



BROOKTON RAILWAY STATION REFURBISHMENT
Specification for
ELECTRICAL SERVICES

BCA Project Number: 230722

Date: May 2024

Revision: Tender



BCA CONSULTANTS

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INSTALLATION**

**BCA CONSULTANTS
STEPHEN CARRICK ARCHITECTS**

**Consulting Engineers
Architect**

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INFORMATION TO ELECTRICAL TENDERS

TENDER FORM

1. GENERAL

1.1. DESCRIPTION OF WORK

Scope of Work

The Electrical Services Work comprises the supply, installation, testing, commissioning, maintenance and defects liability service of materials, labour and equipment for the complete Electrical Services installations detailed in the sections of this specification and on the Contract drawings. The Work shall include all necessary minor and incidental work required to implement the intent and meaning of this specification and associated drawings.

Whether or not the words “supply and install” appear in this specification or on the drawings, unless clearly excluded, all items of equipment for the complete installation are required and shall be supplied and installed.

Contract Drawings

Electrical Services drawings associated with and forming part of this specification are listed below:

Drawing No.	Title
230722-E01	Legend, Schedules & Line Diagrams
230722-E02	Site Plan – Stage 1
230722-E03	Lighting, Power & Communications Layout – Stage 2

Work by Building Trade

The following list is a summary of the major items of associated work by the building trades and does not necessarily include all work:

- Switchrooms, electrical services risers and cupboards.
- Forming and framing holes in ceilings for linear fluorescent recessed luminaires.
- Openings in the building structure, ceilings, walls and floors where noted on the drawings.

1.2. APPROVED ELECTRICAL TRADES

An approved electrical trade with experience in this type of work shall carry out the Electrical Services installations.

1.3. AUSTRALIAN STANDARDS AND REGULATIONS

The whole of the Works shall comply with current Statutory Regulations, Australian Standards, Supply Authority regulations and any other Authority having jurisdiction over the works or portion of the Works.

- AS 1319 : Safety signs for the occupational environment
- AS/NZS 1680 : Interior lighting
- AS/NZS 1768 : Lightning protection
- AS/NZS 2032: Installation of PVC Pipe Systems
- AS/NZS 2053: Conduits and Fittings for Electrical Installations
- AS/NZS 2293: Emergency lighting and exit signs for buildings
- AS/NZS 2648: Underground Marking Tape
- AS/NZS 3000 : Electrical installations (known as the Australian/New Zealand Wiring Rules)
- AS/NZS 3008 : Electrical installations - Selection of cables
- AS/NZS 3012: Electrical installations - Construction and demolition sites
- AS/NZS 3013: Electrical installations - Classification of the fire and mechanical performance of wiring system elements
- AS/NZS 3084: Telecommunications installations - Telecommunications pathways and spaces for commercial buildings

- AS/NZS 3085 : Telecommunications installations - Administration of communications cabling systems - Basic requirements
- AS3820: Essential safety requirements for electrical equipment
- AS/NZS 4282: Control of the obtrusive effects of outdoor lighting
- AS/NZS 4417 series: Regulatory compliance mark for electrical and electronic equipment
- AS/NZS 4836 : Safe working on or near low-voltage electrical installations and equipment
- AS/NZS 11801.1: Information technology - Generic cabling for customer premises - General requirements
- AS/NZS 11801.2: Information technology - Generic cabling for customer premises - Office premises
- AS/NZS 11801.6: Information technology - Generic cabling for customer premises - Distributed building services
- AS/NZS ISO 45001 : Requirements with guidance for use - Occupational health and safety management systems - Requirements with guidance for use
- AS/NZS 61000: Electromagnetic compatibility (EMC)
- AS/NZS 61058: Switches for appliances
- AS/NZS 61439: Low-voltage switchgear and control gear assemblies
- AS 60529-2004 (R2018): Degrees of protection provided by enclosures (IP Code)
- AS 62053 series - Electricity metering equipment
- AS/CA S008: Requirements for customer cabling products
- AS/CA S009: Installation requirements for customer cabling
- WA Electrical Requirements
- WA Electricity Act 1945
- The National Construction Code (Building Code of Australia.)
- Western Australian Environmental Protection Act 1986.
- Western Australian Occupational Safety and Health Act 1984 and amendments.
- Radiocommunications (Electromagnetic Radiation — Human Exposure) Standard 2014
- Regulations and requirements of the local Supply Authority, including “Western Australian Service and Installation Requirements” for Western Power & Horizon Power.
- Regulations and requirements of NBNC Co including MDU building Engineering and Design Standard
- The requirements of the Chief Inspectors of the relevant Statutory Authorities.
- Any other regulations that apply directly or indirectly to such installations in the locations.

Where Australian Standards and Code do not exist the relevant International Standard or Code shall apply.

Where conflict arises between this Specification and any of the applicable Acts, Codes or Standards the highest standard of materials and workmanship shall prevail and shall be incorporated into the Work.

1.4. STATUTORY AUTHORITIES

Where notice is required by a Statutory Authority having jurisdiction over the Contract Works and/or approval required there from give such notice and information as may be called for and/or obtain such approval.

Obtain all permits within such time as to ensure no delay to the work and pay all fees associated therewith.

Arrange for the necessary inspections and make any tests required by the Statutory Authority at no cost to the Contract. Carry out such tests in the presence of a representative of the Statutory Authority. Give advice of such tests to the Contract Administrator no later than 7 days prior to such tests taking place.

1.5. DEFECTS LIABILITY

Warrant the complete Contract Works against defective workmanship, materials and against non-compliance of equipment or systems with the specified performance and operation for the specified Defects Liability Period.

Replace all lamps that fail within the Defects Liability Period before the completion of their rated life.

At the completion of the Defects Liability Period carry out a final inspection of the site and carry out any remedial work required.

Defects shall be rectified within an acceptable period. Upon failure to rectify within an acceptable period the Contract Administrator shall issue two (2) weeks written notice to rectify the defect. Where works are no completed within an agreed time from the Contract Administrator may authorise a qualified company to rectify the work with associated costs deducted from retention monies.

1.6. MAINTENANCE

Carry out maintenance of all Electrical Services Work from the commencement of, and for a period equal to, the defects liability period.

Maintenance shall be strictly in accordance with manufacturer's recommendations and as set out in the maintenance manual and includes the work listed below:

- Required tests by statutory regulations and manufacturers.
- Required servicing of the installed plant.
- Attendance on site to emergency or breakdown calls.

In the event that any maintenance work is outstanding at the end of the specified period, continue the maintenance obligations until such work is completed and the Contract Administrator has advised in writing that it is acceptable.

Submit to the Contract Administrator copies of all test results carried out as part of the maintenance (i.e. RCD and Emergency Lighting etc.).

1.7. SHOP DRAWINGS

Submit four (4) copies of the shop drawings listed in the sections of this specification. Drawings shall be supplied in sufficient time, but in any case not less than ten working days, for examination and revision, if necessary, to occur before drawings are required for use.

Shop drawings shall show single line schematics, control diagrams, floor plans, elevations, dimensions, equipment type, labelling, panel layouts and other details to clearly describe the equipment/systems to be installed. Works required by other trades shall be clearly defined on the drawings.

One (1) copy of marked up drawings "permission to use" shall be returned when the Contract Administrator considers that such documents are suitable for use for the purposes of the Contract. Such permission is given in principle only and shall not relieve the author of the documents from responsibility for the correctness of such documents except any error in or omission from such documents has been caused by an error or omission from the Contract documents.

1.8. AS CONSTRUCTED DRAWINGS

Provide three (3) hard copies and two (2) electronic copies on DVD/CD-ROM or USB flash drive of "As Constructed" drawings of the Work. Provide the same level of detail shown on the contract drawings and the following additional information listed below:

- Changes to the works due to site conditions.
- Contract variations.
- Any other alterations or changes to the work.
- Further requirements detailed in the technical sections of this specification and on the drawings.

Submit to the Contract Administrator a preliminary set of "As Constructed" drawings for review prior to the commissioning of the works.

ELECTRONIC COPIES SHALL COMPLY WITH THE REQUIREMENTS LISTED BELOW.

Perform all drafting work in accordance with AS1100, AS1102, AS1103 or as otherwise specified.

1.9. INTERPRETATION OF DRAWINGS

Check all relevant dimensions on site before commencing the works. Unless dimensioned the layout of plant and equipment shall be taken as diagrammatic only and all measurements and information required to carry out the works shall be obtained on site.

1.10. TECHNICAL MANUAL

General

On completion of the Work, provide three (3) sets of a technical manual. Design and compile the manual to provide a full and detailed set of information on the Electrical Services installations to facilitate maintenance and assist in fault finding, ordering, installing and re-adjusting any failed component.

The manual shall be vinyl hard-back folder with the Project Title, Architect's name, Electrical Consultant's name and volume number printed on the front and spine of the folder. Provide rigid, visible and labelled dividers between the various sections of the manual. All manufacturers' documentation shall be in the English language.

Four weeks before practical completion provide a prototype manual for review and comment by the Contract Administrator. Amend and include additional detail into the manual as instructed.

Sections

The manuals shall contain separately identified sections with an index in the front of the manual.

Include a section at the start of the manual containing a list of the various Electrical Services installers, including business and out-of-hours telephone numbers for all service and breakdown calls.

Provide technical sections each corresponding to the sections of this specification. Include the following minimum information for each section:

- Instructions for operation of equipment.
- Installation and maintenance instructions and protection settings.
- Commissioning results.
- Details including manufacturer's literature, of all items of equipment supplied.
- Copies of manufactures warranties.
- A3 size schematic and wiring drawings.
- A3 size approved shop drawings.

At the rear of the manual provide a section for "As Constructed" drawings comprising of a set of A3 hard copies and an electronic copy on DVD/CD-ROM or USB flash drive.

1.11. WARRANTIES

General

Obtain the necessary details and transfer manufacturer's warranties to the nominated person or organisation.

1.12. INSTALLATION GENERALLY

General

Unless specified otherwise, follow the manufacturer's recommendations with regard to installation procedures, workmanship and associated materials, equipment, components and devices, whether or not the particular manufacturer has been specified.

Provide materials, equipment, components and devices of new and current manufacture and maintain consistency of manufacturer throughout each product range incorporated in the Work.

Where phases are not nominated for particular loads, balance the loads between the individual phases of the supply to the satisfaction of the Contract Administrator and Local Supply Authority.

Co-ordination with Other Trades

Co-ordinate and check all Work against the shop drawings of other trades. In particular verify the following minimum details.

- Check that the locations of switchboards, control panels, etc provided by other trades have not changed from the locations shown on the Electrical Services drawings.
- Check that cable, conduit, tray, and duct runs clear other services.
- Check the equipment ratings have not altered to that indicated on the Electrical Services drawings.

Notify the Contract Administrator of any discrepancies between the Electrical Services drawings and other trade drawings.

Liaise with other trades as required and provide all work to resolve any conflict between the affected Services without cost variation. Obtain approval prior to commencing any work on site.

Positioning of Accessories and Equipment

The location of accessories and equipment shown on the drawings is diagrammatic only. Determine the exact locations on site with the Contract Administrator prior to commencing the Work.

Variation: Allow re-locating any GPO, lighting switch, luminaire or wall bracket up to 2m without cost variation if the change is advised before the item is installed.

1.13. SPECIFIC METHODS

Fixings and Plugs

Drill holes by electric or compressed air drill. Do not use explosive charge fixing devices.

Use approved metal expansion anchor devices except that in certain locations plastic expansion devices may be used when and where approved by the Contract Administrator.

Obtain approval prior to drilling any structural element.

Chasing and Penetrations

Provide all chasing and penetrations for recessed conduits, wall boxes and accessories in accordance with the criteria listed below.

- Keep chasing of walls to a minimum width and depth.
- Check the proposed finish of the surface to be chased prior to chasing.
- Provide sufficient depth so that conduit is a minimum of 15mm below the surface after final rendering or plastering.
- Do not chase face brickwork, face block-work, or concrete tilt panels.
- Horizontal chasing is not permitted.
- Secure conduits in chases with saddles or wire ties.

Carry out all chasing with equipment that has dust suppression and which complies with relevant statutory regulations and good work practice.

Build in conduits in single leaf double-sided face brick walls by slotting bricks and concealing conduits without altering the pattern of the face brickwork.

Sealing

Where conduits, pipes, cables or any other materials or equipment penetrate any roofs, walls or floors through which moisture or dampness could penetrate weatherproof and seal all such penetrations to approval. In particular fully seal the conduit end to prevent ingress of moisture around cables.

Fire Proofing

Unless otherwise specified, where conduits, pipes, cables or any other materials or equipment penetrate fire rated walls, roofs, or floors seal the penetration with a fire rated foam, divide, or other approved method, to achieve a fire rating equal to the wall, floor, or roof.

Where equipment, including switches, socket-outlets and other accessories is recessed into a fire rated wall, roof or floor, fire rated wall boxes shall be provided. Fire rated wall boxes shall be suitable to maintain the required fire rating of wall.

Electrical equipment recessed in a fire rated wall, roof, or floor shall be arranged to provide a separation of not less than 300mm horizontally and 600mm vertically from any opening or recess in the opposite side of the wall, roof or floor.

Openings made for electrical equipment in a fire rated barrier shall not penetrate beyond 50% of the thickness of the fire rated barrier.

1.14. INSTALLATION IDENTIFICATION

Clearly identify all equipment including luminaires, accessories, switchboards, control panels, switchgear, appliances, enclosures and underground cables.

<u>Item</u>	<u>Label Type</u>	<u>Comment</u>	<u>Letter Height</u>
Accessories including switches and socket outlets	Plug-in studs	Phase-colour and circuit number coded	
Escutcheon panels main and isolating switches	Laminated plastic plates	Engraved black lettering on white background bevel-edged	5mm

For accessories with “clip on” cover plates, conceal and fix all identification behind the cover plate.

Provide an index-card mounted in an index-card holder on the inside face of the enclosure door of each switchboard and distribution board. The card shall detail the following minimum information listed below.

- Type, size and origin of mains and sub-mains circuits.
- The circuit number, phase, rating and function of each circuit or sub-circuit interrupting device.
- Size and type of cable of each out-going circuit or sub-circuit.
- The index card shall be dated.

The index-card shall be a white, rigid card printed or typed in black.

1.15. PAINTING AND FINISHES

Where factory painted or enamelled surfaces to equipment have been chipped or damaged on site carry out the repair work by filling, painting and restoring to the exact finish and colour of the surrounding paintwork.

1.16. TESTING AND COMMISSIONING

Provide the necessary skilled and competent personnel together with all test equipment, fuel and electric power required to test and commission each Electrical Services installation covered by this specification.

Submit a comprehensive testing and commissioning program for review, in sufficient time to allow amendment and revision to occur, but in any case not less than six weeks prior to planned commencement. Allow in the program for the Contract Administrator to witness all testing and commissioning activities.

The program shall include a detailed break-up of the required activities for each Electrical Services installation.

Provide two weeks' notice to the Contract Administrator of intention to commence testing and commissioning activities, then carry out the activities in the presence of the Contract Administrator.

Tests shall include but not limited to:

- Maximum load test on all mains and sub-mains.
- Insulation test on all mains, sub-mains and final circuits.
- Neutral connection test
- Earthing test
- Earth Fault Loop Impedance Tests
- RCD Tests
- Test further specified within this specification.

1.17. ALTERNATIVE EQUIPMENT

Alternative equipment that will reduce the cost but not alter the performance or quality may be submitted as a separate section for approval with a complying tender. The Contract Administrator may in its discretion accept or reject submitted alternative without cost penalty or extension of time unless otherwise agreed.

Alternatives will not be accepted as a result of failure to order equipment in sufficient time to avoid delay unless it can be demonstrated that the delay was out of the control of the Contractor.

Where specified equipment is unavailable or will incur delays to the Contract, submit written advice to the Contract Administrator.

The offer of alternative luminaires shall include certified lighting calculations for the associated areas to AS1680 and re-calculation of Section J6 compliance.

Preference will be given to alternatives of Australian made equipment.

1.18. EXISTING SITE CONDITIONS

Prior to submission of tender inspect the existing site conditions, including the existing Site Main Switchboard / Meter Panel and consumer mains. Variations arising from works that could have been determined on site will not be considered.

2. ELECTRICITY SUPPLY AND EARTHING

2.1. SUPPLY GENERALLY

Electricity Supply

Design all equipment to operate on the local Supply Authority and maintain the correct phase sequence throughout the works.

Electrical equipment incorporated in the Works shall be marked suitable for connection to this system except where this specification includes for the supply and installation of extra low voltage equipment in which cases such equipment shall be marked accordingly.

Minimise power disruptions and where disruptions cannot be avoided undertake the works at pre-determined times with the contract administrator and users.

Supply Authority

Liaise with and provide notice and all project details to, the Supply Authority and arrange for the Supply Authority to carry out all required work for the provision of electricity supply to the site.

Provide sufficient notice to the Supply Authority to enable the work to be installed, tested and energised within the project programme. Include due allowance for early provision of power to nominated services, e.g. For testing and commissioning.

Submit to the Contract Administrator copies of all correspondence with the Supply Authority.

Pay any required fees to the Supply Authority for establishment and connection of the site electricity supply.

Connection to Supply

Prior to commencement of works request from the Contract Administrator a copy of the Local Supply Authority supply quotation and ensure all conditions of installation have been allowed for.

Liaise with the Local Supply Authority to confirm the point of attachment prior to the undertaking of any works.

Provide in accordance with the Local Supply Authority's Guidelines all cable tails, cable lugs and crimping equipment to enable final termination of the consumer mains.

Consumer Mains

Provide all work associated with the provision of consumer's mains cable installations for the site. The Work includes, but is not limited to, the items listed below.

- Conduits between the site main switchboard/s and the Supply Authority's point of supply. Coordinate and liaise with the Supply Authority on exact requirements.
- Consumer's mains cables and cable lugs including terminations at both cable ends.

2.2. LOCAL SUPPLY AUTHORITY METERING

Tariff Meters

CT Connected Meters: Arrange for the Local Supply Authority to supply, install / relocate and connect the meters.

Direct Connected Meters: Obtain all meters from the Local Supply Authority and install and connect the meters.

Make application to the Local Supply Authority and pay all account establishment fees for all Tariff meter installations. Obtain the required account details from the Contract Administrator.

2.3. EARTHING

General

Provide all earthing to the Electrical Services work in accordance with AS/NZS 3000, the Local Supply Authority, Regulatory Authorities and any additional requirements detailed in the specification and on the drawings.

Earthing shall be provided for all accessories, appliances and exposed metal of equipment and shall include the items listed below.

- Enclosures and wiring systems.
- Earthing pin of outlets, luminaires and lighting points.
- Structural metal work and conductive building materials.

The system of earthing shall be the Multiple Earthed Neutral System (MEN).

Circuit Earth Conductors

Provide a separate earth conductor for each submain and sub circuit installation in accordance with the methods listed below.

- Incorporated in the sheath of multi-core cables.
- Laid with double insulated single core cable circuits.
- Laid with single insulated single core cable in conduit or other enclosures.

Connect submain and subcircuit earth conductors at the switchboard or distribution board from which the associated active conductors originate.

Do not use metallic wiring enclosures as an earthing conductor.

Main Earth Conductor

Provide a main earthing conductor from the main switchboard and connect to an earth electrode and water service pipe. Enclose the electrode connection in an earth pit complete with lid marked "Main Earth".

Use only copper, copper clad or stainless steel rod type earth electrodes. All connections shall be treated against corrosion.

2.4. EQUIPOTENTIAL BONDING

General

Provide all equipotential bonding installations in accordance with AS/NZS 3000, the Local Supply Authority, Regulatory Authorities and additional requirements detailed in the specification and on the drawings.

Liaise with equipment suppliers and determine all equipment and accessory bonding requirements.

Submit samples of all bonding connection methods for review by the Contract Administrator.

All bonding conductors shall be installed in a discreet manner to the approval of the Contract Administrator.

Shop drawings

Provide shop drawings, based on architectural backgrounds that show the location of all required bonding installations. Bonding installations shall include the items listed below.

- Metallic Piping.
- Telecommunications Systems.

3. SWITCHBOARDS

3.1. GENERAL

Scope of Work

Supply and install switchboards in the locations shown on the drawings, complete with all switchgear, control and protection devices and power sources. Switchboards shall comply with AS/NZS 61439 and be constructed in accordance with this specification and contract drawings.

Shop Drawings

Provide the following minimum details listed below for all switchboards.

- Dimensioned plan, front and rear elevations, and section views for each cubicle variation at 1:10 scale.
- Equipment schedule and ratings, and busbar and support arrangements.
- Label and material schedules and cabling provisions.

Submit shop drawings to the Supply Authority for approval and submit copies of all correspondence with the Supply Authority to the Contract Administrator.

Manufacturer

One of the following switchboard manufacturers shall be engaged to build the switchboards:

- PGS Industries
- Price Trandos Engineering
- C.P.E Pty Ltd
- NRP Switchboards
- Ray Brookes Pty Ltd

Other switchboard manufacturers may be considered subject to approval.

Schematic Diagram

On the wall adjacent to each main switchboard, supply and install a schematic wiring diagram of the complete switchboard including all incoming and outgoing cable sizes and types and fuse ratings. The wiring diagram shall be fixed into a frame with a non-reflective transparent cover.

3.2. SWITCHBOARD DESIGN

General

Confirm that switchboards can pass through door openings and access ways and be installed in the nominated locations and that clearances comply with the regulations and standards.

Prior to manufacture, notify the Contract Administrator in writing of any conflict between switchboards and access or installation locations.

Modify the switchboard design in accordance with the available building or site access provisions.

Confirm all switchboard names prior to labelling.

Site Main Switchboard

Type: Weatherproof, totally enclosed, marine grade brushed aluminium, modular construction, pole mounted.

Designation

Rated voltage
Fault Level (minimum)
Form of segregation
Cable Entry
Connection
Arcing fault containment
Service Conditions

Criteria

415V rms
Refer to the single line diagram
Form 2
Top & Bottom
Front
Not applicable
Outdoor

Degree of protection	IP56
Safety measure	1
Colour	Confirm prior to manufacture

New Building Distribution Board

Type: Can be suitable wall mounted proprietary panel board or loadcentre.

<u>Designation</u>	<u>Criteria</u>
Rated voltage	415V rms
Fault Level (minimum)	Refer to the single line diagram
Form of segregation	Form 2
Cable Entry	Top and bottom
Connection	Front
Arcing fault containment	Not applicable
Service Conditions	Internal
Degree of protection	IP23
Safety measure	1
Colour	Confirm prior to manufacture

3.3. CONSTRUCTION

General

Construct LV SCA from commercial quality marine grade aluminium or drawn bright mild sheet steel, machine bent and folded, flat, smooth and free from warps, twists or other distortions on a supporting structure. Use sheet steel free from rust and scale and a minimum thickness 1.6mm.

Floor mounted switchboards shall be mounted on galvanised steel frame bases of minimum height 75mm to form a kick rail.

Frame or reinforce all sections over 900mm. Where angle iron framing is used it shall not be visible from the outside of the switchboard.

Provide louvres for heat dissipation of equipment located at top and bottom on the sides of the switchboard. Attach brass flywire mesh behind the louvres.

Interiors of switchboard shall be gloss white. External colour shall be as specified. **Confirm colour prior to manufacture.**

Prepare the edges of holes or cut outs so that they are free from burrs and are ground to a clean face.

Following on-site delivery and during the construction of the building, ensure that the switchboard is suitably covered and locked to prevent damage to the cabinet or equipment. Make good any damage during delivery or following installation, and completely repaint to match the original finish.

Fixing and Fastening

Locate and mount equipment incorporated on the switchboard in readily accessible compartments. All identical switch and control gear assemblies shall be interchangeable.

Bolts and machine screws shall be of non-corrosive types complete with hexagon nuts and washer with excess threaded sections cut and filed. Where exposed to view chrome plate all nuts, bolts and machine screws.

Use captive bolts and nuts wherever possible. Lock nuts shall be used on bolts securing submain cable lugs.

Access

Escutcheon panels shall be manufactured using dustproof construction with rubber or neoprene gaskets and 13mm lips all round. They shall be secured by chrome plated large knurled captive head machine screws. Provide locating pins to accurately locate removable panels when they are being replaced. Provide lifting handles to all removable panels over 500mm W or 800mm H. Escutcheon panels shall expose switch and circuit breaker handles and toggles and fuse carriers.

All escutcheon panels shall be designed to prevent contact with live parts by insulated barriers in accordance with AS3439.

Provide cable entry via removable non-metallic gland plates or pre-punched conduit knockouts (for proprietary distribution boards).

Doors shall be manufactured to be weatherproof with rubber or neoprene gaskets, 13mm lips all round, and concealed lift off chrome hinges with staggered length hinge pins. Mount doors to open a minimum of 110° with restraints at full open position.

Escutcheon Panels: Escutcheon panels shall expose switch and circuit breaker handles and toggles and fuse carriers.

3.4. BUSBARS AND LINKS

Purpose Made Busbars

Purpose made busbars shall high conductivity electrolytic copper of adequate size for the maximum current rating of each and all items of switchgear, rigidly supported on approved material and able to withstand the fault levels nominated for 1 second.

All main interconnections and tee-offs in excess of 60amp rating shall be busbar.

The minimum size of copper busbar to be incorporated in the construction of the busbar system, including final connection to components is to be 25 x 6.3mm.

Insulated supports through which busbars pass shall be clearance fit not exceeding total of 1mm.

Ensure joints and tee offs are accessible for visual inspection and for access with a tension wrench.

Cutting techniques to be such that edges are without lip and are smooth and free of deformation. Remove burrs and ensure that mating surfaces of joints are true and flat.

Bend and form busbars using bending devices and jigs specifically designed for the purpose. Bends and sets shall be free from cracks. Distortion of the busbar cross section to be minimal. The internal radius of bends to be approximately twice the thickness of the busbar being bent. Annealing is not permitted.

Drill bolt holes through aligned busbars concentric, having maximum 1mm clearance on diameter over the bolt size.

Identify phases with 25mm wide bands of flat enamel paint or heat shrink sleaving at regular intervals located so that when any section of the busbar system is exposed, the phase colour may be easily seen and identified.

Proprietary Busbar Assembly

Proprietary busbar assemblies shall be double dipped with horizontal connection for mounting two vertical rows of circuit breakers and same manufacture as the required circuit breakers.

Earth and Neutral Links

Earth and neutral links shall be of brass and have a sufficient number of terminations to suit the maximum possible development of the switchboard. Links shall be readily accessible from the front of the switchboard when escutcheons are removed.

Provide separate sets of earth and neutral links for lighting and power circuits.

Where a switchboard is supplied by more than one submain provide separate earth and neutral links for each submain section.

Fully insulate neutral bars from switchboard and metalware by non-hygroscopic material.

Mount earth bars directly to switchboard metalware.

4. SWITCHGEAR AND CONTROLGEAR & ACCESSORIES

4.1. SWITCHGEAR

General

Circuit breakers shall be utilised for all transformer, submains and final circuit protection unless otherwise indicated on the contract drawings.

Isolating switches for Local Supply Authority Transformers or Customer owned transformers 500kVA or greater shall be protected by air circuit breakers. Isolating switches for transformers less than 500kVA may utilise moulded case circuit breakers if line-side transformer isolating links sized to 110% of the transformer capacity are provided.

Moulded case circuit breakers shall be used for sub-main and final circuit protection over 100amps and less than 1200amps. Protection of circuits less than 100amps may utilise miniature circuit breakers.

Trip units shall be capable of continuous operation at the full load rating nominated on the contract drawings or as specified in this specification.

Moulded Case Circuit Breakers (MCCB's)

The MCCB's thermal magnetic trip unit shall have instantaneous short circuit and inverse-time over-current tripping characteristics or fully adjustable, solid state, trip unit insensitive to changes in ambient temperature. The unit shall be true r.m.s sensing and include the functions listed below.

- LTD, STD, and instantaneous overcurrent.
- Earth fault.
- Pre-trip alarm and self-diagnostic function.
- Current transformers.

MCCB's shall have positive identification of breaker status "ON", "OFF" and "CENTRE TRIP" positions.

All solid-state breakers shall be capable of field testing with a hand-held test unit while still in service and without exposure to live parts. The tester is to operate from a 240V 50Hz outlet and be capable of testing the overload calibration and short circuit performance of each breaker. A push-to-trip button shall be provided on the breaker face for mechanical verification.

Removable line and load covers shall be provided to allow inspection and retightening of the breaker terminals.

Approved Manufacture: Schneider, NHP

Miniature Circuit Breakers (MCB's)

MCB's shall be mounted on a purpose made chassis. Removal of any breakers shall not disturb connections to other circuit breakers.

MCB's shall have instantaneous short circuit and inverse-time over-current tripping characteristics with positive identification status of "ON", "OFF" and "CENTRE TRIP", positions.

1-phase MCB/RCD combination units shall be single module units rated at 30mA unless otherwise indicated.

3-phase MCB/RCD combination units shall be single 3-pole module units rated at 30mA unless otherwise indicated.

Approved Manufacture: Schneider, NHP

4.2. CONTROLGEAR

Control Switches

Mechanically capable of a minimum of one (1) million operations and derated where applicable to provide an electrical life expectancy of one (1) million operations.

Selector switches shall be Cam operated rotary type switches.

Auto/manual/lock-out/Test Switches shall be key operated with similar locks and supplied with four (4) keys.

Voltmeter Switches shall be Phase to Phase and Phase to Neutral selection with off position.

Contactors

Contactors shall have a utilisation category of AC5a or AC5b for lighting loads, AC3 for motor loads with a 1,000,000 no load operating cycles unless otherwise detailed. Current ratings shown on the drawing are minimum ratings after de-rating for enclosure and temperature.

Contactor coils shall be 240V unless otherwise specified.

Approved Manufacture: SPRECHER & SCHUH or MERLIN GERIN

Time Switches

Time switches shall be 7-day, day omitting, with capacity of 4 switching periods per day and equipped with manual override switch. The switching periods shall be adjustable with a minimum period being 1 hour.

Provide with a minimum of 24-hour battery reserve capacity to maintain accurate time during power outages.

Contact rating of time switches shall be a minimum of 15amp, 240 Volt AC.

4.3. KILOWATT HOUR METERS (NON-UTILITY METERS) & MULTIFUNCTION METERS

Supply and install Kilowatt Hour Meters detailed in the specification and as shown on drawings. Kilowatt Hour Meters shall be Indication type, three elements for three phase circuits, single element for single phase circuits. Accuracy shall be Class 1, unless otherwise indicated. Install Kilowatt Hour Meters complete with potential fuses. Unless meters specified can measure direct currents for branches with circuit protection of 100 Amp or less, Current Transformers (CTs) shall be supplied and installed for each meter. Mark on the scale the CT ratio and the multiplying factor applied to the meter.

Kilowatt Hour Meters shall be approved by the National Measurement Institute (NMI). Provide a current NMI Certificate for Kilowatt Hour Meters with the tender submission and prior to order and installation of Kilowatt Hour Meters.

Each Kilowatt Hour Meter shall be provided with an RS232 communication port compliant with IEC 62056-21.

Commissioning process for Kilowatt Hour Meters using CTs shall follow the NABERS Guide for "Validating non-utility meters for NABERS ratings" (available at www.NABERS.com.au). Contractor shall provide dated and signed validation records for all non-utility Kilowatt Hour Meters in the operation and maintenance manuals.

Kilowatt-hour meters shall have facility to be interlinked by a communications system that collates the time of use energy consumption data to a single interface monitoring system where it can be stored, analysed and reviewed.

Digital DIN rail mounted multifunction meters shall have facility to monitor and display the following (as a minimum):

- Kilowatt-hour consumption
- Active and Reactive energy
- Phase to Phase and Phase to Neutral voltage
- Phase and Neutral current
- Current demand
- Current (I) maximum (peak) demand
- Power factor
- Maximum demand power
- Total harmonic distortion

Approved Manufacture: Schneider or approved equivalent.

Current Transformers

Current Transformers used for general purpose shall have 5amp secondary windings and Class 0.5 accuracy unless otherwise detailed.

Protection current transformers shall have 5amp secondary windings and be Class P with a Composite Error of 2.5 and Rated Accuracy Limit Factor of 20 unless otherwise detailed.

4.4. SURGE DIVERTER

General

Supply and install a power line surge diverter at the nominated switchboard as indicated on the drawings. The surge diverter shall provide protection against multiple impulses caused by lightning and other transient disturbances.

The surge diverter shall have the following nominal ratings:

Nominal voltage:	240/415V
Nominal frequency:	50Hz
Rated Load Current:	Refer to single line diagrams

Manufacturer

Surge Diverter shall be from one of the following manufacturers:

- Novaris
- LPI
- Critec

Standards

The surge diverter shall comply with AS1768 and shall be suitable for AS1768 Location Category C. Safe failure mechanisms of surge diverter shall meet Standards IEC 61643-1 or UL 1449.

Construction

Main Switchboard with MEN

The surge diverter shall consist of three individually replaceable single-phase modules.

Each module shall provide protection between one phase and neutral.

The modules shall be based on metal oxide varistor (MOV) technology. For single shot 8/20 μ s surge current rating of 100 kA or more the MOV shall be housed in metal enclosures.

Each module shall comprise no less than four replaceable individually fused protection segments.

Each module shall include a thermal sensor that detects if a MOV overheats.

Secondary Main Switchboard without MEN or Sub-Distribution Board

The surge diverter shall provide protection for all modes (L-N, L-E & N-E). A single metal oxide varistor (MOV) shall be connected between each phase and neutral, and a gas discharge tube (GDT) shall be connected between neutral and earth. A fuse or circuit breaker shall be connected in series with each MOV. The surge diverter shall comprise a thermal sensor for each phase that detects if the MOV overheats.

The surge diverter shall be installed in compliance with AS4070, AS3000, and the manufacturer's installation instructions.

Surge rating

The phase-to-neutral single shot 8/20 μ s surge current rating I_{max} of each module shall be as nominated on electrical drawings or where not nominated as per AS1768 Table 5.1, Category C.

The modules shall not rely upon current sharing between MOV components. That is, individual MOV components must be able to withstand multiple AS1768 Category C surges.

Performance

Unless otherwise nominated on electrical drawings the let-through voltage of the surge diverter, U_P as defined in AS1768, shall not exceed 800V for 3kA surge at 8/20 μ s or 1000V for 20kA surge at 8/20 μ s.

Unless otherwise nominated on electrical drawings the maximum continuous operating voltage, U_C as defined in AS1768, shall be at least 275V. Where surge diverter is provided at the site main switchboard

the surge diverter shall be able to tolerate temporary over voltage (TOV) up to 1.7 times the nominal operating voltage. This may be achieved via transient discrimination technology or by providing a spark gap in series with a MOV. In either case the surge diverter shall not exceed the nominated let-through voltage U_P .

Display

The surge diverter display shall comprise a status indicating LED for each phase. The LED shall extinguish under any of the following conditions:

1. Loss of power
2. Operation of the fuse or circuit breaker protecting the surge diverter
3. Operation of the thermal sensor

The display shall provide specifically distinguishable indication of operation of the thermal sensor.

Alarm

The surge diverter shall have an external alarm in the form of voltage-free changeover contacts. The alarm shall be activated when there is 50% depletion of the surge material on any line or under any of the following conditions:

1. Loss of power
2. Operation of any protection segment fuse or circuit breaker
3. Operation of the thermal sensor

The voltage free-changeover contacts shall have no less than 4kV isolation from all other circuitry. The surge protection device shall have at least 2 replaceable modules for change-over after an alarm condition.

Installation

Surge Diverter should be installed after the main switch but prior to any RCD devices.

Surge Protection Device wire length of the active and neutral or earth connections for each surge diverters should not exceed 1000mm and such connection should be a minimum of 16mm² copper conductors or to suit upstream circuit breaker or fuse and be as short as practicable. For optimal protection and performance the total length of the individual connections should not exceed 300mm.

Where surge diverter is fitted to existing switchboards, they should be cabled with the shortest possible length of cable and should connect to the first outgoing sub-circuit fuse or circuit breaker after the main switch.

Provide a circuit breaker for over current protection of the surge diverter to manufacturer's recommendation. The circuit breaker must safely isolate the surge diverter during failure but must allow the rated surge current to pass without failure. The fault rating of the fuse or circuit breaker must be consistent with the fault rating of the switchboard.

5. CABLES AND WIRING

5.1. GENERAL

Scope of Work

Supply, install, connect and test all cables and wiring (hereafter referred to as cables), enclosures and supports for the Electrical Services work documented in the various sections of this specification. The work shall include all requirements, whether specified in detail or not in the specification or on the drawings, in order to provide complete working circuits or systems.

The cables, enclosures and support installations detailed in the various sections of this specification and on the drawings detail the minimum requirements for specific work. Provide all additional installations that are required in order to complete the Electrical Services Work.

Shop Drawings

Submit the following schedules to the Contract Administrator for review prior to ordering the Contract quantities of cables, enclosures and supports.

Selections: A schedule of all cable selections where specific details are not nominated in the Contract Documents. This requirement may be met by incorporation of the details on the shop drawings associated with the various sections of the specification and drawings.

Enclosures and Supports: A schedule of all enclosure and support selections where specific details are not nominated in the Contract Documents. This requirement may be met by incorporation of the details on the shop drawings associated with the various sections of the specification and drawings.

Changes: A schedule detailing any proposed changes to cables, enclosures and supports specified in the Contract Documents.

Testing and Commissioning

Test and commission cables in accordance with the manufacturer's recommendations, Australian Standards and Regulatory Body requirements pertaining to the work, and as further detailed in this specification and on the drawings.

5.2. DESIGN AND SELECTION

Review the contract drawings, including architectural, mechanical, fire and hydraulic services, and all trade shop drawings, and select the appropriate route and method of enclosure and/or support for cables. In particular, co-ordinate the work with the installations by other trades and obtain all measurements on site.

Where cable types and sizes are not specified in the Contract documents, select the required cables in accordance with the required duty and performance outcome.

Design of all cable enclosure and support systems shall comply with the respective manufacturer's recommendations. Unless otherwise specified, allow 30% spare capacity for future cables and wiring.

Deliver cables to site in original packages, marked to clearly indicate manufacturer and contents.

5.3. INSTALLATION GENERALLY

General

Provide cables and associated enclosures and supports (hereafter referred to as cable installations) in accordance with the general requirements detailed in this specification and on the drawings, and any additional requirements recommended by the manufacturer or supplier.

Install cables between the point of supply and associated accessories on a loop-in/loop-out system, or directly between the point of supply and equipment. No joints, splices or intermediate connections shall be permitted.

Conceal all cable installations, generally within ceiling spaces, cavity walls and other concealed spaces within the building structure. Alternatively, underground installations or installations enclosed and cast into concrete and other hard surfaces. In plant rooms and electrical cupboards surface mounted installations are acceptable.

Run cables in a neat and workmanlike manner, parallel to building elements, eliminating strain on cables and terminations. Run straight for at least 300mm prior to entering equipment.

Every attempt shall be made to ensure that bending radii are not less than twenty (20X) times the cable diameter, and under no circumstances shall be manufacturer's minimum bend radius be violated.

Cable ends left exposed shall be sealed or taped where protected from weather. Where exposed to moisture take-up, ends shall be sealed with Raychem caps or equal approved.

Conditions

Hot Surfaces: Fix with sufficient clearance from hot surfaces to preclude damage or derating of current carrying capacity cable due to excessive ambient temperature. Ensure 150mm minimum clearance from hot pipework.

Pipework: Maintain a minimum of 25mm clearance from other Services pipework.

Layers: Limit cable layers to 2 maximum.

Rising Cables: Install cables that would impose stress to terminals on cable trays, ladders or other approved support systems. Maintain minimum 12mm spacing between cable and support fixing surface. Support rising cables at not less than 1200mm centres using approved clamps or ties.

5.4. SPECIFIC LOCATIONS

Hard Surfaces: Enclose all cables in conduit where embedded in hard surfaces or finishes. Size and install enclosures to ensure cable withdrawal and replacement without damage to finishes.

Cavity Walls: Fix cable enclosures against the inner face, clear of the outer skin. For unenclosed cables, run insulated and sheathed cables slack and clear of all sharp projections.

Face Masonry Elements: Built enclosures into the elements avoiding damage to associated element faces.

Partitions: For partitions, provide insulated and sheathed cables run slack and installed clear of all sharp projections.

Ceiling Space: Support cables using catenary wires or from the ceiling suspension system. Fix to approval at maximum of 1200mm centres.

Exposed to the Weather: Enclose cables and wiring in heavy duty, rigid, ultraviolet resistant HFT PVC conduit, sealed watertight. Locate conduits to ensure protection from mechanical damage.

5.5. LV CABLES AND WIRING

Minimum size

Where cables sizes are not shown use stranded copper conductors of the following minimum sizes. Increase sizes where necessary for reason of voltage drop or de-rating.

<u>Circuit Type</u>	<u>Conductor Size</u>
Lighting Circuits including Emergency and Exit	2.5mm ² Cu
General purpose power and socket outlet circuits	2.5mm ² Cu
Control circuits	1.5mm ² Cu
Flexible cords	30/0.25mm Cu

Circuit Protective Devices: unless otherwise specified, match the protective device rating to the cable rating.

Equipment Loading

The specified conductor sizes for Mechanical, Hydraulic, Fire and other permanent appliances or equipment connections are based on the preliminary design data. Obtain a detailed schedule in writing from the supplier of this equipment, listing nameplate and final current load. Increase conductor sizes and protective device sizes to match any increased loadings including allowance for volt drop.

Submit a schedule detailing any proposed changes to cables and wiring specified in the Contract Documents, as a result of changes to preliminary equipment or appliance loadings

Derating

Conductor sizes specified on the drawings or herein are rated in accordance with AS3008 Part 1 without application of derating factors for enclosure or grouping of cables. Where the method of installation requires

enclosure and/or grouping of cables apply the appropriate derating factors and increase conductor size to maintain circuit current capacity.

Installation

Install 3 phase single core cable circuits in trefoil formation.

Install only cables from the same distribution board or sub-circuit in a common enclosure. In particular, segregate cables from different systems.

Connect conductors of area 10mm² or greater using approved compression lugs into studs or bolts. Ensure compression fittings are installed to manufacturer's recommendations.

Terminate all un-enclosed cables entering equipment with proprietary cable glands, sized and installed to the cable manufacturer's recommendations.

Cabling passing through roofs shall be via a mechanical screw-up gland sealed with a UV resistant non hardening sealant.

5.6. FIRE RATED CABLES

Non-Metallic Sheathed Cables

Retain cables using stainless steel cable clips fixed at maximum 600mm centres or as recommended by the manufacturer to maintain the Wiring System rating.

MIMS Cables

Install MIMS cables neatly and free of kinks, bond to manufacturer's recommendations to minimise circulating currents, and bush where passing through dissimilar metallic enclosures.

Keep at least 50mm clearance from cables with lower temperature rating insulation and install to facilitate future removal without disturbing adjacent cables.

Retain cables using brass, copper or stainless steel clips, saddles, or straps with brass pins or screws. Fix at maximum 600mm centres or as recommended by the manufacturer to maintain the Wiring System rating, and at maximum 150mm on either side of fittings, accessories or changes of direction.

Seal ends immediately after cutting to length, to preclude moisture entry.

5.7. CONDUITS AND FITTINGS

General

Conduit shall be circular rigid PVC or where exposed to mechanical damage or direct sunlight use galvanised steel or HFT UV stabilised conduit.

Where conduit is subject to vibration medium duty corrugated flexible conduit with fittings compatible with the rigid conduit system. Where flexible conduit is subject to mechanical damage use steel wound reinforced flexible conduit.

Conduits installed underground shall be orange heavy duty circular rigid PVC.

Communication conduits shall be white PVC manufactured in accordance with regulatory requirements.

Provide a Polypropylene "pull through" cord in every conduit, including those containing cables.

Seal both ends of each conduit with a waterproof, non-setting filler.

Draw-in Boxes

Provide draw-in boxes as follows:

- For vertical runs exceeding 7.5 metres - off set entry and exit and provide drain plugs at the lowest point
- For horizontal runs exceeding 25 metres - provide drain plugs and install conduits to fall to the boxes

Fix surface conduits adjacent enclosure terminations as follows:

Up to 25mm diameter, at 150mm maximum from enclosure.

Over 25mm, at 300mm maximum from enclosure.

Externally and in damp areas, use spacers to maintain 13mm spacing from surfaces.

Cast into Concrete

Use medium duty rigid or flexible PVC conduit with maximum conduit diameter 32mm unless otherwise specified.

For concrete slabs, fix between upper and lower reinforcing steel, spaced to approval, and provide deep PVC conduit boxes with lids flush with the underside of the slab.

For concrete columns fix to approval behind ligatures.

At expansion or construction joints, provide a 300mm length of internally greased conduit of the next largest size symmetrically across the joint. Fit conduits in adjoining sections of slab into the sleeve, leaving 100mm expansion gap symmetrically across the joint, and tape waterproof prior to pouring of the slab.

5.8. CABLE LADDERS AND TRAYS

General

Cable Ladders - galvanised steel with minimum 70mm deep lipped side rails with rungs spaced at maximum 450mm.

Cable Trays - normal and reverse slotted galva-bond with minimum 19mm deep radiused folded edge. Minimum thickness 1mm to 300mm width, 1.6mm to 600mm width. For horizontal installation, open mesh trays may be used.

Provide complete with manufactured bends, risers, tees, reducers, splices, crosses, joints, fixing brackets, supports, hangers and all other necessary accessories.

Select ladders and trays with lateral bars, connections and hangers to limit fully loaded deflection to 10mm from true horizontal, measured between supports, with 25% spare load factor.

Installation

- Complete support installation prior to cable installation.
- Terminate ladders or trays 25mm either side of penetrations.
- Fix cables or conduits at maximum 1200mm centres using approved non-corrosive clamps or saddles.
- Nylon ties may be used for sub-circuit cables on cable trays.
- Use only mushroom, cheese or round head bolts, washers and nuts.
- Maintain common nuts throughout and remove any sharp penetrations from the support face of the ladder or tray.

6. UNDERGROUND INSTALLATIONS

6.1. GENERAL

Scope of Work

Provide all underground installations, comprising conduit systems and direct buried cabling, for the Electrical Services Work documented in the various sections of this specification and on the drawings.

The underground installations detailed in the various sections of this specification and on the drawings detail the minimum requirements for specific work. Provide all additional underground installations for cabling and wiring that are required in order to complete the Electrical Services Work.

Shop Drawings

Provide shop drawings showing the route and installation details for any underground installations, not shown on the Contract Documents.

6.2. INSTALLATIONS GENERALLY

Provide for and ensure the requirements of all the specialist electrical trades and services detailed in the specification and on the drawings are incorporated into the Work.

Install underground installations along the routes shown on the drawings. Co-ordinate the work with other trades and advise the Contract Administrator of any clashes with footings, piling and other underground service installations. Modify the route as instructed by the Contract Administrator to avoid clashes.

Where dimensioned, install underground installations in the nominated alignments, and in all cases maintain the clearances specified by Regulatory Authorities.

Where existing services are indicated to be re-located allow to modify and extend each of the individual cable or conduit system installations, including cable pits, in each route by 10m or 15% of the route length, whichever is the greater, at no extra cost to the Contract.

6.3. TRENCHING

Marking Out

Prior to commencing excavation, mark out all trenching routes for review by the Contract Administrator.

Provide one (1) working day minimum notice and allow sufficient time for the review to occur.

Excavation

Unless otherwise indicated, excavate trenches a minimum of 100mm below the depth required to provide the specified cover over cables or conduits.

Clear the bottom of all trenches of debris including rocks, stones and other hard and sharp materials.

Bedding

Prior to cable or enclosure placement, cover the bottom of the trench to a depth of at least 100mm with a base layer of selected clean sand filling.

Provide a minimum cover of 50mm of consolidated clean sand filling across the excavation over the top of the largest cable or conduit.

Backfill and Consolidation

Backfill materials shall be clean and free from stone, sharp objects and all fibrous and vegetable matter or other materials that may attract or be attacked by termites.

Backfill trenches in maximum layers of 150mm.

Mechanically consolidate and ram each layer of backfill to the compaction of surrounding adjacent material.

6.4. CONDUIT SYSTEMS

General

Underground conduit systems shall comprise the required number of continuous PVC conduits, and unless otherwise specified, with cable pits at changes of direction and every 50m in straight runs.

Communication conduits shall be white PVC manufactured in accordance with regulatory requirements pertaining to the type of electrical service. All other conduits shall be heavy duty, orange PVC conduit.

Liaise with the building trade and install conduits to the required locations.

Installation

Lay conduits evenly on the base bedding in an orderly fashion.

Lay continuous marker tape along the route of each separate electrical conduit run, above the conduit, overlapping 1000mm at joints.

Marker tape shall be orange PVC tape 150mm wide with black lettering - "Caution - buried electric cable below".

6.5. CABLE PITS

General

Provide standard size pits for use in the Works, which shall be the minimum size to comply with the associated cable manufacturer's minimum cable bending radii, the number and type of cables passing through the pits and accommodate any required equipment installed in the pits.

Provide the required number of conduit entries to each pit, via machine-drilled holes, correctly sized to the conduit dimensions.

Provide a drainage hole in the pit base, minimum size 25mm diameter.

Provide a concrete collar to every pit. The collar shall be in accordance with the pit manufacturer's recommendations.

Cable pits shall be ACO Plastic or Polymer Concrete or approved equivalent.

Selection

Unless otherwise specified, select pits and covers in accordance with the criteria scheduled hereunder.

Landscaped Areas: In garden and planted areas inaccessible to motor vehicles or any other type of motorised traffic, and subject to a maximum size of 560mm x 560mm, pits shall be high-density polyethylene and polymer concrete cover with a minimum loading of 10kN on the cover and pit structure.

Light Vehicular Traffic: In areas accessible to light motor vehicles, pits shall be polymer concrete and galvanised chequer plate cover, with a minimum loading of not less than 150kN on the cover and pit structure.

Heavy Traffic: In all other areas, designed to withstand the same loading as the surrounding road surface. Obtain advice and specialist design from the manufacturer.

Installation

Install cable pits parallel to building elements or landscape features, and with the pit cover flush and level with the adjacent finished surface areas.

Connect the drainage hole in the pit base by a PVC pipe to a suitable soak away.

Provide a label on each cable where the cable passes through a pit, identifying the circuit and point of supply.

6.6. DIRECT BURIED CABLES

Lay cables evenly on the base bedding in an orderly fashion.

Provide continuous mechanical protection above each direct buried cable installation comprising concrete slabs or Polymeric cable cover strip.

Lay continuous marker tape along the route of each separate electrical cable run, above the mechanical protection, overlapping 1000mm at joints. Marker Tape shall be orange PVC tape 150mm wide with black lettering - "Caution - buried electric cable below".

7. ACCESSORIES AND APPLIANCES

7.1. GENERAL

Supply and install all accessories, appliance connections and specified appliances, complete with required fastenings and fixings, detailed in the specification and as shown on the drawings.

Confirm the location of all accessories and appliances with the Contract Administrator prior to commencement of site installations.

Where directed by the Contract Administrator, re-locate any accessories or appliance 2 metres in any direction from the location shown on the drawing at no extra cost to the Contract. This requirement only applies where site work for the specific accessory or appliance has not commenced.

7.2. ACCESSORIES

General

Provide IPA stud markers for circuit identification to all accessories.

Provide accessories of flush mount design. Obtain approval for any surface mount installations.

Unless otherwise specified provide Clipsal 2000 Series or equal and approved. Where works are alterations or additions to existing buildings, accessories shall be of a type to match the existing unless otherwise specified.

Prior to ordering accessories, obtain an accessories colour schedule from the Contract Administrator with no cost variation for colours within the manufacturer's standard colour range. Make allowance for the manufacturer's ordering time.

Heights indicated on the drawings or specified herein are from the finished floor level to the centre of the equipment. Unless otherwise noted:

- Outlets (power, comms, etc.) to be installed 1350mm AFFL (unless on skirting duct).
- Outlets indicated as above bench to be at 150mm above the bench top.
- Light switches to be installed at 1350mm AFFL.

Confirm heights from Architectural room elevations prior to installation.

Lighting Switches

Unless otherwise specified use 15A rated rocker switches "Clipsal 30USM".

Provide multi switch positions ganged under one cover plate, arranged in ganged boxes similar in plan to the lighting points controlled. Where 6 or more light switches are indicated in a single location install a stainless steel light control panel.

Multi-gang stainless steel cover light control panels shall be Clipsal Stainless Steel B Series equipped with switch mechanisms with engraved identification. Fix cover plates to wall boxes using flush head countersunk stainless steel screws. Provide means of alignment and adjustment of the cover plate

Mount any switches from different phases on separate faceplates and segregate wall boxes by physical barriers.

Mount all lighting switches on the latch side of doors or as shown. Confirm the arrangement of all door swings before installation of any conduit or wall box.

Socket Outlets

Socket outlets shall have a minimum rating of 10amp 250volt. Single socket outlets shall be Clipsal 2000 series Cat No. 2015 and double sockets Clipsal 2000 series Cat No. 2025.

Engrave in 3mm high green filled lettering – "RCD Protected" on all GPO's connected a Residual Current Device.

Installation Generally

Install accessories in accordance with the methods listed below.

- Mount accessories located on hollow block, rendered brick or insitu concrete walls recessed in standard metal wall boxes, carefully cut in to produce a neat fit and securely mortared into position.

- Mount accessories located in furniture on lightweight stud walls or demountable partitions directly on the panelling using proprietary fixing brackets.
- Suitably insulate any accessories mounted on fixed furniture and mechanically protect at the rear.

Industrial Accessories

Unless otherwise specified all three-phase outlets shall be 5-pin IP56 type rated for 440volt.

Three-Phase outlets unless otherwise specified shall be complete with local RCD protection mounted in the same enclosure as the outlet.

Industrial accessories shall be Clipsal 56 series or equal and approved.

7.3. APPLIANCES

Provide all appliances internally wired and complete with control switches, controllers and connecting links.

Unless otherwise stated provide a lockable IP56 isolating switch adjacent all direct connected appliances and equipment.

A circuit for a fixed or stationary cooking appliance shall be provided with a functional switch, in accordance with AS/NZS 3000, mounted near the appliance in an accessible position.

Provide each three-phase appliance with a separate neutral and earth.

Check appliance loading immediately on all equipment arriving on site for its electrical loading and phase connections. Advise in writing where equipment is deemed to be unsuitable for connection to the designated building supply.

Install the final connection to any equipment installed away from, but within 600mm of, a wall or column in flexible PVC conduit. Where any equipment is located at greater than 600mm from the wall, provide cabling installed within concealed conduit, in-floor ducting cast into the slab or service pole.

8. LIGHTING

8.1. GENERAL

Scope of Works

Provide all luminaires complete with connecting leads, auxiliaries, lamps, light control devices and suspension gear. Determine quantities and types of each luminaire and associated equipment from the drawings and schedules.

Approved Manufacture

Provide light fittings and associated equipment of the precise manufacture, type and detail stated in the specification, or as shown on the drawings. Do not change the manufacture, type or detail of any light fittings without written approval.

Shop Drawings

Provide detailed 1:10 scale shop drawings of specific light fittings noted in the luminaire schedule, which are to be constructed to specific size requirements.

Samples

Supply and deliver to the Contract Administrator, a sample production fitting of each prototype and standard type of fitting to establish that the manufacturing process meets with the required standard of quality. Delivery of samples shall be made at the commencement of the contract to ensure that the review and approval does not affect the order and delivery to site of the luminaires.

Where prototypes are required to be submitted the prototypes should be sufficiently complete to give a clear indication of the final appearance and to determine its suitability for the required application with reference to the ceiling module, special location and similar details.

After approval has been given, deliver these samples to site where they will be held and used as a standard for acceptance or rejection of subsequent production fittings. Upon approval of the Contract Administrator, the sample fittings may subsequently be incorporated into the project.

8.2. LUMINAIRE DESIGN

General

All fittings where of standard or special manufacture shall be of sound thermal design with adequate ventilation.

Light fittings shall be guaranteed against faulty design, workmanship, materials and components for the Defects Liability Period. The guarantee shall cover the cost of all labour, transport and materials to rectify any such faults on site during the period of guarantee including the disconnection, removal and reinstallation of the fittings.

Standards

Provide luminaires of sound thermal and acoustic design with adequate ventilation complying with Australian Standard 3137 - Luminaires (lighting fittings).

Provide NATA type test certificates where and when required for approval to demonstrate compliance with the specified photometric requirements. Commence production only after approvals are given.

Cables

Cables and wiring entering ELV and High Intensity Discharge luminaires shall have a temperature rating not less than 95°C.

8.3. (LED) LIGHTING PRODUCTS

Provide LED light sources, modules and luminaires as follows:

- Supply of the above should be from a reputable LED luminaire manufacturer that publishes detailed product specifications that are measured in compliance with IEC and Australian Standards performance requirements IEC 60598/IEC 62031.
- C-Tick approval for EMC classification.
- Photometric performance equivalent to the published specification to be provided.

- All components including adhesives, sealants, gaskets, finish (paint), housing, control gear, electrical connections, PCB's, thermal management, optical and mechanical systems to be equivalent to the rated life of the light source and comply with Zhaga standards.
- Control gear matched for optimum performance.
- Correct power factor to not less than 0.85 lagging.
- Colour temperature tolerances beyond a 4-step MacAdam ellipse are considered unacceptable.
- Colour rendering index of 80+ as a minimum.
- Installation to be in an operational environment that is within the recommended operating temperatures of the manufacturer.

8.4. EMERGENCY EVACUATION LIGHTING

Supply and install all emergency and exit lighting in accordance with AS/NZS 2293 and as shown on the drawings and as specified in this section.

Power supply units shall be fully matched units and be capable of a 2-hour performance at a temperature of 60°C. Batteries and chargers shall be mounted in a stable thermal environment.

Provide dual rated battery charger for each luminaire.

Batteries: Provide sealed lithium-ion batteries suitable to 60°C operation.

Provide emergency lighting test switches within all distribution boards to check the discharge rate of all emergency evacuation luminaires.

Arrange cabling such that the operation of the test switches disconnects the normal supply from the lamps connected with emergency lighting packs. Other lamps connected in the circuit or luminaire shall remain in normal operation.

Approved Manufacture: Clevertronics

8.5. INSTALLATION

General

Install all fittings in an approved manner and as detailed and located on the drawings. Verify the exact locations of all luminaires with the architectural drawings prior to installation. Provide suspensions, brackets, timber battens, recessing frames and fixings necessary for the erection of fittings.

Examine light fittings on delivery for standard of workmanship and acceptability. Ensure every light fitting package delivered to site is clearly marked on the outside with the contents.

Just prior to the practical completion, thoroughly clean lamps, tubes, diffusers and reflectors and demonstrate that the fittings are in first class working order.

Any damage or soiling of fittings, diffusers and reflectors shall be made good to approval and without additional cost.

Recessed Fittings

Provide 1500mm of 3 core 0.75mm standard PVC/PVC flexible cable and 3 pin plug top to all recessed luminaires unless otherwise specified.

Provide all trimmed holes necessary for all recessed light fittings during the progress of work. Ensure that holes are correctly sized and located. Prior to the installation of ceilings mark out the exact locations of all recessed lights and ensure that they do not clash with ceiling obstructions or the structure. The height of recessed luminaires shall be checked by measurement from the floor level using a marked pole or similar.

Once this is completed the location shall be approved by the Contract Administrator. The locations shall then be transferred to the floor prior to the fitting of ceilings. The nominated Sub-Contractor shall be responsible for any costs associated with having to relocate light fittings due to these procedures not being carried out correctly.

Suspended Fittings

Suspended fittings supported by chains, stainless steel cable or rods shall be installed such that they hang in a level plane.

Where chain suspension is specified use cadmium plated welded link chains. Folded 'Jackchain' is not acceptable. Neatly clip flexible cable to the suspension chair from the ceiling rose to the light fittings. Ceiling roses shall not be installed greater than 130mm from the chain suspension point.

Where rod suspension is specified the rods shall be either galvanised threaded steel rods covered with PVC tubing to a colour to be advised, or hollow aluminium tubing painted to a colour to be advised. Where hollow tube is specified the sub-circuit cabling shall be concealed within the suspension rod.

Where light fittings are specified to be suspended from steel channel sections (eg. 'Unistrut') the whole suspension system shall be galvanised, etch primed, and painted to a colour to be advised.

Where wire suspensions are specified the cable shall be stainless steel sized to accommodate the luminaire weight and be complete with all anchor and luminaire fixings.

Aiming

Where luminaires have adjustable aiming angles, allow for aiming adjustments including at night to all luminaires at the completion of the project to the complete satisfaction of the Contract Administrator.

9. INTRUDER DETECTION SYSTEM

9.1. GENERAL

Scope of Work

Design, supply, install, test and commission an Intruder Detection System as specified herein and shown in the drawings. The work includes, but is not limited to, the items listed below.

- Alarm System Control Equipment.
- Power and control cabling, cable enclosures and supports.
- Programming and commissioning.
- Training of staff in the use of the systems.

Approved Trade

The Intruder Detection System installation shall be carried out by a licensed security trade with experience in this type of work.

Approved Manufacture

Tecom Challenger or approved equivalent.

Shop Drawings

Provide the following minimum details:

- General arrangement of each equipment location showing panel layout and dimensions.
- Single line diagram of the overall system showing all components and interfaces.
- Location of power supplies.

Manuals

The following information shall be included:

- Block diagrams shall show the interconnection between major pieces of equipment.
- Circuit diagrams.
- Layout diagrams, which shall indicate the location of major pieces of equipment and the location of each component within each piece of equipment.
- Where pieces of equipment or parts of equipment are identifiable by Model Numbers, those numbers with the make shall be stated.
- A complete component list, listing all components with their appropriate ratings and/or part number, shall be given.
- An operational description of each circuit shall be given.
- Operating instructions, which shall clearly set out the operation of each piece of equipment.

9.2. SITE SECURITY SYSTEM

The site security system shall comprise of a distributed arrangement of standalone panels linked by a LAN network to a headend controller. Each panel shall support the functions detailed herein or as shown on the drawings.

The headend Controller shall incorporate the following functions:

- Provide supervisor of all network cabling.
- Include Multipath IP or GPRS auto dial out facility to offsite monitoring.
- Provision for secure remote access to the system.

Each panel shall incorporate the following features:

- Mains power supply with battery backup.
- Support monitored alarm circuits.

- Support output relays for integration with other systems.
- Expandable to support the total site development.

Off Site Monitoring

Connect the system to an offsite monitoring centre via NBN network and include for a 12-month monitoring contract with a quotation for a further 12 months contract. Confirm this requirement with the Client prior to ordering and Commissioning.

9.3. ALARM SYSTEM

Design Criteria

Provide an Alarm System arranged to provide intruder detection to the areas indicated on the drawings.

The system shall include, but is not limited to, the following:

- Data gathering panels.
- Movement detectors.
- Door reed switches.
- Glass break detectors.
- Arm and disarm stations.
- Smoke and Thermal Detection.
- Tamper switches.

Alarms

Arrange for the following alarm conditions described to be transmitted to the monitoring station.

- Activation of movement detector on glass break detector in an armed area.
- Forced entry.
- Tamper alarm.
- Duress Condition: Activation of the relevant device.

9.4. EQUIPMENT

General

All equipment shall comply with the following general criteria:

- Operate in ambient temperatures from 0°C to 50°C.
- Cooling shall be by natural ventilation.
- Weatherproof in exposed locations.
- Interconnections between equipment and internal modules shall be plug-in type.

Switch contacts shall be rated by the component manufacturer for 100,000 operations at the installed operating current.

Relay coils shall be suitable for operation from their respective supply voltage + 20%-25% in the battery power equipment and + 15% in mains only powered equipment.

Indication lamps shall be LED.

Power Supplies

Panels shall be designed for operation from 240 volt \pm 6% 50Hz mains. All control circuitry shall operate from a DC voltage derived from the mains. This DC voltage shall be battery supported via fully sealed lead acid batteries with sufficient capacity to maintain full operation of the system for at least 12 hours after mains failure.

The batteries shall be maintained in a fully recharging battery from fully discharged conditions, in not more than 24 hours.

The date of installation of the battery shall be clearly and indelibly marked on the body of the battery.
The changeover to battery operations shall be completely automatic without initiation of an alarm signal.
Exposed plug-in step-down transformers are not acceptable.

Movement Detectors

Movement detectors shall be of an approved passive infrared type with integral LED.

The passive infrared detection range shall not decrease as room temperature nears body temperature.

The detection pattern shall be designed to cover all areas.

The detection sensitivity shall be adjustable.

The motion sensor shall signal an alarm when its alarm relay is de-energised (NC). Tamper switch shall be closed when the equipment is fully assembled.

An alarm-indicating LED on the sensor shall be capable of being disabled, but shall indicate trouble by flashing, even when disabled.

Arm & Disarm Stations

Install arm/disarm station shall be by an LCD alphanumeric type caption of showing alarm and systems status. The keypads shall be a durable construction for user code entry.

Door Contact/Detectors

Install magnetic reed switches to doors at locations indicated on the drawings and complying with the following.

- Where a reed switch is nominated and there are double doors, fit a reed switch to each door and wire them in series on one zone.
- Be fully sealed reed contact type.
- Operate with a door gap of 50mm or less.
- Be end of line monitored.

Door contacts and associated cabling shall be built into doorframes and concealed, co-ordinate installation with other trades.

Monitoring Station Requirements

Prior to the system being connected to the monitoring station provide:

- A comprehensive alarm zone list indicating alarm point number, area covered by relevant alarm point and tamper circuit alarm point allocation as per the Alarm Zone Listing Report.

Interface to the Intelligent Lighting Control System

Provide an interface to the Intelligent Lighting Control System so that when the security system is armed, lighting is turned off to the associated security zone lighting area.

9.5. INSTALLATION

Site Equipment

Install power supplies, panels and other auxiliary components in the communication services cupboard.

All components shall be readily accessible for service and maintenance.

Cabling

Include all site cabling and internal cabling.

Every attempt shall be made to ensure that bend radii are not less than twenty (20X) times the cable diameter, and under no circumstances shall the manufacturers minimum bend radius be violated.

All cable shall run continuously between components of the system. No joints, splices or intermediate connections shall be permitted.

Cable ends left exposed shall be sealed or taped where protected from weather. Where potentially exposed to moisture take-up, ends shall be sealed with Raychem caps 102L022 (RG1), or equal approved.

A minimum of 150mm tails shall be left for cut-off before all termination.

9.6. TESTING & COMMISSIONING

Testing

Test the complete system in the presence of the Contract Administrator and provide all equipment necessary to perform the following tests.

- Test all alarm and control functions.
- Check system operation in power fail mode.
- Check tamper circuit operation.
- Dynamic battery testing.

Commissioning

Commissioning of the system shall be carried out as soon as possible after the completion and testing of the installation. Commissioning will consist of:

- Final inspection of the complete installation.
- Confirmation of all items tested and recorded in the test schedule.
- Training of 5 client representatives in the use of the systems.

INFORMATION TO ELECTRICAL TENDERERS

Tenders

Tenders shall be submitted in duplicate and shall contain sufficient information pertaining to the principal items of equipment as may be necessary for proper evaluation of the tender submitted. Incomplete and/or incorrect data supplied by the Tenderer shall not relieve the obligation to complete the works fully in accordance with the tender documents.

Tenderers shall quote strictly in accordance with the tender documents and shall submit prices on a Fixed Lump Sum basis not subject to Rise and Fall.

The Purchaser and the Consulting Engineer shall not be obliged to accept the lowest or any tender and shall not be responsible for any expenses or losses which may be incurred by the Tenderers in the preparation and submission of their tenders.

Tender Form

Two copies of the attached "Tender Form" and "Schedules of Technical Data", completed by the Tenderer, shall be submitted with the tender. Schedules not completed may result in a tender being considered informal and being rejected without further analysis.

Site

Tenderers are required to make themselves fully aware of the nature of the project, site conditions and all other aspects that may influence their tender submission.

Selection of a Tender

Evaluation and selection of a tender (or tenders as the case may be) will be based on:

- Ability to comply with the technical requirements of the specification.
- Agreement to comply with conditions of contract.
- Ability to meet target construction dates.
- Submission of competitive quotations.
- Previous experience.
- Present commitments.

Addenda

Tenderers shall also state in their tender that they have received and allowed for any Addenda that has been issued during the tendering period and shall name each addendum.

Alternative Tenders

The Tenderers shall submit alternative tenders for separate portions of the works as requested on the "Tender Form".



**BCA CONSULTANTS
CONSULTING ENGINEERS
BROOKTON RAILWAY STATION REFURBISHMENT
ELECTRICAL SERVICES**

Sheet 1 of 2

TENDER FORM

Job No. 230722

We, the undersigned, hereby tender to carry out the complete Electrical Services works for the Brookton Railway Station Refurbishment project in accordance with the specification and drawings for the sum set out hereunder.

1. Tender Sum:

• Preliminaries and Setting Up	\$	
• Testing and Commissioning	\$	
• Manuals	\$	
• Training	\$	
• Site Main Switchboard	\$	
• Building Distribution Board	\$	
• LV Submains	\$	
• LV Reticulation & Distribution including Accessories & Appliance connections	\$	
• Supply of Interior Luminaires including Emergency & Exit	\$	
• Installation of Interior Luminaires	\$	
• Supply of Exterior Luminaires	\$	
• Installation of Exterior Luminaires including All Associated Civic Work	\$	
• Security System	\$	
• Smoke & Thermal Detectors (connected to Security System)	\$	
Tender Sum (exc. GST)	\$	
Tender Sum (incl. GST)	\$	

All of the above prices to be Fixed Lump Sum, NOT subject to Rise and Fall.

NOTE: This form **must** be submitted in duplicate.

Dated this _____ day of _____ 2024

Signature of Tenderer _____

Company _____

Address _____



2. Variations

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.....
.....

3. Addendum

We acknowledge the receipt and inclusion of the following addenda in our tender submission.

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NOTE: This form **must** be submitted in duplicate.

Dated this day of 2024

Signature of Tenderer

Company

Address

.....