

PART E

TECHNICAL REQUIREMENTS

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RailCorp

Integrated Ticketing Early Works

Part E – Technical Requirements

Section 1 – General Specification

Glossary of Terminology

| Acronym / Term | Description |
|----------------|--|
| A | Amp(s), Ampere(s) |
| AFC | Automatic Fare Collection |
| ATOM | Automatic Ticket Office Machine (combination of a computer and magnetic ticket issuer) |
| AVM | Add Value Machine |
| BOM | Booking Office Machine |
| CAD | Computer Aided Design |
| CBD | Central Business District |
| EG | Electronic Gate |
| ESR | Eastern Suburbs Railway |
| EW | Early Works |
| FPD | Fare Payment Device |
| FTE | Fibre optic Termination Enclosure |
| GAC | Gate Access Controller (a type of computer) |
| GHD | GHD Pty Ltd |
| ITP | Tcard Project |
| ITS | Tcard System |
| ITSL | Integrated Transit Solutions Ltd |
| LAN | Local Area Network |
| LS0H | Low Smoke Zero Halogen low toxicity flame retardant (materials) |
| Modem Cabinet | Cabinet containing electronic circuitry and Modems |
| MTI | Magnetic Ticket Issuer, General Dimensions: |
| NATA | National Association of Testing Agencies |
| OTDR | Optical Time Domain Reflectometer |
| PC | Personal Computer |
| RailCorp | Rail Corporation New South Wales (formerly SRA and RIC) |
| RIC | Rail Infrastructure Corporation |
| SAFPD | Stand Alone fare Payment Device |
| SC | Station Controller (existing Device contains electronic circuitry and modems) |
| SCC | Station Control Computer (new device replacing Station Controller) |
| SCU | Station Controller Unit: basically is a computer |
| SRA | State Rail Authority |
| TAC | Transport Administration Corporation |
| TOT | Ticket Office Terminal |
| TVM | Ticket Vending Machine |
| VDC or Vdc | Volts, Direct Current |
| WAN | Wide Area Network |
| WAG | Wide Access Gate, General Dimensions: as above |
| XVCR | Trans-Receiver |

Contents – Section 1

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E1 Scope of Works

E1.1 Scope of this Contract

The work to be done under or in relation to this Contract is as set out in the following sections.

All work and materials not specifically mentioned in the RFT but necessary for the proper and complete installation and operation of the services, as implied in this RFT, shall be deemed to be within this Scope of Work.

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

E1.1.1 Tcard Early Works-Scope of Works

The Scope of Works of the Tcard Project “Early Works” Installation Contracts shall include, but not necessarily be limited to the following:

1. The undertaking of all work in a safe and workmanlike manner having due regard for safety of contractors, station staff and the public and with due regard for the convenience of the public in the environment of an operating rail system
2. The procurement of Service Searches to confirm the existence and to mark the location of existing underground services at stations
3. Design, fabrication and supply of a TVM lifting machine for removing and replacing TVMs from TVM bases. The design of the machine shall be in coordination with RailCorp staff
4. The supply of Worksite Protection Officers when working on or about the rail running lines
5. Liaison with RailCorp staff for access to station buildings and to existing Ticketing Devices
6. Detailed design including the design of equipment enclosures and the supply of prototypes to the Superintendent for approval
7. The supply and installation of new 240V AC station distribution boards (where needed)
8. The addition of new 240V AC circuit breakers at existing station distribution boards and sub distribution boards
9. The supply and installation of new 240V AC sub mains and final sub-circuits
10. Manufacture, supply, fit-out and installation of ITP equipment enclosures including the SAFPD 24V DC Power Supply, UTP patch panel, UTP patch leads, Optical Fibre termination panels and Fibre Optic Patch Leads (at some stations there will be more than one ITP Enclosure)

11. The supply and installation of new 24V DC circuits from the ITP Enclosure(s) to SAFPDs
12. The supply and installation of moisture proof Cat 5e UTP data cabling from the ITP Enclosure(s) to SAFPDs
13. The supply and installation of moisture proof Cat 5e UTP data cabling from the ITP Enclosure(s) to all existing Automatic Ticketing Devices. Where existing conduits cannot be used for access to TVMs the Contractor shall remove the TVM and install new conduiting. An allowance for this is included as a prime cost item in Schedule B3 of this RFT.
14. The supply and installation of new moisture proof Cat 5e UTP data cabling systems from the ITP Enclosure(s) to existing Gate Attendant Consoles and Electronic Gates
15. The supply and installation of new moisture proof Cat 5e UTP data cabling systems from the ITP Enclosure(s) to existing Automatic Ticketing “Modem Enclosures” or “Station Controller Cabinets”
16. The supply and installation of Optical Fibre Cable and fibre termination enclosures where required to interconnect ITP primary and secondary enclosures.
17. The supply and installation of Duplex Optical Fibre data cabling from the ITP Enclosure to the Station Fibre Optic Termination Enclosure (FTE) or at stations where no Optical Fibre connection exists, installation of a moisture proof Cat 5e UTP cable to the Building Distributor
18. The Testing, Commissioning and Certification of Power and Data cabling systems
19. Removal/relocation of station fencing, signage or furniture as indicated on the drawings associated with this RFT
20. The construction of foundations for the mounting of pole-mounted SAFPD’s
21. The fabrication and installation of structural items including wall mounts for wall-mounted and column mounted SAFPD’s
22. The fabrication and installation of plates including floor plates for suspended floor mounted and column mounted SAFPD’s
23. Supply and installation of insulation bushes for bolting of SAFPD wall brackets and poles.
24. Supply and installation of wall gaskets for wall mounted SAFPD brackets and insulating pads for SAFPD poles.
25. The fabrication and fixing of temporary device aperture cover plates for pole-mounted wall-mounted SAFPD’s.
26. Taking delivery of and the installation of LAN Switches in the ITP Enclosures.
Each LAN switch will be supplied with two (2) loose packaged GBIC plug/sockets with LC type connections for fibre optic WAN/LAN connections. The Contractor shall fit the GBIC plug/sockets to the

- LAN switches at the time of installation of the LAN switches on stations.
27. The taking delivery of poles and the installation on the foundations and poles for pole-mounted SAFPD's
 28. Taking delivery of and the installation of brackets and / or supports for wall-mounted SAFPD's
 29. Minor building works and alterations associated with the above, including for example rearrangement or relocation of fencing, new fencing or relocation of station furniture
 30. The revision of the contract documentation, to as installed status using Autocad® Version 2004 showing final equipment location and cable routes. The Contractor shall supply one paper copy and 3 electronic copies on CD to the Superintendent
 31. Assist ITSL as required in acceptance testing of the data and power cabling
 32. Fixing of SAFPD pole backing plates and associated hardware used on the underside of bridges so as to prevent the backing plates and hardware from falling in the event that the pole is removed.

E1.1.2 Supply and Associated Work by Others

1. Programming, configuration and supply into the Contractor's store of LAN Switches that are to be housed in ITP Enclosures by the Contractor.
2. Supply into the Contractor's store of the poles for pole-mounted SAFPD's
3. Supply into the Contractor's store of the mounting brackets for wall-mounted SAFPD's.
4. Supply into the Contractor's store of the 24V Power Cable Plug Assembly for the SAFPD.
5. Supply into the Contractor's store of SAFPD mounting protection bumper.

The location of the store is to be nominated by the Contractor.

E1.2 Contract Drawings

Refer to Section 2 of this RFT for drawing lists.

A number of 'standard' drawings are included in Section 2 of the RFT. These comprise standard Electrical/Data, Civil/Structural details and standard details.

The RFT requires the construction of Civil/Structural Works in accordance with the details on the Standard drawings as amended to take account of conditions local to each site.

Most Electrical/Data drawings are specific to each site and are included in the site specific drawings section for the stations forming part of the scope of this RFT.

Drawings supplied with this RFT are not to be regarded as working drawings, but indicate generally the proposed layout of the plant, systems and equipment.

One hard copy of the Tender Drawings shall be sent to the Tenderers.

The drawings are diagrammatic only and the exact positions of all equipment shall be determined on site. Tenderers shall allow to locate all new or relocated outlets indicated on the drawings to within two metres of the positions shown at no additional cost.

E1.3 Standards & Authorities

E1.3.1 General

Materials and workmanship shall be in accordance with the appropriate standard published by Standards Australia and RailCorp, unless specified otherwise.

Standards, codes and guidelines that are current thirty days prior to the date of closing Tenders shall be deemed to apply unless specified otherwise.

Relevant Standards include, but are not necessarily limited to the following:

E1.3.2 Australian Standards

Concrete Works

| | |
|-----------------|---|
| AS 1012 | Methods of Testing Concrete |
| AS 1082 | Glossary of Formwork Terms |
| AS/NZ S 4671 | Steel reinforcing materials |
| AS 1379 | The Specification and Manufacture of Concrete |
| AS 1478.1 | Chemical admixtures for concrete |
| AS 3610 | Formwork for concrete |
| AS 3799 | Liquid membrane-forming curing compounds for concrete |
| SAAM P 20 | Admixtures for concrete |

| | |
|--------------|-------------------------------------|
| AS 1012 | Methods of Testing Concrete |
| AS 3600 | Concrete Structures |
| SAA HB 64 | Guide to concrete structures |
| SAA HB 67 | Concrete practice on building sites |
| SAA HB 71 | Concrete Design Handbook |
| SAA SP 004 | RC Beams, slabs, columns |
| AS 1302 | Steel Reinforcing Bars for Concrete |
| AS 1303 | Steel Reinforcing Wire for Concrete |

Construction

| | |
|---------|--|
| AS 1012 | Methods of Testing Concrete |
| AS 2601 | Demolition of Structures |
| AS 1289 | Methods of testing soils for Engineering purposes – General Requirements and list of methods |
| AS 1684 | Residential Timber – Framed Construction |
| AS 1720 | Timber Structures – Framed Construction |

Structural Steelwork

Design

| | |
|--------------------|-----------------------|
| AS/NZS 1170 Part 1 | Dead and Live Loads |
| AS/NZS 1170 Part 2 | Wind Loads |
| AS/NZS 1170 Part 4 | Earthquake Loads |
| AS 4100 | Steel Structures Code |

Steel

| | |
|--------------------|--|
| AS 1085 Part 1 | Steel Rails |
| AS 1163 | Structural Steel Hollow Sections |
| AS 1397 | Steel Sheet and Strip – hot dipped zinc coated or aluminium coated |
| AS/NZS 1594 | Hot-Rolled Steel Flat Products |
| AS 2074 | Steel Castings for General Engineering Purposes |
| AS/NZS 3678 | Hot-Rolled Structural Steel Plates, Floor Plates and Slabs |
| AS/NZS 3679 Part 1 | Hot-Rolled Structural Steel Bars and Sections |

Non-Destructive Testing

| | |
|-----------------------|--|
| AS 1710 | Method of Ultrasonic Testing of Carbon and Low Alloy Steel Plate |
| AS 2177 Parts 1 and 2 | Radiographic Examination of Welded Butt Joints in Metal Products |

AS 2207 Non-Destructive Testing - Ultrasonic Testing of Fusion Welded Joints in Carbon and Low Alloy Steel

Workmanship

AS/NZS 1554 Part 1 Structural Steel Welding Code - Welding of Steel Structures

AS 1554 Part 2 Structural Steel Welding Code - Stud Welding (Steel Studs to Steel)

AS 1554 Part 3 Structural Steel Welding Code – Welding of Reinforced Steel

AS/NZS 1554 Part 5 Structural Steel Welding Code – Welding of Steel Structures Subject to High Levels of Fatigue Loading

AS 1627 Metal Finishing – Preparation and Pre-treatment of Surfaces

AS 1796 Welding Certification Code

AS 2214 Structural Steel Welding Supervisors Certification Code

Bolts, Nuts and Washers

AS 1110 ISO Metric Hexagon Precision Bolts and Screws

AS 1111 ISO Metric Hexagon Commercial Bolts and Screws

AS/NZS 1112 ISO Metric Hexagon Nuts, including Thin Nuts, Slotted Nuts and Castle Nuts

AS 1214 Hot Dipped Galvanised Coatings on Threaded Fasteners (ISO metric coarse thread series)

AS 1237 Plain Washers for Metric Bolts, Screws and Nuts for General Purposes

AS/NZS 1252 High Strength Steel Bolts with Associated Nuts and Washers for Structural Engineering

Erection of Structural Steelwork

AS 1470 Health and Safety at Work – Principles and Practices

AS/NZS 1554 Structural Steel Welding Code

AS 1674 Safety in Welding and Allied Processes

AS 2073 Method of Testing Expanding Admixtures for Concrete, Mortar and Grout

AS/NZS 4600 Cold Formed Steel Structures Code

SAA MP20 Part 3 Expanding Admixtures for Use in Concrete, Mortar and Grout

General Technical Requirements

AS 1470 Health And Safety at Work - Principles and Practices

AS 1376 Conversion Factors

AS 1914 Metric Units for Use in Mechanical Engineering and Related Fields

AS 1939 Classification of Degrees of Protection Provided by Enclosures for Electrical Equipment

Information Technology and Data

| | |
|--------------------|--|
| AS 1020 | The Control of Undesirable Electrostatic Electricity |
| AS 1189 Parts 0-24 | Data Processing - Vocabulary |
| AS 2834 | Computer Accommodation |
| AS 3080 | Telecommunications Installations Integrated Communications Cabling Systems for Commercial Premises |
| AS/NZS 3085.1 | Guidelines for the labelling and administration of structured cabling systems |
| AS/NZS 60950 | Safety of Information Technology Equipment |
| AS 3087.1 | Testing of Generic Cabling Systems |
| ACA – TS001 | Safety Requirements for Customer Equipment |
| AS/ACIF – S008 | Requirements for Authorised Cabling Products |
| AS/ACIF – S009 | Installation Requirements for Customer Cabling (Wiring Rules) |

Electrical

| | |
|-----------------------|--|
| AS 2053 | Non-metallic conduits and fittings. |
| AS 2373 Parts 1 and 2 | Electric Cables for Control and Protective circuits |
| AS 2598 | Stabilised Power Supplies DC Output |
| AS 3702 | Item Designation in Electro Technology |
| AS 3000 | SAA Wiring Rules |
| AS 3008 | Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions |
| AS 3100 | Approval and Test Specification-General Requirements for Electrical Equipment |
| AS 3111 | Miniature Over current Circuit Breakers |
| AS 3147 | PVC Insulated Electric Cables and Flexible Cables |
| AS 3760 | In service inspection and testing of equipment |
| AS 60038 | Standard voltages |
| AS/NZS 60950.1 | Information Technology Equipment – Safety Part 1 – General Requirements |

Electromagnetic Radio Interference and Lightning Protection

| | |
|--------------|--|
| AS 1768 | Lightning Protection |
| AS 2279 | Disturbances in Mains Supply Networks |
| AS/NZ4251.1 | Electromagnetic Compatibility Generic Emersion Standard Part 1 Residential Commercial Light Industry |
| AS/NZ 4252.1 | Electromagnetic Compatibility Generic Immunity Standard Part 1 - Residential, Commercial, Light Industry. |

Documentation and Drawing Practice

| | |
|----------------------|---|
| AS 1100 | Technical Drawing |
| Parts 101 and 201 | General Principals |
| AS 1101 Parts 1-6 | Graphical Symbols for General Engineering |
| AS 1102 Parts 1-15 | Graphical Symbols for Electro technology |
| AS/NZS 1100 Part 501 | Technical Drawing-Structural Engineering Drawing |
| AS 1101 Part 3 | Graphical Symbols for General Engineering-Welding and Non-Destructive Examination |
| AS 1103 Parts 1-8 | Diagrams, Charts and Tables for Electro technology |
| AS/NZS 4382 | Preparation of documents used in Electro-Technology. |
| AS 4383 | Preparation of documents used in Electro-Technology |
| | Part 1 - General Requirements |
| | Part 3 - Connection Diagrams, Tables and Lists. |

Quality Systems

| | |
|----------------|---|
| AS/NZ/ISO 9001 | Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation and Servicing |
| AS 4043 | Software configuration management |

E1.4 Statutory Authorities

The Statutory Authorities having jurisdiction over the work include but are not necessarily limited to the following:

- ▶ Rail Corporation New South Wales;
- ▶ Local Supply Authority;
- ▶ The Work Cover Authority of NSW;
- ▶ The NSW Department of Industrial Relations & Employment;
- and
- ▶ Australian Communications Authority.

Advice in writing of all contacts made with Statutory Authorities and furnish copies of all correspondence sent to or received from such Statutory Authorities.

E1.5 Site Inspection

The Contractor shall inspect the site prior to the preparation of the Tender submission to ensure all site conditions and extent of works have been evaluated and included in the Tender price.

It will be assumed, as a condition of the Contract award that the above inspections were appropriately carried out and no variation to the Contract price will therefore be granted on the grounds of unfamiliarity with the pre-existing site conditions.

E1.6 Environmental Conditions

The Contractor is to ensure that the works installed under the Capital Works Contract comply with the requirements detailed in the extract from the TAC Equipment Specification Version 5.4 Section 2.9, which appears below.

E1.6.1 Greater Sydney Operating Environment

| | |
|--------------------------------------|--|
| Outdoor temperature operating range: | -10°C to +46°C (continuous) |
| Indoor temperature operating range: | 5°C to +40°C (continuous), 5°C to +40°C (extreme) |
| Storage temperature range: | -20° C to +60° C |
| Humidity: | 20% to 95% RH, non-condensing (+3% / -2%) |
| Annual rainfall: | 1220mm |
| Maximum wind speed: | 150 km/h |
| Electrical storms: | Occasional |
| Direct sunlight: | 87 clear days per year (average). Full exposure, no protection |
| Vibration & shock: | Newcastle subject to earthquakes |
| Other (dust, grit, rain, etc): | Clean to dusty with blowing grit and sand; Maximum 328 mm of rain per day, wind blown; Snow in outer regions of Sydney |
| Power supply: | 240VAC (+10% / -15%), 50 Hz (±2%) mains supply. |

E1.7 Restrictions on working hours at certain stations

Working hours may be restricted at certain stations, generally construction work is permitted during the period 09:00 to 15:00. Note: Morning and Afternoon peak periods 06:00 to 09:00 hrs and 15:00 to 18:00 hrs Monday to Friday.

E1.8 Work at unattended stations

A significant proportion of the work of site specific Contracts will be undertaken at stations which are unattended or are attended during only part of the day. Details of arrangements to access devices for running data cabling and for access to station buildings are more fully detailed in the site-specific specification.

E2 General Requirements

E2.1 Rail Safety

“On or about the track” terminology means the same as being in the “Danger Zone” as defined in RailCorp Network Rules. Station concourses are not situated in the Danger Zone, however, for the purpose of this project, all associated work is to be assessed and documented by a Qualified Senior Rail Protection Officer to be engaged by the Contractor. Safety measures nominated by the Rail Protection Officer are to be implemented by the Contractor.

All personnel carrying out the work shall have current Track Safety Awareness certification and wear approved high visibility clothing at all times.

E2.2 Approvals

The terms 'approval' 'to approval', 'approved', 'as approved' or 'equal', where used in this RFT, shall require the Contractor to make written application in the form and through the channels indicated in the General Conditions of Contract.

The intention is that all such matters are to be referred to the Superintendent prior to proceeding.

The terms 'witnessed' and 'inspected', where used in this RFT shall require the Contractor to give written notification in the form and through the channels indicated in the General Conditions of Contract.

The intention in that all such matters are to be undertaken in the presence of the Superintendent.

The time involved in these procedures shall be taken into account in establishing the work program and extensions of time for such will not be allowed.

E2.3 Shop Drawings

The Contractor shall prepare and submit shop drawings for approval by the Superintendent prior to fabrication or commencement of works of the following equipment and systems:

- ▶ Distribution boards including sub-mains details, and single line diagrams

Tcard Equipment Enclosure Shop drawings shall detail the following information:

- ▶ configuration and dimensions;
- ▶ equipment layouts and assembly;
- ▶ schematics detailing data and power cabling; and

- specifications for the work and systems.

E2.4 Earthing

A separate 6mm² safety earthing conductor shall be run with each SAFPD 24V power circuit.

All sub-main and final sub -circuit-earthing conductors shall be not less than half the cross-sectional area of the associated active conductor with 7/0.67 mm (2.5 mm²) being the minimum size used.

All final sub-circuit earthing conductors shall be enclosed within the same conduit or sheathing as the associated circuit conductors.

All sub-main and final sub -circuit-earthing conductors shall be connected to the earth bar of the switchboard at which the circuit originates.

E2.5 Final Location and Uniformity

The Contractor shall thoroughly examine the specification and Drawings and check all dimensions immediately after the Contract is awarded and shall obtain from site such measurements and information as may be required to carry out the work.

The locations shown on the Drawings for all equipment, fittings and accessories are approximate only and the final locations shall be determined on the site to comply with site requirements and relevant Standards and Codes of Practice and to suit architectural features.

In general and where applicable, locate equipment to conform to the pattern formed by columns, battens, beams and other services. All equipment shall be accessible for testing and shall be installed clear of lighting fittings, ventilation registers and other ceiling mounted fixtures to conform with relevant codes.

E2.6 Storage of Materials

The Contractor shall make suitable provision for the storage of materials including free issue items, off site, due to the limited storage space available at Stations.

Materials and equipment shall be stored on the site only in locations approved in writing by the Superintendent and only in such manner as will not impede the work and amenity of others and the operation of the railway station.

Materials and equipment subject to damage or deterioration if left in open, shall be stored or protected to the approval of the Superintendent.

E2.7 Inspections

Factory inspections of all components will be undertaken at the discretion of the Superintendent.

Notify the Superintendent ten (10) working days prior to such inspection being required.

E2.7.1 Testing

The installation shall be fully tested to the approval of the Superintendent, and such operations shall be witnessed. Irrespective of any prior tests, the installation shall comply with the RFT, before claims for final payment are met.

The Contractor shall provide complete test and inspection equipment facilities and staff, to ensure that the installation conforms to the requirements of the RFT.

E2.8 Equipment Substitution

Equipment nominated in the RFT and on the drawings shall be used unless written approval is given for alternate equipment by the Superintendent.

The Contractor may be required to pay a fee to cover the review of proposed substitutions. The payment of a fee shall not prejudice the objectivity of the review and no refund will be given if the substitution is or is not approved.

Alternate equipment may be approved providing that it is to an equal or higher standard of manufacture than that specified, its function is similar to that specified and its dimensions do not complicate the installation.

A written application containing full technical information of the proposed substitution, together with reason for change and any cost adjustment that would result must be submitted before any such substitution of equipment will be considered.

The Contractor shall allow at least ten (10) working days for the Superintendent to evaluate the submission.

E2.9 Standardisation of Equipment

Where alternatives of equipment are permitted under this RFT and more than one item is to be supplied, all equipment shall be of the same manufacture and type. All equipment of the same type, supplied under different RFTs of the Contract shall be of the same manufacturer and from a contiguous range.

E2.10 Suitability of Equipment

All equipment supplied and installed under this Contract shall be suitable for connection to the supply. Further, it shall be the Contractor's responsibility to ensure that electrically operated equipment supplied by others is of the correct voltage, frequency, rating, etc. before connecting to the supply.

E2.11 Weatherproof installation

All enclosures installed outside of fully enclosed buildings shall be weather proof to IP54.

E2.12 Drawings

E2.12.1 General

The Contractor shall:

- ▶ Prepare or obtain from manufacturers and suppliers, all drawings and information necessary for fabrication, assembly, installation and commissioning of all plant, equipment and systems.
- ▶ Obtain all drawings and information necessary to enable work to be coordinated with the work of others on the site.
- ▶ Be responsible for the accuracy of all site measurements necessary to correctly locate work.
- ▶ Information or dimensions obtained verbally from others shall be confirmed in writing before being used in laying out or installation of the work.

All drawings are to be prepared in SI metric units.

E2.12.2 As Installed Drawings

The contractor shall maintain a complete set of Contract drawings on site during the course of the Contract for the sole purpose of recording information relevant to the production of 'as-installed' drawings. Progressively mark up those drawings to accurately show the location of the equipment, cabling conduit and cable runs, cable trays and troughing and any changes to the Contract drawings. (See also “Testing, Commissioning and Maintenance”).

E2.13 Care and Protection

The Contractor shall inspect all materials, plant and equipment prior to installation or building in and remove dirt, debris, swarf, filings, burrs and the like.

Leave all unfinished work in a safe condition.

- ▶ Provide adequate protection to the approval of the Superintendent to all equipment during construction.
- ▶ Seal off open ends of pipes and ducts with metal caps to prevent entry of foreign matter until the works have been handed over. Plastic sheet, paper and wood plugs are not acceptable.
- ▶ Provide plastic, cardboard, hardboard, or timbered protection to the approval of the Superintendent to protect items susceptible to scratching, bending or breaking.

- ▶ Maintain weatherproof and dustproof covers over all electrical, control and instrument components.

Care shall be exercised in locating services adjacent to existing plants and trees. Install well clear of existing and future tree root systems.

E2.14 Locks/Keys

The ITP enclosures for Area 1 are Rittal manufacture locked with Rittal lock number 3524. The Contractor shall provide compatible locks to all equipment enclosures and provide two keys for each ITP Enclosure.

E2.15 Metrication

Except where expressly shown otherwise, metric units are used throughout this RFT.

Dimensions are in millimetres unless noted otherwise.

Indicating instruments and controls shall be calibrated in SI metric units unless specified otherwise.

E2.16 Electromagnetic Interference

The entire installation shall not cause any interference to any other service on site including the signalling system, radio communications, television, data and voice communications, computer services, etc. Similarly the installation shall be such that it will not be affected by any other service on site. All in accordance with AS/NZS 4251.1 and 4252.1.

E2.17 Colour of Accessories

Switches, outlets, flush plates, etc. unless particularly indicated otherwise shall be coloured electric white.

E2.18 Corrosion Protection

Separate dissimilar metals in all moist locations by a 3 mm air gap or 1.5 mm PVC or polythene insertion. Isolating ferrules and washers having an electrical resistance not less than the jointing material shall be fitted to all bolts and fasteners.

Fastenings shall have a corrosion resistance equivalent to the parts fastened and shall be of the same or more noble metal or alloy. Surface coatings subject to damage during fastening operations are not acceptable.

Welding of corrosion-protected surfaces will not be permitted unless specifically stated otherwise elsewhere in this RFT.

Metal surfaces in contact shall be cleaned and primed before assembly except as otherwise specified.

Manufacturers' standard finish will be accepted where this conforms to good trade practice and no other direction is given elsewhere in this RFT.

Metal surfaces to be embedded in or in contact with concrete shall be degreased and hand cleaned.

Where practicable, metalwork shall be painted in the factory before dispatch. Blast cleaned surfaces shall be fully primed before delivery to site.

Treated surfaces shall be adequately protected against damage during all handling operations.

Surfaces inaccessible after installation shall be completely painted before installation.

Dry film thickness reading shall be checked using Mikrotest gauges to ensure required film thickness has been applied.

Defective or damaged surface coatings shall be cleaned and repaired in accordance with treatment originally specified.

Surface preparation shall include the removal of all oil, grease, wax and other soluble and loosely adherent matter, followed by further hand, power tool or blast cleaning or pickling in accordance with AS 1629.

Paint and painting materials shall comply strictly with the requirements of the applicable Australian Standards and shall be delivered to the site or factory in the manufacturer's sealed container.

Paint preparation and application shall be by experienced tradesmen and completely in accordance with the manufacturer's instructions and to the approval of the Superintendent.

Apply first coat immediately after surface preparation. Surface must be dry and at maximum temperature of 38°C.

No outdoor painting shall be done in cold or damp weather.

Adequately protect all untreated surfaces adjacent to those to be cleaned and painted.

E2.19 Cutting and Making Good

All cutting and making good required for the installation of work shall only be undertaken by written approval of the Superintendent.

Make good all surfaces damaged during Construction.

The Contractor shall bear the cost for making good of all unnecessary damage to the building structure and finishes and additional cutting and making good required in finished work as a result of incorrect or inadequate details being furnished or failure to comply with the Program.

No welding to or drilling of structural members of the building will be permitted without written permission.

E2.20 Excavation, Backfilling and Restoration

All excavation for trenches, pits, sumps and the like shall be in material as found. Examine the nature of the material to be encountered during excavation and make due allowances for the material as found.

Trench depth shall be increased sufficiently to allow for the bedding material and, if necessary, for the making of joints, construction of manholes etc.

Trench width shall provide sufficient clear space on either side of the conduit to permit proper jointing of the conduit and compaction of backfill.

The clear space between the outside of the pipe and the side of the trench shall not be less than 100 mm.

Trenches shall be excavated at uniform grades in straight lines. A common trench may be constructed where services are parallel and adjacent. Care shall be taken to ensure that all relevant Authorities' requirements are met.

Excavations shall be kept clear of water at all times. Provide for the effective diversion and disposal of surface and ground water during construction. The work shall be arranged so that all water will flow to one or more points from which it shall be drained away by gravity or by efficient pumping equipment of sufficient capacity to keep the excavation de-watered during the time the works are in progress. Install temporary shoring to trenches where required.

Backfilling of trenches shall be carried out only after the conduits and joints have been inspected and written approval from the Superintendent obtained.

Reinstate finished surfaces to the standard existing before excavation.

All bedding and backfill shall be placed uniformly on each side of and over the conduit and compacted in such a manner that the conduit is not disturbed or damaged.

The Contractor shall ensure that normal drainage is not interfered with after completing the backfill. Make good any subsidence that occurs in backfill before the end of the Defects Liability Period.

After backfilling trenches, surplus spoil shall be disposed of in a manner to the approval of the Superintendent.

Leave the works clean, neat and tidy. Remove from the site all rubbish and unused materials relating to the works.

E2.21 Flashing and Vermin Proofing

The Contractor shall be responsible for cap flashing of all ducts, conduits and cables passing through roofs and for all flashing through outside walls and for ensuring that the total flashing system is completely weatherproof.

Cap flashing material shall be electrolytically compatible with the duct, conduit and roofing materials.

All building penetrations associated with the work shall be sealed to make the

installation vermin proof.

E2.22 Painting

Fully paint exposed surfaces of plant, equipment, housings, conduit, cable trays, ducts, insulated surfaces, supports, fixings and plinths and fully paint all surfaces of switchboards, and enclosures, in colours generally selected in accordance with AS 1345. Manufacturers' standard finishes may, but will not necessarily, be accepted.

Galvanised conduit, cable trays and cable duct need not be painted where hidden from view.

The Contractor shall identify to the approval of the Superintendent all equipment throughout the installation.

E2.23 Labelling

All main switchboards, distribution boards, enclosures and internal components namely fuses, relays, terminal strips, circuit breakers shall be comprehensively labelled to clearly indicate their function.

Equipment must be labelled as to their function. Each label shall be 'Traffolyte' or similar material, machine engraved with bevelled edges fixed with at least two (2 No.) screws.

Major equipment labels shall be a minimum of 20mm high, minimum letter size to be 12mm. Minor equipment labels shall be a minimum of 10mm high, medium letter size to be 5mm black on white background.

Laminated electrical circuits schedules and single line diagrams must be placed in a suitable holder mounted to the approval of the Superintendent on the inside of each door compartment of the main switchboard and distribution boards. All such schedules shall be typed and protected by an approved plastic film treatment.

Circuit names (i.e. function and equipment area served) shall be utilised in addition, to any circuit numbering. Field equipment must be labelled with circuit numbers, pan section and switchboard identification.

Determine all circuits as indicated in principle on the single line diagram and generate the as installed version fully amended to reflect the above.

A copy shall be similarly treated to that noted for the circuit schedules and mounted at a convenient approved location either adjacent to the main switchboard or in the plant room. A copy shall also be included in the 'as-installed' manuals.

Provide typed circuit schedules fitted inside the doors of all switchboards behind perspex panels, and comprising:

- ▶ Circuit reference number;
- ▶ Size of cable;

- ▶ Rating of circuit breaker or fuse; and
- ▶ Description of circuit.

E2.24 Penetrations, Core Holes, Sleeves and Embedments

The Contractor shall arrange for and be responsible for all penetrations in floor slabs, walls, roof, etc. necessary to carry out the works and to provide templates, layouts and detail directions to achieve the same.

Where floor slabs or fire walls are penetrated for passage of cables, cable trays, conduits, etc. they shall be sealed to prevent the spread of fire using an approved fire rated non setting intumescent stopping material.

Accurately set out the work, position and install core holes, penetrations for services in floors, walls, beams, columns and pits in conjunction with the fixing of formwork and placing of concrete.

Set out core holes, sleeves and embedments to maintain a maximum tolerance of ± 10 mm from the true position relative to walls, beams and columns. Provide all necessary accurate set out points, survey equipment, plumb bobs, lines, etc and firmly secure all sleeves, cores and embedments to prevent movement during the pouring of the concrete.

Core holes sized to provide the required clearance of service and building elements shall be used for single or multiple pipes and ducts in suspended floors.

Penetration to roofs and walls shall be weatherproofed to the approval of the Superintendent by flashing or caulking as appropriate to the application.

E2.25 Expansion and Spare Capacity

The installation generally shall be designed to enable expansion for additional fare payment devices. The allocation of data switch ports and SAFFPD 24V DC power supply circuits shall incorporate thirty percent spare capacity. This spare capacity requirement has been considered in the design documentation in the contract drawings and shall be maintained as a detailed design requirement.

E3 General Cabling Requirements

E3.1 General

Where cabling is to be run on platforms, the cabling is to be installed within the safe area behind the yellow line either within platform canopies where available or in trenches or ducts in the platform.

All mains, sub-mains and sub-circuits shall be:

- ▶ Of the minimum size and type as shown on the single line diagram.
- ▶ Installed over routes which have been fully coordinated with other services. All power and data shall be segregated by rigid barrier or fixed separation.

Where mains are run underground, they shall be installed in HD PVC conduit coloured ORANGE. Where data are run underground, they shall be installed in PVC conduit coloured **WHITE**.

Where mains are installed within buildings, they shall be:

- ▶ Run in accordance with AS3000 and adequately fixed to supporting tray, conduit or structure.
- ▶ Run on cable tray or in conduit, where run in electrical and data risers, and void areas.
- ▶ Installed using unbroken length of cable.
- ▶ Installed in a workmanlike manner parallel to walls, floors and ceilings, as applicable. Cables shall be concealed in all areas other than plant rooms, switch rooms or areas not normally accessible to the public. Visible cable runs shall be mechanically protected and shall be approved by the Superintendent.
- ▶ Run in a manner eliminating any possibility of strain on the cable itself or on cable terminations.
- ▶ Installed in such a manner that adequate spacing is provided for fixing and for heat dissipation.
- ▶ Kept a safe distance from items liable to become hot. The distance shall be consistent with the maximum temperature possible and the cable type. Cables shall at no point make direct contact with such items.
- ▶ Not embedded in plaster, concrete, mortar or other finishes unless they are in conduit and capable of being fully withdrawn and replaced after the building is finished without damage to finishes.
- ▶ Not installed in the same length of conduit, duct or in the same junction box, where cables are from different distribution systems or switchboards.
- ▶ Installed to reduce inductive effects on surrounding metalwork. Where parallel conductors are used, cables shall be grouped in 3 phase trefoil formations.
- ▶ Installed with bending radii not less than the manufacturer's recommendation and in any case shall be not less than six times the overall cable diameter.

- Run straight for at least 300mm immediately prior to entering switchboards and other equipment.

E3.2 Compliance With AS 3000

All new and reused electrical circuits shall comply with the requirements of AS 3000.

The SAFPD 24V DC Power System shall comply with the SELV requirements of AS 3000 and AS 00950.

E3.3 Power Cables (240V AC, SAFPD 24V DC and Earth)

The Table below specifies cable types to be used

| STATION TYPE | APPLICATION | | |
|---------------------------------------|---|---|--|
| | 240V AC | 24V DC | SAFPD Earth |
| Underground or "Below Ground" Station | Triangle Cable BVA- PAXN/2c2.5B K Black Sheath | Triangle Cable BVA- PAXN/2c2.5B K Black Sheath | Triangle Cable 6mm ² UPA-XXXD/1C Green/Yellow |
| Above Ground Station | 2c+E (Cu) PVC/PVC Circular Orange | 2c2.5 (Cu) PVC/PVC Grey Flexible Cord | 6mm ² (Cu) PVC/PVC Green/ Yellow |

Low Smoke Zero Halogen low toxicity flame retardant cables and conduits shall be used exclusively at all stations defined as "Underground" or "Below Ground"

A list of stations at which this provision applies is included in the site specific RFT.

E3.4 Data Cables

All data cables shall be of approved type and manufacture and only good quality cables specifically suited to the service for which they are utilised shall be provided.

The Table below specifies cable types to be used:

| STATION TYPE | APPLICATION | |
|-------------------------------|---|-----------------------|
| | Balanced Pair Cabling | Optical Fibre Cabling |
| Underground or "Below Ground" | Unscreened Cat 5e UTP Plenum Type Cable | Single Mode |
| "Above Ground" | Unscreened Cat 5e UTP | Single Mode |

Moisture resistant data cables shall be used as indicated on site specific drawings.

Low Smoke Zero Halogen low toxicity flame retardant cables and conduits shall be used exclusively at all stations defined as "Underground" or "Below Ground".

Refer to Section E6 for cable assembly details.

E3.5 Cables in Conduits

In addition to the general requirements, cables shall be fed into conduit in such a way as to prevent twisting and crossing.

Conduits shall be completely assembled and built-in before drawing in cables. Do not use inspection fittings for drawing in cables. Kinked or damaged cables shall be replaced at the Contractor's expense.

E3.6 Cables in Skirting Ducting

Cables in skirting ducting shall be installed as detailed in the Drawings and shall be in accordance with AS 3000 and the Manufacturer's requirements.

E3.7 Cables on Trays and Ladder Trays

Cables shall be fixed neatly to the tray in a single layer or trefoil formation for three phase circuits and shall be installed parallel with the tray edge and shall avoid unnecessary crossovers.

Cables shall be arranged to leave the tray either at an end or over the side. The tray shall be formed or protected to prevent damage to the cables where exits are made from the tray.

Cables shall not be double banked on trays unless specifically allowed by notation on the drawings.

Cables shall be installed such that spare space capacity of not less than 30% of each tray is provided.

Cables shall be fixed at intervals not exceeding 1200mm by means of approved fastenings of non-corrosive materials.

Conduits shall be fixed to trays by means of saddles. PVC/PVC final sub-circuit cables may be fixed by means of nylon ties or by saddles. MIMS cables and PVC/PVC cables greater than 10 sq mm shall be fixed by metallic saddles.

E3.8 Buried Cable Installation

E3.8.1 Buried Cable Routes

The Contractor is to prepare data and drawings and submit requests to the responsible RailCorp Corridor Manager or RailCorp Maintenance Engineer for location of underground services on RailCorp property. The costs for preparation, administration and any follow up of applications are to be included in the lump sum. RailCorp will only reimburse costs charged by the Corridor Manager/Maintenance Engineer on actuals upon presentation of paid Corridor Manager/Maintenance Engineer invoices.

Costs for procuring public utility eg Energy Australia, Sydney Water, Telstra, AGL, etc service searches should be included in the lump sum.

All underground cable routes shall be marked out and approved before commencing excavation.

Trenches shall be located to permit changes of direction in easy stages eliminating strain on cables or ducts.

Accurate records of underground reticulation routes shall be kept for later inclusion in 'As-Built' drawings.

E3.8.2 Excavation

Trenches shall be excavated to a depth not less than 100mm below the minimum depth of laying.

The bottom of the trench shall be cleared of all rocks, stones and other hard and sharp materials.

Where rock is encountered the method of excavation and depth of cover shall be to approval.

Temporary fencing, barriers, footways and night lighting shall be provided as appropriate for the protection of public or property.

Necessary precautions with due regard to the terrain and weather forecasts shall be taken to prevent flooding and cave in of trenches.

E3.8.3 Buried Reticulation

The bottom of all excavations prior to cable placement shall be covered to a depth of at least 50mm with a layer of selected clean sand filling.

Cables, pipes or ducts shall be laid evenly on the bedding in an orderly fashion.

Cables which follow the same route shall be adequately spaced to allow operation at full current rating.

If due to space limitation it is necessary to run cables with a minimum separation, cables shall be de-rated accordingly.

A minimum cover of 50mm of consolidated clean sand filling shall be provided across the excavation over the top of the largest cable, pipe or duct.

Cover slabs, where required, shall be installed before further backfilling commences.

Cables passing beneath paved areas, roadways or paths shall be enclosed in appropriately sized conduit.

E3.8.4 Backfill and Consolidation

Clean washed sand shall be used for bedding around cables and conduits and shall be completely free from all organic matter or other materials that may attract insects.

The backfilling of trenches shall be carried out as soon as practicable.

The backfill shall be placed in excavation in 200mm layers, each layer being thoroughly consolidated by power or hand ramming as approved by the Superintendent.

The material used for backfilling shall be crushed rock, or stabilised crushed rock, concrete, or reinforced concrete. The crushed rock referred to above shall be 20mm Grade 2 fine crushed bluestone rock.

Alternatively, where the native material is suitable as determined by the Superintendent, native material may be utilised for backfill if placed as described above and provided that stones or sharp objects having a nominal dimension of 25mm or greater shall be removed from the material and all organic material is removed.

Backfill material shall not be placed in any excavation containing free water or slurry.

All excess spoil shall be removed from the site.

E3.8.5 Existing Finishes

General

Existing surface finishes, lawns, gardens, bitumen, concrete or paving shall be removed in straight lines and the surface shall be cut using suitable saws if

necessary to maintain edge finishes.

Lawn Areas

Lawn shall be carefully removed along the cable route by cutting into uniform size blocks and storing in neat stacks. Removed lawn shall be maintained in accordance with accepted gardening practice. Lawn sections shall be reinstated, compacted and made level with surrounding surfaces. New lawn shall be used where removed sections are no longer healthy.

Garden Areas

In garden areas cable routes shall deviate wherever possible to avoid established plants. When deviation is not possible, the plants along the cable route shall be carefully removed. New plants of the same variety as those removed and of a size normally available in 380mm high x 190mm wide x 165mm gusset, polythene containers. (Nurserymen's three gallon containers) shall be used for replanting.

Bituminous Areas

Existing bituminous surfaces shall be cut and removed to a minimum distance of 300mm from the side of the proposed excavation.

Existing material or equivalent shall be used to backfill the excavation and shall be consolidated up to the bottom of the pavement to 95% of the modified maximum dry density.

150mm of compacted rock base shall be used as pavement material, and shall be placed to match existing pavement levels after due allowance for surface treatment.

The rock base shall be compacted to 95% of the modified maximum dry density.

The reinstated pavement and the exposed adjacent pavement materials shall be primed using an appropriate grade of cutback applied at the rate of 1.37 litres per square metre.

After the primer has penetrated, apply a two coat seal.

The first seal shall be a rapid breaking bituminous emulsion applied at the rate of 1.8 litres per square metre. A 10mm cover aggregate shall be applied at the rate of 1.1 litres per square metre. A 5mm cover aggregate shall be applied and rolled until well embedded into the bitumen. Surplus aggregate shall be swept off and removed from the site.

The finished patch shall be made free draining without hollows or high spots.

Adjacent finished surfaces shall be protected from bituminous overspray.

All existing surface finishes shall be returned as near as practicable to their original appearance.

E3.8.6 Buried Cable Route-Markers

Underground Cable Route Markers shall be supplied and installed for all external underground cabling systems.

Unless otherwise shown on the drawings, markers shall be spaced a maximum of 90m apart and at all places where the cable changes direction or when the cable enters or leaves a building.

Where markers are set in grassed areas they shall be ramped so as to rise from flush with the surface of the ground at the edge to 25mm above ground level at the warning marker plate.

Orange PVC marker sheeting with indelible lettering giving warning of electric cables below shall be supplied and located across the width and along the entire length of the excavation at a depth of approximately 300mm from finished ground level.

E3.9 Separation of Power and Data cabling

The data cabling to SAFPD's shall be run in a separate conduit system, separated from the power cabling conduits. The minimum separation between power and data conduits shall be 50mm.

The new Cat5e UTP data cabling to existing TVMs and BOMs shall generally run in the existing data cabling conduits and skirting ducts.

It is permissible for short a length (up to 3m) for the 24V DC and data cables to share the same conduit. An example is the short length represented by the height of the SAFPD pole.

E3.10 Retention in-service of existing Ticketing Devices

All existing Automatic Ticketing Equipment is to be reconfigured by the Tcard Equipment Contractor, ITSL.

All existing devices will remain in service using existing power and data cabling systems until they are reconfigured.

Existing 240V power supplies will remain after reconfiguration.

The existing data cabling (4 pair cable) will become redundant when Ethernet replaces the existing RS 485 station network.

The Contractor shall utilise the existing data cabling conduit system to run the new Cat 5e UTP cabling to the existing devices.

At the completion of the above work, the Contractor and RailCorp Representative shall confirm that the existing device has been successfully returned to service.

E3.11 Restrictions on the use of existing Conduits and Ducts.

Existing conduits, pipes, trunking and ducts shall only be used where indicated on the drawings.

In general only existing AFC conduits and ducts may be used. Any departure from this shall require prior approval by the Superintendent.

Running of conduits and cables along platform side wall edges or copings is not permitted.

E4 Conduiting Methods

E4.1 Conduits and Fittings - General

All surface conduits shall be installed in a workmanlike manner parallel to walls, floors and ceilings as applicable, but all conduits cast into concrete pours shall be installed to the most suitable direct route.

Exposed conduits within 3 metres of the ground or in accessible locations shall be rigid steel construction.

All spare conduits shall be complete with 2.5mm galvanised steel draw wires.

Bends shall be made where possible with easy sweeps. Bends of 90 degrees shall be made with a radius of not less than three times the external diameter of the conduit. Conduit shall not be installed under mechanical stress sufficient to cause deformation. The number of 90 degree bends between boxes in any single conduit shall be limited to no more than 2.

Solid elbows shall not be used.

Inspection fittings shall not be cast into concrete or installed in rendered walls or other inaccessible locations.

Where necessary conduit shall be bent cold without altering its section by using an approved type of bending machine or bending block.

Conduits shall not be less than 25mm diameter.

Surface conduits of size up to 25mm diameter shall be fixed within 150mm of its termination onto an enclosure.

Surface conduits greater than 25mm diameter shall be fixed within 300mm of its termination onto an enclosure.

Conduits shall be installed not touching any other pipes and in all cases shall be at least 150mm from gas pipes and pipes containing hot fluids. Conduit shall not be installed above and parallel to hot pipes.

Conduits installed in external cavity walls shall be tied against the face of the inner skin of the masonry walls and kept clear of the outer skin.

Metallic conduits which have been cut and threaded shall be reamed with an approved industrial type reamer, plugged and kept dry during the installation programme. On completion of the conduit installation excessive conduit thread shall not be evident. Joints shall be sealed against water ingress.

Non-metallic conduit shall be jointed using the manufacturers recommended adhesive.

Surface mounted non-metallic conduits shall be terminated in approved junction and surface mounting plastic boxes.

Metal wall boxes shall be used for all flush mounted accessories and shall incorporate fixings which enable alignment and adjustment of the faceplate of the accessory.

Double sided conduit saddles shall be spaced a maximum of 1,200mm apart for metallic conduit or 1,000mm apart for non metallic conduit. In areas subject to high ambient temperatures or other severe duty the saddle spacing for non-metallic conduit shall be reduced to 500 mm. Conduit half saddles are not to be used.

Where two or more conduits are run in parallel they may be grouped.

Where conduits cannot be fixed to suitable surfaces approved brackets shall be provided.

Vertical lengths of conduit runs shall not exceed 7.5 metres unless draw-in boxes are installed with entry and exit conduit offset.

Horizontal lengths of conduit runs shall not exceed 25 metres before a cable draw-in box is installed. Wherever feasible these boxes shall be fixed so that conduits entering them shall have sufficient fall to allow condensate to flow towards drain plugs near any apparatus.

Where runs exceed 25 metres, tee boxes shall be inserted at the lowest points of the runs between draw-in boxes. The branches of the tee boxes shall be pointed downwards and shall be fitted with a drain plug.

Where it is not practicable to insert draw-in boxes in runs exceeding 25 metres, conduit shall be increased to the next size.

Immediately prior to drawing in of cables, the bore of the conduit shall be thoroughly swabbed.

Conduit terminations shall be securely screwed or clamped at metal clad apparatus. Fixed wiring to motors and other appliances requiring flexible connections shall be run in rigid conduit to a junction box adjacent to the item of equipment, and from there in flexible conduit to the equipment. Flexible conduit connections shall be limited to not less than 150mm or more than 450mm in length.

Where conduits terminate at free ends a coupling and male bush shall be attached. Where two or more conduits terminate together they shall be cut to equal lengths.

Conduit take-offs shall be rigidly fastened with locknuts to each side and conduit ends shall be bushed.

E4.2 Conduits and Fittings – Underground

All underground conduits, fittings and pits shall be sealed to prevent the ingress of water into the conduit or pit.

E4.3 Conduits and Fittings - In Situ Concrete

No conduit greater than 32mm diameter shall be cast into structural concrete or built into masonry wall.

Pressed metal boxes shall not be used where metallic or PVC conduit is cast into floor slabs.

Deep type conduit boxes shall be used in reinforced concrete slabs so that the conduit may be run above the bottom layer of reinforcement.

Conduit installed horizontally in concrete columns shall be steel.

Conduit shall be solidly fixed between the top and bottom reinforcing steel in concrete slabs. Where conduits tend to become bunched; eg. at switchboard positions they shall be spaced to the approval of a structural engineer.

Where expansion or construction joints need to be bridged, the in-slab conduit installation shall make allowance for any likely movement between the adjacent slabs. The conduit in the first slab poured shall be finished to within 90mm of the joint and a 300mm long sleeve of the next largest conduit size shall be internally greased and fitted over the first conduit. The conduit in the second slab poured shall likewise be fitted into the larger conduit leaving a clearance of 100mm minimum between the conduit ends for movement. All joints shall be taped and made waterproof prior to the concrete being poured.

E4.4 Conduits and Fittings - In Chasing

Build in chases in rendered walls when installation of conduits and boxes is completed and before plastering commences in the area.

All conduits laid in plaster or in wall chases shall be firmly fixed in position to prevent movement and/or vibration.

A limited amount of building-in to wall chases shall be carried out in order to retain conduits and wall boxes in position.

Where it is found necessary to chase finished areas caused through an omission or fault under these works, the making good shall be completed and the cost will be deleted from the value of these works.

Chasing will not be permitted in face brickwork. Any conduit or wall boxes required in such walls shall be installed on the reverse face or in cavities as applicable. Allow for either biscuiting or V-cutting of all face brick walls as necessary as part of Sub-Contract work.

Where no cavity exists, rendered walls shall be chased to take conduits and wall boxes.

Any chasing required in walls shall be kept to minimum widths and depths but shall be of sufficient depth so that the conduit is a minimum of 15mm below the surface after final rendering.

Structural members and cast walls or columns shall not be cut or chased without prior written approval of a structural engineer.

Conduits run horizontally shall not be chased in without approval of a structural engineer.

Chasing of walls shall be completed using a carborundum disc saw or a diamond tooth-chasing machine.

Conduits greater than 25mm dia. shall not be chased into walls unless directed otherwise in writing.

Where more than one pipe is placed in a chase, a minimum spacing of 10mm shall be maintained.

Where chases are greater than 80mm in width, expanded aluminium mesh shall be provided over the full width and length of the chase.

The requirement for chasing of walls and floor slabs shall be kept to an absolute minimum.

Excessive cutting of walls will not be permitted.

E4.5 Conduits and Fittings - External Use

Where exposed to the weather or dampness junction boxes shall be provided with covers of heavy gauge material fitted with a neoprene gasket.

In damp and/or exterior locations conduits shall be mounted on pre-painted galvanised or PVC saddle spacers to maintain a spacing of not less than 13mm from surfaces concerned.

E4.6 External Conduits and Cable Pits

The Contractor shall Supply, install and commission the external conduits and cable pits as shown on the drawings.

The Contractor shall ensure the external electrical services are coordinated with other external services including storm water, water, sewer and any other existing services that may run through the proposed construction site.

E4.6.1 Cable Pits

The Contractor shall supply, install and commission the nominated cable pits in the locations shown on the drawing.

Cable pits shall be of concrete construction and be fitted with sealed lids. The pit lids shall be provided with engraved "Electricity" and "Data" labels respectfully.

All cable pits shall be sealed to prevent ground water ingress and shall have minimum dimensions of 800 x 800 x 1000 depth.

E4.7 Flexible Conduit

Corrugated flexible conduit may be used where sweep bends are required and

for final connections onto skirting boxes.

Flexible conduit shall not be used for straight runs or chased into walls.

Fittings for use with flexible conduit shall be compatible with the conduit system and shall be suitable for terminating onto rigid conduit where required.

Allowance shall be made for any differences between the cable carrying capacities of rigid and flexible conduits. Install the next larger size of flexible conduit if necessary to maintain the equivalent required cable capacity.

Medium duty flexible PVC conduit may be used for general purposes.

Heavy-duty conduit shall be used where connecting to moveable equipment, equipment subject to vibration or for use outdoors.

Flexible conduit subject to mechanical damage shall be the steel-wound type, similar to Thomas & Betts 'Anaconda' complete with all proprietary fittings and installed in accordance with the manufacturer's recommendations.

Flexible conduits shall not be used underground or for telephone cabling.

E4.8 Mini-Trunking

Mini-trunking shall be constructed from high impact PVC complying with AS 2053 and AS 3100. The trunking shall be available as a complete system of angles, tees, couplings and end pieces from one manufacturer. Systems from different manufacturers shall not be utilised on the project unless approved otherwise.

The trunking shall be fixed with double-sided adhesive tape in accordance with the manufacturer's recommendations.

Where horizontal cable runs are required, cables shall be fixed within the trunking by use of nylon cable tie mounts and ties similar to 'Burndy', mounted at intervals not exceeding 300mm.

The trunking shall be sized to carry the specified quantity of cabling, with space for one additional circuit of the same conductor size.

Subject to approval of the Superintendent, miniduct may only be used where neat surface work is required and the installation is open to view.

The colour of the mini-trunking shall be to the approval of the Superintendent.

E4.9 In-Floor Ducting

Where in-floor cable ducting is specified it shall comply with the detail shown on the relevant station drawing.

E5 Power Systems

E5.1 General

The Contractor shall supply, install and commission:

- ▶ The required modifications to the existing Main Switchboard, Distribution Board or AFC Distribution Board where noted on the drawings for specific stations.
- ▶ New ITP Distribution Boards where required

Run in accordance with AS 3000 and adequately fixed to supporting tray, conduit or structure.

E5.2 240V AC Distribution Boards

The Contractor shall supply, install and commission distribution boards in accordance with relevant Australian Standards, the NSW Service and Installation Rules and Energy Australia's or Integral Energy's requirements in the location indicated on the layout drawings.

New distribution boards shall be of metal clad dust proof construction with a minimum of 30% spare pole capacity for future expansion.

The distribution boards shall be as detailed in single line diagram and shall comply with, as a minimum, the following:

- ▶ Form 1 Construction;
- ▶ Wall mounted;
- ▶ 2mm metal clad and powder coated finish and IP41 rated;
- ▶ vermin and dust proof;
- ▶ Totally enclosed with lockable and lift off hinged and gasketed doors;
- ▶ Contain neutral and earth bars; and labels as specified in this document

E5.3 SAFPD 24V DC Power Supply Units

E5.3.1 General

The power supplies shall comprise 5 Amp and 10 Amp capacity fully assembled modular rack mount unit as shown on the assembly drawings.

The power supply unit(s) shall be installed in the ITP Enclosure.

E5.3.2 Power Supply types

The power supply types and their applications shall be as indicated in the following table:

| Type | Assembly Drawing No. | SAFPD Capacity |
|--------|----------------------|----------------|
| 5 Amp | EL0221274 | 5 devices |
| 10 Amp | EL0221275 | 10 devices |

If the Enclosure has a 10A power supply then 10 double pole CB's are to be fitted.

If the Enclosure has a 5A power supply then 5 double pole CB's are to be fitted.

Note that Secondary Enclosures generally occur at locations where long runs of data cabling exist.

Note that there is more than one hub at a number of sites.

E5.4 SAFPD 24V DC Power Cables

24V DC power cable shall be provided for each SAFPD. The cable consumables shall be in accordance with the following drawings:

| Type | Description | Assembly Drawing Number |
|------|-----------------|-------------------------|
| 1A | PVC Insulation | EL0221254 |
| 1B | LS0H Insulation | EL0221255 |

E5.5 SAFPD Earthing Cables

An individual earthing cable shall be provided from the ITP enclosure to each SAFPD.

The cable shall be looped to each SAFPD mounting component earth stud to form a continuous earth wire.

The earth cable assembly shall be in accordance with the following drawings:

| Type | Description | Assembly Drawing Number |
|------|-----------------|-------------------------|
| 1A | PVC Insulation | EL 0221267 |
| 1B | LS0H Insulation | EL 0221268 |

E5.6 Design Requirements

E5.6.1 Prospective Fault Levels

The Contractor shall ensure that design, construction, or grading of any switchboard, circuit breaker, isolator, busbar, cable and other item of equipment in the installation is such that it will withstand and/or operate without damage during any period that the

maximum asymmetrical current corresponding to the prospective fault level at its installation location would be flowing. Cascaded protection is permissible.

E5.6.2 Discrimination Between Protective Devices

The Contractor shall ensure that all installed protective devices have been selected and/or left adjusted at the time of Practical Completion to achieve proper discrimination and grading between each level of protection and the next highest level in accordance with normal good practice.

E5.6.3 De-rating

The sizes of conductors as specified on the single line diagram are the **minimum** size which shall be provided.

The size, grouping, spacing, enclosure and location of cables shall be installed so that the current rating of the conductors as permitted by AS 3000 is not less than the specified current rating of the circuit breaker which protects the conductor.

Where electrical conductors are installed, grouped, spaced or enclosed by the Contractor in such a manner that their de-rated current rating is less than the specified current rating of the protective device, the size of the conductor shall be increased to provide a current rating of the conductor which is not less than the specified current rating of the respective protective circuit breaker.

E5.6.4 Balancing and Voltage Drop

The Contractor shall be responsible for the final installation having:

- ▶ The three phases balanced with $\pm 5\%$; and
- ▶ Voltage drop within stipulated limits at all locations throughout the installation,

all to the satisfaction of the supply authority.

In calculating the voltage drop on final sub-circuits the Contractor shall allow for the full rated capacity of the mains and sub-mains cables or the full rated capacity of the protective device for the mains and sub-mains.

E5.6.5 Position of Outlets

The positions of outlets, switches and other items of equipment shown on the Drawings are assumed to be correct, but Tenderers shall allow for movement of up to 2000 mm prior to installation without extra cost.

The Contractor shall supply, install and commission all GPOs, socket outlets and isolators complete with mounts and required trunking located in accordance with the electrical services layout drawings, drawing notes and as detailed on the electrical single line diagrams.

All power outlets shall be selected from the Clipsal standard range. All external and IP rated GPOs and outlets shall be from the Clipsal IP56 range.

All new and reused GPOs shall be labelled with distribution board and circuit numbers clearly identifying the power circuit to which the outlet is connected.

E5.7 Testing

E5.7.1 General

The Contractor shall carry out all testing in accordance with AS 3000, NSW Service and Installation Rules, and RailCorp supply authority requirements. The Contractor shall provide required materials, labour, appliances, instruments etc for the tests. Results shall be recorded and submitted to the Superintendent on completion.

The installation shall be tested to the satisfaction of the Superintendent and the Statutory Authorities, prior to the acceptance of the installation and the commencement of the Defects Liability Period.

The tests shall comprise a thorough inspection of the entire installation and the operational and performance tests specified or necessary to confirm compliance with the RFT.

The necessary skilled and competent personnel together with all equipment, fuel and electric power required to test and commission the works shall be provided.

All testing and commissioning shall be carefully pre-planned and scheduled in order that it is fully coordinated with Station and Ticketing Operations. It shall be carried out in a safe and efficient manner with a minimum of inconvenience to operation of the Station. Where the work is being carried out in an occupied or partially occupied building, responsibility shall be taken to advise the users of the building regarding the nature of the tests and coordinate with them to minimise any possible hazards or inconvenience that may arise due to the tests.

The installation shall be tested progressively as the work is carried out then finally tested once it is completed to ensure compliance with the RFT, is mechanically and electrically safe and that it will operate correctly under normal, emergency and fault conditions. Protection and operative devices shall be checked for correct adjustment and rating.

All equipment or materials found to be faulty during testing shall either be replaced or repaired free of charge.

Where work is being carried out in an occupied building the management of the building shall be kept fully informed regarding the nature of the testing and commissioning.

Steps shall be taken that any possible hazards or inconvenience that may arise due to the testing and commissioning shall be minimised.

Should a trial or test be deemed unsatisfactory by the Superintendent it shall be repeated at no further charge after necessary rectification, until such time as a satisfactory result is obtained.

The Superintendent shall be given ten working days notice of any proposed tests and shall be given the opportunity to attend all such tests.

E5.7.2 Earthing

The earthing system shall be tested to the requirements of AS 3000.

E5.7.3 Reticulation and Distribution Systems

All cables shall be tested before and after installation.

E5.7.4 Outlets (GPOs)

All accessories and outlets shall be tested for correct operation. All GPOs shall also be tested to ensure that the active neutral and earth are correctly connected and that the switch controls the active supply.

E5.7.5 Insulated SAFPD mountings

SAFPD mountings fixed to steelwork shall be tested with a 500 Vdc insulation tester between mounting and steelwork as follows:

- Test with mounting equipotential bonds and protective earths connected.
- Test with mounting equipotential bonds and protective earths disconnected.
- Test with mounting equipotential bonds and protective earths reconnected.

E5.7.6 Tests and Installation Equipment

All test equipment shall be provided by the Contractor as necessary to complete the test procedures specified.

E5.7.7 Test Results

All test procedures used and results obtained for both works and site tests shall be submitted in the form of a written 'Test Report'.

Records shall be kept of test results and two copies shall be submitted to the Superintendent at the completion of the work. Approval of the format required for the test results shall be obtained prior to the submission.

A notification of electrical work form (NOEW) shall be completed and submitted to the Superintendent and the relevant power authority for each electrical installation.

E5.7.8 Witnessing of Tests

The Superintendent reserves the right to witness any test.

The Contractor shall give the Superintendent not less than two weeks notice of when each and every test will be carried out.

E6 Data Cabling

E6.1 General

The structured cabling system shall comprise balanced pair and optical fibre cabling as shown on the station interconnection diagrams.

The complete installation shall comply with the following:

| | |
|-----------------------|---------------------------|
| Balanced Pair Cabling | AS 3080 Class D |
| Optical Fibre Cabling | AS 3080 Class OM2 and OS1 |

The Contractor shall terminate data cabling to patch panels or connectors as indicated on the drawings ensuring cable lengths are minimised and are below recommended maximum lengths specified in AS 3080.

The Contractor shall provide all patch leads required from the patch panels to the active equipment.

All materials shall conform to AS/ACIF S008

E6.2 Data Cable Facilities

E6.2.1 Assemblies

The data cable assemblies shall comprise the following Cat 5e UTP and optical fibre types for the applications as indicated in the following table:

| Media | Application | Cable Assembly Type | Drawing Number |
|-------------------------------|---|---------------------|----------------|
| Balanced Pair (Cat 5e UTP) | ITP enclosure patch panel to SAFPD, TVM and EG. Hub | 1A (non LS0H) | EL 0221250 |
| | | 1B (LS0H) | EL 0221251 |
| | ITP enclosure patch panel to TOT | 3A (non LS0H) | EL 0221270 |
| | | 3B (LS0H) | EL 0221270 |
| | ITP enclosure patch panel to AFC enclosure | 2A (non LS0H) | EL 0221252 |
| | | 2B (LS0H) | EL 0221253 |

| | | | |
|---------------|--|--------------------------------------|----------------------------|
| Optical Fibre | ITP enclosure to FTE enclosure ITP primary enclosure FTP to ITP secondary enclosure FTE | Not Applicable Not Applicable | EL 0221272 EL0221276 |
|---------------|--|--------------------------------------|----------------------------|

E6.2.2 Fibre Optics Termination Box

The Fibre Optics Termination Box shall conform to the following:

| Item | Description |
|------------------|--|
| Configuration | <ul style="list-style-type: none"> ▶ Wall Mount ▶ Two Compartment |
| Fibre Facilities | <ul style="list-style-type: none"> ▶ Patch Panel for 16 (minimum) SC Type connectors ▶ Fibre Organiser tray for cable core terminators |

E6.3 Fibre Optic Cable

Fibre Optic cable for interconnection between the primary and secondary ITP enclosures FTE's shall be to the following specification

| Item | Description |
|-----------------|--|
| Type | Single Mode |
| Construction | <ul style="list-style-type: none"> ▶ Tight Buffered ▶ Moisture Proof – above ground station ▶ Low Smoke – Zero Halogen low toxicity flame retardant cables for underground stations |
| Number of Cores | Eight (8) |

E6.4 Cable Installation

All cable installation work shall be done in accordance with AS 2834, AS 3000 and AS 3080 and to the Manufacturer's requirements to meet Manufacturer's warranty requirements, by a licensed cable installer in compliance with the ACA (Australian Communications Authority) requirements.

E6.5 Labelling

Labels shall be fixed at RJ45 outlets and at patch panel ends in accordance with AS 3085. Refer also Cable Assembly drawings for cable labelling requirements.

E6.6 Testing

E6.6.1 Requirements

The Contractor shall provide the required test equipment and labour for the tests. Results shall be recorded and submitted to the Superintendent on completion.

E6.6.2 Balanced Pair Cabling

The Contractor shall carry out testing in accordance with AS 3087.1. All testing shall use an automated testing device such as a Fluke DSP 4000 or equivalent with current NATA calibration to cover the tests as laid out in Table 2 of AS 3087.1 Tests shall include:

- Wire map.
- Attenuation.
- NEXT loss pair to pair measured from the local end.
- NEXT loss pair to pair measured from the remote end.
- NEXT loss power sum at local end.
- NEXT loss power sum at remote end.
- EFLEXT loss pair to pair.
- ELFEXT loss power sum.
- Return loss measured from local end.
- Return loss measured from remote end.
- Propagation delay.
- Delay skew.
- DC loop resistance

Similarly patch cords are to be tested to the requirements of AS 3087.2.

E6.6.3 Fibre Optic Cable

The Contractor shall test the optical fibre cable using an OTDR tester with current NATA calibration. Insertion loss testing of all terminated fibres shall be performed in both directions at 850nm for multi mode cable and 1310nm for single mode cable.

E6.6.4 Inspection and Test Results

All inspection and test procedures used and results obtained for both works and site tests shall be submitted in the form of a written 'Test Report'.

Records shall be kept of results and two (2) copies shall be submitted to the Superintendent at the completion of the work. Approval of the format required for the test results shall be obtained from the Superintendent prior to the submission.

E6.6.5 Witnessing of Tests

The Superintendent reserves the right to witness any test.

The Contractor shall give the Superintendent not less than two weeks notice of when each and every test will be carried out.

E6.7 Approval of Components

Samples of cable, patch panels, modular jacks and labelling methods that are to be used in the cabling installation, shall be provided for inspection and verification by the Superintendent before any installation.

E7 Tcard Project Enclosure

E7.1 General

Enclosures to accommodate the data communications equipment and SAFPD 24V DC power supplies shall be manufactured supplied and installed as part of the works. The type required shall be as indicated on the station-specific drawings and equipment schedules. The enclosures shall be fully assembled, wired and tested.

E7.2 Enclosure Types

Enclosure types and their application shall be as indicated in the following table:

| Description/Type | Assembly Drawing No. | Application |
|--|----------------------|--|
| ITP Enclosure Standard (Horizontal) | EL0221256 | Primary and Secondary Hub at most stations |
| ITP Enclosure Standard (Vertical) | EL0221257 | Generally in CCTV huts |
| Mounting Frame | Not Applicable | For mounting enclosures to framed walls Fabricated as required |

E7.3 Design and Prototype

The Contractor shall complete the detailed design including all mechanical, electrical and ventilation requirements.

Calculations confirming the ventilation design for the heat dissipation within the environmental conditions shall be submitted for approval by the Superintendent.

Following submission and acceptance of “shop” drawings for the ITP Enclosure, the Contractor shall manufacture a fully fitted prototype, complete in all respects. Following approval by the Superintendent, this prototype will be treated as a “standard” and shall remain the property of RailCorp.

E7.4 Installation

The enclosures shall be securely fixed to the wall of station building in the location(s) shown on the drawings using mounting brackets attached to the cabinet. Where the wall is not of sufficient strength for direct mounting (for example a timber framed wall), a fabricated Unistrut-mounting frame shall be used.

E8 Civil and Structural

E8.1 Dilapidation Records

The Contractor shall provide an indexed digital photographic record of the condition of all existing surfaces and finishes for all building surfaces where penetrations and core holes will occur and all building and platform surfaces to be disturbed prior to excavation/penetration.

The Contractor will be responsible for restoring all surfaces to the satisfaction of the Superintendent at the completion of the contract.

E8.2 General

Unless drawings are identified as 'for construction', they shall not be used for construction purposes.

The structural drawings shall be read in conjunction with other drawings and RFTs, and with such other written instructions as may be issued by the Superintendent.

This technical structural specification shall apply unless otherwise varied by the drawings.

Nomination of proprietary items does not indicate exclusive preference but indicates the required properties of the item. Similar alternatives having the required properties may be offered for the approval of the Superintendent.

Refer any discrepancy to the Superintendent before proceeding with the work.

Do not obtain dimensions by scaling from the drawings. All dimensions are in millimetres and all levels are in metres.

Verify setting out dimensions shown on the drawings before construction and fabrication is commenced.

The Superintendent shall be given a minimum of twenty four (24) hours notice of the requirement for an inspection and shall be given a further two (2) hours for such inspection and written approval by the Superintendent or rejection of the work. In the case of reinforcement inspection, concrete shall not be delivered until final approval from the Superintendent is obtained.

Inspections by the Superintendent may be undertaken at shorter notice, however, the Superintendent reserves the right to charge a disruption fee in excess of the normal inspection fee equivalent to the Superintendent's or inspecting engineer's hourly charge-out rate multiplied by the total time involved.

All such additional costs shall be borne by the Contractor and deducted from contract payments.

During construction the structure shall be maintained in a stable condition and no part shall be overstressed.

Provide temporary bracing as required to keep the works and excavations stable at all times.

All workmanship and materials shall be in accordance with the current Standards Australia Codes and the By-Laws and Ordinances of the relevant building authorities.

The structural work shown on the drawings has been designed for the following loads Permanent and Imposed actions, as per AS 1170.1.

A copy of the drawings, RFT and site instructions shall be kept on site in good condition for reference purposes throughout the contract period.

The structural design has been based on the following architectural and/or reference drawings.

| Discipline | Drawing Number | Issue | Date |
|--|----------------|-------|----------|
| 8 Hole Flanged Pole. Pole Mounted. PCP5000. | 35-2669 | B | 26/11/03 |
| Bracket. Wall Mount. PCP5000 | 35-2672 | B | 27/11/03 |
| Bracket Common Piece. 45-Degree Wall Mount Bracket. PCP5000. | 35-2673 | B | 27/11/03 |
| Bracket Right. 45-Degree Wall Mount Bracket. PCP5000. | 35-2675 | B | 27/11/03 |
| Bracket Left. 45-Degree Wall Mount Bracket. PCP5000. | 35-2674 | B | 27/11/03 |

Any physical item or item of work not specifically shown on the drawings or referred to in the RFT which would normally be considered an essential part of the work or required for good workmanship is to be considered as part of the RFT.

E8.3 Pole Footings

Footings have been designed for an allowable bearing intensity of 50 kPa. Foundation material shall be approved for this pressure by the Superintendent before reinforcement and/or concrete are placed.

Classification Procedure: Preliminary estimate to be confirmed on site.

Footings shall be constructed as soon as possible following excavation to avoid softening or drying out by exposure.

Sub-grade foundation materials beneath footings shall be compacted to 95% maximum dry density at $\pm 2\%$ optimum moisture content (standard compaction) in accordance with AS 1289. Unsuitable sub-grade material shall be either excavated and replaced with approved granular base course material or mechanically compacted to achieve the specified designed allowable bearing intensity.

Only approved granular base course materials shall be used where filling beneath footings is shown.

Where a vibrating plate compactor is used, granular materials shall be placed in layers not exceeding 150 mm loose before compaction.

Density testing of sub-grade and compacted base course shall be carried out at a frequency of one test per footing.

E8.4 Concrete

All workmanship and materials shall be in accordance with AS 3600 except where varied by the contract documents.

Quality of concrete elements shall be as set out below. The exposure classifications have been based on a temperate climatic zone.

| Structural Element | Footings & Plinths generally |
|---|------------------------------|
| Exposure Classification | B1/B2 |
| Strength grade | N32 |
| Cement type | GB or GP |
| Characteristic 28 day compressive strength, f_c (MPa) | 32 |
| Characteristic 28 day flexural tensile strength, f_{cf} (MPa) | - |
| Density | Normal |
| Maximum aggregate size, mm | 20 |
| Slump, mm | 80 |
| Minimum cement content (kg/m ³) | 285 |
| Admixtures | None |

E8.5 Sampling, Testing and Acceptance

Permanent records of plant control and project control testing shall be maintained at the plant and project respectively. Copies of these records shall be given promptly to the Superintendent.

Concrete is subject to project assessment or production assessment, as appropriate.

Sampling and testing shall comply with AS 1379 and this RFT and all such costs shall be borne by the Contractor. The sampling and site treatment of project control test specimens shall be carried out by a NATA laboratory other than that of the supplier.

Acceptance of concrete prior to placement shall be based on measured slump for compliance with the RFT.

Acceptance of hardened concrete for design properties shall be in accordance with AS 1379.

E8.6 Pouring and Forming

Additives shall not be used without the Superintendent's prior written approval.

Concrete shall be compacted using mechanical vibrators.

Provide all exposed edges and corners with 20 mm chamfers or fillets.

Form all construction joints and use only where shown on the plans or approved by the Superintendent.

No holes, chases or embedment of pipes, other than those shown on structural engineer's drawings shall be made in concrete members without the written approval of the Superintendent. Conduits, pipes, etc shall only be located in the middle one third of the footing depth.

Curing of concrete shall start immediately after finishing.

Curing of all concrete is to be achieved by keeping surfaces continuously wet for a period of 3 days and the prevention of loss of moisture for a total of 7 days under ambient conditions followed by a gradual drying out. Strength gain at the end of the continuous curing shall be in accordance with the following table.

| AS 3600 Element Exposure Classification | Minimum Required Average Compressive Strength at End of Continuous Curing |
|---|---|
| B1/B2 | 25 MPa |

Approved sprayed on curing compounds may be used where no floor finishes are proposed except for fly ash blended cements. Polythene sheeting or wet hessian may be used if protected from wind and traffic.

Formwork and its removal to be in accordance with AS 3600 and AS 3610 and the section on 'Formwork' within this technical specification.

Lap (at least 200mm) and seal with Sellotape No. 504, 0.2 mm damp-proof membrane to ensure a complete vapour barrier.

E8.7 Tolerances

Construction tolerances to be in accordance with the more stringent requirement of either AS 3600 or AS 3610.

Formed surface tolerances shall be in accordance with AS 3610 based on the specified or appropriate class of surface finish.

Departure from true plane shall not exceed +/-5mm for footings.

Departure from level shall not exceed +/-1mm fro levelling pads.

Finished unformed surface finishes: Footings and Plinths - wood float finish.

E8.8 Formwork

Design and construction of formwork shall be in accordance with AS 3610.

Design information concerning the foundation formwork shall be determined from the conditions existing on site at the time of construction.

Removal of forms and falsework from in situ concrete, unless otherwise approved by the Superintendent, shall be as set out below for Type-A Portland cement based normal class concrete without use of accelerators or retarders and 25:75 fly ash blended cement based concrete.

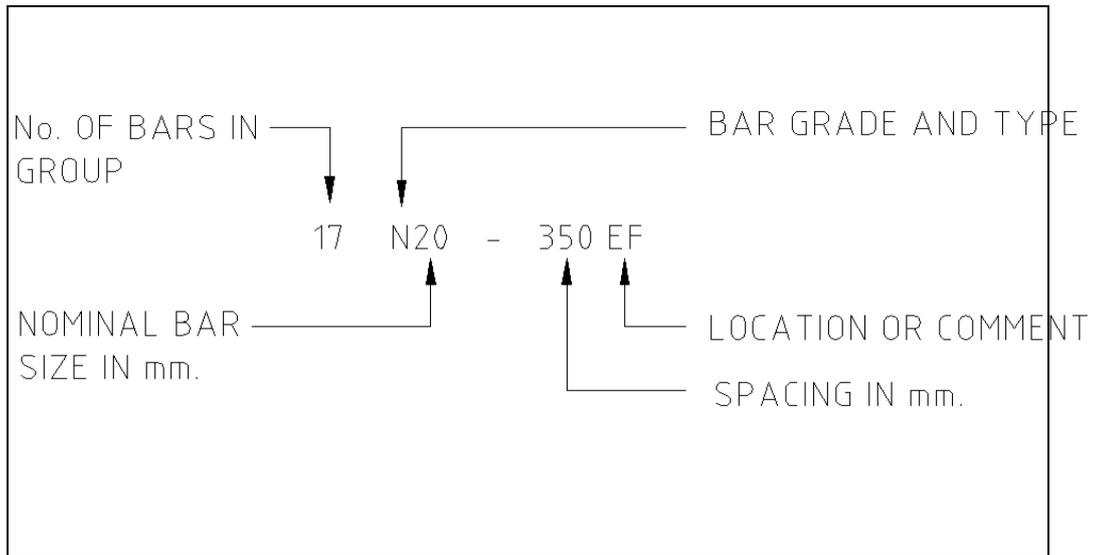
| Member Type | Member | Minimum Stripping Time (days) for Various Average Air Temperatures During Period Prior to Stripping for Type-A Cement and 25:75 Fly Ash Blend Cement Based Normal Class In Situ Concrete | | | |
|--------------------|-------------------|--|-----------|----------|-----------|
| | | 21°C & over | 10 - 21°C | 5 - 10°C | under 5°C |
| | | A 25:75 | A 25:75 | A 25:75 | A 25:75 |
| Vertical, Unloaded | Plinths, Footings | 2 - 4 | 3 - 6 | 5 - 9 | 7 - 11 |

E8.9 Reinforcement

Symbols on drawings for grade and type of reinforcement are as follows:

| Symbol | Reinforcement |
|--------|--|
| R | Grade 250N Plain Round Bar to AS 1302 |
| N | Grade 500N Deformed Bar to AS 4671 |
| SL | Grade 500L Welded Wire Fabric to AS 4671 |

Designation of reinforcement bars is as in example:

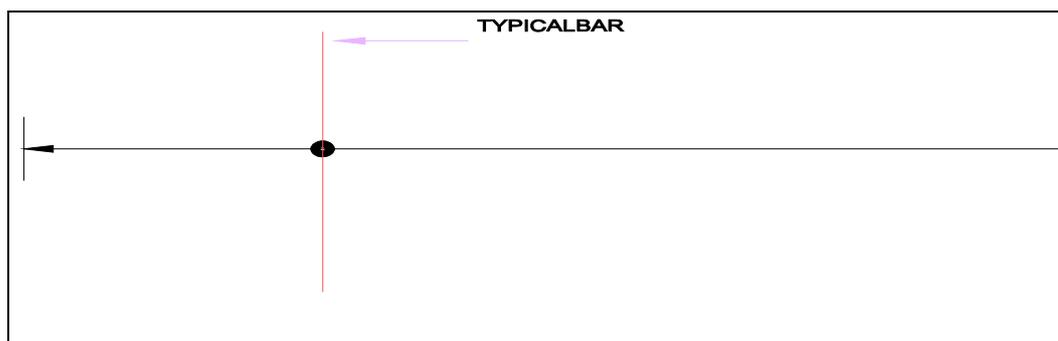


The following abbreviations apply to the location of reinforcement:

| | | | | | |
|----|-----------|----|----------|----|----------------------------|
| EW | Each Way | FF | Far Face | CP | Centrally Placed |
| EF | Each Face | B | Bottom | BB | Bottom Bottom (laid First) |
| NF | Near Face | T | Top | TT | Top Top (Laid Last) |

Cogs and hooks to be standard in accordance with AS 3600.

Main wires of fabric and width of sheets shown in floor plan or wall elevation thus:



Extent of bars shown thus:

Reinforcement is represented diagrammatically and is not necessarily in true projection.

All reinforcement shall be firmly supported by plastic tipped chairs, plastic chairs or concrete chairs to maintain the specified clear concrete cover to reinforcement (including fitments) and the spacing of reinforcement shall be by approved spacers and ties. For slabs, supports shall be spaced at 800 mm maximum cross centres for fabric and bars up to and including 12 mm diameter and 1000 mm maximum cross centres for bars over 12 mm diameter. Bars shall be tied at alternate intersections. Use metal or plastic plates under each bar chair over membrane.

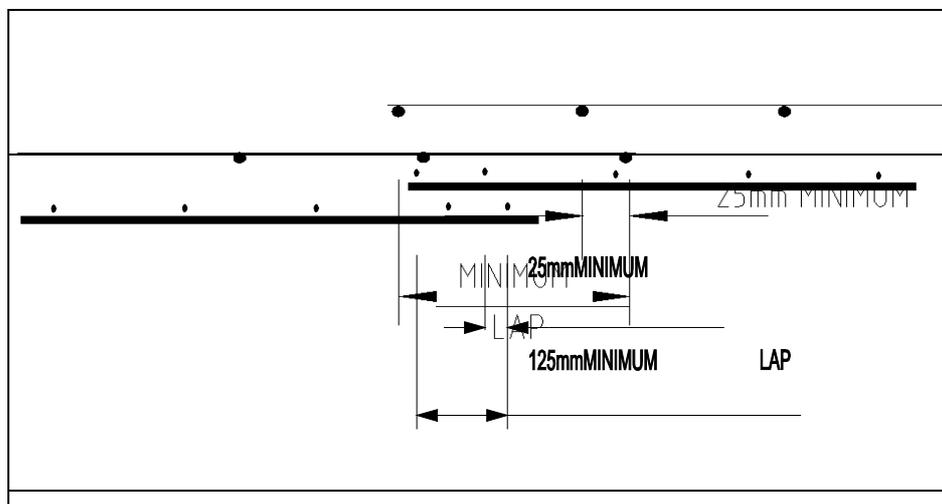
Maintain cover to reinforcement at chamfers, drip grooves and reglets. Clear cover to all reinforcement shall be:

| Element/Location | Exposure Classification | Cover, mm |
|----------------------|-------------------------|-----------|
| Footings - Generally | B1/B2 | 75 |

Splice reinforcement only at locations shown on the drawings, or as approved by the Superintendent. Lap lengths for bars shall be as shown on the drawings.

Fabric splices shall be made by either of the following methods:

Lapping of fabric (standard fabric)



Lapping of fabric (ARCMESH type)

Welding of reinforcement is only permitted where shown on the drawings or otherwise approved by the Superintendent. Where welding of reinforcement is approved, it shall be carried out in accordance with AS 1554, Part 3.

E8.10 Structural Steelwork

E8.10.1 General

All workmanship and materials shall be in accordance with AS 1538, AS 4100 and AS 1554.1.2 or .5 as appropriate except where varied by the contract documents.

All steel shall be in accordance with:

- AS 3678 Grade 300 and Grade 350 for hot rolled structural steel plates, floor plates and slabs
- AS 3679 Grade 300 and Grade 350 for hot rolled structural steel bars and sections
- AS 1163 Grade 350 for circular hollow sections above 165 mm OD.
- AS 1397 Hot-dipped zinc-coated cold-formed steel sheet and strip, 0.25 to 3.5 mm thick
- AS 1594 Grade 250 for hot strip mill coil products

Provide all cleats and drill all holes for fixing steel to steel and timber to steel whether or not detailed on the drawings to the approval a structural engineer. This includes all architectural fixings which are not necessarily shown on a structural engineer's drawings.

E8.10.2 Welding

All welds and weld symbols are to be in accordance with AS 1554 and AS 1101.3 respectively:

- ▶ All welds to be category SP
- ▶ All butt welds to be full penetration
- ▶ All fillet welds to be 6 mm continuous
- ▶ Electrodes to be classification E41XX

Extent of weld inspection:

| | |
|--------|--|
| G P | 100% |
| S P | 100% plus 10% radiographic or ultrasonic |

Designation for connection particulars:

| | |
|--------|-----------------------------------|
| SWC | Single Web Coped |
| DWC | Double Web Coped |
| FC | Flanged Coped |
| FM | Flanged Mitred |
| DF/8 – | Flange weld 8mm fillet both sides |
| DF/6 | Web weld 6mm fillet both sides |

Note that some connections cannot be identical to AISC standard due to the angle of the connection, clearance, etc. In these cases details should be similar to and of equivalent strength to the AISC standard.

E8.10.3 Bolting

Designation for bolt type and tightening procedure shall be as follows:

| Number | Size | Bolt Strength Grade | Tightening Procedure |
|--------|------|---------------------|----------------------|
| 4 | M16 | 8.8 | S |

Bolt strength grade designation:

| Strength Grade | Bolt Types |
|----------------|--|
| 4.6 | Commercial bolts and nuts to AS 1111 |
| 4.8 | High strength structural bolts, nuts, load indicating devices and washers to AS 1252 |

Tightening procedures:

| Symbol | Procedure |
|--------|---|
| S | “Snug Tight” |
| TB | Bearing mode joint, bolts fully tensioned in accordance with AS 4100 |
| TF | Friction mode joint, bolts fully tensioned in accordance with AS 4100 |

Bolted joints with TB and TF tightening procedures shall be installed using approved load indicator washers for example; 4M24 - 8.8/TB (4 off 24 diameter metric high strength structural bolts fully tensioned in a bearing mode.)

All high strength bolted joints to be clearly and permanently marked S, TB or TF before assembly.

Permanent marks to be applied to all assembled high strength bolts and nuts to indicate snug tight position.

Unless otherwise noted all bolts to be M16 – 4.6/S.

All bolts, nuts and washers to be hot dip galvanised in accordance with AS 1214. Bolts shall be fitted with two (2) washers, one under the bolt head and one under the nut.

Tapered washers shall be used where the part under the bolt head or nut is not perpendicular to the centre line of the bolt.

Bolts subject to severe vibration or to tensile force shall be effectively locked in position after tightening.

Contact surfaces for bolted connections using 8.8/TF procedures shall only be painted with system Type S2 to ensure adequate friction between surfaces. A slip factor of 0.35 is taken when contact surfaces comply with Clause 4.12 of AS 1511 and system Type S2 would typically give a value of 0.38.

The galvanised system, Type S4, that is then subsequently abrasive blasted at the joint, is acceptable. A minimum slip factor from 'Galvanising', Galvanisers Association of Australia, of 0.42 is given for this system.

Permanent grout in anchor bolt sleeves, pockets and under base plates shall be of pre-mixed, non-shrink, pourable type such as 'Epirez Five Star Grout' and have a minimum strength of 45 MPa at 28 days.

The contractor shall prepare workshop fabrication drawings and submit three (3) copies of each for the Superintendent's review of general compliance with the design concept at least fourteen (14) days prior to fabrication. Fabrication shall not commence until the shop drawings have been reviewed when two (2) approved copies, appropriately stamped, will be returned to the contractor.

Provide seal plates to all hollow sections, with 'breather' holes if members are to be hot-dip galvanised.

Surface treatment of steelwork surface

- a All working of the material (welding, drilling, grinding, etc) shall be completed and weld spatter, slag, burrs and objectionable surface irregularities removed and all edges smoothed with corners 'radiussed' prior to the commencement of any surface preparation.
- b Oil and grease shall be removed by solvent cleaning in accordance with AS 1627 Part 1.
- c Power tool cleaning shall be carried out in accordance with AS 1627 Part 2 Class 2.
- d Abrasive blast cleaning shall be done in accordance with AS 1627 Part 4 to the class specified with the protective system.
- e Pickled steel surfaces shall be degreased in accordance with AS 1627 Part 5. The final rinse shall contain about 0.75% of sodium dichromate and about 0.5% of orthophosphoric acid which will be the passivating additives.
- f Cleaned surfaces shall be primed or treated as specified for the appropriate coating system as soon as practicable, and in any case within four (4) hours after cleaning.
- g Galvanised coating shall be applied by the hot dip process in accordance with AS 1650. Galvanised surfaces to be painted shall be prepared by the application of a cold phosphate treatment to improve paint adhesion. Mark numbers shall be legible after galvanising.

Repair of galvanised coatings damaged by on-site welding, cutting or severe impacts shall be by use of 'GALVANITE' applied in accordance with the manufacturer's (Jotun Dimet) recommendations.
- h All paint shall be applied strictly in accordance with the manufacturer's specifications. Material for the indication of mark numbers applied prior to painting shall be selected to ensure that they are not detrimental to the paint system.

E8.11 Grout

- a All proprietary grouts and the surfaces they are applied to shall be prepared and applied in accordance with the manufacturers' instructions.
- b Grout around base plates is to have a 45⁰ chamfer around exposed edges.

E8.12 Structural Timber

All workmanship and materials shall be in accordance with AS 1720 and AS 1684.

All timbers shall be visually stress graded and conform to the following:

| Element | Species | Strength Group | Join t Group | Stress Grade | Moisture % |
|---------|-------------------------|----------------|--------------|--------------|--------------|
| | Douglas Fir (Oregon) | S6 | J5 | F7 | Not > 25% |
| General | Mixed Hardwood | | | F11 | Not > 12.5 % |

All timbers shall be protected from the weather before and after fabrication.

All timber shall be free from gum, veins, pockets, knots, holes and splits with 150 mm of any bolt or connector.

All bolts shall be M16 minimum unless noted otherwise and be galvanised and used in 2 mm clearance holes. Grease bolts before assembly. Washers of specified size are to be used under head and nut or bolt. All bolts are to be left accessible and re-tightened at completion of the contract and at the end of the Defects Liability Period.

| MINIMUM REQUIRED SIZE OF WASHERS FOR STRUCTURAL BOLTED JOINTS | | | |
|--|------------------|------------------------------------|--|
| BOLT | WASHER SIZE (mm) | | |
| | Thickness | Minimum Diameter For Round Washers | Minimum Side Length For Square Washers |
| M6 | 1.6 | 30 | 25 |
| M8 | 2.0 | 36 | 32 |
| M10 | 2.5 | 45 | 40 |
| M12 | 3.0 | 55 | 50 |
| M16 | 4.0 | 65 | 57 |
| M20 | 5.0 | 75 | 65 |
| M20 | 6.0 | 85 | 75 |

All timbers permanently exposed to the weather shall be flood brush coated with Koppers 'XJ protective water repellent timber preservation' or an approved oil based equivalent.

NOTE: Coat all timbers before erection. Ensure a liberal coating is applied to all cut ends.

Timber dimensions shall be not less than:

| Nominal Dimension | Minimum Actual |
|-------------------|----------------|
| 50 | 45 |
| 100 | 92 |
| 150 | 140 |

| | |
|------|------|
| 200 | 187 |
| 250 | 235 |
| >250 | - 6% |

E8.13 Demolition

All demolition work shall be in accordance with AS 2601.

Precaution shall be taken to protect the health of persons on or within the vicinity of the site from conditions which are or maybe dangerous to health, including the noxious effects of dust, fumes, liquids, infection, fire, explosion, radiation or other hazards.

The Superintendent shall be notified immediately if any of the following hazardous materials are found on site.

- a Asbestos
- b Flammable or explosive liquids or gasses
- c Toxic, infected or contaminated materials
- d Radiation or radio-active materials
- e Noxious or explosive chemicals
- f Tanks or other containers which have been used for the storage of explosive, toxic, infected or contaminated substances.

The use of explosives in demolition works is forbidden.

Provide supports to adjoining structures where necessary to prevent damage resulting from the demolition work under the contract. Supports shall be deemed to be temporary works unless noted otherwise.

Lateral support by means of shoring or similar approved shall be provided, not less than that given by the structure to be demolished.

Vertical support by means of underpinning and the like shall be provided where necessary.

Relevant demolition works shall not commence until a structural engineers design for the proposed supports is approved by the appropriate regulatory authority.

Approval of the design shall not relieve the contractor of his responsibility for providing sufficient support.

Provide temporary protection where required by covering the whole of temporary openings, or other spaces where shown on the drawings, with approved temporary screens.

All demolished material shall be disposed of unless instructed otherwise, ensuring that encroachment of demolished materials onto adjoining property, including public places,

is prevented.

Any demolished materials infected by vermin, pests or rot shall be destroyed in a way which will minimise the risk of infecting other materials.

Demolished materials which are sound, suitable and approved by the Superintendent may be reused in the works, subject to approval and to such conditions as the Superintendent may impose.

Should the inspection on completion of demolition reveal dampness to adjoining properties or structures which, in the opinion of the Superintendent, is caused by the demolition work, it shall be made good to the satisfaction of the Superintendent.

The Superintendent shall be notified immediately if existing construction or materials are found to be defective during the course of demolition. Do not proceed with demolition in the affected area until instructed.

E8.14 Relocation of existing station furniture

Miscellaneous station furniture such as bins, seats, indicators etc shall be relocated as shown on the drawings.

They shall be re-installed in the new locations in a manner to match existing.
All disturbed wall and/or platform surfaces shall be made good to match existing.

E8.15 Surrounding Pavement

In the event of the surrounding pavement at a Stand Alone Fare Payment Device foundation or steel mounting plate being obviously out of level, the Contractor shall advise the Superintendent for a decision as to the type of remedial action required.

E8.16 Integrity of Existing Structures

The Integrity of existing structures is not to be disturbed.

The Superintendent shall be advised if excavation is required near retaining walls and other structures which support track, buildings, bridges and other facilities.

Structural engineering advice is to be sought to determine the extent and location of excavation in the area.

E9 Drawings and Documentation

E9.1 General

Installation drawings correctly bought up to date to present true and accurate representations of the actual shall be provided at Practical Completion.

The following shall be included in these drawings:

- ▶ Complete layouts showing main and sub-main cable routes and sizes, locations of cable ducts and cast in conduits, junction boxes, switchboards, electrical outlets, data cabling.
- ▶ Complete electrical schematics and line diagrams including fault ratings, sizes, settings and types of protection apparatus and cable sizes.
- ▶ Physical layouts of switchboards showing locations of switch units and control and instrumentation equipment.

All buried cable route details shall be shown on these drawings.

The Contractor shall provide as-installed drawings. All drawings shall be A3 size; the Contractor shall provide one hard copy of the complete “as-installed” set of drawings. The drawings shall be clearly marked “AS-INSTALLED/DATE” in the revisions section of the Drawing.

The as-installed drawings and List of Suppliers shall be supplied within fourteen (14) days, or such other period as directed by the Superintendent after the Date of Practical Completion of the works.

The Contractor shall be responsible for updating the drawings as necessary for work carried out while during the Defects Liability Period.

All drawings and documentation shall be in accordance with AS 1100, 1101, 1102, 1103, 4383 and AS/NZS 4383.

E9.2 Test Report

Test Reports, which consolidates the test and results, shall be provided as a bound copy for each group of stations as per each separable portion.

Each test report shall include results on the following:

- ▶ Power Cable Tests
- ▶ Earth Continuity Test
- ▶ SAFPD Mounting Insulation Tests
- ▶ Data Cabling (balanced pair and fibre optic).

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Part E - Technical Requirements

Section 2 Generic (Standard) Drawings

Contents of Part E Section 2

1. Standard Drawing List
2. Standard Drawings

| Generic | | | |
|-------------------|--|-------------|------------|
| Dwg No: EL | Title | Date | Rev |
| 0221240 | Legend for Electrical Services | 07/04/05 | 1 |
| 0221244 | Earthing Diagram (Generic Design) | 23/07/04 | 0 |
| 0221246 | Offset Location for SAFPD General Arrangement | 23/07/04 | 0 |
| 0221248 | Wall Location for SAFPD General Arrangement | 23/07/04 | 0 |
| 0221250 | Data Cable Assembly - Type 1A Moistureproof | 23/07/04 | 0 |
| 0221251 | Data Cable Assembly - Type 1B Low Smoke Zero Halogen | 23/07/04 | 0 |
| 0221252 | Data Cable Assembly - Type 2A Moisture Proof | 23/07/04 | 0 |
| 0221253 | Data Cable Assembly - Type 2B Low Smoke Zero Halogen | 23/07/04 | 0 |
| 0221254 | 24V DC Power Cable Assembly - Type 1A 24V DC PVC | 07/04/05 | 1 |
| 0221255 | 24V DC Power Cable Assembly - Type 1A (Low Smoke Zero Halogen) | 07/04/05 | 1 |
| 0221256 | ITP Enclosure Type 1 General Arrangement and Assembly (Horizontal) | 18/04/05 | 1 |
| 0221257 | ITP Enclosure Type 2 General Arrangement, Assembly and Location Diagram (Vertical) | | 1 |
| 0221261 | SAFPD Power Supply 24V DC 5A Schematic Diagram | 23/07/04 | 0 |
| 0221263 | SAFPD Power Supply 24V DC 10A Schematic Diagram | 23/07/04 | 0 |
| 0221267 | Earth Cable Assembly - Type 1A (PVC) | 23/07/04 | 0 |
| 0221268 | Earth Cable Assembly - Type 1B (PVC) | 23/07/04 | 0 |
| 0221269 | ITP Enclosure Power Distribution Single Line Diagram | 23/07/04 | 0 |
| 0221270 | Data Cable Assembly - Type 3A Moisture Proof | 23/07/04 | 0 |
| 0221271 | Data Cable Assembly - Type 3B Low Smoke Zero Halogen | 23/07/04 | 0 |
| 0221272 | Single Mode Duplex Optical Fibre Type 4 Cable Assembly Low Smoke Zero Halogen | 23/07/04 | 0 |
| 0221274 | SAFPD Power Supply 24V DC 5A (Vertical Mounting with Traco Power Supply) Assembly | 23/07/04 | 0 |
| 0221275 | SAFPD Power Supply 24V DC 10A (Horizontal Mounting with Traco Power Supply) Assembly | 23/07/04 | 0 |
| 0221276 | Single Mode 8 core Optical Fibre Cable Assembly | 23/07/04 | 0 |
| | STRUCTURAL DRAWINGS | | |
| 0221354 | Reinforced Concrete Foundation For SAFPD Case 1 | 23/07/04 | 0 |
| 0221356 | Steel Mounting Plate on Suspended Reinforced Concrete for SAFPD | | 1 |
| 0221357 | Steel Mounting Plate on Suspended Timber Floor for SAFPD | 23/07/04 | 0 |
| 0221358 | SAFPD Wall Mount on Single Skin Brick | 23/07/04 | 0 |
| 0221359 | SAFPD Wall Mount on Brick Veneer and Timber Veneer | 23/07/04 | 0 |

| Dwg No: EL | Title | Date | Rev |
|-------------------|--|-------------|------------|
| 0221360 | SAFPD Wall Mount on Cavity Brick | 23/07/04 | 0 |
| 0221361 | SAFPD Wall Mount on Double Brick | 23/07/04 | 0 |
| 0221362 | SAFPD Wall Mount on Block Work | 23/07/04 | 0 |
| 0221363 | Flush Floor Ducting Mounting on Suspended Reinforced Concrete for SAFPD No Protection Cover Installation | 23/07/04 | 0 |
| 0221364 | Flush Floor Ducting Mounting on Suspended Reinforced Concrete for SAFPD Wall Protection Cover Installation | 23/07/04 | 0 |
| 0221365 | Pole Floor Mounting on Suspended Reinforced Concrete for SAFPD Flexible Conduit Installation | 23/07/04 | 0 |
| 0221366 | SAFPD Wall Mounting on Steel Column | 23/07/04 | 0 |
| 0221368 | SAFPD Wall Mounting on Timber Column | 23/07/04 | 0 |
| 0221369 | SAFPD Single or Dual Pole Mounting Temporary Face Plate Details | 23/07/04 | 0 |
| 0221370 | Reinforced Concrete Foundation Pedestal for SAFPD Central and Offset Locations | 23/07/04 | 0 |

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Section 3 Site Specific Drawings

Contents of Part E Section 3

1. Site Specific Drawing List
2. Site Specific Drawings

Station Specific

AREA 5

| Dwg No. EL | Title | Date | Rev |
|------------|-------------------------------|----------|--------|
| EL 0221630 | BLACKTOWN LAYOUT Sh 1 of 2 | 07/06/05 | Tender |
| EL 0221631 | BLACKTOWN LAYOUT Sh 2 of 2 | 08/10/05 | Tender |
| EL 0221632 | BLACKTOWN INTERCONNECTION | 22/11/05 | Tender |
| EL 0221880 | CLARENDON LAYOUT | 08/06/05 | Tender |
| EL 0221881 | CLARENDON INTERCONNECTION | 22/11/05 | Tender |
| EL 0221990 | DOONSIDE LAYOUT | 26/09/05 | Tender |
| EL 0221991 | DOONSIDE INTERCONNECTION | 22/11/05 | Tender |
| EI 0222050 | EAST RICHMOND LAYOUT | 08/06/05 | Tender |
| EI 0222051 | EAST RICHMOND INTERCONNECTION | 22/11/05 | Tender |
| EL 0222075 | EMU PLAINS LAYOUT | 26/09/05 | Tender |
| EL 0222076 | EMU PLAINS INTERCONNECTION | 22/11/05 | Tender |
| EL 0222195 | GRANVILLE LAYOUT | 20/09/05 | Tender |
| EL 0222196 | GRANVILLE INTERCONNECTION | 22/11/05 | Tender |
| EL 0222240 | HARRIS PARK LAYOUT | 27/09/05 | Tender |
| EL 0222241 | HARRIS PARK INTERCONNECTION | 22/11/05 | Tender |
| EL 0222400 | KINGSWOOD LAYOUT | 22/09/05 | Tender |
| EL 0222401 | KINGSWOOD INTERCONNECTION | 22/11/05 | Tender |
| EL 0222570 | MARAYONG LAYOUT | 08/06/05 | Tender |
| EL 0222571 | MARAYONG INTERCONNECTION | 22/11/05 | Tender |
| EL 0222740 | MT DRUITT LAYOUT | 21/09/05 | Tender |
| EL 0222741 | MT DRUITT INTERCONNECTION | 22/11/05 | Tender |
| EL 0222765 | MULGRAVE LAYOUT | 09/06/05 | Tender |
| EL 0222766 | MULGRAVE INTERCONNECTION | 22/11/05 | Tender |
| EL 0222910 | PENDLE HILL LAYOUT | 22/09/05 | Tender |
| EL 0222911 | PENDLE HILL INTERCONNECTION | 22/11/05 | Tender |
| EL 0222925 | PENRITH LAYOUT | 06/10/05 | Tender |
| EL 0222926 | PENRITH INTERCONNECTION | 22/11/05 | Tender |
| EL 0222980 | QUAKERS HILL LAYOUT | 09/06/05 | Tender |
| EL 0222981 | QUAKERS HILL INTERCONNECTION | 22/11/05 | Tender |
| EL 0223020 | RICHMOND LAYOUT | 09/06/05 | Tender |
| EL 0223021 | RICHMOND INTERCONNECTION | 22/11/05 | Tender |
| EL 0223025 | RIVERSTONE LAYOUT Sh 1 of 2 | 09/06/05 | Tender |
| EL 0223026 | RIVERSTONE LAYOUT Sh 2 of 2 | 09/06/05 | Tender |
| EL 0223027 | RIVERSTONE INTERCONNECTION | 22/11/05 | Tender |
| EL 0223050 | ROOTY HILL LAYOUT | 21/09/05 | Tender |
| EL 0223051 | ROOTY HILL INTERCONNECTION | 22/11/05 | Tender |
| EL 0223135 | SCHOFIELDS LAYOUT | 10/06/05 | Tender |
| EL 0223136 | SCHOFIELDS INTERCONNECTION | | Tender |

AREA 5 cont

| Dwg No. EL | Title | Date | Rev |
|------------|--------------------------------|----------|--------|
| EL 0223085 | SEVEN HILLS LAYOUT | 10/06/05 | Tender |
| EL 0223086 | SEVEN HILLS INTERCONNECTION | 23/11/05 | Tender |
| EL 0223100 | TOONGABBIE LAYOUT | 21/09/05 | Tender |
| EL 0223101 | TOONGABBIE INTERCONNECTION | 23/11/05 | Tender |
| EL 0223305 | VINEYARD LAYOUT | 21/09/05 | Tender |
| EL 0223306 | VINEYARD INTERCONNECTION | 23/11/05 | Tender |
| EL 0223370 | WENTWORTHVILLE LAYOUT | 10/06/05 | Tender |
| EL 0223371 | WENTWORTHVILLE INTERCONNECTION | 23/11/05 | Tender |
| EL 0223445 | WESTMEAD LAYOUT Sh 1 of 2 | 26/09/05 | Tender |
| EL 0223446 | WESTMEAD LAYOUT Sh 2 of 2 | 23/11/05 | Tender |
| EL 0223457 | WESTMEAD INTERCONNECTION | 27/09/05 | Tender |
| EL 0223465 | WERRINGTON LAYOUT | 27/09/05 | Tender |
| EL 0223466 | WERRINGTON INTERCONNECTION | 23/11/05 | Tender |
| EL 0223500 | WINDSOR LAYOUT | 27/09/05 | Tender |
| EL 0223501 | WINDSOR INTERCONNECTION | 23/11/05 | Tender |

AREA 6

| Dwg No. EL | Title | Date | Rev |
|------------|----------------------------------|----------|--------|
| EL 0221456 | ASQUITH INTERCONNECTION | 24/11/05 | Tender |
| EL 0221455 | ASQUITH LAYOUT | 19/08/05 | Tender |
| EL 0221585 | BEROWRA LAYOUT | 23/08/05 | Tender |
| EL 0221586 | BEROWRA INTERCONNECTION | 24/11/05 | Tender |
| EL 0221935 | COWAN LAYOUT | 23/08/05 | Tender |
| EL 0221936 | COWAN INTERCONNECTION | 24/11/05 | Tender |
| EL 0222250 | HAWKESBURY RIVER LAYOUT | 18/08/05 | Tender |
| EL 0222251 | HAWKESBURY RIVER INTERCONNECTION | 24/11/05 | Tender |
| EL 0222305 | HORNSBY LAYOUT | 19/08/05 | Tender |
| EL 0222306 | HORNSBY INTERCONNECTION | 24/11/05 | Tender |
| EL 0222750 | MT KURRING-GAI LAYOUT | 30/08/05 | Tender |
| EL 0222751 | MT KURRING-GAI INTERCONNECTION | 24/11/05 | Tender |
| EL 0222755 | MT COLAH LAYOUT | 19/08/05 | Tender |
| EL 0222756 | MT COLAH INTERCONNECTION | 24/11/05 | Tender |
| EL 0222975 | PYMBLE LAYOUT | 23/08/05 | Tender |
| EL 0222976 | PYMBLE INTERCONNECTION | 24/11/05 | Tender |
| EL 0223340 | TURRAMURRA LAYOUT | 23/08/05 | Tender |
| EL 0223341 | TURRAMURRA INTERCONNECTION | 24/11/05 | Tender |
| EL 0223375 | WAHROONGA LAYOUT | 19/08/05 | Tender |
| EL 0223376 | WAHROONGA INTERCONNECTION | 24/11/05 | Tender |
| EL 0223380 | WAITARA LAYOUT | 19/08/05 | Tender |
| EL 0223381 | WAITARA INTERCONNECTION | 24/11/05 | Tender |
| EL 0223400 | WARRAWEE LAYOUT | 23/08/05 | Tender |
| EL 0223401 | WARRAWEE INTERCONNECTION | 24/11/05 | Tender |
| EL 0223545 | WONDABYNE LAYOUT | 30/08/05 | Tender |
| EL 0223546 | WONDABYNE INTERCONNECTION | 24/11/05 | Tender |
| EL 0223565 | WOY WOY LAYOUT | 23/08/05 | Tender |
| EL 0223566 | WOY WOY INTERCONNECTION | 24/11/05 | Tender |

| AREA 7 | | | |
|---------------|-----------------------------|----------|--------|
| Dwg No. EL | Title | Date | Rev |
| EL 0221475 | AUSTINMER LAYOUT | 05/10/05 | Tender |
| EL 0221476 | AUSTINMER INTERCONNECTION | | Tender |
| EL 0221805 | CARINGBAH LAYOUT | 30/09/05 | Tender |
| EL 0221806 | CARINGBAH INTERCONNECTION | | Tender |
| EL 0221895 | COALCLIFF LAYOUT | 29/09/95 | Tender |
| EL 0221896 | COALCLIFF INTERCONNECTION | | Tender |
| EL 0221910 | COMO LAYOUT | 29/09/05 | Tender |
| EL 0221911 | COMO INTERCONNECTION | | Tender |
| EL 0221945 | CRONULLA LAYOUT | 29/09/05 | Tender |
| EL 0221946 | CRONULLA INTERCONNECTION | | Tender |
| EL 0222085 | ENGADINE LAYOUT | 04/10/05 | Tender |
| EL 0222086 | ENGADINE INTERCONNECTION | | Tender |
| EL 0222230 | GYMEA LAYOUT | 06/10/05 | Tender |
| EL 0222231 | GYMEA INTERCONNECTION | | Tender |
| EL 0222260 | HEATHCOTE LAYOUT | 28/09/05 | Tender |
| EL 0222261 | HEATHCOTE INTERCONNECTION | | Tender |
| EL 0222270 | HELENSBURGH LAYOUT | 29/09/05 | Tender |
| EL 0222271 | HELENSBURGH INTERCONNECTION | | Tender |
| EL 0222320 | HURSTVILLE LAYOUT | 17/06/05 | Tender |
| EL 0222321 | HURSTVILLE INTERCONNECTION | | Tender |
| EL 0222350 | JANNALI LAYOUT | 05/10/05 | Tender |
| EL 0222351 | JANNALI INTERCONNECTION | | Tender |
| EL 0222405 | KIRRAWEE LAYOUT | 06/10/05 | Tender |
| EL 0222406 | KIRRAWEE INTERCONNECTION | | Tender |
| EL 0222525 | LOFTUS LAYOUT | 30/09/05 | Tender |
| EL 0222526 | LOFTUS INTERCONNECTION | | Tender |
| EL 0222695 | MIRANDA LAYOUT | 30/09/05 | Tender |
| EL 0222696 | MIRANDA INTERCONNECTION | | Tender |
| EL 0222720 | MORTDALE LAYOUT | 04/10/05 | Tender |
| EL 0222721 | MORTDALE INTERCONNECTION | | Tender |
| EL 0222855 | OATLEY LAYOUT | 05/10/05 | Tender |
| EL 0222856 | OATLEY INTERCONNECTION | | Tender |
| EL 0222870 | OTFORD LAYOUT | 29/09/05 | Tender |
| EL 0222871 | OTFORD INTERCONNECTION | | Tender |
| EL 0222905 | COLEDALE LAYOUT | 05/10/05 | Tender |
| EL 0222906 | COLEDALE INTERCONNECTION | | Tender |
| EL 0222940 | PENSHURST LAYOUT | 05/10/05 | Tender |
| EL 0222941 | PENSHURST INTERCONNECTION | | Tender |
| EL 0223080 | SCARBOROUGH LAYOUT | 28/09/05 | Tender |
| EL 0223081 | SCARBOROUGH INTERCONNECTION | | Tender |

AREA 7 cont

| Dwg No. EL | Title | Date | Rev |
|------------|-------------------------------|----------|--------|
| EL 0223170 | STANWELL PARK LAYOUT | 28/09/05 | Tender |
| EL 0223171 | STANWELL PARK INTERCONNECTION | | Tender |
| EL 0223195 | SUTHERLAND LAYOUT Sh 1 of 2 | 30/09/05 | Tender |
| EL 0223196 | SUTHERLAND LAYOUT Sh 2 of 2 | 30/09/05 | Tender |
| EL 0223197 | SUTHERLAND INTERCONNECTION | | Tender |
| EL 0223280 | THIRROUL LAYOUT | 27/09/05 | Tender |
| EL 0223281 | THIRROUL INTERCONNECTION | | Tender |
| EL 0223420 | WATERFALL LAYOUT | 29/09/05 | Tender |
| EL 0223421 | WATERFALL INTERCONNECTION | | Tender |
| EL 0223540 | WOMBARRA LAYOUT | 29/09/05 | Tender |
| EL 0223541 | WOMBARRA INTERCONNECTION | | Tender |
| EL 0223555 | WOOLOOWARE LAYOUT | 29/09/05 | Tender |
| EL 0223556 | WOOLOOWARE INTERCONNECTION | | Tender |