



ELECTRICAL DESIGN GROUP

ELECTRICAL BUILDING SERVICES CONSULTANTS

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PROJECT

MARABOON TAVERN, EMERALD - 2025 ALTERATIONS

DOCUMENT

ELECTRICAL SERVICES SPECIFICATION

SITE ADDRESS

5 ESMOND STREET, EMERALD QLD 4720

ARCHITECT

**CAYAS + WARD
SUITE 2, 19-25 MUSK AVENUE
KELVIN GROVE QLD 4059**

DESCRIPTION

REVISION: C

DATE: 15 DECEMBER 2025

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Post the tender revision the most recent changes are in italic and bold as per this note.

1.0 EXTENT OF WORKS

1.1 SCOPE

The electrical services sub-contract includes but is not limited to the following:

- Supply and installation of all components forming part of the electrical services.
- Attendance at a handover meeting.
- Co-ordination.
- Authorities' approvals.
- Approvals.
- Shop drawings.
- Installation drawings.
- Work-as-executed drawings.
- Inspections.
- Testing and commissioning.
- Maintenance.
- Programming.
- Manuals.
- Cabling, cable support systems and access.
- Spare conduits, wall boxes and draw wires for future use and use by other trades.
- Quality assurance.
- Power distribution.
- Lighting.
- Communication cabling.
- Fire Detection System.
- Removal of all existing electrical services including fire detection and alarm services that become redundant due to the works.
- Making good after all redundant electrical services and fire detection and alarm services have been removed.
- Signage.
- Provisional allowances.
- All minor components and incidental works not specifically referred to, however necessary to complete the electrical services installation such that it is handed over complete, operational and fit for the intended use.

With the tender response provide a copy of the Electrical Sub Contractor's licence. Include a copy of all of the above licences in the Maintenance Manual.

Accept full responsibility for liaising, arranging and co-ordination all works that have an effect on or will be affected by the electrical services.

Should the Electrical Sub Contractor not provide the information required to be submitted by this specification and the Schedule Of Information To Be Submitted within two weeks of being requested to do so or as agreed to in writing, the Electrical Sub Contractor is to agree to a variation credit of \$2,000.00 to the contract in lieu of the provision of such information.

Should the Electrical Sub Contractor not provide the Work-As-Executed drawings within two weeks of practical completion or as agreed to in writing, the Electrical Sub Contractor is to agree to a variation credit of \$2,000.00 to the contract in lieu of the provision of the Work-As-Executed drawings.

Should the Electrical Sub Contractor not provide the Operations and Maintenance Manual within two weeks of practical completion or as agreed to in writing, the Electrical Sub Contractor is to agree to a variation credit of \$2,000.00 to the contract in lieu of the provision of the Operations and Maintenance Manual.

1.2 ASSOCIATED WORKS

Co-ordinate with the relevant bodies for the following works associated with but excluded from the electrical services sub-contract. The electrical sub contractor is responsible for coordinating the interface of the electrical services with the following services:

Service	Responsibility
Cool rooms and freezers	Refrigeration services sub contractor.
Active communications equipment	Clients Representative.
Illuminated signage	Signage contractor
Connection of the power supply from the isolator to the sign.	Specialist signage contractor.
Mechanical Services	Mechanical services sub contractor.
Sub mains from the MSSB to the mechanical plant.	Mechanical services sub contractor.
Hydraulic Services	Hydraulic services sub contractor.
Fixed equipment such as HWS and cooking equipment.	Dependant on the equipment either the contractor, other sub contractor, specialist contractor or the clients representative.
Plug in equipment such as fax machines.	Dependant on the equipment either the contractor, other sub contractor, specialist contractor or the clients representative.
Communications equipment fly leads.	Clients representative.
Build in sleeves, supports, hangers, fixings, anchorages and the like	Contractor
Make good after the installation of electrical services provided it is in the normal construction sequence	Contractor
Fire rated boots over recessed lights in fire rated ceilings	Contractor
Rebates/cut-outs in fire stair door jambs for electric strikes and reed switches	Contractor
Provision of penetrations through floors and walls. The electrical contractor to provide fire rating to penetrations after cables are installed if required.	Contractor
Anti-termite treatments	Contractor

1.3 CONTRACT DRAWINGS

The electrical services document schedule C3446a-0001.xls details the electrical drawings, details, schedules and associated documents that form part of the electrical service's sub-contract. The electrical services documents are diagrammatic only and the Electrical Sub Contractor must familiarise themselves with all other services documents and the architectural documents to establish the scope to be allowed for.

The current architectural drawings form part of the electrical sub-contract and as such information which appears on the architectural drawings which affects the electrical services will not be accepted as the basis of a cost variation. The electrical installation must be installed in accordance with the architectural drawings issued for construction.

1.4 SITE CONDITIONS

As part of the tender, the tenderer is required to familiarise themselves with all site conditions and allow for such conditions within the tender. Changes or additions due to site conditions or requirements which could have been established during a tender period site inspection will not be accepted as the basis of a cost variation.

1.5 DEFINITIONS

Refer to the principles contract for the definitions to be read into the electrical services documents

1.6 PRELIMINARIES

Carry out all of the electrical services works in accordance with the principles contract.

1.7 CORROSION AND UV PROTECTION

Ensure that all metal surfaces are suitably protected against corrosion, and that all plastic materials are UV stabilised. Repair to new condition or replace any components showing any signs of corrosion during the defects liability period.

Ensure that all metal surfaces are suitably protected against corrosion likely to be experienced during the life of the installation. Cover all electrical terminations including terminal screws and exposed raw metal including exposed conductors with clear synthetic resin based insulating enamel before fixing the terminal covers in place. Provide all fixings exposed to the weather and those in potentially corrosive environments as stainless steel. Do not use materials that will react with or cause galvanic reactions with adjacent materials or surfaces.

Use only plastic materials, paints, insulation materials and coatings that are UV stabilised and will not break down with the normal exposure to ultra violet radiation during the life of the installation. Provide written evidence for approval that all such materials are UV stabilised. Do not install PVC in locations it will be exposed to direct sunlight.

1.8 WORKMANSHIP

Ensure that the work is performed by the holder of a current Electrical Sub Contractor license. Provide a copy of the license before commencing work onsite and include a copy in the Operations and Maintenance Manual.

Ensure the installation and all components, fixtures, fittings, outlets and cables are supplied and installed to a high standard throughout, and installed in a neat and tradesman like manner, to the current industry standards. Ensure all materials and components of a similar type are of the same manufacturer and installed in a uniform manner.

It is the Electrical Sub Contractor's responsibility to ensure that the installation is fit for purpose and is provided as a complete working installation. It is the Electrical Sub Contractor's responsibility to provide all components, fittings, fixtures, systems, programming etc irrespective of the level detailed in the documents such that the installation is provided as a complete working installation.

Irrespective of the information documented it is the Electrical Sub Contractor's responsibility to ensure all aspects of the installation comply with and meet the requirements of all relevant authorities and the relevant current Australian Standards.

Provide all materials as new, and of the highest class available for their respective types.

It is the electrical sub contractor's responsibility to ensure all conduits are not damaged during concrete pours.

Within the tender allow to conceal all wiring and conduits. Exposed cabling or conduits are generally not acceptable. For extreme circumstances a written request to allow the running of an exposed service in a specific location may be considered. In such circumstances the Electrical Sub Contractor is to agree to a variation credit of \$1,000.00 to the contract for each exposed service.

Provide all circuits and outlets required by any control or communications equipment supplied as part of this contract, irrespective of whether these outlets and circuits are shown on the drawings. Such outlets may include, but are not limited to, the following:

- Amplifiers.
- Control panels.
- Communication and intruder detection equipment.

During the course of the building being painted, remove flush plates, light fittings and other equipment that is likely to be marred by painting and mask/cover other equipment such as switchboards and the like. On completion of the painting replace all equipment; remove masking/covers and the like. Clean off any paint marks and return the finish to as new condition.

Install components and equipment in accordance with the manufacturer's recommendations and ensure such components and equipment are not operated outside of the limits specified by the manufacturer.

Irrespective of the extent of information or the accuracy of such information it is the Electrical Sub Contractor's responsibility to confirm the location of all existing services on site. The cost of repairing and of disruption to service due to damage to existing services is to be met by the Electrical Sub Contractor.

Ensure all components, equipment and materials supplied are new, unused, designed and selected to ensure satisfactory operation under varying atmosphere, climatic, humid tropical conditions without distortion and deterioration in any part affecting efficiency and reliability of the systems. Design and select all equipment to provide the necessary safety to human life and property during operation and maintenance with particular attention given to electrical safety and segregation precautions.

Check the finished paintwork around the area of each installation and touch up all damaged parts and finishes after the installation of the electrical services.

Within the tender response provide a list of sub contractors that will be engaged by the electrical sub contractor including the postal address, fax number, telephone number and email address. Within two weeks of being awarded the contract provide the names and contact phone numbers of the electrical sub contractor's supervisor and site foreman as well as the supervisor and site foreman of each of the sub contractors that are to be engaged by the electrical sub contractor.

Provide an electronic digital photograph for approval of all works that are carried out that will not be visible after installation, within five working days after the respective work has been completed. Each photograph is to be electronically stamped with the time and date and be either named with descriptive name that allows the location to be simply identified or accompanied with a tabulated description. Include a copy of the photos in the in the Operations and Maintenance Manual.

1.9 PROGRAM

Carry out all of the electrical services works in accordance with the principles contract.

Where a component or document is noted as requiring to be submitted for approval, it is the electrical sub contractor's responsibility to obtain in writing the approval of such from the engineer unless the approval is specifically noted as being required from another entity. The electrical sub contractor must give each of the approving parties one weeks' notice of the pending requirement for the approval and give each approving party a minimum of two working days to respond. Should an approval not be given it is the electrical sub contractor's responsibility to revise the material being submitted for approval and resubmit such material. The re-submission of material for approval does not constitute grounds for an extension of time.

1.10 ACCESS

Allow to provide all necessary access to install and complete the electrical services irrespective of the electrical services access provisions detailed on the drawings. The electrical services access provisions detailed on the drawings are not intended to be comprehensive or provide all of the access requirements necessary to complete the electrical installation. This includes though is not limited to the following:

- Conduits.
- Blockouts.
- Ducts.
- Risers.
- Hat sections.
- Covers.
- Cable trays and ladders.
- Chasing.
- Cutouts.
- Pits and trenching.

1.11 ALTERNATIVES

Alternative components and design will be considered with the cost of the consideration being borne by the Electrical Sub Contractor. Any alternative may be rejected without a reason being provided. Alternatives which are used without written approval must be removed from the installation and replaced with the complying item at the electrical sub contractor's cost.

1.12 DEFECTS

Should more than two defect inspections due to poor workmanship, be required to be performed by the electrical engineer the cost of \$2,500.00 plus GST of such inspections will be passed on the electrical sub contractor. The approval of the contract payment will be dependent upon the rectification of such defects and the settlement of the respective inspection costs.

When advice of a defect is received by the electrical sub contractor provide written advice within 24 hours of the date the defect will be rectified.

The expiration of the warranty period does not exclude the contractor or the electrical sub contractor from the responsibility of latent defects discovered after the warranty has expired.

1.13 ANOMALIES

It is a requirement that the tenderer allow for within the tender, the most expensive solution to address anomalies which may exist between any of the drawings, the drawings and the specification or between any of the contract documents and an authority requirement or a relevant Australian Standard. The Electrical Sub Contractor is to identify any anomalies and request in writing a direction on which option to proceed with. Any such direction will not constitute grounds for a variation or an extension of time.

1.14 APPROVALS

Where information has been nominated as requiring to be submitted for approval or the information must be approved, apply the following definition:

Each request for approval must be made in writing, accompanied with all necessary supporting information to allow for the prompt assessment of the request.

It is the Electrical Sub Contractor's responsibility to seek approvals and do so in a timely manner with the understanding that approvals may not be given and the request for approval may have to be modified and resubmitted. Delays in submitting requests for approval and resubmitting revised requests for approval will not constitute grounds for an extension of time. Unless advised otherwise the Electrical Sub Contractor must allow one working week for the approval to be given by each approving entity.

1.15 CUSTOMER ACCEPTANCE

At the conclusion of the installation a preliminary walkthrough with the installation contractor and the customer's representative will be performed to check for installation quality, accurate performance of the work, and to verify the accuracy of work-as-executed documents. Complete any modifications to the documentation or the installation that may be required within a 2 week period from the walkthrough. Customer Acceptance will be given following a final walkthrough with the installation contractor and the customer's representative if all previously identified issues have been addressed.

If the Electrical Sub Contractor has advised that the previously identified issues have been addressed and it is found they have not been, the Electrical Sub Contractor is responsible for meeting the costs of subsequent customer acceptance inspections at the rate of \$200.00 per hour plus GST plus disbursements. The walk through will be scheduled within 3 weeks of the completion of the installation in order to turn the project and documentation over to the end user. Please note that "Customer Acceptance" does not release the Contractor from repairing any cabling errors or improperly labelled circuits, caused by the Contractor that may be discovered at a later date.

2.0 QUALITY REQUIREMENTS

2.1 STANDARDS

Irrespective of information contained in the electrical services documents or in instructions, it is the electrical sub contractor's responsibility to ensure all electrical services works are be installed in accordance with the requirements of the following. Refer any discrepancies between the requirements of the following and/or the electrical services documents and instructions to the Architect for clarification prior to the placing of orders, fabrication or installation of the items/methods in discrepancy.

- NCC Building Code of Australia.
- Electricity Act.
- Electrical Safety Act.
- Workplace Health and Safety Act.
- Telecommunications Act.

Unless specifically detailed within this specification, undertake all works to the requirements of the relevant standards included in the Standards Schedule C3446a-0008.xls. Refer any discrepancies between the following standards and or the specification to the Architect for clarification prior to the placing of orders, fabrication or installation of the items/methods in discrepancy.

It is the electrical sub contractor's responsibility to obtain from all equipment and component suppliers confirmation that the equipment and components supplied as part of the electrical services installation comply with all of the following relevant standards and codes. Specific specification of equipment or a component does not alleviate the electrical sub contractor of the aforementioned requirement.

Keep on the site a copy of AS1670.1, AS3000, AS3008, AS2293.1 and AS2293.2.

2.2 AUTHORITIES

Ensure all of the electrical services comply with the requirements of all regulatory authorities having jurisdiction over the site including but not limited to the following authorities, codes, standards and regulations:

- ACMA.
- Local Council.
- Local Supply Authority.
- State Government Department of Environment and Heritage.
- Queensland Department of Justice and Attorney-General, Workplace Health and Safety Queensland
- Queensland Health
- Queensland Department of Justice and Attorney-General, Industrial Relations
- Building Regulations 2006
- Fire and Rescue Services Act 1990
- Building Fire Safety Regulation 2008
- Queensland Electricity Act
- Queensland Electricity Regulation
- Queensland Electrical Safety Act
- Queensland Electrical Safety Regulation
- Queensland Development Code
- Queensland Fire Department (QFD)
- Queensland Electricity Connection and Metering Manual
- SAA Communications Cabling Manual
- AS/NZS 3000 SAA Wiring Rules
- The building certifier.
- Queensland Sustainable Planning Act and Regulation 2009
- Queensland Building Act 1975
- National Construction Code (NCC) Building Code of Australia (BCA).

If any of the responsible Authorities, pursuant to the statutory powers vested in them, elect to perform, supply, inspect or test wholly or part of the works, make all necessary arrangements and co-ordinate with the Authorities.

Provide "for approval" copies of all Authorities' Approvals.

Pay all relevant authority fees and charges necessary to complete the electrical services installation to leave it in operating condition meeting all of the authority requirements.

2.3 CONTRACTOR DOCUMENTS

2.3.1 SHOP DRAWINGS

Before commencing fabrication or erection of the nominated item, submit an AutoCAD 2000 format electronic copy of detailed shop drawings via compact disc or via email to brisbane@edg.net.au for approval. Prepare all drawings as A3 or A1 size to AS1100, AS1102, AS1103 and AS3702 with information detailed at the following minimum scales:

- Layout Drawings: 1:100
- Site Plans: 1:500
- Equipment Assemblies: 1:50

Ensure the shop drawings include the following information:

- General arrangement of all equipment: Include layout and clearances around equipment.
- Mounting details, structural details and calculations verifying the structural efficiency of load-bearing slabs, etc., footings and the like, supporting electrical equipment mounting structures, poles, lighting masts, etc.
- Supports: Details of equipment and cable support brackets and fixings including mountings.
- Physical cable layouts: Showing arrangement, location and identification of interconnecting wiring and cabling. All cable penetrations, connections and terminations details. Include all forms of conductors such as Bus Bars and Bus ducts.
- Labelling: Details of labelling and engraving.
- Earthing.
- The type, rating and capacity of all equipment and components.
- Comprehensive schematic diagrams showing the configuration and operation of all components.
- Co-ordination details with all other services.
- Plant Room Layouts.

2.3.2 WORK-AS-EXECUTED DRAWINGS

Prior to practical completion, provide for approval the following Work-as-Executed Drawings:

- Reticulation Drawings.
- Layout Drawings.
- Schematic Drawings.

Ensure the Work-as-Executed Drawings include the following information:

- All information required by the shop drawings.
- Comprehensive details on the reticulation for all of the Electrical Services including:
 - Support types and locations.
 - Conduit types and locations.
 - Junction Boxes.
 - All cable locations.
 - Circuiting.
 - Driver and transformer power supply positions.

- Comprehensive details on the layout of all outlets, fittings and equipment of all of the Electrical Services including:
 - Outlet types and locations.
 - Equipment types and locations.
 - Mounting Detailing.
- Cross reference to the onsite labelling and numbering of all components and outlets.

Submit an AutoCAD 2000 format electronic copy of the work-as-executed drawings via compact disc or via email to brisbane@edg.net.au for approval.

2.4 MAINTENANCE / BUILDING TUNING

Undertake all necessary maintenance of the electrical installation during the Defects Liability Period for a period of 12 months.

Carry out periodic inspections and perform maintenance work at the frequencies and following the procedures recommended by the manufacturers of the supplied equipment with at least one visit each three months. Promptly rectify all faults. Replace faulty materials and equipment, including luminaire lamps, and accessories.

The defects and liability period will not end until such certification has been approved.

2.5 DOCUMENTATION

2.5.1 OPERATIONS AND MAINTENANCE MANUAL

Within ten working days prior to practical completion, provide an electronic copy of combined Operations and Maintenance technical manuals for approval, written in clear concise English, containing the following data in the following format:

Within ten working days of receiving approval of the combined Operations and Maintenance technical manuals, provide the two copies of each of the approved combined Operations and Maintenance technical manuals.

Within ten working days of practical completion, provide the two copies of a combined Operations and Maintenance technical manuals, written in clear concise English, containing the following data in the following format: A typical combined Operations and Maintenance technical manual is available for download and editing from the Electrical Design Group web site www.edg.net.au.

- Contents.
- Project details.
 - Description of the project and the electrical services sub-contract.
 - Description of the major components of the electrical services sub-contract.
 - Description of the manual and its intended use.
 - Contact details of the electrical sub contractor and each of the major suppliers.
- Licences and certificates.
 - Copies of all licences, certificates and statements of compliance as required by the specification.
- Operating instructions.
 - Provide an overall description of the operation of the electrical installation.
 - Describe the safe working procedures of the electrical installation.
 - Detail the environment that must be maintained for the safe and satisfactory operation of the electrical installation.
 - Detail the specific operating requirements for each component of the electrical installation.
 - Include a reference to the following government website for Electrical Safety at Work information.
<http://www.justice.qld.gov.au/fair-and-safe-work/electrical-safety/business-and-industry/electrical-safety-at-work#cords>
 - Include a copy of relevant first aid hints.

- Maintenance instructions.
 - Include a description of the general maintenance requirements for the electrical installation.
 - Include a description of the safe working procedures for the maintenance of the electrical installation.
 - Detail the specific maintenance requirements for each component of the electrical installation.
- Fire Alarm System.
 - Provide a copy of the schematic layout of the fire alarm system detailing the catalogue number of each component and how each component is connected.
 - Operating instructions An overall description of the operation of the fire alarm system.
 - Simple instructions on what to do upon an alarm.
 - Simple instruction on what to do upon a fault.
 - Maintenance instructions.
 - Include a description of the mandatory maintenance requirements.
 - Detail the specific maintenance requirements for each component.
 - Maintenance log.
 - Test results.
 - As constructed drawings including a layout detailing the catalogue number of each component and how each component is connected.
 - Provide a brochure of each component and details on how to configure / adjust / programme the component / system.
 - Include a copy of the manufacturer's brochure and manual for each component.
 - Provide a copy of the fire alarm system training notes / instructions.

Provide the manuals as A4 size, machine printed or typed on durable printing paper, with each page consecutively numbered, and neatly bound in a permanently labelled durable white vinyl covered ring binder folder. Securely fix a labelled USB flash drive containing all of the information in the manual including Auto CAD files of all drawings.

2.6 LAYING OUT

The positions of outlets, switches, and equipment shown on drawings are diagrammatic only. Check on site for positions and verify locations and mounting heights with the clients representative. When any relocating is required to conform to the above, undertake such relocation without additional costs. Verify locations of all outlets, switches, and equipment to ensure:-

- The work of any other trade does not interfere with the electrical installation.
- They are not shrouded by door swings and tracks, furniture or equipment.
- They conform to any pattern formed by ceilings, panels, tiles, beams, and the like.
- They are not located in restricted zones as defined by AS3000. It is the Electrical Sub Contractor's responsibility to check the volume of all sinks, tubs and basins.

Promptly report any anomalies, for consideration and instructions. Work proceeding without obtaining approval, will not be accepted as basis for a variation.

Locate all adjacent outlets at the same height and ensure power and non power outlets are segregated by 150mm.

2.7 OPERATING PARAMETERS

Ensure the electrical services installation is installed in accordance with the following operating parameters and service conditions:

- Nominal voltages:
- Line: 400-volt
- Phase: 230-volt
- Frequency: (Hz): 50Hz
- Number of phases: Three
- Number of wires: Four
- Neutral Connection: Star Point

• Earthing System:	MEN
• Ambient air temperature range: (°C):	-5°C to 40°C
• Maximum relative humidity: (%):	90%

2.8 QUALITY ASSURANCE

Establish and maintain records which give evidence that the trade works has passed inspection and/or test with defined acceptance criteria and submit one (1) copy of all such records within seven (7) days of completion of the relevant work.

Allow approved representatives the right to verify at source or upon receipt that the purchased product conforms to the specified requirements. Such verification will not absolve the Electrical Sub Contractor of the responsibility to provide acceptable product nor will it preclude subsequent rejection.

Ensure a quality system is planned, established, implemented and maintained during the carrying out of the Services.

Allow approved representatives appointed as a Quality System Auditors the right to undertake a quality assurance audit. Provide access and all necessary assistance to the Auditors in order to demonstrate compliance with the requirements of the quality standard.

Review and analyse the cause of any deficiency revealed in the report of an audit by the Quality System Auditors and develop and implement or procure the development and implementation of corrective action to prevent recurrence.

2.9 LABELLING

Permanently label and individually number all components, fixtures, fittings, outlets and cables installed as part of this contract such that they can be quickly and accurately identified. All labels must be permanent with the type and size of label appropriate to the location and conditions. The label type must be appropriate for weathering, UV exposure, vandalism and mechanical damage. Stick on and hand written labels are not acceptable. The numbering and identification is to be consistent and consecutive for all items. Provide matching labelling and numbering where an existing numbering and labelling system exists. Submit all labelling types, identification schemes and numbering schemes for approval. Ensure all labelling is clearly identified and cross-referenced in the manual and on the work-as-executed drawing. Double sided tape is not acceptable as a method of securing labels.

- Power outlets and light switches with clip-on faceplate / surrounds are to have the circuit identification labelled by using indelible ink in a concealed location under the clip-on faceplate / surround on the screw fixed plate.
- Isolators and power outlets and light switches that do not have clip-on faceplate / surrounds (such as weather proof outlets) are to have the circuit identification labelled by engraving with a contrasting infill colour on the faceplate of all power outlets and isolators in a permanently visible location. Such engraving is not permitted to be located on clip on faceplates / surrounds. If the entire faceplate is clip on then the label is to be provided as a screw fixed tefolite panel engraved with a contrasting infill colour mounted immediately above the outlet.
- Communication outlets are to have the circuit / channel identification labelled by engraving with a contrasting infill colour on the faceplate of all outlets in a permanently visible location. Such engraving is not permitted to be located on clip on faceplates / surrounds. If the entire faceplate is clip on then the label is to be provided as a screw fixed tefolite panel engraved with a contrasting infill colour mounted immediately above the outlet.
- All exposed labels and identification method are to be identical in type and style.

2.10 KEYING

Ensure all of the lockable enclosures provided as part of the electrical installation are keyed alike and keyed as part of the sites master key system. Where enclosures are required to be accessed by authorities, key the enclosure to the authorities' requirement.

2.11 INSPECTION AND WITNESSING

Arrange for and give sufficient notice so that inspection for approval may be at the following stages:

- Concealed conduits: Prior to concrete pours, etc.
- Cables laid: After laying underground cables and before and after laying protective covering and marker tape.
- Roughin: Cables have been installed in walls and the ceiling space before the like has been sheeted.
- Connection: Connection of cabling and wiring.
- Factory testing of all control panels and switchboards.
- Factory inspection of all custom made components.
- Earthing: Installation and connection of earthing system.
- Acceptance: Installation ready for acceptance.
- Inspections required by Regulatory Authorities prior to their approval of the installation or its stages.
- All testing and commissioning.

To prevent any abortive factory visits, the manufacturer is to provide written evidence, including appropriate certification, that testing has been carried out to the required specification prior to the factory visit. As part of the factory testing and commissioning all operational, functional and safety sequences are to be simulated and checked. Should the factory testing and witnessing have to be repeated due to the manufacturer failing to provide the required written evidence or appropriate certification and or failing to carry out the testing prior to the visit, the Electrical Sub Contractor is to agree to a variation credit of \$2,000.00 to the contract per repeated factory test.

The manufacturer is to undertake the following prior to the factory visit:

- Undertake all required tests and ensure that signed test sheets and relevant product documentation and certification are in place.
- Obtain copies of the latest design specification and drawings
- Confirm the 'as built' drawings incorporate the latest modifications to the design drawings.
- Wire external switches on a temporary basis to simulate operational conditions for testing. Note that external switches and ports can be connected for test purposes.

2.12 TESTING

Arrange for and give two week's notice so that, the tests may be witnessed for approval.

Undertake on site the following tests:

- Insulation resistance measurements: On motors and major medium voltage equipment items, at 1000-volt D.C.; on cables and wiring.
- Functional checks: Full functional and operational checks on energised control equipment and circuits, including adjustments for the correct operation of safety devices.
- Motor rotation: Checking and where necessary altering connections for the correct motor rotation.
- Earth resistance.
- Earthing: Confirmation of effective earthing of the exposed metal of electrical equipment.

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

Provide all Test Results for approval within one (1) week of the test being undertaken on A4 paper and as an electronic PDF file copy on CD for approval.

Check control systems for correct operation under representative operational conditions. During the commissioning period these conditions may not arise because the building is unoccupied, and it is difficult properly to verify the performance of seasonal variations in control strategies. Control systems should therefore be checked when the building is occupied. In addition, illuminances cannot be checked until the space is completely fitted out and furnished. Representative operational conditions will often involve checks at dusk and/or night time.

The extent and frequency of post-occupancy checks should be included in the control system specification as part of the contract between the building owner and the construction supply chain and will depend on the nature and complexity of the control system. Lease documents should support any contractual requirements for post-occupancy evaluation and ensure that the leaseholder is required to provide reasonable access for their performance.

Post-handover checks comprise a continuation of functional checking relating directly to the lighting control system. Where a central control system is implemented, use should be made of its logging functions and the ability to display trend logs once it is confirmed that they are operating accurately.

2.13 COMMISSIONING

Commission all components of the electrical services to ensure the correct interfacing operation and control of all systems to the satisfaction of the engineer as per the approved commissioning method statement and commissioning plan. Arrange for and give two week's notice so the commissioning may be witnessed for approval.

Provide all necessary software, equipment and personnel to fully program and configure all systems to the satisfaction of the clients representative.

Following the completion of the commissioning and prior to Practical Completion thoroughly clean all components of the electrical installation to the satisfaction of the engineer.

Following commissioning, operate each component and system at the convenience of the engineer to the satisfaction to provide evidence to the engineer that each component and system is working correctly.

A record of all settings, set point and offsets should be maintained throughout the commissioning period and included in the Operations and Maintenance Manual. Update the Operations and Maintenance Manual record following the completion of each of the post practical completion commissioning requirements. The defects and liability period will not end until the Operations and Maintenance Manual has been updated.

As part of the commissioning process ensure the following actions are completed:

- Check that time schedules enable the intended operation at the correct times.
- Check that the specified routine to ensure unified time clocks throughout the complete control system operates correctly.
- Check for the correct control and operation on start-up and shutdown. Check that the defined restart routine operates correctly when power is reinstated after failure. Check for any specified sequenced start-up to accommodate high loads.

Check the control system to confirm its specified operation following a mains power supply failure. In particular undertake the following checks:

- Check that controllers preserve control strategy configuration data for a specified period when the mains power is lost.
- Check that the condition of any volatile data protection system is regularly and automatically monitored. Check that an alarm is raised on loss of data by any controller or other device and/or failure of the monitoring system.
- Check that the control system operates correctly under generator standby and UPS power if applicable,

- Check that the control system will automatically return to normal action without operator intervention restoration of the mains electrical power supply.
- Check that any specified load shedding procedures operate correctly.

All wiring is to undergo though not be limited to the following checks and testing:

- Cable type as specified
- Cable identified at both ends
- Cable cores identified at both ends if not self numbered or colour coded
- Security of fixing/protection of cables to walls etc where surface-run
- Cable carrier/container in accordance with the specification (tray, basket, conduit/trunking etc)
- Cable management in accordance with the specification
- Cables not damaged
- Secure termination of wires (using ferrules)
- Screening continuity
- Cable only earthed at one end (field controller) or as specified
- Electrical continuity ('belling out')
- Correct polarity where applicable
- Correct input/output (by briefly disconnecting cable)
- Correct and secure termination
- Separation of mains and signals cables
- No short circuits line-to-line and line-to-earth
- Volt-free contacts are volt-free (prior to the installation of the field controllers).

Undertake including though not limited to the following on site communications network checks and tests:

- All network devices such as routers and bridges are installed correctly.
- All control devices can be addressed over the communication network.
- When used in conjunction with an office IT network ensure that permission has been granted from the IT manager. All network data routing is correctly set up by the IT department including allocation of the appropriate TCP/IP addresses and default router addresses.
- For structured cabling systems ensure that all outlets are properly labelled and assigned. Ensure that any changes to the cabling system are reflected in the updated documentation.

Undertake including though not limited to the following on site insitu field control devices (controllers, outstations and unitary controllers etc) checks and tests using NATA approved testing equipment:

- Type as specified
- Size as specified
- Enclosures as specified
- Number and location (height, access) as specified
- Adequate mechanical fixing
- Identification by mnemonic labelling
- All cables terminated and identified
- All terminals used (check that any unused terminals are intended to be spare)
- Continuous power available and of an appropriate quality
- Fuse correct type/spares if specified
- Hardware configuration agrees with the specification
- All printed circuit boards in place
- All connection cables plugged in
- Document wallet containing wiring diagram where appropriate, i.e. when located in a control panel

2.14 TRAINING

Provide the clients representative with sufficient training such that they are capable of understanding how the system operates as a complete system and how the controls work as part of the system.

Beyond time spent during commissioning stage, at times to be agreed with the clients representative, instruct the clients representative's staff in the recommended methods of operation the electrical services. Allow to provide two such operational training sessions on site each for duration of 2 hours.

Provide the basic clients representative training such that following the training an clients representative with this level of training will have a basic understanding of the control system operation and have the ability to view point data. It is not expected that the clients representative will make any alterations to the system. The basic clients representative abilities include;

- Simple instructions on what to do upon a fire alarm.
- Simple instruction on what to do upon a fault with the fire alarm system.

In addition to the clients representative training above at times to be agreed with the clients representative, instruct the clients representative's maintenance staff in the recommended methods of operation and maintenance of the electrical services. Allow to provide two such operation and maintenance training sessions on site each for duration of 2 hours.

Ensure the maintenance staff training includes the following information:

- A review of the Operations and Maintenance Manual.
- The types of luminaries used.
- The correct types of lamps to be used for each luminaire type.
- The correct type and location of all consumables used within the electrical installation. This is to include though not be limited to lamps, indicating lamps, fuses, surge protection devices etc.
- Advised maintenance cycles.
- Access for maintenance.
- The location of spares.
- The location of switches.
- Basic trouble shooting and fault finding techniques.

3.0 INSTALLATION REQUIREMENTS

3.1 CABLES

3.1.1 INSTALLATION

Unless otherwise specified, install and terminate cables in accordance with the manufacturers' recommendations. Unless noted otherwise joints are not acceptable. Install power wiring utilising the loop-in, loop-out system with joints in cables being affected at outlets.

Ensure oil, wax and powder based electrical cable lubricants are not used as cable lubricants. If cable lubricants are required to be used then use polymer-based for copper cables and silicon-based for optical fibre cables.

Remove redundant equipment and wiring, including that in accessible ceiling spaces, and make good exposed surfaces before commencing the installation of new wiring.

Handle cables so as to avoid damage to insulation and serving or sheathing. Replace all wiring with insulation damage after determining and removing the cause of damage.

Identify multicore cables and trefoil groups at each end and at crowded intermediate points by means of stamped, non-ferrous tags, clipped around each cable, or trefoil group.

Install and adequately support fixed wiring as specified throughout the installation. In accessible false ceilings, keep cables clear of all ceiling insulating material and/or removable ceiling tiles by securely fixing the cabling to permanent structural members. If the structural members are more than 1,200mm above the suspended ceiling, provide a catenary support system. It is not allowable to fix cables to the ceiling hangers.

Provide flexible connections or an approved form of vibration/movement isolation on the terminations of all cables that will experience vibration or movement under their normal operation.

Cable installation in areas where there are motors and/or generators shall comply with the guidelines set out in AS/NZS 3548 and AS/NZS 2834.

3.1.2 GENERAL CABLING REQUIREMENTS

The terms wiring and cabling are used interchangeably throughout this contract to refer to any cabling types and relevant standards.

Ensure all of the electrical services cabling comply with the following requirements:

- All cables are installed without joints.
- All cabling is concealed from view.
- All cabling installed externally is installed in conduit.
- All cabling that is installed in locations that are not concealed such on exposed roof trusses, are to be run in conduit.
- Cabling fixed to trusses and beams in concealed ceiling spaces is to be fixed to the side of the truss / beam and not on top of the bottom cord of the truss / beam.
- Chasing of masonry walls is co-ordinated with other trades. Horizontal wall chases must be approved.
- Coordination of the installation of conduits and cables in the ceiling space does not interfere with the operation or maintenance of any equipment.
- Cables do not come into contact with hot water pipes.
- Above suspended ceilings, all conduits and cables are secured to the ceiling support members or roof structure above. Conduits and cables laid directly on the ceilings (on the ceiling suspension system or framing) are not acceptable.
- All cables in underground conduits are approved by the manufacturer for external underground use.

- Enclose cables from above down to switches, outlets and equipment in conduits where the equipment is installed on single leaf masonry walls or concrete walls. TPS power cables where installed in cavity walls may be unenclosed within the cavities, unless otherwise detailed.
- Cables are secured to prevent any strain on the cable terminations. Support cables at a maximum of 1200mm spacing with minimum sag.
- The use of spring clips will not be permitted without approval.
- Do not install double insulated cables in locations where they can not easily be withdrawn for rewiring purposes. Where double insulated cables are installed in accessible locations such as cavities, stud partitions and the like, do not clip or secure the cables such that they can not be withdrawn.
- Double insulated cables are installed in conduits where they are installed within cement render, masonry walls or concrete slabs.
- External cabling is installed underground where installed between buildings, connecting signs, luminaries and the like.
- Catenaries are provided between cable trays and access conduits.
- Where cables traverse areas above set plasterboard ceiling (or similar) particularly in an office environment and providing access difficulties, use conduit secured to a catenary wire, or suitably saddled to the ceiling.
- Support all horizontal cabling via a dedicated catenary, cable tray, cable ladder, or via a structurally secure cable support system specifically installed to support cabling. All cable support systems must be submitted for approval. It is not acceptable to use double sided tape, stick on hangers to support cables or to support cables from the ceiling support system or any other services support system.
- All cables entering wall cavities are to enter vertically above the outlet position and the access into the cavity allows for simple withdrawal of the cable and the simple installation of a second cable of equal size.
- Do not run cables horizontally through walls. Where such runs are necessary, (half height walls), use corrugated conduit to facilitate the cable run to the outlet or switch. Indicate the extent and location of all cables reticulated horizontally through walls.
- All cables passing through a metal surface, any sharp surface or any surface that could damage the cable insulation over the life of the installation is to be protected by grommetted nylon bushes.
- Replace all wiring that contains kinks or abrasions.
- Provide all final connections from the wall box or isolator in flexible smooth wall PVC conduit to equipment. Enter the isolator with flexible conduit from the underside thus forming a drip loop and neatly install such conduit to minimise retention of grease, etc.
- The cable sizes indicated on the drawings are provided as a minimum only. The current capacity, voltage drop and fault capacity of the cables must be established by the Electrical Sub Contractor and the cables sized accordingly by the Electrical Sub Contractor. Size all cables to accommodate the respective loads, starting currents and maintain a spare capacity of 10%. All loads and fault levels must be confirmed on site by the Electrical Sub Contractor with the actual equipment being supplied.
- Unless otherwise approved, terminate copper conductors to equipment, other than small accessory and luminary terminals, by means of compression-type lugs of the correct size for the conductor, compressed only by the correct tool.
- Loom and lace together, with PVC straps, all conductors from within the same cable or conduit from the point of cable sheath or conduit termination to the terminal block. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.
- Provide flexible connections on the terminations of all cables that would experience sufficient stress/force under a bolted line fault condition that would cause damage to the cable termination or the equipment.

Provide mechanical protection of all cables in the following locations:

- Within 2,400mm of any floor, platform or landing that is accessible under normal operation and routine maintenance.
- All locations it is reasonable to expect that the cabling would be interfered with.
- All locations the cable could be subject to damage during normal operation and maintenance.

Provide all power and lighting cabling in accordance with the following:

- All T.P.I and T.P.S power and lighting wiring is to utilise stranded copper conductors with a minimum size of 2.5 mm sq with 0.6/1kV V90 PVC insulation .
- Ensure all power and lighting wiring and cabling utilises stranded copper conductors.
- Ensure all wiring is provided and installed in such a manner that its installed overload rating exceeds the overload rating of the protective device.
- For fixed power wiring, colour the conductor insulation or, if this is not practicable, slide not less than 150 mm of close-fitting coloured sleeving to each conductor at the termination points as follows:
 - Active conductors in single phase circuits: RED.
 - Active conductors in polyphase circuits:
 - A PHASE - RED
 - B PHASE - WHITE
 - C PHASE - BLUE

3.1.3 SETTING OUT OF RETICULATION

The routes shown on the Drawings are approximate only. Determine the final routes to suit the building structure or site conditions. Unless otherwise specified, conceal and protect cables and conduits. Arrange cables and conduits parallel with walls, ceilings and floors.

3.1.4 WIRING IN CONDUIT

Complete and permanently fix the conduit run before installing the wiring. Use draw wires to pull in the conductor groups from outlet to outlet. For vertical conduit runs in excess of 15m make adequate provision for supporting the weight of the wiring to avoid insulation damage. Run circuits originating at different distribution boards in separate conduits.

3.1.5 TERMINATIONS

Terminate all cables installed as part of this contract. It is the Electrical Sub Contractor's responsibility to check and ensure the component or equipment the cable is being terminated to be appropriate and suitable for the cable to be terminated to. Advise the clients representative of any concerns with the component or equipment prior to the cable being terminated.

Where core identification is required, fit to each core durable numbered ferrules permanently engraved with numbers and/or letters to suit the specified connection diagrams. Terminate and identify any spare cores into spare terminals, if available; otherwise neatly insulate and bind the spare cores to the terminated cores.

Insulation displacement terminations or connections are not acceptable for 240 volt cabling. All 240 volt terminations must be screw type.

3.2 CONDUITS

Ensure all conduits installed as part of the electrical services are installed in accordance with the following requirements:

- Corrugated conduits are not permitted in any food preparation, food storage, food servery area or under any bar or servery counters.
- Conduits are sized to permit drawing-in of cables to finished conduit runs without damage to cables.
- Protect all PVC conduits against UV exposure.
- Steel and galvanized conduit are not installed underground.
- Rigid UPVC conduit fittings are fastened to the conduits by fresh solvent cement in accordance with the manufacturer's recommendations. The cement is to be a contrasting colour to the conduit.
- Corrugated UPVC conduit fittings may be fastened with solvent cement as above or by use of snap-lock connectors in accordance with the manufacturer's recommendations.
- Flexible smooth wall PVC conduit fittings of the black nylon conduit clamp band type are provided.
- Conduits, pipes and conduit fittings are not visible on any wall, floor or ceiling surface with the exception of Switch rooms, Plant rooms and risers.

- Installation of conduits enables wiring to be drawn in and out at any future time without damage to the building and cabling and without disruption of the conduit continuity.
- Only conduit, deep draw-in boxes and couplings are to be cast in concrete. Do not cast conduit tees and elbows in concrete.
- Constant supervision at all times is provided when concrete containing conduits is being poured.
- Conduits passing through expansion joints are provided in concrete slabs with approved flexible expansion couplings.
- Conduits with expansion joints are provided as required to accommodate the expansion of the conduits and the supporting surfaces with a minimum of an expansion joint in straight runs at intervals of no more than 12,000mm.
- Unless noted otherwise provide conduit located internally as PVC light duty (LD), high impact rigid, minimum size being 20mm circular. Corrugated PVC conduit shall not be used unless approved.
- Unless noted otherwise, provide conduit located externally as PVC heavy duty (HD) conduit and stamped "underground" type.
- Conduit adaptors are lock nutted into metal wall boxes or welded into PVC boxes.
- Conduits, fittings and welding solution of the same manufacturer are used.
- All change directions of conduits are set. Undertake setting by warming the conduit and bending around an internal spring. Ensure burn marks are not visible as a result of warming. Cold bending is not permitted. Secure conduits within 50mm of each change in direction.
- Secure 40mm or larger conduits every 500mm or less. Secure conduits less than 40mm every 300mm or less.
- Conduit ends above ceilings at right angles are set in the direction of the cable run.
- Conduit ends are cut square and free from sharp edges, burrs, and the like.
- Where subject to mechanical damage, exposure to sunlight, weather and/or damp conditions and/or ambient or contact temperatures exceeding 60 degrees Celsius, use heavy duty galvanised screwed steel conduit. Provide mechanical protection to UPVC conduit for a height of not less than 3m above ground or platform level.
- Where PVC conduit is embedded in concrete which is screeded or vibrated after pouring, or where conduits may be subjected to heavy traffic prior to concrete pour, provide constant supervision by a tradesperson to ensure that conduits are not damaged.
- All conduits are installed in concrete slabs above the bottom layer of reinforcement and securely tied in place. Boxes are firmly fixed to the formwork.
- Groups of conduits in slabs are separated by a distance equal to the diameter of the conduit/s. Obtain approval prior to installing conduits greater than 40mm OD in concrete slabs.
- Proprietary sealing caps (or aluminised flashing tape if sealing caps are not manufactured) are fixed to all conduit ends prior to the commencement of pouring of slabs, laying of bitumen, gravel, and the like and are to remain in position until the conduits are finally terminated.
- All conduits cast into a concrete slab, protrude perpendicular 100mm above the surface of the slab and are located as close as practicable to a wall.
- Prior to the installation of wiring, ensure conduits are clear of debris and liquids.
- All underground electrical conduits and conduits/pipes for special services (including spares) are sealed internally to approval at switchboards and/or at special services enclosures and where entering buildings to prevent the ingress of water.
- Metallic saddles with corrosion protection equal to hot dipped galvanizing with two galvanized fixings per conduit saddle are used to secure all surface mounted conduits. Do not use explosive-powered or similar equipment unless approved. Ensure the metallic saddles and fixings do not create a galvanic reaction with the support structure. In locations it is not practical to use saddles, submit details of the proposed conduit securing method for approval prior to commencing installation of the conduit. Any alternative conduit securing method must provide corrosion protection equal or better than galvanizing.
- UPVC conduits installed in accessible roof spaces and the like are protected by timber battens.
- Up to the commercially obtainable conduit lengths of run, conduits are installed without joints. Remove all jags, burrs, and sharp edges from each length before completing each conduit joint. Fit moulded plastic screwed bushes to the free ends of metallic conduit runs before installing the conductors.
- All inspection fittings and the like are accessible.
- Draw-in boxes are provided at suitable intervals not exceeding 30m in straight runs, and at intervals not exceeding 25m in other runs including directional changes.
- Conduits are not run in topping slabs unless approved.

- After removal of sharp edges, burrs, etc., ends and joint threads of steel conduits are painted with a rust-inhibiting metallic paint, which maintains conductivity.
- Standard size wall boxes of the same material as the conduit are used. Where special size boxes are specified and where such boxes are not obtainable in UPVC, use pre-fabricated metal boxes.
- Galvanised steel water pipe may be used for cable enclosures buried in the ground or run in concrete trenches or the like. Seal joints against the entry of water or moisture. Associated fittings will be either galvanised steel, cast iron or approved non-ferrous metal.
- Round off sharp edges and provide PVC bushes or the like for cable entries into metallic ducting.
- All conduits and ducts on cool room panels are mounted on 25mm stand offs.
- Arrange conduits below 2,700 AFFL such that a person cannot hang from or climb from the conduit by using the conduit as a foot hold or hand hold.
- All PVC conduits located externally above ground to a height of 2,000mm AFFL are protected with 1.6mm thick folded galvanised sheet steel hat section. Galvanized conduit may be substituted in the above ground location in lieu of the PVC conduit and steel hat section.
- Where the conduit is in an exposed location, paint the exposed conduit and hat section to match the building colour.
- All conduits are installed such that any moisture in the conduit drains away from the electrical connections. Where required provide the conduits with weep holes and drip loops.
- All conduits are installed and sealed such that insects can not nest or seek refuge in them.
- All conduits are sealed such that the sealant can be removed in the following locations to prevent vermin and moisture entering through the conduits:
 - Conduits passing between different functional parts of the building such as food preparation areas, plant rooms, service areas and public areas.
 - Conduits passing between levels.
 - Conduits entering or leaving the building.
- Do not use conduits smaller than 20mm diameter in any circumstance or conduits smaller than 25mm diameter underground.
- Do not use light duty (MD-UPVC) conduit underground or where it may be exposed to mechanical damage or to sunlight.
- Ensure all associated plastic conduit fittings are of the same material as the conduits.
- Install conduits so the installation can be wired using the 'draw-in loop-in' principle.
- Provide power circuit conduit s so the power circuit wiring is drawn in only at outlets and the initial conduit entry point.
- Install conduits directly from the entry point to the termination point, with the minimum number of sets ensuring the number bends does not exceed the equivalent of 3 x 90 degree bends.
- Do not install elbows, tees, etc. in inaccessible locations.
- Cap all conduits during construction.
- Do not run conduits in roof spaces directly below the thermal insulation or sisalation.
- Do not run conduits in roof spaces or ceiling spaces directly on top of the ceiling.
- Provide deep pattern wall boxes securely fixed such that the front edge of the box is no more than 10mm behind the wall finish.
- Do not install wall boxes across the junction between different wall finishes.
- Provide all plastic wall boxes with threaded brass inserts for securing the flush plates.
- Do not use wall boxes with sliding type lugs for attaching flush plates.
- Earth all metal wall boxes.
- Run conduits within concrete slabs such that they are securely fixed to the reinforcing rods and pass above a single layer of rods or between a double layer of rods, generally midway in the thickness of the slab.
- Space parallel conduits within concrete slabs more than 75mm apart.
- Arrange conduits within concrete slabs such that cross overs are avoided and the number of conduits in one location is kept to a minimum.

Rectify all damage caused by flooding or vermin ingress that has occurred as a result of the conduits not being correctly sealed. Any such damage post practical completion is to be considered a latent defect and must be rectified as such.

3.3 PENETRATIONS

The building includes areas / levels which are required to be fire isolated and all penetrations through such areas as defined on the architectural documents must be appropriately fire rated.

Seal all penetrations in a neat and tidy manner in such a way that the sealing material can be removed to allow future use of the penetration. Ensure all penetrations are sealed to at least the original integrity of the member or structure being penetrated. Provide independent certification of all fire rated and sound rated penetrations. Do not penetrate fire rated finishes, structural members, acoustically rated finishes or damp courses without approval. Run pipes entering a building at ground level under the waterproof membrane and vertically penetrate the membrane and the floor slab. Provide a suitable seal between the pipe and the roofing material.

Fit a UPVC sleeve for each penetration through ground floor slabs, ground floor beams and external walls for cables not enclosed in conduit. Provide a penetration of diameter 10mm greater than the pipe or sleeve diameter for pipes and sleeves penetrating existing external walls, ground slab, or ground floor beams.

Provide all electrical penetrations into refrigerated enclosures as rigid conduit extending a minimum of 50mm beyond each side of the refrigerated panel. Seal inside and outside of the refrigerated panel around the conduit with Sikaflex. After the cabling has been installed, seal around the cable within the conduit with Sikaflex. Ensure all penetrations into outlets, switches and fittings within refrigerated enclosures are waterproof.

In all locations where underground conduits pass under a building or structure, provide flexible conduit with a smooth interior for 300mm each side of the transfer to accommodate movement of the building or structure. All such conduits are to be similar to Vindex Coreflow conduit.

Provide all outlets and switches flush mounted within floors, walls and ceilings that have an acoustic rating with additional protection to achieve the same acoustic rating as the base structure. Provide a copy of an independent certification for approval of the additional protection that the required acoustic rating is achieved with the installation method and components employed. Provide a copy of the certification in the maintenance manual and indicate the location of all such additional protection installations on the as build documents. Surface mounted wall blocks are not acceptable as methods of achieving the required rating if the outlet / switch has been specified as flush. If additional furring channel and or wall / ceiling sheeting is required that is not part of the base design all such additional materials must be included as part of the tender price.

Provide ceiling roses or flush faceplates with a cable gland to trim all cables penetrating a wall or ceiling that are to be connected to equipment that is bracket mounted that does not inherently accommodate concealed cabling.

3.4 ACCESSORIES AND FITTINGS

Provide all accessories and fittings in accordance with the following requirements:

- All switches and outlets provided are of a like appearance, flush set sized at 115 x 70mm.
- Switch flush plates are mounted with the 115 dimension orientated vertically. Outlets are mounted with the 115 dimension orientated horizontally.
- All accessories shall be flush mounted rocker action type. Use red switch toggle marker 'dots' on GPO's but not on light switches. Provide accessories as white in colour unless specifically detailed otherwise.
- Flush plates are installed plumb and fit hard against wall surfaces. Wall boxes are used for masonry and concrete walls and proprietary mounting accessories for "stud" type partition walls.
- Switches and power outlets in exposed locations and in areas such as plant rooms are provided as IP56 rated light grey in colour with one piece covers where available.
- All wall boxes specified for future use are provided with blank flush plates.
- Instructions for final positions of all outlets and switches are requested at least ten working days in advance.

- Relocation of outlets and switches is allowed for at a maximum of 1.5m without additional cost, providing chasing is not required.
- Outlets, switches and accessories are installed to suit tiling and surrounding fixtures. The mounting heights shown on the electrical services drawings shall be taken as indicative only.
- All accessories are to be flush mounted installed in wall boxes.
- Supply of all outlets mounted within the joiners or nominated as being mounted below bench via surface duct run within the joinery is allowed for. Allow to mount all such outlets on surface mounting blocks. Coordinate the location of the duct and the outlets on site with the joinery. If the installation permits counselled cabling and flush mounted outlets do not install the surface duct or mounting blocks.
- All suspended equipment provided is mounted off a raked ceiling with an adjustable ceiling mounting such that all suspended equipment hangs vertically.
- All fittings and accessories installed in refrigerated rooms and enclosures must be non ferris.
- All mechanisms and blank mechanism fillers are to be screwed fixed in place on the rear of the faceplate.

3.5 EARTHING

Provide a comprehensive earthing system throughout the project addressing all aspects of the structure, all services, all systems and components in addition to those forming part of the power distribution.

Run a PVC-insulated copper conductor from the building's main protective earth bar to the slab reinforcing mesh. Clamp conductor to mesh (one point of contact only required) with a brass earth clamp. Wrap clamp and exposed copper conductor with insulation tape. Provide a label engraved 'Slab Reinforcing Mesh Bond' adjacent to the termination on earth bar.

Copper conductor is to penetrate slab inside building enclosure and be such as to avoid moisture penetration to slab reinforcing mesh.

Bond the electrical earth to all piped services (if metallic pipes) at the closest practical point to where these piped services enter the building. This includes cold water, hot water, soft water, steam, condensate return, waste, medical gases, suction and the like. The bonding earth conductor to be 6 sq. mm minimum.

3.6 ACCESS

In non-habitable locations such as plant rooms and store rooms provide cable access to surface mounted electrical equipment such as switchboards, control panels, intruder detection panels and communication equipment by surface mounted PVC or metal duct. Provide the duct with a removable lid of lengths not exceeding 1,200mm and arrange the duct such that it runs square with the building. Silicon seal between the duct the wall, the floor and the ceiling. Cover all conduits entering through the floor with such duct. Where the duct abuts the boards/panels provide neat cutouts free of burrs in the duct and boards/panels to allow cable access. Where the duct does not adjoin the boards/panels provide cable glands in the duct and the boards/panels for all cable access. Ensure all of the cables run within the duct are supported vertically and horizontally to the cable manufacturers requirements and as a maximum such supports are not to exceed 1,200mm. Provide or paint the duct to match the wall colour.

3.7 CATENARY SUPPORTS

Provide catenary supports in accordance with the following requirements:

- Use catenary wire as a minimum as seven strands galvanised steel wire.
- Catenaries are anchored and supported to the ceiling slab or structural members and tensioned by way of 2 wire clamp turnbuckles fixed in place by Dynabolts with a minimum size of 6mm.
- Where the cable loading is excessive for catenary wire or saddled enclosures, use tray/ladder.
- Catenary wire is supported by jack chain or similar at distances of no more than 3 metres. Do not use ceiling hangers as support for catenaries or cabling.
- Where cables leave a catenary, they must be supported in PVC conduit and/or PVC ridged and/or flexible conduit and/or an additional catenary and then the conduits. The conduits will be fastened to

the catenary and then at every change of direction in a workmanship like manner. Corrugated conduits should not lay about in ceiling spaces.

- Attach an earth to the catenary with a 2 screw tunnel type connector.
- Catenary wire systems must be installed be true to the building line in such a manner that they are not interfered with or in contact by the structure or any other service.

3.8 CABLE LADDER AND TRAY

Bolt the tray/ladder to single sided brackets for horizontal runs and roll steel channel in vertical runs. Provide cable tray as rolled or folded steel at least 1mm thick galvanised prior to delivery or from extruded structural grade aluminium with a thickness not less than 1.5mm. Use cable ladder with cable support rungs between the two rails spaced at intervals of not more than 300mm. Each adjacent length of the cable tray is to be bolted together.

Use tray/ladder 150 mm, 300mm, 450mm or 600mm wide. Provide bends, connectors, trays, ladders, brackets, and other support necessary to make a complete cable or conduit support system of the same manufacture, sized to adequately support the installed cabling.

Provide cable ladder with a cable contact area of less than 10% for power cables required to be supported on tray/ladder. Provide perforated cable tray for all non-power cables required to be supported on cable ladder or tray. Use tray that has slots that on both the normal and reverse sides there are no burrs or sharp edges. All trays and ladders must be galvanised after manufacture, prior to delivery to site.

Do not run cables with an outside diameter smaller than 13mm on cable ladder unless supported at intervals not exceeding 100mm. Slots or ladder rails will be considered suitable for fixing cable ties, strapping or saddles. Ensure all bends have a minimum inside radius of not less than twelve times the outside diameter of the largest diameter cable carried. Provide sufficient space on the tray or ladder for not less than 50% more cables or conduits than specified.

Position the tray/ladder to give adequate access for inspecting, replacing, or adding cable. Fix cable to the tray/ladder by proprietary nylon ties, straps or saddles, at 1000 mm centres for vertical runs and 2000mm centres for horizontal runs. Provide a slightly curved support surface under cables leaving the tray/ladder to protect the cable sheath from impingement by the tray/ladder edge.

Where the tray/ladder is exposed, provide a cover over the tray/ladder. Provide the cover as removable galvanised sheet steel screw fixed to the tray in lengths that allow it to be safely removed by a single person. Ensure the cover is installed in a neat manner without undue gaps and is free from burrs.

3.9 CEILING SUPPORTS

Provide termite resistant plywood support to all components mounted within lay-in ceiling tiles such that the weight of the component and any associated control gear is supported on the ceiling grid and not on the tile. Provide all necessary T Bars and cut tiles required to accommodate the installation of all components mounted within suspended tile ceilings. Provide all necessary additional structural supports and T Bar rails to mount the fittings and support the plywood support. Provide all cutouts in set plaster ceilings and modify the structural support of the ceiling where necessary to accommodate the cut-out.

3.10 MOUNTING REQUIREMENTS

As part of the electrical-sub contract works allow for all necessary mounting brackets, fixings, trims, cutouts, blockouts and any other incidental component that will be required to complete the electrical installation. Provide a shop drawing of all such components including how they are mounted for approval.

Fittings and components that have any moving parts or weigh more than 2.5 kgs that are fixed to the lined ceiling or walls must be provided with independent support system connected to the structure.

4.0 POWER DISTRIBUTION

4.1 SCOPE

Modify the existing distribution boards DB-G to accommodate the new MCB to supply the new distribution board DB-A.

Undertake all power distribution cabling works including any temporary works that may be necessary to ensure the power supply is maintained such that the venue can remain operational. All change overs / cutovers and interruptions to the power supply are to be between 1.00 am and 5.00 am.

Provide the clients representative with two weeks' notice of any interruptions. Should an interruption to the supply be required during the venue's normal hours of operation, an alternative power supply must be provided and be connected / disconnected between 1.00 am and 5.00 am as noted above.

Allow to reconnect all existing circuits that remain such that any outlets, equipment, fittings and plant that remains which was disconnected by the works is reconnected and is operation to the same level of control that was present prior to the works.

Provide written advice to all associated contractors and sub-contractors of the following information where switchboards and control panels are supplied outside of the electrical services and are provided with power by the electrical services: Provide a copy of such advice for approval and provide a copy of each piece of advice within the Operations and Maintenance Manual.

- Upstream protective device size and configurations.
- The fault level at the final point of termination.
- The cable size, type and configuration.
- Control and interface configuration and requirements.

Provide shop drawings of all distribution boards and the cable termination enclosure.

All suppliers and sub-contractors to the Electrical Sub Contractor must ensure they are familiar with and comply with the requirements of sections 1.0, 2.0 and 3.0 of this specification

4.2 INSTALLATION

4.2.1 SWITCHBOARDS

Ensure all switchboard enclosures are appropriate for the location they are intended to be installed in and have appropriate space and capacity to contain all equipment and cabling in the final configuration.

The switchgear sizes indicated on the drawings are provided as a minimum only. The current capacity and fault capacity of the switchgear must be established by the Electrical Sub Contractor and the switchgear sized accordingly by the Electrical Sub Contractor. Size all switchgear to accommodate the respective loads, starting currents and maintain a spare capacity of 10%. All loads and fault levels must be confirmed on site by the Electrical Sub Contractor with the actual equipment being supplied.

All switchgear is to be provided as Schneider or NHP Terasaki.

All switchgear throughout the entire site is to be of the same manufacturer. All miniature circuit breakers are to be compact DIN style DIN rail mounted circuit breakers.

4.2.2 OUTLETS AND ACCESSORIES

The outlet and accessories sizes indicated on the drawings are provided as a minimum only. The current capacity and fault capacity of the outlet and accessories must be established by the Electrical Sub Contractor and the outlet and accessories be sized accordingly by the Electrical Sub Contractor. Size all outlets and accessories to accommodate the respective loads, starting currents and maintain a spare capacity of 10%. All loads and fault levels must be confirmed on site by the Electrical Sub Contractor with the actual equipment being supplied.

Ensure all electrical connections to equipment other than light fittings and control panels or switchboards with integral isolators are via a switched outlet or a switchable isolator. Provide all isolators as 20 Amp, lockable, IP56 isolators. Connect all isolators to the respective equipment via smooth flexible conduit unless noted otherwise.

Do not connect any motors larger than 5Kw to an isolator without motor protection relay and a control contactor.

4.2.3 FAULT PROTECTION

Unless specifically shown otherwise, provide overload, short circuit and earth fault protection utilizing automatically operated circuit breakers.

Provide 30mA earth fault protection of all cabling and outlets within residential areas, all general purpose outlets and circuits that the public could have access to during normal operation.

Ensure all circuits are suitably protected against earth faults and the protective device operates within the required time. Include details of how such protection is achieved with the testing and commissioning data for the worst case point on every circuit and submain. Such details must be in the form of one of the following:

- Circuit protected by a 30 mA RCD.
- Perspective fault current at the point, circuit impedance and protective device tripping characteristics

4.2.4 CABLING

Unless otherwise specified provide all power cables with copper conductors, a minimum size of 2.5mm² with insulation coloured as follows:

- Actives of single phase circuits: Red
- Actives of multiphase circuits:
- A phase: Red
- B phase: White
- C phase: Blue
- All neutrals: Black

4.3 COMMISSIONING

As part of the commissioning of the power distribution undertake the following tests as relevant on all components of the power distribution installation:

- Has been fully commissioned in accordance with this specification.
- Phase rotation.
- Power availability.
- Resistance to earth.
- Voltage.
- Overload protection.
- Fault protection.
- Earth leakage residual current protection.
- All mechanical fixings.

Schedule the results for each item and component and include a copy of all test results in the Operations and Maintenance Manual.

Balance the load as evenly as practicable at Practical Completion. Re-check and, where necessary, re-balance the load at completion of the Defects Liability Period. Submit the balance results for approval and include a copy of the results in the Operations and Maintenance Manual.

As part of the commissioning of the power distribution, undertake any necessary adjustments to components of the power distribution installation which, have integral adjustment capacity as directed. Record all adjustments undertaken and include a copy of all adjustments in the Operations and Maintenance Manual.

Ensure the following components of the power distribution system installation are complete and have been checked and tested prior to the adjusting of the power distribution system installation to commence:

- Labelling.
- Correct operation of the power distribution system.
- All components have been installed and are operating.

Should these items not be complete prior to the adjusting of the power distribution installation the additional expenses in re-attending the installation to undertake the adjusting of the power distribution installation as incurred by the engineer will be charged to the Electrical Sub Contractor.

Provide all equipment such as ladders, scaffolding and tools necessary for adjusting the power distribution installation. Should the Electrical Sub Contractor not have available the necessary equipment to complete the adjusting and aiming of the power distribution installation, the additional expenses in re-attending the installation to undertake the adjusting and aiming of the power distribution installation as incurred by the engineer will be charged to the Electrical Sub Contractor.

The adjusting and aiming of the power distribution installation will include the following:

- Adjusting mountings and brackets.
- Adjusting switch gear settings.
- Testing all operations of the power distribution installation.
- PE Cells.
- Time clocks.

Allow attending site twice during the defects and liability period and undertaking the above adjustments to and reprogram as directed by the engineer.

At practical completion provide a Queensland Government, Department of Local Government and Planning Form 16 certifying the power installation and include a copy in the Operations and Maintenance Manual.

4.4 OUTLETS

Provide all power outlets and connections as follows:

- Provide isolators for motors with a suitable motor rating; where motors are supplied by other trades, confirm motor ratings prior to sizing isolators.
- Unless otherwise detailed, all appliances will be supplied and installed by other trades, and connected by the Electrical Sub Contractor either by means of an isolator or by means of a power outlet.
- It will be the responsibility of the Electrical Sub Contractor to check with suppliers that cable and circuit breaker/fuse sizes are suitable for the equipment being installed prior to the installation of cables and circuit breakers and/or fuses.
- Specific details regarding connection to various items of equipment are not given in the specification where it is considered that the installation is of a straightforward nature and full details are available from single line diagrams/circuit schedules.
- Ensure all three phase power outlets throughout the installation have identical phase rotation and polarity.
- Install a neutral conductor to every three phase power outlet.
- The location of sinks and fittings and swing of doors shall be confirmed before the installation of general purpose outlets and light switches.
- Mount outlets of the one type where grouped together under the common flush plate.

- Provide all outlets mounted on stainless steel joinery of the flush stainless steel type with black mechanisms.
- On face plates, secure the mechanism with retaining screws, or construct the faceplate and mechanism so that the mechanism cannot be displaced during normal operation.
- Orientate switch mechanisms to operate in the vertical plane.
- Provide all GPOs, 10 amps, 3 flat pin flush, impact resistant, polycarbonate switch plug combinations, all mounted under the one cover plate with the earth pin at the 6 o'clock position.
- Mount all special purpose outlets with the earth pin at the 6 o'clock position, the neutral pin in the centre, and the red, white and blue phases in a clockwise sequence when viewed from the front of the socket.
- Provide a matching plug top with a screw ring for each three phase and screw type outlet.
- All accessories are to be flush mounted installed in wall boxes.

4.5 ESCUTCHEON PLATES

The maximum width of any escutcheon is 750 mm and the maximum height is 1,200mm. Hang escutcheons on stainless steel lift off pintail hinges and provide captive stainless steel 8mm square quarter turn locks such that they remain part of the panel or cover when the panel or cover is removed. Provide two stainless steel 'D' type handles to each escutcheon. Provide the escutcheon plates with neat cutouts for circuit breaker handles and the like. Provide a continuous 12 mm wide support frame for the fixing of each escutcheon plate, including additional support where necessary to prevent panel distortion. Hang escutcheon plates on hinges, which allow opening through a minimum of 90 and permit the removal of the escutcheon when in the open position.

Provide cutouts in the escutcheons for all spare future circuit breakers. Provide blank fillers in all spare escutcheon cut-outs.

Ensure all circuit breaker labels and adjustment dials are visible through the escutcheon when the escutcheon is closed.

5.0 LIGHTING

5.1 SCOPE

The lighting component of this contract includes internal lighting to all areas of the building, external lighting, general lighting control, emergency and evacuation lighting and the lighting sub circuit wiring. All of the light fittings and accessories are to be provided as part of this contract.

The lighting component of this contract includes, but is not limited to the following extent of work:

- Lighting.
- Light fittings and accessories.
- Earthing of the lighting installation.
- Lighting control.
- Emergency and exit lighting.
- Lighting subcircuits.

Irrespective of the mounting heights given in the electrical documents, the mounting and suspension heights of all wall mounted and suspended light fittings must be confirmed with the clients representative. Provide written evidence such confirmation has been received. If any wall mounted or suspended lights are installed without the height confirmed by the clients representative, adjusting the height will not be acceptable grounds for a variation.

All suppliers and sub-contractors to the Electrical Sub Contractor must ensure they are familiar with and comply with the requirements of sections 1.0, 2.0 and 3.0 of this specification.

5.2 COMMISSIONING

5.2.1 GENERAL

As part of the commissioning of the lighting, undertake the following tests as relevant on all components of the lighting installation:

Schedule the results for each item and component and include a copy of all test results in the Operations and Maintenance Manual.

As part of the commissioning of the lighting, undertake any necessary adjustments to components of the lighting installation which have integral adjustment capacity as directed by the clients representative. Record all adjustments and include a copy of the adjustment records in the Operations and Maintenance Manual.

Chemically clean all reflectors, lenses, diffusers and lamps prior to the aiming and adjusting of the lighting installation.

Undertake each of the following mechanical checks for each component of the lighting installation as part of the commissioning process:

- All luminaires have been positioned to coordinate with other installers (such as air conditioning contractors, installers of girders and plasterers).
- All luminaires are in the correct position and in the correct orientation.
- All luminaires are clean and undamaged with the correct lamps fitted (i.e. manufacturer, rating, phosphor and electrical type).
- All channel dials and function switches (as appropriate) have been set to the specified settings.
- All sensor levels have been set to the specified levels.
- All components are uniquely and clearly labelled.
- The alignment of all luminaires has been adjusted to avoid glare and unwanted over-spill.
- All cover plates have been fitted and electrical segregation is complete.
- All safety chains, safety cords and filter holders etc. on luminaires have been securely mounted; associated control gear have been fixed securely on lighting trusses, booms, barrels and bars, or placed in a secure position.

Undertake each of the following electrical checks for each component of the lighting installation as part of the commissioning process:

- All luminaries, switched and sensors have been wired according to the wiring diagram provided.
- All lights and track circuits have been wired to the specified control switch or dimmer.
- All mains wiring has been tested and certified as complying with the recommendations of AS3000.
- The voltage and frequency is stable and within the relevant authority limits.
- Control operation.
- The Resistance to earth of each fitting switch panel and exposed metallic component.
- The supply voltage and frequency at each fitting.
- Overload protection has been installed and operates correctly.
- Fault protection has been installed and operates correctly.

Undertake the following operational tests of the lighting control system.

- Each of the master switches operates correctly
- Each of the individual switches operates correctly.
- Each of the during hours run on times operates correctly.
- Each of the after-hours run-on time operates correctly.
- Changes to the run on times and calendar save and operate correctly.

5.2.2 LIGHTING CONTROLS

Confirm all light sensors are located in an appropriate representative location for the intended task. Calibrate the light sensor to indicate the light levels as advised by the engineer on site. Confirm the calibration of the light sensors with an independent NATA certified portable light sensor.

The calibration should take place remotely to the sensor at the lighting controller or at a remote workstation (via configuration software).

Confirm all light occupancy sensors are located and orientated appropriately in relation to the occupants. Confirm the occupancy sensor sensitivity is appropriate by adjusting the detector sensitivity to ensure the occupant movement is detected throughout the occupied zone. Configure the sensitivity to ensure seated occupants are detected, whilst movement outside the controlled zone does not activate the lights. Confirm the time delay setting is representative of the occupant work/movement patterns and is assessed when the building is occupied.

Set all presets, upper and lower limits of all dimmers as advised by the engineer on site.

Set all start and stop times along with override controls (e.g. occupant or security staff override) as advised by the engineer on site.

Ensure that scenes operate as advised by the engineer on site. Ensure that scenes are labelled adequately to allow an untrained user to select the correct option.

5.2.3 INTERIOR LIGHTING

Confirm the aiming and focusing of adjustable luminaires is adequately addressed. If all other lighting needs to be switched off during this process, ensure the site to be free from other workers requiring light.

Provide a safety method statement that allows those aiming and focusing the luminaires to use appropriate access gear belonging to, or hired by, the installer. If it is intended that the luminaires be adjusted by the end user after practical completion of the project, this must be indicated in the commissioning method statement.

5.2.4 EMERGENCY LIGHTING

Undertake the commissioning of emergency lighting in accordance with AS2293.

5.3 LUMINARIES

5.3.1 GENERAL

It is the electrical sub contractor's responsibility to ensure the luminaire is appropriate for the intended location considering the following:

- Mounting requirements.
- Lay in diffusers are sized such that they do not fall out of the light fitting or ceiling when the installation is subjected to normal air pressure changes and or winds.
- Fitting size.
- IP protection.
- Exposure to corrosive environment.
- Hazardous environment.
- UV exposure.
- Safety.
- Heat.
- Vandalism.

Irrespective of the fitting type specified, provide all light fittings in compliance with the restricted zone requirements of AS3000. Provide all light fittings over baths as Class II double insulated.

Provide each fitting with a screw tunnel type fused terminal block capable of housing 4x2.5mm² conductors in each terminal.

Provide all discharge fittings with low loss control gear. Replace any ballasts causing audible humming or crackling. Ensure all discharge lamps are compatible with the ballasts and other starting and control gear. Provide written evidence from the manufacturer of such and include it within the manuals.

Provide recessed luminaries with an external 1500 mm length of 1mm² 3-core PVC/PVC flexible cord to AS 3191, connected to a 10 A 3-pin plug top to AS 3112 (Flex and Plug).

Provide all discharge light fittings with power factor correction to achieve a power factor of not less than 0.9 lagging after two hours of continuous operation.

Where required by the supply authority, provide blocking inductors to the authority's approval.

Provide luminaries with all internal wiring colour coded to AS3137.

5.3.2 MOUNTING

Co-ordinate with other trades to ensure that mounting locations are clear of other services. Ensure the locations of all luminaries are symmetrical with the adjacent fixtures and that unintentional glare is avoided.

Provide luminaries suitable for mounting in the required position or ceiling type. Ensure that all luminaries and luminary control gear are not covered by insulation and have appropriate ventilation. Mount all light fittings to fixed rigid supports.

Provide termite resistant plywood support to all luminaries mounted within lay-in ceiling tiles such that the weight of the light fitting and control gear is supported on the ceiling grid and not on the tile. Provide all necessary T Bars and cut tiles required to accommodate the installation of luminaries mounted within suspended tile ceilings. Provide all necessary additional structural supports and T Bar rails to mount the fittings and support the plywood support. Provide all cutouts in set plaster ceilings and modify the structural support of the ceiling where necessary to accommodate the cut-out.

Provide all light fittings mounted within T Bar ceilings with a flexible lead and plug and an unswitched active. Provide such fittings with an approved plug base securely fixed to the structure above the fitting.

For fixing of surface-mounted luminaries to ceilings or walls, provide not less than, four fixings in square and rectangular luminaries and three fixings in circular luminaries, placed symmetrically.

In locations light fittings are recessed into thermal or acoustic insulation provide all necessary supports and modifications to the insulation to allow the fitting to be installed and the integrity of the insulation to be maintained.

Provide all fittings in food preparation areas as follows:

- Sealed with no top surfaces less than 45 deg exposed to the room air.
- All lamps are fully enclosed.
- All trims are sealed against the ceiling.
- All diffusers are to be held in place in a sealed frame.
- The diffuser frame is to be fixed in place with a positive contact sealing gasket against the fitting trim and secured in place by a minimum of four stainless steel screws.
- Diffusers sealed into the fitting trim by a sealant are not acceptable.

Provide suspensions and luminaries suspension connectors capable of supporting, without damage, five times the mass of the luminaries, or 25kg, whichever is the greater. Ensure all suspended light fittings hang horizontal and adjacent fittings are hung to the same level. Provide all light fittings suspended from a raked ceiling with an adjustable ceiling mounting such that the fitting equipment hangs vertically. Where light fittings are not supplied with integral suspensions provide the suspensions as follows:

- Structurally support the light fittings on threaded booker rod.
- Cover the booker rod with conduit painted to match the light fitting colour.
- Run all wiring to the light fitting through the conduit.
- Fix the conduit into a ceiling rose on the ceiling to provide a neat finish to the conduit.

In all cases suspended light fittings are subject to movement due to wind or air conditioning breeze provide the suspensions as fixed rod suspensions.

5.4 EMERGENCY LIGHTING

Provide a single point emergency lighting system that complies with the latest issue of all parts.

Install emergency light fittings nominated as maintained as follows:

- The lamp is to be permanently on supplied via an unswitched active mains supply when the mains supply is available. When the mains supply is not available, the lamp is to remain on supplied by the emergency pack. Single lamp maintained emergency lights are not switched with the local general area lighting. (The lamp is always on.)

Install emergency light fittings nominated as non-maintained as follows:

- If the fitting is not shown as being switched, the lamp is to remain off when the mains supply is available. When the mains supply is not available the lamp is to be switched on supplied by the emergency pack. Unswitched single lamp non-maintained emergency lights are not switched with the local general area lighting. (The lamp is on only when the mains supply is not available.)
- If the fitting is shown as being switched, the lamp is to be supplied and controlled with the local general area lighting when the mains supply is available. When the mains supply is not available the lamp is to be switched on, supplied by the emergency pack. (The lamp is on when turned on with the local general lighting or the main supply is not available.)

Provide the emergency lights as the self contained type, Twin rate constant current, constant voltage, and temperature compensated type with automatically selected boost and float charging rates, 70°C rated sealed plastic type lithium iron with a rated battery life of 10 years. Indelibly stamp each battery with its date of manufacture. Protect the inverter system against damage whilst in operation in the event of failure, removal or replacement of a lamp.

Label each circuit breaker which controls the unswitched active to exit lights with a label fixed adjacent; engraved plastic laminate, green background with white characters:-

**WARNING
INTERRUPTING SUPPLY WILL DISCHARGE
EMERGENCY LIGHTING BATTERIES**

Provide written evidence of the initial commissioning and testing and testing for the duration of the maintenance period in accordance with AS 2293.2.

This evidence is to be in the form of a log book similar to the General Lighting Service Pty Ltd "Emergency Lighting Maintenance Log Book and Manual" which is to be provided by the electrical sub contractor and have all entries fully completed and be presented for inspection at practical completion. The log book is to be retained by the electrical sub contractor for the duration of the maintenance period, and the six monthly test and maintenance results entered. The log book is to be presented for approval at final completion (expiry of the maintenance period) and will be forwarded to the clients representative for their use.

Provide maintenance of the emergency and exit lighting installation including records in accordance with the latest issue of all parts AS2293.

Provide the emergency lighting system with a supply sensing and testing facility in accordance with AS 2293.1 where noted in the distribution board schedule.

5.5 LIGHTING CONTROL SYSTEM

Provide all switch mechanisms in bathrooms, laundries, toilets, amenities and in locations the switch is within 2,000mm of a tap as IP56.

Provide a programmable lighting control system which incorporates multi channel control panels, sensors, switch panels, programmable time clock and a programmable PE cell all daisy-chained together via a STP data bus. Provide dedicated data bus for each distribution board with each separate bus interconnected via an optically isolated bridge unit.

As part of the programmable lighting control system, allow to program the operation of the programmable lighting control system on site under the instruction of the engineer to the satisfaction of the engineer. Allow to attend site and adjust the programming of the programmable lighting control system a further four times following practical completion.

Schedule the results of the programming and include a copy of them in the Operations and Maintenance Manual.

5.6 ADJUSTING AND AIMING OF LIGHTING INSTALLATION

Ensure the following components of the lighting Installation are complete and have been checked and tested prior to the adjusting and aiming of the lighting installation to commence:

- Circuiting.
- Labelling.
- Connection of correct lights to correct channels.
- Correct operation of lighting control system.
- All lights have been installed and are operating.

Should these items not be complete prior to the adjusting and aiming of the lighting installation the additional expenses in re-attending the installation to undertake the adjusting and aiming of the lighting installation as incurred by the clients representative will be charged to the Electrical Sub Contractor.

Allow for the adjustment and aiming of luminaries over a period of four (4) hours per night for two (2) nights during the hours of darkness to achieve final set-up. This work will be carried out under the direction and to the satisfaction of the clients representative.

Provide all equipment such as ladders, scaffolding and tools necessary for adjusting each luminaries. Should the Electrical Sub Contractor not have available the necessary equipment to complete the adjusting and aiming of the lighting installation, the additional expenses in re-attending the installation to undertake the adjusting and aiming of the lighting installation as incurred by the engineer will be charged to the Electrical Sub Contractor.

The adjusting and aiming of the lighting installation will include the following:

- Setting all PE cells and time clocks.
- Focusing of lights.
- Adjusting mountings and brackets.
- Aiming of fittings.
- Setting all sensors.
- Testing all operations of the lighting control system.
- Testing the emergency and exit lighting system.

Allow attending site twice during the defects and liability period and undertaking the above adjustments to and reprogram as directed by the clients representative.

Document the final results of all adjusting and aiming of the lighting installation and include them in the Operations and Maintenance Manual.

6.0 COMMUNICATIONS CABLING

6.1 SCOPE

The communications cabling component of this contract includes an integrated telephone and data EIA/TIA 568-A Category 6 Molex or CommScope certified RJ45 cabling solution.

The existing gaming room communications cabling and Delion wireless access cabling is to remain as is. All remaining communications outlets are to be replaced and re-cabled to the new communications rack. All of the existing communications cabling that is redundant is to be removed.

The existing NBN service and Delion rack are to remain as is.

Provide three 600 wide x 800 deep 19 inch racks within the new level 1 communications room being:

- CR-B General communications.
- CR-A Gaming.
- CR-C Security and audio visual.

Within all cases in this contract, Category 6 and Cat 6 is to be read as Category 6 Class E.

The terms Category and Cat are used interchangeably throughout this contract to refer to cabling types and standards.

Provide all copper products within the communications cabling scope as being capable of supporting the provision of power to the Data Terminal Equipment via the electrically conductive Media Dependant Interfaces as specified in the latest IEEE 802.3af "Power over Ethernet" standard.

Use only the 568A wiring scheme for 8-position modular components throughout the site. Do not mix 568A and 568B wiring schemes.

The communications cabling component of this contract includes but is not limited to the following extent of work:

- Communications cabling.
- Cable access ways.
- Relocation of the existing lead-in service.
- Earthing.
- Facility cabling.
- 19-inch equipment rack/s.
- Patch panels.
- Communications outlets.
- Independent certification.
- Testing and commissioning.
- Factory terminated patch leads.

Provide the communications system as a propriety structured cabling system with a component manufacturer's 25 year warranty over the communications installation. Include a copy of the propriety structured cabling system manufacturer's warranty in the Operations and Maintenance Manual.

Provide comprehensive details for approval of the structured cabling solution including the manufacturer's performance and installation requirements as well as details of the patch panels, frames, patch leads, cables, faceplates, outlets, and fly leads.

All suppliers and sub-contractors to the Electrical Sub Contractor must ensure they are familiar with and comply with the requirements of sections 1.0, 2.0 and 3.0 of this specification

Ensure that the work is performed by the holder of a current ACMA license and the staff member has been trained and is certified by the propriety structured cabling system manufacturer. Provide a copy of the appropriate ACMA license and propriety structured cabling system manufacturer's certification for approval prior to commencing work onsite and include a copy in the Operations and Maintenance Manual.

Provide independent testing and certification of the performance of the communications installation and include a copy of such in the Operations and Maintenance Manual.

Ensure that the work is performed by the holder of a current ACMA license and the staff member has been trained and is certified by the propriety structured cabling system manufacturer. Provide a copy of the appropriate ACMA license and propriety structured cabling system manufacturer's certification for approval prior to commencing work onsite and include a copy in the operating and maintenance manual.

Provide as part of the tender response, a list of the technical support staff and installation staff, together with their working experience in the relevant field who are proposed to undertake the installation and provide maintenance support. Include the date each of the nominated staff members received formal classroom training by the structured cable system manufacturer. Nominate the location of the office proposed to control and support the installation and maintenance.

6.2 INSTALLATION REQUIREMENTS

6.2.1 GENERAL

Unless otherwise specified, install and terminate cables in accordance with the manufacturers' recommendations. Unless noted otherwise, joints are not acceptable.

Handle cables to avoid damage to insulation and serving or sheathing. Replace all wiring with insulation damage after determining and removing the cause of damage.

Ensure all communications cables are not installed with a pulling force that exceeds the manufacturer's recommended maximum pulling force and in no case is the maximum hauling tension to exceed 260kg. Use cable mounted pulling eyes / cable netting to install cables with the hauling tension simultaneously applied to the central strength member and outside sheath / jacket.

Do not use motorised winches or vehicles to pull in communications cables.

Ensure the cable manufacturer's minimum bending radii are not exceeded at any time. Any cables that exceed the cable manufacturer's minimum bending radii or are kinked must be entirely replaced. If the cable manufacturer's minimum bending radii is not available ensure that a minimum bending radius at least 20 times the cable diameter during installation or long-term under load are not exceeded.

Ensure tension on the cable tie is such that ties must be able to be moved laterally along the cable run and yet still maintain the cable to the support structure.

Utilise installation procedures that ensure that no undue stress is placed on any cable and there is not any evidence of sag or kinks.

Ensure all of the cabling complies with the following requirements:

- All cabling that is installed in locations that are not concealed such on exposed roof trusses, are to be run in conduit.
- Cabling fixed to trusses and beams in concealed ceiling spaces is to be fixed to the side of the truss / beam and not on top of the bottom cord of the truss / beam.
- Cables do not come into contact with hot water pipes.
- Above suspended ceilings, all conduits and cables are secured to the ceiling support members or roof structure above. Conduits and cables laid directly on the ceilings (on the ceiling suspension system or framing) are not acceptable.
- The use of spring clips will not be permitted without approval.

- Where cables traverse areas above set plasterboard ceiling (or similar) particularly in an office environment and providing access difficulties, use conduit secured to a catenary wire, or suitably saddled to the ceiling.
- All cables passing through a metal surface, any sharp surface or any surface that could damage the cable insulation over the life of the installation is to be protected by grommeted nylon bushes.
- Replace all wiring that contains kinks or abrasions.
- Provide flexible connections on the terminations of all cables that would experience sufficient stress/force under a bolted line fault condition that would cause damage to the cable termination or the equipment.

The communications cables are to avoid areas of concentration of electrical power and mechanical and hydraulic services.

Ensure where cables are reticulated via catenary wire, horizontal cables are tied off loosely, to the catenary wire at intervals no greater than 600 mm. Ensure a maximum of twenty-four (24) four pair UTP cables are supported on a single catenary wire support.

Ensure tension on the cable tie is such that ties must be able to be moved laterally along the cable run and yet still maintain the cable to the support structure.

Utilise installation procedures that ensure that no undue stress is placed on any cable and there is not any evidence of sag or kinks.

Ensure cable entry into a power pole, riser column, duct or cavity is preceded by at least a one-turn service loop of minimum 300 mm in diameter prior to entry into the pole, column, duct or cavity to allow for minor moves and changes allowances.

Use waterfall type control accessories for vertical direction changes of more than 45 degrees.

Ensure all cables have a unique cable identification permanently and legibly placed at each end of the terminated cable within approximately 200 mm from where the cable is terminated utilising a Brady type wrap around each label.

Do not install more than 10 UTP cables in a 35 x 40 duct or 15 UTP cables in a 40 x 50 duct or 18 UTP cables in a 50 x 50 duct. Do not install more than 75 UTP cables on a 150 wide tray or more than 160 UTP cable on a 300 wide tray. Do not install more than 2 UTP cables in a 20 dia conduit or 2 UTP cables in a 25 dia conduit or 7 UTP cables in a 32 dia conduit or 18 UTP cables in a 50 dia conduit. All communications cable trays are to be supported by cantilever L type brackets.

Ensure all communications conduits have 50% of the cross sectional area as spare after all of the cabling has been installed.

Use cable supports that are smooth and at least 34 mm wide with rounded-off edges.

Segregate the communications cables from other services by a minimum of 50mm. Increase the segregation distance as required to ensure the other services do not cause interference in the communications cabling.

For segregation between communications cabling and power cabling where a metallic earthed barrier is not present ensure:

- Where there are no more than 15 bunched circuits and all of the circuit are protected by an overcurrent device less than 60 Amps, a 200mm physical segregation is maintained.
- Where there are between 16 and 30 bunched circuits and all of the circuit are protected by an overcurrent device less than 60 Amps, a 300mm physical segregation is maintained.
- Where there are more than 30 bunched circuits and all of the circuit are protected by an overcurrent device less than 60 Amps, a 600mm physical segregation is maintained.

- Where any circuit is protected by an overcurrent device larger than 60 Amps a 600mm physical segregation is maintained.

For segregation between communications cabling and power cabling where a continuous metallic earthed barrier is present ensure:

- Where there are no more than 15 bunched circuits and all of the circuit are protected by an overcurrent device less than 30 Amps, a 50mm physical segregation is maintained.
- Where there are between 16 and 30 bunched circuits and all of the circuit are protected by an overcurrent device less than 30 Amps, a 100mm physical segregation is maintained.
- Where there are more than 30 bunched circuits and all of the circuit are protected by an overcurrent device less than 30 Amps, a 150mm physical segregation is maintained.
- Where there are no more than 15 bunched circuits and all of the circuit are protected by an overcurrent device less than 60 Amps, a 150mm physical segregation is maintained.
- Where there are more than 16 bunched circuits and all of the circuit are protected by an overcurrent device less than 60 Amps, a 300mm physical segregation is maintained.
- Where there are no more than 30 bunched circuits and all of the circuit are protected by an overcurrent device 60 Amps or more, a 300mm physical segregation is maintained.
- Where there are more than 30 bunched circuits and all of the circuit are protected by an overcurrent device 60 Amps or more, a 450mm physical segregation is maintained.

Ensure all UTP cabling is segregated from the following equipment by at least the dimension given:

- Segregate from all electrical appliances by more than 300mm.
- Segregate from all light fittings including remote control gear by more than 150mm.
- Segregate from all photocopiers and printers by more than 500mm.
- Segregate from all mains switching devices by more than 500mm.
- Segregate from all lighting system dimming equipment by more than 500mm.
- Segregate from all UPS less than 10kVA by more than 100mm.
- Segregate from all UPS between 10kVA and 30kVA by more than 300mm.
- Obtain a specific direction for the segregation distances for UPS larger than 30kVA.
- Segregate from all VSD controllers and VSD to motor cabling by more than 3,000mm.
- Segregate from all radio (wireless) transmitters by more than 3,000mm.
- Segregate from all thermostats by more than 500mm.

6.2.2 UNSHIELDED TWISTED PAIR CABLING

UTP cables within bundles or on tray are to be laid randomly and not installed in straight lines.

Install cables so coils and any bends follow the natural spiral lay of the cable.

Do not bundle more than 24 UTP cables in the same bundle and do not mix different category UTP cables in the same bundle.

Ensure the untwist in a pair at the IDC termination is less than, 13 mm for all cables.

Ensure all permanent Category 6 cables have a minimum length of 15 m.

Secure Cat 6 cables with 6mm wide elastic Velcro™ ties applied at random spacing's up to 300mm apart on catenary wires and on vertical runs such that the weight of the cables are adequately supported.

Irrespective of the manufacturers recommendations, ensure that the bending radius is not less than 50 mm radius (100 mm dia) during cable pulling, and not less than 25 mm radius (50 mm dia) for hand placement.

Avoid the provision of spare cable where possible unless specifically called for. If spare cable is specified as being required locate the spare cable so it is fully supported and that the minimum bending radius is maintained. Do not locate the spare cable inside service poles or skirting ducts. If spare cable is contained in loops, ensure there are no more than 4 loops in a coil and each loop is a different diameter with minimum diameter of 300 mm.

Ensure the cable sheath stripped back at any termination less than 10 mm from termination module.

Provide all facility cable as unshielded twisted pair having the following characteristics:

- Ensure the facility cables do not exceed 90m in length.
- 24 AWG 0.51mm solid plain annealed copper conductors.
- 4 pair/8 conductors.
- The insulated conductors shall be twisted into pairs, with the pairs balanced for maximum performance and noise reduction.
- Colour coded high density PVC-V75 diameter 1mm insulation.
- PVC-V75 sheath.
- 100+/- 15 Ohm.
- Conductor DC Resistance (Max): 9.38 Ohm/100m @ 20°C.
- DC Resistance unbalanced (Max): 5% @ 20°C.
- Insulation Resistance (Min): 5000 MOhm/km@ 20°C.
- Mutual Capacitance (Typical): 5.6nF/100m.
- Characteristics impedance: 100Ohm+/- 3Ohm@ 100MHz.
- Worst Case Cable Skew : 25 nsec/100 meters

Ensure the length of each cable is based on the distance set out in the tables and formulas in ISO/IEC 11801 plus de-rating for ambient temperature.

Provide all above ground communications conduits with draw-in boxes at least every 30m or after the equivalent of two 90 degree bends whatever being the lesser distance. The draw-in boxes are to be located in straight runs of conduit and are not to be used for bends. Provide the draw-in boxes with an IP66 screw fixed lid and a conduit saddle within 50mm of the draw-in boxes on each conduit.

6.2.3 SERVICE OUTLETS

Provide all UTP service outlets as clip in female RJ45 socket terminals, clipped into an outlet face plate. Mount the outlets with the keyway at the bottom and the contacts at the top. Provide the faceplates with a dust cover flap to prevent dust from entering the outlet when not in use. In locations where outlets are immediately adjacent, up to 6 outlets are to be accommodated on a single faceplate. The general communication outlet faceplates are to match the adjacent GPO in style, brand and colour. Ensure the outlets are a minimum of 150mm from the nearest power outlet contact.

Where there is insufficient depth behind the outlet to accommodate the cable bending radii, utilise angled faceplates. Obtain approval for the use of all angled faceplates prior to installation.

All cables must be arranged such that there is no Z bends or kinks in the cable behind the service outlet once it has been installed.

Ensure the UTP communications outlets have the following performance characteristics:

- Near End Crosstalk (NEXT) performance greater than 54dB @ 100MHz, and greater than 46dB @ 250MHz.
- RJ Interface resistance less than 20 mOhm
- Insulation resistance greater than 100 MOhm at 500 vDC
- Contact resistance less than of 20 mOhm
- Current rating greater than 2A at 20°C
- Rated for 1000 operations
- A contact force greater than 100g per contact using a FCC-approved plug.

- A plug retention force greater than 133 N.
- Rated for operation with a temperature range of -20°C to +75°C
- A minimum thickness hard gold contact plating on each pin of 1.3um
- A minimum thickness nickel contact plating on each pin of 2.0um under the gold coating.

6.2.4 INSULATION DISPLACEMENTS CONNECTIONS (IDC)

Ensure all IDCs have the following performance characteristics and features:

- A minimum of 3 mechanical forces must be applied to the wire to provide a reliable and stress-free resistant connection.
- The IDC termination must have a 45 deg angular configuration when connecting with the cable conductor.
- The IDC contact element is to be spring special brass with silver plating, angularly arranged across the axis of the conductor.
- The contact range is to be silver-plated.
- The insulation displacement connectors of the outlets are to accept two insulated solid conductors of 26 to 22 AWG (0.40 - 0.65 mm) of the same size.
- Insulation resistance greater than 100 MΩ at 500 VDC
- Contact resistance less than 20 mΩ
- Current rating greater than 2A at 20°C
- Rated for 1000 operations
- Rated for operation with a temperature range of -20°C to +75°C

6.2.5 EARTHING

Provide a dual-purpose telecommunications earthing system for both functional earthing and protective earthing purposes. Bond each communications rack and frame to a Communications Earthing Terminal (CET) Block located not more than 10m away from the communications rack or distribution frame. Bond each CET to the local power distribution system protective earth. Provide permanent machine printed labelling on / adjacent the CET with the wording "Communications Earthing Terminal". All earthing conductors are to have green/yellow insulation and a stranded copper conductor with a minimum area of 6 mm². Ensure each communications rack and frame has a resistance to earth of less than .5 ohm.

Earth a metallic cable access systems with a 2.5mm² stranded copper conductor with green/yellow insulation to the power distribution system protective earth and ensure the resistance to earth is less than 1 ohm.

6.2.6 RECORDS AND LABELLING

Label every component within the communications cabling system including though not limited to, outlets, patch panels, break out panels, cables, patch leads, racks, distribution panels, consolidation points and cable access pathways. The labelling between all components is to correspond allowing all associations between the source and destinations to be readily made. All labelling is to be arranged logically and be consecutive. Use a dash between numbers and abbreviations without any spaces.

Provide a machine printed label with the wording "Communications Cabling" on all communications cable pathways every 10 metres.

All names and labels are to read from bottom to top, left to right, omitting the letters "I" and "O".

Submit the labelling scheme for approval.

Provide each rack containing patch panels with a patching record book that contains the records of the connection of patch panel numbers to work station outlet numbers, the date and signature of the patching installer, a schematic drawing and a floor plan of the area detailing the location and labelling of all communications outlets and equipment within the area the associated panel or rack serves. Ensure the log book is able to simply accommodate future additions, moves and changes and it contains at least 50% or three, whatever is the lesser, spare pages All entries in the log book are to be legible and only in pencil. Clearly designate the sites name and the name of the distribution panel or rack the log book applies to on the cover and on every page of the log book.

Submit a blank example page from the log book for approval.

Provide the data room with a wall mounted laminated A3 floor plan of each level detailing the location and labelling of all communications outlets and equipment within the area the associated panel or rack serves. Include a copy of the floor plan in the Operations and Maintenance Manual.

Ensure all racks and distribution panels are uniquely identified with the label located on the external face of any door or cover that is normally closed and, on the body, if the door or cover is removable or lift off. For all racks and equipment that are floor mounted, provide the unique identifying label on both the front and rear doors / covers and the body.

Provide a machined typed label either clear wrap around self-adhesive type or slip-on plastic ring type or a long plastic strip type fixed onto each permanent cable within 100 - 150mm from the termination point for UTP cabling.

Permanently label each communications outlet with the channel number in accordance with clause 2.9. In addition to the label that is normally visible, neatly hand write in indelible ink the channel number on the faceplate behind the surround such that it is covered when the faceplate is in place.

6.3 COMMISSIONING

6.3.1 GENERAL

As part of the commissioning of the communications cabling, undertake the following tests as relevant on all components of the communications cabling installation including each pair in every cable for:

- Has been fully commissioned in accordance with this specification.
- Has been fully commissioned in accordance with the requirements of the system manufacturer.
- Compliance with the cabling diagram.
- Continuity.
- Cable location, identification, and length.
- The installation of all cables must be complete and the cables and terminations cleaned prior to testing.
- All tests in accordance with the communication system certifying manufacturer's requirements.
- Undertake all tests in accordance with the recommendation of the testing equipment manufacturer.
- Test the resistance to earth of each Communications Earthing Terminal (CET) Block, each communications rack and each frame.
- Test the resistance to earth of each metallic cable access system.

6.3.2 UNSHIELDED TWISTED PAIR CABLING

Test every UTP cable / link in accordance with the following requirements:

- Correct sequence.
- Reversed pairs.
- Transposition and split pairs.
- Attenuation.
- Impedance matching of all twisted pairs within each UTP cable in the form of impedance Vs distance and impedance Vs frequency graphs.
- All mechanical fixings.
- Electrical length.

- The difference between the signal attenuation and the near-end cross talk (ACR).
- Power Sum ARC (PSARC)
- Near End Cross Talk (NEXT).
- Power Sum Near End Cross Talk (PSNEXT)
- Insertion Loss,
- ELFEXT, PSELFEXT.
- Return Loss.
- Delay Skew.
- Propagation Delay.
- All Cat 5 cables and components are to be tested in accordance with the requirements specified in the latest draft of ISO 11801 Class D.
- All Cat 6 cables and components are to be tested in accordance with the requirements specified in the latest draft of ISO 11801 Class E.

The UTP cables / links are to meet or better the following requirements:

	Cat 6
Correct sequence.	Pass
Reversed pairs.	Pass
Transposition and split pairs.	Pass
Attenuation.	21.7 dB
All mechanical fixings.	Pass
Electrical length.	<90m
ACR	18.2 dB
PSARC	15.4 dB
NEXT	33.9 dB
PSNEXT	37.1 dB
Insertion Loss,	21.3 dB
ELFEXT	23.2 dB
PSELFEXT.	20.2 dB
Return Loss.	12 dB
Delay Skew.	50nsec
Propagation Delay.	548nsec

Tester and testing equipment

- Ensure the tester batteries are adequately charged and do not fall below 25% of the total battery capacity.
- Ensure all test gear and equipment is not worn, dirty and is in good as new working order.
- Ensure the NVP is not set HIGHER than specified for the cable.
- Ensure the tester “Margin Warning” or “Star-Pass” is always enabled during testing.
- The latest software available for the tester is being used.
- The tester has been independently calibrated within 12 months of the test.

Configure the tester for Cat 6 cabling as (F/UTP PVC 65% / UTP LSZH 79% / UTP PVC 69%), permanent Link Test limit to ISO 11801 Class E and channel test limit to ISO 11801 Channel Class E.

Configure the tester for Cat 5 cabling as (F/UTP PVC 69% / UTP LSZH 70% / UTP PVC 69%), permanent Link Test limit to ISO 11801 Class D and channel test limit to ISO 11801 Channel Class D.

The following testers are acceptable:

- Fluke DTX-18003.
- Fluke DTX-1200
- LANTEK 6A and 7G
- LANTEK II
- Agilent WireScope Pro
- Agilent WireScope WS350

Negative results (e.g. - 0.5 dB) for NEXT or RL on runs less than 15m even though a PASS is indicated in the test results are unacceptable and must be considered as unacceptable terminations.

Poor UTP terminations must be fixed by adding twist into the pairs, re-terminated and re-tested.

6.4 PATCH PANELS

Provide UTP patch panels as modular, 1RU high, 24 port, Cat 6, RJ45 19inch rack mounted, black fully numbered with outlets to the same specification and performance as the respective service outlets with the worst pair NEXT loss values for the outlet greater than 54dB at 100MHz and greater than 46dB at 250MHz. The rear of the patch panels are to be provided with integrated cable management supports, strain relief posts, colour coded wiring guides and IDC's to facilitate cable termination. Provide patch panels with modular ports that can be removed and that facilitate access to the IDC's without having to remove the entire patch panel.

Provide sufficient patch panels to accommodate all of the facility cabling with a dedicated patch panel port for each service outlet. Provide sufficient patch panel ports to accommodate all of the tie cables with 2 pairs per patch panel port for tie cables.

6.5 PATCH LEADS

Patch lead will be provided by the clients representative as part of the clients representative configuration of the venues IT network

7.0 FIRE ALARM SYSTEM

7.1 SCOPE

The fire alarm system scope is to include a brigade monitored AS1670.1:2024 compliant addressable fire detection and level 1 alarm system throughout the hotel building.

Irrespective of the services detailed on the drawing, the system must be compliant with AS1670.1:2024 and the requirements of the Queensland Fire and Emergency Services.

The contractor is responsible for paying any call out fees issued by QFD that are the result of defective works, cabling, or system components

Ensure all AS1670.1:2024 works are undertaken by, or under the direction of a suitably qualified and experienced fire alarm system installer who hold the required QBCC and Fire Protection Contractors Registration Board of Queensland Inc registrations.

Include a copy of all the above registrations and licences in the manual

Prior to practical completion certify the installation on a Form 16 as complying with the relevant codes and standards and include a copy of the certification in the manual.

In addition to the detectors detailed on the drawings, allow for the following provisional additional detectors to be located on site:

- 12 Smoke detectors.
- 6 Thermal detectors.
- 12 Concealed space detectors including FAMCO access brackets.

Separately identify the total cost of the above provisional allowance within the tender.

Provide separate prices in the tender for optional extended maintenance agreements of the fire alarm system for three years and five years beyond the end of the defects and liability period.

Provide the following performance guarantees:

- That all components will have adequate size, capacity and performance.
- The installation will be acceptable to the Queensland Fire and Emergency Service.
- The installation will not be subject to faulty equipment or workmanship.
- The installation will not be subject to undue false alarms.
- The installation will be considered fit for purpose.
- All of the equipment provided is from a reputable manufacturer with more than ten years of experience in supplying like components into Australia and the manufacturer has at least a 10% share of the Australian market for such components.

This contract includes but is not limited to the following specific items extent of work:

- Fire Detection Panel (FDCIE) and all associate components.
- Emergency Warning Panel (EWCIE) and all associate components.
- Power Supplies.
- Brigade monitoring.
- Strobe.
- Duct probe smoke detectors.
- Smoke detectors.
- Thermal detectors.
- Multi criteria detectors.
- Concealed space detectors.
- System interface diagram.

- Speakers and horns.
- Provision of any additional speakers and horns to achieve evacuation sound levels with a minimum of 10dB (A) above ambient, and not less than 65dB (A) and no more than 105dB (A).
- Cabling.
- Interface to the AV system.
- Commercial kitchen exhaust hood control system.
- 240-volt power supplies.
- Accommodation kitchen exhaust fans and associated controls.
- As constructed documentation.
- Manual.
- Training.
- Testing and commissioning.
- Certification
- Log book.
- Cable access.
- Removal of all existing fire detection and alarm services that become redundant due to the works.
- Making good after all redundant fire detection and alarm services have been removed.
- Maintenance during the defects and liability period in accordance with MP6.1 of the QDC and AS1851.
- Pay all costs associated with the isolation and connection of the brigade monitoring of the fire alarm system.
- All minor components and incidental works not specifically referred to, however necessary to complete the installation such that it is handed over complete, operational, and fit for the intended use.

Remove existing fire alarm system including the manual call points

7.2 INSTALLATION REQUIREMENTS

Remove all existing detectors and smoke alarms then and for any exposed penetrations left by the removal of the existing services, patch or cover them with a blank face plate

Ensure that all components and equipment installed as part of the fire alarm system are suitable for the intended location and use.

Provide all wiring within the fire alarm system as "loop-in loop-out" with no joints, except at fittings. Ensure that detector wiring does not pass through a battery compartment. Provide all wiring from the FIP to relays, contactors and control equipment, including air handling plant shut down and the like to be fail safe, supervised circuits using red sheath. It is acceptable to utilise the existing wiring if it is unacceptable condition and meets the requirements of this specification.

Ensure that all wiring within the fire alarm system complies with the following:

- 240-volt wiring: 1.5mm² (stranded) minimum.
- DC wiring: 1.5mm² (stranded) minimum.
- Wiring to remote indicators: 0.75mm² (stranded).
- 240 V wiring: Grey sheath.
- DC fire alarm wiring: Red sheath.
- Multi-stranded copper conductors.
- All smoke fan control wiring is fire rated.

Separate all speakers wiring from 240-volt wiring. Space fire alarm system cabling from all other wiring or otherwise protected, to ensure that the magnitude of induced voltages cannot cause interference.

The current capacity, voltage drop and fault capacity of the cables must be established by the Contractor and the cables sized accordingly by the Contractor. Size all cables to accommodate the respective loads, starting currents and maintain a spare capacity of 10%. All loads and fault levels must be confirmed onsite by the Contractor. Provide all components with 25% spare capacity.

Ensure the fire alarm system cabling is protected from mechanical damage and complies with AS 3013 and all fire rated cabling meets or exceeds WS52W installation requirements. Secure all fire alarm system cabling with stainless steel cable ties.

7.3 COMMISSIONING

7.3.1 TESTING

Undertake on site the following tests:

- Insulation resistance measurements.
- Functional checks: Full functional and operational checks on energised control equipment and circuits, including adjustments for the correct operation of safety devices.
- Earth resistance.
- Earthing: Confirmation of effective earthing of the exposed metal of all equipment.

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

Provide all Test Results for approval within one (1) week of the test being undertaken as an electronic PDF file for approval. Once approved include a copy of all such test results in the manual.

Check control systems for correct operation under representative operational conditions.

7.3.2 COMMISSIONING

As part of the commissioning, ensure that all components of the installation are adjusted, programmed, and are operating correctly in accordance with the manufacturer's recommendations and the relevant standard the equipment has been installed.

Submit for approval two weeks prior to commencing any testing and commissioning a testing and commissioning method statement and program for the commissioning and testing.

As part of the commissioning of the fire alarm system, undertake the following tests as relevant on all components of the fire alarm installation:

- All testing required by AS 1670.
- Authorities' tests: Additional tests, which may be required by the relevant authority.
- Resistance to earth.
- Voltage.
- Overload protection.
- Fault protection.
- All mechanical fixings.
- Map of sound pressure levels at Floor Level.
- The operation of the fans under both simulated automatic and manual control conditions.
- The operation of the MCP and each detector.
- The operation of the FDCID and EWCID.
- The operation of the brigade monitoring system.
- The operation of the monitoring of each circuit.
- The of the monitoring of smoke suppression systems.
- The operation of the gas solenoid.
- The operation of the gas supply emergency shut off.
- The operation of the kitchen hood exhaust fan isolation.
- The operation of the kitchen hood cooking equipment power isolation.
- The operation of the accommodation smoke exhaust fan,

Provide at least two qualified personnel with two-way radios for all testing and commissioning. Ensure all testing equipment is calibrated, within the past six (6) months, and provide supporting documentation of the calibration upon request.

The testing equipment includes, though is not limited to the following:

- Smoke Detector Testing apparatus approved by detector manufacturer
- Thermal Detector Calibrated heater tester
- Manual Call Points (MCP) Suitable MCP Key
- Occupancy Warning speaker Sound level meter and Speech Transmission Index (STI) meter

Schedule the commissioning results for each item and include a copy of all results in the manual.

As part of the commissioning of the fire alarm, undertake any necessary adjustments to the installation.

Upon the completion of the commissioning, provide a written and signed statement that the installation:

- Has been fully programmed as necessary.
- Has been tested.
- Complies with the intent of the contract.
- Complies with the relevant authority requirements.
- Complies with the relevant standards and codes.
- Is fit for purpose and suitable for the intended use.

Provide a copy of the statement of compliance in the manual.

Ensure the following components of the installation are complete and have been checked and tested prior to commissioning:

- Labelling.
- Correct operation of the fire alarm system.
- All components have been installed and are operating.

Should these items not be complete prior to the commissioning the additional expenses in re-attending the installation to witness the commissioning as incurred by the engineer will be charged to the Contractor.

Provide all equipment such as ladders, scaffolding and tools necessary for adjusting each detector and speaker. Should the Contractor not have available the necessary equipment to complete the commissioning, the additional expenses in re-attending the witnessing of the commissioning as incurred by the engineer will be charged to the Contractor.

The commissioning of the installation will include the following:

- Adjusting mountings and brackets.
- Adjusting detectors.
- Testing all operations of the fire alarm system.
- Balancing of all speakers.

Demonstrate to the satisfaction of the Authorities the operation of the systems installed in accordance with Authority requirement.

Commission all components to ensure the correct interfacing operation and control of all systems to the satisfaction of the engineer as per the approved commissioning method statement and commissioning plan. Arrange for and give two weeks' notice so the commissioning may be witnessed for approval.

Provide all necessary software, equipment, and personnel to fully program and configure all systems.

Following the completion of the commissioning and prior to Practical Completion thoroughly clean all components of the installation to the satisfaction of the engineer.

Following commissioning, operate each component and system at the convenience of the engineer to the satisfaction to provide evidence to the engineer that each component and system is working correctly.

Maintain a record of all settings, set point and offsets throughout the commissioning period and included in the manual. Update the manual record following the completion of each of the post practical completion commissioning requirements. The defects and liability period will not end until the manual has been updated.

As part of the commissioning process ensure the following actions are completed:

- Check that time schedules enable the intended operation at/for the correct times.
- Check that the calendar/date function can take leap years into account.
- Check the correct operation of the interfaces by individually switching each item of plant.
- Check for the correct sequencing control in response to varying inputs operates in the correct order and at the desired set points.

Check the control system to confirm its specified operation following a mains power supply failure. Undertake the following checks:

- Check that controllers preserve control strategy configuration data for a specified period when the mains power is lost.
- Check that the condition of any volatile data protection system is regularly and automatically monitored. Check that an alarm is raised on loss of mains supply by any controller or device.
- Check that the system operates correctly under battery power without mains power.
- Check that the system will automatically return to normal action without operator intervention restoration of the mains electrical power supply.

Check the application software and certify quality control off-site. Specific items or routines to be checked include though is not limited to:

- Specified set points have been configured.
- Each control loop is in place and that realistic default values have been added to enable commissioning to proceed.
- Configured software will operate the specified events, alarm, and items of plant in the correct sequence.
- All specified alarms are configured along with any the required time delays, masking, and alarm categorisation in order to avoid unwarranted alarms.
- The use of mnemonics and abbreviations is checked between the display and the graphics to avoid inconsistencies.
- Data logging routines and parameters are set up in accordance with the control system specification.

7.4 TRAINING

Provide the clients representative with sufficient training such that they are capable of:

- Advised of the mandatory fire alarm system maintenance cycles.
- Basic trouble shooting and fault-finding techniques within the fire alarm system.
- Basic response to an unwanted alarm including how to locate the source of the unwanted alarm.
- Basic response to a fault in the fire alarm system.
- How to mitigate unwanted alarms.

7.5 MAINTENANCE

Provide maintenance of the complete fire alarm system for the defects and liability period. Undertake all inspections, tests, maintenance services and repairs in accordance with the equipment manufacturer's recommendations/ instructions, the Queensland Development Code MP6.1, AS 1851-2005 and the emergency services authority requirements.

Ensure the fire alarm system is maintained in a safe and operative condition. Ensure minimum interruption to the operation of the fire alarm system during the maintenance procedures. Coordinate the start and completion of each maintenance session with the Building Manager.

Ensure all maintenance and associated certification is completed by competent, experienced, and licensed technicians equipped with the appropriate testing instruments, tools, equipment, etc. All such maintenance and testing tools and equipment must be appropriate and calibrated for the required task.

At the end of the defects and liability period, provide certification all maintenance has been completed in accordance at the end the annual maintenance period in accordance with the equipment manufacturer's recommendations/ instructions, the Queensland Development Code MP6.1, AS 1851-2005 and the emergency services authority requirements.

Record all maintenance events within the log book.

7.6 COMPONENTS

7.6.1 FIRE INDICATOR PANEL (FIP)

Provide a FIP that contains a FDCIE and an EWCIE.

Provide the FIP with a 240-volt dedicated RCBO protected circuit in accordance with AS3000.

Provide the FIP in accordance with the requirements of 1670 and the QFES.

All cabling associated with the FIP must be concealed. If the FIP panels are noted as being recessed then they must be provided with a recess trim. If the FIP panels are surface mounted on an existing masonry wall provide a visually attractive surface mounted duct coloured to match the wall to provide concealed cable access.

Interface the FDCIE to the EWCIP and other systems including any door controls, gas solenoid, kitchen fire suppression systems, cooking equipment contactors and kitchen exhaust fan contactors.

Provide a FDCIE that includes the following:

- Is listed on ACTIVEFIRE as approved to AS7240.2 and AS7240.4
- Manufacturer's name and panel type clearly and permanently marked on the housing or door.
- Brigade signalling equipment.
- Interfaced to the EWCIE.
- IP44 rating.
- White or off white.
- Microprocessor based.
- LCD display.
- Non-volatile event log with at least an1000 event record capacity.
- Incorporates active unwanted alarm mitigation strategies.
- Utilizes an open protocol.
- Single button test facility.
- Internal power supply and battery charger.
- Lockable door keyed to the brigades' requirements.
- Door switch with associated warning lamp, to isolate the sounder and associated control equipment.
- Expandable number of detector loops.
- Configurable IOs.
- 25% spare IO ports beyond the initial number used.
- LED zone indicators.
- Manual call point
- Arranged in a logical manner, be simple to operate with all controls clearly labelled to prevent confusion and incorrect use.
- Separate alarm groups as per AS1670.1
- Battery test facility including voltage, current and charge status.
- Testing and maintenance facilities.
- Lithium-ion battery.
- Mains power available indication.
- Alarm group facilities including alarm indicator, fault indicator, alarm test, fault test, isolation and reset facility which must be visible with the door locked.
- Audible fault alarm.
- Audible fault isolation switch.
- Audible fault isolate indicator.

Provide a EWCIE that includes the following:

- Integrated into the FDCIE panel and power supply or in separate panel of equal width, depth and appearance to the FDCIE.
- Manufacturer's name and panel type clearly and permanently marked on the housing or door.
- Interfaced to the FDCIE.
- IP44 rating.
- Class D amplifiers sized such that they are loaded less than 50% when the maximum signal is being distributed.
- Dedicated Emergency Microphone
- Monitored Strobe Output
- Alert and Evacuation Signals to AS 1670.1 / NZS 4512
- Phased Evacuation programming facility
- Speaker Line Monitoring and Protection
- Emergency Warning, Fault, and Test Mode relay outputs
- Volume Control
- Auto/Manual/Isolate facility.
- All Call facility.
- System Status controls and indicators.
- Simple operating instructions mounted on the panel.
- Power supply.

7.6.2 DETECTORS

All detectors are to be white / off white unless mounted on a dark / black ceiling in which case they are to be black.

During construction protect all smoke detectors from the build-up of dust and contamination due to building work. Remove the protective covers immediately prior though no earlier than 24 hours prior to practical completion.

Provide detectors that are two part (removable plug and fixed base). All detectors must an indicator to identify activation.

Reduce the number of detectors permitted to an alarm zone to 75% of that allowed under AS1670.

Provide detectors of a type that will be effective in the location and avoid false alarms. Provide all detectors as addressable and ensure they comply with the requirements of AS1670 and are compatible with the FDCIE.

CONCEALED SPACE

Provide remote indicator in accordance with AS1603.15 comprising a light emitting diode mounted on an engraved plastic plate identifying the location of the detector for each detector located in a concealed position including locked cupboards.

Provide concealed space detectors as a proprietary item suitable for a concealed space depth of 600mm to 3,000mm, of a type that they can be removed through the exposed surface faceplate and man holes or access panels are not required for maintenance.

THERMAL

Unless noted otherwise, provide thermal detectors that comply with AS 1603.1, AS 7240.5, and are type A.

Where noted as a type B thermal detector, all such detectors are to be provided as Type B and be sealed to a level suitable for mounting in high moisture locations.

Where noted as a type D thermal detector, all such detectors are to be provided as Type D.

Where noted as air duct type E thermal detector, all such detectors are to be provided as Type E and mounted within the air stream as far as practical along the air stream.

SMOKE

Unless noted otherwise, provide smoke detectors that comply with AS 1603.2, AS 7240.7, and are photo-optical with a performance of 6 to 12 % Obs/m set at 7.8 %. Ensure the sampling device smoke detectors comply with AS 1603.13. During construction protect all smoke detectors from the build-up of dust and contamination due to building work. Remove the protective covers immediately prior though no earlier than 24 hours prior to practical completion.

7.6.3 SPEAKERS

All cone speakers are to be the same colour as the ceiling they are being mounted on / in.

Provide speakers in accordance with AS1670.4 to achieve the sound levels as specified in AS1670. The speaker types and locations detailed on the drawings are indicative of an acceptable type and layout. It is the Contractor's responsibility to ensure that the installation meets the tone and alert requirements of AS1670.

The speakers must be dedicated to the fire alarm system and must not be combined with entertainment speakers.

Provide ceiling speakers with the following:

- 8 Ohms impedance.
- 93 dB sensitivity.
- Full range multi tapped transformer.
- Circuit fault monitoring.
- Screwed terminal block.
- Match the adjacent sound system (PA or music) speakers or 200mm Dia if the project does not include a sound system.
- Plastic flush grille.
- Frequency response 60 Hz to 20 kHz.
- Flush mounted in all suspended ceilings that are not asbestos.

Provide horn speakers with the following:

- 8 Ohms impedance.
- Full range multi tapped transformer.
- Circuit fault monitoring.
- Screwed terminal block.
- Surface mounted adjustable bracket.
- Metal construction.
- IP56.

7.7 FUNCTION

7.7.1 AV SYSTEM

Provide a fail-safe output from the FDCIE to the background music matrix switcher located in CR-C to isolate the amplified audio services via an undervoltage trip upon alarm.

7.7.2 KITCHEN EXHAUST HOOD CONTROL SYSTEM

Provide a kitchen exhaust hood control system that provides the following:

- Control the gas supply to the cooking equipment in accordance with AS5601 including isolating the gas supply when the kitchen exhaust fan is not running.

- Controls the operation of the kitchen exhaust fan including shutting down the fan when the exhaust duct detector goes into alarm.
- Isolate the gas supply upon operation of the fire suppression system.
- Provide an alarm signal to the FIP upon operation of the fire suppression system.
- Isolate the electricity to the electric cooking equipment located under the exhaust hood upon operation of the fire suppression system.

Provide the pre assemble gas valve assembly to the gas sub-contractor to install.