# TUMUT MULTIPURPOSE AND EVACUATION CENTRE

# ELECTRICAL SERVICES

# SPECIFICATION


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## SUBSECTION A GENERAL REQUIREMENTS

## 1 GENERAL

### 1.1 GENERAL

**Precedence**

Requirements of individual technical sections of the specification override conflicting requirements in this section.

### 1.2 REFERENCED DOCUMENTS

**Current editions**

Use referenced documents which are editions, with amendments, current 3 months before the closing date for tenders, except where other editions or amendments are required by statutory authorities.

**Contractual relationships**

Responsibilities and duties of the principal, contractor and superintendent are not altered by requirements in referenced documents.

**General standards**

Electrical work: To AS 3000.

Degree of protection: To AS 1939.

Emergency & exit lighting: To AS 2293.

Cables: To AS 3008

Lighting: To AS 1680

Fire Detection and BOWS : To AS 1670.1

Switchboards: To AS/NZS 61439.

Telecommunications: AS3080 and AS 3084.

Building Code of Australia 2022 Amdt No 1

Local Supply Authority Services and Installation Rules.

### 1.3 INTERPRETATIONS

**General**

Unless the context otherwise requires, the following definitions apply:

- Supply: "Supply", "furnish" and similar expressions mean "supply only".
- Install: "Install", "fix" and similar expressions mean "install only".
- Provide: "Provide" and similar expressions mean "supply and install".

- Approved: "Approved", "reviewed", "directed", "rejected", "endorsed" and similar expressions mean "approved (reviewed, directed, rejected, endorsed) in writing by the superintendent".

- Give notice: "Give notice", "submit", "advise", "inform" and similar expressions mean "give notice (submit, advise, inform) in writing to the Superintendent".

- Obtain: "Obtain", "seek" and similar expressions mean "obtain (seek) in writing from the superintendent".

- Proprietary: "Proprietary" mean identifiable by naming manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.

- Samples: Includes samples, prototypes and sample panels.

**Tests**
Except where otherwise defined in referenced documents, the following definitions apply:

- Pre-completion tests: Tests carried out before completion tests.

  . Type tests: Tests carried out on an item identical with a production item, before delivery to the site.

  . Site tests: Tests carried out on site.

- Completion tests: Acceptance tests and final tests.

  . Acceptance tests: Tests carried out on completed installations or systems and, except for final tests, before the date for practical completion, to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements.

  . Final tests: Acceptance tests carried out before completion of the maintenance period.

**Maintenance period**
Co-extensive with the defects liability period.

## 1.4 CONTRACT DOCUMENTS

**General**
Diagrammatic layouts: Layouts of service lines, plant and equipment shown on the drawings are diagrammatic only, except where figured dimensions are provided or calculable. Before commencing work, obtain measurements and other necessary information from site or Architectural drawings.

## 1.5 DESIGN

**Space requirements**
Check space requirements of equipment and services indicated diagrammatically in the contract documents. All equipment shall be designed and manufactured to suit the space allocated.

**Electrical supply system**
415 V, 3-phase, 4-wire, 50 Hz. Maximum prospective fault level is 30KA at the Main switchboard or as advised by the Supply Authority.

**Radio frequency interference**
Use equipment which generates interference within limits set by AS/NZS 1044. If necessary, provide suppression devices. If appropriate, shield equipment to AS/NZS 1044.

**Electromagnetic compatibility**
Electrical and electronic apparatus: To AS/NZS 4251.1 and AS/NZS 4252.1.

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

## 2 QUALITY

### 2.1 INSPECTION

**Notice**
General: If notice of inspection is to be given in respect of parts of the works, do not conceal those parts without approval.

Minimum notice for inspections to be made: 4 hours for on-site inspectors, otherwise 2 working days.

### 2.2 TESTS

**Notice**
General: Give sufficient notice so that designated tests may be witnessed. Do not carry out designated tests without approval.
Minimum notice for tests to be witnessed:

- 5 working days for site tests; and
- 10 working days for local pre-delivery tests.

**Testing authorities**
General: Except for site tests, have tests carried out by authorities accredited by NATA to test in the relevant field, or an organisation outside Australia recognised by NATA through a mutual recognition agreement. Co-operate as required with testing authorities.

The Contractor shall make all arrangements to have the total installation inspected by the local Authorities having jurisdiction over the works (ie: Supply Authority, NBN Co etc) and attend to all notices served by such Authorities complete with the payment of all fees, charges, levies etc as required.

Site tests: Use instruments regularly calibrated by authorities accredited by NATA.

**Reports**
General: Submit copies of test reports, including certificates for type tests, showing the observations and results of tests and compliance or non-compliance with requirements.

**Endorsement**
If tests are to be carried out on parts of the works, do not conceal those parts and do not commence further work on those parts until the tests have been satisfactorily completed and compliance verified.

## 2.3 SAMPLES

The Contractor shall submit the following samples or manufacturers technical data sheets for approval by the Superintendent:

- all light fittings;
- all service outlets and switches;
- emergency lights and exit signs;
- security system peripheral devices (reeds, etc)
- infra-red motion detectors
- Smoke and Thermal Detectors
- BOWS speakers and Visual Alarm Devices
- CCTV Cameras

**Timing**
Delays: Co-ordinate submissions of related samples. Do not cause delays by making late submissions or submitting inadequate samples.

**Quantity**
General: Submit a sample of each designated item and 2 copies of supporting documentation. Include ancillary items such as fasteners, flashings and seals.

**Identification**
Identify the project, contractor, subcontractor or supplier, manufacturer, applicable product, model number and options, as appropriate and include pertinent contract document references. Include service connection requirements and product certification. Identify non-compliances with project requirements, and characteristics which may be detrimental to successful performance of the completed work.

**Approval**
General: Do not commence work affected by samples until the samples have been approved by Superintendent. Submit further samples as necessary.

**Retention**
Keep approved samples in good condition on site, until practical completion.

**Incorporation**

Incorporate in the works samples which have been approved for incorporation. Do not incorporate other samples.

**Criteria**
Match approved samples throughout the works.

## 2.4 CONTRACTOR'S SUBMISSIONS

**Timing**
General: Submit documents in a timely manner, to suit the construction program. Advise if any of the documents are to be returned.

Delays: Co-ordinate submissions of related items. Do not cause delays by making late or inadequate submissions.

**Quantity**
Bound documents: 3 copies.

**Identification**
Identify the project, contractor, subcontractor or supplier, manufacturer, applicable product, model number and options, as appropriate and include pertinent contract document references. Include service connection requirements
and product certification. Identify non-compliances with project requirements, and characteristics which may be detrimental to successful performance of the completed work.

**Endorsement**
General: Do not commence work affected by contractor's submissions until, if appropriate, the submissions have been endorsed as satisfactory,
Errors: If a document contains errors, submit a new or amended document as appropriate, indicating changes since the previous submission.

**Design**
General: Submit all design documents showing the layout and details of the installation.

Variation documents: If it is proposed to change the installation from that shown on the design documents, or if changes are required by statutory authorities, submit variation documents showing the proposed changes.

**Shop drawings**
General: Submit dimensioned drawings showing details of the fabrication and installation of all designed services and equipment, including relationship to building structure and other services, cable type and size, and marking details.

The Contractor shall submit the following shop drawings for approval by the Superintendent:

- Main switchboard
- Distribution boards;
- telecommunications system schematics;

- security system schematics;
- Fire Detection & BOWS system schematics;
- CCTV system schematics;

**Authorities**
Correspondence: Submit copies of correspondence and notes of meetings with authorities.

Authorities' approvals: Submit documents showing approval of the authorities whose requirements apply to the work.

**Tests**
Tests program: Submit a testing and commissioning program which is consistent with the construction program. Include particulars of test stages and procedures.

Test records: For designated tests, including pre-delivery tests, record results and submits reports or certificates in a form suitable for inclusion in operation and maintenance manuals.

**Materials and components**
Product data: For proprietary equipment, submit the manufacturers product data including

- technical specifications and drawings;
- type test reports;
- performance and rating tables; and
- recommendations for installation and maintenance.

Proposed products schedules: For major products not specified as proprietary items, within 3 weeks of site possession submit a schedule of those proposed for use.

Product certification: If products must comply with product certification schemes, submit evidence of compliance.

**Installation**
Fixing of services: Submit typical details of locations, types and methods of fixing of services to structure, before installation.

Embedded services: Submit proposals for embedding services in concrete walls or floors, or chasing into concrete or masonry walls.

Inaccessible services: If services are to be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.

## 3 MATERIALS AND COMPONENTS

### 3.1 GENERAL

**Proprietary items**
Implication: If provided in design documents identification of a proprietary item does not necessarily imply exclusive preference for the item so identified, but indicates the necessary properties of the item. The Contractor is at liberty to utilise an approved equivalent product, if approved by Superintendent.

Alternatives: If alternatives are proposed, submit proposed alternatives and include samples, available technical information, reasons for proposed substitutions and cost. If necessary, provide an English translation. State if use of proposed alternatives will necessitate alteration to other parts of the works and advise consequent costs.

**Manufacturers' or suppliers' recommendations**
General: Select, and transport, deliver, store, handle, protect, finish, adjust, prepare for use, and use manufactured items in accordance with the current written recommendations and instructions of the manufacturer or supplier.

Instructions: Submit the recommendations and instructions, and advise of conflicts with other requirements.

Project modifications: Advise of activities that supplement, or are contrary to, manufacturers or suppliers' written recommendations and instructions.

Product certification: If products must comply with product certification schemes, use them in accordance with the certification requirements.

**Sealed containers**
If materials or products are supplied by the manufacturer in closed or sealed containers or packages, bring the materials or products to point of use in the original containers or packages.

**Consistency**
For the whole quantity of each material or product use the same manufacturer or source and provide consistent type, size, quality and appearance.

## 3.2 FACTORY FINISHES

**Joint finishing**
Finish visible joints made by welding, brazing or soldering using methods appropriate to the class of work (including grinding or buffing) before further treatment such as painting, galvanising or electroplating.

**Preparation for coating**
General: Before applying coatings to metalwork, complete cutting, drilling and other fabrication, and prepare surfaces to AS 1627.

**Galvanising**
General: To AS 1650.

Minimum coating class: Z200.

Coating type for wire: Type A.

**Thermoset powder coating**

Preparation: Use chemical pretreatments. If recommended, provide conversion coatings.

Internal use: To GPC P-155/1 or 4.

External use: To GPC P-155/2 or 5.
Finish: Full gloss.

**Equipment paint system**
Brush or spray application using paint to GPC specifications as follows:
- Prime coat to metal surfaces generally: P-32 or P-162.

- Prime coat to zinc-coated steel: P-13/4 or P-13/5.

- Undercoat: U-23.

- Full gloss enamel finish coats, oil and petrol resistant: E-24, two coats.

**Two-pack liquid coating**
Primer: Two-pack epoxy primer to GPC C-29/7.

Topcoat:
- Internal use: Proprietary polyurethane or epoxy acrylic system.

- External use: Proprietary polyurethane system.

Application: Spray.

Finish: Full gloss.

**Air-drying enamel**
Internal use:

- Primer: Two-pack epoxy primer to GPC C-29/7.

- Topcoats: 2 coats to GPC E-15/3.

Application: Spray or brush.

Finish: Full gloss.

**Stoving enamel**
Internal use:
- Primer: To GPC P-65.

- Topcoat: To GPC E-66/3.

Application: Spray or dip.

# 4 INSTALLATION

## 4.1 GENERAL

**Installation**
General: Install equipment and services plumb, fix securely and organise reticulated services neatly. Provide for movement in both structure and services. The Contractor shall be responsible for the design of equipment such that it fits within the space designated.

Arrangement: Arrange services so that services running together are parallel with each other and with adjacent building elements. Under suspended ground floors, keep services at least 150 mm clear above ground surface, additional to insulation, and ensure access is not impeded.

Lifting: Provide permanent fixtures attached to the equipment, for lifting heavy items of equipment, as recommended by the manufacturer.

## 4.2 SERVICES CONNECTIONS

**Statutory authorities' requirements**
If the authorities elect to perform or supply part of the works, make the necessary arrangements. Install equipment supplied, but not installed, by the authorities. Pay all fees as necessary associated with such works.

**Connections**
Connect to statutory authorities' services or service points. Excavate to locate and expose connection points. On completion reinstate the surfaces and facilities which have been disturbed.

## 4.3 SYSTEM INTEGRATION

**General**
Interconnect system elements so that the installations perform their designated functions.

## 4.4 WIRING

**General**
Concealed wiring: Conceal wiring runs, except within plant areas. Install concealed wiring so that it can be rewired easily and without damage to finishes or materials.

## 4.5 BUILDING PENETRATIONS

**Piping sleeves**
General: Provide metal or UPVC sleeves formed from pipe sections, for penetrations through building elements.

Sleeve diameter (for non fire-rated building elements): Sufficient to provide an annular space around the service of at least 12-mm.

Minimum sleeve thickness:
- Metal: 1 mm.

- UPVC: 3 mm.

Sleeve terminations:

- If cover plates are fitted: Flush with the finished building surface.
- In floors draining to floor wastes: 50 mm above finished floor.

- In fire-rated and acoustic-rated building elements: 50 mm beyond finished building surface.

- Elsewhere: 5 mm beyond finished building surface.

Finish: Prime paint ferrous surfaces.

**Cable sleeves**
Provide UPVC sleeves formed from pipe sections, for penetrations through ground floor slabs and beams and external walls by cables not enclosed in conduit. In addition, for MIMS cables, provide sleeves for penetrations through masonry.
**Fire rated building elements**
Seal penetrations using a system to AS 4072.1.

**Non-fire rated building elements**
Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is acoustic rated, maintain the rating.

**Limitations**
General: Do not penetrate or fix to the following without approval:

- Structural building elements including external walls, fire walls, floor slabs and beams.

- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings.

Membranes: If approval is given to penetrate membranes, provide a waterproof seal between the membrane and the penetrating component.

## 4.6 FIXING

**General**
If equipment and services are not suitable for fixing to non-structural building elements, fix directly to structure and trim around holes or penetrations in non-structural elements.
**Fasteners**
Use proprietary fasteners capable of transmitting the loads imposed, and sufficient to ensure the rigidity of the assembly.

## 4.7 LABELLING

**General**
General: Label all equipment, electrical wiring, conduits and ducts, to provide a ready means of identification.
Conduits and ducts: To AS 1345, as applicable.

**Labels**
The Contractor shall allow for the labelling of all items of electrical equipment throughout the installation to the approval of the Superintendent. Equipment shall include all general purpose outlets, permanent connections, light switches, telecommunication outlets, circuit breakers, contactors etc.

Labelling of standard bakelite outlets and switches shall be in the form of typed adhesive type labels unless noted otherwise on the drawings or within this specification. All other equipment, switchboards etc shall be engraved traffolyte labelling.

Bakelite labelling (ie: GPO's etc) shall clearly identify the origin DB of the subcircuit plus its circuit breaker number.

The Contractor shall submit details of the labelling method to the Superintendent for approval prior to proceeding.

**Minimum lettering heights**
Equipment nameplates: 40 mm.

Warning notices: 7 mm.

Automatic controls and electrical equipment: 5 mm.
Isolating switches: 5 mm.

Inside electrical enclosures: 3.5 mm.

Other: 3 mm.
**Location**
General: Locate labels so that they are easily seen and are either attached to, below or next to the item being marked.

Exposed locations: Use durable materials.

**Fixing**
General: Use mechanical fixing. Do not penetrate vapour barriers.

**Contents**
General: Match terminology of work-as-executed drawings.

**Electrical**
Mark operable control devices, indicators, isolating switches and outlets to provide a ready means of identification.

## 5 COMPLETION

### 5.1 GENERAL

**Contractor's submissions**
Within 2 weeks after practical completion, submit 3 copies of designated documents.

**Warranties**
General: Name the principal as warrantee. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

Commencement: Commence warranty periods at practical completion or at acceptance of installation, if acceptance is not concurrent with practical completion.

Approval of installer: If installation is not by manufacturer, and product warranty is conditional on the manufacturer's approval of the installer, submit the manufacturers written approval of the installing firm.

## 5.2 RECORD DRAWINGS

### General

Submit record drawings. Show dimensions, types and location of equipment, cables, conduits and cable ducts in relation to permanent site features and other underground services. Show the "as installed" locations of building elements, plant and equipment. Show off-the-grid dimensions where applicable. Include relationship to building structure and other services, and changes made during commissioning and the maintenance period. Include diagrammatic drawings of each system showing wiring, and principal items of equipment.

### Format

Use the same borders and title block as the contract drawings.

## 5.3 OPERATION AND MAINTENANCE MANUALS

### General

General: Submit operation and maintenance manuals for the installation.

Authors and compilers: Use personnel experienced in the maintenance and operation of equipment and systems installed, and with editorial ability.

Subdivision: By installation or system, depending on project size.
Referenced documents: If referenced documents or technical sections require that manuals be submitted, include corresponding material in the operation and maintenance manuals.

### Format

A4 size loose leaf, in commercial quality, 4 ring binders with hard covers, each indexed, divided and titled. Include the following features:

- Pagination: Number pages consecutively.

- Cover: Identify each binder with typed or printed title "*OPERATION AND MAINTENANCE MANUAL*", to spine. Identify title of project, volume number, volume subject matter, and date of issue.

- Ring size: 50 mm maximum, with compressor bars.

- Text: Manufacturers' printed data, including associated diagrams, or typewritten, single-sided on bond paper, in clear concise English.

- Dividers: Durable divider for each separate element, with typed description of system and major equipment components. Clearly print short titles under laminated plastic tabs.

- Drawings: Fold drawings to A4 size and accommodate them in the binders so that they may be unfolded without being detached from the rings. Provide with reinforced punched binder tabs.

### Contents

Include the following:

- Drawings and technical data: As necessary for the efficient operation and maintenance of the installation.

- Table of contents: For each volume. Title to match cover.

- Directory: Names, addresses, and telephone and facsimile numbers of principal consultant, subconsultants, contractor, subcontractors and names of responsible parties.

- Installation description: General description of installation.

- Systems descriptions: Technical description of the systems installed, written to ensure that the principal's staff fully understand the scope and facilities provided. Identify function, normal operating characteristics, and limiting conditions.

- Systems performance: Technical description of the mode of operation of the systems installed.

- Equipment descriptions:

  . Name, address and telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers.

  . Schedules (system by system) of equipment, stating locations, duties, performance figures and dates of manufacture. Provide a unique code number cross-referenced to the record and diagrammatic drawings and schedules, including spare parts schedule, for each item of equipment installed.

  . Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation.

  . Supplements to product data to illustrate relations of component parts. Include typed text as necessary.

- Operation procedures:

  . Manufacturer's technical literature as appropriate.

  . Safe starting up, running-in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure.

  . Control sequences and flow diagrams for systems installed.

  . Legend for colour-coded services.

  . Schedules of fixed and variable equipment settings established during commissioning and maintenance.

- Maintenance procedures:

  . Manufacturer's technical literature as appropriate. Register with manufacturer as necessary. Retain copies delivered with equipment.

. Detailed recommendations for preventative maintenance frequency and procedures which should be adopted by the principal to ensure the most efficient operation of the systems installed.

. Safe trouble-shooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, balancing and checking procedures. Provide logical step-by-step sequence of instructions for each procedure.

. Schedule of spares recommended to be held on site, being those items subject to wear or deterioration and which may involve the principal in extended deliveries when replacements are required. Include complete nomenclature and model numbers, and local sources of supply.

. Schedule of normal consumable items, local sources of supply, and expected replacement intervals up to a running time of 40,000 hours. Include lubricant and lubrication schedules for equipment.

. Instructions for use of tools and testing equipment.

. Emergency procedures, including telephone numbers for emergency services, and procedures for fault finding.

- Certificates:

. Copies of manufacturers' warranties.

. Certificates from authorities.

. Product certification.

. Copies of test certificates for the mechanical installation and equipment used in the installation.

. Test and balancing reports.

- Drawings:

. Record drawings, full size.

. Switchgear and controlgear assembly circuit schedules including electrical service characteristics, controls and communications.

**Timing and quantity**

Draft manuals: Submit 2 draft manuals 8 weeks before the date for practical completion to enable the principal's staff to familiarise themselves with the installation. Include provisional record drawings and preliminary performance data.

- Format: As for the final manuals, with temporary insertions for items which cannot be finalised until the installation is commissioned and tested.

Revised draft manuals: Submit revised draft manuals 2 weeks before commissioning.

Final drafts: Submit for review after completion of commissioning and no later than 2 weeks before the date for practical completion. If available, include certificates from authorities, and warranties.

Final copies: Submit 1 complete hard copy set and an electronic copy (in pdf) of final volumes within 2 weeks after practical completion. Incorporate feedback from review and from training of principal's staff, including preparation and insertion of additional data.

## 5.4 TRAINING

### General

Operation and maintenance manuals: Use items and procedures listed in the final draft operation and maintenance manuals as the basis for instruction. Review contents with the principal's staff in detail.
Format: Conduct training at agreed time, at system or equipment location.

### Operation

Immediately after practical completion, explain and demonstrate to the principal the purpose, function and operation of the installations.

### Maintenance

Immediately after practical completion, explain and demonstrate to the principal the purpose, function and maintenance of the installations.

### Demonstrators

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

## 5.5 SPARES

### General

Schedule: At least 8 weeks before the date for practical completion, submit a schedule of spare parts necessary for maintenance of the installation. State against each item the recommended quantity, and the manufacturer’s current price, including for

- packaging and delivery to site
- checking receipt, marking and numbering in accordance with the spare parts schedule
- referencing equipment schedules in the operation and maintenance manuals and
- painting, greasing and packing to prevent deterioration during storage.

### Cables

At each ceiling-mounted accessory, provide 2m spare cable attached to the accessory.

## 5.6 COMMISSIONING

### Reports

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

**Notice**
Give sufficient notice for inspection to be made of the commissioning of the installation.

**Starting up**
General: Co-ordinate schedules for starting up of various systems and equipment. Give 5 working days notice before starting up each item.

Checks: Before starting, verify that each piece of equipment has been checked for control sequence, circuit protection or for other conditions which may cause damage.

Tests: Verify that tests, meter readings, and specified electrical characteristics agree with those required by the manufacturer.

Wiring: Verify wiring and support components for equipment are complete and tested.
Manufacturers' representatives: Have authorised manufacturers' representatives present on site to inspect, check, and approve equipment or system installation prior to starting up, and to supervise placing equipment and operation.

Report: Submit a report demonstrating that equipment has been properly installed and is functioning correctly.

**Circuit protection**
Confirm that circuit protective devices are sized and adjusted to protect installed circuits.

## 5.7 COMPLETION TESTS

**General**
Carry out acceptance tests and final tests.

**Functional checks**
Carry out functional and operational checks on energised equipment and circuits and make adjustments for the correct operation of safety devices.

Residual current devices: Verify earth leakage tripping times and currents.

## 5.8 CLEANING

**General**
At practical completion, clean the following:

- Luminaires. Relamp luminaires used during construction.
- Insides of switchgear and controlgear assemblies.
- Switchgear and contactors, and other electrical contacts. Adjust as necessary.
- Electrical and communication cupboards.
- Inside all cable pits.

## 5.9 MAINTENANCE

**General**

General: During the maintenance period, carry out periodic inspections and maintenance work as recommended by manufacturers of supplied equipment, and promptly rectify faults.

Emergencies: Attend emergency calls promptly.

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

**Site control**
Report to the principal's designated representative on arriving at and before leaving the site.

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

Number of pages: The greater of 100 pages or enough pages for the maintenance period and a further 12 months.
Certificates: Include test and approval certificates.

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

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

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

## 6. SCOPE OF WORKS AND DRAWINGS

### 6.1 GENERAL

The work to be carried out under or in relation to this Contract is as set out below, and as may be further described elsewhere in this Specification and associated drawings.

All work and materials not specifically mentioned in this Specification but obviously necessary for the proper and complete installation and operation of the services, as envisaged in this Contract, shall be deemed to have been included in the tender.

Tenderers are referred to site for all local information required in the preparation of their tenders. They must satisfy themselves as to any work involved and the nature and extent of all work to be done. No extras shall be allowed for necessary work unforeseen by the Contractor through not having visited the site.

Unless specified otherwise all equipment and materials installed under this Contract shall be new.

The Contractor shall co-ordinate the specified work with other services and trades.
The work covered by this specification comprises the supply, installation, commissioning, testing, placing into service, warranty on installation, and maintenance of the electrical services and shall include but not be restricted to the following:

- Main Switchboard;
- Distribution Boards ;
- Supply Authority metering provisions
- Submains;
- Light fittings,
- Emergency & Exit Lighting;
- Lighting Control & Dimming provisions (Intelligent Lighting Control system);
- Addressable Fire Detection and combined BOWS System;
- Telecommunications system;
- PV system and battery storage system
- Earthing provisions
- Security System & Access control;
- IP CCTV System;
- Power supplies to Hydraulic, Mechanical & Catering services;
- Power supplies and switching controls to Sports Hall Electric Heaters
- Power outlets and permanent connections along with sub-circuit cabling;
- Temporary Generator Connection provisions
- Underground pits and conduits;
- Cable ducting, Cable tray and other cable management provisions
- 12 months Maintenance and Defects Liability warranty;

- Testing commissioning of all systems installed under this contract;
- Workshop drawings and "As Installed" drawings in Auto CAD format Release 2022;
- Preparation of submission of operating and maintenance manuals;
- All other minor works as described elsewhere in this specification or as indicated on the drawings.

## 6.2 DRAWINGS

Drawings associated with this electrical installation and to supplement this specification are as follows:

| | |
|---|---|
| E- 00 | Legend & Cover Sheet |
| E- 01 | Lighting & Dry Fire Detection Layouts – Sheet No 1 |
| E- 02 | Lighting & Dry Fire Detection Layouts – Sheet No 2 |
| E- 03 | Power, Communications & Security Layouts – Sheet No 1 |
| E- 04 | Power, Communications & Security Layouts – Sheet No 2 |
| E- 05 | Electrical Details – Sheet No 1 |
| E- 200 | Site Services & Carpark Lighting Layout |
| E- 300 | Main Switchboard Single Line Diagram |
| E- 301 | Telecommunications Schematic |
| E-302 | Distribution Boards Schematics |
| E-303 | Distribution Board Schematics & Typical Details |
| E-304 | Photovoltaic System General Schematic |

**Temporary provisions and demolition works**

All redundant equipment and cabling used for the temporary construction works shall be removed at the completion of the works by the contractor.

The contractor shall be responsible for the safe disconnection and removal of all redundant electrical equipment, lighting, switchboards, cabling and any associated outlets utilised during construction

## Staging of the Works

The contractor shall be required to pay particular attention to the Main Contractors overall staging and construction strategy for the project.

## SUBSECTION B - SUPPLY ARRANGEMENTS, SUBSTATION, CONSUMER MAINS, SUBMAINS & PV SYSTEM

## 1. GENERAL

The Contractor shall supply and install new submains as detailed on the drawings. When installing such cabling the Contractor shall ensure the following minimum requirements:

- submains and subcircuit cabling shall be fixed to cable tray within plantroom areas, underfloor areas, open indoor pool hall areas and within dedicated Electrical cupboards.

- cabling shall be reticulated in such a manner so as to ensure that derating of the cabling is kept to a minimum;

- the reticulation of all such cabling shall be co-ordinated with all other services in the region;

- cabling size and type is identified at each end in the form of labelling on the distribution boards;

All underground submains shall be installed in HDUPVC conduit as detailed on the drawings.

The Contractor shall undertake all necessary liaison and pay all Supply Authority fees associated with new consumers mains and costs associated with specialist Level 2 sub-contractor as necessary to facilitate connection of consumers mains to new dedicated substation to be established under these contract works.

**Existing submains and cabling**

The Contractor shall allow to disconnect and remove any submains and cabling which becomes redundant as a result of this project and shall be responsible for protecting existing cabling which is required to be retained.

## 2. SUPPLY ARRANGEMENTS – SUBSTATION

The local Supply Authority Essential Energy have determined that the existing pole mounted substation located on Russell st will be upgraded to supply the proposed works on this site.

The design, procurement, commissioning, testing and warranty of this new substation shall be undertaken by the Head Building contractor directly and shall not form part of the electrical trade contract works.

The contractor shall allow to liaise and coordinate his work with the successful Level 1 contractor and shall allow to undertake Level 2 works associated with the installation of consumers mains from a new supply authority approved connection pillar to the new site Main Switchboard including all necessary conduits and cable pits.

Refer to the Electrical drawings for further details.

## 3. METERING

The contractor shall design, supply and install all metering panels to Supply Authority requirements and shall include in his tender price for all fees, levies and charges for the provision of metering including the supply and installation of meter bases, meters, cabling, service fuses, C.T's, links etc.

## 4. PHOTOVOLTAIC POWER GENERATION SYSTEM

### 4.1 General requirements

The contractor shall provide a photovoltaic (PV) array system inclusive of all solar panels, modules, cables, cable management, power and control cabling, switchgear, inverters, batteries etc.

The general location of the PV system is nominated on the electrical layout roof plans however the contractor shall be at liberty to increase/decrease or alter the arrangement to achieve maximum PV system efficiency

The PV system shall be designed and constructed to provide 200 kW power (Net). The PV array shall consist of a series of 450W solar panels divided into sub arrays. Each sub array shall consist of strings with 38 modules per string.

Each sub array shall be provided with an individual inverter which shall convert the DC power to AC. Sub array shall be wired in parallel as necessary.

All DC cabling, switchgear and equipment shall be rated a minimum of 10.5 A 450 DC and shall be installed as double insulated in accordance with AS/NZS 3000:2007.

All outdoor equipment shall be specified to minimum IP65 rated and shall utilise UV resistant construction materials.

The entire PV system shall be provided with an unconditional 20-year warranty period back by the equipment suppliers in addition to the contractor.

The PV system including PV cells, interconnection cabling, batteries and inverters shall be installed by a specialist sub-contractor and shall form part of the overall electrical trade scope of works for this project.

The contractor shall allow to run connection submains between the dedicated Photo Voltaic System Control cabinet and the PV inverters location as nominated on the drawings and shall allow for Main Switchboard and Distribution board connection provisions including a suitable circuit breaker as nominated in the single line diagrams.

Allow to install a dedicated PV system isolation switch adjacent the building Fire Indicator Panel as nominated on layouts.

Refer to schematics for further details.

## 4.2 PV Array system components

### 4.2.1 Metering provisions and data control

The PV system shall be provided with an export metering panel to be located within the nominated switchboards complete with dedicated three phase service sufficiently sized to allow for the nominated future upgrade. The completed PV system arrangement shall allow surplus energy to be exported to the integrated 160kWhr battery storage bank to allow use of the power after sunset. Once the battery system is fully charged surplus generated power shall be automatically exported to the Supply Authority grid via the existing site main switchboard.

The metering panel shall incorporate an automatic safety switch which prevents power being fed back to the Supply Authority grid when the mains incoming power from the substation is off. In this regard the entire system shall meet the NSW Service and Installation rules. The contractor shall ensure the entire PV system meets current regulatory guidelines.

The entire PV system shall be arranged to automatically shut down including isolation of battery supply in the event of a fire alarm trip from the FIP or a signal from the generator manual changeover switch which indicates the building has been switched to portable generator supply.

A cluster management system shall allow real time automated control and information monitoring of the PV system energy export output to the grid. The system shall be programmed to limit the PV inverter export energy output to not exceed 100 kW (or as otherwise permitted by the local Supply Authority). The contractor shall be required to confirm this maximum permissible export power rating and shall program the cluster control management system to comply.

The cluster management system to be provided shall be fully integrated to the PV system selected hardware and shall permit full functionality, programming and data display capabilities.

The contractor shall allow to complete all necessary liaison with and shall seek Supply Authority approval for the proposed arrangement including the completion of any necessary formal applications for connection to local supply authority grid.

The PV system shall include a MODBUS compatible digital meter to allow communication of collected information to the new Cluster centralised data collection & management system. The digital meter shall be able to provide the following information as a minimum:

- Phase to phase voltage (RMS and Peak)
- Phase to neutral voltage (RMS and Peak)
- Power factor
- Current (each phase separately)
- Current and Voltage Distortion (%)
- Cumulative KW produced

### 4.2.2 Inverters

Inverters to be utilised shall comply with AS4777 and shall be capable of connecting two separate strings. Each string shall be connected to an individual element.

Inverters shall be weatherproof and UV resistant and are to be installed adjacent the PV modules to which they are connected. Inverters shall be suitable for outdoor applications and be minimum IP56 rated.

Inverters shall be minimum 98% efficient with integral digital display.

Inverters used for this project shall be SUNGROW Cat No SG50CX (50kW) manufacture unless approved otherwise. The inverter shall be provided with min 20 year warranty

### 4.2.3 Photovoltaic Modules

PV modules utilised for this project shall be installed complete with support frame and located/angled to minimise shading and increase maximum exposure to the sun. The PV modules shall be electrically insulated from their support framework and the supporting framework shall be earthed at regular intervals in accordance with AS3000 requirements.

The multipurpose building roof where the new PV panels will be installed consists of ‘ArcPanel’ roof sheeting. The contractor shall be required to utilise ArcPanel approved mounting brackets for the installation of the PV system panels and any associated cable tray / ducting.

PV module mounting system shall be structurally sound and fully tested to withstand wind speeds that a regularly experienced in the area without experiencing damage. The completed new PV system array shall comply with AS/NZS 1170.2 (Wind Loads)

All new PV system panels shall be installed away from roof edges, skylights or mechanical system exhaust ducts to ensure easy and safe future access for maintenance purposes.

### 4.2.4 PV String Isolation

Each string shall be provided with dedicated protection fuses to both active and neutral and a 2 pole isolation switch. These isolation components shall be installed within a weatherproof equipment box.

### 4.2.5 Earthing

The contractor shall ensure that all PV array components including cabling are double insulated and that all cabling is enclosed in suitable cable enclosures.

All mounted equipment shall be insulated from the mounting frame. All metal chassis and equipment frames shall be solidly earthed to both the building structure and the electrical system. All earthing joints shall be treated to prevent corrosion of earthing connections.

### 4.2.6 Battery Storage

The contractor shall allow to provide a fully interfaced battery storage system to capture and store excess generated power from the rooftop PV system. The battery storage system shall be rated at 160kWhr capacity but shall be modular in design to allow future interface and expansion with the addition of battery modules.

The overall PV system shall be programmed to provide first priority use of generated power to the daily needs of the multipurpose centre. Any surplus power generated shall then be automatically directed to the charging of the battery storage system.

Once the battery system storage capacity has been met any excess generated power shall be automatically exported to the local Supply Authority grid. Any exported power to the grid shall be limited to the maximum permissible cap allowed for the local area as directed by the network provider (Ausgrid).

The battery storage modules shall be IP56 rated and suitable for outdoor applications with minimum 10-year manufacturer's warranty and shall utilise Lithium Iron Phosphate (LFP) Cell technology and incorporate communications port to allow status monitoring and alarms via an RS485 link.

The battery storage system modules used for this project shall be SUNGROW Cat No SBH400 (160kWhr) manufacture unless approved otherwise.

### 4.2.7 PV Monitoring System Software

The contractor shall allow to provide a fully integrated management and tracking software system which will allow real time tracking and analysis of all PV system performance data. The system shall utilise cloud-based backup data storage and well as local hardware-based data storage.

The software shall allow among other capabilities display and tracking of power generated, power quality, equipment failure notifications, export power tracking, battery storage capacity, graphic display of overall PV system interconnections etc.

The software system shall be programmed to provide alarm notification and trouble shooting capabilities and shall incorporate security data access control.

The PV System Monitoring software to be used for this project shall be SUNGROW **iSolarCloud** manufacture unless approved otherwise.

### 4.2.8 Labelling

The contractor shall allow to clearly label all main equipment associated with the PV system. All labelling shall be in accordance with AS/NZS 3000 and AS5033.

All labelling exposed to the elements shall be metallic stamped labelling which will remain readable for the life of the equipment.

Switches shall clearly indicate ON & OFF positions and the PV array main switch shall be labelled “PV ARRAY MAIN SWITCH”

### 4.2.9 Commissioning

The contractor shall fully test and certify the completed system and shall perform all necessary tests to ensure the expanded PV system is operating to its peak designed performance including any insulation testing and shall check that the system is communicating with the energy data gathering & management system on completion.

Provide within the project maintenance manual a dedicated section with clear maintenance procedures , recommended maintenance cycles, information on each component in the PV system including suppliers contact details etc.

The maintenance manual shall include schematic wiring diagrams for the specific system installed at this site and shall include all cable size information and component identification. The information to be provided shall be sufficiently clear to allow any experienced tradesman who work with these PV systems to understand how the system is interconnected and maintained.

## 5.0 SPORTS HALL ELECTRIC HEATERS

### 4.1 General requirements

The contractor shall note that the Sports Hall is served by a number of high level electric radiant heaters.

The heaters shall be supplied and installed under the Mechanical trade contract. The electrical trade contractor shall allow to supply and install all power supply cabling via a system of suspended cable tray and shall allow for the supply and installation of heater control/switching provisions as outlined on the layouts & schematics including the provision of a dedicated heater master control panel to be located in the Control Desk area of the building.

The Mechanical trade shall provide appropriate mounting frames to each heater to ensure they area well separated (min 600mm) from the supporting cable tray assembly to avoid any heating of electrical cables installed in the cable tray system.

## SUBSECTION C MAIN SWITCHBOARD

## 1 GENERAL

The Contractor shall allow to supply and install a new site Main Switchboard complete with the features and specifications contained within this specification and as further described in the associated drawings. The new site Main Switchboard shall be an IP42 rated indoor assembly complete with lockable doors .

Power shutdowns to the site shall not occur without the prior written approval of the Superintendent.

MSB Shop drawings and any other required performance data shall be submitted for review and approval by the contractor to the local supply authority inspector prior to commencement of assembly construction.

The Main Switchboard shall incorporate a manual generator changeover switch to allow connection of a temporary portable generator via an integrated cable connection cubicle integral to the MSB assembly. Refer to schematics for further details.

All switchgear utilised in the new MSB shall be of Schneider or NHP manufacture unless approved otherwise by the Superintendent.

## 2 QUALITY

### 2.1 INSPECTION

**Notice**

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

- Assembly installed and connected.
- Acceptance.

### 2.2 PRE-COMPLETION TESTS

**Type tests**

To AS/NZS 61439.

Testing facility: Accredited by NATA or registered with the Association of Short-Circuit Testing Authorities (ASTA).

**Production tests**

Carry out the following tests:

- Assemblies: Electrical and mechanical routine function tests at the factory using externally connected simulated circuits and equipment.
- Dielectric testing:
    - . NTTAs and PTTAs: 2.5 kV r.m.s. for 15 s.

- Functional testing: Operate mechanical devices, relays, programmable logic controllers and logic controls, protection, interlocking and alarm equipment.

- Protection relays: Primary current injection tests or, if approved, secondary current injection tests, to verify time/current characteristics and settings.

**Site tests**
Carry out secondary current injection tests on adjustable trip circuit breakers after installation and before energisation, to verify time/current characteristics and settings.

## 2.3 CONTRACTOR'S SUBMISSIONS

**General**
Submit type test certificates for components, functional units and assemblies including internal arcing-fault tests and factory test data.

**Discrimination Study**
The contractor shall be required to have a full discrimination study performed for all functional units installed in the Main Switchboard as part of these contract works.

The discrimination study will need to confirm that all new functional units have been selected to operate correctly in fault conditions and that suitable fault protection is provided by the larger upstream circuit breakers including the SPD.

**Calculations**
General: Submit detailed certified calculations verifying design characteristics.

Standard: To AS 3865 and IEC 890.

**Type test data**
General: Verify that type tests and internal arcing-fault tests, if any, were carried out at not less than the designated fault currents at rated operational voltage.

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

**Shop drawings of custom-built assemblies**
Submit shop drawings showing:

- Types, model numbers and ratings of assemblies.

- Component details, functional units and transient protection.

- Detailed dimensions.

- Shipping sections, general arrangement, plan view, front elevations and cross-section of each compartment.

- Projections from the assembly that may affect clearances or inadvertent operation, such as handles, knobs, arcing-fault venting flaps and withdrawable components.

- Fault level and rated short circuit capacity characteristics.
- IP rating.
- Fixing details for floor or wall mounting.
- Front and back equipment connections and top and bottom cable entries.
- Door swings.
- External and internal paint colours and paint systems.
- Quantity, brand name, type and rating of control and protection equipment.
- Construction and plinth details, ventilation openings, internal arcing-fault venting and gland plate details.
- Terminal block layouts and control circuit identification.
- Single line power and circuit diagrams.
- Details of mains and submain routes within assemblies.
- Busbar arrangements, links and supports, spacing between busbar phases, and spacing between assemblies, the enclosure and other equipment and clearances to earthed metals.
- Dimensions of busbars and interconnecting cables in sufficient detail for calculations to be performed to AS 3008.1, AS 3786 and AS 3865.
- Internal separation and form of separation and details of shrouding of terminals
- Labels and engraving schedules.

## 3 CUSTOM-BUILT ASSEMBLIES

### 3.1 CONSTRUCTION

**General**

Provide rigid, ventilated, insect-screened enclosures consisting of panels, doors, or both, giving the designated enclosure, separation and degree of protection.

**TTAs and PTTAs**

Use construction methods verified by required tests to at least the nominated fault level and temperature-rise limits and internal arcing-fault containment and venting.

**NTTAs**

Fabricate from sheet metal of rigid folded and welded construction.

**Layout**

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

Equipment mounting heights above floor to the centre line of the equipment:

- Toggles and handles of circuit breakers, fused switch units and isolators:
  - . Wall mounted assemblies: 500 - 900 mm.
  - . Floor mounted assemblies: 200 - 1900 mm.
  - Control switches, indicating lights, meters and instruments on doors:
  - . Wall mounted assemblies: 1 - 1.7 m.
  - . Floor mounted assemblies: 200 - 1800 mm.
  - Push-button emergency switching devices: 800 - 1600 mm.

Equipment on doors: Set out in a logical manner in functional unit groups, so it is accessible without the use of tools or keys.

- Degree of protection: Minimum IP42 or as nominated on the drawings.

**Enclosures**
Steel enclosures:

- General: Minimum 2.0 mm thick galvanised mild steel steel.

**Insect proofing**
Cover ventilation openings using non-combustible and non-corroding 1-mm mesh.

**Equipment mounting panels**
General: Strong enough to support the weight of mounted equipment. Construct using minimum 3-mm thick metal or non-metallic board with heavy metal angle supports or plates bolted or welded to enclosure sides.

Front accessible cable zones: 450-mm minimum width.

**Equipment fixing**
Spacing: Provide sufficient thermal, mechanical and electrical clearance between equipment to ensure proper functioning. Provide 50 mm minimum clearance between:

- busbars for fire services and building emergency services; and
- general installation services, busbars and equipment.

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

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

**Earth continuity**
Effectively bond equipment and assembly cabinet metal frame to the protective earth conductor. Strip painted surfaces and coat with corrosion resistant material immediately before bolting to the earth bar. Provide serrated washers under bolt heads and nuts at painted, structural metal-to-metal joints.

**Lifting provisions**
For assemblies with shipping dimensions exceeding 1.8 m high x 600 mm wide, provide fixings in the supporting structure and removable attachments for lifting.

**Supporting structure**
Provide concealed fixings or brackets to allow assemblies to be mounted and fixed in position without removing equipment.

**Wall-mounting**
Reinforce at bolt holes. For flush or semi-flush assemblies, provide angle trims of the same material and finish as the enclosure.

**Floor-mounting**
Provide mild steel channel plinth, galvanised to class Z600, with toe-out profile, nominal 75 mm high x 40 mm wide x 6 mm thick, for mounting complete assemblies on site. Drill M12 clearance holes in assembly and channel and bolt assemblies to channel. Prime drilled holes using zinc rich organic binder to GPC-C-29/16.

**Vertical cable zones**
Vertical cable zones shall be sized to suit the submains cable sizes specified and shall allow for the convenient installation of cable lugs and allow for suitable cable bending radii. In all cases the vertical cable zones shall be minimum 500mm wide clear internal.

## 3.2 CABLE ENTRIES

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

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

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

Materials: 1.5 mm thick steel, 5 mm thick composite material or laminated phenolic.

**Covers**

Maximum dimensions: 900 mm wide and 1.2 $m^2$ surface area.

Fixing: Fix to frames using at least 4 fixings. Provide corrosion-resistant acorn nuts if the cover exceeds 600 mm in width. Rest cover edges on the cubicle body or on mullions. Do not use interlocked covers.

Handles: Provide corrosion-resistant "D" type handles.

**Escutcheons**
For doors enclosing circuit breakers, provide escutcheon plates as barriers between operating mechanisms and live parts.

**Escutcheon plates**
General: Provide plates or removable covers with neat circuit breaker toggle cut-outs allowing interchangeability of 1, 2 and 3 pole circuit breakers. Provide corrosion-resistant lifting handles or knobs. Provide unused circuit breaker toggle cut-outs with blanking in-fill pole covers.
Maximum dimensions: 900 mm wide and 1.2 $m^2$ surface area.

## 3.3 FACTORY FINISHES

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

**Finish coats**
Thermoset powder coating or two-pack liquid coating.

**Paint colours**
Standard: To AS 2700.

Colours:

- Indoor assemblies: Electric Orange
- Outdoor assemblies: Storm Grey
- Removable equipment panels: Off white Y35.
- Assembly interior: Gloss White.

# 4 BUSBARS

## 4.1 BUSBARS

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

**Standards**
To AS 3768, AS 3865 and IEC 890.

**Definitions**
Incoming busbars: Busbars connecting incoming terminals to line side terminals of main switches.

Main circuit supply busbars: Busbars connecting incoming functional unit terminals, or incoming busbars where no main switches are included, to outgoing functional unit terminals or outgoing functional unit tee-offs.

Tee-off busbars: Busbars connecting main busbars to incoming terminals of outgoing functional units.

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

**Temperature rise limits - active and neutral conductors**

Maximum rated current temperature rise limits: 65 ± 1.5$^{O}$C by type test or calculation to AS 3768 or IEC 890.

Maximum short-circuit withstand current temperature rise limits: 160$^{O}$C by calculation to AS 3865.

**Cross section**
Rectangular with radiused edges.

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

Material: Non-hygroscopic insulation capable of holding busbars at 105$^{O}$C.

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

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

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

Neutral busbar: Black

MEN link: Green-yellow and black.

Protective earth busbar: Green-yellow.

Restrictions: Do not use adhesive type colour bands.

**Busbar systems**
Use multi-pole proprietary busbar assemblies or busbar systems, which have been verified for short circuit capacity and temperature rise-limits by type tests.

**Current carrying capacity**
Active conductors: Take into account thermal stresses due to short circuit current, assuming magnetic material enclosures located indoors in well-ventilated rooms and 90$^{O}$C final temperature.

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

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

**Tee-off busbars current rating**
For individual outgoing functional units: Equal to maximum frame size rating of the functional unit.

For multiple functional units: Equal to the diversity factors of AS/NZS 61439, based on frame size rating.

**MEN links**
MEN links > 10 mm$^2$ in section: Bolted removable busbar links stamped "*MEN LINK*", located in the incoming compartment, between neutral and earth busbars.

**Busbar links**
For current transformers, provide removable busbar links  450 mm long.

**Cable connection flags**
General: Provide and support busbar flags for equipment with main terminals too small for cable lugs. Use flags sized to suit cable lug termination, with current rating of at least the maximum equipment frame size.
Phase isolation: Provide phase isolation between flags where the minimum clearance distances phase-to-phase and phase-to-earth are below the component terminal spacing.

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

**Jointing**
Use high tensile steel bolts, washers and nuts, with lock nuts or locking tabs. Do not use tapped holes and studs or the like for jointing current carrying sections.

## 5 MAIN SWITCHES

### 5.1 SWITCH-ISOLATOR

**Standard**
To AS 3947.3.

**Type**
Poles: 3.
Rated current: To suit unit installed in enclosure.

**Rated fault capacity**
Short circuit making capacity: At least the fault level at assembly incoming terminals.

Breaking capacity: At least the rated full load current.

**Utilisation category**
At least AC-22.

**Rated duty**
Uninterrupted in non-ventilated enclosure.

**Operation**
Independent manual operation including positive "*ON/OFF*" indicator.

**Locking**
Provide for padlocking in the "*OFF*" position.

## 6 CIRCUIT BREAKERS

### 6.1 AIR CIRCUIT BREAKERS

**Standard**
To AS 3858.

**Type**
Open construction, withdrawable 3 pole, back connected, trip free.

**Rated duty**
Based on uninterrupted duty in a non-ventilated enclosure.

**Utilisation category**
Type B for partial and full discrimination.

**Rated service short-circuit breaking capacity**
At least the fault level at incoming terminals of the assembly.

**Closing operation**
Provide trip free closing mechanisms for operation, with positive mechanically operated "*ON/OFF*" indications.

**Opening operation**
Provide mechanically operated release for opening.

**Compartment**

House each circuit breaker in a separated self-contained enclosed subsection module within the assembly.

## 6.2 MOULDED CASE AND MINIATURE CIRCUIT BREAKERS

### General

All circuit breakers utilised for this project shall be of Schneider, NHP or Terasaki manufacture unless approved otherwise

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

**Utilisation category**
Partial or full discrimination: Type B.

**Adjustable current settings**
General: If trip current adjustment control is exposed with covers in position, provide for sealing to prevent tampering.

Labels: Provide labels indicating trip settings.

# 7 LINKS

## 7.1 NEUTRAL AND EARTH LINKS

**Terminals**
Provide terminals for future circuits.

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

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

Mounting: Mount neutral links on an insulated base.
Control circuits: Provide separate neutral and earth links.
Labels: Provide labels for neutral and earth terminals.

**Cables > 10 mm$^2$**
Provide bolts or studs.

# 8 INTERNAL WIRING

## 8.1 WIRING

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

**Cable interconnections**

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

- Use 1.5 $mm^2$ (minimum) internal cables, with minimum V75 insulation rating with stranded copper conductors rated to AS 3008.1. Use cables with current ratings suitable for the internal assembly ambient air temperature and for temperature rise limits of equipment within the assembly.

- Run cables clear of busbars and metal edges.

- Provide cables capable of withstanding maximum thermal and magnetic stresses associated with relevant fault level and duration.

- Run cables neatly. Provide slotted trunking sized for future cables or tie at 150 mm maximum intervals using ties strong enough to withstand magnetic stresses created at the specified fault current. Do not use adhesive supports.

- Ensure wiring for future equipment can be installed without removal of existing equipment.

- Identify power and control cables at both ends using neat fitting ring type ferrules agreeing with record circuit diagrams. Mark to AS 1103.

- Terminate control cables and motor control circuits in tunnel terminals or, if necessary, use suitable palm type lugs and correct crimp tool.

- For equipment mounted on hinged doors run cables on the hinge side to avoid restricting the door opening. Bundle cables using spiral wrap PVC.

- If recommended by device manufacturers, provide shielded wiring.

Adjacent circuit breakers: If suitable proprietary multi-pole busbar assemblies are available to link adjacent circuit breakers, do not use cable interconnections.

**Cables > 6 $mm^2$**
Terminations:

- Tunnel terminals: Single cables.

- Other connection points or terminals: > 2 cables.

Doors:

Do not run cables to hinged doors or removable panels.

Supports:

- Spacing at enclosure: > 200 mm from a termination.

- Spacing generally: < 400 mm.

- Strength: Capable of withstanding forces exerted during fault conditions.

Single core cables rated at 300 A: Do not use ferrous type metal cable saddles.

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

**Control and indication circuits**
General: Provide conductors sized to suit the current carrying capacity of the particular circuit.

Minimum size: 1 $mm^2$ with 32/0.2 stranding.

**Cable colours**
Colour code wiring as follows:

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

## 9 MEASUREMENT ACCESSORIES

### 9.1 CURRENT TRANSFORMERS (METERING)

**Standard**
Measurement current transformers: To AS 1675.

**Test links**
Provide test links for connection of calibration instruments and meters and for shorting of current transformer secondaries. Provide energy meters, maximum demand meters, ammeters and protection relays, with sets of rail-mounted links consisting of screw-clamped slide links and an earth link.

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

**Accuracy classification**
Energy measurements: Class 0.5M.

Indicating instruments: Class 2M.

**Ratings**

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

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

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

**Type**
If practicable, use cast resin encapsulated window-type with busbar clamping devices. Otherwise use wound-primary type with mounting feet.

**Installation**
General: Install transformers to permit easy removal.

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

## 9.2 INSTRUMENTS AND METERS

**Standards**
Indicating instruments: To AS 1042.

Electricity meters: To AS 1284 Parts 1, 3 and 4.
Transducers: To AS 1384.

**Transducers**
If necessary for transducer operation, provide auxiliary supply. Connect outputs to dedicated rail-mounted isolating type terminals.

**Accuracy**
Indicating instruments and accessories: Accuracy class 1.5 or lower class index number except Class 3 for thermal maximum demand indicators.

Electricity meters: Class 0.5.

Power factor meters, phase angle meters and synchroscopes: 2 electrical degrees maximum error.

Transducers: Class 0.5.

**Mounting**
Flush mount meters on hinged panels. Wire with multi stranded flexible cables.

**Protection devices**
Meter potential protection devices: Group together behind associated meter cover or hinged door, preferably next to current transformer test links.

**Labels**
If associated exclusively with one phase, label meters "*RED*", "*WHITE*", or "*BLUE*" as applicable.

## 9.3 INDICATOR LIGHTS

**Standard**
To AS 3947.5.1.

**Degree of protection**
At least that of the assembly/operating face.

**Incandescent indicators**
Type: Incandescent oil tight type minimum 22 mm diameter or 22 x 22 mm.

Lamps: Changeable from front of panel without removing the holder.

Lamp rating: 1.2 - 5 W.

**Press-to-test**
Compartments/subsections with < 5 indicating lights: Provide each indicating light with a fitted integral press-to-test lamp actuator.

Compartments/subsections with ³ 5 indicating lights: Provide a common press-to-test lamp push-button.

## 9.4 MULTIFUNCTION DIGITAL METERS & ENERGY MONITORING

The Main Switchboard shall be fitted with digital meters complete with RS485 communication capabilities. The meters shall be capable of reading and recording the following as a minimum:

- Phase to phase voltage (RMS and Peak)
- Phase to neutral voltage (RMS and Peak)
- Power factor
- Current (each phase separately)
- Current and Voltage Distortion (%)
- Maximum demand
- KVAr and KW

The meters shall be capable of recording any of the above parameters and shall be capable of downloading the information via its communication port to a remote PC or BMS system.

The meters shall be capable of communicating via the Ethernet protocol to allow connection to the centralised power monitoring software.

**Energy Monitoring System**

Provide an energy monitoring data capture system complete with the following features:

- Easy to use Graphic user interface (located in Main Switchroom)
- Secure Remote (cloud based) data storage
- Data accessible from anywhere via secure internet access and software
- Mobile app features

The energy monitoring system to be provided for the site shall be similar to Schneider Electric. ‘Facility Expert’ system with Com X 210 Energy Server or an approved equivalent.

## 9.5 SURGE PROTECTION

The Contractor shall provide Surge Diverters within the Main Switchboard. The Surge Diverter shall be connected between each Switchboard active/neutral busbar and the MEN earth link.

The Surge Diverter shall utilise Metal Oxide Varistors individually fused and shall incorporate a voltage free normally closed contact to provide an individual phase segment failure alarm to future external BMS monitoring system. The surge diverter unit shall also have a local digital display visible without removable of eschuteon indicating percentage active per phase and each integral alarm to indicate required maintenance.

Unit specification:

| | |
|---|---|
| Operating voltage | 250 VAC |
| Surge withstand | ANSI C62.41-1991 Cat A, B, C<br>AS1768 Cat A, B, C |
| Surge rating: | 8/20 us pulse response 100KA |
| Performance: | < 600 V clamp voltage for 3KA Cat C<br>< 1200 V clamp voltage for 20KA Cat C |
| Alarms: | Local digital display<br>External clean contact C/O on one segment failure. |
| Max Conductor: | 16mm$^2$ |

The surge diverters shall be factory fitted to the Main Switchboard Board and shall be ERICO Model TDX100M-277-480 or an approved equal.

# 10 INSTALLATION

## 10.1 ASSEMBLY INSTALLATION

**Fixing**

Before making interpanel connections, fix assemblies and metering equipment enclosures into position, level and plumb.

## 10.2 ASSEMBLY ENTRIES

**Cable entries**

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

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

**Cable enclosures**

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

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

**Bus trunking system entry**
Provide entry plates with close tolerance cut-out to accommodate busbars, fitted with a flange bolted and sealed to assembly enclosure to maintain assembly IP rating. Earth busway enclosure to assembly protective earth conductor. Fit busway flanges at assembly manufacturer's premises and retain for transportation.

## 11 LABELLING

### 11.1 LABELLING

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

**Identifying labels**
Provide labels fixed to access panels, doors, covers and escutcheon panels and internal equipment, indicating the relevant section and component.

**Minimum lettering heights**
Main assembly designation: 25 mm.

Distribution assembly designations: 15 mm.

Small proprietary distribution boards: 10 mm.

Main switches: 10 mm.

Outgoing functional units: 8 mm.

Identifying labels (on outside of cabinet rear covers): 4 mm.

Danger, warning and caution notices: 10 mm for main heading, 5 mm for remainder.

Other labels including equipment labels within cabinets: 3 mm.

**Label colours**
Generally: Black lettering on white background.

Main switch and caution labels: Red lettering on white background.

Danger, warning labels: White lettering on red background.

**Fixing**

General: Fix labels securely.

Method: Select from the following:

- Screws and double-sided adhesive.

- Fixed in extruded aluminium sections fixed to panels using rivets or countersunk screws.

Aluminium labels: Use aluminium or monel rivets.

Restrictions: Do not use self-tapping or thread-cutting screws.

**Set-out**
Align horizontally and vertically with adjacent labels.

**Labels on assembly exteriors**
Manufacturer's name: Required.

Assemblies: Label with essential markings.

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

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

- Circuit designation for main switches, main controls and submains controls.

- Details of consumers mains and submains.

- Incoming busbar or cable rating to first tee-off.

- Fuse link size.

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

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

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

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

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

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

## 11.2 CIRCUIT SCHEDULE

**Schedule cards**

General: For all switchboards provide schedule cards of minimum size 200 x 150 mm, with typewritten text showing the following as-installed information:

- Submain designation, rating and short-circuit protective device.

Mounting: Mount schedule cards in a holder fixed to the inside of the assembly or cupboard door, next to the distribution circuit switches. Protect with hard plastic transparent covers.

**Single-line diagrams**

Custom-built assemblies: Provide single-line diagrams.

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

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

# 12 COMPLETION

## 12.1 SPARES

**Tools**

Accessories: Provide one set of racking tools for circuit breakers, and special installation, operation and servicing tools.

Indicator lights: Provide 3 spare lamps and one lamp extractor per 10 indicating lights. Locate in spares cabinet.

## 12.2 COMPLETION TESTS

**General**

Carry out the following tests:

- Electrical operation.

- Dielectric.

## 12.3 MAINTENANCE

**General**

General: Carry out the following:

- Monthly inspections and maintenance work to maintain the assembly, including battery systems.

- Rectify faults, make adjustments, and replace consumable and faulty materials and equipment within 24 hours of notification.

Standard: To AS 2467.

## SUBSECTION D DISTRIBUTION BOARDS

## 1 GENERAL

### 1.1 STANDARD

**General**

To AS/NZS 61439.

All distribution boards utilised for this project shall be new unless noted otherwise.

### 1.2 INTERPRETATIONS

**Definitions**

Proprietary assemblies: Low voltage switchgear and controlgear assemblies available as a catalogue item, consisting of manufacturer's standard layouts and equipment.

Rated currents: Rated currents are continuous uninterrupted current ratings within the assembly environment under in-service operating conditions.

**Abbreviations**

TTA: Type tested assemblies.

NTTA: Non-type tested assemblies.

PTTA: Partially type tested assemblies.

### 1.3 DESIGN

**Layout**

Position equipment to provide safe and easy access for operation and maintenance. The Contractor shall design and build distribution board/meters/etc to fit within within the cupboard spaces allocated. Refer Architects drawings.

**Fault levels**

Rated short-circuit currents: Maximum prospective symmetrical r.m.s. current values shall be as advised by the Supply Authority.

Moulded case or miniature overcurrent circuit breakers rated up to 100 **A,** connected to circuits for lighting**,** general purpose outlets and small single or multi**-**phase electrical accessories**:** Mount any number of circuit breakers within **a** Form **1** separated subsection**,** provided the circuit breakers are mounted on an approved multi**-**pole busbar chassis assembly**,** concealed with an escutcheon panel and removable door**.**

**Degree of protection**

Minimum: IP42 Unless noted otherwise on design drawings.

**Spare facilities**

Provide at least 20% spare pole capacity or as shown on the drawings. Whichever is the greater.

Wall mounted: Front access assemblies with frontal areas < 2 $m^2$.

**Lighting , Power & Mechanical Chassis metering**

All new distribution boards shall be designed to incorporate separately metered lighting , power & mechanical services chassis as detailed on the drawings. All chassis metering shall be digital unless noted otherwise.

All such metering shall be provided with communications port which is Ethernet based to allow RS485 connection to the centralised power monitoring software system. The contractor shall ensure all meters are compatible to the Schneider or equivalent site data gathering system.

**Connection**
Indoor cable entries: Top and bottom.

## 2 QUALITY

### 2.1 INSPECTION

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

- Assembly installed and connected.
- Acceptance.

### 2.2 PRE-COMPLETION TESTS

**Site Tests**
Visual and functional inspection.

### 2.3 CONTRACTOR'S SUBMISSIONS

**Product data for proprietary assemblies**

Submit design drawings showing the following:

- General assembly;
- Types and model numbers of items of equipment;
- Overall dimensions;
- Fault level;
- IP rating;
- Rated current of components;
- Number of poles and spare capacity;
- Mounting details;
- Paint colours and finishes;

- Access details;
- Schedule of labels.
- Shop drawings of custom-built assemblies

## 3 PROPRIETARY ASSEMBLIES

### 3.1 GENERAL

All distribution boards not enclosed within a dedicated electrical cupboard shall be provided with a lockable hinged door. All new D.Bs shall be provided with an 'NMB'-key lock mechanism.

**General Construction material**

Generally distribution boards for this project shall be constructed from mild steel with powdercoat finish to manufacturers standard colour range

.

In nominated locations such as within plantrooms or external situations distribution boards shall be constructed from marine grade stainless steel complete with powdercoat finish to manufacturers standard colour range.

### 3.2 REQUIREMENT

Provide removable escutcheon plates with neat cut-outs for circuit breakers. Each escutcheon shall be secured by a minimum of 4 fixings each consisting of an M8 plated stud fixed to the cubicle and fitted with a serrated star washer and a chromium plated acorn nut. Lockable distribution boards shall be fitted with a chromium plated lever-type handle.

## 4 BUSBARS

### 4.1 BUSBARS

**General**

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

**Standards**

To AS 3768, AS 3865 and AS 4388.

**Definitions**

Incoming busbars: Busbars connecting incoming terminals to line side terminals of main switches.

Main circuit supply busbars: Busbars connecting incoming functional unit terminals, or incoming busbars where no main switches are included, to outgoing functional unit terminals or outgoing functional unit tee-offs.

Tee-off busbars: Busbars connecting main busbars to incoming terminals of outgoing functional units.

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

**Temperature rise limits - active and neutral conductors**

Maximum rated current temperature rise limits: 65 ± 1.5$^{O}$C by type test or calculation to AS 3768 or AS 4388.

Maximum short-circuit withstand current temperature rise limits: 160$^{O}$C by calculation to AS 3865.

**Cross section**
Rectangular with radiused edges.

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

Material: Non-hygroscopic insulation capable of holding busbars at 105$^{O}$C.

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

**Colour coding**

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

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

Neutral busbar: Black

MEN link: Green-yellow and black.

Protective earth busbar: Green-yellow.

Restrictions: Do not use adhesive type colour bands.

**Busbar systems**
Use multi-pole proprietary busbar assemblies or busbar systems, which have been verified for short circuit capacity and temperature rise-limits by type tests.

**Current carrying capacity**
Active conductors: Take into account thermal stresses due to short circuit current, assuming magnetic material enclosures located indoors in well-ventilated rooms and 90$^{O}$C final temperature.

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

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

**Tee-off busbars current rating**
For individual outgoing functional units: Equal to maximum frame size rating of the functional unit.

For multiple functional units: Equal to the diversity factors of AS/NZS 61439, based on frame size rating.

**MEN links**
MEN links > 10 $mm^2$ in section: Bolted removable busbar links stamped "*MEN LINK*", located in the incoming compartment, between neutral and earth busbars.

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

**Busbar links**
For current transformers, provide removable busbar links ≤ 450 mm long.

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

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

**Jointing**
Use high tensile steel bolts, washers and nuts, with lock nuts or locking tabs. Do not use tapped holes and studs or the like for jointing current carrying sections.

**Busbar insulation**
Active and neutral busbars and joints: Select from the following:

- Polyethylene: At least 0.4 mm thick with dielectric strength of 2.5 kV r.m.s for 1 min, applied by a fluidised bed process in which the material is phase coloured and directly cured onto the bars.

- Close fitting busbar insulation mouldings at least 1 mm thick.

- Heat shrink material: Use only on rounded edge busbars.

Damaged insulation: Repair damaged insulation before energising.

## 5 MAIN SWITCHES

### 5.1 SWITCH-ISOLATOR
**Standard**

To AS 3947.3.

**Type**
Poles: 3.

Rated current: To suit unit installed in enclosure.

**Rated fault capacity**
Short circuit making capacity: At least the fault level at assembly incoming terminals.

Breaking capacity: At least the rated full load current.

**Utilisation category**
Circuits consisting of motors or other highly inductive loads: At least AC-23.
Other circuits: At least AC-22.
**Rated duty**
Uninterrupted in non-ventilated enclosure.

**Operation**
Independent manual operation including positive "*ON/OFF*" indicator.

**Construction**
General: Either

- totally enclosed; or

- with full and direct shrouding to fixed live parts of switches and fuses, so that insertion of a screwdriver does not cause faults between phases.

Shrouding: Effective over range of air break switch positions.
Incorporate the following:

- Earthing terminal.

- Neutral link mounted within unit.

- Contact position clearly indicated whether cover is in place or not. For fuses mounted in withdrawable carriage ensuring isolation from supply before access to fuses is possible, secondary indication may be omitted.

## 6 CIRCUIT BREAKERS

### 6.1 MOULDED CASE AND MINIATURE CIRCUIT BREAKERS

**Standard**
Fault capacity ≥ 6 kA: To AS 3858.

To be suitable for the fault level present.

All distribution board circuit breakers shall be of Schneider, NHP or Terasaki manufacture unless noted or approved otherwise.

**Miniature circuit breakers**
Fault capacity < 6 kA, current rating < 100 A: Use miniature overcurrent circuit breakers.

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

**Utilisation category**
Non-discrimination: Type A.

## 7 LINKS

### 7.1 NEUTRAL AND EARTH LINKS

**Terminals**
Provide terminals for future circuits.

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

Mounting: Mount neutral links on an insulated base.

Control circuits: Provide separate neutral and earth links.

Labels: Provide labels for neutral and earth terminals.

**Cables > 10 mm$^2$**
Provide bolts or studs.

## 8 INTERNAL WIRING

### 8.1 WIRING

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

**Cables > 6 mm$^2$**
Terminations:

- Tunnel terminals: Single cables.

- Other connection points or terminals: ≤ 2 cables.

Supports:

- Spacing at enclosure: ≤ 200 mm from a termination.
- Spacing generally: ≤ 400 mm.

- Strength: Capable of withstanding forces exerted during fault conditions.

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

**Control and indication circuits**
General: Provide conductors sized to suit the current carrying capacity of the particular circuit.

Minimum size: 1 $mm^2$ with 32/0.2 stranding.

**Cable colours**
Colour code wiring as follows:

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

## 8.2 TERMINATIONS

**Submains, light and power circuits**
Connect direct to the circuit breaker terminals.

**Other circuits**
Connection to circuits ≤ 16 $mm^2$: Provide DIN-type tunnel terminal blocks.

Tunnel terminals: Provide insulated sleeve ferrules to flexible cables terminated in tunnel terminals.

Identification: Identify cables at both ends using neat ring-type ferrules.

Type: Screw-tightened, clip-on, 35 mm DIN-type, flexible, non-flammable and, as a minimum, suitable for the insertion of a screwdriver blade.

Location: Locate terminals to provide ready access to outgoing terminations.

Mounting rails: Screw or rivet mounting rails to assembly at ≤ 500 mm centres. Provide sufficient length to accept a further 20% terminals or 3 terminals, whichever is the greater.

- Arrangement: Terminate internal wiring to one side of the terminal block, leaving the other side for outgoing circuits.
- Grouping: Provide separate terminal groups for final subcircuit and control wiring. Provide oversized barriers between each group of terminals having different voltages and terminal size.

- Terminals for power wiring: 3 phases or single phase and neutral.

- Control terminals: In alphabetical or numerical order of wire identification, with the lowest number or letter next to the power terminals.

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

## 9 SWITCHGEAR ACCESSORIES

### 9.1 RESIDUAL CURRENT DEVICES

**Integral type**

General: Incorporate earth leakage in circuit breaker protection operation.

Mounting: Comply with Moulded case and miniature circuit breakers, in the Circuit breakers subsection.

**Tripping**

Residual current classification: Type II.

Maximum tripping current: 30 mA.

**Requirement**

RCD protection shall be provided to all equipment,outlets and lighting to meet AS3000:2007 requirements. 30mA RCD circuit breakers shall be used in all cases.

## 10 CONTROL GEAR

### 10.1 CONTACTORS

**Standard**

A.c. contactors: To AS 1029.1 or AS 3947.4.1.

**Type**

Block type, air break, electro-magnetic.

**Poles**

3.

**Minimum rated values**

Rated operational current: Full load current of the circuit protective device.

Rating: 16 A.

Mechanical endurance: 10.

Contacts life: 1 million operations at AC-3.

**Auxiliary contacts**

General: Provide auxiliary contacts with at least one normally-open and one normally-closed separate contacts with rating of 6 A at 240 V a.c.

Utilisation category: AC-1.

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

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

**Interconnection**
Do not connect contactors in series or parallel to achieve ratings.

## 11 INSTALLATION

### 11.1 ASSEMBLY INSTALLATION

**Fixing**
Before making interpanel connections, fix assemblies and metering equipment enclosures into position, level and plumb.

### 11.2 ASSEMBLY ENTRIES

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

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

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

## 12 SURGE PROTECTION

The Contractor shall provide a Surge Diverters within each distribution board. The Surge Diverters shall be connected between each switchboard active/neutral busbar and the earth bar.

The Surge Diverters shall utilise Metal Oxide Varistors individually fused and shall incorporate a voltage free normally closed contact to provide an individual phase segment failure alarm to future external BMS monitoring system. The surge diverter unit shall also have a local digital display visible without removable of eschuteon indicating percentage active per phase and each integral alarm to indicate required maintenance.

**Unit specification:**

Operating voltage 250 VAC

| | |
|---|---|
| Surge withstand | ANSI C62.41.2 Cat A, B, C<br>AS1768 Cat A, B, C |
| Surge rating: | 8/20 us pulse response 30KA |
| Nominal discharge current | 25kA at 8/20us |
| Performance: | < 400 V clamp voltage for 3KA Cat C<br>< 1000 V clamp voltage for 20KA Cat C |
| Alarms: | Local digital display<br>External clean contact C/O on one segment failure. |
| Max Conductor: | 16mm$^2$ |

The surge diverters shall be factory fitted to the distribution boards and shall be ERICO Model TDS330-TT-277 or an approved equal.

## 13 LABELLING

### 13.1 LABELLING

**GENERAL**

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

**Identifying labels**

Provide labels fixed to access panels, doors, covers and escutcheon panels and internal equipment, indicating the relevant section and component.

**Minimum lettering heights**

Main assembly designation: 25 mm.

Distribution assembly designations: 15 mm.

Small proprietary distribution boards: 10 mm.

Main switches: 10 mm.

Outgoing functional units: 8 mm.

Identifying labels (on outside of cabinet rear covers): 4 mm.

Danger, warning and caution notices: 10 mm for main heading, 5 mm for remainder.

Other labels including equipment labels within cabinets: 3 mm.

**Label colours**

Generally: Black lettering on white background.

Main switch and caution labels: Red lettering on white background.

Danger, warning labels: White lettering on red background.

**Fixing**
General: Fix labels securely.

Method: Select from the following:

- Screws and double-sided adhesive.

- Fixed in extruded aluminium sections fixed to panels using rivets or countersunk screws.

Aluminium labels: Use aluminium or monel rivets.

Restrictions: Do not use self-tapping or thread-cutting screws.

**Set-out**
Align horizontally and vertically with adjacent labels.

**Labels on assembly exteriors**
Manufacturer's name: Required.

Assemblies: Label with essential markings.

Designation labels: For other than main assemblies, provide designation label stating source of electrical supply. Identify separate sections of enclosures.
Assembly controls: Label controls and fault current limiters, including the following:

- Circuit designation for main switches, main controls and submains controls.

- Details of consumers mains and incoming submains.

- Incoming busbar or cable rating to first tee-off.

- Fuse link size.

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

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

**Danger, warning and caution notices**

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

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

Externally controlled equipment: To prevent accidental contact with live parts, provide warning notices for equipment on assemblies not isolated by main switch or local main switch. Positioning: Locate notices so that they can be readily seen, next to or, if impracticable, on busbar chamber covers of functional units, and behind the front cover of functional units. Provide circuit identification labels in the cabling chamber of each functional unit, located next to external terminations.

### 13.2 CIRCUIT SCHEDULE

**Schedule cards**
General: For all distribution boards provide schedule cards of minimum size 200 x 150 mm, with typewritten text showing the following as-installed information:

- Submain designation, rating and short-circuit protective device.

- Light and power circuit numbers and current ratings, cable sizes and type and areas supplied.

Mounting: Mount schedule cards in a holder fixed to the inside of the assembly or cupboard door, next to the distribution circuit switches. Protect with hard plastic transparent covers.

## 14 COMPLETION

### 14.1 COMPLETION TESTS
**General**
Carry out the following tests:

- Electrical operation.

### 14.2 MAINTENANCE
**General**
General: Carry out the following:

- Monthly inspections and maintenance work to maintain the assembly.

- Rectify faults, make adjustments, and replace consumable and faulty materials and equipment within 24 hours of notification.Standard: To AS 2467.

## SUBSECTION E LUMINAIRES

## 1 GENERAL

The Contractor shall note that the type and location of all luminaires shall be as specified in the accompanying drawings. Alternatives to the fittings specified shall not be accepted without written approval from the Superintendent.

All lights shall be provided complete with lamps, diffusers, ballasts, drivers as necessary.

### 1.1 STANDARDS

**Standards**

Luminaires: To AS 3137.

Radio interference limits: To AS/NZS 4051.

### 1.2 INTERPRETATIONS

**Definitions**

Proprietary luminaires: Luminaires available as a catalogue item.

## 2 QUALITY

### 2.1 SAMPLES

Submit samples of each proposed luminaire for approval by the Superintendent.

## 3 LUMINAIRES

### 3.1 COMPLETE

**Lamps**

Provide luminaires complete with lamps and accessories.

## 4 ACCESSORIES AND CONTROL EQUIPMENT

### 4.1 BALLASTS

Current total harmonic distortion: < 15%.

All fluorescent lights shall be fitted with high frequency electronic ballasts unless noted otherwise.

### 4.2 LED DRIVERS

All LED fittings shall be provided with suitably rated LED drivers to manufacturers recommendations.

Where dimmable LED fittings are nominated all such fittings shall be provided with DALI dimmable drivers and these shall be controlled by a KNX intelligent lighting control system

**Sports Hall Lighting:**

Within the new Sports Hall area the design includes a series of separately controlled suspended LED High Bay fittings. These fittings shall be installed on a suspended system of heavy duty cable trays at the height nominated on the layout drawings. The suspension system shall utilise an approved rod suspension suspension system selected by the contractor with suitable strength for the expected live and dead loads. All suspension and fixing methods shall be suitable for the Arc Panel roofing system and shall be submitted to the Superintendent for approval prior to commencing any works on site. All fixing methods shall meet Arcpanel manufacturers recommendations and shall be suitably rated for the expected loads.

The contractor shall allow to provide switching and dimming control of all Sports Hall area lighting to be controlled at a central lighting control location at the Control Desk area. The lighting control panel for lighting control shall utilise a DALI intelligent lighting control system such as CBUS or KNX

Nominal mounting heights have been indicated on the drawings for all light fittings however final coordination between lighting mounting heights and other Mechanical services ducts and cable trays in the area shall be undertaken on site to ensure shadowing and services clashes are avoided.

## 5 LAMPS

### 5.1 LED LAMPS

All fittings utilising LED lamps shall use LEDs which are rated at minimum 60 000 hours lamp life at the operating current. Unless nominated otherwise all indoor LED lamps shall be 4000 deg K colour temperature and all outdoor LED lamps shall be 4000 deg K colour temperature with a minimum CRI of 80.

## 6 INSTALLATION

### 6.1 GENERAL

**General**

Mount luminaires on proprietary supports using battens, trims, noggings, roses and packing material, as necessary.

**Surface mounted luminaires**

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

Fixing: Use 2 fixings at each end of fluorescent luminaires. A single fixing at each end in conjunction with 1.6 mm backing plates may be used for narrow luminaires.

**Recessed luminaires**
Connect recessed troffer fluorescent luminaires to a plug socket outlet.

## 6.2 POSITIONING

Final positioning of luminaires, both internally and externally, shall be carried out on site in consultation with the Architectural drawings and the Superintendent. The Contractor shall not carry out any installation work without first undertaking such co-ordination and gaining approval.

## 6.3 POLE LIGHTS

The contractor shall allow to supply and install new pole lights within the new carpark area as nominated on the drawings complete with bored reinforced concrete footings and rag bolt assembly.

Light poles shall be provided with powdercoat finish to match the selected light fitting colour finish unless approved otherwise by the Architect.

All lighting poles shall be fitted with suitable access panels and cable terminal block which will allow access to cabling installed within the pole

The contractor shall provide a structural engineers certification from a certified practising engineer that all light pole footings are fit for the intended use, pole height and the soil classification at the site.

The contractor shall submit workshop drawings of proposed lighting poles prior to commencing construction.

# 7 SPECIFIC LIGHTING REQUIREMENTS

## 7.1 LIGHTING CONTROL

The Contractor shall allow for the following lighting control;

**External Lighting Control**

- all nominated external lighting shall be controlled using a combined PE cell and multichannel timer with ON/OFF/AUTO switches for each channel. A consolidated external lighting control panel shall be provided at the Control desk area. Refer drawings for further details

External lighting circuits control shall be arranged as follows:

- A single PE cell to turn “ON” all external lighting via contactors located at the supply Distribution Board.
- A multiple channel digital timer shall be provided within the local Switchboard to allow separate programmable :OFF” times for each external lighting circuit. From the digital timer location control cabling shall be run to various distribution boards around the site

to allow control of local external lighting circuits via contactors. Refer schematics for further details.

**General Lighting Control**

Some internal public area lighting shall be master controlled from the Control desk areas as nominated on the drawings. Within some nominated areas (as indicated on the drawings) local adjustable motion sensing light switches shall be provided within individual rooms/areas to automatically turn lights "ON" for a programmed period of time. The Contractor shall allow to liaise with Centre Manager to set appropriate run times within/areas fitted with motion sensing devices. Run times shall not be set to less than 10 mins.

Within nominated areas 24hr security lighting shall be provided as nominated on the layout drawings.

**Security system lighting control interface**

All internal lighting circuits within the building shall be provided with contactors at the local supply distribution board to allow master lighting control by the security system to meet BCA Section J requirements.

The security system/lighting interface shall be arranged so that as areas of the building are ARMED the corresponding lighting circuits within that ARMED area shall be isolated via contactors installed at the supply DB. The contractor shall arrange voltage free signals between the security system panels and all distribution boards contactors and Intelligent lighting control system panel to facilitate this operation. The voltage free signals to be provided shall correspond to the security system ARM/DISARM zones. Refer to the Security system specification section for further zoning details.

The security system interface shall include a voltage free signal connection to the Sports hall Distribution Board and the Intelligent lighting control system panel to allow all lighting within the Sports hall area to be controlled in the same way via the Security system arming signal.

As areas of the building are DISARMED the lighting circuit contactors shall be automatically closed allowing normal local light switching operations to take place within that area of the building.

A security alarm trip on any zone after hours shall automatically close the relevant lighting contactor for that zone and allow normal lighting control from within the building until the zone is REARMED.

## 8.0 SPORTS HALL SUSPENDED LIGHTING SYSTEM

The contractor shall note that due to the use of the exposed Arcpanel roof panel system to be utilised in the new sports hall area there will be limited opportunity to establish fixing points for suspended lighting. Generally fixing points shall not exceed 1500mm intervals. Closer fixing points shall be utilised if available This shall be confirmed on

site by the contractor in consultation with the Superintendent and in line with Arcpanel recommendations.

**Note**: The suspended cable tray mounting system within the Sports Hall shall be installed by the electrical trade contractor and the proposed final arrangements shall be submitted to the structural engineer for approval prior to installation.

## 9 SPORTS HALL LIGHTING & CONTROL SYSTEM

All lighting within the Sports Hall shall be controlled via a CBUS (or KNX) intelligent lighting control panel located at the centre Main Control desk area and other lighting control panels around the site. Refer to the drawings for further details

### 9.1 MAIN SPORTS HALL LIGHTING PROGRAMMING

Within the Sports Hall area light fittings have been specified to include DALI dimmable LED drivers. The contractor shall allow to provide intelligent DALI LED drivers within the nominated light fittings interfaced to a Clipsal CBUS (or ABB KNX) DALI lighting control system. The lighting control system shall allow dimming capabilities from a CBUS (or KNX) touch screen control panel to be located at the Main Control desk area.

The contractor shall allow for full programming of the CBUS (or KNX) lighting control system and shall provide preset lighting scenes within the Sports Hall area to be programmed and shall provide full system training to nominated centre management staff

The programmed preset lighting scenes shall include 0% dimming , 50% dimming and 75% dimming as a minimum to the Sports Hall lighting. Other lighting scenes may be requested by the user representative on site

## 10 MISCELLANEOUS CONTROL PROVISIONS (BASKETBALL BACKBOARDS, CRICKET NETS & SEPARATION CURTAIN)

The contractor shall allow for control of separator curtain, cricket nets and basketball backboards winches.
These items are all operated by reversible motor winches which will require the installation of 4 wire system ie with 2 actives to drive winches forward and reverse.

The winches will be supplied and installed by the Sports Equipment supplier and the electrical trade contractor will provide wiring to the fixed winch locations. Proprietary keyed switch mechanisms associated with each of the winches will be supplied by the Sports equipment supplier and installed on a dedicated control panel by the electrical trade contractor.

Refer to electrical drawings for further schematic and layout information.

## SUBSECTION F EMERGENCY EVACUATION & EXIT LIGHTING

## 1 GENERAL

### 1.1 STANDARDS

**General**

Design and installation: AS 2293.1.

Inspection, tests and maintenance: AS 2293.2.

## 2 QUALITY

### 2.1 CONTRACTOR'S SUBMISSIONS

**Product data**

Submit manufacturer's data for each type of luminaire and exit sign including tables indicating the maximum luminaire spacing for a given mounting height.

**Type test data**

Submit the following:

- Photometric data and temperature test reports for each type of luminaire and exit sign.

## 3 COMPONENTS

### 3.1 SINGLE-POINT SYSTEM LUMINAIRES

**General**

Visual indicator lights: Provide a red indicator, readily visible when the luminaire is in its operating location, which indicates that the battery is being charged.
Inverter system: Provide protection of the inverter system against damage in the event of failure, removal or replacement of the lamp, while in normal operation.

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

**Lamps**

All emergency and exit lighting used on this project shall utilise LED lamps with minimum 50 000 hour rated lamps life.

**Batteries**

General: Use lithium – iron-phosphate batteries capable of operating each lamp at its rated output continuously at least 2 hours during acceptance tests and 1.5 hours during subsequent tests.

Battery life: At least 3 years when operating under normal conditions at an ambient temperature of 25$^{O}$C and subjected to charging and discharging at 6 monthly intervals.

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

## 4 INSTALLATION

### 4.1 GENERAL

**Power supply to single-point systems**

Provide a 240 V active supply to each luminaire and exit sign to monitor, the nearest local lighting final sub-circuit.

All exit and emergency luminaires shall monitor a local lighting circuit which shall be fitted with automatically switched and variable timed circuitry capable of simulating a power failure on the monitored circuit without effecting general lighting in the area. Test switches shall be installed within local distribution board and labelled “Emergency Lighting Test Switch”. Design of test circuit to AS 2293.1.

## 5 COMPLETION

### 5.1 COMMISSIONING

**Mains supply**

Before commissioning, ensure mains supply has been continuously connected for at least 24 hours.

**Single-point systems**

Simulate mains supply failure to each general lighting final sub-circuit and verify the correct operation of luminaires and exit signs for a continuous period of 2 hours. Then restore normal supply and verify the operation of the indicator lights on each luminaire.

### 5.2 COMPLETION TESTS

**Single-point systems**

Carry out the 6-monthly procedures before practical completion and again before the end of the maintenance period. Provide certification to meet BCA requirements.

### 5.3 MAINTENANCE

**General**

Carry out the 6-monthly procedures.

Provide appropriate log book for entering test performance of Emergency and Exit lights.

# SUBSECTION G TELECOMMUNICATIONS

## 1 GENERAL REQUIREMENTS

### 1.1 GENERAL STANDARDS

AS 3080: Integrated Communications cabling system for commercial premises.

AS 2054: Telecommunication services pathways and spaces for commercial buildings.

AUSTEL Standard TS-008: Requirements of Authorised cabling products.

AUSTEL Standard TS-009: Installation requirements for customer cabling.

E1A/T1A 568

E1A/T1A TSB-36

E1A/T1A TSB-40

## 2 SCOPE OF WORKS AND DRAWINGS

### 2.1 SCOPE OF WORKS

The scope of the contract telecommunications works as detailed within this specification and associated drawings shall include, but not be limited to, the following:

- supply and install new Cat 6A multi-pair cabling;
-
- supply and install new fibre optic backbone cabling
- supply, install below ground conduits, pits and trenching;
- supply and installation of equipment racks and Cat 6A patch panels;
- supply, installation and termination of RJ 45 telecommunications outlets;
- supply and install conduit and cabling tray as necessary;
- testing, commissioning and training;
- all other minor works as deemed necessary to ensure a fully functional system;

The system shall be provided with the manufacturer's minimum 20 year certification.

## 3 TELECOMMUNICATIONS INSTALLATION

### 3.1 OUTLETS AND ASSOCIATED CABLING

The Contractor shall supply and install telephone/data outlets consisting of 8 position, 8 conductor, non-keyed, RJ 45 jacks in accordance with EIA 568 at each designated point nominated on the drawing. All outlets shall be of KRONE manufacture or an approved equivalent.

The building wiring shall be terminated to the rear of the RJ 45 jack by the use of insulation displacement connections forming a gas tight joint.

All outlets shall be flush mounted, with a finishing faceplate.

The Contractor shall ensure that a minimum separation from a noise source (ie: power cabling) shall be 100mm.

Each outlet faceplate shall be a standard size switch faceplate and capable of accepting installation of two or three individual RJ 45 sockets along the long/horizontal axis. Any unused socket positions shall be fitted with suitable blanking pieces.

a) Each RJ 45 outlet shall be wired back to the Building Distributor (BD) patch panel via unshielded twisted pair (UTP) cables. All such cabling shall be Category 6A.

b) The Contractor shall provide detailed technical specifications of the performance of the proposed cable to be used. The Contractor shall ensure that the cable complies with the following minimum specifications:-

(i) Cable type- All cables are to be unshielded twisted pair type 4 pair cable of Cat 6 performance.

(ii) Gauge- 24 AWG (except for 8 wire RJ 45 jumper cables).

(iii) Characteristic Impedance- 95-105 ohms at 1 Mhz.

(iv) Attenuation- Less than 2.5 dB(A) per 100 meters at 1 Mhz (for 4 pair cables).

(v) Resistance - Less than 8.5 ohms per 100 meters.

The complete structured cabling system shall meet the CATEGORY 6A performance criteria of TSB-36 and TSB-40.

## 3.2 FIELD CABLE COLOUR CODING

Unless nominated otherwise the contractor shall utilise CAT 6 cabling with the following sheathing colours to allow easy identification of each services facility cabling once installed:

RJ45 outlets – **Blue sheath**
CCTV Cameras – **Green sheath**
WAPs (Wireless Access Points) – **Yellow sheath**

Where cabling can be exposed to weather and water all cabling shall be jelly filled and manufacturer certified suitable for external use.

## 4 CABLE PATHWAYS

- No UTP cable run shall exceed 90 mts in length
- Each cable run from the patch panel to the data outlet shall be one continuous length. No splicing or joining in any form shall be allowed.
- UTP cables should not be run in parallel with power cable of any kind and cable routes should avoid devices such as fluorescent lights, plant equipment, etc.
- All wiring shall be installed in a neat and tidy fashion with all physical site disturbances and damages attributable to the contractor being made good by the contractor.
- Work area cabling shall be supported within the ceiling or under the floor of the buildings by cable tray or catenary wire.
- Cable tray, cable ladder or 100x100mm cable duct shall be installed to provide a cable pathway into each of the communications cabinets
- Minimum bend radius figures specified by the cable manufacture shall be strictly observed.
- All wiring inside panels or enclosures shall be grouped and fixed in location by cable ties.
- All points of entry, supporting frames shall be free of burrs or other obstructions so as to prevent damage to the cable insulation or conductors

## 5 PATCH PANELS

The Contractor shall supply and install patch panels each with capacity to accommodate all telephone and data outlets as shown on the drawings plus provide a further 30% spare capacity or as shown on the drawings, whichever is the greater.

Patch panels are to be located, arranged and centred as shown on the drawings.

All patch panels shall be of KRONE manufacture (or approved equivalent), CAT 6A complaint and 568A sequence manufactured.

A patch cable support system shall be integral to the patch panel. Allow one patch lead per port plus 20% spares.

A cable management system shall be integral to the patch panel/equipment rack arrangement.

The building wiring shall be terminated to the rear of the RJ 45 jacks, forming the patch panel, by the use of insulation displacement connections forming a gas tight connection.

## 6 CABLE TERMINATIONS

Cable pairs shall be terminated in a neat and professional manner in the 568A sequence. The sequence of termination cables on the patch panels shall reflect the sequence of data outlets.

Cable conductors shall be terminated in IDC punch down slots as per the manufactures' recommendations using the correct punch down tools.

At both termination ends, trimming of the outer jacket of the cable shall be 13mm in length and the twists of the cable pairs shall be maintained as close to the punchdown slots as possible.

All cables at their termination ends shall be tied up properly so as to prevent strain due to the weight of the cable.

## 7 EQUIPMENT RACKS

The Contractor shall supply and install an equipment rack to house various items of communications equipment. The rack shall consist of the following:

- Dimensions of nominal 800mm wide, nominal 800mm deep and 45 RU in height or as nominated on drawings.

- The communications cabinets will be floor mounted as nominated on the drawings.

- Floor mounted cabinet shall be fitted with a lockable tinted glass acrylic front door, lockable metal rear door, equipment mounting rails and horizontal power rail.

- Cabinets are to be manufactured by Rack Technologies or approved equivalent.

- Be fitted with a 15 way power outlets bus, mounted horizontally in the rear of each cabinet. The power bus shall be fitted with a 2 meter input cable and captive plug.

- With provision for top cable entry. Cable entry points shall be suitably bushed and grommeted with 200% spare capacity.

Patchleads: RJ45 to RJ45 patchleads are required for connection from the RJ45 patch panels to the active network hardware. The quantity to be supplied shall be equal to the number of installed data outlets.

## 8 LABELLING

The Contractor shall provide, as a minimum, fixed, indelible labelling as follows:

**Outlets:**

- Each individual RJ 45 outlet point (ie: two (2) per outlet plate) shall be clearly labelled with a Traffolyte style label indicating an individual outlet number.

**Recommended numbering scheme:**

Building Distributor: BD01-05, where BD01 represents building distributor 01 and 05 represents the outlet location. ie, at building distributor 02 outlet 23 would be labelled BD02-23.

**Patch Panels**

- Each patch panel outlet shall be labelled in sequential numbers from top to bottom, left to right;

- Each pair in a horizontal shall have provision for the installation of written label;

- Each patch panel outlet shall be numbered in accordance with the numbering system used for the outlets.

**Equipment Racks**

- Each equipment rack shall have an identification label. The label shall be engraved traffolyte or equivalent 75mm x 25mm. This label shall be fixed external at the top centre of the rack. The engraving details are to be advised by the Superintendent.

## 9 TESTING AND COMMISSIONING

### 9.1 TESTING

- All tests shall be recorded and presented as part of the "as installed" documentation.

The following tests shall be performed:

Field outlet to Patch Panel cabling:

- Pair polarity continuity check - to check for pair and wire reversal and compliance with EIA 568 (Fig. 11.1) for arrangement of pairs.

- Resistivity check to determine the exact length of each cable (it will only be necessary to perform this test on one pair in each workstation cable).

- Impedance testing.

**NOTE:**
As an alternative a TDR (Time Domain Relectometer) can be used to determine cable lengths.

**Tie Cables:**

- Pair polarity continuity check - to check for pair to pair and wire to wire reversals.

- Resistivity check to determine the exact length of each cable (it will only be necessary to perform this test on one pair in (each riser cable binder bundle).

### 9.2 COMMISSIONING

The Contractor shall demonstrate that the voice/data system complies with requirements of the drawings and specification and operates in a satisfactory manner including the following as a minimum:

- Arrange acceptance tests to be carried out in the presence of the Superintendent to demonstrate satisfactory operation of the system;

- The Superintendent may request verification of any of the previously performed tests;
- Carry out the tests on cable pairs selected at random by the Superintendent;
- The Superintendent may also request demonstrations of the functionality of the various transmission types as detailed in this section of the specification;

- Provision of all test equipment and provision of a list of all proposed test equipment to be utilised in the commissioning tests.

**NOTICE**
Give sufficient notice that commissioning of the integrated voice/data system is to commence.

## 9.3 ACTIVE SWITCHING HARDWARE AND PABX / VOIP

The supply of active switching hardware, VOIP equipment and /or upgrade, servers etc required for this site shall not form part of this contract. All such equipment shall be supplied and installed by specialist contractors outside these main works.

# 10 TRAINING

## 10.1 TRAINING

The Contractor shall provide a training course to fully acquaint users with the structured cabling system. The course shall be configured to cover the principles of the system and its maintenance, including moves and changes.

## SUBSECTION H NBN CABLING SERVICES

## 1 GENERAL

### 1.1 STANDARDS

**General**

Cabling products: To AUSTEL TS 008.
Installation of cabling: To AUSTEL TS 009.

## 2 QUALITY

### 2.1 CONTRACTOR'S SUBMISSIONS

**Product data**

Submit product data for components.

### 2.2 CONTRACTOR'S QUALIFICATIONS

All works shall be performed by the holder of an appropriate AUSTEL licence.

## 3 TELEPHONY INCOMING NBN CO SERVICE CABLING

### 3.1 MAIN INCOMING SERVICE CABLING PROVISIONS

The contractor shall allow for the conduit pathways provisions from the nearest existing NBN/Telstra pit for the installation of new NBN Co service cabling & any other future carrier service cabling. The new conduit provisions shall be minimum 2 x 50mm dia white HDUPVC conduits.

Arrangement of new internet and telephone services to the site shall be arranged by the councils internal IT department in consultation with the relevant service provider however suitable cable pathways shall be made available by the contractor under this project.

### 3.3 INCOMING NBN CO CABLING

The Contractor shall allow to clearly mark the incoming underground NBN Co service cable / conduit to the site and to ensure its location is clearly visible to minimise the chances of damage during the construction works at the site

### 3.3 SEGREGATION

**Requirements**

Segregate communications cables from other services to AS3000, AS3080 and TS009. On parallel runs longer than 1000mm long, Telecommunication cabling shall be separate from power cabling by 100mm min.

## 3.4 TESTING

**Pair tests**

Test each pair in every cable for:

- continuity;
- correct sequence

## SUBSECTION I ELECTRONIC SECURITY

### 1 GENERAL

The Contractor shall supply, install and commission a new electronic security system to serve the new buildings. The security system shall be of "Integriti" manufacture by Inner Range unless approved otherwise by the Superintendant.

### 2 SCOPE OF WORK

**GENERAL**

All cabling shall be hidden in risers, false ceilings on (communications) cable tray etc.
The scope of the security works shall include but not limited to the following:

- Supply and installation of security / access control panels.
- Supply and installation of expander panels as required.
- Supply and installation of new security peripheral devices (reed switches and motion sensors) as nominated on the drawings
- Duress alarm call provisions
- Supply and install audible and visual alarms;
- Supply and install electric strikes and magnetic locks as applicable
- Supply and install alphanumeric keypads;
- Supply and installation of LAN Isolation equipment.
- Full testing, commissioning and 12 months defects liability of the installation including 24 hour hotline support.
- "As installed" drawings and maintenance manuals for all works performed under this contract.
- All miscellaneous minor works necessary for a fully functional security system.

**CONTRACTOR'S SUBMISSIONS**

Submit shop drawings showing the following:

- Block diagram of the systems.
- Access control schematics.
- Schematics outlining interfacing with other systems.

**POWER SUPPLY**

Any plug packs, signal/power separation filters and power supplies necessary for a fully functioning security system shall be supplied by the Contractor.

The Security system shall be provided with a dedicated supply. Label the switchboard circuit breaker from which power for the Security system is obtained *"SECURITY SYSTEM - Do not switch off"*. The socket should be of a lockable variety

The power circuit shall be provided with a single phase, power surge filter with a minimum 15 KA surge rating utilising Metal Oxide Varistor primary protection and low pass LC filter secondary protection. The surge protection units shall incorporate an alarm function and LEDs which monitor the filter's integrity and external alarm contacts.

## 2.1 MAIN SECURITY PANEL

The new main security system panel shall be installed within the new dedicated electrical/comms room as indicated on the drawings.

The Contractor shall provide appropriate cabling to allow LAN communication between all remote keypads & expander modules and the main security panel. The system configuration and cabling shall be strictly in accordance with the manufacturers recommendations.

The final system configuration shall allow the following functions:

- Full (or partial) arm and disarm of the security system from designated proximity readers.
- Full programming capabilities treating every peripheral device individually

LAN isolator modules shall be provided as necessary for communication to remote expander modules and provide protection against voltage spikes and surges.

**EXPANDER PANELS**

The Contractor shall supply and install expander panels as required within the buildings, to connect all peripheral security devices.

The Contractor shall provide battery back-up to each security panel and expander such that in the event that the site experiences a power failure, the entire security system shall be capable of normal monitoring operation for 24 Hrs on battery supply. The system shall notify remote monitoring security of the power failure via a dedicated communications link.

Expander panels shall generally be installed in electrical or communication cupboards or other approved locations, not subject to tampering or vandalism.

The contractor shall allow to supply and install dedicated power supply 20A / 240V circuit with surge protection for each expander panel

## 3 REED SWITCHES

All reed switches shall be connected to security panels building as individual zones. Double leaf doors with 2 reeds shall be treated as one zone.

All reed switches shall be recessed into doors and frames. All reed switch cabling shall be hidden from view unless otherwise approved. Surface mounted reed switches shall only be permitted if approved by the Superintendent.

## 4 LAN CABLING

The LAN cabling linking all security panels within the buildings shall be installed by the Contractor within the communications risers, cable tray and conduits servicing the buildings.

## 5 SIRENS AND STROBES

Sirens and strobes shall be installed outside on the facade of the building and internal sirens within the building as nominated on the drawings.

Strobes shall comply with the following requirements:

- strobes shall be blue in colour, waterproof and have a minimum rated life of 500,000 flashes.

- Strobes shall be programmed to flash continuously from time of alarm activation until panel is disarmed.

- Strobes shall be rated 12-14 Volts DC with a minimum continuous running time of 150 hours.

- They shall be installed in locations inaccessible to tamper but highly visible. (Min 3500mm AFFL).

Sirens shall comply with the following requirements:

- they shall have a variable electronic tone

- they shall be programmed to operate for a maximum of 8 minutes externally and housed in a weatherproof, tamperproof enclosure.

- internal sirens shall be piezo type and recessed ceiling type.

## 6 REED SWITCHES

All reed switches shall be new commercial grade door recessed devices. Reed switches for roller doors shall be industrial grade floor mounted complete with heavy duty aluminium protective cover and flexible steel conduit.

## 7 MOTION DETECTORS

All Infra-red detectors shall be new dual-technology detectors incorporating motion and heat sensing elements complete with variable sensitivity. Where nominated motion detectors shall be installed with a 360 degree field of view

## 8 MAGNETIC LOCKS

At the locations nominated the contractor shall allow to supply and install weatherproof magnetic locks on nominated doors and gates. All such locks shall be similar to Lockwood PADDE Series Z8 with a minimum of 550kg holding force. The lock status shall be 24hr monitored by the security system and shall set off a local alarm of held open beyond its programmed time of forced open.
All such locks shall be provided with fire signal release relay.

## 9 COMPLETION

The security system expansion shall be fully tested, commissioned and provided with a comprehensive maintenance manual and as-installed drawings. The contractor shall provide full 12 months (parts & labour) warranty for the entire system.

## 10 SECURITY SCHEDULE

The contractor shall produce a typed schedule indicating the zone allocation to each protected area and device. For example:

Zone 1 - Room 5, PIR

Zone 2 - Entrance South, Reed switch etc

This schedule shall be mounted in a clear plastic holder adjacent the security panel within managers office.

Another copy of the schedules for the building shall be combined into a manual for use by the Superintendent.

## 11 LIGHTING & SPORTS HALL HEATING CONTROL INTERFACE

The security system shall be provided with voltage free relays to provide master lighting control to the nominated internal lighting and Radiant heaters located in the Sports Hall .

The system shall be arranged so that a lighting and heater control relay shall be provided for each separate security ARM/DISARM zone within the development. This will ensure that as each zone is ARMED the relevant lighting and radiant heater circuits within the ARMED zone will be automatically isolated via contactors provided within the local supply distribution board. When that particular zone is DISARMED the lighting and radiant heater circuits within the disarmed zone shall return to their original status allowing normal local switching control.

The following zoning shall be initially allowed for this project

| | |
|---|---|
| Zone 1 | Indoor Sports Hall and associated Store rooms etc |
| Zone 2 | Main Entry/Control/Admin/Kitchen/Amenities Area |

## 12 DURESS ALARM PROVISIONS

At the locations nominated on the drawings the contractor shall provide duress alarm pushbuttons with keyed resent capabilities. When one of these buttons is activated the security system shall automatically dial the local police for assistance and shall play a pre recorded message.

The duress buttons shall be each a 24 hour separately monitored input to the security system but when pressed they shall not provide any local audible or visual alarm.

The duress pushbuttons shall be discreetly installed under benches or at other locations nominated on the drawings.

## SUBSECTION J CLOSED CIRCUIT TV SYSTEM (CCTV)

## 1 GENERAL

### GENERAL

Provide a new & complete IP Based CCTV system incorporating cameras, cabling, monitors and digital recording.

The CCTV system shall utilise software and hardware which is readily available to numerous specialist installers, and supply outlets Australia wide.

The CCTV System shall be I.P. based and shall use appropriate Panasonic IP digital cameras (or approved equal), connected to Panasonic IP Encoders to allow access to the L.A.N. A Panasonic Network Digital Recorder shall be installed to allow recording of all the system cameras, while allowing for future modular integrated system expansion.

All Hardware installed shall be able to be updated with the latest firmware/Software at no additional cost or hardware upgrade.

### SYSTEM ADMINISTRATION

The System administration and Operation shall be controlled from a nominated Administration P.C supplied by the Superintendent. The network video recorder (NVR) shall have a Full HD HDMI video output and a spot output monitor. It shall be possible to operate the NVR using a mouse connected directly to the NVR.

It shall be possible for up to 16 users to be registered to the NVR and the images to be viewed from any P.C. (Optional with permissible administrator access rights)

The contractor shall provide the Superintendent with all system codes, passwords, software and administration rights at the commissioning of the completed CCTV system to permit service and maintenance of the system by any appropriately qualified security technician once the initial warranty period is over

The Administration / User software shall be capable of searching for recorded images, based on motion, time, alarms, and camera analytics if nominated. Motion shall be detected on a user configurable motion sensitivity scale.

The NVR administration software shall be capable of allocating edge device IP address automatically from two mouse clicks. This will be accomplished even if all the devices initially have the same IP address.

The Administration software shall allow 5 user levels to be defined. In addition each registered user shall be allocated operable cameras as part of the registration.

The Administration and User software shall allow up to 16 cameras to be replayed simultaneously by site explorer group or salvo in a multi-view playback format

## NETWORK VIDEO RECORDER (NVR)

The Networked Video Recorder (NVR) shall be provided with minimum 20 TB storage, or equivalent, shall have enough storage for a minimum of 30 days of constant recording, with 30 ips/camera at a minimum HD (1280x960) resolution for each camera.

The NVR shall be capable of connecting up to 32 digital CCTV cameras

The NVR shall be installed within the Communications rack complete with any required power supplies and a dedicated management LCD HDMI monitor and mouse.

NVR's shall allow transmission of CCTV images to local PC's via the structured cabling system and shall allow down-load of video material to both hard disk and standard removable media. The down-loaded video material must use a player that can authenticate the material has not been altered.

The NVR shall be fitted with Alarm / Event facilities which will allow the system to trigger recording of cameras on the sensing of motion within the cameras field of view outside normal business hours for the centre. When triggered this function shall allow the automatic texting (or emailing) of a nominated mobile phone, IPAD or another nominated device with a programmable message complete with a clear 15 sec (programmable) video stream. The quality of the video images shall be of sufficient high quality to allow facial recognition by contacted security staff.

The system shall be able to store up to 500 such events complete with the video stream, time & date for review later by security staff

## CAMERAS AND LENSES

All cameras shall be suitable for internal and external use. Cameras shall have the ability to mount C and CS lenses and be able to be powered by 12 volts direct current or via a PoE switch.

All cameras shall use 1/3" digital colour CCD technology with dual power input supply (12Vdc /PoE) interline transfer providing effective 2529,792 pixels with a micro-lens on each pixel, and shall achieve high sensitivity of 0.08 lux minimum illumination with slow shutter off. It shall be capable of a resolution of min 2048x1536 and a dynamic range of 52 dB.

Cameras should include "Super Dynamic" capability where the ambient lighting or Sunlight may cause non-Dynamic cameras viewing problems.

Intelligent backlight compensation shall be incorporated with digital signal processing.

Indoor cameras shall be provided with appropriate mounting brackets.
Outdoor cameras shall be suitable for wall or ceiling mount applications as appropriate.

All CCTV cameras shall be provided with motion detection capabilities which will allow cameras to automatically record events or movement which happen within their field of view within programmed out of hours times. This function shall be fully programmable and shall allow both the field of view and the size of the moving object needed to trigger recording to be adjusted on site according to site conditions.

The Contractor shall be responsible for selecting lenses to suit the applications. The control of lenses shall be totally automatic. All lenses shall have 1/3" CS Mounts auto-iris megapixel vari-focal.

All lenses shall be colour corrected.

The camera shall have a face detection feature on board and use automatic back-focus to adjust the camera focus.

## CAMERA SURVEILLANCE DOMES

Provide discreet surveillance domes where suitable to all internal and external CCTV cameras at locations nominated on the drawings with the following specifications:

- Fully sealed assembly, IP65 rated with rubber gaskets, to prevent ingress of dust, smoke and moisture.
- The camera housings shall be 100% optically corrected.

## ENVIRONMENTAL HOUSING

Cameras mounted externally, shall be installed in environmental enclosures. The enclosures shall be purpose designed for CCTV. They shall be compact, made from aluminium, with a baked enamel finish. The lid may be the sliding type or may be hinged. The lid must be lockable with screws or hexagonal screws. Each environmental housing shall include a tamper alarm that is monitored by a sector on the intrusion alarm system where applicable. The housing shall be rated at IP66. The camera mounting shall be adjustable and capable of supporting the weight of the camera and lens.

The housing shall include a powder coated adjustable sunshield and shall be suited to the weather conditions experienced in the area. External housings shall include a demister

## CCTV MONITORS

CCTV monitors shall be provided with appropriate wall mounting brackets and shall be 26" High resolution LCD Colour HD.

The Contractor shall allow to provide monitors complete with wall/ceiling mounting brackets in the locations nominated on the drawings.

Provide two off CCTV monitors complete with wall mounting brackets within the centre control desk area. The exact location shall be agreed on site with the Superintendent.

# SUBSECTION K FIRE DETECTION AND COMBINED BOWS SYSTEM

## 1 GENERAL

### 1.1 STANDARD

**General**

To AS 1670 and BCA

## 2 SCOPE

### 2.1 GENERAL

The scope of works associated with the fire detection system to be undertaken by the Contractor shall include, but not be limited to the design, supply, installation and commissioning of the following:

- Thermal and smoke detectors;
- BOWS speakers and visual emergency indicating lights;
- Manual call points;
- Fire indicator panel (FIP);
- BOWS system panel with microphone & zoning provisions;
- Supply and installation of Fire Alarm Sounders;
- Fire Trip signals to Mechanical Services Control panels , individual AC units, motorised sliding doors, access controlled doors and any other access controlled doors / gates.
- Fire trip signals to the Photovoltaic system including storage battery system to initiate automatic shutdown

## 3 QUALITY

### 3.1 CONTRACTOR'S SUBMISSIONS

**Product data**

Submit product data for components.

- Thermal and smoke detectors;
- Manual call points;
- Fire bell and flashing light;
- BOWS speakers

**Shop drawings**

Submit shop drawings showing the following:

- Fire detector layout.
- Dimensions and details of control and indicating equipment.
- Location.
- Circuit identification.
- Labelling details.

# 4 DETECTION AND ALARM SYSTEMS

## 4.1 AUTHORISED PRODUCTS

**General**

Use equipment listed in the SSL Register of Accredited Products - Fire Protection Equipment.

## 4.2 INSTALLATION WIRING

**Wiring and connections**

**Detectors**

Conductor size: 1.5 $mm^2$ TPI 250 V rated, with red and white insulation.

Sheathing: Red.

**Main Fire Indicator Panel**

Conductor: 1.5$mm^2$ Radox back to main FIP

## 4.3 CONTROL AND INDICATING EQUIPMENT

**Standard**

To AS 1603.4.

**Fire Indicator Panel**

Provide a new Analogue Addressable Fire Indictor Panel with AS1670.1 functionality and digital display, integral battery backup and modem provisions for remote accredited fire alarm monitoring. Provide alarm signal interface to new Building Occupant Warning System (BOWS) panel.

The new analogue addressable Fire panel shall be similar to **AMPAC Fire Finder Plus** or other approved similar system.

All peripheral devices utilised as part of the fire detection system shall be fully interfaced with the selected fire indicator panel

**Fire Trips**

The Contractor shall allow for fire trip cabling from the fire indicator panel to all mechanical distribution boards and individual AC equipment. Fire trips shall be of the latched type at the FIP and shall be cabled using fire rated cable. Mechanical services shall remain isolated until fire trip is reset at the FIP.

Fire trip signals shall be required to all mechanical services control panels within the building.

Provide fire trip signal to all auto sliding, motorized doors, access controlled doors and to allow automatic/manual opening in the event of a fire alarm.

The contractor shall also allow for fire trip signal to be provided to all external emergency exit gates. Refer to the layout drawings for further details.

## 4.4 DETECTORS

**Standards**

Heat detectors: To AS 1603.1.

Thermal detectors shall be of the analogue addressable Type A variety with normal temperature duty, incorporating both fixed temperature and rate-of-rise temperature. All thermal detectors shall match the type already in use in the Hospital.

**Point type smoke detectors: To AS 1603.2.**
Smoke detectors shall be of the analogue addressable optical type. Optical detectors shall cause an alarm when the smoke entering the detectors scatters the light beam between the light emitting diode and the light photo sensing diode.

**Beam type detectors:**
Beam type detectors shall be analogue addressable and shall utilised in the nominated location and shall ultilise a combination of Ultraviolet (UV) and Infrared (IR) beams to minimise the likelihood of false alarms. The beam detectors shall have a maximum range of 100m and shall be provided with an IP66 enclosure. The beam detectors shall be OSID by Xtralis or an approved performance equivalent.

**Self-indicating detectors**
General: Provide a light emitting diode mounted in a clearly visible position, which illuminates whenever detector operation causes an alarm condition to register on the fire indicator panel. Provide self-indicating devices which, if faulty, will not render the detector inoperative under fire conditions.

Mounting positions of light emitting diodes:

- Visible detectors: On the outside of the detector or its base.
- Detectors concealed above ceilings: On the underside of the ceiling immediately below the detector.

**Installation**
Install detectors so they can be easily inspected and tested in site, and readily withdrawn from service.

## 4.5 MANUAL CALL POINTS

**Standard**
To AS1603.5

Manual Call points shall be installed as required to meet AS16701.1 requirements

## 4.6 ALARM BELLS

Fire alarm bells: To AS1603.6

Bell circuits to AS 1603.4

Location of external audible/visual alarm beacons shall meet the requirements of AS16701.1 and BCA.

## 4.7 COMPLETION

**Maintenance**
**Standard**
Maintenance and records: To AS1851.8

# 5 BUILDING OCCUPANT WARNING SYSTEM (BOWS)

## 5.1 General

The contractor shall provide a BOWS system fully complying with the requirements of AS 1670.1 , AS1670.4 and the BCA.

The BOWS system shall be configured to allow use as a PA system (in emergency circumstances) and allow transmission of voice messages and background music using BOWS system cabling and speakers.

In event of an emergency situation normal BOWS system audible tones shall override any public address announcements, background music and any volume control shall be bypassed automatically.

**BOWS PA System Functionality**

The new BOWS system shall be capable of providing 'all-call', single room and group call facilities. The system shall be commissioned with a series of preset "groups" generally as detailed below.

The system shall incorporate emergency tone and pre recorded announcement input capabilities.

**ZONES**
The PA system zoning shall be arranged as follows:

| | |
|---|---|
| Zone 1 | Indoor Sports Hall and associated Store rooms etc |
| Zone 2 | Male & Female amenities areas |
| Zone 3 | Meeting Rm/Kitchenette/Store/Comms room |
| Zone 4 | Main Entry/Control/Admin/Kitchen/Corridor Areas |

**FUNCTIONS**

The BOWS system shall come complete with following additional PA facilities equipment installed within a dedicated rack in the control desk area:

1. Emergency tone generator
2. Recorded announcement provisions
3. Commercial grade CD player rated for continuous operation
4. Digital AM/FM tuner.
5. Blue Tooth communications provisions

**SPEAKERS**
Speakers shall be high fidelity ceiling recessed type with a white perforated baffle. Such speakers shall have the following specifications.

- Comply with AS1670.4 requirements
- 5 Watts RMS Power rating minimum
- Frequency response 65-15000Hz (Hertz)
- With built in volume control via transformer line tap.

- Moisture resistant construction

**HORN SPEAKERS**
Within the Main Sports Hall area the Contractor shall provide horn-type speakers. Such horn-type speakers shall have the following specifications:

- Comply with AS1670.4 requirements
- IP65 rating, Impact resistant , ABS resin body, with wide angle paging projector for external “corner” locations as necessary.
- 20 Watt RMS Power rating
- Volume Control via taps
- Frequency response 225-14000HZ
- Complete with line matching transformer and impedance-wattage selector switch.
- Provided with protective wire guard (white powder coat finish)

**AMPLIFIERS**
The BOWS/PA system shall be provided with suitably rated power amplifiers sized by the Contractor to suit the number of speakers in the completed system. The amplifiers shall generally have the following minimum performance specifications.

- Comply with AS1670.4 requirements
- Frequency response 30 to 20,000 HZ (-3dB ref RPO).
- Less than 2% Harmonic distortion at rated power
- Hum and Noise, 80db below rated output Regulation, Better than 2dB from full load to no load.
- Thermal cutout electronic overload.

**MICROPHONES**
The combined BOWS/PA system shall be provided with a desk mounted Omnidirectional microphone complete with gooseneck mounting brackets at each of the following locations:

- Control Desk (Main Entry)

The microphones shall have a Push-to-Talk switch with a uniform frequency response of 50 to 15000HZ Hertz.

All microphones shall incorporate a zone selection console to select into which zone announcements will be made without the need to go to the amplifier rack or BOWS panel. The zone selector shall incorporate an “All Call” function to allow calls to all speakers connected to the system.

## 5.2 STANDARDS

**General**
To AS1670.4

## 5.3 COMPLETION TESTS

**Test Reports**

Submit the sealed batteries test report, the commissioning test report, the system installer's statement, system test certificates, and system information in the forms provided in AS1670.4 Appendices D, E, F, G, and H.

## 5.4 MAINTENANCE

**Standard**
To AS1851.10

**General**
Perform Level 2 maintenance routines

## SUBSECTION L WIRING AND ACCESSORIES

## 1 GENERAL

## 2 QUALITY

### 2.1 SITE TESTS
Test the insulation resistance before the final connection of equipment and before energisation.

### 2.2 CONTRACTOR'S SUBMISSIONS
**Cable routes**
If not shown on the drawings in detail, submit details of the following:

- Sub-main cable tray routes and signs.

- Switchboard cupboard layouts including risers.

## 3 WIRING SYSTEMS

### 3.1 SELECTION
**General**
Use the following systems:

- Cast concrete slabs: Unsheathed cable in heavy duty UPVC conduit.
- Accessible spaces: Thermoplastic insulated and sheathed cables fixed to catenary.
- Concealed spaces: Unsheathed cable in UPVC conduit.
- Plastered or rendered surfaces: Cable in UPVC conduit.
- Stud walls without bulk insulation: Thermoplastic insulated and sheathed cables.

### 3.2 INSTALLATION
**Standard**
Fire or mechanical damage: Classifications to AS/NZS 3013.

**Installation methods table**

| Wall construction | **Installation and concealed cabling facilities** |
|---|---|
| Rendered masonry partition | Flush wall box - conduit chased into wall |
| Double sided face brick partition | Vertically mounted flush wall box with conduit concealed in cut bricks |
| Face brick external cavity wall | Flush wall box with thermoplastic insulated cables in conduit run in cavity and tied against inner brick surface, or thermoplastic sheathed cables run in cavity |
| Stud partition | Rewirable |

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

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

**Cable joints**
Locate in accessible positions in junction boxes.

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

**Conductor colours**
General: For fixed wiring, use coloured conductor insulation. If this is not practicable, slide at least 150 mm of close fitting coloured sleeving on to each conductor at the termination points.

Active conductors in single phase circuits: Red.

Active conductors in polyphase circuits:

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

**Tagging**
Identify multicore cables and trefoil groups at each end using stamped non-ferrous tags clipped around each cable or trefoil group.

**Marking**
Identify the origin of all wiring using legible indelible marking.

## 4 POWER CABLES

### 4.1 SELECTION

**Cable**
Minimum size:

- Lighting sub-circuits: 1.5 $mm^2$.
- Power sub-circuits: 2.5 $mm^2$.
- External Pole Lighting: 6 $mm^2$
- Sub-mains: 6 $mm^2$.

### 4.2 UNSHEATHED - INSTALLATION

**General**
Use permanently fixed conduit enclosures assembled before installing wiring. Use draw wires to pull in conductor groups from outlet to outlet, or use ducts with removable covers.

# 5 TERMINATIONS

## 5.1 COPPER CONDUCTORS

### General

Other than for small accessory and luminaire terminals, terminate copper conductors to equipment, using compression-type lugs of the correct size for the conductor. Compress using the correct tool or use soldering.

### Within assemblies and equipment

General: Loom and tie together conductors from within the same cable or conduit from the terminal block to the point of cable sheath or conduit termination. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

- Alternative: run cables in UPVC cable duct with fitted cover.

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

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

# 6 WIRING ENCLOSURES AND CABLE SUPPORTS

## 6.1 CONDUITS

### Minimum sizes

Metallic and non-metallic conduits: 20 mm.

Galvanised water pipe: Medium or heavy, to AS 1074.

### Rigid conduits

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

### Galvanising

If installed in damp locations, galvanise mild steel wiring enclosures and support systems.

### Set out

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

### Inspection fittings

Locate in accessible positions.

### Draw cords

General: Provide draw cords in conduits not in use. Leave 1 m of cord coiled at each end of the run.

Material: Polypropylene cord, or insulated stranded earth wire, 2.5 $mm^2$ minimum size.

### Draw-in boxes

General: Provide draw-in boxes at intervals not exceeding 30 m in straight runs, and at changes of level or direction.

Underground draw-in boxes: Provide gasketted covers and seal against moisture.

## 6.2 CONCEALED CONDUITS

**Routes**

Conduits concealed in wall chases, embedded in floor slabs or installed in inaccessible locations: Run directly between points of termination, minimising the number of sets. Do not use inspection fittings

.

**Conduits in concrete slabs**

Route: Do not run in concrete toppings. Do not run within pretensioning cable zones; cross pretensioning cable zones at right angles. Route to avoid crossovers and minimise the number of conduits in any location. Space parallel conduits at least 50 mm apart.

Minimum cover: Conduit diameter or 20 mm.

Conduit size: 40 mm maximum diameter.

Fixing: Fix directly to top of the bottom layer of reinforcing where the conduits pass above a single layer of reinforcing.

**Columns**

General: Do not place more than four 25 mm (maximum) diameter conduits centrally in each column.

Bends: Enter columns via bends with minimum radius of 150 mm.

Chasing: Do not chase columns.

## 6.3 METALLIC CONDUITS AND FITTINGS

**Standard**

Metallic conduits and fittings: AS/NZS 2053.7 or AS/NZS 2053.8.

**Type**

Screwed steel.

Corrosion protection

For steel conduits, paint ends and joint threads with zinc rich organic binder to GPC-C-29/16.

**Expansion joints**

General: Provide flexible couplings consisting of flexible conduit and fittings, at:

- structural expansion joints; and

- in long straight runs if the ambient temperature varies by more than $40^{O}C$.

Conductivity: Maintain electrical conductivity between the two ends of rigid metallic conduit.

Movement: Provide conduit support saddles close to flexible couplings to permit free movement for expansion and contraction.

## 6.4 NON-METALLIC CONDUITS AND FITTINGS

**Standard**
Non-metallic conduits and fittings: AS/NZS 2053 Parts 2, 3, 4, 5 or 6.

**Conduits in roof spaces**
Locate below roof insulation and sarking. In accessible roof spaces, provide mechanical protection for light-duty conduits.

**Conduit in slabs**
Use high compression corrugated conduit and restrain at regular intervals to achieve a nominally straight run.

**Category A conduit**
For direct buried installations requiring the use of Category A conduit, use protective cover strips and corrugated conduit.

**Flexible conduit**
Use for equipment and plant subjected to vibration. If necessary, use for adjustment or ease of maintenance. Provide the minimum possible length.

**Associated fittings**
General: Use fittings of the same type and material as the conduit.

Wall boxes on UPVC conduits: For special size wall boxes not available in UPVC, use prefabricated earthed metal boxes.

**Inspection fittings**
Use inspection-type fittings only in accessible locations and where exposed to view.

**Joints**
General: Use cemented or snap on joints.

Expansion couplings: If encased in concrete, do not use bellows type.

## 6.5 CABLE SUPPORTS

**System**
If required provide a complete cable support system consisting of trays or ladders and including brackets, fixings and accessories. Fabricate brackets, racks and hangers using structural steel sections or other materials in sections of equivalent strength.

**Manufacture**
Use proprietary trays, ladders and accessories from a single manufacturer in the same application.

**Cable trays**
Materials:

- Interior: Zinc-coated steel, or steel with two-pack liquid coating, air-drying enamel or stoving enamel finish.
- Cable tray in visible locations shall be powdercoat finished in white gloss

- Exterior: Hot dip galvanised steel.
  Minimum steel thickness:
  - Trays < 150 mm wide: 1 mm.
  - Trays ≥ 150 mm, < 300 mm wide: 1.2 mm.
  - Trays ≥ 300 mm wide: 1.6 mm.

Perforations: To Admiralty pattern, reverse stamping.

**Cable ladders**
General: Use 2 folded steel or extruded structural grade aluminium side rails with cable support rungs between the rails.
Steel ladders: Galvanised.

Rung spacing: 300 mm maximum.

Small cables: Run cables less than 13 mm diameter in cable trays or ducts.

Structural sections:
- Angles and bars: 6.5 mm minimum thickness.
- Rods: 10 mm minimum diameter.

**Fixing to building structure**
General: Fix supports to the building structure or fabric using direct fixing, hangers or brackets.

Spacing: Space supports at maximum intervals of 1.5 m for trays and 3 m for ladders.

**Access**
Provide a minimum of 150-mm free space above and 600 mm free space on one side of trays and ladders.
**Cable fixing**
Provide slats or rails suitable for fixing cable ties, strapping or saddles.

**Bend radius**
Provide bends with a minimum inside radius of 12 times the outside diameter of the largest diameter cable carried.

**Cable protection**
Provide rounded support surfaces under cables where they leave trays or ladders.
**Cable strapping**
Use steel straps on MIMS cables.

**Minimum clearances**
Hot water pipes: 200 mm.

Boilers or furnaces: 500 mm.

## 7 UNDERGROUND SERVICES

### 7.1 CABLES IN TRENCHES

**Sand bed and surround**
Provide clean sharp sand around cables and conduits installed underground.

**Sealing ducts and conduits**
Seal buried entries to ducts and conduits using waterproof seals. Seal spare ducts and conduits immediately after installation. Seal other ducts and conduits after cable installation.

## 7.2 CABLE PITS

**General**
Draw-in pits: Pit sizes shall be as indicated on the drawings. If specific sizes have not been nominated the contractor shall make pit size selections taking into consideration cable bending radii.

The top of all pits shall be installed to match the finished ground level around them to avoid trip hazards.

All pits shall be heavy duty rated suitable for heavy vehicle loading with chequer plate galvanised steel covers.

**Conduit Terminations**
All conduits shall be cut neatly at the entry wall of the pit with all rough edges and burrs removed. Once cabling installation is completed all conduits (used and spare) shall be sealed with an approved expansion foam to prevent the pit and conduits becoming filled with dirt and debris over time.

**Proprietary cable pits**
For pits smaller than 1.2 x 1.2 m, provide proprietary pits can be utilised.

**In situ construction**
For pits greater than 1.2 x 1.2 m, select from the following:

- Proprietary cable pits.

- Construct walls and bottoms using rendered brickwork or 75 mm thick reinforced concrete. Incorporate a waterproofing agent in the render or concrete.

**Pit covers**
General: Provide pit covers to suit heavy traffic loads. Fit flush with the top of the pit. Pit covers shall be reinforced concrete or prefabricated concrete as appropriate

Standard: To AS 3996.

Maximum weight: 20 kg for any section of the cover.

Lifting handles: Provide a lifting handle for each size of cover section.

**Drainage**
General: Provide drainage from the bottom of cable pits, to absorption trenches filled with rubble or to the stormwater drainage system if sufficient depth is available in the stormwater system.

Where the contractor connects pit drainage to the stormwater system , backflow prevention valves shall be provided to stop stormwater flowing into the electrical pit system.

Absorption trenches: Minimum size 300(D) x 300(W) x 2000(L) mm. Absorption trenches shall be interconnected with 90 mm dia agricultural pipe following the line of underground conduits.

## 7.3 UNDERGROUND CABLE ROUTES

**Survey**

Accurately record the routes of underground cables before backfilling.

**Location marking**

General: Accurately mark the location of underground cables using route markers consisting of a marker plate set flush in a concrete base.

Location: Place markers at each joint, route junction, change of direction, termination and building entry point and in straight runs at intervals of not more than 100 m.

Concrete bases: 200 mm diameter x 200 mm deep, minimum.
Direction marking: Show the direction of the cable run using direction arrows on the marker plate. Indicate distance to the next marker.

Plates: Brass, minimum size 75 x 75 x 1 mm thick.

Plate fixing: Waterproof adhesive and 4 brass or stainless steel countersunk screws.

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

**Marker tape**

Where electric bricks or covers are not provided over underground wiring, provide a 150 mm wide yellow or orange marker tape bearing the words "*WARNING - electric cable buried below*", laid in the trench 150 mm below ground level.

## 7.4 LIGHTING AND SOCKET OUTLET SWITCHES

**Minimum rating**

15 A, 240 V a.c.

## 7.5 GENERAL PURPOSE OUTLETS

**Pin arrangement**

Mount outlets with the earth pins at the 6 o'clock position.
GPO’s shall be recessed into a wall. Surface mount wall boxes shall not be used.

## 7.6 LIGHTING OUTLETS

**Pin arrangement**

Standard: 3 flat pin with looping terminal.

Emergency lighting: 4 flat pin if self-contained emergency lighting is to be connected.

## 7.7 INSTALLATION

**General**

Provide flush mounted accessories except in plant rooms.

**Surface mounting**
Use proprietary mounting blocks.

**Restricted location**
Do not install wall boxes across junctions of wall finishes.

**Marking**
Label isolating switches and outlets to identify circuit origin.

## 7.8 OUTLETS AND SWITCHES

All outlets and switches are to be of the HPM or Clipsal manufacture with removeable faceplates.

# TUMUT MULTIPURPOSE & EVACUATION CENTRE

## ELECTRICAL SERVICES

## SCHEDULE OF UNIT RATES

**Return this completed schedule to Superintendant as part of Tender submission.**
(Note: The accompanying submitted tender rates shall be utilised for additions and deletions as instructed by the Superintendent.)

1. Supply, installation and circuiting of the following light fittings complete with lamps.

| **Light Fitting** | **Rate** |
|---|---|
| Type “BL” LED Bollard complete concrete footing, integral driver & powder coat finish | $_____ |
| Type “LP1” Pole mounted luminaire with 4.5m Light Pole complete concrete footing & powder coat finish | $_____ |
| Type “4WP2” LED Surface mounted Weatherproof Fitting | $_____ |
| Type “4B2” LED Surface mounted Batten Fitting with diffuser | $_____ |
| Type” W1” LED external wall light | $_____ |
| Type” L2” recessed LED strip light with IP65 rating and diffuser | $_____/m |
| Type” F1” IP65 rated recessed LED downlight | $_____ |
| Type” 4T2” Recessed LED Panel light suitable for T-Bar ceiling installation | $_____ |
| Type” 4K2” Recessed LED Panel light with IP65 rating suitable for food preparation areas | $_____ |
| Type” F2” IP65 rated recessed LED downlight | $_____ |

| | |
|---|---|
| Type “L1” LED Extrusion luminaire with diffuser and integral driver | $_____/m |
| 10W Track light fitted to surface track | $_____ |
| Type “G” Café Style Pendant luminaire | $_____ |
| Type “HB” Suspended IP65 rated LED High Bay fitting complete with DALI dimmable integral driver & Polycarbonate diffuser | $_____ |
| Type “ E” 2x10W LED IP65 rated Floodlight style emergency light with battery pack | $_____ |
| Recessed 2W LED recessed emergency light with LiFe battery pack | $_____ |
| Exit sign with LED lamp IP65 rated complete with LiFe battery pack | $_____ |

2. Electrical services outlets and other miscellaneous electrical items

| Electrical Item | Rate |
|---|---|
| Supply and Install double GPO within 10m of existing | $_____ |
| Supply and install 20 amp single phase permanent connection complete with RCD circuit breaker and within 30 metres of distribution board. | $_____ |
| Supply and install 20 amp three phase permanent connection complete with RCD circuit breaker and within 30 metres of distribution board | $_____ |
| Supply and install recessed style BOWS system speaker within 40m system amplifier | $_____ |
| Supply and install IP65 rated BOWS system speaker within 40m of system amplifier | $_____ |
| Supply and install recessed style security reed switch | $_____ |
| Supply and install new light switch complete with 10m of switch wire. | $_____ |

| | |
|---|---|
| Supply and install CAT 6A double RJ45 telecommunications outlet within 40m of communications rack | $_____ |
| Supply and install ceiling mounted motion sensor light switch with 360 deg field of view | $_____ |
| Supply and Install IP CCTV camera complete with protective dome complete with 40m of cabling to CCTV recorder | $_____ |
| Supply and Install security system alphanumeric keypad | $_____ |
| Supply and Install security system dual technology PIR | $_____ |
| Supply and Install security system duress alarm button with keyed reset | $_____ |
| Supply and Install proximity Card reader within 40m of nearest security panel | $_____ |
| Supply and install addressable smoke detector with 10m cabling | $_____ |
| Supply and install addressable thermal detector with 10m cabling | $_____ |
| Supply and install concealed addressable smoke detector complete with ceiling mounted LED indicator and 10m cabling | $_____ |
| Supply and Install BOWS system visual alarm device (VAD) with 10m cabling | $_____ |
| Supply and install microphone socket within 40m of amplifier system | $_____ |
| | |

| **Tender Company Name** | **Representative signature** | **Date** |
|---|---|---|
| | | |

# TUMUT MULTIPURPOSE & EVACUATION CENTRE

## ELECTRICAL SERVICES

## SCHEDULE OF PRICE BREAK-UP

**Return this completed schedule to Superintendant as part of Tender submission.**

| | | |
|---|---|---|
| 1 | Consumers Main including termination to new substation (Level2 works) | $_____ |
| 2 | Submains including new Consumers Mains | $_____ |
| 3 | Fibre Optic & copper backbone cabling | $_____ |
| 4 | Main Switchboard and metering | $_____ |
| 5 | Distribution Boards | $_____ |
| 6 | Earthing provisions | $_____ |
| 7 | PV system (200kW capacity) and Battery Storage system (160kWhr) | $_____ |
| 8 | Emergency and Exit lighting | $_____ |
| 9 | GPOs and permanent connections along with subcircuit cabling and isolators | $_____ |
| 10 | Telecommunications outlets and structured cabling system including rack and patch panels | $_____ |
| 11 | Security System including Duress alarm & access control provisions | $_____ |

| | | |
|---|---|---|
| 12 | Addressable Fire Detection system and combined BOWS/PA system | $_____ |
| 13 | IP CCTV system including CCTV monitors & NVRs | $_____ |
| 14 | Internal luminaires including switching & dimming control cabling provisions | $_____ |
| 15 | Intelligent Lighting Control system including touch screen control panel (CBUS or ABB KNX manufacture) | $_____ |
| 16 | Cable tray and other internal cable management provisions | $_____ |
| 17 | External lighting including pole lights, bollards & switching/control provisions | $_____ |
| 18 | Underground conduit & pit system | $_____ |
| 19 | Temporary equipment and cabling associated with the works inc demolition works | $_____ |
| 20 | Remainder of the installation including preliminaries | $_____ |
| 21 | As Installed drawings and maintenance manuals | $_____ |
| | **TOTAL** | **$_____** |

| **Tender Company Name** | **Representative signature** | **Date** |
|---|---|---|
| | | |