SPECIFICATION 713

UNINTERRUPTIBLE POWER SUPPLY FOR ELECTRICAL AND INTELLIGENT TRANSPORT SYSTEMS EQUIPMENT

REVISION REGISTER			
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CONTENTS

GENERAL

713.01 SCOPE

1. This Specification defines the requirements for the design, fabrication, installation, testing, commissioning and handover of an Uninterruptable Power Supply (UPS), for the operation of Main Roads Electrical and Intelligent Transport Systems (ITS) within the state of Western Australia.

2. UPSs must be in accordance with AS 5715 UPS for Roadside Devices. This specification includes any requirements not mentioned in the aforementioned standard, clarifications, and any additional specifications.

3. The scope of work covered by this Specification includes:

    a) The supply and installation of the UPS with associated Roadside Cabinet;

    b) The supply and installation of all electrical and associated components;

    c) The supply and installation surrounding civil requirements; and

    d) Testing, Commissioning and Asset Handover, including comprehensive Installation, Operation and Maintenance Manuals (IOM).

4. This Specification must be read in conjunction with the specification datasheets, and are included in Annexure 713B. Examples of previous solutions are listed in Annexure 713A for information only and can be found on the Main Roads external website.

5. The Contractor must lodge all notices required by power supply and communications authorities or any other authority having jurisdiction over the installation. The Contractor must pay any fees required.

713.02 REFERENCES

Australian Standards (AS), Main Roads Western Australia Standards and Main Roads Western Australia Test Methods are referred to in abbreviated form (e.g. AS 1234, MRS 67-08-43 or WA 123). For convenience, the full titles are given below:

Acts and Regulations

Electricity Act 1945 (WA)

Electricity (Licensing) Regulations 1991 (WA)

Western Australian Electrical Requirements

Australian Standards

AS 1100 (Set) Technical drawing

AS 1102 (Set)	Graphical Symbols for Electrotechnology
AS 1319	Safety Signs for the Occupational Environment
AS 1906.1	Retroreflective Materials and Devices for Road Traffic Control Purposes
AS 2700	Colour Standards for General Purposes
AS 3731.2	Stationary Batteries - Nickel-cadmium – Valve Regulated
AS 4044	Battery Chargers for Stationary Batteries
AS 4262.1	Telecommunications Overvoltages – Protection of Persons
AS 4262.2	Telecommunications Overvoltages – Protection of Equipment
AS 5715	Uninterruptible Power Systems (UPS) for Roadside Devices
AS 60269.1	Low-voltage Fuses – General Requirements
AS 60529	Degrees of Protection Provided by Enclosures (IP code)
AS 62040.1	Uninterruptible Power Systems (UPS) Part 1: Safety Requirements (IEC 62040-1:2017 (ED 2.0), MOD)
AS IEC 62040.2	Uninterruptible Power Systems (UPS) – Electromagnetic Compatibility (EMC) Requirements
AS IEC 62040.3	Uninterruptible Power Systems (UPS) – Method of Specifying the Performance and Test Requirements

Australian and New Zealand Standards

AS/NZS 1020	The Control of Undesirable Static Electricity
AS/NZS 1125	Conductors in Insulated Electric Cables and Flexible Cords
AS/NZS 1170.2	Structural Design Actions Part 2: Wind Actions
AS/NZS 1269.1	Occupational Noise Management and Assessment of Noise Immission and Exposure
AS/NZS 1580.457.1	Paint and Related Materials – Methods of Test – Resistance to Natural Weathering
AS/NZS 1664.1	Aluminium Structures Part 1: Limit State Design
AS/NZS 1664.2	Aluminium Structures Part 2: Allowable Stress Design
AS/NZS 1768	Lightning Protection

AS/NZS 3000 Electrical Installations (known as the Wiring Rules)

AS/NZS 3100 Approval and Test Specification – General Requirements for Electrical Equipment

AS/NZS 3111 Approval and Test Specification – Miniature Over-current Circuit Breakers

AS/NZS 3439.1 Low-Voltage Switchgear and Controlgear Assemblies – Type-tested and Partially Type-tested Assemblies

AS/NZS 4029.2 Stationary Batteries – Lead Acid Part 2: Valve-regulated Type (IEC 60896-2:1995, MOD)

AS/NZS 4680 Hot-dip Galvanized (Zinc) Coatings on Fabricated Ferrous Articles

AS/NZS 5000.1 Electric Cables – Polymeric Insulated – for Working Voltages up to and Including 0.6/1(1.2) kV

AS/NZS 61000.6.1 Electromagnetic Compatibility (EMC) Generic Standards – Immunity for Residential, Commercial and Light-industrial Environments

AS/NZS 61439.1 Low-voltage Switchgear and Controlgear Assemblies General Rules (IEC 61439-1, Ed. 2.0 (2011) MOD)

AS/NZS 61558.1 Safety of Transformers, Power Supply Units and Similar Part 1: General Requirements and Tests (IEC 61558-1 Ed 1.1, MOD)

AS/NZS ISO 9001 Quality Management Systems – Requirements

AS/NZS ISO 9002 Quality Systems - Model for Quality Assurance in Production, Installation and Servicing

Main Roads Specifications and Documents

All documentation in this part are available from the Main Roads external website or Main Roads direct, by quoting the relevant document number.

SPECIFICATION 100 GENERAL REQUIREMENTS

SPECIFICATION 202 TRAFFIC

SPECIFICATION 301 VEGETATION CLEARING AND DEMOLITION

SPECIFICATION 302 EARTHWORKS

SPECIFICATION 703 CLOSED CIRCUIT TELEVISION (CCTV) CAMERAS

SPECIFICATION 704 CABLE CONDUITS & PITS FOR ITS

SPECIFICATION 705 OPTICAL FIBRE INSTALLATIONS

SPECIFICATION 707	VARIABLE MESSAGE SIGNS (FIXED TYPE)
SPECIFICATION 708	VEHICLE DETECTION STATIONS
SPECIFICATION 712	TRAFFIC SIGNALS
SPECIFICATION 801	EXCAVATION AND BACKFILL FOR STRUCTURES
SPECIFICATION 901	CONCRETE – GENERAL WORKS
SPECIFICATION 908	ANTI-GRAFFITI COATINGS
D11#38472	Main Roads Supplement to Austroads Guide to Road Design Part 6: Roadside Design, Safety and Barriers
D17#362799	Main Roads ITS Testing and Commissioning Guidelines
D17#708814	Asset Data Requirements List
D17#744632	Handover of Electrical and ITS Assets Policy
D17#748571	Handover of Electrical and ITS Assets Procedure
D17#786208	Electrical and ITS Asset Drawing and Data Requirements Policy
D17#877844	Electrical and ITS Asset Drawing and Data Requirements Procedure
D19#622530	Electrical and ITS Infrastructure Asset Drawing Guidelines
D20#454904	Main Roads Specification 713 Uninterruptible Power Supply for Electrical and Intelligent Transport Systems Equipment
D20#488209	Main Roads Specification 713 Uninterruptible Power Supply for Electrical and Intelligent Transport Systems Equipment Asset Data Requirements List

Note: Internal Main Road document numbers are referenced above for convenience; however, all these documents are available from the Main Roads external website. Example drawings are listed separately in Annexure 713A.

Definition of Terms

AC	Alternating Current
ADRL	Asset Data Requirements List
AS	Australian Standards
AS/NZS	Australian and New Zealand Standard

CDDL	Contract Drawing and Data List
DC	Direct Current
DIN	Metal rail of standard type used for the mounting on circuit breakers and industrial control equipment
EMC	Electromagnetic Compatibility
IOM	Installation, Operation and Maintenance Manuals
IP	Ingress Protection
ITP	Inspection and Test Plan
ITS	Intelligent Transport System
$L_{Aeq,8h}$	Eight hour equivalent continuous A-weighted sound pressure level in dB(A) referenced to 20 micro Pascals.
LCD	Liquid Crystal Display
LED	Light Emitting Diode
Main Roads	Main Roads of Western Australia
MEN	Multiple Earthed Neutral
RCBO	Residual Current Circuit Breaker with Over Current Protection
RCD	Residual Current Device
SNMP	Simple Network Management Protocol
Superintendent	Main Roads Contract Manager as defined in AS 2124
UPS	Uninterruptible Power Supply
UV	Ultraviolet

713.03 – 713.05 NOT USED

PRODUCTS AND MATERIALS

713.06 QUALITY OF MATERIALS

New Materials

1. All materials used must be new and of the finest quality and class most suitable for working under the conditions specified.

Materials Withstand

2. Materials must withstand the variations of temperature and loading arising under working conditions without:

    a) Distortion;

    b) Deteriorating at an unreasonable rate;

    c) The setting up of undue stresses at any point; and

    d) Affecting its strength and suitability to do the work to which they have to perform.

Exceptions

3. All materials provided by the Contractor must satisfy the requirements of this Specification. Where it is unclear that an item will fully satisfy these requirements or the item does not satisfy the requirements, the Contractor must submit details of the item to the Superintendent for approval. Details must include the manufacturer datasheets, how the item specifically does not meet compliance and any other required information.

Conformance

4. When the Contractor is using unspecified materials and equipment, they must demonstrate conformance to the requirements of this specification and associated project documentation.

713.07 FIVE AND TEN YEAR SPARE PARTS

Spare Parts

1. A spare parts list with pricing must be provided with equipment tender as per code V05 of the model Asset Data Requirements List (ADRL) in Annexure 713C. The list must at least contain spare parts recommended to ensure five years of operation. A further option of additional spare parts for ten years of operation must also be provided.

Commissioning Spares

2. A commissioning spare parts list must also be provided after award as per code V06 of the model ADRL in Annexure 713C.

713.08 PREFERRED EQUIPMENT

Preferred Equipment

1. All applicable equipment must be ordered in accordance with the Electrical and ITS Preferred Equipment List. Refer Main Roads external website.

DESIGN

713.09 GENERAL

1. The UPS must be designed to power Main Roads Electrical and ITS Roadside devices under all general conditions expected to be encountered at the roadside, where continuity of service and safety are prime considerations. Design must also facilitate inspection, cleaning and repairs. Apparatus must be selected to ensure satisfactory operation under variations of load as may be met on the system, including short circuit.

Design Consideration

2. The design must provide for the specified equipment and materials in accordance with the intent and provisions of this Specification and other standards and requirements referred to or included. Obligations not expressly mentioned but which are necessary for the satisfactory provision of complete and operational equipment and materials, ready to install and commission, must be deemed included at no additional cost to Main Roads.

Specified Equipment

3. The designer is fully responsible for all aspects of the design and must check all details to ensure accuracy and adequacy for the installation. This includes all protection, cable and battery sizing calculations.

Design Responsibility

4. The UPS must be fully enclosed inside a Roadside Cabinet, as specified in this document.

5. All equipment covered by this Specification must comply with AS/NZS 61000.6.1 Electromagnetic Compatibility (EMC) Generic Standards – Immunity for Residential, Commercial and Light-industrial Environments.

Electromagnetic Compatibility

6. The UPS must be in accordance with the requirements of AS IEC 62040.2 UPS – EMC Requirements and AS IEC 62040.3 UPS – Method of Specifying the Performance and Test Requirements.

UPS EMC Requirements

7. All equipment covered by this specification must comply with AS/NZS 1020 The Control of Undesirable Static Electricity.

Static

8. Design drawings and documentation must be in accordance with Main Roads Electrical and Intelligent Transport Systems Infrastructure Asset Drawing Guidelines, AS 1100 (Set) and AS 1102 (Set).

Drawing Guidelines

713.10 ELECTRICAL INPUT / OUTPUT SPECIFICATIONS

1. It is the responsibility of the Purchaser to specify the electrical parameters in accordance with Annexure 713B, such as the following:

    a) Rated input / output voltages ± 10 %;

    b) Number of input / output phases ± 10 %;

    c) Continuous apparent power output rating; and

    d) System fault level.

Electrical Parameters

Input voltage and frequency may be subject to voltage sags and swells within the power supply authorities' expected range. Supply disturbances must not affect the operation of the UPS. Under normal conditions, the input frequency is 50 Hz ± 2.5 %.

713.11 CONSTRUCTION DESIGN

1. All construction design detail must be approved by the Superintendent prior to commencement of installation. Construction design includes but not limited to the following:

    a) Verification of equipment locations and mounting methods;

    b) Verification of cable and conduit routes; ***HOLD POINT***

    c) Underground cable trenching layout and dimensions;

    d) Conduit sizes and lengths;

    e) Verification of pit locations, conduit entry depths and directions; and

    f) Concrete pad and plinth layout, dimensions and interface with cabinet.

2. All equipment must be arranged so that cabling is bottom entry. ***Cable Entry***

3. The Contractor must 'as-build' all necessary construction drawings, schedules and lists in legible marked-up form to reflect all construction design changes and actual installation. The marked-up documents must be issued to the Superintendent for approval prior to final electronic updating of Main Roads Asset Drawings. Refer Electrical and Intelligent Transport Systems Infrastructure Asset Drawing Guidelines, on the Main Roads external website. ***As-Built***

713.12 MAINTAINABILITY

1. Carrying out routine maintenance on the UPS, roadside cabinet and inherent components must not require proprietary or specialist tools. ***Tools***

2. All internal equipment and cabling must be easily accessible during routine maintenance. There must be no need to remove or adjust other equipment, cable management trays or racks, if applicable. ***Accessibility***

713.13 UPS CONTROLLER

713.13.01 GENERAL

1. The UPS system must consist of a battery charger/rectifier, batteries, inverter and protective devices and must be of the 'double conversion' type. The DC system must not be earthed. The inverter, battery charger and batteries must act as a back-up source of power providing the total load current requirements specified, whilst simultaneously maintaining the batteries in a fully charged state. ***Double Conversion***

2. When the primary power supply is not within the expected tolerances,

the UPS must provide continuity of power for the time specified in Annexure 713B, without affecting the operation of the roadside devices. Upon restoration of the primary power supply, the UPS must revert to the primary supply without affecting the operation of the roadside devices.

UPS Operation

3. The UPS must be capable of operating from any of the following supplies:

Power Source

   a) Mains power;

   b) Portable generator supply; and

   c) Storage batteries.

4. The UPS must be provided with an integral single emergency power off device or terminals for the connection of a remote emergency power off device, which prevents further supply to the load by the UPS in any mode of operation, in accordance with AS 62040.1.

Emergency Power Off Device

5. The UPS must be equipped with RS232/RS485 and Ethernet communication capabilities for programming, access and remote monitoring of all operation diagnostics, UPS status, alarms and event recorder data using an industry standard protocol, as specified in Annexure 713B. UPS must be fully capable of being fully managed and monitored through a web server with secure connection protocol.

Remote Monitoring

6. The UPS must provide non-volatile memory for the storage of all logs, test data configuration setting and user accounts. Passwords must be stored in an encrypted form.

Memory

7. The UPS must have automatic and manual bypass functionality as specified in Annexure 713B.

Bypass Requirement

8. The UPS must be rack mounted.

Rack Mounted

9. The UPS must have a minimum operational life as specified in Annexure 713B.

Operating Life

713.13.02 BATTERY CHARGER / RECTIFIER AND MANAGEMENT SYSTEM

1. The battery charger must be as specified in AS 5715 and in accordance with AS 4044, filter the incoming supply, and convert the voltage to DC and process the DC power for input to the inverter and charging the UPS batteries.

Battery Charger

2. The battery charger must comply with the EMC requirements of AS/NZS 61000.6.1 and be in accordance with the requirements of AS 5715.

Battery Charger EMC

3. The Battery Management System must be as detailed in AS 5715 and may be included as part of the battery pack.

Battery Management System

4. If the batteries are discharged to the maximum depth of discharge prior to power restoration, the UPS must automatically restart to normal operation, including recharging the batteries to their fully charged state, within the maximum time specified in Annexure 713B.

Depth of Discharge

5. The battery charger must be operational when the UPS is powered by a portable generator.

Generator

6. The batteries must be protected against overcharging.

Battery Protection

713.13.03 INVERTER

1. The inverter must be as specified in AS 5715.

Inverter

713.13.04 METERING AND STATUS MONITORING

1. The UPS must include a front panel screen to display real-time measurements of various parameters and system status, as specified in AS 5715, including displaying the following parameters:

Display Parameters

   a) UPS operating mode;

   b) Input AC parameters including voltage, frequency, current and power;

   c) Inverter output AC parameters including voltage, frequency, current, power and temperature;

   d) Battery parameters including voltage, charge/discharge current and remaining autonomy time; and

   e) Alarms in reverse chronological order.

2. The operational status of the UPS must be indicated on the front panel, either on the screen or with LCD/LED indicators. As a minimum, they must cover:

Operational Status

   a) Start-up UPS;

   b) Shut down UPS;

   c) UPS mode of operation;

   d) Charger / Inverter units failure;

   e) Battery power availability;

   f) Charging status; and

   g) Internal diagnostic fault checks.

3. The LCD/LED indications must be clearly visible and readable at all times.

713.13.05 ALARM INDICATIONS AND CONTROLS

1. As a minimum, the following alarm conditions must initiate an audible alarm, single failure output and be displayed on the UPS front panel screen/indication lights:

Alarm Indications

   a) Start-up UPS;

b) Shut Down UPS;

c) Manual select for UPS mode of operation;

d) Charger/Inverter units operational;

e) Battery power availability;

f) Charging status; and

g) Internal diagnostic fault checks.

2. The following control switches must be available on the UPS front panel:

Control Switches

a) Alarm Reset/Silence that must cancel an audible alarm but leave actuated alarm indications illuminated until rectified;

b) UPS ON/OFF switch; and

c) Transfer control switch for manual source selection and switching.

713.13.06 PROGRAMMABLE CONTACTS

1. UPSs must provide for a minimum of six programmable volt-free changeover contacts, in order to assign different alarms as required, for remote monitoring and future controls. The contacts must be suitably rated.

Remote Monitoring

As a minimum requirement, they must provide for the following information:

a) UPS on;

b) Battery low;

c) UPS fault; and

d) Main Failure.

713.14 BATTERIES

1. Batteries must meet the requirements of AS 5715.

Battery Compliance

2. Batteries must comply with the requirements of AS/NZS 4029.2 and AS 3731.2.

3. The batteries capacity must be such that the equipment will operate for the minimum time specified in Annexure 713B at rated load, with no charge from the charge controller. This must be specified by the Purchaser, in accordance with the requirements detailed in the relevant Main Roads 700 Series Technical Specification.

Capacity

Charge Time

4. The batteries must have a maximum charge time from the cut-off voltage to full charge as specified in Annexure 713B.

5. The batteries must be of the type specified in AS 5715 and Annexure 713B. ***Battery Type***

6. The batteries life expectancy must be greater than the minimum specified in Annexure 713B, considering all anticipated environmental conditions. ***Battery Life***

7. Batteries must be maintenance-free type. ***Maintenance Free***

8. The batteries must be arranged on withdrawable racks inside the roadside cabinet and designed to facilitate replacement of a faulty battery without disturbing the remaining batteries in the battery bank. ***Withdrawable Shelf***

9. The battery compartment areas must include a form of battery constraint, sufficient to prevent the battery from falling out of the compartment in the event of the cabinet being struck by a vehicle. ***Battery Constraint***

10. Batteries must have a suitably rated isolator switch. ***Isolator***

11. A battery diagram connection must be included, clearly visible to service personnel. ***Connection Diagram***

713.15 MAINTENANCE BYPASS MODE

1. The UPS must include a maintenance bypass switch that will enable the transfer of load to the main incoming supply with no interruption in power to the load. In the event of component failure, the UPS must automatically switch over to mains power. The maintenance bypass must allow serviceable components of the UPS and batteries to be maintained safely. ***Maintenance Bypass Switch***

2. With the load supplied via the maintenance bypass, it must enable removal and replacement of the UPS without affecting the operation of the roadside devices. ***Removal / Replacement***

713.16 STAND-BY GENERATOR CONNECTION

1. The UPS and its housing must facilitate the connection of a portable generator to supply power to the UPS during extended mains outages, in accordance with the requirements of AS 5715. ***Standby Generator***

2. No power must be fed into the mains supply during switching and generator connection. ***Back Feed***

713.17 UPS ROADSIDE CABINET

713.17.01 GENERAL

1. The UPS and all accessories must be enclosed in their own Roadside Cabinet as specified in Annexure 713B. ***Enclosure***

2. The configuration should be such that the effect of heat on the batteries are kept to a minimum; therefore, the cabinet layout must be in accordance with the requirements of AS 5715. ***Cabinet Layout***

713.17.02 LIFTING, TRANSPORTATION AND MOUNTING

1. The cabinet must be fitted with lifting anchors or similar, capable of supporting a cabinet complete with all internal componentry, excluding any batteries for transportation. ***Lifting Anchors***

713.17.03 MATERIALS

1. The cabinet's structural rigidity and overall integrity for the site-specific conditions must be such that the minimum life duration exceeds the minimum specified in Annexure 713B. ***Structural Rigidity***

2. Cabinets must be marine grade aluminium with minimum thickness as specified in Annexure 713B. ***Enclosure Material***

3. All materials, fixing methods and surface treatment must inherently be corrosion resistant or be treated to prevent electrolytic and galvanic corrosion. ***Corrosion Resistant***

4. All hardware must be hot-dipped galvanised in accordance with AS/NZS 4680. Contact between dissimilar metals must comply with the requirements of AS/NZS 1664.1 and AS/NZS 1664.2. ***Hardware***

713.17.04 DIMENSIONS

1. Cabinets must be within the dimensions specified in Annexure 713B. ***Dimension***

2. 100 mm clearance must be maintained between rack frame/equipment and side panels or doors. ***Clearance***

3. Weather shields may be installed on external surfaces to assist in controlling the internal temperature. Shields must be of same material as cabinet body. ***Weather Shield***

4. Cabinets must provide for water runoff. ***Water Runoff***

713.17.05 DOORS AND HINGES

1. Cabinets must have a minimum number of doors as specified in Annexure 713B. ***Number of Doors***

2. All doors must be fitted with internal stiffeners. ***Internal Stiffeners***

3. Cabinets must have a three point locking mechanism on all doors, keyed as specified in the Electrical and ITS Preferred Equipment List. ***Locks***

4. All doors must have a door compression gasket, to prevent ingress of water and dust, adhering to IP rating specified in Annexure 713B. Gaskets must be ultraviolet (UV) stabilised, capable of maintaining its elasticity and memory over the life of the cabinet. ***Gasket***

5. All doors must have a locking mechanism, capable of being locked in the open position at an angle greater or equal than specified in Annexure 713B. Mechanism to be hot-dip galvanized or 316 Stainless Steel. ***Hold Open Mechanism***

6. All doors must have internal map pockets with finger slots of minimum size specified in Annexure 713B. ***Map Pockets***

7. A fluorescent or LED light must be installed at the top of all doors, operate automatically upon opening and be RCD protected. The light must adequately illuminate all internal components. ***Lights***

8. All door sizes must be practicably maximised to the relative cabinet face. ***Door Size***

9. Doors must be of the same material and colour of the cabinet and to the requirements specified in Section 713.16.03. ***Door Features***

713.17.06 EXTERIOR FINISH

1. Exterior must be free from all protrusions and burrs. ***Protrusions***

2. All exterior corners must have a bend radius exceeding 3 mm. ***Bend Radius***

3. Primer and undercoat must be powder coated in accordance with manufacturer's recommendations. ***Powder Coated***

4. Cabinet to be primed and finished ripple free to the colour specified in Annexure 713B and in accordance with AS 2700. ***Colour***

5. A clear anti-graffiti coating must be applied to cabinet exterior in accordance with Main Roads SPECIFICATION 908 ANTI-GRAFFITI. ***ANTI-GRAFFITI***

6. Exterior finish must be resistant to natural weathering, in accordance with AS/NZS 1580.457.1. ***Finish***

713.17.07 ENVIRONMENTAL REQUIREMENTS

1. UPSs must be designed to operate under any combination of the following conditions, in order to exceed the specified minimum service life of equipment:

    a) Ambient air temperatures within the range -10 ºC to 60 ºC;

    b) Relative humidity up to 95 %;

    c) Insolation of up to 1000 Wm^{-2}, incident angle of 30º from the vertical, applied to the maximum exposed surface of equipment; and ***Operating Conditions***

    d) High levels of continuous exposure of motor vehicle exhaust gases or salt laden environments.

2. Cabinets must be have a minimum IP rating as specified in Annexure 713B, in accordance with the requirements of AS 60529. ***IP Rating***

3. Cabinets must maintain an internal operating temperature of ± 10 ºC with respect to the outside ambient temperature but within the range specified in 713B. ***Temperature***

4. Cabinets must be thermostat regulated. ***Thermostat***

5. The cabinet must use a minimum number of vents and fans to minimise the build-up of condensation, as specified in Annexure 713B. Fans must be complete with replaceable filters. ***Vents and Fans***

6. Moisture absorbing gel packs must be provided with the cabinet, as specified in Annexure 713B. ***Gel Packs***

7. Wind loading requirements must be in accordance with AS/NZS 1170.2. ***Wind Loading***

713.18 GENERAL ELECTRICAL REQUIREMENTS

713.18.01 SWITCHBOARD PANEL

1. Each cabinet must be supplied with a dedicated switchboard panel of dimensions specified in Annexure 713B. ***Panel***

2. Switchboard panel to have escutcheon with the following features: ***Escutcheon Features***

    a) Openings for the projection of switchgear;

    b) Be of same material as cabinet with edges folded at right angles, to provide structural rigidity;

    c) Complete with suitable fillers over all unused openings;

    d) Secured by captive thumbscrews that require a tool for removal;

    e) Lifting handles; and

    f) Guide pin slots.

3. Particular attention must be given to the location and clearance of handles, levers and switches, in respect to the safety of personnel operating the equipment. ***Clearance***

713.18.02 CABLE MANAGEMENT

1. Cable trunks must be of a non-conductive material complete with slotted ducts and covers, as specified in Annexure 713B. ***Cable Trunks***

2. Cable trunks must have minimum dimensions and spare capacity as specified in Annexure 713B. ***Dimension and Spare***

3. Cable trunks must traverse the full vertical length of the cabinet and not interfere with the internal racking system. ***Length***

4. Cabinets must be provided with gland plates, designed to maintain the integrity of the cabinet's IP rating, as specified in Annexure 713B. ***Gland Plates***

5. Gland plates must be of same material specified in Section 713.17.03.

6. Cable entry must be from the bottom only. ***Bottom Entry***

713.18.03 POWER SURGE AND LIGHTNING PROTECTION

1. All protection equipment must comply with AS 4262.1, AS 4262.2 and AS/NZS 1768. ***Protection***

2. All protection devices must have a visual indictor to determine their operating state. ***Visual Indicator***

3. All protection devices must be DIN rail mountable. ***DIN Rail***

4. All protection devices must have a voltage free contact for remote monitoring purposes. ***Volt Free Contacts***

713.18.04 SWITCHES, CIRCUIT BREAKERS, AND RESIDUAL CURRENT DEVICES

1. Switches and circuit breakers must include the following characteristics: ***Switches/ Circuit Breakers***

    a) Be lockable in the off position;

    b) Double pole, where practicable; and

    c) DIN rail mountable.

2. Residual Current Devices (RCD) must include the following characteristics: ***RCD***

    a) Have a maximum operation leakage current of 30 mA;

    b) Be testable; and

    c) DIN rail mountable.

3. Combined Residual Current Breakers with Over-current Protection (RCBO) are preferred, where practicable. ***RCBO***

713.18.05 NEUTRAL AND EARTH BARS

1. Neutral and earth bars must include the following characteristics:

    a) Be tunnel type for field connections and hex bolt for incomer termination;

    b) Be suitable for connecting all incoming and internal conductors as specified in the design drawings; ***Neutral / Earth Bars***

    c) Be drilled and tapped, numbered brass bars with stud bolt and screws; and

    d) An allowance of 30% spare capacity must be provided as a minimum, unless otherwise specified.

713.18.06 TERMINALS

Terminals

1. Terminals must be sized and rated for the connection of field equipment power cables, as outlined in the design's termination and interconnection diagram.

DIN Rail

2. Terminals are to be DIN rail mountable.

713.19 NOISE LEVEL

1. Noise levels of the assembly under normal operation must be within limits set in the National Standard for Occupational Noise (NOHSC: 1007-2000) and must not exceed an eight-hour equivalent continuous A-weighted sound pressure level, $L_{Aeq,8h}$ specified in Annexure 713B. The $L_{Aeq,8h}$ is to be determined in accordance with AS/NZS 1269.1.

Noise Level

713.20 –713.25 NOT USED

CONSTRUCTION – CIVIL REQUIREMENTS

713.26 CONFLICT WITH OTHER SERVICES

Conflict

1. Prior to the commencement of any work, the Contractor must verify the exact location of services and structures likely to be utilised, modified or in any way affected by the proposed installation.

Excavation

2. Excavation nearby other services must be undertaken in a manner that minimises the risk of damage, e.g. hand digging or vacuum excavations.

Damage

3. Damage caused by the activities of the Contractor must be rectified by the Contractor.

Existing Services

4. Utilisation of any existing services or structures for any purpose requires approval from Main Roads.

713.27 TRENCHING AND BACKFILL

Excavation and Backfill

1. All trenching and backfill must be undertaken in accordance with Main Roads SPECIFICATION 801 EXCAVATION AND BACKFILL FOR STRUCTURES.

Earthworks

2. Earthworks must be carried out in accordance with Main Roads SPECIFICATION 302 EARTHWORKS.

Backfill

3. When an excavation is necessary for the installation of cable pits and conduits, the trench must be backfilled with full surface remediation.

Compacting

4. The backfill must be compacted to match the surrounding soil density and graded to match surrounding surface level. The top 100 mm layer above the conduits and 50 mm below conduit must be clean sand and 50 mm of clean sand below conduit.

HOLD POINT

5. The Contractor requires approval from the Superintendent or site representative prior to the initiation of any backfilling.

Open Trenches

6. The Contractor must progress the works such that the length of open

trench is kept to a minimum. No open trenches must be left unattended or accessible by the public at any time.

713.28 REINSTATEMENT AND CLEAN-UP

1. Disturbed pavement surfaces for non-motorised traffic such as concrete or brick paved areas and pathways must be reinstated to original condition and to the satisfaction of the Superintendent. ***Reinstatement***

2. Any surplus or waste materials such as unused conduits, off-cuts and packaging must be removed from site by the Contractor. The Contractor must also be responsible for all cartage and disposal charges. ***Waste Material***

713.29 ROAD AND RAIL CROSSINGS

1. Conduits requiring underground traversing of a road must be installed using directional drilling methods. Any road-crossing conduit requiring an open trench will require approval from the Superintendent. ***Conduit***

2. Conduits requiring underground traversing of a rail line must require concurrent approval from the Public Transport Authority and Superintendent. ***Rail Crossing Conduit***

713.30 – 713.31 NOT USED

CONSTRUCTION – INSTALLATION REQUIREMENTS

713.32 GENERAL

713.32.01 QUALIFICATIONS

1. All work must be performed by suitably qualified personnel. ***Qualified Personnel***

713.32.02 NOTICES

1. The Contractor must lodge all notices required by the power supply authority and any other authority having jurisdiction over the installation, including the payment of any required fees. ***Notices***

713.32.03 PUBLIC SAFETY

1. Control of traffic including pedestrians and cyclists must be undertaken by the Contractor in accordance with MAIN ROADS SPECIFICATION 202 TRAFFIC, where required. ***Traffic***

713.32.04 VEGETATION CLEARING AND DEMOLITION

1. Vegetation clearing and demolition must be undertaken in accordance with Main Roads SPECIFICATION 301 VEGETATION CLEARING AND DEMOLITION. ***Vegetation Clearing***

713.33 CONCRETE SLAB AND CONCRETE PLINTH

1. Slab and plinth must be approved for the specific location by a registered structural engineer. ***Independent Verification***

2. Cabinets must be supplied with a concrete slab and plinth as specified in Annexure 713B. ***Slab***

3. All concrete must be of minimum class as specified in Annexure 713B and in accordance with Main Roads SPECIFICATION 901 CONCRETE GENERAL WORKS. ***Concrete***

4. Plinth must be 100 mm proud of concrete slab and sized to match cabinet. ***Plinth***

5. Plinth and slab must allow for the provision of conduit entry. ***Conduit Entry***

6. Slab must be level with top of curb or 100 mm above road pavement. ***Level***

7. Slab must have a wood floated with a broomed finish parallel to direction of traffic. ***Finish***

8. Slab must have all edges chamfered. ***Chamfered Edge***

713.34 UPS CABINET INSTALLATION

713.34.01 GENERAL

1. The cabinet must be located at a safe distance from all services and trafficable infrastructure as per Main Roads Supplement to Austroads Guide to Road Design. ***Safe Distance***

2. Cabinet doors must open away from traffic, such that service personnel do not have their back to traffic, where practicable. ***Open Away***

3. Where conduits enter the cabinet, vermin proof inserts must be provided. ***Vermin Proof Insert***

4. Cabinets must be installed as per the design requirements and manufacturer's guidelines. ***Manufacturer's Guidelines***

713.34.02 FRANGIBILITY

1. The cabinet must be suitable for mounting on a flat surfaced concrete plinth and fixed with a minimum of four M12 anchor bolts, complete with double nuts, spring washers and flat washers, in accordance with the manufacturer's recommendations. Bolts and hardware must be hot dip galvanised. ***Frangibility***

2. The cabinet must be fastened to the anchor bolts by means of a frangible plate or fitting, such that in the event of a severe impact from a vehicle, the cabinet will be dislodged without damage to the anchor bolts. Refer AS 5715. ***Mounting***

713.34.03 CABINET EXTERNAL MARKINGS

1. Cabinet asset numbers must be clearly shown on the roadside face of each cabinet. They must be made up of 50 mm black characters on a 50 mm x 60 mm background of adhesive class 2 yellow retro-reflective material as per AS 1906.1. New asset numbers are to be requested via the Electrical Asset Number Request Form and submitted electronically to electricalassetrequest@mainroads.wa.gov.au. Refer Main Roads ***Asset Numbers***

external website.

2. A further label of the same material above, consisting of two lines of 35 mm black characters, must be placed 30 mm above the cabinet number. Line one must read: '138 138' and line two: 'MAIN ROADS WA'. ***External Label***

3. Manufacturer's nameplates or other markings must not be visible externally. ***Manufacturer's Nameplate***

713.35 ELECTRICAL REQUIREMENTS

713.35.01 GENERAL

1. All electrical equipment and cabling must comply with AS/NZS 3100, AS/NZS 3000, AS/NZS 3111, AS/NZS 5000.1 and the Western Australian Electrical Requirements. ***Electrical Standards***

2. Low voltage cabling must be secure and shielded from inadvertent access. ***Shielding***

3. Equipment must be hardwired using industry standard connections and terminal panels. ***Hard-wired***

4. All low voltage fuses must be in accordance with AS/NZS 60269.1 Low-voltage Fuses – General Requirements. ***Fuses***

5. Transformers and power supply units must be in accordance with AS/NZS 61558.1 Safety of Transformers, Power Supply Units and Similar Part 1: General Requirements and Tests (IEC 61558-1 Ed 1.1, MOD). ***Power Supply Units***

6. All low voltage switchgear must be in accordance with AS/NZS 61439.1 Low-voltage Switchgear and Controlgear Assemblies Part 1: General Rules (IEC 61439-1, Ed. 2.0 (2011), MOD). ***Switchgear***

7. Low voltage terminations, including neutrals, must be behind escutcheon where practicable. ***Terminations***

8. The cabinet must not contain socket outlets. ***Socket Outlets***

713.35.02 PRIMARY POWER CONNECTION

1. Primary power must be either via an unmetered supply in accordance with Western Power requirements, or directly from a Main Roads switchboard, dependant on application and project specific requirements. Other arrangements can be considered, in accordance with AS/NZS 3000, although prior approval must be sought from the Superintendent. ***Connection***

2. If the primary power is via a Main Roads switchboard, it must be via an always-on source, not via a dusk to dawn circuit. ***Always-on***

3. All power external from the cabinet must be reticulated underground. ***Reticulation***

4. The power supply must be detailed on the datasheet attached. All equipment must be designed to operate at the correct voltages prior to installation. All equipment must be suitable for the maximum prospective

short-circuit current specified on the datasheet and confirmed for the specific application at the point of installation. ***Power Supply***

713.35.03 SWITCHBOARD PANEL

1. Neutral bars and earth bars must be located behind switchboard panel and easily accessible for all incoming and outgoing cable conductors. They must be positioned such that maximum practicable distance is maintained between live conductors and enclosure, to permit connections to be made safely at all times. ***Neutral / Earth Bars***

2. The cabinet is to have a double pole main switch, terminating both the active and neutral conductors. ***Double Pole Switch***

3. Live parts upstream of double pole main switch including neutral must be completely covered with insulation, only removable by destruction or use of a tool, in accordance with AS/NZS 61439.1. ***Insulation***

4. Neutral and earth bars must be clearly labelled and distinguishable from each other. ***Labelling***

5. A minimum allowance of 30% spare capacity must be provided as a minimum, unless otherwise specified. ***Spare Capacity***

6. If a MEN link is required, it must be clearly labelled and must read; 'MEN LINK MUST BE CONNECTED'. ***MEN Link***

713.35.04 EARTHING

1. Protective earthing conductors must be terminated at the earth bar, directly connected to main earth bar in accordance with the requirements of AS/NZS 3000. ***Terminations***

2. Earth bar must be suitable to withstand any anticipated earth fault currents and have provision for the connection of a MEN link. ***Fault Withstand***

3. All conductive frames must be effectively earthed. In particular, the following items must be connected to the earth bar by copper conductors of not less than 2.5 mm^2 cross sectional area:

    a) Hinged doors and removable panels which are fitted with electrical equipment or cables; ***Equipotential Bonding***

    b) Metal cases of instruments;

    c) Battery trays; and

    d) Equipment, which is separately mounted in a case, or has an earth terminal provision.

4. If a "clean earth" is required for particular equipment, the manufacturer must be consulted in order to confirm specific requirements. ***Clean Earth***

713.35.05 POWER SURGE AND LIGHTNING PROTECTION

1. All protection devices must connect to an approved earthing system, in accordance with AS/NZS 3000 and the manufacturer's ***Surge Protection***

recommendations.

2. A surge diverter must be installed directly downstream from the incoming mains switch, as specified in Annexure 713B. ***Surge Diverter***

713.35.06 WIRING AND TERMINATION

1. Standard industry wire ferruling must be used on all terminations, in accordance with the electrical schematic and termination and interconnection diagrams. ***Ferruling***

2. Ferrule numbers must be placed near the termination on either end of the wire. The wire number must be legible and placed in a location where it can be read without disturbing other wires. ***Legible***

3. All low voltage terminations not behind switchboard panel escutcheon must be mechanically shrouded and labelled. In the event that low voltage terminations including neutrals are not behind an escutcheon, a polycarbonate standoff must be installed with an electrical shock sticker, in accordance with Table B3 Sign Number 447 of AS 1319. ***Low Voltage Terminations***

4. Low voltage terminal blocks must be segregated from extra-low voltage and control circuits and be uniquely labelled. ***Segregation***

5. Where wiring bridges to a hinged panel or door, the arrangement must be such that the opening of the hinged panel will cause the wiring loom to twist longitudinally and not bend or rub on a panel edge or face. At no point must any undue stress be placed upon the wires. Stick-on type wiring harness anchors will not be accepted. ***Wiring Bridges***

6. There must be no jointing or teeing of wires between terminals. Only one conductor must terminate on any one side of a terminal. Terminal link bars must be used should there be a requirement for more than one conductor at any one point. ***No Jointing***

7. An allowance must be made on the length of wire at each terminal to permit cutting and remaking of the wire termination at least once without interference with the main run of the wire. ***Sufficient Slack***

8. Terminal blocks must be spaced at least 200 mm above gland plates and adjacent terminal blocks must be spaced no less than 75 mm from ducting and must be set to give easy access to terminations and to enable ferrule numbers to be read without difficulty. Terminals must be numbered, in accordance with the termination and interconnection diagram. ***Terminal Block Spacing***

9. All wire insulation must be non-hygroscopic, incapable of supporting combustion and suitable for the site-specific climatic conditions. ***Non-hygroscopic***

10. Electrical internal wiring must of minimum size specified in Annexure 713B and suitably rated, as per the cable schedule. ***Conductor Size***

11. A minimum allowance of 20% spare terminals must be provided as a minimum, unless otherwise specified. ***Spare***

12. Electrical wiring must be suitably de-rated for the maximum panel temperature. ***De-rating***

13. It must be possible to check the tightness of all bolted and screwed connections, by removing covers if necessary, post-cabinet assembly and installation. ***Tightness***

14. All serial and control cable must be of minimum size as specified in Annexure 713B. ***Conductor Size***

15. Conductors must be in accordance with the requirements of AS/NZS 1125 Conductors in Insulated Electric Cables and Flexible Cords. ***Insulation***

16. Conductor colours must be in accordance with AS/NZS 3000. Communication cables and leads must be in accordance with Table 1 below. ***Colour Identification***

Table 1 - Cable Colours

Cable Type	Colour
Active Phase	Red, White or Blue
Neutral	Black
Earth	Yellow/Green
Serial cables	Grey
Fibre patch leads	Yellow
Ethernet cables	Blue
Control cables	Grey

17. Battery cables must be must be flexible, multi-stranded and colour coded as follows: ***Battery Cables***

    a) Positive – Red;

    b) Negative – Blue; and

    c) Battery interconnecting – Black.

713.36 LABELS

1. All equipment and devices must be identified with engraved traffolyte nameplates. Titles must be as specified on equipment electrical schematics and termination and interconnection diagrams and in accordance with AS/NZS 3000. Refer Main Roads Electrical and Intelligent Transport Systems Infrastructure Asset Drawing Guidelines on Main Roads external website for equipment identifiers. ***Nameplates***

2. Labels must be black letters on white background engraved traffolyte and fixed by stainless steel screws only in slotted holes. Adhesive labels will not be accepted. ***Labels***

3. Labels must be located so that they are not obscured by wiring or equipment and are visible from the normal access point. Labels must not be fixed to removable equipment such as duct covers and switchgear. ***Locations***

4. Letter sizes must be as follows: ***Letter Sizing***

a) Main designation label	25 mm
b) Danger labels, including MEN links	12 mm
c) Instrument/equipment label	6 mm

5. Where access may be gained to live equipment with a voltage of 110 V AC or above, red traffolyte labels with white lettering engraved 'DANGER' *, where * is the voltage present, must be installed. ***Danger***

6. The cabinet must not contain a label for the MEN link, if the link is not required. ***MEN Link***

713.37 COMMUNICATIONS

1. Cabinets must be connected to the Main Roads Network via Main Roads fibre, where practicable. In the event that connection to Main Roads fibre is impracticable, other mediums can be used in accordance with the approved design. ***Media***

2. Fibre optic requirements must be in accordance with Main Roads SPECIFICATION 705 OPTICAL FIBRE INSTALLATIONS. ***Optical Fibre***

713.38 CONDUITS AND PITS

1. Conduits and pits must be supplied and installed in accordance with Main Roads SPECIFICATION 704 CABLE CONDUITS & PITS FOR INTELLIGENT TRANSPORT SYSTEMS. ***Pits and Conduits***

713.39 – 713.58 NOT USED

INSPECTION AND TESTING

713.59 GENERAL

1. The technological complexity of electrical and ITS equipment installed on Main Roads' network continues to increase, requiring rigorous and definitive inspection and testing of new works. The installed value of the equipment is also increasing, such that it is essential for Main Roads maintenance staff to have access to relevant design and manufacturer information in order to undertake asset maintenance, repair and life extension.

Rationale

2. Accordingly, the Contractor must undertake Testing and Commissioning in accordance with the Main Roads ITS Testing and Commissioning Guidelines. IOMs must also be prepared and provided in accordance with the Electrical and ITS Asset Drawing and Data Requirements Process. The documentation in respect of these processes is available on the Main Roads external website as referenced above.

ADRL Process

713.60 ASSET DATA REQUIREMENTS LIST

1. Main Roads has developed a comprehensive ADRL of all documentation, which can be expected to be provided for a standard UPS installation. This list is included with this Specification as Annexure 713C.

ADRL List

713.61 CONTRACT DRAWING AND DATA LIST

1. The Contractor is expected to take the ADRL and develop their own Contract Drawing and Data List (CDDL). This CDDL is to be submitted at tender under code V01 and will be competitively assessed prior to award. The CDDL must include all proposed specific drawing and document titles and drawing numbers. It is not expected that the actual documents will be submitted, just the descriptive titles.

CDDL List

2. A CDDL format is included within the Electrical and ITS ADRL Procedure.

CDDL Format

713.62 DATASHEETS

1. The Contractor must submit the completed technical datasheets in Annexure 713B. This is to be submitted under ADRL codes E08 and IO3, as per Annexure 713C. The purpose of the datasheet is to identify, at an early stage of manufacture, any deviations from the Specification.

Datasheets

713.63 INSPECTION AND TEST PLAN

1. The Contractor is expected to prepare a sample Inspection and Test Plan (ITP) to meet the requirements of the ITS Testing and Commissioning Guidelines. This sample ITP is to be submitted under code V02 as per Annexure 713C and will be competitively assessed prior to award.

ITP

713.64 WORKS SCHEDULE

1. The Contractor is expected to prepare an engineering/ procurement/ fabrication schedule for the works. This schedule is to be submitted under code V04 as per Annexure 713C and will be competitively assessed prior to award. The purpose of the schedule is to inform quality assurance and inspection activities by Main Roads. ***Schedule***

713.65 SPARE PARTS AND PRICING

1. The Contractor must provide a list of spare parts with pricing at tender under ADRL code V05 as per Annexure 713C for competitive assessment. ***Spare Parts***

713.66 TESTING AND COMMISSIONING COSTS

1. The Contractor must supply all labour, materials and equipment required to fully test and commission the installation. Testing must be carried out in the presence of a Main Roads representative. ***Costs***

2. Installation and/or equipment will be accepted only after satisfactory completion of commissioning tests. If a test is unsuccessful, the equipment must be repaired and re-erected as appropriate and subject to retest until successful. ***Failed Tests***

3. The cost of any retesting if necessary must be borne by the Contractor. ***Retesting***

713.67 – 713.80 NOT USED

AS BUILT AND HANDOVER REQUIREMENTS

713.81 DOCUMENTATION REQUIREMENTS

713.81.01 GENERAL

1. The Contactor is required to prepare an IOM under code V09 of the ADRL. This manual is made up of all the other documentation codes of the ADRL. A Manufacturer's Data Report is also to be prepared under ADRL code V08 as per Annexure 713C. ***IOM***

2. After award, the Contractor is required to submit the completed technical datasheets in Annexure 713B. This is to be submitted under ADRL codes E08 and IO3 as per Annexure 713C. The purpose of the datasheet is to identify at an early stage of manufacture any deviations from the specification. ***Drawings***

3. The Contractor must supply Electrical and ITS Drawings conforming to the Main Roads Electrical and Intelligent Transport Systems Infrastructure Asset Drawing Guidelines. These guidelines are available on the Main Roads external website. ***Drawing Guidelines***

713.81.02 STAGED REVIEW

1. The documentation included in the IOM is to have been individually reviewed at a time specified in the 'Wks from start' column of the ADRL. This staged process has the intention of identifying and resolving issues ***Staged Review***

as early as possible in the design and fabrication process. The submittal of documentation should be staggered to avoid a "rush" of information at any one point in the process.

713.81.03 PROCESS DOCUMENTATION

1. The Contractor is to submit design drawings and documentation, for the purpose of staged reviews in accordance with:

Documentation

   a) Electrical and ITS Asset Drawing and Data Requirements Policy; and

   b) Electrical and ITS Asset Drawing and Data Requirements Procedure.

713.82 HANDOVER REQUIREMENTS

713.82.01 GENERAL

1. The Contractor is required to cooperate and participate in respect of Main Roads quality and compliance inspection processes. These processes are detailed in the:

Handover

   a) Handover of Electrical and ITS Assets Policy; and

   b) Handover of Electrical and ITS Assets Procedure.

2. The above process is available on the Main Roads external website as referenced above in section 713.02.

3. All work must be carried out generally in accordance with requirements of AS/NZS ISO 9001 Quality Management Systems – Requirements and AS/NZS ISO 9002 Quality Systems – Model for Quality Assurance in Production, Installation and Servicing.

Quality

713.82.02 AGREEMENT OF INSPECTION CRITERIA AND FINDINGS

1. Main Roads will undertake inspection according to prepared criteria, agreement of the Contractor that these criteria accurately represent obligations under the contract will be sought. The Contractor is required to make reasonable efforts to arrive at an agreed set of criteria. Main Roads reserves the right to proceed with inspection without agreement from the Contractor.

Agreement

2. Main Roads will prepare findings of non-conformance against the criteria and seek agreement from the Contractor. The Contractor is required to make reasonable efforts to arrive at agreed findings. Main Roads reserves the right to issue findings without agreement from the Contractor.

Findings

713.82.03 DEVELOPMENT OF ACTION PLAN / RECTIFICATION OF NON-CONFORMANCES FOR SUPERINTENDENT APPROVAL

Action Plan

1. The Contractor is required to develop an action plan to address non-conformances in accordance with AS/NZS ISO 9001. The Contractor is

expected to make reasonable efforts to arrive at agreement in respect of the plan with Main Roads. The Contractor is required to implement their action plan to address non-conformances.

713.83 - 713.90 NOT USED

CONTRACT SPECIFIC REQUIREMENTS

713.91 - 713.99 NOT USED

ANNEXURE 713A MAIN ROADS STANDARD DRAWINGS

Example Drawings for Information Only

Drawing No.	Description
0748-3118	UPS for Traffic Signal Controller – Foundation Detail
0748-3358	MLA UPS Cabinet – Type 1 General Arrangement
0748-3359	MLA UPS Cabinet – Type 1 Single Line Diagram & Control Schematic
0748-3360	MLA UPS Cabinet – Type 2 General Arrangement
0748-3361	MLA UPS Cabinet – Type 2 Single Line Diagram & Control Schematic
0748-3362	MLA UPS Cabinet – Type 3 General Arrangement
0478-3363	MLA UPS Cabinet – Type 3 Single Line Diagram & Control Schematic
0748-3364	Magellan Cabinet General Arrangement
0748-3365	Magellan Cabinet Single Line Diagram
0748-3366	Magellan Cabinet Single Line Diagram - Earth

ANNEXURE 713B EQUIPMENT DATASHEETS

UPS – SUBMIT UNDER ADRL CODE E08

ITEM	DESCRIPTION	UNITS	DATA BY PURCHASER	DATA BY SUPPLIER
1.0	Manufacturer's Details			
1.1	Manufacturer's name		Supplier	
1.2	Place of manufacture		Supplier	
1.3	UPS model		Supplier	
1.4	UPS type		Double Conversion	
1.5	Minimum operational life		Supplier	
2.0	UPS ratings			
2.1	Rated operational input voltage	Vac	240 / 415	
2.2	Rated operational input frequency	Hz	50	
2.3	Number of phases in system – input side		Purchaser	
2.4	System fault level		Purchaser	
2.5	Rated operational output voltage	Vac	230 / 400	
2.6	Rated operational output frequency	Hz	50	
2.7	Number of phases in system – output side		Purchaser	
2.8	Continuous VA output rating	VA	Purchaser	
2.9	Output voltage wave shape		Sine wave	
2.10	Output voltage harmonics	% THD	Supplier	
2.11	Rated withstand voltage	Vac	Supplier	
2.12	System efficiency at rated output	%	>90	
2.13	EMC compliance		Yes	
2.14	Heat generated at rated current		Supplier	
2.15	Internal bypass		Yes	
2.16	Maintenance bypass mode compatible		Yes	
2.17	Rack mounted		Yes	
2.18	Dimensions	mm	Supplier	
2.19	Mass	kg	Supplier	
2.20	Cold start capable		Yes	
2.21	Rectifier –Voltmeter and Ammeter LCD/LED digital display		Yes	
2.22	Inverter –Voltmeter and Ammeter LCD/LED digital display		Yes	
2.23	Non-volatile memory		Yes	
2.23	Communication		RS232/RS484 and Ethernet	
2.24	Supports SNMP v2 or better		Yes	
3.0	Environmental			

3.1	Operating ambient air temperature range	ºC	-10 - 60	
3.2	Operating relative humidity range	%	0 - 95 (non-condensing)	
3.3	Storage temperature range	ºC	-10 - 70	
3.4	Maximum A-weighted sound pressure level	dbA	60	
3.5	Minimum IP rating		45	

Note: Supplier / Purchaser to complete all fields

BATTERIES – SUBMIT UNDER ADRL CODE E08

ITEM	DESCRIPTION	UNITS	DATA BY PURCHASER	DATA BY SUPPLIER
1.0	Manufacturer's Details			
1.1	Manufacturer		Supplier	
1.2	Place of manufacture		Supplier	
2.0	Chemistry and Ratings			
2.1	Chemistry		Supplier	
2.2	Battery model		Supplier	
2.3	No. of battery cells		Supplier	
2.4	Battery construction materials		Supplier	
2.5	Nominal cell voltage	Vdc	Supplier	
2.6	Battery nominal output voltage	Vdc	Supplier	
2.7	No. of parallel sets of cells		Supplier	
2.8	Battery Ampere-Hour rating	Ah	Supplier	
2.9	Battery minimum capacity at rated load	Hours	Purchaser	
2.10	Maximum battery charge time	Hours	8	
2.11	Battery minimum expected life	Years	5	

Note: Supplier / Purchaser to complete all fields

UPS ROADSIDE CABINET – SUBMIT UNDER ADRL CODE I03

ITEM	DESCRIPTION	UNITS	DATA BY PURCHASER	DATA BY SUPPLIER
1.0	Manufacturer's Details			
1.1	Manufacturer's name		Supplier	
1.2	Place of manufacture		Suppler	
1.3	Minimum life	years	15	
2.0	Cabinet Dimensions			
2.1	Height range	mm	1375 - 1700	
2.2	Width range	mm	365 - 420	
2.3	Depth range	mm	780 - 800	
2.4	Minimum number of doors		1	
2.5	Minimum locking mechanism angle	degrees	110	
2.6	Internal map pockets size	mm	300x420x20	
2.7	Switchboard panel size		Supplier	
2.8	Meter box required		Yes/No	
2.9	Door lock three point locking mechanism		Yes	
2.10	Hinges		Concealed type	
3.0	Cabinet General			
3.1	Minimum aluminium grade		A5251 H34 / A5005 H34	
3.2	Minimum thickness	mm	2.5	
3.3	IP rating (minimum)		55	
3.4	Hardware hot-dipped galvanized		Yes	
3.5	Weather shields		Supplier	
3.6	Removal lifting anchors		Yes	
3.7	Cable trunk material		Supplier	
3.8	Cable trunk dimensions	mm	50x75 min	
3.9	Cable trunk spare capacity	%	25	
3.10	Internal temperature range	ºC	10-60	
3.11	Cabinet temperature differential	ºC	±10	
3.12	Number of vents		Supplier	
3.13	Removable filters		Yes	
3.14	Moisture absorbing gel packs		Yes	
3.15	Cabinet cleaned etched and primed		Yes	
3.16	Cabinet colour		Smoke Blue No. T33	
3.17	Gaskets		UV stabilised	
3.18	Thermostat make and model		Supplier	
3.19	Internal LED light make and model		Supplier	
3.20	Internal wiring minimum	mm^2	2.5	
4.0	Concrete Slab and Plinth			
4.1	Minimum class concrete		N32	
4.2	Slab dimensions (minimum)	mm	2500 x 2500	
4.3	Slab thickness (minimum)	mm	200	
4.4	Plinth height (minimum)	mm	100	

5.0	Surge Protection			
5.1	Stage 1 surge diverter – Class and Category		Class 2 and Category C	
5.2	Visual indicator		Yes	
5.3	Volt free contact		Yes	
5.4	Surge Diverter max discharge current rating at 8/20 µs	kA	60	
5.6	Visual indicator		Yes	
5.7	Volt free contact		Yes	
5.8	Device mounting		DIN rail	

Note: Supplier to complete all fields

ANNEXURE 713C MODEL ASSET DATA REQUIREMENTS LIST

D20#488209

ASSET DATA REQUIREMENTS LIST - ADRL
Electrical and Intelligent Transport Systems

EQUIPMENT DESCRIPTION :	Uninterruptible Power Supply					Rev:		0
ADRL No :						Date:		30/06/2020
ADRL Code	DESCRIPTION	TENDER	MRWA REVIEW		MRWA EAM REVIEW	FINAL	INCLUDE IN:	AS CONSTRUCTED
		No. of copies	No. of copies	Wks from start	required	No. of copies		required
V	**Management / Execution Documents**							
V01	Contract Drawing & Data List (CDDL)	1	1			1E,1P	IOM	
V02	Inspection And Test Plans (ITPs) - Sample only for Tender	1	1			1E,1P	MDR	
V03	Non Conformance Reports		1			1E,1P	MDR	
V04	Engineering / Procurement / Fabrication Schedule	1				1E,1P	MDR	
V05	Spare Parts with Pricing	1				1E,1P	IOM	
V06	Commissioning Spare Parts List		1			1E,1P	IOM	
V07	Manufacturer's Data Report (MDR) Index/IOM Index		1			1E,1P		
V08	Manufacturer's Data Report (MDR) (Note 1)					1E,1P		
V09	Installation, Operation and Maintenance Manual (IOM) (Note 2)					1E,1P		
M	**Mechanical**							
M01	Equipment List		1			1E,1P	IOM	
M02	Outline / General Arrangements		1			1E,1P	IOM	
M03	Cross Sectional Drawings		1			1E,1P	IOM	
M04	Shop Fabrication Drawings		1			1E,1P	IOM	
M05	Detail Drawings with Parts List		1			1E,1P	IOM	
M06	Preliminary Structural Design Information		1			1E,1P	IOM	
M07	Final Structural Design Calculations		1			1E,1P	IOM	
M08	Weights and COG		1			1E,1P	IOM	
M09	Foundation Details & Loading Data		1			1E,1P	IOM	
M10	Lifting Drawings		1			1E,1P	IOM	
E	**Electrical**							
E01	Electrical Equipment List	1				1E,1P	IOM	
E02	Power Consumption List		1			1E,1P	IOM	
E03	Electrical Wiring Diagram	1				1E,1P	IOM	
E04	Electrical Schematics		1			1E,1P	IOM	
E05	Electrical Layout Drawings		1			1E,1P	IOM	
E06	Cable Interconnection Diagrams		1			1E,1P	IOM	
E07	Earthing Layout / Details		1			1E,1P	IOM	
E08	Electrical Data Sheets & Curves		1			1E,1P	IOM	
E09	Cable Schedules		1			1E,1P	IOM	
E10	Outline / General Arrangement Drawings	1				1E,1P	IOM	
E11	Electrical Calculations		1			1E,1P	MDR	
E12	Nameplate Details		1			1E,1P	MDR	
I	**Intelligent Transport Systems**							
I01	Instrument Index		1			1E,1P	IOM	
I02	Calibration Sheets		1			1E,1P	IOM	
I03	Data Sheets		1			1E,1P	IOM	
I04	Logic Diagrams		1			1E,1P	IOM	
I05	I/O Schedule		1			1E,1P	IOM	
I06	Interconnection Diagrams		1			1E,1P	IOM	
I07	Cable Schedule		1			1E,1P	IOM	
I08	Outline / General Arrangement Drawings		1			1E,1P	IOM	
I09	Control Panel Termination Diagrams		1			1E,1P	IOM	
I10	Control Panel - Internal and External Layout		1			1E,1P	IOM	
I11	Control Panel Wiring Diagram		1			1E,1P	IOM	
I12	Cable block Diagrams		1			1E,1P	IOM	
I13	Calculations		1			1E,1P	MDR	
F	**Supplier Fabrication Procedures**							
F01	Welding Procedure Specifications (WPS) including repair procedures		1			1E,1P	MDR	
F02	Welding Procedure Qualification Records (PQR)		1			1E,1P	MDR	
F03	Welding Map / Schedule		1			1E,1P	MDR	
F04	Welder Qualification Register		1			1E,1P	MDR	
F05	Fabrication Procedures		1			1E,1P	MDR	
F06	Paint & Surface Preparation Procedure		1			1E,1P	MDR	
F07	Handling Procedure and Special Lifting Requirements		1			1E,1P	MDR	

P	**Supplier Inspection / Test / Procedures (Note 3)**							
P01	Inspection and Test Record (ITR) Procedures		1			1E,1P	IOM	
P02	Factory Acceptance Testing Procedures (FAT)		1			1E,1P	IOM	
P03	Pre-Installation Testing Procedures (PIT)		1			1E,1P	IOM	
P04	Installation Acceptance Testing Procedures (IAT)		1			1E,1P	IOM	
P05	Site Acceptance Testing Procedures (SAT)		1			1E,1P	IOM	
P06	Network Integration Testing Procedures (NIT)		1			1E,1P	IOM	
P07	System Integration Acceptance Testing Procedures (SIAT)		1			1E,1P	IOM	
P08	Final System Testing Procedures (FST)		1			1E,1P	IOM	
T	**Supplier Test / Inspection Reports / Records**							
T01	Mechanical Inspection and Test Records (ITRs)		1			1E,1P	MDR	
T02	Instrument Inspection and Test Records (ITRs)		1			1E,1P	MDR	
T03	Electrical Inspection and Test Records (ITRs)		1			1E,1P	MDR	
T04	Civil / Structural Inspection and Test Records (ITRs)		1			1E,1P	MDR	
T05	Factory Acceptance Testing Report (FAT)		1			1E,1P	MDR	
C	**Material / Supplier Certificates**							
C01	Certificates of Compliance		1			1E,1P	MDR	
C02	Warranty Certificates		1			1E,1P	MDR	
	EQUIPMENT DESCRIPTION :	**Uninterruptible Power Supply**						
	ADRL No :	**0**						

REVISION HISTORY

Rev	Description	Prepared by	Date	Approved by	Date
0	UPS Specification 713	Tom Peacock	12/06/2020	Andrew Martin	30/06/2020

Notes:	
1	MDR documents due 2 weeks after delivery
2	IOM documents due 4 weeks before delivery
3	PIT is to replicate the onsite installation and operation prior to the installation. IAT is to confirm that the equipment has been installed and to correct installation errors.
	SAT is to verify the operation of the ITS equipment and devices in their installed state. NIT is to verify the operation of ITS equipment connected to the TCS network.
	SIAT is to verify the end-to-end system integration and operations of the device. FST is to verify the end-to-end delivery from device to control system (STREAMS).
	Refer to the MRWA ITS Testing and Commissioning Guidelines D17#362799 for more detailed information.

GUIDANCE NOTES

FOR REFERENCE ONLY – DELETE GUIDANCE NOTES FROM FINAL DOCUMENT

1. All edits to downloaded Specifications must be made using *Track Changes*, to clearly show added/deleted text.

2. If **all** information relating to a clause is deleted, the clause number should be retained and the words **"NOT USED"** should be inserted.

3. The proposed documents with tracked changes must be submitted to the Superintendent for review and agreement with the Custodian, prior to printing the final batch of documents. When this final printing is carried out, the tracked changes option is to be turned off.

4. Before printing accept all changes in the document, turn off *Track Changes* and refresh the Table of Contents.

5. The Custodian of this Specification is the Principal Electrical Standards Engineer.

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1. SCOPE

1.1 This Specification covers the requirements for new UPS installations.

1.2 Where modifications to existing UPS cabinets are proposed, then the scope (Clause 713.01) will need careful editing to clearly outline the extent of the Works. The relevant clauses in the document would also need to be updated to ensure the information provided accurately outlines the extent of the works required.

2. CROSS REFERENCING TO OTHER CONTRACTS

2.1 The final UPS specification must include cross-referencing to other relevant specifications, as likely to be required, such as:

SPECIFICATION 100	GENERAL REQUIREMENTS
SPECIFICATION 202	TRAFFIC
SPECIFICATION 301	VEGETATION CLEARING AND DEMOLITION
SPECIFICATION 302	EARTHWORKS
SPECIFICATION 703	CLOSED CIRCUIT TELEVISION (CCTV) CAMERAS
SPECIFICATION 704	CABLE CONDUITS & PITS FOR ITS
SPECIFICATION 707	VARIABLE MESSAGE SIGNS (FIXED TYPE)
SPECIFICATION 708	VEHICLE DETECTION STATIONS
SPECIFICATION 705	OPTICAL FIBRE INSTALLATIONS
SPECIFICATION 712	TRAFFIC SIGNALS
SPECIFICATION 801	EXCAVATION AND BACKFILL FOR STRUCTURES

SPECIFICATION 901 CONCRETE – GENERAL WORKS

SPECIFICATION 908 ANTI-GRAFFITI COATINGS

CONTRACT SPECIFIC REQUIREMENTS

The following clauses are to be placed under the CONTRACT SPECIFIC REQUIREMENTS, as required. After inserting the clause, change the clause number and heading to style “H2 SP” so it appears in the Table of Contents. Note that all document numbering must be checked after modification, as MS Word occasionally “corrupts” and modifies numbers not changed, especially the first heading number 7XX.01-7XX.05. Also note that the right hand sidebars are all linked together, so the sidebar text needs to be adjusted by adding additional “Enter Lines” into the sidebar.

XXX.XX SUB HEADING (H2 SP)

Insert text (Main Table SP) ***Keyword SP***

Insert text (Main Table SP)

XXX.XX SUB HEADING (H2 SP)

Insert text (Main Table SP)

Insert text (Main Table SP)

AMENDMENT CHECKLIST

Specification No. **713** Title: **UPS for Electrical and ITS Equipment** Revision No:_____

Superintendent: _____ Signature:_____ Date:_____

Checked by: _____ Signature:_____ Date:_____

Contract No: _____ Contract Description:_____

ITEM	DESCRIPTION	SIGN OFF
Note: All changes/amendments must be shown in Tracked Changes mode until approved.		
1.	Superintendent has reviewed Specification and identified Additions and Amendments.	
2.	**CONTRACT SPECIFIC REQUIREMENTS** addressed? Contract specific materials, products, clauses added? (Refer Specification Guidance Notes for guidance).	
3.	Any unlisted materials/products proposed and approved by the Superintendent? If "Yes" provide details at 16.	
4.	Standard clauses amended? **MUST SEEK** approval from Manager Contracts.	
5.	Clause deletes shows as **"NOT USED"**.	
6.	Appropriate **INSPECTION AND TESTING** parameters included in Spec 201 (Text Methods, Minimum Testing Frequencies verified).	
7.	**ANNEXURES** completed (refer Specification Guidance Notes).	
8.	**HANDOVER** and **AS BUILT** requirements addressed.	
9.	Main Roads QS has approved changes to **SMM**.	
10.	Superintendent certifies completed Specification reflects intent of the design.	
11.	Completed Specification – independent verification arranged by Superintendent.	
12.	Superintendent's review completed.	
13.	**SPECIFICATION GUIDANCE NOTES** deleted.	
14.	**TABLE OF CONTENTS** updated.	
15.	**FOOTER** updated with Document No., Contract No. and Contract Name.	
16.	Supporting information prepared and submitted to Superintendent.	
Further action necessary:		

Signed: _____ *(Superintendent)* Date:_____