



## Leichhardt Park - Child Care

# Electrical Services Specification

Prepared by

**Peter Mizza**

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Level 6, Building B, 207 Pacific Highway, St Leonards NSW 2065

**T:** (02) 8484 7000 **F:** (02) 8484 7100 **E:** [sydney@wge.com.au](mailto:sydney@wge.com.au) **W:** [www.wge.com.au](http://www.wge.com.au)

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**PART A.            PRELIMINARIES**

Refer to Head Contract for Preliminaries.

**PART B.                    PROJECT SPECIFIC INFORMATION**

**B.1                         ELECTRICAL SERVICES**

Carry out work as detailed and in accordance with this specification and drawings, the whole of which shall be deemed to constitute one document.

Whether or not the words "supply and install" appear in the instructions, drawing and schedules of this specification, understand that, unless clearly excluded, materials and labour for the complete installation is required and must be supplied, delivered to site and installed.

**B.1.1                      Work Included**

The work includes but is not limited to the following main elements:

- Consumers Mains and Submains
- Switchboards
- Conduiting, Cable Trays and Cable Ducts
- Accessories
- Lighting Installation
- Emergency Lighting and Exit Signs
- Power Installation
- Fire Detection and Alarm Installation
- Telephone Installation
- Master Antenna Television System (MATV)
- Access Control System
- Commissioning and Testing
- Proprietor Instruction
- As Constructed Drawings
- Maintenance and Operating Instructions
- Maintenance

**B.1.2                      Co-ordination with other Trades**

Prior to purchase, installation or fabrication of any electrical equipment associated with switchboards or equipment to be installed by other trades check the actual requirements with the other trade and advise the Consulting Engineer if there are any discrepancies.

The following work associated with the electrical services will be carried out by other trades. The descriptions below are not intended to be a full specification of the work involved and indicate the general extent of work only. Liaise with the contractors and sub-contractors indicated to ensure that the work is properly co-ordinated.

**B.1.2.1**            Work by the Building Contractor

Provision of temporary light and power facilities for construction purposes.

Filling in with mortar and making good of conduit chases.

Final filling around and making good around wall boxes.

Cutting of wall tiles for wall boxes.

Supply and fitting of automatic awning shade and associated motor and control gear.

Position ceiling hangers to suit lighting layout.

**B.1.2.2**            Work by the Mechanical Service Sub-Contractor

Electrical work associated with the mechanical services installation apart from the work specified herein.

**B.1.2.3**            Work by the Hydraulic Services Sub-Contractor

Electrical work associated with the hydraulic services installation apart from the work specified herein.

**B.1.3**                **Samples and Details**

Samples of the items listed below shall be submitted for approval prior to purchase, at least 2 weeks before approval is required. Samples shall be clearly marked with the manufacturer's name and catalogue number.

After approval, samples will be available for incorporation in the works:

- One sample of all types of light fittings, clearly labelled with the letter designation from the light fitting schedule.

**B.1.4**                **Shop Drawings**

Prepare, and submit for review, shop drawings before commencing manufacture or installation.

Drawings shall be prepared using AS 1102 drafting standard symbols.

Drawings shall be provided with a legend of symbols, where applicable.

Shop drawings shall all be on the same size drawing sheets and shall be to the scale of not less than 1:100 and larger where necessary.

Shop drawings shall be of the same size as the project drawings.

Shop drawings shall cover the following parts of the work:

- All switchboards
- Fire Indicator Panel
- Communications Rack

Three copies of shop drawings shall be submitted. Allow 2 weeks for return of shop drawings. When requested amend shop drawings and resubmit.

Note that shop drawings are reviewed for general principle of design only and review of shop drawings by the Consulting Engineer in no way relieves the Contractor of his responsibility to comply with the requirements of this specification and associated drawings.

## **B.2 POWER SUPPLY**

### **B.2.1 General**

Power supply to the installation will be three phase, four wire, 415/240V, 50 Hz. All equipment supplied as part of this Contract shall be suitable for the actual voltage and frequency available.

The Electrical Services Sub-Contractor shall ensure that all equipment supplied conforms to the following requirements:

- Phases shall be balanced on all boards to within 10% of each other.
- Power quality, including a full harmonic study, shall be checked prior to occupation and afterwards to confirm that this conforms to AS 61000 and Supply Authority's requirements.

### **B.2.2 Interruption to Supply**

Any interruption to the power supply during the course of construction shall be kept to a minimum and shall be at a time to suit the Proprietor. Three weeks notice shall be given prior to any shutdown and allowance shall be made to perform the work associated outside of normal working hours.

### **B.2.3 Point of Attachment - Pole**

Obtain a price from a Level 1 installer for the connection of the new incoming power supply to the building from a new consumer's pole. Provide new consumer's pole and all conduiting as shown on the drawings.

Liaise carefully with the Supply Authority for the exact position of the point of connection required for Consumer Mains prior to the installation of cables or conduit.

The point of attachment required for Consumer Mains cables is at the point of attachment pole. Supply and install this pole in the position nominated by the Supply Authority. The diameter, gauge height and details of hardware at the top of the pole shall be to Supply Authority Approval.

Cables shall enter the top of the pole by means of a goose neck and shall be concealed within the pole.

The base of the pole shall be set in not less than 2 cubic metres of concrete. The top of the concrete shall be 150 below finished ground level.

All metalwork shall be hot dipped galvanised etch primed and painted with two coats of approved colour enamel.

### **B.2.4 Supply Authority Metering**

Make application for connection of the premises upon lodgement of the final ticket. Application shall be made and the security deposit (where applicable) paid for each meter.

Request the account details for each meter from the Consulting Engineer two weeks prior to application for connection.

Provide metering panel for energy meter as shown on the drawings within the electrical switchroom. Energy meter shall be EDM1 Mk10A. Alternative meters must be submitted to Superintendent prior to installation. Provide a mounting board for meter installation and ensure the meters are labelled in a neat and indelible fashion.

### **B.3 SWITCHBOARDS**

#### **B.3.1 General**

The Contractor shall supply and install the following switchboards:-

<b>ID</b>	<b>Description</b>	<b>Size</b>	<b>Width</b>	<b>Location</b>
MDB	New main distribution board.	160A	1600	External Wall
DB-2	New distribution board	100A	1500	Corridor Cupboard

The Electrical Sub-Contractor shall take care to advise his switchboard manufacturer of the size of sub-mains being run to each board and whether top or bottom entry in order that adequate space and provision for terminations is made.

Construction of switchboards is to ensure that at the completion of the contract that a minimum of 30 per cent spare pole space is available to each switchboard. Remaining poles on final sub-circuit chassis are to be filled with 20A 30mA circuit breakers of same type specified.

All switchboards shall be labelled as to their designation. Descriptors are to be approved before manufacture.

Detailed requirements specific to each switchboard are described on the single line diagrams within the drawing set and are to be included as part of the contract documents.

#### **B.3.2 Approved Switchboard Manufacturer**

The Switchboard Manufacturer is to be a member of the National Electrical Switchboard Manufacturer's Association (NESMA). The Switchboard Manufacturer is responsible for manufacture, assembly, testing and commissioning of all switchboards.

### **B.4 EARTHING**

#### **B.4.1 Main Earth**

Supply and install a 70 square millimetre green PVC insulated copper earth conductor enclosed in G.W.P. from the main switchboard to the earth connection point. At the earth connection point supply and install 12mm dia. copper clad steel core electrodes power driven to at least 2100mm deep.

The earth connection point shall be enclosed in a James Hardie Fibrolite valve box (P.W.D. type) type No. 4. The concrete lid of the box shall be marked "Main Earth". The top face of the lid shall be level with the surface of the ground.

Note The position of each earth connection point shall be approved by the Supply Authority and shall be clearly described on a plastic covered drawing mounted in the main switchboard.



#### **B.4.2 Earthing and Bonding**

The earth pin of all power outlets and the metalwork associated with all light fittings shall be directly earthed. Bare earth wire in close proximity to all live metal i.e., behind accessories and switchboard, etc. shall be covered with green plastic sleeving.

Metallic piping of a water supply system, any portion of which is underground installed within a building containing an electrical installation shall be bonded to the main earthing conductor.

All metallic trays, conduits, ducts, skirting ducts and equipment enclosures shall be earthed in accordance with AS 3000 and Austel Customer Premises Cabling Manual.

#### **B.5 ACCESSORIES**

Unless otherwise specified all accessories shall be flush mounted polycarbonate (Electric White). Accessories shall be of Clipsal or HPM manufacture, one make and style throughout. Accessories on concrete and masonry walls, etc. shall be mounted over wall boxes.

Flush plates shall be plumb and fit hard against wall surfaces. Heights as specified or shown on drawings shall be from finished floor level to the centre of the accessory.

Light switches shall be at 1100 unless otherwise shown. The exact position of all accessories, light fittings, etc. shall be decided on site by the Architect.

The Contractor shall ask for these positions not less than ten (10) days before positions are required. Regardless of positions shown, accessories on wall tiling shall be located centrally over the nearest tile course intersection.

Light switches generally, shall be 15 amp miniature rocker action mechanism in miniature flush plates to partitions and vertical standard size flush plates elsewhere. Mechanisms shall be "X" rated for use with fluorescent fittings.

Socket outlets shall be 10 or 15 amp (as required) switch socket combinations with miniature flush plates on skirting and standard size horizontal flush plates elsewhere.

Each socket outlet shall be fitted with an IPA marker of appropriate phase, colour and circuit number.

Time delay switches shall be HPM Cat XLTX770/1 or approved equivalent, plus capacitor and shall be time adjustable without needing to remove the switch from the wall box.

#### **B.6 LIGHTING INSTALLATION**

##### **B.6.1 General**

Supply and install all light fittings as specified herein and indicated on attached drawings.

All fittings must be installed square to the building lines.

All fittings shall be rigidly secured to the building structure either directly or with suitable trimmers.

Fluorescent lamp ballasts and starters shall be approved by an Australian Approved Authority.

Fluorescent fittings shall be complete with tubes white in colour unless otherwise specified and of one make. Fluorescent lamp ballasts and starters shall be approved by an Australian Approval Authority. Incandescent fittings shall be complete with Airam or similar 240V 5000 hour life lamps of the maximum wattage lamp recommended by the light fitting manufacturer.

All light fittings shall include an integral fuse in a fuse holder suitable for the temperatures expected.

#### **B.6.2 Security Lighting**

Security lighting shall be controlled over the hours of darkness by a contactor, operated by a photo-electric relay similar to National which shall be located in an approved position at high level.

A manual override switch for the contactor shall be provided on the switchboard unless otherwise specified.

#### **B.6.3 Time Switched Lighting**

Time switched lighting shall be turned on by separate contactors operated by the photo-electric relay but shall be turned off by a time switch. The time switch shall have 9 hours spring reserve.

A manual override switch for the contactor shall be provided on the switchboard unless otherwise specified.

#### **B.6.4 Emergency Light Fittings**

Where shown, supply and install self contained proprietary kits to convert one tube of the fitting nominated to being a maintained emergency light as a "single point system" all in accordance with AS 2293.

These kits shall be complete with Nickel Cadmium cells of Nife or other approved manufacture.

Where such fittings are switched, supply an active feed from the line side of the switch to each emergency fitting for supply failure sensing.

#### **B.6.5 Exit Signs**

Exit signs shall be maintained "single point systems" in accordance with AS 2293.

Exit signs shall be unswitched remaining permanently on.

#### **B.6.6 Lighting Control**

Provide lighting control as outlined on the drawings. Allow for proprietor training for the system.

#### **B.6.7 Pole top Luminaires**

Provide external pole mount luminaires as shown on the drawing.

Poles shall be of the height shown on the drawings and designed to comply with the following standards:

SAA 1170:1988 Part 1	Dead and Live Loads
SAA 1170:1988 Part 2	Wind Forces
SAA AS1250:1990	Structural Steel Code (where applicable)
SAA AS1798:1975	Preferred dimensions for lighting columns and bracket arms.
SAA AS1650	Galvanising
SAA AS1554	Welding

Each pole shall be structurally designed to support the load intended.

Ensure that spigots are the correct size to suit the luminaire entry.

The luminaire attachment to the pole shall be a threaded conduit entry with locknut. The point of attachment shall be weatherproof.

The poles shall be hot dipped galvanised steel as detailed on the drawings.

Each light fitting shall be connected via cable installed underground within heavy duty PVC conduit. Supply, install and connect all cabling and conduit.

Each light fitting shall be earthed to Ausgrid requirements.

The number of light fittings shall be as indicated on the drawings.

Luminaires shall have a minimum rating of IP 54. All seals shall be of neoprene construction.

Luminaires shall be fitted with lamps of voltage rated to suit and be guaranteed for 10,000 hours of operation.

All metal components installed underground whether painted or galvanised shall be coated in a protective bituminous coating prior to backfilling of soil (ie all foundation bolts, washers, nuts, pole base plate etc). All welds shall be galvanised.

The top of all concrete pole foundations shall be concealed underground.

Lighting poles and foundations shall comply with Australian Standards to suit the wind and soil conditions of the area. All designs must be certified by a practising structural engineer prior to fabrication.

Provide a fuse within each lighting pole.

Within each pole provide an access hatch 500mm above ground level for fuse and RCD housing. Secure hatch with torx screw or similar.

## **B.7 POWER INSTALLATION**

### **B.7.1 General**

Supply and install and wire all socket outlets and power fittings as specified herein and shown on the attached drawings.

### **B.7.2 RCD Protected Socket Outlets**

Provide residual current device (RCD) protection to the socket outlets in accordance with the requirements of AS/NZS 3000, wiring rules and with the requirements of regulation 3.60 of the Occupational Safety and Health Regulations.

RCD protection shall be provided via combined MACB/RCD or RCBOs units installed at the switchboard with a separate MACB/RCD unit for each socket outlet circuit.

The flushplate of each RCD protected socket outlet shall be engraved "RCD PROTECTED".

The flushplate of each non RCD protected socket outlet shall be engraved "NOT RCD PROTECTED".

An engraved label shall be installed on the door of each switchboard containing RCD protection reading "NON-PORTABLE RCD'S INSTALLED FOR SOME SOCKET OUTLET CIRCUITS".

### **B.7.3 Exhaust Fans**

Exhaust fans will be supplied and installed by the Mechanical Services Sub-Contractor.

The Contractor shall wire and switch same using lighting pattern switches engraved "EXHAUST FAN" in 3mm red filled upper case letters and shall provide an isolator adjacent to each fan where required.

Three phase fans shall be cabled in 2.5 square millimetre cable protected with a 16A TP MCB/RCD unless otherwise specified and shall each be provided with a contactor and overload relay on the switchboard. The overload relay shall be set to the actual name-plate rating of the fan.

Single phase fans shall, unless otherwise specified, be cabled from the nearest room lighting circuit in 2.5 square millimetre cables to a socket outlet fixed to the structure adjacent. The fan shall be fitted with a matching 3 pin plug top and flexible cable.

Duplicate toilet exhaust fans shall be controlled and cabled as shown on drawings.

### **B.7.4 Soft Wiring**

The soft wiring installation shall be as specified in the architectural documents and the desk equipment shall be supplied by the Contractor (Builder). Supply and install a power supply to each of the starter sockets located at desk level as shown on the drawing. Liaise with desk installer for exact locations.

Supply and install umbilical cords in locations shown on the drawing, colour is to be confirmed by the Superintendent. Supply and install cable tray to these drop down locations. For umbilical cords labelled 'future' provide the power supply coiled in the ceiling or cable tray and supply the umbilical cord for future installation.

### **B.7.5 Hand Dryers**

Provide hand dryers within the amenities as shown on the drawings. Hand Dryers shall be Dyson Airblade DB. Confirm exact location of hand dryer location with architectural elevations prior to roughing in supply cable.

### **B.7.6 Mechanical Services Power**

Provide power to the mechanical services isolator as shown on the drawings. Refer to the Mechanical Services Specification for details of control required to be installed within each of the switchboards.

### **B.7.7 Hot Water Units**

Hot water units will be supplied and installed by the hydraulic services trade.

Hot water units shall be direct connected via a local isolator. Allow for all final connections of unit to the isolator.

### **B.7.8 Awning Power Supply**

Provide a socket outlet within the awnings where shown for the power supply to the retractable awning motor. Liaise with the awning installer for any

## **B.8 FIRE DETECTION AND ALARM INSTALLATION**

### **B.8.1 General**

Engage an approved Fire Alarm Installer to supply, install, commission and maintain for twelve months a complete automatic Fire Alarm Installation using thermal and/or smoke detectors in the building as shown on the drawings and as specified herein.

The whole of the Fire Alarm Installation shall be carried out in accordance with the requirements of FESA Fire & Emergency Services Authority of Western Australia and the following Australian Standards, where applicable:

AS 3000	Part 1 Wiring Rules.
AS 1670	Automatic Fire Alarm Installations.
AS 2362.23	Manually Operated Fire Alarm Call Points.
AS 1668-Part 1	Fire Precautions in Buildings with Air Handling Systems.

The fire detection and alarm system shall be a conventional system.

### **B.8.2 Scope of Work**

- Supply, installation and wiring of a Fire Indicator Panel (FIP) complete with batteries, battery charger and reporting provisions for monitoring station.
- Supply, installation and wiring of thermal and/or photo-optic smoke detectors as shown.
- Supply and installation and wiring of manual alarm call points where shown.
- Supply, installation and wiring of flashing amber lights where shown. Lights to be visible for 1000m in daylight. Exact position will be given on site.
- Supply and installation of circuits from the FIB to control power to air handling equipment, exhaust and/or pressurisation fans as further described.
- Supply, installation and wiring of a Fire Alarm Bell to be positioned adjacent to the Main entrance where approved both by the Architect and local fire brigade.
- Supply and installation of circuits from the FIB to initiate operation of the Emergency Warning System.
- Supply and installation of engraved traffolyte building block plans on or adjacent to the FIB showing the zoning and coding.
- Supply and installation of a 2 core MIMS cable from the FIB to the MDF for the telephone land line link to the appropriate Fire Brigade premises. Pay the Telecom and Fire Brigade Connection Fee and first year's rental and monitoring fee.
- Supply and installation of Fire Alarm Protection Earth and connection via 6mm<sup>2</sup> stranded earth wire to ELU.
- Five (5) copies of the operating and maintenance instructions to be handed to the Consulting Engineer.
- Supply, installation and wiring of thermal detectors in the ceiling space located where required as per AS 1670.
- Supply, installation and wiring of remote ceiling mounted high intensity LED beneath each ceiling space detector.
- Twelve (12) months free maintenance and servicing.
- Testing and Commissioning including payment of fees to Witnessing Authorities and provision of materials such as smoke generators etc.

The fire alarm system shall be wired in stranded TPS cables with red sheath. Liaise with Fire Alarm System Installer to ensure that any conduits required to be embedded in concrete or built-in during the course of the contract are in fact installed.

All cables entering the Fire Indicator Panel shall be coded with plastic ferrules indicating the relevant zones. Each detector location shall consist of a deep conduit junction box finished flush with the underside of the ceiling or roof onto which the detectors shall be fitted. Full provisions shall be made on the Fire Indicator Panel for the addition of a further 2 zones at some future date (for future floors).

Each floor and fire isolated subsection of a floor of a building shall comprise a zone.

An alarm from any zone shall cause de-energisation of the tripping relay in the FIP for that zone.

### **B.8.3 Thermal Detectors**

Thermal detectors shall be generally Type A normal temperature duty incorporating fixed temperature and rate of rise actuation except where specifically required otherwise due to the local environmental conditions.

Detectors shall be mounted on plug-in type bases to allow easy replacement of detectors and shall be complete with LEDs to provide local visual indication when the detector initiates an alarm.

Detectors shall be approved detectors listed by SSL (Scientific Services Laboratory) Activfire.

### **B.8.4 Smoke Detectors**

Smoke detectors shall be mounted on plug-in type bases to allow easy replacement of detectors and shall be complete with LEDs to provide local visual indication when the detector initiates an alarm.

Where air sampling devices are required provide cut-outs in the ductwork as necessary and seal around the device after installation to prevent air leakage.

### **B.8.5 Additional Detectors**

Allow to supply and install fifteen thermal detectors and five ionisation type smoke detectors in addition to those shown on the drawings.

If these additional detectors are not all required then at the completion of the contract the contract sum will be adjusted in accordance with the schedule of unit rates.

### **B.8.6 Mechanical Services Fire Mode Operation**

Provide controls and cabling to operate the mechanical services generally in accordance with AS 1668 Fire Precautions in Buildings with Air Handling Systems and as further described below. All cabling shall be MIMS.

Where cabling is installed to switchboards provided by the Mechanical Services Sub-Contractor terminate cabling at the terminals provided.

Closely co-ordinate and plan the installation with the Mechanical Services Sub-Contractor. Shop drawings for the Mechanical Services Fire Mode Controls shall be inspected and accepted by the Mechanical Services Sub-Contractor prior to submission for approval.

#### Air Handling Units

Provide a common air handling unit "stop" signal and connect to each mechanical services switchboard.

The air handling unit "stop" signal shall be initiated automatically upon receipt of any fire alarm signal to the FIP.

Provide an "Auto-Off" manual control switch on the FIP to enable the air handling units to be manually shut down if required.

#### Toilet Exhaust

Provide a toilet exhaust "start" signal and connect to the appropriate mechanical services switchboard.

The toilet exhaust "start" signal shall be initiated automatically upon receipt of any fire alarm signal at the FIP.

Manual controls for the toilet exhaust are not required at the FIP.

### **B.9 BUILDING OCCUPANT WARNING SYSTEM**

An Occupant Warning System (BOWS) or similar approved shall be installed throughout the building in accordance with this specification.

The prime function of a BOWS is to transmit alert signals, evacuation signals and verbal address clearly and reliably via speakers in emergency zones.

The BOWS shall automatically initiate evacuation procedures within different areas of the building dependent on the origin of the alarm (i.e. "EVACUATE" in the active zone, or "ALERT" -> "EVACUATE" in the non-active zone).

The BOWS shall automatically initiate evacuation procedures or be manually operated. The BOWS shall also be used for non-emergency functions.

The system shall be provided with a microphone to enable announcements via a PA facility, and shall allow manual override control.

#### **B.9.1 Rules and Regulations**

The OWS shall comply with the current requirements of:

- AS1670
- AS3000
- Building Code of Australia
- The local Fire Brigade
- All relevant authorities

A copy of the certificate of compliance for the OWS shall be submitted upon request for:

- Emergency Control Panel (ECP)

#### **B.9.2 Control Panel**

The Control Panel for each zone of the evacuation system shall be located within the main FIP cubicle, with separate labelling to indicate the area served. All equipment shall be serviceable via front access only, by using plug in modules, with the field terminations accessible by opening the swing frame.

The Control Panel shall contain the Auto/Manual/Isolate/Public Address facility, and the common System Status controls and indicators.

A set of emergency operating instructions shall be mounted on the left hand side of the master control panel.

The Cabinet shall be a wall or floor-mounting cubicle with an internal swing frame. All equipment shall be serviceable via front access only, by using plug in modules, with the field terminations accessible by opening the swing frame.

The control sections of the equipment shall be secured by a locked door keyed to the Principal's requirements. All controls and indicators shall remain visible with the door closed.

The battery section shall be segregated from the main equipment section.

The operator's manual shall be accommodated in the inner side of the locked door.

The colour finish shall be Arch White or as nominated by Consultant.

The Control Panel shall contain the Auto/Manual/Isolate facility, the All Call facility and the common System Status controls and indicators.

A set of emergency operating instructions shall be mounted on the left hand side of the master control panel.

### **B.9.3 Automatic/Manual/Isolate Key Switch**

#### **B.9.3.1 Automatic Position**

In the Automatic Position the BOWS shall enter the programmed evacuation sequence when an alarm signal is received from the fire sprinkler system.

The switch key shall be removable only in this position.

A green indicator shall illuminate when the switch is in the automatic position.

#### **B.9.3.2 Manual Position**

The purpose of this position is to take manual control of the building evacuation, irrespective of the state of the alarm signals. This position shall also allow routine testing of the fire sprinkler system and BOWS.

The automatic initiation of an evacuation sequence shall be inhibited.

If the BOWS has entered the evacuation sequence whilst in the AUTOMATIC position and the BOWS is switched to the MANUAL position, the state of the BOWS at that instant shall be held, i.e. each zone's output remains static.

If the BOWS is then switched back to the AUTOMATIC position without any zone control switches being operated, the automatic evacuation sequence shall continue as normal, i.e. the evacuation sequence shall resume from the point immediately before the BOWS was switched to the MANUAL position.

If the BOWS is switched back to the AUTOMATIC position and the control switches have been operated, the automatic evacuation sequence shall not continue. If a new alarm input is received, this shall override the current state of the zones.

The system shall be reset (when required) by first acknowledging the alarm input, via the buzzer mute switch and then pressing the master reset switch.



#### B.9.3.3 Isolate Position

This position shall not isolate the alarm inputs.

This key-switch position is local to the control panel. A green indicator shall illuminate when the switch is in this position.

### B.9.4 **System Status Controls and Indicators**

#### B.9.4.1 Buzzer Mute

When the BUZZER MUTE button is pressed, all outstanding alarm and fault conditions shall be acknowledged. All flashing indicators shall go steady, and the buzzer silenced. For system wide faults (see below), pressing the BUZZER MUTE shall acknowledge the fault.

System wide faults are:

- amplifier / speaker line faults
- alarm system fault
- communications fault
- system on batteries - if all ECP's remotely powered
- battery fault - if all ECP's remotely powered
- charger fail - if all ECP's remotely powered
- tone generator fail / microphone pre-amp fail
- module fault
- system fault

#### B.9.4.2 Lamp Test Facility

The LAMP TEST shall be invoked by momentarily pressing the LAMP TEST button.

#### B.9.4.3 Zone Status (Fault Diagnostics)

To aid in diagnosing the type of fault on an evacuation zone, three buttons shall be included on the Control Panel. These buttons shall represent the three types of evacuation zone faults that can occur, i.e. alarm system, amplifier/speaker line and visual indicator. When one of these buttons is pressed, only the zones with a fault present as represented by the push button shall have their BOWS fault origin indicators illuminated. This facility shall be non-latching and therefore the BOWS fault origin indicators shall return to their former state when the button is released.

There are twelve system status indicators. These shall illuminate as detailed:

- |                     |   |   |
|---------------------|---|---|
| Power On            | - | when the control panel is operating from mains supply |
| System on Batteries | - | when the control panel is operating from batteries    |
| Charger Fault       | - | when the battery charger fails                        |

Battery Fault	-	when the battery voltage drops below the lower limit
Battery Isolated	-	when the batteries have been isolated from the battery charger
Tone Fault	-	when the signal/speech generator has failed
ECP In Control	-	see MANUAL POSITION for the key-switch
CPU Fault	-	whenever the microprocessor controlling the control panel is held in RESET
Comms Fault	-	whenever a fault is detected in the communications bus
System Fault	-	whenever a module in the system has a fault
Module Fault	-	when any module in the system has failed
Microphone Fault	-	when the microphone

#### **B.9.5 Emergency Warning System**

Each evacuation zone identified in this specification or on the drawings shall have amplifier(s) and a number of associated speakers. In sections of the building where background noise is high, visual alarm devices shall be used in addition to speakers. Each evacuation zone may have one of four audio channels. These channels are PA, Alert signal, Evac signal and Off. The Off channel shall be configured on site (via a jumper) on a zone basis to one of the following sources:

The BOWS system shall have a microphone for the PA input, and a tone generator module (TGM), which is responsible for generating the alert and evacuation signals.

The BOWS shall have two possible types of alarm signal inputs to indicate that an emergency condition is occurring in the building. These are:

- Emergency Alarm Initiating Devices (EAIDS)
- Fire Alarm

These inputs shall be grouped according to the building evacuation zones.

When an input initiates an alarm signal, the BOWS if in automatic mode, shall initiate a preset evacuation sequence. The evacuation sequence shall sound the alert and the Evac signals to the evacuation zones within the building (and activating the visual alarm devices if installed) according to the pre-programmed evacuation sequence. The manual override shall cease the pre-programmed evacuation sequence, and output alert and Evac signals to evacuation zones as dictated via the BOWS panel control switches.

The BOWS shall provide full system status and fault indication facilities.

#### **B.9.6 Occupant Warning System Zone Control Switches and Indicators**

The control switches shall allow any of the audio channels to be switched to any of the zones. The Control Switches shall be inhibited when the BOWS is in the AUTOMATIC state.

Pressing any of the control switches for an evacuation zone shall automatically cancel the previous selection for that zone, i.e. only one audio channel shall be assigned to a zone at any one time.

For each evacuation zone there shall be a set of control switches and associated indicators:

- CANCEL - Control switch only
- PA - Control switch and indicator
- ALERT - Control switch and indicator
- EVAC - Control switch and indicator

#### B.9.6.1 Occupant Warning System Zone Fault

BOWS Zone Fault indicator shall flash when a fault is detected by the MAIN EQUIPMENT on any of the wiring or components associated with that zone, and go steady when the fault is, acknowledged by the buzzer mute switch.

#### B.9.6.2 Alarm Origin

Alarm Origin indicator shall flash when an input, associated with that zone, has been activated and go steady when the alarm is, acknowledged by the buzzer mute switch.

Fault and Alarm indicators shall not be inhibited by any key-switch operation.

##### B.9.6.2.1 Signal Generator

This shall generate the alert and Evac signals to comply with the Australian Standard AS1670 clause 8.7.

When the alert signal is first initiated to a zone, the signal bursts shall increase in amplitude, starting at 50db down and increasing at 10db increments to full output by the sixth step.

The Evac signal shall have four bursts of Evac signal.

##### B.9.6.2.2 Microphone

The Microphone shall be used for the PA facility. The microphone shall have a press to talk (PTT) switch.

##### B.9.6.2.3 Zone Volume Adjustment

Each Amplifier shall have a volume adjustment on the front edge of the module. This may be field adjusted to suit.

##### B.9.6.2.4 Emergency Alarm Initiating Device

The EAID on the control panel shall be one of the Alarm inputs for the evacuation zone that corresponds to the section of the building where the control panel is located.

##### B.9.6.2.5 Power Supply/Charger

Provide a power supply/battery charger of modular construction. Each module is to be used in parallel and rated at 7.5 amps. As well as being modular the power supply must comply with AS2220 part 1 and 2.

Mains supply shall be 240V AC (+6% ± 10%) at 50Hz and installed in accordance with AS3000 and AS1670 - 1986.

##### B.9.6.2.6 Batteries

Supply and install sealed lead acid batteries that comply with AS1670.

#### B.9.6.2.7 Field Devices

All field devices shall:

- Be designed and installed in locations with a view to minimise the detrimental effects of moisture, dust, insects and other foreign materials.
- Be installed in accordance with manufactures recommendations.

#### B.9.6.2.8 Speakers

All ceiling speakers shall:

- Have an overall maximum diameter of 100mm
- Have a multi-tap transformer
- Be supplied with a matching grill
- All horn speakers shall:
  - Have a minimum power rating of 10 watts
  - Be reflex horn type with a multi-tap transformer

#### B.9.6.2.9 Visual Alarms

All visual alarms shall:

- Have an overall diameter of 100mm
- Incorporate a xenon tube

#### B.9.6.2.10 Emergency Alarm Initiating Devices

All break-glass EAID's used as EAID's shall:

- Be white in colour
- Be approved to AS2036

#### B.9.6.2.11 Testing

The system shall be tested in accordance with AS2220 Part 2 Appendix E, F, G and H and the results submitted to this office as part of the as installed drawings.

#### B.9.6.2.12 System Test

Each control panel shall be equipped with a SYSTEM TEST button, to be used for commissioning and testing.

If the BOWS system is in automatic and if the system test button is depressed, and then the key-switch moved from auto ->manual->auto, and the system test button is released, then the zone off switches shall become active for 20 seconds. Depressing a zone off switch within 20 seconds will cause the evacuation sequence for that zone to be commenced. The sequence shall be aborted if the key-switch is moved, or the BOWS receives an alarm input.

Similarly, if the BOWS system is in the automatic mode, and the system test button is depressed, then the key-switch is moved to the isolate position and the system test button released, the system test button shall be active in the isolate state. With the system test button active, if it is depressed and then released, then the evacuation sequence for any zone shall commence by depressing the corresponding zone off switch within 20 seconds of releasing the system test button for the second time. The evacuation sequence shall be indication only, i.e. zone speakers and visual display devices are inhibited, and all time-outs are reduced to 5 seconds. The sequence shall be aborted if the key-switch is moved, or the BOWS receives an alarm input.

#### B.9.6.2.13 Operators Manual

Provide an operators manual detailing full operation of the system.

#### B.9.6.2.14 System Cabling

The system cabling shall comply with the Australian Standards listed under rules and regulations of this document and follow the appropriate guidelines listed below.

#### B.9.6.2.15 Control Panel to Speakers

A two core cable from each amplifier shall be installed to the first speaker and then looped to the other speakers in that zone. An E.O.L. resistor shall be installed across the 100V line at the last speaker of each zone.

#### B.9.6.2.16 Master Emergency Control Panel to Visual Alarms

A two core cable shall be installed to the first pair of visual alarms and then looped to the other VA's in that zone.

A building occupant warning system is to be installed utilising the PA system and speakers to provide the tones.

Supply and install to the fire indicator panel an output module to initiate a building occupant warning signal. Liaise with the PA system installer as to the signal requirements and confirm compatibility of signal output with the input to the PA system. From the fire indicator panel supply and install fire rated cabling to the evacuation module of the PA system. The PA system installer will terminate the cable into the evacuation module. Allow to test the cable for the instruction of the PA system installer in the termination of the cable. Assist the commissioning of the building occupant warning system. Provide the relevant documentation to the PA system installer to confirm compliance of the system. Intercommunication Point (WIP).

## **B.10 PHOTOVOLTAIC INSTALLATION**

### **B.10.1 General**

Engage a the qualified photovoltaic installer to provide a complete 4kW photovoltaic power generation system. System shall be non-export and non-grid connected and contain the following:

- System Design
- Panels
- Inverter
- Web Box
- DC Cabling
- Interface to data network

System shall be designed in accordance with the following standards:

- AS 5033:2012 – Installation and safety requirements for photovoltaic (PV) arrays
- AS 4509 Stand-alone power systems
- AS 3000 Electrical Wiring Rules
- AS 1768 Lightning Protection
- AS 1170.2 Wind Loads
- AS 4777.2:2005 Grid Connection of Energy Systems via Inverters – Inverter Requirements

Photovoltaic installer shall have all the relevant qualifications including CEC accreditation.

System design shall be submitted to the Consulting Engineer for review. Allow one week for comment returns.

#### **B.10.2 Panels**

Supply and install multicrystalline panels from a Tier 1 Photovoltaic panel manufacturer on Playroom 4 roof. Panels shall be high efficiency with textured glass to deliver minimum 15% efficiency.

Panels shall comply with IEC 61730 Class A, panels shall comply with IEC 61215 or IEC 61646.

Provide all brackets and fixings for the panel mounting frame to comply with AS1170.2 to ensure the system is fixed securely.

Layout of panels and wiring configuration shall be included in the system design submission.

Any proposed panel must have an “energy payback period” of less than 1.5 years i.e. an individual panel has an allowable maximum of 1.5 years to generate the energy expended during the manufacture of the panel.

All photovoltaic panels should be manufactured in accordance with IEC 61646 for thin film types or IEC 61215 for crystalline types.

Each panel shall be fitted with a back mounted junction box for termination of DC cabling. The junction box shall have a weatherproof rating of IP54 (minimum).

Each panel shall incorporate a bypass diode to prevent reverse currents and hot spotting in accordance with AS 5033.

Photovoltaic panels shall be orientated so as to ensure optimum panel output.

#### **B.10.3 Inverter**

Provide 1 off 5kW three phase SMA Sunny Tripower inverter, located wall mounted adjacent to the Main Distribution Board within the Workshop. Inverter efficiency shall be greater than 95% with tracking system. Maximum output current of each inverter shall be 16A and power factor output shall be 1.

Inverters shall have string fuse, string failure detection and DC surge arrester.

The inverters are required to have the following protection functions:

- Under voltage trip set point

- Over voltage trip set point
- Under / over voltage close time delay
- Under frequency trip set point
- Over frequency trip set point
- Under / over frequency close time delay
- Over frequency power reduction
- Voltage increase protection
- Phase shift protection
- Neutral voltage displacement

Inverter shall export data to a Sunny Web Box, mounted adjacent, and provide system data. Provide all necessary Cat 6 ethernet cabling and commissioning required to connect inverters to web box and from web box to the communications rack.

Liaise with builder prior to installing inverters to determine the space available within the Comms Room.

#### **B.10.4 Power Connection**

Provide connection of cable to Main Distribution Board with 1 off 16A MCBs located within an enclosure in the Comms Room protecting 1 sets of 4 core 16mm<sup>2</sup> XLPE copper cables connected to 1 off 16A isolators within MDB.

System design shall verify the cable size, fault capacity and voltage drop of the AC connection.

#### **B.10.5 Structural Requirements**

General requirements: Fabricate and erect the structural steel in a safe manner, without interfering with or damaging adjacent structures, using methods complying with the requirements of AS 4100 for materials, construction, fabrication and erection.

Design and fixing of the photovoltaic panels support frames shall adhere to the following structural requirements.

Existing purlin sizes, spans, spacings and roof sheeting types where panels are to be fixed down are to be confirmed and submitted for review to ensure design assumptions made..

Contractor to confirm no strengthening and bolting connection to the existing purlins or structural steel beams are expected to be required as the weight of the photovoltaic panels or any resultant wind uplift force is to be spread evenly and sufficiently over the roof sheeting through spreader beams and closely spaced bulb-tite rivets.

The spreader beams are to be 125PFC (or similar subject to contractor design checks) and are to be Grade 300. Each beam is to extend at least two (2) ribs beyond the end of the photovoltaic panels. Each end of a spreader beam is also to extend over to the next closest purlin from the end of the photovoltaic panels.

The spreader beams are to be fixed to the top of the roof sheeting with bulb-tite rivets (or similar subject to contractor design checks) at 200 c/c spacing to the roof sheeting's rib locations.

The spreader steel beams are to be laid with a slight fall to allow draining of water under gravity.

The spreader beams are to be galvanised for corrosion protection to AS.

The design of the panel support frames and fixing including the bulb-tite rivets are to be carried out by the contractor. All design and construction responsibility is to be carried by the contractor.

The total weight of the photovoltaic panels is not to exceed 15kg per 1m<sup>2</sup> area or 0.15kPa working load.

Wind loading to be considered in the design and fixing of the panels support frames including the design of the bulb-tite rivets is to be in accordance with AS 1170 Part 2.

Water tightness at the rivet fixing locations is to be addressed and is the responsibility of the contractor. All fixings shall be non-penetrative, clamp type where possible.

Locations of photovoltaic panels on the existing roof are flexible however the followings are to be avoided:

- Existing roof sheeting joints
- Walkways
- Platforms
- Mechanical ducts
- Local towers and domes

#### **B.10.6                      Warranty**

Provide a 20 year warranty for the full installation of the Photovoltaic system.

#### **B.11                              INTERCOM SYSTEM**

##### **B.11.1                      General**

Provide a new intercom system to allow communication between the external primary access door and the internal circulation space. Allow to provide all equipment, power supplies, installation, commissioning and proprietor training for a complete product.

##### **B.11.2                      Functionality**

The intercom system shall be designed to allow after hours call from the front entrance to the bell system throughout the centre. The indoor receiver shall communicate with the entrance panel and allow unlock access to the front door.

##### **B.11.3                      Equipment**

The Entrance Panel shall be Urmet Sinthesi or similar with video and audio transmission capability.

The Indoor Receiver shall be Urmet Arco or similar with video and audio receiving capability.

#### **B.12                              COMMUNICATIONS INSTALLATION**

##### **B.12.1                      General**

The communications installation shall be carried out by an approved Specialist Communications Installer. The complete installation shall comply with the requirements of the Client.



## B.12.2 Telephone Backbone Cabling Installation

### ▪ General

Supply and install the telephone backbone cabling installation including the following main items:

- Main distribution frame (MDF), boxes and blocks.
- Telephone backbone cabling.
- Telecommunication reference conductor system.
- All miscellaneous items such as insulating crossings and cable and covers, cable trays, conduits, ducts, battens and sundries such as clips, screws, masonry anchors, fasteners, etc. as required for a complete concealed re-wireable installation.

All telephone cabling shall be carried out by an approved General Premises Cabling Contractor.

All work shall be carried out in accordance with the current issue of "Customer Premises Cabling Manual" issued by Australian Communications Authority (ACA) and in accordance with all other requirements of AS 3080.

### ▪ Lead-in Cable

The lead-in cable shall be installed and terminated at each end by contractor from the existing network. Provide cable access for the lead-in cable as shown and as directed by the Superintendent.

### ▪ Main Telephone Distribution Frame

Supply and install patch panels for the main distribution frame (MDF), mounted in the MDF Room as shown on the drawing.

### ▪ Telephone Backbone Cabling

Supply and install 50 pair backbone telephone cable from the MDF to each Communication Distribution Frame and Tenancy Distribution Frame, terminate each cable at Krone Highway (or equivalent) patch panels mounted on 19" racks in accordance with the communications schematic diagram.

### ▪ Provide cable record book at the MDF location.

## B.12.3 Combined Data and Voice Cabling Installation

### B.12.3.1 General

The communications installation is a Category 6, combined voice and data installation. All telephone and data outlets shall be supplied from the communications racks located in the following communications rooms:

### ▪ Standards

The installation shall be carried out in accordance with the latest editions of the following standards and regulations:

- AS 3000 SAA Wiring Rules
- AS 3080 Integrated Communications Cabling Systems for Commercial Premises

- AS 3084 Telecommunications Pathways and Spaces for Commercial Buildings
- AS 3085 Administration of Communications Cabling Systems
- EIA/TIA 568A or 568B as appropriate
- TIA/EIA 568B.2.1 Transmission Performance Specifications for 4 Pair 100 ohm Category 6 Cabling
- Australia Communications Authority.

In addition, all items of equipment and cabling used in this installation shall comply with the following Electromagnetic Compatibility (EMC) standards to ensure acceptable immunity to Electromagnetic Interference (EMI):

- IEC 801-2, (IEC 1000-4-2) Electrostatic Discharge (ESD)
- IEC 801-3, (IEC 1000-4-3) Electric Field Susceptibility
- IEC 801-4, (IEC 1000-4-4) Electrical Fast Transients (Burst).

▪ Work included

The communications installation shall comprise the following main items:

- Category 6, 4-pair, Unshielded Twisted Pair (UTP) integrated cabling plant complete with RJ45 outlets for provision of the voice and data requirements as detailed herein and indicated on the electrical drawings.
- Supply, install and connect Cat 6, 4 pair UTP cabling from the patch panels to each data/telephone outlet.
- Supply and install all patch panels and leads RJ45 to RJ45 within each communications rack or cabinet as specified herein.
- Supply and install all telephone and data outlets mounted behind flush plates on wall fittings, in floor boxes or skirting duct or power poles.
- Supply UTP cat 6 (4 pair) patch and fly leads as follows
  - i. 3,000mm fly leads for every installed outlet for data use +10%.
  - ii. An appropriate length patch lead for every installed outlet +10%.
- Supply and install all connectors and cable support systems as required.
- Supply and install all necessary accessories as required to complete the installation.
- Provide cable records and outlet numbering.
- Testing and commissioning of the system as a Category 6 installation.

All communications cabling supplied under this contract shall be similar and shall be suitable for use at all data rates up to and including 200 MHz, (tested to 250MHz) whether suited as initially being used for data or telephone. This applies to cabling initially used for telephone and data outlets.

All equipment and materials supplied and used shall be new and of a make and manufacture as specified herein. Any variations from this specification must be discussed with and approved by the Engineer prior to proceeding.

All equipment and materials supplied and used shall be unobtrusive and shall, as far as practicable, blend with the quality, décor and tone of the surrounding area.

The complete installation shall utilise one make of equipment if possible.

#### B.12.3.2 Installation

The cable type for this installation is to be Category 6, 4-pair 100 Ohm Unshielded Twisted Pair (UTP) cable of Pirelli Max 6, Belden Mediatwist or General Command Linx 6 or approved equivalent manufacture.

The route length of all UTP cable runs from the communications rack patch panels to the workstation outlets shall not exceed 90m.

All UTP cabling shall cross other runs of cables at ninety (90) degrees wherever possible.

All UTP cabling shall be terminated at both ends.

All UTP cabling shall be installed to avoid stretching, kinking, tight bends and damage from adjacent fixtures or plant.

All cables shall appear on the communications rack patch panels in a logical sequence relative to their position on the floor plan. The two or three runs of cable from each position shall be terminated on adjacent outlets at the communications rack patch panels.

The UTP cabling from the communications rack patch panels to the outlets shall be installed on the cable trays or clipped to the building structure in the ceiling space.

As far as is practicable, all UTP cabling shall be separated as far as possible from other cabling, with long runs close to and parallel to other cabling being avoided. Cabling not installed in ducting shall be separated from power cables and other sources of electrical interference by a minimum distance of 300mm. Cabling installed within walls and workstations shall be installed a minimum of 50mm from power cables.

The cables associated with each patch panel in the communications racks shall be kept together. Wherever required, cable management systems shall be utilised to complete a neat installation.

#### B.12.3.3 Enclosures

Supply and install one off 40RU high, 19 inch cabinet assembly to the Main Communications Cupboard.

The dimensions and the requirements of racks/cabinets are as detailed on the drawings and as follows:

- Useable height 40RU.
- Useable depth 700mm (minimum) as indicated on the schematics.
- Finish of rack/cabinet to be Dulux Powdercoat.
- Secure rack to the floor through the base. The base of the rack is to be large enough to maintain rigidity when fully fitted out and in use. The base of the rack is not to extend more than 100mm in front of the rack face, and not more than 500mm behind the rack face.
- Racks/cabinet to be mild steel and to have all edges, corners, etc, rounded and made smooth.

- Provide 1RU high cable management system to each patch panel in accordance with the drawings.
- Provide rear cable support system to each patch panel or utilise front and rear horizontal cable managers.
- Provide 40RU high lacing bar to the front of each rack/cabinet or equal and approved cable management system.
- Provide vertical type power rail with minimum of 20 GPO's for each rack.
- Provide dual rack in the Main Communications Room on First Floor.

Submit details of proposed rack to the Engineer for approval before construction of the rack to ensure suitability of the product offered.

▪ Cable Access

Install from top of one cabinet to bottom of the next cabinet on the floor above a 300mm wide cable tray. When fixing to gyprock stud wall ensure the tray is adequately supported so as not to damage the wall to which it is attached. Dual cabinets shall include cable ladder across the tops.

B.12.3.4 Connectors

All connectors shall be 8-pin, RJ45 type modular sockets and plugs.

The connect pins configuration for each RJ45 connector shall be as follows:

Pair	Colour	Pin
1	White – Blue	5
	Blue – White	4
2	White – Orange	3
	Orange – White	6
3	White – Green	1
	Green – White	2
4	White – Brown	7
	Brown – White	8

B.12.3.5 Plaster Dust Protection

All existing data outlets shall be protected by plaster dust and other foreign matter from entering the outlet during building work. Provide 3M Scotch #810 Magic Tape or Pritt Invisible Tap 24mm to seal outlets during construction. No other tape shall be permitted to be used.

#### B.12.3.6 Outlets

All facility UTP cabling shall be terminated in RJ45 outlets with integral cable strain relief. Each outlet shall be mounted on a flushplate that match those used for GPO's. An alternative shall be the angled faceplates to reduce cable bend radii associated with skirting duct or modular furniture.

#### B.12.3.7 Patch Panels

Supply and install 1RU high 1 x 24-way patch panels complete with Category 6, RJ45 outlets.

The number of patch panels per rack in each communications rack shall be adequate for the incoming and outgoing cables and an allowance of 30% spare capacity.

Each patch panel shall be complete with a rear cable support bracket running the full length of the panel and spaced approximately 100mm behind the panel or an equal and approved cable management system.

Generally, the exact location of the panels within each rack shall be as shown on the drawings. Confirm locations with the Engineer prior to installation.

Supply and install horizontal cable management system for each patch panel.

#### B.12.3.8 Communications Earthing

Provide a communications earth installation and connection to the communications racks in accordance with the ACA Customer Premises Cabling Manual "Telecommunications Reference Conductor".

#### B.12.3.9 Cable Records and Labelling

Outlets on the communications rack patch panels shall be numbered consecutively from left to right, top to bottom, using a permanent proprietary numbering system. Typewritten or handwritten lettering is not acceptable.

Each voice or data outlet shall be labelled with the full identification of the corresponding patch panel outlet.

Each outlet shall be labelled by engraving the outlet flushplate. Each outlet shall have a unique label.

Full documentation (i.e. record book) is to be provided at each communications rack and Computer room giving complete connection details and a plan of the area of the building with each outlet supplied from the communications rack identified.

The Record books shall be located in a suitable housing secured on the inside door of the communications riser or room.

### **B.13 MASTER ANTENNA TELEVISION SYSTEM (MATV)**

#### **B.13.1 General**

All work shall be carried out in accordance with AS 1367 Multiple Outlet TV Systems.

The system shall produce a high quality colour and black and white picture at each outlet for all local VHF and UHF relay channels. Sufficient isolation between outlets shall be provided to prevent interaction between them. The minimum signal strength of any outlet shall be 1 millivolt.

- The Contractor shall engage an approved specialist T.V. Sub-Contractor to carry out:

- Installation and wiring of antenna(e) including all necessary brackets and flashing on the roof. The proposed antenna position shall be approved by the Architect prior to any installation commencing.
- Supply and installation of all cabling between antenna(e) amplifier(s) and outlets. Cabling to be 75 ohm coaxial DSC2.1 and DSC3.2 as necessary.
- Supply and installation of TV amplifier(s) as required, located as further described.
- Supply and installation of outlet plates.
- All other miscellaneous equipment necessary.
- Testing and commissioning the system.

#### **B.13.2 Details**

The Contractor shall supply and install all conduits required by the TV cabling.

#### **B.14 COMMISSIONING AND TESTING**

##### **B.14.1 General**

The installation shall be tested to the satisfaction of the Consulting Engineer and the Statutory Authorities prior to Practical Completion.

The installation shall be tested progressively as areas of work are completed and the whole installation shall be tested when complete in sufficient detail to ensure the following:

- Installation is mechanically and electrically safe.
- Installation operates correctly under normal, emergency and fault conditions.
- Phases shall be balanced on all boards to be within of 10% of each other.
- Power quality audit, which includes a full harmonics study, shall be carried out prior to occupation and afterwards to confirm that this conforms to AS/NZS61000 and Supply Authority's requirements. This includes the Mechanical and Hydraulics Services switchboards. Any non-conformance prior to occupation shall be rectified by the relevant Electrical, Mechanical or Hydraulic Services Trade.

Any equipment or materials found to be faulty during testing shall be repaired or replaced to approval and retested.

Carry out specific commissioning procedures as set out in the following clauses and allow all costs of materials and labour required.

Within the construction programme allow adequate time for carrying out all commissioning prior to practical completion.

Record results of all commissioning and testing, including date of test and provide copies of test results to the Consulting Engineer when requested.

As each area of the installation has been satisfactorily tested/commissioned, advise the Consulting Engineer in writing. Repeat the tests when requested to be witnessed by the Consulting Engineer.

Where Statutory Authorities require to witness commissioning/testing procedures, the Contractor shall advise them in writing of the test results and repeat the tests as required by that Authority.

It shall be the Contractor's responsibility to obtain the approval of the Statutory Authority prior to practical completion.

#### **B.14.2 Time Switches**

Adjust the setting as instructed. Prove that the time switch controls the correct circuits as specified and show that the manual override switch is operative.

#### **B.14.3 Photocells**

Check the operation of the photocell by shading and check that the correct circuits are controlled. Check that manual override switches operate correctly.

#### **B.14.4 Motor Controls**

Check that overloads are set to the nameplate rating of the motor and will trip the motor out in the event of an overload.

Test each element of the control circuit to ensure that it is operative and that it performs its correct function.

Control devices representing pressure, temperature, flow, water level, etc., shall be actuated to prove their correct function.

Manual start/stop functions shall be tested. Alarm provisions shall be tested to ensure they operate as specified.

Duty/standby selection whether manual or automatic, shall be tested.

#### **B.14.5 Emergency Lights and Exit Signs**

Check that each emergency light operates correctly when the appropriate normal power circuit voltage fails.

For fittings with maintained operation, check that the manual switches energise the appropriate fittings.

Check the power available light and the test switch on single point fittings are operative.

Conduct commissioning tests in accordance with AS 2293.

#### **B.14.6 Fire Detection and Alarm Installation**

Carry out commissioning as specified in AS 1670.

#### **B.14.7 Communications Installation**

Each cable run shall be tested for conformance with the minimum requirements for Category 6 operation in accordance with the latest edition of TIA/EIA 568B.2.1 and as detailed herein.

Each cable run that fails to meet the minimum requirements for Category 6 operation shall be replaced in its entirety at no extra cost to the Principal.

All test results shall be documented with the cable (routes) under test being identified by its outlet label as specified in the previous clause.

Perform TIA/EIA Category 6 Permanent Link Tests using the latest model of the Fluke DSP tester with Omniscanner and PM 25 leads with the latest software and standard versions current at time of testing or other vendor approved Level 4 tester and permanent link leads.

All testing shall be conducted with calibrated test equipment, which shall be nominated at tender stage. Current calibration test certificates shall be checked by the Vendor and made available for inspection at any time by the Superintendent.

Typical test parameters for Cat 6, UTP, Class E, 250 MHz frequency, 1000Mbps throughput and 1000 Base T Application shall include, but not be limited to, the following:

- Correct wire map
- Electrical length
- NEXT
- PS NEXT
- ELFEXT
- PS ELFEXT
- Return Loss
- Attenuation
- Delay
- Delay Skew.

All test results shall be checked and signed off by the Vendor and made available for inspection by the Superintendent, along with the Final System Certification.

#### **B.14.8 Intercom System**

Check the operation of all master and slave stations when initiating and receiving calls.

#### **B.14.9 Security System**

Check the operation of each separate monitoring device (e.g.. door reed switches, motion detectors, vibration detectors, photo-electric detectors) by initiating operation of the device and checking that an alarm is registered as specified, including remote monitoring of the alarm when specified.

Check the operation of each card reader for both a valid and an invalid card-key.

Check the operation of each electric lock in both the locked and un-locked position.

Check that the tamper and door ajar alarms are operational for at least two different points.

Check that the battery power supply for the system is adequate by isolating the normal supply and operating the system for the specified period.

#### **B.14.10 MATV System**

At each outlet measure the output voltage for each programme signal normally receivable in the designated area and for any local input signals (e.g. video recorder).



Adjust equipment as necessary to ensure that all measurements are within the system performance criteria specified in AS 1367 Multiple Outlet Distribution Systems.

At the outlets nominated by the Consulting Engineer connect a colour monitor and check that the picture quality is acceptable for each programme signal normally receivable in the designated area and for any local input signals.

#### **B.15 PROPRIETOR INSTRUCTION**

Provide experienced personnel to instruct the Proprietor's nominated representatives in the operation of the electrical service equipment and systems.

#### **B.16 AS CONSTRUCTED DRAWINGS SUPPLIED BY CONTRACTOR**

Approaching Practical Completion, the Electrical Sub-Contractor shall, at his request, be supplied with a copy of the CAD drawings (format shall be in accordance with Wood & Grieve Engineers current software).

He shall record the positions and sizes of all conduits, boxes, cable trays, cables, and cable pits to produce "as constructed" drawings.

Drawings shall be amended by a competent draftsman with CAD experience.

The Electrical Sub-Contractor shall sign these drawings and mark each one "as constructed" and return same to the Architect.

The Electrical Sub-Contractor shall provide the following copies of the "as constructed" drawings:

- One complete set of all drawings in reproducible format.
- One copy of CAD drawings on disk.
- Three sets of reduced A3 prints of all drawings to be included in the maintenance and operating instructions.

#### **B.17 MAINTENANCE AND OPERATING INSTRUCTIONS**

Provide 3 copies of the maintenance and operating instructions. The instructions shall be bound in a hard cover, plastic covered, ring binder. The cover and spine shall be labelled in block lettering.

The instructions shall include the following sections:

- Description of System
- Operating Instructions
- Maintenance Instructions
- Warranty Maintenance
- Fault Finding
- Equipment Schedule (including lamps and globes)
- Control Schedule
- Name plate Details

- As Constructed Drawings.

#### **B.18 MAINTENANCE**

Provide corrective maintenance and repair to all electrical equipment and systems which become defective, or is found to be defective, during the Defects Liability Period, including the making good of any resulting damage.

In addition, provide preventative maintenance of the electrical services for the full duration of the Defects Liability Period, in accordance with this section.

Prepare and retain copies of all service reports, including details of all preventative and corrective maintenance work carried out and copies of log book entries. At the completion of the maintenance period or at any other time when requested submit a copy of all records to the Superintendent.

## **PART C.            TECHNICAL**

### **C.1                    GENERAL**

Part C is the standard specification and together with the rest of the specification and drawings are deemed to constitute one document.

Whether or not the words "supply and install" appear in the instructions, drawing and schedules of this specification, understand that, unless clearly excluded, materials and labour for the complete installation is required and must be supplied, delivered to site and installed.

### **C.2                    LOW VOLTAGE (LV) INSTALLATION**

#### **C.2.1                Earthing and Bonding**

The earth pin of all power outlets and the metalwork associated with all light fittings shall be directly earthed. Bare earth wire in close proximity to all live metal i.e., behind accessories and switchboard etc. shall be covered with green plastic sleeving.

Metallic piping of a water supply system, any portion of which is underground installed within a building containing an electrical installation shall be bonded to the main earthing conductor.

All metallic trays, conduits, ducts, skirting ducts and equipment enclosures shall be earthed in accordance with AS 3000 and Austel Customer Premises Cabling Manual.

#### **C.2.2                Switchboards**

##### **C.2.2.1            General Requirements**

- Switchboards shall be manufactured, factory-assembled, tested and commissioned by a specialist switchboard manufacturer.
- Switchboards shall comply with AS 3439.1:2002 with minimum ingress protection to IP31.
- Internal separation shall be to Form 3B or as specified in particular requirements.
- Unless specified, the switchboards shall comply with the specialist manufacturers' standard range, be fully type tested. Evidence of compliance with the Type Testing requirements shall be submitted with the Tender. Certified documentation shall also be provided indicating the maximum temperature rise within the switchboard, when operating at full load. Careful consideration shall be given to the location of relays, PLC's, etc., to ensure that their operation / life is not affected by the heat generated by the switchboard and ease of access.
- The switchgear layout shown on the drawings is diagrammatic only. An outline drawing of the proposed switchboard, identifying the principal dimensions and weight shall be provided with the Tender. The areas available for switchboards together with the proposed routes and details of all incoming and outgoing cables relative to the switchboard shall be checked to ensure that they are adequate for the equipment proposed.
- Before manufacture commences a detailed technical submittal shall be submitted for each of the switchboards to be provided on the Project. The submittal shall include, but not be limited to, the following:
  - General arrangement drawings
  - Wiring schematics

- Bus-bar layouts
- Interface diagrams
- PLC ladder logic diagrams, where appropriate
- Individual component data sheets
- Description of all auto-changeover systems, load shedding and interfaces with other systems such as generators, etc., where appropriate
- Type test certificates shall be provided for each type of switchboard to be provided, including short-circuit withstand and temperature rise tests. In addition, the switchgear manufacturer shall submit, with their Tender submission, copies of the full type test certificates for each size of breaker utilised within the switchboard. The manufacturer shall confirm, in writing, the heat output figures for all breaker ratings and shall also confirm the design of the switchboard caters for all of the cumulative heat outputs at full load
- No building alteration shall be permitted when moving the switchboard into position. The switchboard being supplied in sections, where required, to facilitate installation into position. Switchgear shall be delivered to site to suit the Contract Programme and the progress of the works
- Protective covering shall be applied to the switchboard during delivery and installation to preserve the manufacturer's paint finish
- Switchboards shall be fixed to the wall / floor by Rawlbolts, or other approved fixings, suitable for the type of structure
- On completion of the erection of the switchboard, the works tests shall be repeated and witnessed by the Engineer
- A continuous rubber mat shall be provided in front of all electrical apparatus in Switchrooms and Plantrooms.

#### C.2.2.2 Construction

Sheetmetal cubicles, frames, brackets, door escutcheons, etc. shall be of machine folded and welded construction, from first class quality furniture steel mounted upon a fully welded channel iron base with "toes" turned outwards.

Unless otherwise specified, all switchboards shall not exceed 2100mm in height when fixed into position on site.

All metal work shall be rigid, symmetrical and neat in appearance with all visible joints filled and ground smooth.

Doors, escutcheons and panels shall be of not less than 1.6mm and shall have double turned edges for rigidity. Cubicles and brackets etc. shall be of not less than 2mm.

All hinged panels and removable sections shall close onto resilient full hollow perimeter rubber seals to exclude dust - such seals being fixed within deep channel frames around the perimeter of all openings - and arranged so as to be reasonably compressed at all points when the panel is secured.

ACBs, switches, fuses etc. shall be mounted on brackets (insulated where necessary) and shall protrude through neatly formed individual openings in escutcheons these shall solidly engage with the escutcheon.

All separate groups of ACBs, fuses i.e. lighting, power, contactor controlled groups etc. shall be identified by means of labelling and 6mm white painted dividing lines on the escutcheon.

In all cases, covered, escutcheon cut-outs and drilled mounting brackets shall be provided for an extra 30% of future additional equipment.

Proprietary snap-in pole fillers shall be used throughout.

Meters, phase selection switches, indicating lights etc. shall preferably be mounted on fixed panels only. Circuit breaker "ON-OFF" operating handles shall be accessible through the front of the panel.

External doors shall have lift off type 135 degree full swing hinges. Hinges shall be chrome plated brass with steel pivot pins and plastic bearing washers.

Hinged access doors should be free from switchgear and metering equipment but where this is impracticable quick connect type plug/socket connections and flexible wiring shall be provided.

Contactors and motor starters shall be mounted within a separate compartment within each switchboard. Allow 30% spare space in the compartment.

This compartment shall have a separate hinged door to which shall be fixed alarm lights and overload reset buttons.

Where lift-off access panels are provided they shall incorporate two lifting handles and a centrally located (on vertical centre line of panel) dowels and receptacles to assist in locating the panel on the main frame of the cubicle. Each panel shall have at least two lockable automobile type catches in addition to cadmium plated hexagon head fixing screws.

Any exposed screw fixings on front panels, doors or covers shall be terminated with chrome plated "acorn" nuts or knurled headed captive screws depending upon the necessity or otherwise for ready access.

Escutcheons shall be fitted with knurled, captive, thumb nuts with screwdriver slot and fibre washers and with two "D" type handles located centrally top and bottom of each escutcheon.

Cable, ducting and covers shall be fabricated and finished as for, and to match switchboard cubicles. All hardware shall be chrome plated externally and chrome or cadmium plated internally.

After fabrication metalwork shall be cleaned of rust, scale, oil, etc., primer etched, undercoated and painted with two coats of good quality enamel.

Internal surfaces shall be finished in white, high gloss. External surfaces for switchboards in plantrooms and riser cupboards shall be electric orange, in other locations the colour will be advised upon request.

The final finish shall be free from blemishes, orange peel effect, weld and metal finishing marks.

The Contractor shall take all necessary precautions to ensure that paintwork is not damaged.

At Practical Completion any scratches or damage shall be properly rubbed down and repainted to a finish and appearance as good as the original.

### C.2.2.3 External Switchboards

All external switchboards shall have lockable doors.

External switchboards shall, unless otherwise specified, be fabricated from 3mm aluminium sheet Comalco H34-5005.

Free standing external switchboards shall include a galvanised rolled steel channel base fixed with washered nylon bolts through a bituminous impregnated cork gasket over the full bearing area of the base. Provide a concrete plinth for the switchboard 100mm above finished ground level.

Where external switchboards are main switchboards, provide an armour glass meter viewing window in accordance with Supply Authority requirements.

#### C.2.2.4 Surge Protection

Provide transient surge suppression on the supply of the main switchboard and each sub distribution board. Supply, install and connect a Invensys, Liebert, Merlin Gerin, Tercel, Transtech or approved equal, surge diverter unit with 65kA single shot surge capacity operating in all modes (L-N, L-E and N-E), as shown on the drawings. The surge protectors shall be UL 1449 listed.

The installation of the unit shall be strictly in accordance with the manufacturer's recommendations. Refer to drawings for further details.

Where indicated on the power circuit schedules supply, install and connect surge protection within the distribution boards to protect individual circuits. These units shall be Invensys, Liebert, Merlin Gerin, Tercel, Transtech or approved equivalent in-line surge protectors, rated according to the circuit rating and fault level. The in-line surge protectors shall offer protection against high frequency noise and transients in all modes (L-N, L-E and N-E). The in-line surge protectors shall be UL 1449 listed.

Where alternatives are offered the tenderer shall supply sufficient data to prove that the alternatives comply with the specification and perform as specified.

All surge protection devices shall be protruding through the distribution board escutcheon plate and shall have a visible indication of its status.

#### C.2.2.5 Performance and Fault Capacity

All switchboards and auxiliary panels shall comply with AS1136 Switchgear and Control Gear Assemblies and AS1939 Classification of degrees of protection.

Where type tested construction is specified, design and construction shall conform to the manufacturer's type test certificate.

The design and construction of switchboards and auxiliary panels, associated components and connections shall give satisfactory performance under all variations of load conditions as may be met within the service including short time overloads and short circuits.

The building Main Switchboard and Essential Services Switchboard circuit breakers shall be Schneider or Terasaki fault current limiting breakers or equal approved. All the switchboards downstream shall include an isolator as the main switch and all MACBs shall afford discrimination with the main switchboard circuit breaker feeding the switchboard in accordance with AS 3947-2. Cascading shall also be utilised when selecting the downstream switchgear to achieve the lowest fault current (kA) rating possible. Details shall be provided to the Engineer for approval. These details shall include, but not limited to, time current curves between the upstream and downstream circuit breakers and comparing the let through energy.

#### C.2.2.6 Equipment

Unless otherwise specified or shown on drawings, final power sub circuits shall be protected with 16 amp miniature automatic circuit breakers and final lighting sub circuits with 10 amp miniature automatic circuit breakers.

All equipment shall be neatly and logically arranged in groups, rows, etc. EQUIPMENT shall be mounted to a maximum height of 2000mm above the surrounding floor level of any switchboard location.

Contactors, relays and motor starters shall be Sprecher and Schuh or Lovato, open type, unless otherwise specified.

Motor starters shall be fitted with correct size overload (reset buttons to protrude through escutcheons). Motor nameplate ratings shall be checked on site and overloads set accordingly.

ACBs shall be Merlin Gerin, Terasaki or approved equivalent as specified above.

HRC fuses SHALL BE English Electric, Red Spot Series.

Generally switches shall be Kraus and Naimer C16 (or larger as required) rotary type.

Generally the number of ACBs, fuses, etc. for each switchboard shall be as required by drawings and subsequent sections of the Specification.

Bolted busbar connections shall have minimum clearance holes only drilled to accommodate bolts to maintain maximum cross section of copper at the connection. Each steel bolt shall be equipped with flat machined washers under heads and nuts in addition to locking washers.

#### C.2.2.7 Wiring and Busbar

The line side connections to all protection equipment shall be made with high conductivity, hard drawn copper busbar.

Each busbar shall have sufficient capacity to carry the current shown on the drawing or where no current rating is shown the full connected load plus 50% without exceeding a temperature rise of 60 degrees Centigrade, after allowing for derating due to the degree of enclosure in accordance with Appendix C of AS 3000.

Busbars and the supports shall be designed and constructed to withstand all short circuit faults.

Permalin shall not be used for busbar supports.

All busbar work shall comply with BSS 159.

Circuit wiring through switchboards shall be contained in slotted side PVC duct.

Elsewhere PVC cables shall be neatly laid up, laced and fixed where necessary.

Cables terminating on bolts or studs shall be fitted with compression type cable lugs.

Adequate provision shall be made on all switchboards for the neat termination of all incoming and outgoing cables, conduits and troughing.

Crimp type solderless lugs shall be used for all main, sub-main and neutral cable terminations.

All main and sub main connections made electrically within the switchboards shall incorporate anti-vibration "Belleville" washers or approved equal to prevent bolted connections and termination from working loose.

#### C.2.2.8 Labelling

Unless otherwise specified single pole ACBs or fuses protecting final sub-circuits shall be marked with IPA coloured and numbered markers.

All ACBs protecting submains or rated in excess of 50 Amps shall be identified with traffolyte labels.

A typewritten schedule showing the phase and number of each ACB and fuse and the equipment supplied by each shall be fitted in a clear plastic fronted metal frame fixed on or near each switchboard.

An "as installed" single line diagram for the main switchboard shall be fitted in a clear plastic fronted metal frame on or near the main switchboard.

Rotary switch escutcheons shall be engraved to approval.

All remaining equipment, including ACBs, KWh meters switches, reset buttons and contactors shall be identified with appropriately engraved traffolyte labels fixed to panels using screws.

Labelling external and internal shall be standard lettering on black background using laminated traffolyte with bevelled edges. The labels shall be fixed to the sheetmetal panels using screws. Adhesive labels are not acceptable.

Any equipment, fitting or accessory on a particular board which is energised or controlled by equipment on another board shall be permanently labelled to that effect in an approved manner.

All incoming and outgoing circuit wiring and cabling shall be identified WITHOUT EXCEPTION. Identification shall be in accordance with the final approved "as installed" wiring diagrams and/or drawings.

#### C.2.2.9 Switchboard Approval

Submit to the Consulting Engineer for approval complete working drawings of each different type of switchboard, together with a panel layout of every switchboard, before manufacture. The main switchboard drawing shall be submitted to the Supply Authority for approval.

The wording of all labels must be shown.

Before completing drawings check the available space and required method of mounting of each switchboard from inspection on site.

When requested, submit type test certificates and/or design calculations to prove that each switchboard can withstand the nominated fault conditions.

### C.2.3 **Cabling and Wiring**

#### C.2.3.1 General

All cable shall be unconditionally guaranteed and such guarantee shall cover replacement of faulty cable and full reimbursement of all costs involved.

Unless otherwise specified all cable shall have copper conductors and V75 grade PVC insulation, and sheathed where required as set out below.

TPS cables shall be used in the following situations:

- In accessible ceiling spaces.
- In underground conduits.
- In wall cavities, stud walls and door mullions.
- In skirting ducts, floor ducts and other cable duct systems.
- Where required by the Supply Authority.

In ceiling spaces, TPS cables shall be clipped to the roof structure or slab at a maximum distance of 900 between clips. Elsewhere, unless otherwise specified, TPS or PVC insulated cable shall be installed in conduit.



In all cases every cable shall be installed in a manner such that it is replaceable at any time without damage to the building.

All wiring shall be carried out under the loop in system and no joints or connectors will be allowed.

Unless otherwise specified power and light wiring shall be carried out with 4 square millimetres and 2.5 square millimetres cable respectively in accordance with AS3000 and the WA Electrical Requirements.

Derating of sub circuit cabling in accordance with AS/NZS 3000:2000 and AS/NZS 3008.1.1 shall be the contractor's responsibility and all cables shall be appropriately sized and derated to suit the method of installation.

The following colour code shall be adhered to throughout the installation:

Phases	-	Red, White and Blue as applicable
Neutral	-	Black
Switchwires	-	Grey

Generally, all wiring shall be concealed. Where unavoidably exposed, conduit shall only be installed as directed by the Consulting Engineer.

At all times refer to drawings and requirements of other trades and services in particular plumbing and mechanical services and install all cables, cable ducts, conduits and electrical equipment clear of same.

#### C.2.3.2 Main and Sub-Main Cables

Where submains are to be installed to switchboards or equipment provided by other trades liaise carefully with them for the exact point of connection required. Unless otherwise specified an adequate earthwire shall be run with each set of cables.

#### C.2.3.3 MIMS/Fire Rated Cables

MIMS cables shall be 1000V/1000V class except for 250 volt final sub-circuits which shall be 600V/600V class. All MIMS cable fittings shall be supplied and installed in accordance with the manufacturer's recommendations.

Accessories, tools and junction boxes shall be as recommended by the manufacturer and shall be similar to "Pyrotex" manufacture.

PVC covered type MIMS cables and fittings shall be used where exposed to the weather, dampness or corrosion or where installed in contact with dissimilar metals.

Cables shall not be cut and left unsealed during installation. Immediately after cable is cut to length the end shall be sealed, if necessary temporarily.

All cables shall be fixed by means of brass or copper clips or saddles secured by brass pins or screws, which will not cause electrolytic corrosion with the cable or the support to which it is fixed. Bushes shall be provided where cables pass through dissimilar metallic materials.

Clips or saddles shall be spaced not more than 150mm on either side of a fitting, accessory or right angle bend and not more than 600mm apart elsewhere.

MIMS cables shall be properly dressed into neat and symmetrical forms.

MIMS cables may be run in the same duct or on the same tray as PVC/PVC cables. In such cases allowance shall be made for derating the PVC cables and an air gap of at least 25mm shall be maintained between MIMS and PVC cables.

## **C.2.4 Cable Enclosures and Materials**

### **C.2.4.1 Conduiting**

Generally class B rigid PVC conduit shall be used except where exposed to mechanical damage or sunlight where galvanised screwed steel conduit or G.W.P. shall be used.

Where necessary PVC sheathed flexible Kopex conduit shall be used to enclose final connections to fixed equipment.

The minimum size conduit shall be 20mm. Except where conduit size is specified, conduits shall have capacity for one additional circuit.

Conduit sizes shown on drawings are for rigid conduit. If corrugated conduit being used select size to give equivalent internal diameter.

Conduits, unavoidably exposed shall be run square and plumb with building lines and as directed by the Consulting Engineer. All conduit ends and boxes shall be plugged in an approved manner until permanent fittings are installed. The Contractor shall be present at all times when concrete containing conduit is being poured.

Conduit in concrete shall be installed in accordance with AS 3600 Section 14. Generally this requires conduits in slabs to be installed between the top and bottom layers of reinforcing steel. In columns and beams conduits shall be inside the ligatures with clearance from longitudinal steel reinforcement no less than the concrete cover to the steel reinforcement.

A gap of at least 40mm shall be provided between parallel conduits.

Unless otherwise specified, no conduit fittings other than deep conduit boxes, couplings and unions shall be installed in concrete.

To change direction conduits shall be set.

Flexible joints shall be made at right angles across concrete expansion joints. The ends of the conduit shall be kept 19mm apart (across the joints) and belled to form a firm sliding fit inside a larger size conduit sleeve (200mm long minimum). The sleeve shall be taped to conduits with "Scotchrap" to prevent ingress of slurry to the expansion joint. PVC accessories shall be used wherever possible.

Unless otherwise specified all joints in PVC conduit shall be welded.

One make of conduit, fittings and welding solution shall be used throughout.

Couplings on conduits shall be locknutted. Conduit ends shall be bushed throughout.

Conduit boxes shall be proprietary units with conduit access facilities.

All joints in galvanised conduits and water pipe installations shall be made waterproof by use of "thread Seal Tape" or similar.

The ends of conduits shall be internally reamed clear of sharp edges and projections.

All spare conduits shall be provided with a suitable, durable draw-wire.

#### C.2.4.2 Underground Conduits

Install conduits 600mm below finished ground level, except where shown otherwise.

Install conduits to the manufacturer's preferred recommended practice.

Excavate trenches straight and true and to an adequate depth to provide the required cover for conduits.

Ensure the bottom of trenches are flat and clear of protrusions such as rocks, tree roots and the like, prior to installation of conduits.

Arrange conduits so that the maker's identification and the conduit category are uppermost in clear view.

Install conduits from buildings with a slight fall to the first junction box or cable pit external to the building.

Whether containing cables or not, underground conduits shall be provided with a 7/0.67 (2.5 sq.mm) PVC covered draw wire.

Make joints between conduits, between conduits and accessories solid and waterproof.

Cover conduits with 150mm depth of rubble free sand and place an identification tape, 150mm above the conduit along the entire length of the installation. Use orange plastic tape, approximately 150mm wide and indelibly marked "DANGER ELECTRIC CABLE BELOW", at not more than 1 metre intervals.

Complete backfilling of trenches using clean fill and compact to match surrounding material.

Backfilling and tamping of trenches where passing under buildings, paths, car parks and other load bearing areas shall be carried out in layers, 200mm maximum thickness.

#### C.2.4.3 Cable Trays

Cable trays shall be fabricated from perforated zincanneal sheet steel not less than 1.25mm thick.

Provide metal brackets, fixings at intervals such that deflection does not exceed 6mm at any point. Brackets shall be hot dipped galvanised.

Changes of direction shall be of radius not less than the minimum bending radius of the largest cable installed on the tray and shall be complete with transition pieces, plates etc. If the size is not specified, then trays shall have spare room to accommodate 30% extra cables.

#### C.2.4.4 Cable Ducts

Shall be fabricated from not less than 1mm thick zincseal sheet machine folded with returned edges for rigidity.

Fixings shall be by means of metal thread screws through the bottom of the duct to that wall surface or to metal brackets provided by the Contractor. Brackets shall be hot dipped galvanised.

The ducts shall be complete with removable clip on lids fixed at each end with metal thread screws.

Changes of direction shall be of radius not less than the minimum bending radius of the largest cable installed in the duct and shall be complete with transition pieces, plates etc.

If the size is not specified then ducts shall be sized to give spare space for 30% additional cables without exceeding the requirements of AS 3000.

## **C.2.5 Lighting Installation**

### **C.2.5.1 General**

Supply and install all light fittings as specified herein and indicated on attached drawings.

All fittings must be installed square to the building lines.

All fittings shall be rigidly secured to the building structure either directly or with suitable trimmers.

All light fittings shall include an integral fuse in a fuse holder suitable for the temperatures expected.

### **C.2.5.2 Recessed Fluorescent Light Fittings**

Supply, install and connect recessed fluorescent light fittings as shown. Each fitting shall be connected via a fixed 10 amp, 3 pin socket and plug top with 1800mm flexible cable.

Circuit wiring shall terminate in compatible socket outlets fixed to the structure within the ceiling space.

Fluorescent light fittings shall comply with the following minimum specifications.

Within four weeks of Contract Award, the Contractor shall produce a sample of the proposed fitting, complete with lamps and all control gear, to the Principal's Authorised Representative for review. Upon return of review, the light fitting supplier will be required install the fitting into a sample section of the ceiling to check appearance and consistency of dimensions. Allowance shall be provided for rubbing down and repainting the sample fitting and for final delivery to site as it will form part of the required number for final installation, if approved.

### **C.2.5.3 Construction**

The fittings shall be designed to be supported by the main ceiling support Tee bars. The design shall be such that two fittings may be mounted end to end if required.

The general design shall be as shown on the drawing. Dimensions shown are nominal and exact dimensions must suit the actual ceiling and tee bars used.

The fittings shall be complete with diffusers and optics as specified.

Sheetmetal shall be of not less than 1mm furniture grade zincanneal, machine folded and welded construction, rigid, symmetrical and neat in appearance with all visible joints filled and ground smooth.

Heavy gauge metal sections and/or adequate bracing shall be provided where necessary for rigidity.

Starter switches shall be replaceable without removal of tubes and auxiliary cover.

### **C.2.5.4 Painting**

Metalwork shall be painted gloss white.

Before application of finishing coats metal shall be thoroughly prepared for good paint adhesion and treated to prevent rust, cracking or deterioration of surface finish.

All paintwork shall be of a first class finish appropriate to the application.

Fittings with inferior or damaged paint will be rejected.

Inspect each fitting as it is removed from its package. Damaged fittings shall be replaced or rectified to approval of the Superintendent.

#### C.2.5.5 Auxiliary Equipment

Fittings shall be complete with all auxiliary equipment necessary for switch-start operation.

Tenderers intending to supply equipment other than the makes specified below must obtain approval, in writing, for same from the Superintendent, prior to tenders closing.

Ballasts shall be Tridonic Atco or similar with connection pins complying with Australian Standards Nos. 2643 and 3168 and shall be indelibly labelled as such. All ballasts to be of one manufacture.

Ballasts are to be A1 or A2 EEI type and shall have an efficiency of at least 90% ballast (hot).

Condensers shall be Ducon or AEE (one manufacture throughout) and shall comply with AS 2644.

Each fitting shall be fitted with condensers to correct power factor to not less than 0.80.

Condensers shall be adequately spaced from ballasts.

Lampholders shall be Pierlite standard holders with brass contacts and screw type cable terminals.

Starters shall be of a manufacture tested and marked to comply with IEC 155 or BS 3772.

Each fitting shall be complete with fused terminal block.

#### C.2.5.6 Lamps

For tender purposes only, all lamps shall be white with colour co-ordinates approximately  $X = 0.380$  and  $Y = 0.377$ . Final choice of colour temperature shall be advised by the Superintendent prior to installation.

Lamps shall have a rated life not less than 19000 hours.

#### C.2.5.7 Wiring

Fittings shall be internally wired with high temperature PVC flexible cable to the terminal block.

Wiring shall be neatly laced.

#### C.2.5.8

#### C.2.5.9 LED Light Fittings

All LED luminaires are to be provided complete for 240V operation. Any remote drivers must be housed and/or fixed in a secure and mechanically protected location suitable for the manufacturer's recommendation.

All LED luminaires must be installed in an arrangement which adequately dissipates heat created by the LED, driver or control gear.

LED luminaire light output must achieve a CRI of 80% for illumination lighting. LEDs for illumination must be RGB mixed or phosphor converted light output. Each LED luminaire must be within 3-step MacAdam ellipse for LED colour matching.

If a LED colour temperature has not been provided it is assumed to be 4000k.

It will be the light fitting supplier's responsibility to ensure that the control gear, the lamp and the light fitting are all tested and compatible, whether control gear is remote or integral with the light fitting. The maximum distance that the control gear must be from the light fitting must be 2,000mm or as approved by the control gear and lamp manufacturer.

LED light fitting supplier shall supply the LM-79 and LM-80 test sheets to the Principal's Authorised Representative for review prior to ordering any light fitting.

#### C.2.5.10 Security Lighting

Security lighting shall be controlled over the hours of darkness by a contactor, operated by a photo-electric relay similar to National which shall be located in an approved position at high level.

A manual override switch for the contactor shall be provided on the switchboard unless otherwise specified.

#### C.2.5.11 Time Switched Lighting

Time switched lighting shall be turned on by separate contactors operated by the photo-electric relay but shall be turned off by a time switch. The time switch shall have 9 hours spring reserve.

A manual override switch for the contactor shall be provided on the switchboard unless otherwise specified.

#### C.2.5.12 Emergency Light Fittings

Where shown, supply and install self contained proprietary kits to convert one tube of the fitting nominated to being a maintained emergency light as a "single point system" all in accordance with A.S. 2293.

These kits shall be complete with Nickel Cadmium cells of Nife or other approved manufacture.

Where such fittings are switched, supply an active feed from the line side of the switch to each emergency fitting for supply failure sensing.

#### C.2.5.13 Exit Signs

Exit signs shall be maintained "single point systems" in accordance with AS 2293.

**PART D.            APPENDICES**

**D.1                    APPENDIX A - CONTRACT DRAWINGS**

DRAWING NO	DESCRIPTION	REVISION
E-001	LEGEND, SITE PLAN AND LIGHT FITTING SCHEDULE	E
E-100	LIGHTING AND FIRE DETECTION LAYOUT	E
E-200	POWER AND COMMUNICATIONS LAYOUT	E
E-500	SINGLE LINE DIAGRAMS	C

**D.2                    APPENDIX B - PROVISIONAL SUMS/CONTINGENCY SUM**

**D.2.1                Provisional Sums**

Description	Cost	GST	Total

**D.2.2                Contingency Sum**

Contingency Sum            :    \$ \_\_\_\_\_

**D.3 APPENDIX C - TENDER SUMMARY**

Tenderers shall submit a breakdown of the total tender price including administration cost and profit for each section of the works as follows:

The amounts included in the Total Tender sum including overhead costs and profit margins are as follows:

(a) Level 1 works	\$ _____
(b) Switchboards	\$ _____
(c) Main and Sub-main cables	\$ _____
(d) Cable trays, ducts and conduits	\$ _____
(e) Sub-circuit cabling	\$ _____
(f) Accessories, Outlets and Appliances	\$ _____
(g) Lighting Fittings	\$ _____
(h) Emergency Evacuation Lighting	\$ _____
(i) Fire Detection and Alarm Installation	\$ _____
(j) Communications Installation	\$ _____
(k) MATV Installation	\$ _____
(l) Photovoltaic Installation	\$ _____
(m) Testing and Commissioning	\$ _____
(Minimum of 2% of Total Tender Sum)	
(n) Maintenance	\$ _____
(o) Miscellaneous	\$ _____
<b>TOTAL TENDER AMOUNT (EXCLUDING GST)</b>	\$ _____
<b>GOODS &amp; SERVICES TAX (10%)</b>	\$ _____
	-----
<b>TOTAL TENDER AMOUNT (INCLUDING GST)</b>	\$ _____
	-----

NAME OF TENDERER: \_\_\_\_\_

CONTRACT: \_\_\_\_\_



**D.4 APPENDIX D - SCHEDULE OF CONTRACT RATES**

Tenders shall submit the following Schedule to allow assessment of variations:

**Composite Rates:**

The following rates shall include for the supply and delivery of all materials, transport, erection and labour to complete the installation of the following elements in the works: surveillance

Description	Unit	Cost/Unit	GST	Total/Unit

**Hourly Labour Rates (including GST):**

Period	Labour 1	Labour 2	Labour 3	Labour 4	Labour 5	Labour 6
Ordinary Time						
Time and a Half						
Double time						

NAME OF TENDERER: \_\_\_\_\_

CONTRACT: \_\_\_\_\_

**(b) MATERIAL**

Mark-up to be applied on cost to purchase materials \_\_\_\_\_%

**(c) SWITCHBOARDS**

Supply and installation of 16A single phase RCBO including termination of sub circuit cable	\$_____ea
Supply and installation of 20A single phase RCBO including termination of sub circuit cable	\$_____ea
Supply and installation of 20A three phase MACB including termination of sub circuit cable	\$_____ea
Supply and installation of 32A three phase MACB including termination of sub circuit cable	\$_____ea

**(d) POWER**

Supply and installation of standard 10A DGPO (dual) including 30m of cable, wall mounted	\$_____ea
Supply and installation of standard 10A DGPO (dual) including 30m of cable, skirting mounted	\$_____ea
Supply and installation of standard 15A GPO including 30m of cable, wall mounted	\$_____ea
Supply and installation of 1-phase 20A connection to equipment including 30m of cabling and local isolator	\$_____ea
Supply and installation of 2c 2.5mm <sup>2</sup> + E Cu TPS	\$_____ per metre
Supply and installation of 2c 4mm <sup>2</sup> + E Cu TPS	\$_____ per metre
Supply and installation of 2c 6mm <sup>2</sup> + E Cu TPS	\$_____ per metre
Supply and installation of 2c 10mm <sup>2</sup> + E Cu TPS	\$_____ per metre
Supply and installation of 2c 4mm <sup>2</sup> + E Cu Fire rated	\$_____ per metre
Supply and installation of 2c 6mm <sup>2</sup> + E Cu Fire rated	\$_____ per metre
Supply and installation of 2c 10mm <sup>2</sup> + E Cu Fire rated	\$_____ per metre
Supply and installation of 4c 4mm <sup>2</sup> + E Cu TPS	\$_____ per metre
Supply and installation of 4c 6mm <sup>2</sup> + E Cu TPS	\$_____ per metre
Supply and installation of 4c 10mm <sup>2</sup> + E Cu TPS	\$_____ per metre
Supply and installation of 4c 4mm <sup>2</sup> + E Cu Fire rated	\$_____ per metre
Supply and installation of 4c 6mm <sup>2</sup> + E Cu Fire rated	\$_____ per metre
Supply and installation of 4c 10mm <sup>2</sup> + E Cu Fire rated	\$_____ per metre
Supply and installation of 4c 16mm <sup>2</sup> + E Cu XLPE	\$_____ per metre
Supply and installation of 4c 25mm <sup>2</sup> + E Cu XLPE	\$_____ per metre
Supply and installation of 4c 25mm <sup>2</sup> + E Cu XLPE	\$_____ per metre
Supply and installation of 4c 35mm <sup>2</sup> + E Cu XLPE	\$_____ per metre

Supply and installation of 4c 50mm <sup>2</sup> + E Cu XLPE	\$_____ per metre
Supply and installation of 4c 70mm <sup>2</sup> + E Cu XLPE	\$_____ per metre
Supply and installation of 4x1c 95mm <sup>2</sup> + E Cu XLPE	\$_____ per metre
Supply and installation of 4x1c 120mm <sup>2</sup> + E Cu XLPE	\$_____ per metre
Supply and installation of 4x1c 150mm <sup>2</sup> + E Cu XLPE	\$_____ per metre
Supply and installation of 4x1c 185mm <sup>2</sup> + E Cu XLPE	\$_____ per metre
Supply and installation of 4x1c 240mm <sup>2</sup> + E Cu XLPE	\$_____ per metre

(e) **LIGHTING**

Supply and installation of one light switch including 15m of cable \$\_\_\_\_\_ea

Supply and installation of one motion detector switched circuit \$\_\_\_\_\_ea

Supply and installation of one external motion sensor \$\_\_\_\_\_ea

Supply and installation of one general motion sensor \$\_\_\_\_\_ea

Supply and installation of the following specified light fitting types as shown on the light fitting schedule on E-001:

Ref	Supply Only	Delete Only*	Supply and Install
A1			
B1			
B2			
C1			
C2			
D1			
E1			
E2			
EX1			
EX2			
F			
G			
H	Allow \$450 per fitting		
P			
Q			

\* Cost for deletion is current until the light fitting sample review sign-off is completed by the Superintendent.

**(f) DATA AND VOICE COMMUNICATIONS SYSTEM**

Supply and installation of one data or telephone RJ45 outlet complete with 50m of UTP Cat6 (4 pair) cable and termination. \$\_\_\_\_\_ea

Supply and installation of two data RJ 45 outlets, (one double outlet) complete with 50m of UTP Cat 6 (4 pair) cable to each outlet and termination \$\_\_\_\_\_ea

Supply and installation of 100m of telephone cable including termination at both ends. \$\_\_\_\_\_ea

**(g) FIRE DETECTION AND EWIS SYSTEM**

Supply and installation of one Smoke Detector and 30m wiring \$\_\_\_\_\_ea

Supply and installation of one Thermal Detector and 30m wiring \$\_\_\_\_\_ea

Supply and installation of one Manual Call point and 30m wiring \$\_\_\_\_\_ea

Supply and installation of one Detector in concealed space complete with remote indicator and 30m wiring \$\_\_\_\_\_ea

Supply and installation of one flush ceiling mounted emergency warning speaker with grill and 20m of cabling \$\_\_\_\_\_ea

Supply and installation of one surface mounted emergency warning speaker with grill and 20m of cabling \$\_\_\_\_\_ea

Supply and installation of cable tray mounted emergency warning speaker, complete with bracket and 20m of cabling \$\_\_\_\_\_ea

Supply and installation of one visual indicator complete with 40m of cabling \$\_\_\_\_\_ea

Supply and installation of one fire signal to equipment with 40m of cabling \$\_\_\_\_\_ea

**(h) MATV SYSTEM**

Supply and installation of one MATV outlet complete with 40m of cabling \$\_\_\_\_\_ea