

APARTMENT DEVELOPMENT

11-13 WEST STREET, HINDMARSH SA

Project No: LCE13404

Electrical Services Specification

Tender Issue Revision T2

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1 GENERAL

1.1 CROSS REFERENCES

All work covered within this specification shall be read in conjunction with the following trade packages and contracts. Should any discrepancy occur between the references the larger/greater shall be assumed and referred to the Engineer prior to proceeding with any works.

- Preliminaries and General Contract Conditions
- Architectural Drawings and Specification
- Mechanical Services Drawings and Specification for termination points
- Fire Services Drawings and Specification for termination points
- Hydraulic Services Drawing and Specification for termination points
- Structural Drawings for details of footings, piers, beams, columns or the like

1.2 PROJECT DETAILS

The works described within this specification pertain to the Electrical Services installation at 13 West Street, Hindmarsh SA.

The works involve the construction of a new three storey apartment development including Ground Floor car parking area, four apartments per level on Levels 1-2 & three apartments in level 3, and Roof level plant area. Each apartment is to be provided with kitchen, laundry, and amenities facilities.

The contractor should note the specific requirement for connection of services off the adjacent site located at 17 West Street. All access is to be arranged in conjunction with the builder and strata manager for the property.

1.3 FIXED PRICE LUMP SUM CONTRACT

The Electrical Contractor is to enter into a fixed price lump sum type contract. The following specification and accompanying drawings outline the general scope of works and have been prepared to enable specialist contractors to submit fixed sum tender prices for the electrical services installation. The drawings are intended to indicate the principles of design and should not be taken to define all offsets, bends etc which may be required to complete the installation and or be coordinated with other services.

The Electrical services constructor will be responsible for final coordination with other trades and for final coordination with architectural drawings and building structure. The tender drawings are not to be used for architectural or structural work but are to be read in conjunction with architectural, structural and other relevant drawings.

Coordinate all cable runs, trays and installations with "MECHANICAL, HYDRAULIC AND FIRE SERVICES" trade to ensure non-clashing of services.

Deviation from the design principals shown will not be permitted without the written consent of the Superintendent. Any discrepancies which may affect the installations shall be brought to the superintendent's attention before the work proceeds.

Note apartment internal lighting, power, communications and fire alarm layouts and requirements have not been specifically defined by the specification and accompanying drawings. Refer to the architectural documentation for the lighting and power layouts of the apartments. These layouts and drawings will need to be considered and defined as part of the electrical tender for review by the builder, consulting engineer and client.

1.4 DEFINITION OF TERMS

Consulting Engineers	-	Lucid Consulting Australia
Proprietor/Principal	-	Client or end user of the proposed building
Architect	-	Milne Architects
Electrical Supply Authority	-	SA Power Networks – Frank Greco
Telecommunications	-	NBN Co. – Jim Kellet
Supply Authority		
Head Contractor	-	Building Contractor appointed to carry out the construction of the building. Electrical Contractor shall enter contract to undertake the Fire Services installation with the successful Head Contractor
Contractor	-	Installer undertaking the works.
Works	-	As described within this specification
Provide	-	Design, construct, supply, install, commission and place into service
Equal Approved	-	Alternative product/method of installation which is presented to the Consulting Engineer and written approval is received.

1.5 DRAWINGS

Tender Drawings

Drawings associated with and forming part of this specification are scheduled below:

Drawing No.	Drawing Title
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LCE13404-E01	General Notes, Legend of Symbols, Locality Plan and Drawing Index.
LCE13404-E02	Ground Floor Power, Communications, Luminaire and Fire Detector Arrangement.
LCE13404-E03	First and Second Floor Power, Luminaire and Fire Detector Arrangement.
LCE13404-E04	Third Floor and Roof Power, Luminaire, Communications and Fire Detector Arrangement.
LCE13404-E05	Single Line Diagram and Standard Details.

The arrangements and details indicated on the above drawings are approximate only. Check all dimensions and building details prior to commencement of the work.

A contractor walk through will be arranged for the contractor to raise queries and provide comment during the tender period.

1.6 SCOPE

Outline description: The work covered by this specification includes the following:

The provision of an electrical installation that satisfies all statutory, legislative and code requirements and conforms with the general details herein.

The planning, scheduling, procurement of components and their installation to meet the program. Completion of the works to meet the proposed and required staging, in coordination and liaison with other trade packages.

Full responsibility for the execution of the complete installation in accordance with the project specification and all drawings.

The installation, testing, commissioning, maintenance, service and warranty; and all sundry and material items whether mentioned in detail or not, required to complete the installation and put it into working order.

Description of the Installation

The following works generally describe the Electrical Services installation and shall be carried out under this specification:

- Provision of new submains from the existing site main switchboard. Provide new circuit breaker in the existing MSB to service the new building.
- Liaise with the incumbent embedded energy metering provider (Savant) for the installation of the Child meters. Child meters shall be free issued to the electrical contractor by Savant. Meter panels to be supplied and installed by the electrical contractor.
- New main distribution board including all switchgear, controlgear and auxiliary panels.
- Multiple submains and distribution boards throughout the installation, including cable trays, cable ladders, supports, conduits, switchgear and controlgear, auxiliary panels and enclosures and all ancillary equipment to complete the installation.
- Earthing systems to all accessories, outlets, equipment, luminaires, other services, building structure, switchboards and communications cabling systems including provision of equipotential earthing system to slab reinforcement in all wet areas in accordance with AS3000 and in co-ordination with the Builder.
- General power installation throughout including access provisions, supports, cabling and outlets.
- RCD protection of all socket outlet circuits, lighting circuits and other circuits and equipment as required.
- Power supplies to Mechanical, Hydraulic and specialised services including provision of supplies, outlets or isolators as nominated.
- Fire rated power supply to Lift Services and lift equipment.
- Provision of general and specialised lighting throughout the complex including luminaires, lamps and specialist controls to suit BCA power density and energy efficiency requirements.
- Refer architectural drawings for scope of lighting and power allowance within the apartments
- Exit and emergency lighting throughout the installation complying with the requirements of AS 2293.

- Access conduits and cable trays for communications systems including those for NBN Co and internal voice and data copper, and optical fibre cables, inclusive of pits and draw wires.
- Telecommunications facility cabling including support systems, accessories and terminations.
- Provision of reticulated MATV system to all Apartments for digital FTA and Digital distribution including the ability for high definition digital TV distribution, including backbone cabling, outlet cabling, passive and active equipment, racking, satellite dish, aerial installation, head-end equipment auxiliary equipment and accessories to each apartment to complete the installation.
- Provision of combined fire / access control systems to car park and common areas including card readers, door hardware, proximity cards, door release buttons, emergency break glass door releases buttons, detectors, strobe sirens, TCP/IP interface between systems, interface to the intercom system, control equipment and programming.
- Provision of labelling to the circuit breaker upstream of each isolator (car park exhaust fan and bin room fan).
- Audio intercom systems to all apartments including audio equipment, audio building entrance stations, audio apartment monitoring stations, individual apartment door bells facility, bus control equipment, equipment enclosures, main entrance access controllers, main entrance push button release, cabling, supports, auxiliary equipment, interface to building access control system and all other accessories to complete the installation.
- Provision of all hoisting and access equipment required to install all systems.
- Provision of training of management and maintenance staff for all systems.
- Make timely applications and liaise with electrical and telecommunication authorities and utilities for all infrastructure and connections associated with the project on behalf of the Proprietor/Principal to meet the construction program milestones.
- Testing and commissioning of the above systems.
- Maintenance and servicing, defects liability and warranty for 12 months from the date of practical completion.
- Bound volumes of Installation and Operating Manuals, and work-as-executed drawings.

Variations to the Scope

Instructions may be issued throughout the project which may alter the scope of works. Any aspects of any such works which are not specifically mentioned in any instruction are to comply with this specification.

Any claims for any additional costs or credits for any such variations must be submitted with a complete breakdown of costs including quantities and rates for all labour, materials and equipment. Variation Claims submitted without breakdowns will be rejected.

1.7 ASSOCIATED WORKS

Related Works

The following work related to the Electrical Services installation shall be carried out under control of the Head Contractor. Provide any additional work required for the completion and

full operation of the Electrical Services Works including the provision of access panels for the proper maintenance of all equipment.

- Trimmed openings within plasterboard ceilings for luminaires.
- Formed block-outs and penetrations through walls, slabs, footings, columns and beams as detailed on the architectural plans. If not indicated the Electrical contractor will be responsible for arranging directly with the associated trade to form the penetration and allow for the associated cost in their tender. Any required minor penetration through concrete beams or floors shall be sleeved by the Electrical contractor. Should a penetration be required to be cored after construction, the Electrical contractor shall arrange for and bear all associated costs.
- All trenching and reinstatement of surfaces.
- Provision of door signage and associated danger notices.
- Provision of equipment indicated by other trades including installation with exception of electrical connections.
- Provision of temporary power, lighting and emergency lighting during construction in accordance with the requirements of AS3012, including minimum emergency lighting levels of 20 lux.
- Provision of Hoisting of all equipment.
- Space for site shed and storage of equipment delivered to site.
- Provision of 2 off single-phase switched socket outlets adjacent communications cabinet in the car park for connection to Savant Energy's 'Gateway' data logger with 4G wireless access.

Termination Points - sub-contractors

Termination points with other sub-contractors are as follows:-

Mechanical Services Sub-Contractor:-

- Wiring and final connection from weatherproof roof mounted isolators for air conditioning condensing units shall be provided by the Mechanical Services Contractor. Electrical services contractor shall provide individual electrical supplies from local apartment distribution boards for each air conditioning condensing unit.
- Flex and plug and final connection from controlled socket outlets within ceiling space for toilet and laundry exhaust fans shall be provided by the Mechanical Services Contractor. Electrical services contractor shall provide socket outlets within ceiling space supplied from local apartment power circuits and controlled from a combined light/fan switchplate within each location.
- Flex and plug and final connection from unswitched socket outlets within ceiling space for outside air fans shall be provided by the Mechanical Services Contractor. Electrical services contractor shall provide socket outlets within ceiling space supplied from local apartment power circuits. Controls for interlocking operation of outside air fan with local fan coil unit to be provided by the Mechanical Services contractor.
- For all roof mounted and indoor plants the Electrical Contractor shall provide isolators installed to pedestals located adjacent plant equipment and labelled to reference plant equipment. No isolators shall be installed directly on plant equipment.
- The Electrical Contractor shall provide dedicated circuits to the two isolators powering car park exhaust fan and bin room fan. The Electrical Contractor shall also provide

labelling to the circuit breaker upstream of each isolator (car park exhaust fan and bin room fan).

Hydraulics Sub-Contractor:-

- Provision of 2 off weatherproof single-phase double switched socket outlet for connection to of building central hot water plant shall be provided by the Electrical Services Contractor.
- Provision of 1 off weatherproof single-phase isolator adjacent to the building hot water circulating pump assembly control panel including wiring to and final connection to control panel shall be provided by the Electrical Services Contractor.
- Provision of 1 off single-phase switched socket outlet located adjacent to each dishwasher within cupboard space adjacent dishwasher recess, within each apartment shall be provided by the Electrical Services Contractor. Arrange with Joiner for cable and plug access via joinery divider.
- Provision of 1 off single-phase switched socket outlet located under gas hot plate within each apartment kitchen shall be provided by the Electrical Services Contractor.
- Wiring and final connections from socket outlets and isolators to all Hydraulic Services Equipment to be provided by the Electrical Contractor under this contact.
- For all roof mounted and indoor plant the Electrical Contractor shall provide isolators installed to pedestals located adjacent plant equipment, and labelled to reference plant equipment. No isolators shall be installed directly on plant equipment.

Lift Sub-contractor:-

- Final connections of all submains to Lift Services Switchboards shall be provided by the Electrical Contractor under this contract. Final locations to be co-ordinated with Lift Services Contractor.

Termination Points/Associated Works - Authorities

Termination points and associated works with utilities and authorities are as follows:

NBN Co:

- The Electrical Contractor shall provide all access provisions in the form of conduits and cable supports for all NBN Co cabling in accordance with NBN Co requirements.
- The Electrical Contractor shall prepare drawings and arrange approval of NBN Co Workshop Drawings, approval of cable pathways during construction, and handover of cable pathways to NBN Co.
- The Electrical Contractor shall co-ordinate with NBN Co for the provision of a fibre optic lead-in and associated active equipment to site.

1.8 STANDARDS

Referenced documents: The following standards are referred by and/or form part of this Specification:

Code	Year	Description
AS/NZS 1158 Set	2010	Lighting for roads and Public Spaces
AS/NZS 1170.4	2007	Structural design actions - Earthquake actions

		in Australia
AS/NZS 1345	1995	Identification of the contents of piping, conduits and ducts
AS/NZS 1367	2016	Coaxial cable and optical fibre systems for the RF distribution of digital television, radio and in-house analog television signals in single and multiple dwelling installations
AS/NZS 1627 Set	1997	Metal Finishing - Preparation and pretreatment of surfaces
AS/NZS 1680 Set	2009	Interior Lighting
AS 1882	2002	Earth and bonding clamps
AS/NZS 1939 Set	1990	Degrees of protection provided by enclosure for electrical equipment (IP Code)
AS/NZS 2053 Set	2001	Conduit and fittings for electrical installations set
AS 2067	2016	Substations and high voltage installations exceeding 1 kV A.C.
AS/NZS 2201 Set	2008	Intruder alarm systems set
AS/NZS 2293 Set	2017	Emergency escape lighting and exit signs for buildings
AS/NZS 2700	2011	Colour standards for general purposes
AS 2946	1991	Suspended ceilings, recessed luminaires and air diffusers - Interface requirements for physical compatibility
AS/NZS 3000	2018	Electrical Installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3008	2017	Electrical Installations – Selection of Cables
AS/NZS 3012	2010	Electrical Installations – Construction and Demolition Sites
AS/NZS 3080	2013	Information technology - Generic cabling for customer premises
AS/NZS 3084	2003	Telecommunications Pathways and Spaces
AS/NZS 3111	2009	Approval and test specification - Miniature overcurrent circuit-breakers
AS 3786	2014	Smoke alarms using scattered light, transmitted light or ionization
AS/NZS 3820	2009	Essential safety requirements for electrical equipment
AS 4282	1997	Control of the obtrusive effects of outdoor lighting
AS 4607	1999	Personal response systems
AS/NZS 4680	2006	Hot-dip galvanized (zinc) coatings on

		fabricated ferrous articles
AS/NZS 4792	2006	Hot-dip galvanized (zinc) coatings on ferrous hollow sections, applied by a continuous or a specialized process
AS/NZS 5000 Set	2005	Electric cables - Polymeric insulated set
AS/NZS 60079 Set	2012	Electrical apparatus for explosive gas atmospheres set
AS/NZS 60598 Set	2013	Luminaires set
AS/NZS 60947 Set	2015	Low-voltage switchgear and control gear
AS/NZS 61000 Set	2000	Electromagnetic Compatibility (EMC) set
AS/NZS 61439 Set	2016	Low-voltage switchgear and control gear assemblies
AS/CA S008	2010	Requirements for customer cabling products
AS/CA S009	2013	Installation requirements for customer cabling (Wiring rules)
AS/NZS CISPR Set		Electromagnetic Compatibility

Comply fully with all relevant Standards and Regulatory Codes published and in force at the time of construction, including the following:

- The local and national Electricity Acts and Regulations
- Occupational Health Safety & Welfare Act and Regulations
- National Construction Code (NCC)
- Standards Australia
- Electricity Supply Authority Service Rules and Conditions of Supply
- ACMA Regulations
- Telstra Standards and Guidelines
- NBN Corporation Technical Guidelines
- Federal, State and Local Government Building Acts and Regulations

2 CONTRACT SUBMISSIONS / REQUIREMENTS

2.1 HOLD POINTS

The following is a summary of Hold Points referenced for completion prior to progression:-

Clause Ref.	Submission Stage	Hold Point	Response Time
2.3	Tender	Tender Submission	5 Working Days
2.4	Pre-Construction	Technical Datasheets	10 Working Days
		Workshop Drawings	5 Working Days
		Calculations	5 Working Days
		Functional Controls Specification	5 Working Days
		Construction Approvals	5 Working Days
2.5	Construction	Inspections	2 Working Days
		Commissioning & Witnessing Plans	10 Working Days
		Testing and Commissioning Results	5 Working Days
		User Training	10 Working Days
		Prototype copies of Operation and Maintenance Manuals (including As-constructed Drawings)	5 Working Days
2.5	Post-Construction	Operation Maintenance	10 Working Days

2.2 TENDER DRAWINGS

The Tender Issue drawings accompanying this specification illustrate the design intent of the proposed works. It is the responsibility of the Electrical Contractor to design and construct the installation based on the Tender Issue drawings provided.

Where sizes, ratings, loads and the like have been identified on the Tender Issue drawings, they are to be considered as the minimum values. The Electrical Contractor is to confirm all sizes, ratings, loads and the like and provide an installation that meets or exceeds the values shown.

The Electrical Contractor shall accept all responsibility for the proposed works and shall present any deviations or exclusions from the design intent identified in the Tender Issue drawings within their tender offer. Prior to submitting the tender offer the Electrical Contractor shall become fully acquainted with the nature and extent of the Contractor

Works. If any doubt exists as to the meaning of any part of the tender documents, clarification must be obtained 7 days prior to the tender closing date.

2.3 TENDER SUBMISSIONS

The submissions required at Tender shall incorporate, as a minimum, all information defined within the Appendices of this Specification. Any appendices not completely filled out will be rejected.

In addition to the Appendices the Manufacturer's selections data shall be provided incorporating the following:

- Electrical full load amps, voltage and phase data
- Performance data relevant to the equipment specification clause
- Acoustic data measured in Sound Power as per the equipment specification clause
- Size and weight information including maintenance clearance

Conduct of the Tender Submissions shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.4 PRE-CONSTRUCTION SUBMISSIONS

2.4.1 TECHNICAL DATASHEETS

Requirement: Submit technical datasheets for approval and permission. All subsequent materials and workmanship are to match the approved technical datasheets.

Conduct of the Technical Datasheet Submissions shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

Delay: Bear total responsibility for the consequences of delay resulting from failure to allow adequate time for assessment and approval of technical datasheets, including rejection of technical datasheets that are not approved for whatever reason.

Required technical datasheets: Submit technical datasheets of the following:

- Luminaires
- Motion Sensors
- Power Outlets
- Light Switches
- Smoke detectors
- MATV Outlets

2.4.2 WORKSHOP DRAWINGS

Diagrammatic layouts: Tender Drawings forming part of this Specification are diagrammatic for tender only and shall not be used for installation purposes. Before commencing work, determine the exact positions of all electrical equipment in conjunction with and to the approval of the Consulting Engineer having regard to interior design, building features, other services, and the requirements of regulatory authorities and standards indicated above.

Construction Workshop Drawings for Review:

Requirement: Supply construction workshop drawings coordinated fully with other trades and the main contractor detailing the following items:-

- Main Switchboards and all Distribution Boards including:-
 - General plans, elevations and sections, construction and weights.
 - Circuit diagrams, busbar and cable sizes
 - Current carrying capacity, current and fault ratings
 - Equipment types and models, labelling and finishes.
 - Additionally provide documentary evidence of fault withstand type tests relevant to the applicable enclosure(s).
- Co-ordinate final lighting, power and communications layouts (and all other provisions detailed herein) with other services and to suit final furniture locations including wardrobes. Provide shop drawings showing fully co-ordinated floor and ceiling plans complete with dimensions.
- Cable supports and pathways for NBN Co cabling as described in the NBN Co technical guidelines.
- Combined fire/access control system showing the location and mounting details of system equipment and all associated power supplies (SSOs) including functional description for operation of the system.
- Cable tray proposed routes in full coordination with Mechanical Services workshop drawings detailing submain quantities, locations, penetrations and support details.
- MATV schematic drawings showing locations of all active and passive equipment (including SSOs) and all outlets, and estimated signal strength at each outlet.
- Termination points with all other trades.
- Details of all proposed labelling and engraving.
- Earthing layouts and bonding connection locations and details.

Conduct of the Workshop Drawings Submissions shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

Number of copies: 3 off print copies or 1 off electronic copy.

Preparation: Prepare all drawings to AS 1100, AS 1102, AS 1103 and AS 3702 to the same scales and on the same size standard sheets as the Contract Drawings (Size A1 sheets).

Work-as-executed drawings - Electrical Services

Requirement: Before the Date of Practical Completion and as a pre-condition to Practical Completion supply work-as-executed drawings based on the Contract 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

- NBN Co cable pathways and supports.
- Location depths of all underground conduits and pits dimensioned from permanent landmarks

Include these drawings once approved in the Electrical Services Installation Manuals.

Provide a laminated copy of the main switchboard single line diagram to the approval of the Principal and Consulting Engineer; mount adjacent the Main Switchboard.

Provide a laminated copy of the NBN Pathway Drawings and mount within the Communications Room. Provide a bound set of communications floor plans indicating labelling and wiring routes and locate within the Communications Room.

AutoCAD version 2007 files in DWG format of the tender drawings are available from Lucid Consulting. (One single coordinated electronic transfer will be issued).

Work-as-executed drawings are to be provided by the Electrical Sub-contractor in both electronic on CD-Rom and hard copies within each Installation Manual.

2.4.3 AUTHORITIES, PERMITS, FEES, CERTIFICATES AND APPROVALS

Tariffs and installation of meters

Make applications for the timely works of all relevant authorities and utilities. Pay all associated fees and costs.

Complete all forms and applications and arrange for signing by the Proprietor as appropriate.

Provide documents evidencing approval of regulatory authorities, before and as a pre-condition to Practical Completion or other specified dates, including the State Fire Service.

Provide Certificates of Compliance indicating self-certification of all aspects of the project as required by the Electricity Act.

Allow to obtain approvals or connections from authorities and utilities in a staged manner to suit the program, construction and occupation of the project.

Upon request, submit for approval any item related to the installation, including data sheets on materials and equipment and licence certificates.

Conduct of the Construction Approvals Submissions shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.5 CONSTRUCTION SUBMISSIONS

2.5.1 INSPECTIONS

Notice: Give sufficient notice so that inspection may be made at the following minimum stages:

- Trenching: Approval of routes, common trench arrangements (where proposed) and depths;

- Cabling: Commencement of cabling installation (including that of any sub-contractor);
- Connection: Connection of cabling and wiring;
- Earthing: Installation and connection of earthing system;
- Acceptance: Installation ready for acceptance;
- Testing of systems
- Commissioning of systems

2.5.2 COMMISSIONING & WITNESSING PLANS

The contractor shall submit for approval a detailed commissioning plan indicating step by step testing strategy for all equipment. The commissioning plan shall be developed in conjunction with other trades and shall be required to be submitted to the head contractor and Consulting Engineer for review prior to any commencement of commissioning. The electrical services contractor shall be responsible for providing commissioning duration period to head contractor for inclusion in the construction programme.

Any witnessing of commissioning required by the Consulting Engineer, prior to practical completion, shall be allowed for within the commissioning plan.

Conduct of the Commissioning & Witnessing Plans Submissions shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.5.3 TESTING AND COMMISSIONING RESULTS

Provide testing and commissioning results in accordance with the Testing and Commissioning section of this specification as a pre-condition of Practical Completion.

Submission of satisfactory testing and commissioning results shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.5.4 USER TRAINING

Carry out training on systems as nominated within this specification with user groups and other parties as nominated by the Superintendent. Provide a program for user training for approval by the Superintendent and Building Services Consulting Engineer.

Completion of user training shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.5.5 INSTALLATION MANUALS

Requirement: Before commencement of operational maintenance and prior to Practical Completion, provide the specified number of copies of a combined operating and maintenance manual, written in clear concise English, containing a title page listing suppliers' names, addresses and telephone numbers, a table of contents, and the following sections:

- Front cover including Project Name, Location, Builder and Electrical Contractor
- Index
- Contractor's Name, Address, Telephone number and emergency telephone numbers

- General description of the installation, written as briefly as possible, consistent with providing a general understanding of its features and operation.
- Schedule of Technical Data
- List of Equipment Suppliers' and Manufacturers' catalogues and descriptive matter to provide a complete source of information. (All manufacturers' literature shall be original copies.)
- A copy of "Work-As-Executed Drawings" showing all circuiting, circuit numbers, phase annotation and communications outlets designations. All underground cable routes shall be dimensioned from permanent landmarks. Photographic and video records of concealed works.
- A copy of switchboard workshop drawings and all other construction drawings.
- A copy of all final distribution board legend cards.
- Maintenance Instructions
 - Routine
 - Preventative
- Test results taken during acceptable tests and Authority Certificates including:-
 - RCD Test results
 - Exit and Emergency lighting discharge results
 - Communications cabling including calibration certificate for testing equipment
 - Electrical COCs
 - TCA1 form
- List of guarantees and warranties of Equipment Suppliers.

Form: A4 size, printed or typed on durable printing paper, with each page consecutively numbered, and neatly bound in durable vinyl or similar hard covers with embossed covers. Provide multiple volumes as required.

Number of copies: 3

Installation manuals are to be provided by the Electrical Sub-contractor in both hard copies and electronic form (USB drive within each Installation Manual).

Prototype copy: Provide a prototype copy for approval before proceeding with final copies. Co-ordinate the manuals with all other trades.

Final approval copies are to be received before and as a pre-condition to Practical Completion.

Submission of prototype copies of Operation and Maintenance Manuals shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.5.6 MAINTENANCE AND TESTING OF SAFETY INSTALLATION MANUAL INSERTS

Requirement: Prior to Practical Completion provide the specified number of copies of inserts into Maintenance and Testing of Safety Installation Manual as provided by the Fire Services Contractor, written in clear, concise English. Co-ordinate with the Head Contractor and all other trades for submission of the inserts.

Include the following inserts:

- Signage including exit and emergency lighting details, including locations and testing requirements.
- General description of the exit and emergency lighting system.
- Maintenance and testing of NBN Co NTU's servicing essential communications systems including fire and lift lines.

The manual shall comply with AS 1851 - Maintenance of Fire Protection Equipment.

Form: A4 size, type written-on durable printing paper, with consecutively numbered pages, neatly bound in red vinyl hard-covers with embossed covers.

Number of Copies: 3.

Submission of prototype copies of Maintenance and Testing of Safety Installation Manual inserts shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.6 POST-CONSTRUCTION SUBMISSIONS

2.6.1 OPERATIONAL MAINTENANCE

Maintenance period: 12 months from the date of Practical Completion.

Requirement: Provide 24 hour emergency call-out services and arrive on site to rectify defective items within 2 hours of notification of a defective item. During the maintenance period:

- Carry out monthly inspections and perform maintenance work at the frequencies and following the procedures recommended by the manufacturers of the supplied equipment;
- Check all terminations and connections within switchboards, identify and correct any overheating.
- Promptly rectify faults. Replace faulty materials and equipment, including all luminaire lamps, and accessories.
- Check the operation of evacuation lights and exit signs at three monthly intervals. Provide logbook and log all tests.
- Clean off dust and corrosion build-up to all plant and equipment.

Provide maintenance check sheets and arrange for signing of these by the nominated site representation. Provide a copy of the check sheets to the Consulting Engineer on a monthly basis.

Certification: At the end of the maintenance period make a final service visit and, upon satisfactory completion of the above procedures, certify in writing that the installation is operating correctly.

Approval for the release of retention monies will not be granted until 12 consecutive monthly check sheets have been received by both the Proprietor and the Consulting Engineer.

Conduct of the Operational Maintenance Submissions shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

Operational instruction: Coinciding with Commissioning and routine inspection visits, at times to be agreed with the Superintendent, instruct the Principal's operational maintenance staff in the recommended methods of operation and maintenance of the systems.

In addition provide a time allowance of 16 hours for the initial instruction in the operation of all systems.

3 MATERIALS & WORKMANSHIP

3.1 GENERAL

The following clauses set out the general requirements for the works. These requirements are not intended to cover all aspects of the installation and must be read in conjunction with all other sections of the Specification and the drawings.

Workmanship shall be of a high standard and each section of the work shall be properly and neatly executed to the best trade practice.

The tender drawings indicate the sizes of cables and the approved cable routes throughout the building. They do not, however, purport to show all minor cable offsets, hangers, method of fixing and clearances, all of which must be coordinated with other trades, measured on site and in accordance with AS 3000. All cable arrangements shall be coordinated with architectural, structural and other services on site prior to commencement of installation.

3.2 QUALITY ASSURANCE

Implement a Quality Assurance System for the works in accordance with the following Australian Standards:

- AS/NZS ISO 9000
- AS/NZS ISO 9001

The Quality Assurance System shall cover the following minimum aspects:

- Detailed plan setting out supervision, quality control and checking (witness point) procedures.
- Details of the Electrical Contractor's Quality Assurance Plan shall be submitted to the Superintendent upon request.

3.3 EXISTING SITE CONDITIONS

The contractor shall visit the site to familiarise himself with the extent of work. No extras shall be considered from neglect of this provision.

Minimum notice required for all required inspections; 10 working days

The Electrical Contractor shall check with all relevant authorities as to possible locations of any underground services on site and in adjacent footpaths/roadways and locate before commencing excavation.

The Electrical Contractor shall allow to terminate all redundant services as necessary to allow demolition to commence.

3.4 COMPLETED SITE CONDITION

Thoroughly clean all fixtures and fittings and leave the installation in a first class working condition.

Untidy work whether exposed to view or concealed will not be accepted and rectified at nil cost.

3.5 UNIFORMITY AND QUALITY

Obtain approval for and maintain uniformity of the manufacturer and type of all materials and equipment. Use only new, current manufacture, first quality materials and equipment.

Comply with the manufacturer's recommendations in respect to installation techniques and the requirements for associated materials, access clearances, equipment, components and devices.

Ensure compatibility of materials and equipment with the installed environment in respect of ambient temperatures, utilities supplies and vibration.

Support all Electrical services equipment including cabling and the like, independently of other services and/or non-structural building elements.

3.6 WARRANTIES

Warranties shall extend for a minimum of 12 months.

All equipment and workmanship to be provided with a warranty.

Warranty to commence at date of practical completion.

Details for all products with extended manufacturers warranties shall be provided within final Operating and Maintenance manuals.

3.7 INSTALLATION COORDINATION

Check on site at regular intervals the building working dimensions, tolerances and the setting out of the associated works. Immediately report any discrepancy.

Requirements

The positions of outlets, switches, luminaires and equipment shown on Drawings accompanying the Specification are for Tender purposes and are diagrammatic only. Check on site for positions and obtain approval and verification of all locations with the Principal and mounting heights prior to first fixing. When any relocating is required to conform to the above, undertake such relocation without additional costs to the Principal. Allow relocation of accessories and equipment a distance of 3m before and during first fix without variation to the contract.

Verify locations of all outlets, switches and equipment to ensure:-

- Co-ordination with final furniture arrangements and interior design;
- Co-ordination with other trades construction workshop drawings;
- The work of any other trade does not interfere with the electrical installation;
- They are not shrouded by door swings and tracks, furniture or equipment;
- Conformity with any pattern formed by ceilings, panels, tiles beams and the like;
- Full compliance with AS 3000 and Electricity Act requirements.

Anomalies

Promptly report any anomalies, for consideration and instructions. Work proceeding without obtaining approval, and subsequently rejected by the Superintendent shall be made good at nil additional expense to the Principal.

Co-ordination

Provide sizes and depths of recessed equipment including SCA cubicles and luminaires to other trades in writing for coordination before placing orders and before commencement of the relevant trade's construction workshop drawings.

Segregation

Physically mechanically segregate and separate circuits or services at common coverplates using approved isolating barriers.

Physically segregate the Electrical Wiring Systems from all other wiring and sub-wiring systems and equipment using physical isolation or approved isolating barriers.

Cable routes: The routes shown on the Drawings accompanying the specification are diagrammatic only and will require onsite coordination. Determine the final routes to suit the building structure, site conditions and penetration locations.

Approval: Obtain approval for the final routes prior to installing consumers mains, major sub mains and submains.

Concealment: Unless otherwise specified, conceal and protect cables and conduits.

Arrangement: Arrange cables and conduits parallel with walls, ceilings, floors and other building elements.

Separate conduits: Run circuits originating at different distribution boards in separate conduits or enclosures.

Derating: Unless otherwise stated, all cables shown on drawings or specified are based on nominal derating factors. Where the cable installation method chosen involves a derating factor of less than unity upgrade the cables so that the current carrying capacity of the new cable, multiplied by the derating factor, is at least equal to the current carrying capacity of the minimum specified cable.

Cutting and making good: Unless included as associated works, cut all openings and penetrations, and install all sleeves required for the electrical installation. Maintain fire ratings in all instances.

Segregation: Maintain physical barrier segregation and separation between the electrical system and all other wiring systems and services. Liaise with all other services and trades where required to maintain this segregation.

3.8 PENETRATIONS

Generally

Provide treatment to the penetrations as follows. Refer to architectural drawings for indication of all fire walls, floors ceilings, and the like, for allowance required to fire rated penetrations throughout:-

Fire walls, ceilings and structural members: Do not penetrate without approval. Restore the fire rating of all fireproof building members at barriers where penetrated by electrical services once cable installation is complete using an approved method. Provide approved proprietary fire-rated wall-boxes for accessories to be installed on fire rated walls. Seal to approval of Consulting Engineer and Authority.

Acoustic walls and ceilings: Do not penetrate without approval. Restore the acoustic rating of barriers where penetrated by electrical services once cable installation is complete using an approved method. Provide approved proprietary acoustic-rated wall-boxes for accessories to be installed on acoustically rated walls. Seal to approval of Consulting Engineer and acoustic engineer.

Damp courses: Do not penetrate.

Floor slab: Run conduits entering a building at ground level under the waterproof membrane and vertically penetrate the membrane and the floor slab.

Existing structures: Obtain approval from a Structural Engineer for any penetrations through existing structures. Pay all associated costs for structural engineering advice.

Penetration size: Provide penetrations of diameter 10 mm greater than the pipe or sleeve diameter for pipes and sleeves penetrating existing external walls, ground slab, or ground floor beams.

Sealing: Seal penetrations around conduits and sleeves with a weak sand/cement mix, or similar sealing compound. Seal the space between cables within sleeves with a pliable waterproof compound or intumescent fire rating material as required.

Fire Stopping Penetrations

Where services penetrate fire walls, floors or other fire rated barrier, sealant for those penetrations shall be sealed to the approval of the relevant Authorities.

Tenderers shall note the specific requirements to fire stop all cable penetrations through each floor and fire rated wall.

Submit details of proposed fire resistant sealants for approval prior to installations.

Fire Proofing: Fire proof each penetration through fire proof building members, irrespective of size, upon completion of installation of cables. Ensure fireproofing complies with all Building Code, Local Authority and Supply Authority requirements, utilising fire barrier pillows and mastic.

Sleeves

Fit a UPVC sleeve for each penetration through floor slabs, ground floor beams and external walls for cables not enclosed in conduit. In addition, for MIMS cables fit a sleeve for each masonry penetration.

Final location shall be accurately determined and installed to the approval of the Structural Engineer during construction. Provide shop drawings indicating location and size of all service penetrations for approval by the Structural Engineer.

Major External Penetrations (greater than 250mm)

Install weatherproof overflashings to upstand and complete with appropriate silicone sealant to prevent water ingress through penetration. Provide trimmer beams or other reinforcement necessary to support equipment, conduits and cabling passing through the penetration.

The over flashing shall be of the same material as the conduit passing through the roof and shall be securely fixed to it.

On completion the contractor shall test all penetrations for leaks to the satisfaction of the Architect.

Minor External Penetrations (Less than 250mm)

Utilise "Dektite" or "Roofite" seal or equal approved and silicon sealant. Utilise a single seal for each conduit where not concealed under flashings. Utilise a multiple seal where seal is protected under sheetmetal flashing, not exceeding three (3) services through the Seal. Appropriately size all seals, silicone around the top of each seal and install clamps.

Exposed Penetrations

In addition to the above, flash penetrations where exposed to view with sheet metal escutcheon plates. Paint sheet metal to the architects approved colour

3.9 CONCEALED SERVICES

Conceal all services in areas other than plant or utility areas. Install services as follows:

Cavity walls, hollow block and dry walls – install services concealed within cavity.

Single leaf brickwork, concrete – surface mounted conduit or "mini-duct" and seek approval prior to installation.

Do not chase walls.

Consumers Mains/Submains protection: Provide HDPE conduit protection to all consumers mains, submains and other non-RCD protected cabling reticulating within close proximity to the surface of walls, floors, ceilings and roofs.

Cable protection: Provide non-metallic conduit protection to TPS cables installed in poured concrete members, concrete blockwork, partitions and the like. Size such conduits to accommodate the TPS cables with sheath intact.

Load Centre Protection: Provide 3mm thick steel plate behind load centres when installed within cavity walls.

Installation methods

Wall construction:	Installation and cabling facilities:
Rendered partition:	Flush wall box - Heavy duty conduit chased into wall.
Face partition:	Flush wall box - Heavy duty conduit concealed in cut or cored brick-work.
Face brick /block external cavity wall:	Flush wall box - Unless otherwise specified, cable run in cavity and tied against inner leaf of brickwork.
Stud partition:	Fixed clip - cable run in cavity. Provide shrouds as required to preserve segregation requirements.

3.10 TRENCH EXCAVATION, BACKFILLING AND COMPACTION

General: Underground submains cabling and communications access provisions shall be carried out by the Electrical Sub-contractor including the supervision of all associated trenching and backfilling and coordination with other trades for provision of common trenches where proposed or required.

Underground power conduits shall be of the heavy duty (orange) type. Underground conduits for Communications services shall be class B (white) type as approved by ACMA and NBN Co. All conduits shall be complete with suitable expansion couplers and suitable care shall be taken where conduits enter buildings to allow for earth/building movements.

Conduits shall be installed with suitable falls to allow for drainage and installed to the following minimum depths:-

- | | |
|----------------------------|------------------|
| - Electrical Conduits (LV) | - 600 mm minimum |
| - Communications Conduits | - 600 mm minimum |

Conduit segregation distances shall exceed the requirements of ACMA and NBN Co Regulations.

After installation of cables all conduits shall be sealed to prevent ingress of dirt and moisture. Spare conduits shall be capped for future use.

Marker strips & location markers: Proprietary marker strips and location markers shall be installed above all runs of new underground cabling and conduits.

Marker Strips shall be polymeric batts and shall:

- Be formed from polythene sheet, not less than 200mm wide.
- Have black block letters 150mm high on an orange background printed "DANGER - ELECTRICAL CABLE" or "DANGER - COMMUNICATIONS" indicating the service buried beneath.
- Be of proprietary manufacture and incorporate an insulated tracer wire within.

- Be laid continuously 230mm below the surface of the ground and above each conduit.
- Be laid continuously at 50% of depth of cover for each electrical conduit and at least 150mm above each communications conduit.

Location markers shall:

- Consist of 200mm square or round flush aluminium warning plate complete with direction arrows and service designation set into concrete.
- Be of proprietary manufacture.
- Be located every 30m in straight runs and at junctions or changes of direction for all underground conduits.
- Be located wherever services enter a building.

Trenching, Backfilling and Reinstatement: Include the supervision of all trenching, backfilling and reinstatement. Mark out for approval all proposed routes before commencement of any excavation. Obtain Council approval for all trenching outside the extent of the site and pay all associated fees.

Maintain a digital photographic record of all trenching. Include records within the Installation Manuals.

Make due consideration for prevailing weather conditions and allow for de-watering of trenches as required.

Locations and the extent of existing and new underground or underconcrete routes as shown on the drawings accompanying the specification are indicative only. Obtain from all relevant authorities and the Superintendent all known details of underground services in the vicinity of proposed trenches.

Trace and mark and allow for all costs for relevant authorities to trace and mark the locations of existing underground services where in the vicinity of proposed trenching as follows:

- Power - trace cables electronically using detector or tracer and mark.
- Telecommunications and audio-visual - as above.
- Water - as above (metallic pipes).
- Sewer - provide internal metallic tracer for detection.
- Stormwater - provide internal metallic tracer for detection.
- Gas - as for power above.

Allow within the tender submission to hand dig new trenches within the vicinity of existing underground services and modify conduit installation as required and as directed on site.

Where solid rock is encountered, obtain approval for conduit invert levels and sand/slab as required in accordance with AS 3000 without variation to the work. Shale rock shall be removed without variation to the work.

Select trenching routes so as to avoid tree roots. Where tree roots are encountered, allow to remove as part of the work. For larger root systems install conduits beneath. Avoid trenching near large tree specimens.

Bear total responsibility and cost for the repair of underground services damaged in all cases without variation to the work.

Provide barriers to all trenching routes left open and temporary night lighting where this is deemed a requirement by the Superintendent and in all cases where trenching is left open after hours. The barriers shall not be removed until completion of all work.

Trenches must be kept clear of water at all times and timbered where necessary to prevent collapse. They shall be excavated only sufficiently in advance of laying to allow that work to proceed without delay.

Where necessary and/or required by the Authorities for safe and efficient completion of the work, supply, erect shoring, timbering, planking, etc. of sufficient strength and quality to prevent earth and other materials entering the excavations, tunnels, etc.

Work shall be carried out in accordance with SafeWork SA requirements.

Remove all shoring and timbering in an approved manner on completion of the work and after the inspections have taken place.

Ensure trenches are excavated to a depth 150mm lower than that required for final installation and provide a bed of clean, washed sand. Install new services within trenches and arrange for inspection before backfill.

Excess excavation below the required level shall be backfilled at the Contractor's expense with sand, gravel or other material as directed by the Superintendent, and thoroughly compacted. Any soft or yielding material shall be removed and replaced with sound material and compacted to the satisfaction of the Superintendent.

Ensure trenches are backfilled using quarry sand under pavements and excavated material in landscaped areas after removal of all sharp stones and vegetation. Place the backfill in maximum of 150mm layers and consolidate to 95% modified maximum dry density in paved areas and 85% modified maximum dry density in landscaped areas. Bear responsibility for future subsidence.

After completion of backfilling remove excess material from the site immediately. All cartage costs and tipping fees shall be paid by the Contractor.

Reinstate all surfaces to match existing. Saw-cut and remove 100mm to either side of trenches through bitumen. Provide fine crushed rock pavement material to match existing depth and compact to 95% of the modified maximum dry density. Provide a minimum of 30mm of 10mm Hotmix Surface Course. Ensure no high or low areas are produced.

Reinstate concrete surfaces to match existing using concrete of strength 20 Mpa or greater. Provide reinforcement to match existing where applicable and dowel into existing. Match existing concrete finishes in all respects.

Reinstate unit-paved or other paved surfaces to match existing after preparing the surface as above, with the addition of 50mm sand bed. Replace any damaged pavers with a type to match that damaged.

Reinstate existing lawn and garden surfaces to match those prior to trenching in terms of planning, compaction and levels.

Replace damaged plant specimens with approved plant types.

Reseed all damaged grassed areas.

3.11 PAINTING

All concealed pipe work and metal surfaces, excepting galvanised surfaces, shall be supplied with one coat of red zinc chromate primer applied. The paint shall be undiluted and in accordance with the appropriate SAA Code. All surfaces to be painted shall be thoroughly dry, cleaned down, free from weld splatter, burrs, dust, rust, cement and grease and the like.

Include painting of all equipment supplied including the applicable supports and fixings.

Do not paint surfaces pre-prepared by the respective manufacturer or equipment not recommended by the manufacturer to be painted.

Paint system: Unless otherwise specified paint all equipment as follows:

- Indoor locations: A system not inferior to full gloss - solvent borne.
- Outdoor locations: A system not inferior to full gloss - solvent borne.

Provide protection to all painted surfaces and make good any damage prior to practical completion. If damage is extensive totally repaint damaged equipment surfaces.

All switchboards, control panels and the like shall be cleaned down and polished with automotive polish prior to practical completion.

Paint colours are to be approved by the Consulting Engineer in each case.

Exposed conduits, wiring ducts, cable trays, brackets, frames, covers, etc. shall be painted with at least two coats of best quality oil paint of a colour nominated by the consulting engineer.

Galvanised surfaces shall be etch primed before painting.

Metal surfaces shall be painted, where scheduled, with one prep coat and two finishing gloss coats to selected colours. Carry out any other treatment (e.g. etch priming for galvanised surfaces, degreasing) to ensure a satisfactory result.

Damaged or unsatisfactory painting shall be made good.

3.12 IDENTIFICATION

Switchboards: Number all circuit breakers within each switchboard and on the appropriate escutcheon; Number every hole on earth and neutral bars; Note these numbers on the switchboard circuit schedule. Label main switches. Identify all circuits with exit and emergency lighting.

All lift supplies to have an engraved Traffolyte label adjacent isolator reading "LIFT SUPPLY - DO NOT SWITCH OFF".

Outlets: Where applicable, identify all isolators, outlets, lighting control switches and power outlets with 2 IPA studs indicating the number and phase of the circuit and distribution

board to which it is connected. Locate IPA studs in accordance with the manufacturer's recommendation. For socket outlets with ID windows use the ID tags in lieu of IPA studs.

Provide engraved Traffolyte labelling for all isolators, outlets, lighting switches and equipment indicating:-

- Distribution board supply
- Circuit reference

Use engraved and filled stainless steel labels for external areas. Brother labelling (or the like) will not be accepted.

Indicators: Where the circuit number has two numerals, provide an indicator with two numerals on the stud.

Additional marking: Provide marking as follows in addition to that required by AS 3000:

- Each Switchboard component.
- Each circuit breaker on the switchboard escutcheon, and with escutcheon removed.
- Complete circuit schedule (machine printed) at each switchboard
- Each fuse - fuse rating - visible without deadening circuit.
- Circuit number and switchboard on each light switch, power outlet and isolating switch.
- Each Main Switch

Label types: Unless otherwise specified, provide the following label types:

- For interior use: Engraved two-colour laminated plastic.
- For exterior use: Engraved and filled stainless steel.
- For interior general purpose outlets and switches: Push-in I.P.A. type studs.

Label edges: Round or bevel the edges of labels exceeding 1.5 mm thickness.

Colours:

- | | |
|--|------------------------------------|
| - Warning notices: | White letters on a red background. |
| - Essential & fire equipment circuits: | Red letters on a white background. |
| - Other labels: | Black letters on white background |

Fixing: Fix each label by not less than two chrome plated screws. Where adjacent to terminations, locate the label so that the installed wiring does not mask the label.

Generally not less than the following:

- | | |
|---------------------|-------|
| Isolating switches: | 10 mm |
| Other equipment: | 4 mm |
| Warning notices: | 4 mm |
| Inside enclosures: | 3 mm |

3.13 IDENTIFICATION OF MAIN SWITCHBOARD

The electrical contractor shall provide signage in compliance with the AS/NZS 3000: 'Wiring Rules'.

- The main switchboard shall be legibly and permanently marked 'MAIN SWITCHBOARD'.
- The location of the main switchboard shall be legibly and permanently indicated by a conspicuous notice at each entry to the building that may be used by emergency services personnel.
- Notices indicating the location of the main switchboard shall be of permanent construction and shall incorporate 'MAIN SWITCHBOARD' in contrasting colours.
- The location of the main switchboard need not be marked where the location can be readily determined, e.g. where it is clearly visible from the main entry to the electrical installation.

The electrical contractor shall liaise with the builder to confirm final locations.

3.14 ELECTRICAL INTERFERENCE

Design and use electrical equipment which will not cause interference with electronic and electrical equipment in the vicinity. In the event that the inherent characteristics of equipment make interference possible, fit effective suppressors to eliminate the interference.

Maintain radio and television interference level within the limits set out in Australian/New Zealand Standard 1044 – Limits and methods of measurement of radio disturbance characteristics of electrical motor-operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus.

Maintain electrical disturbances within the limits set out in Australian Standard 2279 – Disturbances in mains supply networks. Comply with Australian Standard 4252 – Electromagnetic compatibility – Generic immunity standard.

3.15 DISSIMILAR METALS

Where clips, brackets, and pipe supports are of dissimilar metal to the actual piping used, completely insulate the piping at all fixing points with at least four layers of 50mm wide black polyethylene tape wrapped around the pipe prior to fixing in position.

3.15.1 CONCRETE PLINTHS

Construction

General: Provide plinths under all equipment located on concrete floor slabs as follows:

For all floor mounted equipment. Hot dipped or galvanised.

Concrete: Grade N25

Finish: Steel float flush with the surround.

Reinforcement: Single layer of F72 fabric.

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.

3.16 METALLIC SUPPORT SYSTEMS AND FIXINGS

Fabrication: Provide brackets, racks, hangers and other supports sized to adequately support the installed system and equipment, fabricated from structural steel sections or from other materials in sections of equivalent strength.

Minimum thickness of structural steel sections:

- Angles and bars: 6.5mm.
- Rods: 10mm diameter.

Fixing to building structure: Fix the supports by surface fixing to ceilings and walls, or suspension hangers from ceilings, or angle brackets or racks from walls, using the following methods, as appropriate:

- Masonry or concrete walls: Embedded Fixings
- Concrete slab ceilings: Embedded Fixings
- Structural steel: Bolts and nuts through clearance holes

Spacing: Space the supports at intervals of not more than 1 m and provide a support at each joint in the tray or ladder system.

Fixing of tray or ladder: Bolt the tray or ladder to the brackets, racks and other supports.

Galvanising: To AS 1650. Galvanise steel conduits and support systems exposed to the weather or installed in damp locations. Conduits and support systems where exposed to view shall be painted.

3.17 EARTHQUAKE FIXINGS AND SUPPORTS

All plant, equipment and conduits shall comply with the requirements of Australian Standard 1170.4 - SAA Loading Code – Earthquake, AS2670 – Vibration, AS2625 Mechanical Vibration, ISO1940:2003 – Mechanical Vibration.

Where greater incorporate the Design, Selection and Installation with requirements of ASHRAE Handbook 2011, Applications Chapter 48.

For further information regarding earthquake restraining, refer to following:-

- Gripple Seismic Installation Manual
- Tyco flow control, 2002, unistrut seismic bracing systems
- Fema e-74, January 2011, reducing the risks of non-structural earthquake damage - a practical guide.
- S.M.A.C.N.A seismic restraint manual, guidelines for mechanical systems, 1998, S.M.A.C.N.A, sheet metal and air conditioning contractors' national association.

Provide restraints and supports designed and certified by a structural engineer, to all plant, equipment, conduits and cable trays in accordance with Australian Standard 1170.4-2007 Section 8, incorporating the following:-

Criteria	Unit	Factor
Importance Level	I	2
Annual Probability of Exceedance	yr	500
Soil Classification		De
Hazard Factor	Z	0.1
Probability Factor	Kp	1
Structural Classification	EDC	2

All restraints and supports shall be issued to the structural engineer to review the adequacy of the structure to support the services loads, including seismic forces.

The following do not require seismic bracing:

- All electrical conduit less than 64mm internal diameter

Transverse bracing for cable trays to be at 6.00m maximum centres and at section ends.

Longitudinal bracing for cable trays to be at 12.00m maximum centres and at section ends.

Transverse bracing on adjacent runs may be considered the longitudinal bracing for the adjacent section.

Spacing of the bracing may need to be reduced for example:

- Brace both sides of conduit or cable trays at flexible connections
- Brace to avoid collision between conduit or cable trays and other non-structural components
- Brace within 600mm of changes in direction, whether it be horizontal or vertical changes
- Brace where components penetrate floors or ceilings
- Brace in both directions at the top of all risers where risers exceed 900mm

The spacing of bracing along a run of conduit or cable tray should not vary greatly in order to ensure uniform deflection and loading.

Each unit of equipment connected to a run of conduit or cable tray shall be individually and independently braced. Thermal expansion and contraction forces, where present, must be considered in the layout of transverse and longitudinal braces. Flexibility should be provided where conduits pass through seismic or expansion joints or connect to equipment with vibration isolators.

Services braced in accordance with AS 1170.1-2007 section 8 shall have a minimum of 50mm clearance from all ceiling hangers and the ceiling grid.

Do not core through, cut through or otherwise damage steel reinforcement in concrete slabs, beams or columns when installing seismic bracing.

3.18 EARTHING SYSTEMS

Earthing system: The following earthing system is to be provided for the supply in accordance with AS 3000.

- Type: MEN system (Existing)
- Maximum earth resistance: In accordance with AS 3000.
- Electrodes: Copper Clad Stainless Steel - 2.4m length.
- Pits: Proprietary earthing pit (300 mm x 300 mm).

Earth all metallic structure and equipment where this relates to the Electrical Services or Telecommunications installation.

The location of the earth stake shall be identified at the Main Switchboard.

Connections: For the connection of the main earthing conductor and interconnecting bonding use clamps to AS 1882.

Additional earthing and bonding: Provide additional bonding between the earthing system and all piped services within each building, at the closest practical point to where the piped services enter the building. Include all piped services, including Hot Water, Cold Water and the like, where applicable.

Earth all cable supports including by not limited to cable trays, ladders and catenaries.

Telecommunications Earthing: Provide a protective earthing system for the Communications cabling systems in accordance with ACMA regulations. Provide a dedicated 16 mm² earth cable to each CTL location and NBNCo. The earth cable shall be an uninterrupted link from the nearest Distribution Board.

Do not allow the earthing conductor of any rack equipment frame or any earth connection between the communications raised floor and equipment earth. Insulate support equipment brackets to suit.

Showers and Bathrooms: Provide additional bonding to conductive reinforcement within a concrete floors and/or walls forming part of a shower or bathroom construction. The equipotential bonding conductor shall have a cross sectional area not less than 4mm² and shall be bonded to the nearest adjacent earthing system of the electrical installation.

Provide additional earth stakes where required by the Supply Authority or to achieve the earth resistance stated in AS 3000.

Submains: Provide an earth wire with each group of submains sized to meet the minimum requirements outlined in AS/NZS 3000.

Final subcircuits: Provide a separate earth wire to each final subcircuit. Within each respective switchboard connect each earth wire to an earth bar. Ensure that earth bar numbers correspond with circuit breaker and neutral bar numbers.

3.19 WIRING TO AND CONNECTION OF EQUIPMENT

Equipment status: Unless indicated equipment will be supplied internally wired.

Connection: Wire to the equipment through an isolating switch mounted adjacent, unless a plug top is provided.

Three-phase wiring: Provide a neutral cable equal in size to active conductors with all three phase wiring unless nominated otherwise.

Final connection: Provide all final connections unless advised otherwise.

Within 600mm of wall: Enclose the final connection in flexible PVC conduit, with approved type flexible conduit terminators.

More than 600mm from wall: Wire through conduit cast into or secured to slab. Final connection using flexible PVC conduit with approved terminators.

Flexible conduit type: Use galvanised steel flexible conduit for equipment requiring heavy duty protection or within plant rooms.

4 TESTING AND COMMISSIONING

4.1 TESTING

General: All testing and commissioning shall be undertaken in accordance with regulatory requirements, manufacturers requirements, and the requirements listed below.

Notice: Give sufficient notice so that all Testing may be witnessed by the Building Services Consulting Engineer.

Inspection / Testing Schedule: Provide a comprehensive Inspection and Testing Schedule a minimum of 10 working weeks prior to first inspection/test.

Minimum notice required: Provide 10 working days notice for exact time and date of each test/inspection.

Testing certificates: Provide test certificates and Certificates of Compliance for approval. Include copies within Installation Manuals.

Approval for energising: Obtain approval before energising newly installed or reconnected wiring or equipment.

Faulty installation: During testing, replace fuses and all equipment damaged as a result of incorrect installation work.

Testing and Tagging: Undertake all testing in accordance with AS/NZS 3760 for all electrical equipment and accessories installed under this contract. Provide tags on the flex cable (if fixed) or on the chassis (if flex cable is removable).

Provide a schedule of equipment that has been tested and tagged under this contract in the Installation Manuals, and confirm whether or not the appliance has passed or failed, date of test, and schedule for next test.

4.2 COMMISSIONING

Notice: Give sufficient notice that commissioning of the electrical services is to commence.

Minimum notice required: 5 working days

Phase sequence: Test phase sequence prior to commencement of works and ensure the correct phase sequence is maintained throughout the installation.

Balancing of load: Balance the load as evenly as practicable at Practical Completion. Recheck and, where necessary, rebalance the load at completion of the Defects Liability Period. Arrange all circuits so that balance is obtained at maximum demand as well as normal operating conditions, in accordance with AS/NZS 3000.

Site commissioning: Include the following:

Reticulation, Switchboards and Accessories:-

- Test and provide Certificates of Compliance for the installation in accordance with the requirements of the Electricity Act.
- Insulation resistance measurements.

- Provide full functional and operational checks on energised control equipment and circuits, including adjustments for the correct operation of safety devices.
- Provide full functional and operational checks for all SSOs and RCDs. Log all RCD test results.
- Labelling of all switches and outlets.
- Earth resistance measurement: To AS 3000.
- Earthing: Confirmation of effective earthing of the exposed metal of electrical equipment.

Multi-Function:-

- Check and verify operation, calibration and correct output of all meters. Provide calibration certificate and test results.

Circuit protection:-

- Confirm that circuit protective devices are sized altered and adjusted, wherever necessary, to protect the installed circuits.

Luminaires:-

- Clean luminaire reflectors, mirrors and diffusers. Replace faulty components including lamps. Check for correct switching and demonstrate.

Exit and Emergency Evacuation Lighting:-

- Discharge test in accordance with AS 2293 and the Building Code of Australia.

MATV:-

- Test the operation of each outlet as specified under the MATV Section of this specification.

Communications Cabling:-

- Provide TCA 1 form compliance for communication system.
- Refer Communications Cabling Section of this specification.

Movement Detection:-

- Test and commission each lighting movement sensor in accordance with the manufacturers requirements to ensure a fully operational system.
- Undertake a walkthrough of each control zone to ensure functionality is as specified.
- Engage the services of the manufacturer as required.

NBN Corporation Cable Pathways:-

- Refer to NBN Corporation technical guidelines and the NBN Corporation section of this specification.

Combined Fire / Access Control System:-

- Test and demonstrate the operation of each door lock, reed switch and card reader.
- Test and demonstrate the operation of each smoke detector, thermal detector and siren.

- Test and demonstrate the interface operation of car park roller door / motion detection with Car Park Supply Fan control panel.
- Programme time groups, schedules and key-tags in accordance with the requirements of the proprietor.

Intercom:-

- Test the operation of each station as specified under the Intercom Section of this specification.

Defects:-

- Rectify all defects upon notification. Provide written notice to the Project Manager of completion of defects. Retention monies will not be released until completion and rectification to the Proprietors approval of all defects.

5 ACCESSORIES & EQUIPMENT

5.1 LIGHT SWITCHES

Rating and Type: 240 V, 15 A. All mechanisms shall be of heavy duty type suitable for inductive loads, of manufacture 'Clipsal 30 USM' (or equal approved). Mount to accessory plates of 'Clipsal C2000' Series (or equal approved) high impact polycarbonate.

Where switches are nominated as weatherproof they shall be of "Clipsal 56" Series manufacture (or equal approved) with locking provisions. Switches shall be UV stabilised where installed in external areas.

Limit light switch and lighting circuit loadings to 75% of sub-circuit capacity maximum, irrespective of circuiting arrangements indicated. Provide interposing relays where the load of any equipment exceeds 75% of the switchgear or circuit protection manufacturer's recommendation.

Mechanism: On face plates secure the mechanism with retaining screws, so that it cannot be displaced during normal operation.

Mounting: Provide all switches and lighting control panels as flush mounting type, generally matching, in flush mounting standard pattern or proprietary wall-boxes. Mount all accessories in flush wall boxes except where mounted on duct or surface mounted to approval. Where switches are located on fire rated, inter-tenancy or acoustic walls they shall be provided with fire rated and acoustic wall boxes to maintain the integrity of the wall. Group switches together on one face plate where possible. Architrave switchplates will not be accepted unless approved. Do not install circuits from differing phases behind a single plate without provision of approved mechanical shrouds or barriers. Switches within disabled areas shall be mounted at a height to the approval of the Architect, but generally all switches are to be mounted between 900 to 1100 AFFL and no closer than 500mm to any internal corners. Leave 10mm free space between adjacent faceplates.

Colour: To architects approval

Location: Check the exact location of each water container, door swings and other services for adequate clearance in compliance with AS/NZS 3000 before locating switches and outlets.

5.2 ISOLATING SWITCHES

Minimum rating: 415V, 20A minimum, or to exceed the connected load. All isolators shall be of heavy duty type suitable for inductive loads. IP Rating shall 56 minimum, fully complying with AS 3000.

Where isolators are nominated as weatherproof they shall be of "Clipsal 56" Series (or equal approved) high impact polycarbonate with locking provisions. Clipsal "Weathershield WHB IP66" Series (or equal approved) is acceptable in general external areas except in plant rooms, roofs or for specialist requirements.

Enclose the isolating switches to suit their operating environment. Label each isolating switch with the item of plant served with Traffolyte labelling.

Carry out all final connections to all equipment fitted with isolating switches.

Mechanisms: Isolating switches are to be provided with a rotating toggle with external locking facilities both in the 'on' and 'off' position.

The mechanism is to be rated in excess of the connected equipment.

Provide upstands and associated flashings as required for isolators. Do not mount isolators directly to equipment.

Colour: To the Consulting Engineers approval.

Location: Check the location of the isolator in respect to the connected plant and locate as close as practicable and within 600 mm.

5.3 SWITCHED SOCKET OUTLETS (SSO)

Rating and Type: 240V, 10A rated. Mount the outlet with the earth pin at the 6 o'clock position. Mount to accessory plates of "Clipsal C2000" series (or equal approved) high impact polycarbonate.

Mounting: Where SSOs are located on fire rated, inter-tenancy or acoustic walls they shall be provided with fire rated and acoustic wall boxes to maintain the integrity of the wall. SSOs shall be typically mounted at 300 AFFL. In areas where occupants may be of limited mobility install the SSOs no closer than 500mm to any internal corner.

Auto switched socket outlets shall not be provided without prior approval from architect and consulting engineer.

Where SSOs are pendant mounted they shall be of approved type suspended by means of a multi strand plastic coated stainless steel strain cable secured to building fabric (not ceiling system). Pendant outlets shall have a ceiling rose that matches the colour of the flex cable.

Where SSO's are nominated as weatherproof they shall be of "Clipsal 56" Series (or equal approved) manufacture. Clipsal "Weathershield IP53" Series (or equal approved) is acceptable in general external areas except in plant rooms, roofs or where IP66 rating is a requirement.

Provide SSO's with LED indicators where indicated.

Provide 15 Amp or 20 Amp SSO's in locations nominated, being equal to other accessories.

Colour: To the Architects approval.

Location: Check the exact location of water containers, inspection points, shower heads, eye wash outlets, door swings and other equipment for compliance with AS 3000 before locating SSO's.

5.4 MOVEMENT SENSORS

Provide ceiling mounted movement sensors equal to "Clipsal 751 or 753", for control of nominated lighting circuits as shown on the drawings accompanying this specification.

All sensors shall have the following minimum requirements:-

- White in colour

- LED status indicators
- Ceiling/soffit surface mounted
- Low temperature/humidity resistant in external and wet areas
- Dual pole to all areas
- PIR detection
- Daylight switching to areas nominated and set to switch lighting off at 600 lux at 0.75m AFFL.
- Default setting at 10 mins (adjustable from 0 – 30 minutes)

The Contractor shall liaise with the manufacturer during installation and commissioning as required ensure the system functions as scoped.

5.5 SMOKE ALARMS

Standard: AS 3786

Provide smoke alarms to apartments as nominated . The alarms shall be mains powered from the unswitched active of the lighting circuit, and shall include the following performance characteristics:

9V DC battery backup (replaceable batter)

85dB at 3 metres alarm

Low battery indication (audible and visual)

Built-in test facility

CSIRO and ActivFire certified.

Photoelectric detection.

Flush mounted

Where multiple smoke alarms are required within individual apartments they shall be interlinked to provide a common alarm within the space.

Where smoke alarms are connected to a security / access control type system for monitoring they shall be connected such that each individual detector is a separate zone.

Selection: Alarms shall be of "Clipsal FireTek" series of equal approved.

6 CABLES & ENCLOSURE

6.1 CABLE SELECTION

Standards: Select cables in accordance with AS/NZS 3000 and AS/NZS 3008.1.

Ratings: Use AS/NZS 3008.1 for the determination of current ratings, voltage drop and cable size.

Voltage Drop: The maximum voltage drop to each final sub-circuit is not to exceed 2.5% unless specified otherwise.

Conductors: Unless otherwise specified, use multi-stranded copper conductors. Aluminium cabling will not be accepted.

Minimum Sub-Circuit size: 2.5mm² for power and lighting circuits.

Minimum Sub-Main and Consumers Mains size: As shown on the drawings accompanying this specification. In any case, they shall be sized to the maximum circuit protection device rating on the circuit, and shall not be sized any less to those shown on the drawings.

Sub-Circuit cable types: Unless otherwise specified use cabling with V-90 (PVC) insulation and PVC sheath, or R-HF-110 (Elastomer) insulation and HFS-110-TP (Elastomer) sheath for fire and life safety services.

Sub-Main/Consumers Mains cable types: Unless otherwise specified use X-90 (XLPE) insulation and PVC sheath, or R-HF-110 (Elastomer) insulation and HFS-110-TP (Elastomer) sheath for fire and life safety services.

Underground cables: Use X-90 (XLPE) insulation and PVC sheath cable in underground enclosures unless specified otherwise.

6.2 CABLE INSTALLATION

Standard: To AS 3000.

Manufacturers' recommendations: Unless otherwise specified, install, terminate and joint cables in accordance with manufacturers' recommendations.

Terminations: Terminate each circular multicore cable, and each single core TPS cable of greater cross section than 35mm², using a nonferrous gland at each end of each cable. Provide non-ferrous gland plates for all single core cables.

Handling cables: Handle cables so as to avoid damage to insulation and serving or sheathing. Report all damage and replace or repair damaged cable as directed.

Straight-through joints: Unless unavoidable due to length or difficult installation conditions, run cables for their entire route length without intermediate straight-through joints. Locate and carry out approved joints as directed. Cable joints and junctions shall not be accepted unless approved by the Engineer prior to installation.

Installation: Install and adequately support fixed wiring as specified throughout the installation. For cabling routes not specified in detail, submit a proposed route layout and gain approval prior to ordering cables or support equipment. All multi-phase circuits with

single conductors shall be installed in trefoil configuration, strictly in accordance with the requirements of AS 3008.

Should cabling require to be painted for concealment, the cabling shall be installed within a suitably sized conduit, with only the conduit painted in the desired colour. Under no circumstances shall cabling be painted.

Conductors:

Identification: For fixed wiring colour the conductor insulation as follows:-

- Active conductors in single phase circuits: RED.
- Active conductors in polyphase circuits:
 - A PHASE - RED
 - B PHASE - WHITE
 - C PHASE - BLUE
- Neutral conductors - BLACK
- Earth conductors - GREEN with YELLOW stripe
- Switched active conductors to and between fittings: WHITE
- Other conductors: To AS 3000.
- Sheathing: White for single phase and orange for 3-phase.

Tagging: Identify multicore cables and trefoil groups at each end and at crowded intermediate points by means of stamped, non-ferrous tags, clipped around each cable, or trefoil group. Tagging shall identify circuit details, equipment serviced and cable specification.

6.3 DOUBLE INSULATED WIRING

Conceal all cabling, and utilise the loop-in, loop-out system with all joints being effected at outlets only. Obtain approval for the location of any junction boxes and joint cables in an approved manner and in an accessible location.

6.4 COPPER CONDUCTOR TERMINATIONS

Requirement: Unless otherwise approved, terminate copper conductors to equipment, other than small accessory and luminaire terminals, by means of compression-type lugs of the correct size for the conductor, compressed only by the correct tool.

Within switchboards and equipment: Install all conductors within slotted ducts. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

Identification ferrules: Where core identification is required, fit to each core durable numbered ferrules permanently engraved with numbers and/or letters to suit the specified connection diagrams.

Spare cores: Terminate and identify any spare cores into spare terminals.

6.5 CONDUITS GENERALLY

Minimum sizes: Metallic and non-metallic conduits: 25mm.

Galvanised water pipe: Medium or heavy tube to AS 1074, 25mm nominal minimum bore.

Fixings: Utilise dual fixing conduit saddles. Single fixing conduit saddles are not acceptable. Maintain fire rating of all wall surfaces.

Do not use explosive-powered or similar fixing equipment unless approved.

To woodwork: Conduit matching saddles and round head plated steel wood screws.

To masonry: Galvanised saddles and round head plated steel screws screwed into approved metallic expansion devices. Wooden plugs, explosive powered fixings and adhesive fastenings are not permitted.

To steelwork: Plated steel metal-thread screws. Drill and tap the steelwork for each saddle.

Support: Unless otherwise specified, fix conduit saddles at a maximum of 1 m intervals in both horizontal and vertical runs. Ensure that installed conduits are fully supported during construction.

Lengths: Up to the commercially obtainable conduit lengths of run, install conduits without joints. Remove all rags, burrs, and sharp edges from each length before completing each conduit joint. Fit moulded plastic screwed bushes to the free ends of metallic conduit runs before installing the conductors.

Inspection fittings: Inspection fittings and the like shall be accessible.

Draw-in boxes: Provide draw-in boxes at suitable intervals not exceeding 30 m in straight runs, and at intervals not exceeding 25 m in other runs including directional changes.

Underground boxes: Fit draw-in boxes installed underground with gasketed covers and seal them against entry of moisture.

6.6 CONCEALED CONDUITS

Route of run: Provide conduits in all concealed in wall chases, embedded in floor slabs and installed in inaccessible locations, direct between points of termination with a minimum number of sets. Do not conceal conduit fittings. Install conduits so as to allow future rewiring of the cabling system.

Location: Locate conduits run in concrete slabs entirely within the structural slab. Do not run conduits in concrete toppings.

Steel conduit: Steel conduit shall be galvanised if run in concrete slabs.

Fixing: Fix conduits directly to the reinforcing where the conduits pass above a single layer of reinforcing, or fix midway between double layers of reinforcing. Route the conduits in slabs so as to avoid crossovers and to keep the number of conduits in any one location to a minimum. Space conduits 75 mm apart in slabs.

Attendance at pours: Ensure that conduits are not displaced, broken, or damaged during concrete pours.

6.7 NON-METALLIC CONDUITS AND FITTINGS

Type: Unless otherwise specified, use heavy duty conduits. Associated fittings shall be of the same material as specified for the conduit.

Joints: Use cemented joints. Adopt the manufacturer's recommended procedure for making joints.

Fittings: Use inspection-type fittings in accessible and exposed locations.

Conduit setting: At site, apply heat to form sets in UPVC conduit. Bends shall be of large radii and, after setting, shall maintain effective diameter and shape. Conduit sets distorted by kinks, wrinkles, flats or heating will be rejected.

Expansion joints: Install flexible couplings where structural expansion joints occur in buildings and in straight runs not embedded in wall chases or floor slabs. Install conduit saddles close to the flexible coupling in a manner which allows free movement for expansion and contraction.

Mechanical damage: In situations where the conduit is exposed to mechanical damage and external to buildings, provide mechanical protection to UPVC conduit for a height of not less than 3 m above ground or platform level.

6.8 FLEXIBLE CONDUIT

Type: Use PVC flexible heavy-duty conduit with protective outer sheath with associated fittings unless otherwise specified.

Use: In addition to its use on expansion joints, fit flexible conduit to equipment and plant subjected to vibration or where necessary for adjustment or ease of maintenance.

Length: The maximum length of a flexible conduit connection shall be 600 mm. Obtain approval for lengths greater than 600mm.

6.9 CABLE TRAYS AND LADDERS

Support system: Bends, connectors, trays, ladders, brackets, and other supports necessary to make a complete cable or conduit support system shall be of the same manufacture, sized to adequately support the installed cabling.

General: All cables greater than 50mm² cross sectional conductor area, shall be supported via cable tray. All cable runs that require greater than 2 catenaries in a single run shall be supported via cable tray.

Steel trays: Perforated pre-galvanised.

Minimum steel thickness:

- Trays up to 150mm wide: 1.0mm
- Trays from 150mm to 300mm wide: 1.2mm

- Trays over 300mm wide: 1.6mm

Folded edge: Minimum height 20 mm, radiused.

Slotting: Normal or reverse with no burrs or sharp edges on the side to which cables are attached.

Construction: Manufacture cable ladder trays and cable ladder from two folded steel or extruded structural grade aluminium side rails with cable support rungs between the two rails spaced at intervals of not more than 300mm (ladder) and 100mm (ladder trays).

Small cable: Do not run cables smaller than 13mm outside diameter on the cable ladder unless continuously supported.

Cable fixing: Slots or ladder rails shall be suitable for fixing cable ties, strapping or saddles. Communications cabling shall be fixed with Velcro cable ties.

Bend radius: Bends shall have a minimum inside radius of not less than twelve times the outside diameter of the largest diameter cable carried. Bends shall be manufactured by the supplier. The contractor shall not modify trays or ladders to provide bends.

Spare capacity: Provide sufficient space on the tray or ladder for not less than 20% more cables or conduits than specified, irrespective of sizes indicated on the drawings. The sizes and quantities nominated on the drawings are indicative, and are to be confirmed by the Electrical Contractor based on final cable quantities, sizes and locations.

Route: Cable tray routes shown on the drawings accompanying this specification are shown indicatively, and are to be confirmed by the Electrical with reference to conditions on site and the Structural Engineers drawings. In any case, cable trays shall be run parallel and perpendicular to the building structure.

Access: Position the support system to give adequate access for inspecting, replacing, or adding cable.

Support: Provide support brackets of the cantilever type (ie. one side of the bracket left open), cold galvanised after fabrication. Mount brackets to manufacturer's recommendations, with no appreciable sag between supports.

Cable strapping: Fix cable to the support system by proprietary nylon ties, straps or saddles, at 500 mm centres for vertical runs and 1000mm centres for horizontal runs. Use nylon ties for smaller cables (up to 15mm diameter single core cables, 25mm multicore cables), non-magnetic saddles or strapping for larger cables. All data cabling shall be fixed to cable trays with Velcro cable ties.

Cable protection: Provide a slightly curved support surface under cables leaving the tray or cable ladder to protect the cable sheath from impingement by the tray or ladder edge.

Clearance: Maintain at least 200 mm clearance from hot water pipes 500 mm clearance from boilers or furnaces, and 100 mm clearance (minimum) from all other services.

Segregation: Segregation from electrical, communications, security etc. cabling shall be maintained in accordance with the relevant standards. Cabling can be reticulated on the same cable trays, provided a fixed partition (barrier) is installed to the cable tray.

Earthing: Earth all cable trays, ladder trays and ladders in accordance with the requirements of AS/NZS 3000 and ACMA technical standards.

6.10 CATENARIES

Construction: Provide commercial manufactured catenaries as follows:-

Properly rated for the weight of the cabling to be installed.

Provide uniform support throughout cable length.

Be fixed at each end.

Capable of withstanding any mechanical stresses within the environment installed.

Consist of material equally resistant to corrosion and deterioration.

2.7mm minimum diameter.

1.5kN minimum break force.

Zinc coated.

Cables themselves shall not be used as catenaries.

Installation: Install catenaries as follows:-

Provide no more than 3 groups of 5 bundles cables to each catenary.

Provide hangers at 1000mm intervals.

Shall be supported off the Building structure, and not off other plant and/or equipment.

Installed so as to run parallel and/or perpendicular to building structure.

Cable fixing: Nylon cables ties shall be provided for fixing electric cabling, and Velcro cable ties shall be provided for communications cabling at 500mm intervals.

Clearance: Locate cabling 100mm from moving parts of any equipment operating at elevated temperature.

Earthing: Earth all catenaries in accordance with the requirements of AS/NZS 3000 and ACMA technical standards.

6.11 FIRE RATED CABLING AND SUPPORTS

Standard: To AS 3000 and AS/NZS 3013.

General: Provide supports for fire rated cabling as follows:-

Comply with the requirements outlined in AS/NZS 3000 Appendix A and Appendix H.

Shall be certified and tested in accordance with AS/NZS 3013.

Cables shall be installed in accordance with the requirements outlined in AS/NZS 3013 in order to ensure a fully certified cable support system is provided.

Cables shall be fixed at maximum 1200mm centres using certified steel clips. Nylon cable ties will not be accepted.

Arrange in single layer or trefoil groups for side entry or exit. Protect cables from damage at entries.

Avoid unnecessary cable crossovers and maintain minimum 30% spare support width.

7 SWITCHGEAR & CONTROLGEAR ASSEMBLIES (SCA)

7.1 SCOPE

Outline description: The work covered by this section of the specification includes the following:

Provision of new main switch board, distribution boards, load centres and auxiliary panels throughout the installation including enclosures and internal switching and control equipment.

7.2 DESIGN CRITERIA

Design SCA to comply with the following minimum criteria:-

Main Switch Board No(s)

Designation(s)	–	MDB
Maximum Dimensions	–	1600mm Wide x 400 mm Deep x 1200 mm High
Rating	–	200 Amps, 3 phase, 415 Volts
Degree of Protection	–	IP56 Non-combustible material with smoke sealed openings in accordance with BCA requirements (BCA-D2)
Installation	–	Outdoor, Free-standing
Fault Rating	–	19 kA for 1 second
Form Factor	–	Form 2
Chassis Size	–	As shown
Connection	–	Front connected
Incoming Cable Entry	–	Below via gland plate
Incoming Cable Reticulation	–	Overhead
Outgoing Cable Exit	–	Above via gland plates
Outgoing Cable Reticulation	–	Overhead via cable tray.
Plinth	–	Painted galvanised 75mm steel channel
Accessories	–	Exit/Emergency Lighting push-button test facility
Paint Colour	–	To approval of Architect
Rating/ Nameplates	–	To front door of Main Switchboard(s)
Doors	–	Required, ensure 600mm clearance around door swing in accordance with AS3000 requirements, provide barn door arrangement as required.

Typical Apartment Load Centre(s)

Designation(s)	– LC.XX
Maximum Dimensions	– to suit available accommodation
Make	– Clipsal '4FC' series or equal approved.
Rating	– To match upstream circuit breaker unit rating and/or isolator (whichever the greater)
Degree of Protection	– IP33 internally
Installation	– Recessed with flushing frame. Provide 3mm thick steel plate behind enclosure.
Fault Rating	– 6 kA RMS Symmetrical (conditional)
Form of Segregation	– Form 1
Connection	– Front connected
Chassis Size	– Sized to accommodate all circuits shown plus 30% spare space
Cable Entry / Exit	– Above and below
Cable Reticulation	– Cabling shall be reticulated within wall cavity with suitable mechanical protection. Constructed to AS/NZS 3013 WS Classification – WS-10
Colour	– White
Doors	– Required

7.3 EXTERNAL DESIGN

REQUIREMENT: Provide an enclosure comprising panels, doors and the like, giving the specified enclosure, segregation and degree of protection as specified.

- Design and Construction: To AS/NZS 3439.
- Degree of Protection: To AS/NZS 1939 & AS/NZS 60529

Supporting Structure: Fabricate supporting frames from rolled, cold formed or extruded metal sections, with joints fully welded and ground smooth. Provide concealed fixing or brackets located to allow the assembly to be mounted and fixed in the specified location without removal of equipment.

Panels: Machine fold sheet metal angles, corners and edges with a minimum return of 25mm around the edges of front and rear panels, and 13mm minimum return edge around doors. Provide stiffening to panels and doors where necessary to prevent distortion or drumming.

Equipment Fixing: Provide equipment mounting panels fixed to threaded metal inserts located inside the enclosure at the rear of the mounting panels.

Lifting Provisions: Provide fixings in the supporting structure, and removable attachments, for lifting switchboard assemblies where floor-mounted. Provide switchboards in sections as required to enable installation in their final location.

Floor-Mounting: Provide a galvanised steel plinth channel, not less than 75mm high, for mounting the complete switchboard assembly on site. Drill sufficient clearance holes for 12mm diameter bolts, in the switchboard and the plinth, to rigidly fix the switchboard assembly to the plinth and the plinth to the floor.

Wall-Mounting: For flush or semi-flush switchboards: Provide a facing flange, of the same material and finish as the enclosure, and of a section which incorporates a return allowing the outside edge to fit neatly against the wall. For switchboards located on external walls, provide angled top to prevent water from pooling.

Minimum flange width: 32mm

Cable Entries

Provide sufficient clear space within each enclosure, adjacent to the cable entries, to allow the incoming cables and wiring to be neatly run and terminated, without overcrowding.

For cable entry and internal distribution, provide cable entries of not less than 100mm depth by the full width of cubicle space which is unrestricted by equipment or internal wiring.

Provide to each entry a removable gland plate fitted with a gasket to maintain the specified degree of protection.

Cable bushes for all entering and exiting cables (bunches of cables) to provide a close fit around cabling in accordance with the requirements of AS/NZS 3000. Seal cable entries to provide a close fit in all instances and to maintain the switchboard protection rating.

Doors

Maximum Width: To suit accommodation or as specified

Maintain 600mm clearance around distribution boards with equipment racked out and doors open. Provide barn door arrangement and/or bi-folding doors to enclosures as required to achieve this requirement. Alternative door construction shall not compromise the fit and finish or degree of protection of the switchboard.

Minimum Door Swing: Through 135° minimum or 180° where located in corridors.

Hang doors on heavy-duty chromium-plated block hinges which allow easy removal of the door when in the open position.

Ensure all doors operate smoothly and without sticking or creaking and close/latch with nominal clearances.

Provide a chromium plated lever-type handle to each door, operating a latching system with latching bar and guides. Key to 604 code.

Provide roller rods to all boards incorporating a 3-point locking system.

Number of keys required: 3 with engraved identification labels

Smoke Seals: Provide a resilient strip seal, of foamed neoprene or the like, around each door, housed in a suitable channel or housing and fixed with an approved industrial adhesive.

Seal contact: Positive contact with a flat surface of the enclosure at least as wide as the seal strip.

Provide door stiffeners to each door with diagonal length greater than 900mm.

Escutcheon Plates

Requirement: Provide hinged removable escutcheon plates with the front of the circuit breakers protruding through neat cutouts. Provide cutouts for all spare space allowances. Fit insulated clip-in infill panels to each spare pole space. This escutcheon plate shall provide a flush surface between the edges of the distribution board case. Fit chromium plated lifting handles to each escutcheon plate.

Rigidity: The escutcheon panel shall be not less than 1.6mm thick and must be rigid. Stiffen or brace the panel as necessary to achieve this rigidity.

Frame: Provide a continuous 12 mm wide support frame for the fixing of each escutcheon plate, including additional support where necessary to prevent panel distortion.

Fixing: Fix each plate to the frame with metal fixings held captive in the plate and spaced uniformly.

Maximum Height: To suit accommodation or as specified.

Hanging: Hang escutcheon plates on hinges which allow opening through a minimum of 120° and permit the removal of the escutcheon when in the open position.

Cable Duct

Requirement: Provide internal cable ducting sufficient to house cables for maximum board capacity without restricting closure to duct cover.

Minimum size: Cable duct to be a minimum of 70mm wide for all boards and minimum of 100mm for boards with a total capacity greater than 60 poles.

7.4 BUSBARS

Requirement: Provide a three (3) phase busbar assembly with high conductivity electro tinned copper busbars designed for a maximum current density of 1.5 A/sq.mm from the termination of the incoming unit to the line side of the protective equipment for outgoing circuits.

Provide each distribution switchboard segment with a busbar assembly suitable for a minimum 100A take-off at any point.

Future Extensions: Pre-drill the main busbar assembly for future extension and extend busbar droppers to spare locations. Drill each dropper to suit connection of future equipment of the same type as that specified.

Cross Section: Radius edges and corners to prevent damage to insulation.

Support: Provide support sufficient to withstand without damage the maximum prospective fault currents. Do not support busbars from circuit breaker terminals.

Jointing: Make busbar joints with high tensile bolts and nuts, locked in position with lock nuts or locking tabs. Tighten bolts to the manufacturer's recommendation with a tension wrench. Do not use tapped holes and studs or the like for jointing current-carrying sections.

Insulation: Insulate busbars as follows:

Active and neutral busbars: Fully insulate the busbars with suitable plastic insulation of appropriate colours to designate phases. Busbar assemblies shall be red, white, blue phases from left to right when viewed from the front of the switchboard. Maintain phase colours (and rotation) throughout the installation.

Joints: Insulate either by taping or plastic coating, as follows:

Taped joints: Apply a non-adhesive stop-off type tape, coloured to match the specified colour coding, half lapped to achieve a thickness of not less than that of the solid insulation.

Plastic-coated joints: Apply, in accordance with the manufacturer's recommendations, and to a minimum thickness equal to that of the solid insulation, an air-drying plastic coating material which achieves a tensile strength in excess of 17MPa, and a minimum elongation of 300%.

Colour Coding: Colour the insulation as follows:

Active busbars: Red, white or blue.

Neutral busbars: Black where applicable.

Earth busbar: Green and yellow where applicable.

Neutral Busbar: Extend the neutral busbar into each switchboard compartment containing outgoing circuits with neutral connections. Provide terminals or drill the busbar for neutral connections.

Identification: Clearly mark and number terminal connections.

7.5 NEUTRAL AND EARTH LINKS

Location: Locate neutral and earth links within 600mm of each cable entry unless written approval of greater spacing is obtained.

Connections: Provide stud connections for cables of cross section 16mm² or larger.

Identification: Clearly mark and number terminals. Numbers on circuit breakers, neutral link and earth link for each circuit shall correspond.

Terminals: Provide a separate dual screw neutral terminal and earth terminal for each circuit breaker pole or fuse on each switchboard section. Provide additional terminals for future circuits.

Clearances: Provide 100mm (minimum) wiring channel between neutral and earth links and switchboard sheetmetal enclosure. Provide adequate clearance or insulating barrier between links and all live conductors.

7.6 FINISHES

Surface Preparation: Where metal surfaces are to be painted, prepare them appropriately to avoid corrosion, and to withstand the relevant environmental conditions.

Paint Systems: For indoor locations use system not inferior to FULL GLOSS, SOLVENT-BORNE: INTERIOR - PAINTING. Colours are to be provided to AS 2700, to the approval of the Architect.

PAINT COLOURS: To AS 2700, to be approved.

7.7 SWITCHGEAR

Requirement: Provide mains switching, outgoing circuit switching, motor and equipment controls and starters, protection, setting and auxiliary equipment as shown on the Drawings.

7.7.1 MOULDED CASE CIRCUIT BREAKERS (MCCBS)

General

Moulded Case Circuit Breakers shall comply with AS3947-2 and IEC947-2. The breaking capacity performance certificates shall be available for category B to the above mentioned standard where applicable. The test shall be carried out under the breaking performance during operation (Ics) and under the admissible short time withstand.

The ultimate breaking capacity of the circuit breakers shall be at least equal to the prospective fault level at the point of the distribution system where the breakers are installed, unless the limitation capacity of an upstream breaker allows cascading.

The rated service breaking capacity (Ics) shall be a minimum of 50% of the ultimate breaking capacity (Icu). The rated withstand of the breaker shall be equal to the rated service capacity.

For MCCBs up to 630Amps, the service breaking capacity (Ics) shall be 100% of the ultimate breaking capacity (Icu).

All Moulded Case Circuit Breakers shall be designed for horizontal or vertical mounting without any adverse effect on electrical performance.

It shall be possible to reverse feed the breaker without reduction performance.

Moulded Case Circuit Breakers shall be fixed, plug-in or withdrawable models and in 3 pole or 4 pole versions as nominated.

The breakers shall have a rated operational voltage of 690V AC (50/60Hz) and rated insulation voltage of the circuit breakers shall be 750V AC (50/60Hz).

The Moulded Case Circuit Breakers shall provide Class II insulation (to IEC 664) between the front and internal power circuits.

Setting

All adjustable circuit breakers are to be set at the values shown on the drawings accompanying this specification. The Electrical contractor is responsible for setting of MCCB on site to specified values as shown on the accompanying drawings.

Cascading and Discrimination

All protection devices shall be selected to enhance discrimination and avoid cascading between upstream and downstream devices. It shall be arranged so that only the protection device immediately upstream of the fault shall operate to clear the fault.

Construction

Operating mechanism shall be of the quick make, quick break type, with the speed of operation independent of the operator, and mechanically trip free from the operating handle so as to prevent the contacts from being held closed against short circuit and overload conditions. The operating mechanism shall be constructed to operate all poles in a multi pole breaker simultaneously during opening, closing and tripped conditions.

The breakers shall be operated by a toggle or handle which shall clearly indicate the three fundamental positions ON, OFF and TRIPPED.

If required, rotary handles shall be fitted to the breaker.

Moulded Case Circuit Breakers shall be available in normal, high and limiting ranges.

Moulded Case Circuit Breakers of the same range shall have a common depth.

The standard operating mechanism shall provide positive break indication ie: -

- The operating mechanism shall be designed such that the toggle or handle can only be in OFF position if the power contacts are all actually separated.
- Isolation shall be provided by a double break on the main circuit.

The breakers shall provide double insulation from the front face allowing field installable auxiliaries without isolating the unit.

It shall be possible to lock the circuit breaker in the "isolated" position only with the use of a locking device and padlocks.

Protection units

All MCCBs shall be fitted with RMS sensing electronic trip units.

The trip units of MCCBs shall be easily interchanged with standard tools.

All electronic components shall withstand temperatures up to 125oC.

All settings on trip units shall have provision for sealing. Where circuit breakers as nominated to be sealed, the adjustable controls shall be concealed behind an escutcheon sealed with authority tags or otherwise.

Universal electronic trip units shall provide:

- Long time protection with adjustable time delay
- Short time protection with adjustable time delay
- Instantaneous protection
- All with adjustable thresholds

All universal trip units will incorporate a load monitoring function.

It shall be possible to install the following options without increasing the circuit breaker volume:

- high threshold earth-fault protection
- load monitoring with adjustable threshold
- LEDs to indicate the cause of tripping
- data transmission via a BUS

Characteristics

The solid state protection unit shall have as required: -

- Long time protection adjustable from 0.4 to 1 times sensor rating (In).
- Short time protection adjustable from 3 to 6 times the setting made on the long time protection: time delay (when required) adjustable for discrimination with downstream MCCBs.
- Instantaneous threshold set at 35kA.
- Earth fault protection (when required) adjustable from 0.2 to 0.5 times the long time protection setting; adjustable time delay from instantaneous to 0.3s.

The circuit breaker shall provide positive break indication.

When required, motor operated mechanism with or without fault lockout, shunt trip, undervoltage release, auxiliary switches (up to four changeover contacts) and a tripped signal contact shall be provided. Each of these units shall incorporate a pre-wired terminal strip which is accessible from the front of the breaker without removing the cover.

Operation

All circuit breakers shall be provided with the facility for padlocking or keylocking in the open position.

It shall be capable of being used in conjunction with a visible break isolation switch to become one integral unit.

Electronic Trip MCCBs shall be possible to field test the trip units utilizing a secondary injection test kit.

Circuit breakers shall have clearly accessible from the front face:

- Markings of rating
- Marked as suitable for isolation
- "Push to trip" test button to test operation of poles.
- Contact position indication

Auxiliaries and Accessories

All accessories and electrical auxiliaries shall be manufactured in such a way that they can be easily field fitted without adjustment.

The breakers will have a double insulation of the front face allowing field installable auxiliaries without isolating the unit.

All electrical auxiliaries shall be equipped with built-in control terminals. All internal electrical auxiliaries shall be of snap-in type.

It shall be possible to fit the Moulded Case Circuit Breaker with a motor mechanism without affecting the circuit breaker characteristics.

All electrical auxiliaries shall be separated from power circuits and their addition shall not increase the volume of the circuit breaker.

It shall be possible to retrofit a residual current device (RCD) directly to the existing circuit breaker enclosure.

It shall be possible to equip the circuit breakers with devices indicating faults without tripping the circuit breaker.

Miniature Circuit Breakers

Standards: To AS 2184 for fault capacities of 10 kA or more. To AS/NZS 3111 for miniature overcurrent circuit breakers up to 1000 A current rating and less than 10 kA fault capacity.

Type: Provide circuit breakers which are true DIN rail mounted of "Merlin Gerin" manufacture (or equal approved).

Provide non-standard curve type circuit breakers for all mechanical or refrigerative plant. Alternatively increase the size of circuit breakers and sub-circuit cabling to allow starting currents in accordance with AS/NZS 3000. Provide combined MACB/RCD circuit breakers where nominated, having a tripping current imbalance of 30mA within 300ms complying with AS/NZS 3190. MACB/RCD circuit breakers shall utilise a single pole space (alternatively increase pole spaces within distribution boards to suit).

7.7.2 CONTROL, TEST SWITCHES AND EQUIPMENT - SCA

Standard: To AS 60947

Rated operational current: Not less than 6 A at 240 V a.c. at utilisation category AC-11.

Degree of protection: Not less than the degree of protection specified for the switchboard.

7.7.3 CONTACTORS

Standard: To AS 60947

Type: Block type, air break, DIN rail mounted and labelled.

Rated operational current: Not less than the full load current of the load controlled.

Rated duty: Uninterrupted (continuous).

Minimum size: 20 A at 415 V a.c.

Utilisation category: Not less than AC-3 or DC-3 as applicable.

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

Interconnection: Do not connect contactors in series or parallel to achieve the specified ratings.

7.7.4 FUSES WITH ENCLOSED FUSE LINKS

Standard: To AS 6029

Manufacture: Provide fuse-holders and fuse-links or equal to GEC Red Spot manufacture.

Fuse-holder: Mount the fuse-holders so that the fuse carrier may be withdrawn directly towards the operator and away from live parts, and provide fixed insulation which shrouds all live metal when the fuse carrier is withdrawn.

Fuse-links: Enclosed, high rupturing capacity (HRC) type mounted in a fuse carrier. Provide a 'fuse blown' indication which is visible when the link is fitted to its carrier. Where necessary for safe removal and insertion of the fuse carrier, provide extraction handles and mount them on clips within the spares cabinet.

Spares: Provide a minimum of 3 spare fuse-links for each size of fuse-link on each switchboard. Mount the spares on clips within the relevant switchboard.

7.8 ACCESSORIES, INSTRUMENTS, METERS

Electricity Metering Equipment

Standards: To AS 62053.22

Test links: Provide test links for the connection of calibration instruments and meters and for the shorting of current transformer secondaries. Energy meters, maximum demand meters and ammeters, where specified, shall each be provided with a set of links comprising screw-clamped slide links and an earth link.

Current transformers

Standards: AS 60044.1

Accuracy classification and class: To be provided as follows:

- Energy measurements: 0.5M.
- Indicating and recording instruments: 2M.
- With 5A Secondary.

Rated short-time current: Not less than the short-time current equivalent of the potential fault capacity of the circuit in which the current transformer is installed.

8 LUMINAIRES

8.1 SCOPE

Outline description: The work covered by this section includes the following:

Provision of luminaires satisfying all statutory, legislative and code requirements and conforming to the general details indicated herein.

The planning, scheduling and procurement of luminaire components and construction of luminaires to meet the agreed programme.

Full responsibility for packaging, delivery, and unloading on site, storage, maintenance, service and warranty; and all other items whether mentioned in detail or not to complete the luminaires supply and warranty in accordance with this specification.

8.2 PACKAGING

Pack luminaires and components in robust and sealed packages suitable for withstanding conditions between dispatch and installation. Store luminaires within original packaging until installation. Take all steps as necessary for the adequate protection of luminaires.

8.3 TESTING

Standard: To AS/NZS 4847, AS/NZS 4934, AS/NZS 60598.1, AS/NZS CISPR Set

Certification: All luminaire manufacturers shall be members and/or endorsed by the Lighting Council of Australia, and shall be tested at a NATA approved laboratory.

All test results shall be available on request for approval.

8.4 PERFORMANCE STANDARDS

Thermal characteristics: To AS/NZS 60598.1

Glare control: To AS/NZS 1680

8.5 PHOTOMETRIC DATA

Standard: To AS 1680.3

Requirement: Where requested, provide and obtain approval, full photometric data before delivering a standard product, or commencing to manufacture a non-standard product.

8.6 LAMP PERFORMANCE

Requirement: Ensure starter switches and igniters (where applicable), control gear and lampholders are suitable for use with the lamps supplied and when installed in the luminaire body to be supplied will allow the lamps to achieve the performance given in the lamp manufacturer's published data sheets when operating on the power supply provided for the project.

8.7 GENERAL CONSTRUCTION

Stiffness: The materials, body shape, and method of manufacture shall result in a luminaire of adequate stiffness to prevent warping or sagging when installed in position.

Body shape: Rectangular and square luminaires shall have straight parallel edges and square corners.

Surface mounting: For fixing of surface-mounted luminaires to ceilings or walls provide symmetrically placed fixing holes as follows:

- In square and rectangular luminaires: Not less than four holes.
- In circular luminaires: Not less than three holes.

Recessed mounting in suspended ceilings: To AS 2946.

Provide all recessed luminaires with 1.5m 3-core flex and plug type connection.

Ceiling trim: Where ceiling trim is specified attach it to the luminaires with concealed fixings.

Degree of Protection: Construct each luminaire to provide the protection appropriate to its final installed location.

Condensation: Where required provide a facility for draining condensation.

Metal bodies: Preparation: (Except for aluminium bodies which have been etched and anodised): Degrease to AS 1627 Part 1.

Finish: An approved factory applied finish.

Minimum paint thickness: 0.025 mm for each surface and edge.

Diffusers and Visors

Provide diffusers and visors manufactured from UV stabilised acrylic, polycarbonate or other approved material which achieves the specified glare control.

Position: Locate diffusers and visors so that the diffuser or visor temperature does not exceed 75°C.

Colour matching: Colour match diffusers and exposed metal painted surfaces of the same type.

8.8 WIRING

Standard: To AS/NZS 60598.1

Fluorescent and LED luminaires:

Cable: V105 250 V PVC insulated cable copper conductor, minimum size 24/0.2 mm (stranded), or 1/0.80 mm (solid).

Loom wiring: Neatly loom the wiring and install clear of ballasts. Fix the looms with soft metal, polythene or similar approved clips fastened to the luminaire body.

Internal Termination: Wiring within the fixture shall be terminated on suitable rated terminal blocks.

External Termination: Provide external terminations as follows:-

- Luminaire installed within a suspended ceiling – flex and plug terminations are considered suitable
- Luminaire installed in exposed ceiling areas, and external areas – provide a junction box mounted on the top or side or within the luminaire body. Mount a fixed terminal block inside the junction box. Flex and plug connections will not be accepted.

Terminal blocks: Fix each terminal block to the body adjacent to the cable entry. Unless otherwise specified, provide suitably sized terminal blocks to accommodate the required cabling, equal to rapid earth terminal blocks.

Earthing: Provide an earthing connection point comprising an earth bolt or screw of not less than 5 mm diameter x 12 mm length located adjacent to the terminal block with solderless connection lug. Fix the bolt or screw to the luminaire metallic body or junction box by welding or double lock-nuts on to serrated washers.

8.9 ACCESSORIES AND CONTROL GEAR

Electronic Ballasts

Requirement: Electronic controlgear shall be provided for all luminaires and shall be equal to "Tridonic Atco, Philips or Osram" manufacture and include the following features as a minimum:

Constant light output

- Output to be independent of fluctuating supply voltage
- Smart heating (fluorescent and HID luminaires)
- Cathode heating reduction after pre-heat time
- Defined lamp warm start within 0.5s (fluorescent) and 15s (HID)

Voltage Guard

- Overvoltage indication starting at input voltage 267-306 V AC
- Overvoltage protection 320 V AC, 1 h
- Undervoltage protection (shutdown) below 150 V AC/176 V DC
- AC voltage range 220-240 V
- DC voltage range 175-280 V

Other Features

- Power factor > 0.97
- Operating frequency ≥ 40 kHz
- Operating frequency ≥ 140 Hz for discharge luminaires.
- Earth leakage current ≤ 0.5 mA.
- Suitable for automatic and manual wiring with insulation displacement connector (IDC)

- Wide operating temperature range from -25°C to +50°C
- Service life of 50,000 hrs under reference conditions with failure probability of less than 0.2% for every 1000 hrs of operation
- Safe switch off of defective lamps
- Automatic re-start after lamp change
- For luminaries with or an in accordance with EN 60598
- Suitable for luminaries with protection class SK I and SK II
- Ingress protection IP 20
- Thermal protection according to AS/NZS 61347.1
- EMC compliance according AS/NZS CISPR Set
- Integral 2 Amp fuse.

Ballasts shall have ENEC and CE identification and certified to:

- EN 55015
- EN 55022
- EN 61347
- EN 60925
- EN 60929

Ballasts must meet harmonic requirements outlined in AS/NZS 61000.3.2.

Energy class CELMA A-2 Energy Efficiency Index (EEI) and A-1 for dimmable.

Ballasts shall be thermally protected and in compliance with IEC specifications 928 and 929 for safety and performance.

Mounting of Accessories

Location: Positively locate accessories, including ballasts, capacitors, connection blocks, lampholders and the like.

Fixings: Fix accessories to the luminaire body (or to separate enclosures where applicable) with plated metal-thread screws and nuts. Screws shall remain fixed in position when accessories and fixing nuts are removed.

Bayonet cap and Edison screw accessories: Lampholder and socket mountings: Fix lampholder to prevent rotation.

8.10 LAMPS

Requirement: Supply luminaires complete with lamps.

Single manufacturer: Lamps of the one type shall be of the same manufacture.

Lamp identification: Provide a legible label in each luminaire, fixed in a position convenient for reading at the luminaire installed position, which clearly identifies the lamp type to be installed in the luminaire.

LED Lamps

Standard: IEC 62031 Ed 1.0

Lamp: Provide LED lamps of CREE, Philips, Osram, Luxeon, Rebel or Bridgelux manufacture, complying with the following, unless specifically indicated otherwise:-

- Colour Rendering Index (Ra) - Greater than 85
- Colour Temperature - 3000 K

Certification: Only LED lamps that have been tested in accordance with IESNA LM-70, IESNA TM-21 and IEC 62031 shall be accepted.

8.11 RECESSED LUMINAIRES – WARNING SIGNS

Standard: AS/NZ 3000

Requirement: Provide warning signage where recessed downlights are installed within an accessible roof space.

'WARNING: recessed lights have been installed in this roof space. To reduce the risk of fire DO NOT COVER the light fittings with thermal insulation or any other material unless in accordance with instructions provided by the lighting manufacturer,'

8.12 EMERGENCY LIGHTING

Standard: AS/NZS 2293 and Building Code of Australia (BCA)

Outline description: The work covered by this section of the specification:-

The installation of an emergency and evacuation lighting and exit sign system that satisfies all statutory, legislative and code requirements and conforms to the general details indicated herein.

The provision of discharge testing facilities for all emergency and exit luminaires in accordance with AS/NZS 2293 at local area distribution boards classified by the distribution board zoning of the Building.

Emergency and exit lighting shall generally be installed in accordance with AS/NZS 2293 and as shown on the accompanying drawings. However, when installed above doorways exit fittings shall be installed directly above on the transom.

The planning, scheduling and procurement of components, installation to meet the programme, coordination and liaison with other trade packages.

Full responsibility for the execution of the complete installation in accordance with the specification and drawings.

Installation, testing, commissioning, maintenance, service and warranty all building act tests up to the end of the defects liability period; and all other items whether mentioned in detail or not to complete the installation and put it into working order in accordance with this specification.

TESTING

Manufacturers' tests:

Classification testing: To AS/NZS 2293.3 Appendix C.

Type testing: To AS/NZS 2293.3 Appendix D.

Certification: For each size and type of emergency lighting luminaire and exit sign supply copies of a certificate of tests stating the testing authority, manufacturer and details of parameters and results for each test.

Number of copies: Insert one copy of each certificate in each copy of "Operating and Maintenance Manual"

LABELLING

Requirement: To AS 2293.1.

For each distribution board device that will cause emergency or exit lighting to discharge provide the following label: -

'WARNING: INTERRUPTING SUPPLY WILL DISCHARGE EMERGENCY LIGHTING BATTERIES'

The label shall be fixed securely immediately adjacent the device which will operate the discharge facility. Note adhesive labelling will not be accepted.

Provide labelling adjacent each individual circuit that supplies exit and emergency lighting.

MAINTENANCE RECORDS - EMERGENCY LIGHTING

Requirement: To AS 2293.2 and the Building Code of Australia.

Log book: A4 size, printed or typed on durable printing paper and neatly bound in durable vinyl or similar covers, coloured distinctly different from the colour of the operating and maintenance manual covers. Include the log book within the Maintenance and Testing of Safety Equipment Manuals.

SINGLE-POINT SYSTEMS

Battery: Indelibly stamp each battery with its date of manufacture. Provide the manufacturer's warranty on the battery life with the luminaire operating under normal conditions at an ambient temperature of 25°C. Batteries shall be of the high temperature Nickel-Metal Hydride (NiMH) type.

Battery charger: Two-rate, constant current, constant voltage, temperature compensated type with automatically selected boost and float charging rates.

Local Testing facilities: Provide a local test switch on each luminaire. Provide self-testing facilities for each luminaire.

Distribution Board Testing facilities: Provide test facility within each local distribution board that supplies exit and emergency lighting circuits. The test facility shall be constructed as described on the drawings accompanying this specification.

Inverter system: Protect the inverter system against damage whilst in operation in the event of failure, removal or replacement of a lamp.

Installation: To AS 2293.1 Section 2.

Circuiting: Unless shown otherwise all exit and emergency lighting shall be circuited from the un-switched active of the nearest adjacent general lighting circuit. Where essential circuits are available, circuit from the nearest essential general lighting circuit.

8.13 SCHEDULE OF LUMINAIRES

The schedule defining the type of luminaires with designations can be found on the drawings accompanying the specification.

Each luminaire has been selected in accordance with the following criteria:-

- Compliance with relevant Australian and International Standards.
- Energy efficiency with respect to ongoing energy consumption.
- Appearance based on the requirements outlined by the End User and/or Architect.
- Known reliability of the proposed luminaire with respect to longevity, ongoing maintenance and the intended use.
- Relevant trade price of the luminaire.
- Quality of the fixture, including componentry.
- Recognition by the Lighting Council of Australia. Only manufacturers who are members or are endorsed by the Lighting Council of Australia will be accepted.
- Testing undertaken by NATA (National Association of Testing Authorities).
- Testing undertaken in accordance with relevant Australian Standards.
- Photometric data provided for computer lighting simulations.

Where alternative luminaires, lamps, controlgear and the like have been proposed by the Contractor, evidence shall be provided to ensure they are fully compliant with the above requirements. The Contractor shall then engage the services of Lucid Consulting Engineers on an hourly rate basis to undertake all necessary photometric calculations required to ensure the proposed alternatives will provide sufficient light levels within the nominated areas. On submission of the tender offer the Contractor acknowledges by default their acceptance of this requirement.

9 NATIONAL BROADBAND NETWORK (NBN) CORPORATION CABLING SYSTEMS

9.1 SCOPE

Outline Description: The work covered by this section includes the following:

- Access provisions for NBN Co cabling to site.
- Access provisions for NBN Co Network Termination Units (NTU), Power Supply Units (PSU) and Fibre Wall Outlets (FWO).
- Provision of cable supports and pathways in accordance with NBN Co requirements.
- Coordination and arrangement of inspections with NBN Co via the NBN Co Project Officer.
- Coordination with NBN Co for transfer of ownership of all NBN Co cable pathways.
- Testing and commissioning of all systems installed and connected.
- Labelling of systems.
- Other items, whether mentioned in detail or not to complete the installation and put it into working order.

9.2 STANDARDS AND PRACTICE

Conformity to Standards

All materials and practice shall comply with the following standards unless otherwise specified:

Code	Description
AS/CA S008	Requirements for Authorised Cabling Products
AS/CA S009	Installation Requirements for Customer Cabling (Wiring Rules)
AS/NZS 1477	PVC Pipes and Fittings for Pressure Applications
AS/NZS 2032	Installation of PVC Pipe Systems
AS/NZS 3000	Electrical Installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3084	Commercial Building Standards for Telecommunications Pathways and Spaces
AS/NZS 3085.1	Administration of Communications Cabling Systems – Basic Requirements
AS/NZS 3086	Telecommunications Cabling Systems for Small Office/Home Office Premises
AS/NZS 3087	Testing of Balanced Communications Cabling
AS 3996	Access Covers and Grates
AS/NZS 4117	Surge Protection Devices for Telecommunications Cabling
AS/NZS 4129	Fittings for Polyethylene Pipes and Pressure Applications
AS/NZS 4130	Polyethylene Pipes for Pressure Applications
AS/NZS 4586	Slip Resistance Classification of New Pedestrian Surface Materials
AS/CA C524	External Telecommunications Cable Networks

AS/CA G591	Telecommunications in Road Reserves – Operational Guidelines for Installations
SAA HB29	Communications cabling manual

NBN Corporation Technical Guidelines

In addition the entire works shall be carried out by ACMA Open Cabling Registration cabling installers. All materials and equipment supplied shall hold relevant ACMA approvals.

The system shall generally be installed in accordance with the above standards; however reference shall also be made to the manufacturers' requirements. Where there is a discrepancy, the standard which exceeds the requirements of the other shall be adhered to.

9.3 SYSTEM CERTIFICATION AND WARRANTY

Requirement

It is the Electrical Contractor's responsibility to supply, install, design and construct the cable support mechanisms for all NBN Co cabling based on the drawings accompanying this Specification. The cable support system and pit and pipe installation shall be fully certified by NBN Co prior to handover. Any NBN Co cable supports shown on the accompanying drawings are shown indicatively and are to be amended by the Electrical Contractor in consultation with the Electrical Engineer and NBN Co to suit the specific site requirements.

Submission

The Electrical Contractor shall submit all information necessary including final design documents for review and approval to NBN Co as required, to ensure a fully certified system is provided.

It is the Electrical Contractor's responsibility to ensure NBN Co sign-off and acceptance of the installation.

9.4 WORKSHOP DRAWINGS

Diagrammatic layouts: Tender Drawings forming part of this Specification are diagrammatic for tender only and shall not be used for installation purposes. Before commencing work, determine the exact positions of all equipment in conjunction with and to the approval of the Architect, Consulting Engineer and NBN Corporation having regard to interior design, building features, other services, and the requirements of regulatory authorities and standards indicated above.

Requirement: The Electrical Contractor shall submit Workshop Drawings in accordance with NBN Co guidelines to NBN Co for review and sign-off prior to commencement of work on site.

It is the Electrical Contractor's responsibility to ensure NBN Co approval and sign-off of the drawings.

9.5 INSPECTIONS

Arrange for, and give sufficient notice for inspection to the NBN Co Project Officer as follows:-

- Installation of all underground works including conduits and pits.
- Installation of internal cabling cable supports before closing of ceilings.
- Completion of installation prior to handover to NBN Co.

Minimum notice required: 10 Working days

Coordinate with the NBN Co Project Officer to arrange for all necessary inspections required by the Authority. It shall be the Electrical Contractors responsibility to rectify all defects indicated by NBN Co, which shall be rectified without any addition to the construction programme, and at no additional cost to the project.

9.6 GENERAL

Supply and install all trays, ducts, pits, hangers, brackets and the like to suit.

All metallic cable support mechanisms shall be connected to the building protective earth as specified for each case in AS/ACIF S009 or local equivalent, whichever is greater. It shall be the Electrical Contractors responsibility to ensure earth continuity is maintained for the full extent of all cable support mechanisms.

All conduits shall be installed in accordance with NBN Co Pit and Pipe requirements. The system shall be capable of supporting NBN Co cabling, and certified in accordance with NBN Co requirements.

9.7 CABLE SUPPORT SYSTEM

Supports generally:

Shall comply with AS/NZS 3084, manufacturers requirements and NBN Co requirements.

Segregation:

Segregation shall be provided in accordance with NBN Co requirements. However the following shall be incorporated within the installation:-

- Cable pathways are to be generally run parallel and/or perpendicular to the Building structure.
- Cable pathways shall generally be installed below other services to allow ease of access by NBN Co during cabling installation.
- Conduits shall be labelled in accordance with NBN Co requirements.
- Draw wires shall be labelled with tags at both ends to identify

9.8 EXTERNAL WORKS

Provide NBN Co approved P100mm (unless shown otherwise) communications conduits and pits as shown on the drawings, accompanying the Specification. Conduit runs shall generally be straight, however where bends exist they shall not exceed the bend radius requirements outlined in the NBN Co Technical Guidelines.

Refer to the drawings accompanying the specification for approximate locations of pits. Final locations are to be approved on site.

Provide 10mm nylon draw cords within all conduits, with ID tags provided to both ends.

Underground works shall be carried out in accordance with the "Cables & Enclosure" section of this specification, and NBN Co guidelines.

All conduits shall be installed in accordance with NBN Co Pit and Pipe requirements. The system shall be capable of reticulating NBN Co cabling, and certified in accordance with NBN Co requirements.

9.9 TESTING

Undertake all testing as required in the NBN Co technical guidelines.

Results:

Results are to be presented to NBN Co as required to achieve sign-off.

10 STRUCTURED HORIZONTAL CABLING SYSTEMS (SHCS)

10.1 SCOPE

Outline Description: The work covered by this section includes the following:

- Provision of Category 6/Class E compliant Structured Cabling System (SHCS) incorporating horizontal cabling and all cable terminations.
- Provision of cable-trays, vertical ducts and equipment.
- Testing and commissioning of all systems installed and connected.
- Labelling of systems.
- Other items, whether mentioned in detail or not to complete the installation and put it into working order.

10.2 STANDARDS AND PRACTICE

- Conformity to Standards

All materials and practice shall comply with the following standards unless otherwise specified:

AS/ACIF S008

- Requirements for Authorised Cabling Products

AS/ACIF S009

- Installation Requirements for Customer Cabling (Wiring Rules)

AS/NZS 3000

- SAA Electrical Wiring Rules

AS/NZS 3080 – Class E

- Integrated Telecommunications Cabling for Commercial Purposes

AS/NZS 3084

- Commercial Building Standards for Telecommunications Pathways and Spaces

AS/NZS 3085.1

- Administration of Communications Cabling Systems – Basic Requirements

AS/NZS 3086

- Telecommunications Cabling Systems for Small Office/Home Office Premises

AS/NZS 3087

- Testing of Balanced Communications Cabling

AS/NZS 4117

- Surge Protection Devices for Telecommunications Cabling

SAA HB29

- Telecommunications Cabling Handbook

ISO/IEC 11801

- Information Technology – Generic cabling for customer premises

In addition the entire works shall be carried out by ACMA Open Cabling Registration cabling installers. All materials and equipment supplied shall hold relevant ACMA approvals.

The system shall generally be installed in accordance with the above standards; however reference shall also be made to the manufacturers requirements. Where there is a discrepancy the standard which exceeds the requirements of the other shall be adhered too.

Refer to 'Earthing' Section detailing earthing requirements.

10.3 PROTOCOLS AND STANDARDS

The SCS shall be capable of supporting the following minimum protocols and standards:-

- Ethernet Standards:-
 - 10 Base T, 100 Base TX, 1000 Base TX, 10G Base T
 - ATM25
 - ISDN
 - PSTN
- Voice Communications
 - Analogue and digital PABX systems
 - Analogue and digital video applications
 - Video conferencing
 - Broadband video
 - Broadcast television
 - Voice over IP (VoIP).
- Power Over Ethernet
 - PoE in accordance with IEEE 802.3af PoE
 - PoE+ in accordance with IEEE 802.3at PoE

10.4 SYSTEM CERTIFICATION AND WARRANTY

Requirement

The cabling installation shall be provided as an impedance matched end to end solution. The end to end system shall be from one of the following preferred manufacturers TE Connectivity, Siemon, CommScope Systimax, Clipsal Actassi, Molex SCS and Panduit systems. All products shall exceed requirements for Category 6/Class E channel and components.

The installation shall be capable of meeting or exceeding AS/NZS 3080 certification and warranty requirements. The warranty is to comprise of an Applications Assurance and Extended Product/Labour Warranty that will have a valid minimum warranty of 5 years and is to be a fully manufacturer certified system.

The tendering contractor shall be an approved installer of the SCS system.

Submission

Provide with the tender a clear statement of the Applications Assurance and extended product warranty offered on the communications installation.

10.5 INSPECTIONS

Arrange for, and give sufficient notice for inspection of the installation as follows:

- Installation of all underground works including conduits and pits.
- Installation of cabling.
- Installation of internal cabling before closing of ceilings.
- Completion of installation ready for termination.
- Minimum notice required: 10 Working days

10.6 GENERAL

Supply and install all trays, cables, ducts, pits, and mounting blocks/brackets to suit. All data plates to match other accessories.

All distribution frames, cabinets, cable trays and catenary wires shall be connected to the building protective earth as, specified for each case in AS/ACIF S009 or local equivalent, whichever is greater.

Underground works shall be carried out in accordance with the "Cables & Enclosure" section of this specification.

10.7 EXTERNAL WORKS

Provide ACMA and NBN Co approved P50mm and/or P100mm communications conduits and pits as shown on the drawings, accompanying the Specification. Conduit runs shall generally be straight, however where bends exist they shall not exceed the bend radius requirements of the cabling to be installed within. Plan and gain approval for all routes before excavation.

Refer to the drawings accompanying the specification for approximate locations of pits. Final locations are to be approved on site.

Provide 10mm nylon draw cords within all conduits.

Underground works shall be carried out in accordance with the "Cables & Enclosure" section of this specification.

10.8 TESTING

Copper

All cables shall be tested and approved for Category 6/Class E compliance utilising certified test equipment as provided by the Sub-Contractor. Provide certifying evidence of the calibration accuracy of all test equipment.

The following shall be the minimum testing requirements for copper cabling:

- 100% testing of all runs for continuity and polarity.
- 100% testing of all cabling with compliance to Category 6/Class E requirements.
- A written test report for every test (1 per page) and a soft copy on CDROM shall be submitted and included with the as-built documentation. Alternatively, if requested in the Scope of Work, test results to be submitted in .FLW and .PDF format, to allow generation of summary test information in lieu of individual test pages.
- Testing shall be carried out with a minimum of a Level III tester. The contractor prior to performing any testing must seek approval from Principal if any other cable tester is to be used.

The following parameters shall be tested according to AS 3080:-

- Near-End Crosstalk (NEXT) (Both directions)
- Power sum Near-End Crosstalk (PSNEXT) (Both directions)
- Far-End Crosstalk (FEXT) (Both directions)
- Power sum Far-End Crosstalk (PSFEXT) (Both directions)
- Power sum Equal Level Far-End Crosstalk (PS ELFEXT) (Both directions)
- Attenuation
- Return Loss (Both directions)
- Delay Skew
- Continuity
- Wire Map
- Length
- DC Loop resistance
- Attenuation to Crosstalk Ratio (ACR)
- ACR @ remote
- Power sum ACR
- Propagation Delay (Both directions)

General

A complete set of test results shall be provided as part of the Installation Manuals. Inspection and testing of these parameters does not relieve the Contractor of their responsibility to provide and maintain an operational system. Replace any cables not performing within the specified requirements.

Marginal passes will not be accepted.

Provide completed and signed TCA1 form for entire communications system installation.

Results: Provide copies of the test results and TCA1 form and include within Maintenance Manuals.

10.9 COMMUNICATIONS OUTLETS

Provide outlets to each location nominated on the drawings accompanying this specification, which shall generally be provided as follows:-

- Fitted with Category 6/Class E, 8 way RJ45 outlets. Make of RJ45 outlets shall match that of the cable.
- Mounted on face plates of identical manufacture to power outlets.

10.10 LABELLING - COMMUNICATIONS CABLING

All labelling will be in accordance with AS/NZS 3085.1.

Faceplates to match socket outlet Faceplates and are to be supplied and installed by the Contractor. RJ45 Category 6/Class E sockets shall mount into faceplate, which will be flush mounted.

In addition, provide labels for all cables consisting of wrap-around markers, behind faceplates and at communications enclosures. Hand written labelling directly on cables will not be accepted.

All labels, regardless of their location, shall provide for clear and concise ease of identification of its respective point. It is the Contractor's responsibility to provide and install these pre-printed labels sized appropriately to its location.

Labelling requirements shall be defined in conjunction with the Proprietor after submission of Communications Room workshop drawings.

10.11 OUTLETS

Each outlet shall be provided with:

- Faceplate with a socket mounting cut-out, of colour to match other accessories;
- Faceplate socket inserts consisting of Category 6/Class E RJ-45 connectors. This connector shall have the following characteristics:
 - A minimum contact coating of 50 microns (1.27 micro meters) of gold over 50+ microns Nickel
 - 8 pin cable connector of insulation displacement type compliant with the Category 6/Class E transmission performance.
- Cable termination, pin assignments, pair allocation, colour coding and performance shall conform to AS /NZS 3080, option T568A.
- Mount designated dual and triple outlets on a single plate matching other accessories where shown on the contract drawings.
- Approved labelling system utilising the engraved labelling adjacent each outlet, or alternatively utilising the outlets proprietary labelling system.
- Mount designated dual outlets on a single plate matching other accessories where shown on the contract drawings.

10.12 COPPER HORIZONTAL CABLING

Provide Category 6/Class E compliant solid core 4 pair UTP cabling.

Conductor:-

Provide solid bare copper sized accordingly. Stranded cabling will not be accepted.

Insulation and Jacket:-

Provide polyethylene insulation and PVC jacket or LSZH.

Terminations:-

Terminations shall be provided as follows:-

- Terminate all cable pairs and all cables.
- Terminate with connector pin assignment in accordance with AS/NZS 3080, option T568A.
- Maintain cable twists as far as possible up to the point of termination and no more than 8mm from the point of termination.
- Cut back cable sheaths neatly and support adequately.
- Provide adequate and positive strain relief.

Copper Horizontal Cabling:-

Copper backbone and horizontal cabling shall be provided as follows:-

- Cable length of UTP cables, including patch leads shall not to exceed 100 m, and be greater than 15m. Plan all routes so as to achieve this requirement
- Provide copper horizontal cables from the appropriate cable centre to information outlet locations as shown
- Terminate the copper cables at each outlet location and at the relevant NBN NTU unit as shown. Provide a 1m loop within the ceiling space at each end. (loop must be installed in figure eight design)

General:-

All cable installation shall observe the manufacturers recommendations regarding the installation methods and techniques, particularly bending radius.

All cables shall generally be laid at random within cable trays to avoid alien crosstalk.

Perform test on each cable in accordance to manufacturer's testing recommendations and in accordance with AS 3080. Replace any damaged or failed components.

11 COMBINED FIRE / ACCESS CONTROL SYSTEM

11.1 GENERAL

Standard: AS/NZS 2201 Set

Scope

Provide a combined fire / access control system comprising:

- Access control system including door locks
- Car park vehicle access control inclusive of 30No. RF key fobs
- Smoke and thermal detection to common areas including sirens to apartments
- Power supply
- Wiring, conduit and all minor works associated with system.

Work

The work shall include:

- Detailed system design
- Manufacture, supply, installation and wiring
- Testing and commissioning
- Operation and maintenance manuals
- Maintenance during defects liability period
- Liaison with other contractors responsible for door hardware, air conditioning, lifts, etc, as applicable

Alarm Operation

The system shall be self-contained. An alarm condition shall initiate local audible and visual external alarm device.

External Monitoring Interface: The system shall include provisions for an interface suitable for connection to a monitored security company.

System Structure

The system shall be a distributive system with electronic equipment connected via network communications links.

11.2 POWER SUPPLY

Requirements:

Provide 230 volt AC mains power supply to central supervisory system controller/control panel and other devices as required. Incorporate transient voltage protection in all devices.

The Contractor shall provide all necessary power supplies for all equipment and appliances that shall warrant a fully operational system.

Dedicated Circuit:

The supply shall; be provided by a dedicated circuit and the circuit breaker shall be labelled "ACCESS CONTROL SYSTEM – DO NOT SWITCH OFF".

Back-up Supply:

Provide 12 Volt DC battery back-up with minimum capacity in accordance with AS/NZS 2201 Set. The battery shall consist of maintenance free sealed lead acid cells.

11.3 WIRING

General

Cabling shall be reticulated utilising any of the following methods:-

- Cast in situ concrete when installed on concrete walls and the like.
- Reticulated along cable trays in a segregated section using partitions. Cables are to be strapped to the cable trays using nylon cable ties.
- Installed within heavy duty conduit when installed in areas with exposed ceilings, including in areas with cable tray.

Communications Network

Twisted 2 pair screened cable or other as required in conduit linking all controllers. The network shall be supervised.

Cabling shall not exceed 1.5km in length.

11.4 PRE-CONSTRUCTION SUBMISSIONS

The Electrical Contractor shall provide the following minimum information prior to commencing installation of the security system, for approval by the Engineer:-

- Layout drawings showing equipment locations, paths of reticulation and the like.
- Schedules identifying equipment type (make and model) corresponding to the layout drawings.
- Schematic diagrams for the access control system.
- Schedule of interfaces with all equipment and devices separate to the combined fire / access control system e.g. Intercom etc.
- Functional specification identifying the operation of the access control system, including description of each zone, and programming.

11.5 TESTING

Testing and commissioning shall be undertaken in accordance with the system manufacturers' requirements.

Testing and commissioning shall be coordinated with a representative of the manufacturer. Upon completion the security system shall be warranted and approved by the manufacturer.

11.6 MAINTENANCE

Requirement

Maintain system during Defects Liability Period in accordance to AS/NZS 2201 Set.

Site Visits:

Visit site and carry out maintenance procedures at not less than 3 month intervals and whenever advised of a fault.

11.7 MANUALS AND DRAWINGS

The Electrical Contractor shall provide all As-Installed information for inclusion within the Operating and Maintenance Manual as follows:-

- As-Installed drawings showing the following minimum items:-
 - Cable pathways and types.
 - Controllers, detectors, accessories, interfaces locations and the like
 - Control panel types and locations.
 - Schematics and diagrams
- Technical Specification identifying the operation of the system to the Proprietor.
- Handover and training records

11.8 WARRANTY

The system shall be warranted for a minimum 5 year period, which includes parts and installation.

11.9 SYSTEM CONTROL PANEL

Requirement

Provide a wall mounted control panel for monitoring and control of the system comprising a programmable access control processor and control switches, visual indicators, relays, etc. Provide an LCD display with English text to indicate any abnormal condition and to facilitate programming.

Enclosure

Control panel enclosure shall be of sheet steel with acrylic enamel paint finish, stainless steel or impact resistant plastic. Layout and labelling shall facilitate use by operator.

Provide vandal resistant screws on all enclosures.

Location

Enclosure(s) shall be installed between 1500 to 1800 AFFL, and shall be installed over the relevant power and communications outlets.

Locations shown on the drawings accompanying this specification are indicative, and are to be confirmed on site.

Capacity

The controller shall have provision for at least 8 independent alarm systems with up to 256 programmable inputs.

Programming

The controller shall permit system configuration and options to be programmed by an operator using selected access key/code.

Access Control

The control panel shall provide programming of all access control functions.

Time Clock

System shall incorporate a 365 day real time clock with battery backup.

Memory

System shall have a built in memory which allows recall and display of all transactions. Provide a printer to give English text record of all transactions.

Operation

Activation of alarm device when control panel is in secure mode shall:

- Initiate audible/visual alarm on panel
- Initiate external audible/visual alarm if required
- Illuminate appropriate sector indicator on control panel
- Transmit alarm to control station

Mute Button: Provide facility to silence audible alarm while retaining visual indication until alarm is cleared and device is reset.

Reset: Private Code activated facility.

Time Delay: Provide adjustable time delay (30 sec to 3 mins) on motion alarm signals in sectors between control panel and entry/exit doors.

Status

The status of each sector shall be displayed on the control panel.

11.10 ACCESS CONTROL

Make and Model

Access Control System shall be of "Inner Range Integrity" manufacture or equal approved.

Scope

The access control system shall control and monitor selected doors and the movement of lifts cars detailed on the drawings utilising access keys, key pads, key readers, door locks shall be provided.

System Features:

- Independent operation (2 card users/apartment plus 10 spare for building owner)
- Routine reporting to system controller via networking link
- Battery backup for 8 hours
- Communications via telephone line (PSTN) and Ethernet (IP).
- Monitoring and control by each local control unit of 2 doors each with an entry key reader, PIN reader and exit key reader as required.
- Interface to fire alarm system for automatic door release on fire alarm.
- Memory for audit trail.
- Anti-passback support.
- Card status indicator via red/green LED indicators on reader.
- Response time from presentation of a key to operation of the interface contacts shall be less than one second.

Visitor Entry

Entry to the building, outside normal working hours when the building is secured, shall only be available to persons who are holders of authorised access keys or via release signal from building intercom system.

Visitor Exit

Exit from the building be available at all times, including at controlled access points, by push-button control, local movement detector or by operation of internal door handles.

Vehicle Entry

Vehicle entry to the secure car park area shall only be available to persons who are holders of authorised remote transmitters.

Vehicle Exit

Vehicle exit from the secure car park area shall only be available to persons who are holders of authorised remote transmitters.

Authorisation

Entry via access controlled door shall be available to key holders only at entry points authorised to the particular keys. Entry points shall be individually assigned to keys.

Time

Access controlled doors shall remain unlocked for an adjustable period initially set at 30 seconds. On expiry of selected time, doors shall relock.

System Controller

System shall incorporate a programmable controller wired to local control units for central monitoring and control. Programming shall be available to operators with required access code/key.

Local Control Units

Access control devices (key readers, door locks, etc) shall be connected to distributed local micro-processor based control units located within equipment rooms, cupboards or within the ceiling space in approved locations.

Control System: Connect to Security System Controller via communications network.

Access Keys

Type: Keyring fob with RF pushbuttons for auto roller door control

Card Readers

Type: Provide proximity card readers to locations as nominated on the accompanying drawings.

Card readers shall be compatible with all types of cards, fobs and the like specified as part of these works.

Readers shall have distinct LED indicators for "LOCKED" and "UNLOCKED".

Enclosures: Reader head enclosures shall be of minimum protection classifications:

External: IP 66D to AS 1939

Internal: IP 54 to AS 1939

Tamper Switches: Reader enclosures and wiring terminations enclosures shall be fitted with tamper switches. Operation of the tamper switch shall cause the system to ignore any further information from the reader and any associated request to exit buttons. Tamper shall be reported to the security system controller and must be reset manually.

RF Car Park Roller Door Reader

Type: 30070 MicroLatch REC-20 4 Channel Wiegand RF Receiver.

Indicators: On Keeloq™ Reception – Red LED, On Wiegand Transmission – Green LED

Current consumption @ 12VDC 10mA maximum

Physical Dimensions 85mm (L) x 65mm (W) x 32mm (H)

ABS plastic case material

4 Output Channels

Output Options: INT Shunt selectable, REMOVED 10K pull-ups to 5 volt DC, EXT Open collector +5 volt out terminal active for user selectable external pull-ups

433.92MHz RF Operating Frequency

Code Hopping (Keeloq™) AM ASK Superheterodyne for RF Signal Type

Conform to Wiegand standard

Electric Door Strikes

Type: Fail safe, power on to secure. Strike shall engage door latch.

Requirement: Provide electric door strikes for all access controlled doors.

Installation: Supply electric door strike too responsible door hardware trade for installation within door frames. Wire to and commission. Provide concealed conduits for all wiring.

Operation: Secure mode – controlled by access control system. Non-secure mode – access and egress shall be permitted. Provide interface with building fire system for automatic release of all controlled doors on receipt of a fire signal.

Fire Doors: Electric door latch release units fitted to fire rated door frames shall be designed and installed to avoid any loss of the fire rating.

Double Doors: Provide wiring hinge and wiring through fixed leaf door strike position.

Door Release

Provide door release push-button adjacent each nominated controlled door. Push-button is to be mounted on a face plate to match the surrounding power outlets, and labelled accordingly.

Break Glass Release

Provide Break Glass Release adjacent each nominated controlled door. Releases shall be sufficiently labelled, and shall generally be coloured green.

Internal Audible devices

Provide and install sounders to apartments for fire evacuation equal to Aritech AI673

12 MATV SYSTEM

12.1 SCOPE

Outline Description: The system is to reticulate Digital Video Broadcasting – Terrestrial (DVB-T) services from within the metropolitan area to outlet locations nominated.

12.2 STANDARDS

Standards: AS/NZS 1367, AS 1417, IEC 60966 Set.

12.3 SYSTEM DESIGN

Distribution Technique: Radiating main trunk cable from the main antenna position. Outlets are to be supplied from distribution cable using splitters and/or tee units.

On-Site Measurements: Before completing the final design, measure the on-site signal levels of the nominated services, and note the existence and direction of any ghosting sources, and sources causing increased Bit Error Rates (BER). Establish the required aerial height and submit workshop drawings for approval, including mounting proposals.

Final Design: Before commencing the installation submit details of the proposed final design, including expected signal levels at all outlets, and showing the configuration of equipment required to meet the specified performance.

12.4 PERFORMANCE

Picture Quality: At each outlet, the picture received on a domestic TV receiver shall not be noticeably inferior to the picture received when the receiver is connected directly to the antenna, and shall be free from discernible cross-modulation, intermodulation, ringing, noise or other distortion.

Signal Levels:

At any outlet:

- Maximum: 10 mV - Minimum: 2 mV.

Differential signals: To AS 1367.

Sound Carrier Level: At least 9 db less than the vision carrier.

Maximum Voltage Level: 120db(uV) at any point on the distribution system.

12.5 TESTING

Requirement: Carry out tests to demonstrate compliance with the performance and other requirements of the Specification, in the presence of the Superintendent.

Equipment: Provide the equipment, apparatus and materials necessary to perform the tests, including field strength meter and portable TV receiver.

Rectification: Correct the system, and replace components without extra cost, as necessary to achieve compliance.

12.6 CABLES

Type: Single core coaxial cable with a nominal impedance of 75 ohms.

Screen: Copper tape and wire braid.

Dielectric: Polythene 5 cell extrusion.

12.7 CABLE INSTALLATION

Cable Routes: Install cable using the most direct route. Run cables in false ceiling spaces, wall cavities, conduits and ducts, keeping clear of other services. Do not embed in plaster, mortar, cement, or the like, nor run in cracks or joints in walls, ceilings, floor slabs and the like.

Surface Cables: Do not run cables on surfaces without approval.

Continuity: Run cables continuously from the originating point to the terminating point without intermediate joints or connections unless otherwise approved.

Fixing: Fix coaxial cable with plastic clips at 600mm maximum centres.

Bending Radius: Not less than the cable manufacturer's recommended minimum.

Sealing: Seal the ends of cables exposed during the installation with tape or caps to minimise moisture take-up.

Tails: Leave 150mm tails for cut-off before terminating.

Terminations: Prepare cable ends for termination using the 'hot wire' stripping technique. Do not use cutting tools.

12.8 ANTENNA SYSTEM - MATV

Requirement: Provide an antenna system which gives adequate gain, directional characteristics and polarisation for the nominated services.

Balun: Supply, and install in a weathertight enclosure, a balun matching each antenna to the 75 ohm co-axial lead-in cable.

Insertion loss: Less than 0.5 db.

Frequency response: 0.5 db over the channel or band.

12.9 ANTENNA INSTALLATION

Standard: AS 1417.

Locations: Locate antennae upon the roof plant platforms to obtain suitable signals. Obtain prior approval from the Superintendent for the proposed locations before commencement.

Orientation: Orient the antennae to minimise reception of reflected signals.

Lead-In-Cable: Run lead-in cable inside the mast.

Fixing: Attach the antenna to a pipe support, sealed at the top but open at the bottom, fixed to the building and flashed where required.

Weather Proofing: Spray signal receiving parts with silicone or an equivalent weather damage inhibiting spray.

12.10 ANTENNA AMPLIFIERS

Standard: To AS 1367.

Requirement: Install a pre-amplifier at the masthead if the signal level at the distribution amplifier is less than 46 db(uV).

Power Source: Provide low voltage a.c. power to the pre-amplifier via the co-axial feeder cable. Install the power source in an easily accessible location. Include associated costs for power supplies, and power to power supplies within the tender submission. (MATV amplifiers and SSO's for this equipment are not shown on the drawings accompanying the specification). Obtain prior approval to the proposed location.

Frequency Response: Flat to within 1 db across the desired band.

Impedance: Match input and output to provide RLR of at least 15 db for 75 ohm co-axial cable.

Gain: Sufficient to achieve minimum signal level of 46 db(uV) at the distribution amplifiers.

Rating: Continuous use.

12.11 PASSIVE ELEMENTS

Standard: To AS 1367.

Type: Taps, splitters, and the like, shall be of the transformer or directionally coupled type. Components shall be mounted on fibre-glass boards. All connections shall be permanently labelled on the outside of the enclosure to allow fast identification. Cable saddle clamps are to be correctly sized to suit the diameter of the cable.

Frequency Response: Flat to within 2 db over the range 45 MHz – 820 MHz.

Screening: Screen passive elements to minimise the effect of radiation and/or reception of interfering signals.

Plugs and Sockets:

Construction: To be 75 ohm co-axial push-on type, machined from either beryllium-copper, or brass with nickel or silver plating. Where crimp connections are used they shall be performed using the correct crimping tools. All crimping sleeves used shall exceed 5 mm in length. Plugs using the centre conductor of the coaxial cable as the centre pin are not permissible.

Termination Impedance: Install termination impedances on unused splitter and tap-off outlets and at the end of each line.

12.12 OUTLET PLATES AND QUANTITIES

Requirement: Install outlets where shown on the Drawings. Provide outlet plates to match other accessories.

Type: Co-axial cable sockets flush-mounted on high-impact plastic plate. Fix components on a printed board assembly fitted with a clamp and screw for the co-axial cable termination.

13 INTERCOM SYSTEM

13.1 SCOPE

Outline Description

The system shall provide audio communications and main building entry door(s) and control as detailed on the electrical services drawings and schematics to individual apartments.

The system shall be designed, constructed, supplied and installed by an installer certified by the manufacturer.

The install system shall be of commercial manufacture and of 'Bticino' or equal approved, and shall generally provide the following minimum facilities and operation:

- Audio intercom facilities from main building entry door(s) entrance station to individual monitoring stations to allow for controlled visitor entry to the building main entry door(s) and foyer area.
- Interface to building access control system to allow for release of the main entry door(s) locking mechanism(s) and or door controller(s).
- Doorbell facility to individual Apartment main entry doors.

Work

The works shall include the following:

- Detail system design.
- Supply and installation.
- Programming of system.
- Testing and commissioning of system.
- Operation and maintenance manuals.
- Maintenance during the liability period.
- Liaison with other contractors including door hardware, etc as applicable.

13.2 ENTRANCE STATIONS

The entrance stations shall have the minimum features and provide:

- Audio communications to all Apartments.
- Digital apartment call panel including digital name scrolling facility.
- Door release via integrated RFID tag reader or tenants unique password.
- Interface with main entry door(s) release facilities.
- Vandal resistant and IP rated for external conditions.
- Options for hearing impaired persons.

Entrance stations shall be "Bticino" manufacture or equal approved.

13.3 MONITORING STATIONS

The monitoring station shall have the minimum features and provide:

- Audio communications to main building entrance station(s).
- Door release facility to building main entry door(s) including adjustable time delay facility.
- Additional function button for user programmed option.
- Doorbell facility to individual Apartments.
- Integrated help facility.
- Adjustable volume control.
- Integrated hearing aid setup.

Monitoring stations shall be "Bticino" manufacture or equal approved.

13.4 WIRING, POWER AND EQUIPMENT

Requirements

The intercom system shall be an IP based system utilising 2 wire cabling.

Provide all necessary power supplies as required to ensure a fully operational system.

Dedicated Circuit: the supply shall be provided by a dedicated circuit and the circuit breaker shall be labelled "INTERCOM SYSTEM – DO NOT SWITCH OFF" at the relevant area distribution boards throughout the building.

Audio and visual bus wiring types to suit the final system and manufacturers requirements.

Provide all wiring, equipment and accessories to complete the installation.

Provide all cable segregation requirements between power and communications bus cabling.

13.5 TESTING

After the installation is completed, tests to be carried out to demonstrate that the installation is in a satisfactory working order to all stations

Testing shall include the operation of each monitoring station communication to all entry stations and correct interface to access control and lighting control systems including door release and lift call functions.

Programming of system to suit the Proprietor's requirements.

Provide system details, testing and commissioning results within the Installation Manuals.

APPENDIX A - SECTION COSTS & UNIT RATES - ELECTRICAL SERVICES

This schedule is to be completed and submitted with Tender submissions. The amounts indicated in the total tender price including administration costs and profit for sections of the work are as follows:

ITEM	AMOUNT TENDERED
Access Conduits & Pits	\$
Main Switchboard & Distribution Boards	\$
Earthing and Bonding	\$
Consumers Mains and Submains	\$
Cable Trays & Support Systems	\$
Power Subcircuits	\$
Lighting Subcircuits	\$
Accessories & Outlets	\$
Luminaires	\$
Exit & Emergency Luminaires	\$
NBN Corporation Cable Pathways	\$
Structured Cabling System	\$
MATV System	\$
Combined Fire / Access Control System	\$
Intercom System	\$
Testing & Commissioning	\$
Maintenance & Servicing	\$
For Approval/Workshop Drawings	\$
As-Constructed Drawings	\$
Operating and Maintenance Manual	\$
User Training	\$
Other (specify)	\$
SUBTOTAL	\$
GST	\$
	\$
TOTAL	_____

Tenderer **Date**

APPENDIX B - SCHEDULE - SUBCONTRACTORS AND PERSONNEL

Identify below Sub-Contractors included within the tender submission.

ITEM	SUB-CONTRACTOR
SCA
Other

Identify below the following hourly rates that are applicable for the duration of this contract:

Occupation	Normal Time	Overtime	Double Time
	Rate \$/hr	Rate \$/hr	Rate \$/hr
Foreman
Electrical Mechanic
Electrical Apprentice
Communications Technician
Fire/Access Control Technician
Intercom Technician

Tenderer Date

[illegible]

APPENDIX D - SCHEDULE OF UNIT RATES

Include labour and material, profit and overhead costs in each item.

ITEM	ADDITION	DELETION
General Power		
One single-phase double SSO on existing circuit (with 15 metres of cable)	\$.....	\$.....
One single-phase 15A SSO on new circuit (with 15 metres of cable and 16A RCD/MCB)	\$.....	\$.....
One 20A 1-phase Isolator with 30m of 2c 4mm ² cable & 20A circuit breaker	\$.....	\$.....
Installation of light switch and 10 metres of 2c 2.5mm ² switchwire	\$.....	\$.....
Price per metre 2.5mm ² 2c+E installed anywhere in building	\$.....	\$.....
Price per metre 16mm ² 2c+E installed anywhere in the Building	\$.....	\$.....
Price per metre 25mm ² 2c+E installed anywhere in the Building	\$.....	\$.....
Price per metre 35mm ² 2c+E installed anywhere in the Building	\$.....	\$.....
Price per metre 16mm ² 4c+E Cu/X-HF-110/PVC	\$.....	\$.....
Price per metre 95mm ² 4 x 1c+E Cu/XLPE/PVC installed to tray	\$.....	\$.....
Cable tray - 300 mm installed per metre	\$.....	\$.....
- 450 mm installed per metre	\$.....	\$.....
Price per metre installation of 100mm electrical conduit underground to a depth of 600mm cover, including all excavation works and reinstatement	\$.....	\$.....
Copper price at time of Tender	Price per tonne	\$.....

Tenderer Date

SCHEDULE OF UNIT RATES cont'd

ITEM	ADDITION	DELETION
Communications		
One RJ 45 communications outlet, 30 m Category 6 cable and associated terminations at communications enclosure	\$.....	\$.....
As above, but double outlet	\$.....	\$.....
Fire / Access Control		
Key tag (proximity card)	\$.....	\$.....
Key tag detector (proximity fob c/w RF push button)	\$.....	\$.....
Electric Strike	\$.....	\$.....
Smoke Detector	\$.....	\$.....
Thermal Detector	\$.....	\$.....
Access controlled single door within 50m of SCU	\$.....	\$.....

Tenderer **Date**

APPENDIX E - SCHEDULE OF TECHNICAL DETAILS - ELECTRICAL SERVICES

DETAIL – LUMINAIRES

Complete this schedule of material items proposed and include with tender documents. These items must comply with the specification unless the tenderer nominates and includes details of the nonconformity.

Luminaire Designation	Manufacturer	Cat. No.	Lamp Type & Manufacturer	Delivery from Approval

EQUIPMENT CONFORMITY

Itemise below all points where tendered items differ from the specification.

EQUIPMENT ACCOMMODATION

Itemise below any equipment offered that cannot be accommodated in the spaces shown on the drawings.

Tenderer Date

DETAIL - POWER & ACCESSORIES

Complete this schedule of material items proposed and include with Tender. All items shall comply with the specification unless the Tender nominates and includes details of the nonconformity.

1	Cables	Manufacturer	.....
		Cat. No.	.....
2	Conduits	Manufacturer	.....
		Cat. No.	.....
3	SSOs	Manufacturer	.....
		Cat. No.	.....
5	Light Switches	Manufacturer	.....
		Cat. No.	.....
6	Isolators	Manufacturer	.....
		Cat. No.	.....
7	Cable Trays/Ladders	Manufacturer	.....
		Cat. No.	.....
8	Movement Sensors	Manufacturer	.....
		Cat. No.	.....

EQUIPMENT CONFORMITY

Itemise below all points where tendered items differ from the specification.

Tenderer **Date**

DETAIL - SCA

Complete this section of material items proposed and include with the tender. These items must comply with the specification unless the Tender nominates and includes details of the nonconformity.

1 MAIN SWITCH BOARD

	Manufacturer	.....
	Fault & Current rating	.....
	Segregation	.....
Main Switch		
	Manufacturer	.....
	Type	.....
Moulded Case Circuit Breakers		
	Manufacturer	.....
	Type	.....
Dimensions		
	W x H x D	.....
	Mass (kg)	.....

2 APARTMENT LOAD CENTRE(S)

	Manufacturer	.....
	Fault rating	.....
Miniature Circuit Breakers		
	Manufacturer	.....
	Type	.....
Residual Current Devices		
	Manufacturer	.....
	Type	.....
Contactors		
	Manufacturer	.....
	Type	.....
Dimensions		
Typical Load Centre	W x H x D	.....

EQUIPMENT CONFORMITY

Itemise below all points where tendered items differ from the specification.

EQUIPMENT ACCOMMODATION

Itemise below any equipment offered that cannot be accommodated in the spaces shown on the drawings.

DETAIL - COMMUNICATIONS CABLING

Complete this schedule of material items proposed. These items must comply with the specification unless the Tender nominates and includes details of the nonconformity.

1	Cable	Manufacturer	.....
		Cat. No.	.....
2	Outlets	Manufacturer	.....
		Cat. No.	.....
3	Horizontal Cabling Terminations	Manufacturer	.....
		Cat. No.	.....
4	Conduits	Manufacturer	.....
		Cat. No.	.....

EQUIPMENT CONFORMITY

Itemise below all points where tendered items differ from the specification.

EQUIPMENT ACCOMMODATION

Itemise below any equipment offered that cannot be accommodated in the spaces shown on the drawings.

DETAILS OF PROPOSED MANUFACTURER'S WARRANTY

(Attach separate sheets as required)

DETAIL – COMBINED FIRE / ACCESS CONTROL SYSTEM

SYSTEM PANEL

Manufacturer

Cat. No.

Read Distance

PROXIMITY KEY-TAGS (Proximity Card)

Manufacturer

Cat. No.

EMERGENCY BREAK GLASS

Manufacturer

Cat. No.

ELECTRIC STRIKE

Manufacturer

Cat. No.

Type

KEY-TAG READER (Card Reader)

Manufacturer

Cat. No.

Diameter

SMOKE DETECTOR

Manufacturer

Cat. No.

Type

THERMAL DETECTOR

Manufacturer

Cat. No.

Type

Tenderer **Date**

DETAIL - INTERCOM SYSTEM

1 BUILDING ENTRANCE STATION

Manufacturer

Cat. No.

MONITORING STATIONS

Manufacturer

Cat. No.