet	Clipsal '2000 series'	White	Wall Flush mount	RJ45, Cat 6A c/w engraved label on faceplate
UTP cabling	Generic	Blue sheath		Cat 6A

APPENDIX B

SCHEDULE OF TECHNICAL DATA

Provide the following proposed technical data at the time of tender.

Item	Proposed
ACCESSORIES <ul style="list-style-type: none"> - 10A, single SSO – internal use (manufacturer/model no.) - 10A, double SSO – internal use (manufacturer/model no.) - 10A, single SSOs – external use (manufacturer/model no.) - 1ph Isolator (manufacturer/model no.) - 3ph Isolator (manufacturer/model no.) - 15A Light switch (manufacturer/model no.) - Occupancy sensor – ‘type A’ (manufacturer/model no.) - PE Cell (manufacturer/model no.) 	
CABLE TRAYS AND PITS <ul style="list-style-type: none"> - Cable tray – 150mm(w) (manufacturer/model no.) - Cable tray – 300mm(w) (manufacturer/model no.) - Cable tray – 600mm(w) (manufacturer/model no.) 	

<ul style="list-style-type: none"> - NBN pit and lid (manufacturer/model no./dimensions) 	
<p>DOOR INTERCOM SYSTEM</p> <ul style="list-style-type: none"> - Door intercom station – entry door (manufacturer/model no.) - Door intercom panel – apartments (manufacturer/model no.) 	
<p>EMERGENCY LIGHTING SYSTEM</p> <ul style="list-style-type: none"> - Type EM1 (manufacturer/model no.) - Type SL1/EM (manufacturer/model no.) - Type EX1 (manufacturer/model no.) 	
<p>FIRE DETECTION SYSTEM</p> <ul style="list-style-type: none"> - FIP (manufacturer/model no./dimensions) - Addressable smoke detector (manufacturer/model no.) - Addressable thermal detector (manufacturer/model no.) - Hard-wired audible smoke detector (manufacturer/model no.) - Fire audio visual alarm (manufacturer/model no.) - Fire speaker (manufacturer/model no.) 	

<ul style="list-style-type: none"> - Fire horn speaker (manufacturer/model no.) - Void fire detector holder (manufacturer/model no.) 	
LUMINAIRES <ul style="list-style-type: none"> - Type DL1 (manufacturer/model no.) - Type DL2 (manufacturer/model no.) - Type DL3 (manufacturer/model no.) - Type SL1 (manufacturer/model no.) - Type SL2 (manufacturer/model no.) - Type WL1 (manufacturer/model no.) 	
MATV SYSTEM <ul style="list-style-type: none"> - MATV Antenna (manufacturer/model no.) - MATV amplifier (manufacturer/model no.) - MATV splitter (manufacturer/model no.) - MATV outlet (manufacturer/model no.) 	
SWITCHBOARDS MAIN SWITCHBOARD (MSB) <ul style="list-style-type: none"> - Manufacturer - Limiting overall dimensions (width, height, depth) - Busbar rated current (minimum) 	MSB

<ul style="list-style-type: none"> - Rated short-circuit current (minimum) - Form of separation (minimum Form 1) - Degree of protection - Door smoke seal - Future circuits required (min 30% spare pole) - Installation Type - Energy consumption meter (manufacturer/model no.) - Main isolator (manufacturer/model no./min. current rating) - MCB and MCB/RCD (manufacturer/model no.) - Surge diverter (manufacturer/model no.) 	
<p>SWITCHBOARDS MAIN DISTRIBUTION (MSSB)</p> <ul style="list-style-type: none"> - Manufacturer - Limiting overall dimensions (width, height, depth) - Busbar rated current (minimum) - Rated short-circuit current (minimum) - Form of separation (minimum Form 1) 	<p>MSSB</p>

<ul style="list-style-type: none"> - Degree of protection - Door smoke seal - Future circuits required (min 30% spare pole) - Installation Type - Energy consumption meter (manufacturer/model no.) - Main isolator (manufacturer/model no./min. current rating) - MCB and MCB/RCD (manufacturer/model no.) - Surge diverter (manufacturer/model no.) 	
<p>SWITCHBOARDS DISTRIBUTION BOARDS (DSB)</p> <ul style="list-style-type: none"> - Manufacturer - Limiting overall dimensions (width, height, depth) - Busbar rated current (minimum) - Rated short-circuit current (minimum) - Form of separation (minimum Form 1) - Degree of protection - Door smoke seal - Future circuits required (min 30% spare pole) 	

<ul style="list-style-type: none"> - Installation Type - Energy consumption meter (manufacturer/model no.) - Main isolator (manufacturer/model no./min. current rating) - MCB and MCB/RCD (manufacturer/model no.) - Surge diverter (manufacturer/model no.) 	
<p>SWITCHBOARDS LOAD CENTER</p> <ul style="list-style-type: none"> - Manufacturer - Limiting overall dimensions (width, height, depth) - Busbar rated current (minimum) - Rated short-circuit current (minimum) - Form of separation (minimum Form 1) - Degree of protection - Future circuits required (min 30% spare pole) - Installation Type - Main isolator (manufacturer/model no./min. current rating) - MCB and MCB/RCD (manufacturer/model no.) 	<p>LOAD CENTER (Apartments)</p>

- Serge diverter (manufacturer/model no.)	
TELECOMMUNICATIONS SYSTEM - Comms outlet (manufacturer/mode no.)	

EQUIPMENT CONFORMITY

Itemise below all items where the tendered items differ from the specification.

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TENDER SUBMISSION

Include with Tender submission the name of the electrical contractor and all other subcontractors that will be undertaking any of the electrical works including communications and security systems:

ELECTRICAL SERVICES:.....

DOOR INTERCOM SYSTEM:.....

EARTHWORKS:.....

FIRE DETECTION SYSTEM:.....

MATV SYSTEM:.....

SWITCHBOARDS:

NBN / TELECOMMUNICATIONS SYSTEM:

SECTION COST BREAKDOWN

Tenders shall provide itemised cost breakdowns with their submitted tender, for various components of the works listed below.

The listed components of the works are to be included in the total tender sum. The cost is to include supply, delivery, installation, test, warranty maintenance, overhead and profits.

AMOUNT TENDERED

Conduits, Cable Tray and Pits	\$
Door Intercom System	\$
Emergency Evacuation Lighting Monitoring System	\$
Earthworks (trenching, backfilling, compaction and surface re-instatement)	\$
Fire Detection System	\$
Lighting (inc sub-circuit wiring)	\$
MATV System	\$
NBN conduits and cable pits	\$
Switchboards (inc consumer mains and submain cabling)	\$
NBN / Telecommunications System	\$
Labeling	\$
Testing & Commissioning	\$
Maintenance & Servicing	\$
Operating and Maintenance Manuals	\$
Other (specify)	\$
SUBTOTAL	\$
GST	\$
TOTAL	\$

ITEMISED COST BREAKDOWN

Tenders shall provide itemised cost breakdowns with their submitted tender, for various components of the works listed below.

The listed components of the works are to be included in the total tender sum. The cost is to include supply, delivery, installation, test, warranty maintenance, overhead and profits.

Item	Fixed Price
<u>ACCESSORIES</u>	
- 10 Amp, double, SSO (internal use) looped to adjacent outlet with 5m of cable.	\$.....Inc GST
- 10 Amp, double, SSO (internal use) supplied by a dedicated sub-circuit with 40m of cable and RCBO.	\$.....Inc GST
- 10 Amp, single, SSO (external use) looped to adjacent outlet with 5m of cable.	\$.....Inc GST
- 10 Amp, single, SSO (external use) supplied by a dedicated sub-circuit with 40m of cable and RCBO.	\$.....Inc GST
- 1ph, 20 Amp, isolator supplied by a dedicated sub-circuit with 40m of cable and MCB.	\$.....Inc GST
- 1ph, 40 Amp, isolator supplied by a dedicated sub-circuit with 40m of cable and MCB.	\$.....Inc GST
- 3ph, 20 Amp, isolator supplied by a dedicated sub-circuit with 40m of cable and MCB.	\$.....Inc GST
- 3ph, 40 Amp, isolator supplied by a dedicated sub-circuit with 40m of cable and MCB.	\$.....Inc GST
- PIR occupancy sensor (type A)	\$.....Inc GST
<u>CONDUIT, CABLE TRAY AND PITS</u>	
- Excavating trench 300mm(W) x 1000mm(D) by machine (per/m cost).	\$.....Inc GST
- Trench backfilled, compaction and re-instatement of surface (per/m cost).	\$.....Inc GST
- 100mm HD, uPVC power conduit installed in an open trench (per/m cost).	\$.....Inc GST
- 100mm MD, uPVC comms conduit (NBN compliant) installed in an open trench (per/m cost).	\$.....Inc GST

- NBN pit and lid (type C1) \$.....Inc GST
- Above ground cable route marker plate flush mounted concrete base. \$.....Inc GST
- Galvanised cable tray 150mm wide (per/m cost). \$.....Inc GST
- Galvanised cable tray 300mm wide (per/m cost). \$.....Inc GST
- Galvanised cable tray 600mm wide (per/m cost). \$.....Inc GST

DOOR INTERCOM SYSTEM

- Entry door intercom station, c/w 40m of cabling and terminated to controller \$.....Inc GST
- Door intercom panel, c/w 40m of cabling and terminated to controller \$.....Inc GST

FIRE DETECTION SYSTEM

- Addressable smoke detector \$.....Inc GST
- Addressable thermal detector \$.....Inc GST
- Hard-wired smoke detector \$.....Inc GST
- Fire audio visual alarm \$.....Inc GST
- Fire speaker \$.....Inc GST
- Fire horn speaker \$.....Inc GST
- Void fire detector holder \$.....Inc GST

LUMINAIRES

- Type 'DL1' luminaire. \$.....Inc GST
- Type 'DL2' luminaire. \$.....Inc GST
- Type 'EM1' luminaire. \$.....Inc GST
- Type 'EX1' luminaire. \$.....Inc GST
- Type 'SL1' luminaire. \$.....Inc GST
- Type 'SL1/EM' luminaire. \$.....Inc GST
- Type 'SL2' luminaire. \$.....Inc GST

- Type 'WL1' luminaire. \$.....Inc GST

MATV SYSTEM

- Single TV outlet, c/w 40m of RG6Q coaxial cable. \$.....Inc GST

TELECOMMUNICATIONS SYSTEM

- Single, RJ45, Cat 6A data outlet with 60m of cabling,
terminated at both ends. \$.....Inc GST
- Double, RJ45, Cat 6A data outlet with 60m of cabling,
terminated at both ends. \$.....Inc GST