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Specification for Security Bollards Job Number CEW 1669

Parliament House, Canberra

10 August 2004
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Revision: For Tender

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1. Scope of Works

1.1 Background

The Australian Parliament House requires security enhancements including the design and installation of security bollards at key access points around Parliament Drive. These bollards shall be rated to stop vehicles with a total weight of 5 tonnes travelling at 40km per hour.

1.2 Tender Enquiries

All tender enquiries shall be directed to.

Mr Kevin O'Hara
Project Manager
G.E. Shaw & Associates (ACT) Pty Ltd
20 Challis St, Dickson ACT 2602
Tel: (02) 6277 5245

1.3 Associated Drawings

This specification shall be read in association with the following drawings;

DRAWING NUMBER	TITLE	COMMENTS
CEW 1669-A001	Security Enhancement Site Plan	Bollard provider to note.
CEW 1669-A100	Security Enhancement Assembly Area Ground Plan	Type D Fixed Bollard Positions shown
CEW 1669-A101	Security Enhancement Assembly Area Ground Plan	Type D fixed and Type E remote controlled retractable bollard positions shown
CEW 1669-A110	Security Enhancement Parliament Drive Barriers Plans and Sections Sheet 1	Type D fixed and Type E remote controlled retractable bollard positions shown
CEW 1669-A111	Security Enhancement Parliament Drive Barriers Plans and Sections Sheet 2	Type A automated retractable, Type B manual retractable, Type C fixed (red/green indicators), Type D fixed and Type E remote controlled retractable bollard positions shown
CEW 1669-A112	Security Enhancement Parliament Drive Barriers Plans and Sections Sheet 3	Type A automated retractable, Type B manual retractable, Type C fixed (red/green indicators), Type D fixed and Type E remote controlled retractable bollard positions shown
CEW 1669-A113	Security Enhancement Parliament Drive Barriers Plans and Sections Sheet 3	Type A automated retractable, Type B manual retractable, Type C fixed (red/green indicators), Type D fixed and Type E remote controlled retractable bollard positions shown
CEW 1669-A114	Security Enhancement Parliament Drive Barriers Plans and Sections Sheet 5	Type B manual retractable Type D fixed
CEW 1669-A115	Security Enhancement Parliament Drive Barriers Plans and Sections Sheet 6	Type A Type B Type C Type D

CEW 1669-A116	Security Enhancement Parliament Drive Barriers Plans and Sections Sheet 7	Type A Type B Type C Type D
CEW 1669-A117	Security Enhancement Parliament Drive Barriers Plans and Sections Sheet 8	Type A Type B Type C Type D
CEW 1669-A118	Security Enhancement Parliament Drive Barriers Wall Details and Sections	Bollard provider to note.
CEW 1669-S1	Plan of Assembly Area Ground Slabs	Bollard provider to note.
CEW 1669-S2	Assembly Area Ground Details Sheet 1	Bollard provider to note.
CEW 1669-S3	Assembly Area Ground Details Sheet 2	Bollard provider to note.
CEW 1669-E01	Security Enhancement Project Parliament Drive	Bollard provider to note conduits provided by electrical Contractor to bollards.
CEW 1669-E02	Security Enhancement Project Parliament Drive	Bollard provider to note conduits provided by electrical Contractor to bollards.
CEW 1669-E03	Security Enhancement Project Parliament Drive	Bollard provider to note conduits provided by electrical Contractor to bollards.
CEW 1669-E04	Security Enhancement Project Parliament Drive	Bollard provider to note conduits provided by electrical Contractor to bollards.
CEW 1669-E05	Security Enhancement Project Parliament Drive	Bollard provider to note conduits provided by electrical Contractor to bollards.

1.4 Scope

Provide, including design, manufacture, supply, installation, commission, and maintenance for the Defects Liability Period, traffic security bollards to Parliament House, Canberra, in accordance with this specification and associated drawings.

Refer to the drawings for site plan for numbers, sizes, types, location and set-out of the bollards.

Installation of the bollards shall comprise all site construction works necessary to complete the installation including foundations, services, control systems, operation equipment, testing and site rectification.

Tenderers must understand that this building is an Australian icon and workmanship standard and performance is expected to be of world's best practice.

Specific requirements include:

1. Design and install electro-mechanical retractable bollards at certain positions to allow staff to take vehicles into protected areas. These positions are shown on the drawings.
2. Design and install gas strut type manual retractable bollards at certain positions. These positions are shown on the drawings.
3. Design and install fixed bollards with red/green traffic indication lights next to the slip roads from Parliament Drive. These positions are shown on the drawings.
4. Design and install fixed bollards to the forecourt assembly area and other locations as shown on the drawings.

5. Design and install electrically controlled automatic retractable bollards at the slip roads from Parliament Drive to:
   - the Senate Entrance
   - the House of Representatives Entrance
   - the Ministry Entrance
   - the Ceremonial Entrance at the front of the building
6. Provision of all necessary control panels
7. Provision of all necessary power supplies, air supplies (if applicable), reservoirs (if applicable), pumps (if applicable).
8. Provision of interfaces at the control panels to allow the electrically controlled bollards to be operated by signals from an access control system to be installed by the electrical Contractor.
9. Provision of final connection of bollard drain holes to drainage pipes. The drainage pipes will be provided by the drainage contractor.

1.5 Criteria for Selection

The following shall be considered in determining which tenderer will be awarded the contract to design, supply and install security bollards.

1. Tender price
2. Tenderers shall provide a programme of works that demonstrates that the installation and commissioning will be completed by 28 February 2005.
3. Life Cycle costs must be provided for a 10-year life cycle including proposed maintenance and details of likely failures and indication of the mean time between each failure.
4. Value for money.
5. Maintenance requirements which must be commensurate with a highly reliable security system.
6. Routine service intervals which must be commensurate with a highly reliable security system.
7. Maintenance response times which must be commensurate with a highly reliable security system.
8. Provision for Manual override of automatic retractable bollards when failure of automated systems occurs.
9. Availability of spares which must be commensurate with a highly reliable security system.
10. Availability of service personnel in Canberra which must be commensurate with a highly reliable security system.
11. The reliability of the products and systems offered which must be demonstrated and which must be to a high standard. Evidence of high reliability needs to be provided.
12. Aesthetic appearance including resistance to marking on the bollards' surface.
13. Demonstrated experience of the contractor to install similar security bollards. The tenderer is to provide descriptions of similar projects and provide referee contact details.
14. Evidence that the bollards offered can stop a vehicle weighing 5 tonnes travelling at 40 km per hour.
15. Endorsement by the Commonwealth Security and Construction Equipment Committee. If any product offered is not endorsed the tenderer must provide calculations and test results showing that the product complies with the SCEC specification and requirements document entitled "Vehicle Barriers and Perimeter Systems for Ram Raid and Crash Protection Revision 1 dated April 2004". The tenderer must confirm that SCEC endorsement, to the April 2004 Requirements, has been requested and provide written confirmation that the endorsement process has commenced.

2. Standards

The Contractor shall comply with the most recent edition of all:

1. Relevant standards published by Standards Australia
2. The Building Code of Australia.
3. Relevant standards published by the International Standards Organisation.
4. Commonwealth Security Construction and Equipment Committee Specification and Requirements entitled "Vehicle Barrier Systems & Perimeter Barriers for Ram Raid and Crash Protection Revision 1 dated April 2004".
5. ACT Services Regulations
6. Relevant Parliament House Standards including but not limited to:
   - ELV/01 Standard Specification for Electrical Services – Wiring
   - ELV/02 Standard Specification for Electrical Services – Switchboards
   - QAF 031 Parliament House Site Book
   - QAF 033 Contractor Provided Project Documentation
   - SAMP/E3A Strategic Asset Management Plan – Uninterruptable Power Supply (UPS) System Part A – Policy
   - SAMP/E5A Strategic Asset Management Plan – Low Voltage Power Cabling and Switchboards Part A – Policy
   - SAMP/E6 Strategic Asset Management Plan – Earthing and Lightning Protection Part A – Policy

3. Security Bollards

3.1 Architectural Requirements

Finished height of all bollards shall be as shown on the drawings. Note that due to sloping ground and the requirement in some areas for the top of the bollards to be at the same level, bollard heights will vary.

Bollards shall generally be spaced at a maximum of 1.4m centres and as shown on the drawings.

Bollards shall be cylindrical 150mm nominal outside diameter (+ or – 2mm).

Bollards shall be bead blasted stainless steel, matt finish to match the existing bollards at the Great Verandah.

3.2 Types of Bollards

Four types of bollards shall be installed –

1. Type A: electrically controlled (electro-mechanical, pneumatic or hydraulic) retractable.
2. Type B: manually controlled gas-assisted retractable.
3. Type C: fixed – with red /green indicator lights for vehicular access control.
4. Type D: fixed – standard type. and
5. Type E: electrically controlled (electro-mechanical) retractable bollards.

Bollards shall be installed to the lines and levels as shown on the drawings, especially the finished height and centres. Where heights of bollards have not been specified on drawings they shall be 900mm above the finished road, pavement or ground level.

Alternatives may be considered. However, reliability of operation, optimal maintenance requirements and optimal life cycle costing are key criteria for determining which of the technologies will ultimately be selected.

Tenderer's must provide evidence of the reliability of the product offered and also provide life cycle costing information including all projected maintenance costs over a 10 year life.

3.2.1 Type A Bollards

Electrically Controlled Retractable Bollards shall be installed in vehicular slip roads and access points as shown on the drawings. They shall mechanically (ie not manually) retract to finished pavement level to allow vehicular traffic to pass unobstructed. The retraction method shall be by remote operation using a PLC based control system interfaced to an access control system. Operation shall be:

1. By an electro-mechanical system in which an electrical motor shall power the bollard's movement, or
2. By an electro-pneumatic system in which compressed air shall power the bollard's movement, or
3. By an electro-hydraulic system in which fluid pressure shall power the bollard's movement.

The bollard Contractor will be required to coordinate work with the electrical Contractor. The electrical Contractor will provide conduits from plant rooms to a location adjacent to each group of retractable bollards. The bollard Contractor must confirm the suitability of those conduits for the installation of bollard power cables, control cables, or pipes for air or hydraulic fluid. The bollard Contractor shall provide all necessary power and control cables, compressed airlines and hydraulic fluid lines necessary from the plant rooms (as shown on the electrical drawings) to the bollards.

In the event of a power failure, all Type A Bollards must remain in the secure position. The Bollard Contractor must provide all necessary Uninterruptable Power Supplies, air receivers, hydraulic tanks and other equipment necessary to ensure that the Bollards are fully operational for a minimum of 10 minutes after mains power failure. If after 10 minutes the power has not been restored then the bollards shall remain in the secure position. However, during these emergency circumstances there shall be some means for maintenance or security personnel to manually lower and raise the bollards. The tenderer must provide details of this method at the time of tender. The manual operation must require the use of a key that is to be unique to the Federal Parliament House.

Signals shall be provided to the access control system to indicate whether the bollard is in the secure or insecure positions.

3.2.2 Type B Bollards

Manually Operated Retractable Bollards shall be installed at access points as shown on the drawings. They shall manually retract to finished pavement level to allow vehicular traffic to pass unobstructed. The retraction method shall be by manual use of a key that is unique to the Federal Parliament House. It shall not be possible to raise or lower the bollard without the correct key. The bollards must be easy to lower and raise with one hand. A gas strut shall be utilised to ensure the manual lower and raising is a one-hand operation. The gas strut shall be specifically designed for this purpose and shall have provision to alter the gas charge. The gas utilised shall be compressed air.

Signals shall be provided to the access control system to indicate whether the bollard is in the secure or insecure positions.

3.2.3 Type C Bollards

Fixed bollards with red/green indicator lights shall be installed at the locations shown on the drawings. These are typically located at the side of the slip road near the retractable bollards. The purpose of these bollards is two fold:

1. To prevent vehicles from driving around the retractable bollards.
2. To indicate to drivers entering or leaving the slip-road whether or not the bollards are in the fully down position (indicated by a green light) or in the partially up position (indicated by a red light). To achieve this the bollard shall have two 180^0 apertures located one above the other. The higher aperture shall house the red indicator light. The lower aperture shall house the green indicator light.
3. Note that one set of bollards will be used to control entry to the slip-road and a different set of bollards will be used to control egress from the slip road. Therefore, the traffic indicator lights on the bollards shall face the oncoming traffic.

The indicator lights shall be bright enough to be visible to drivers in bright sunlight. However, a dimmer control system shall be provided in the lighting circuits to allow the dimming of the lights during night time operation. The bollard Contractor shall provide a time clock with automated adjustment for the seasonal sunset and sunrise times. The time clock shall control whether or not the indicator lights are switched for full brightness (day time) or are dimmed (night time). There shall be provision to adjust the dimmer level during commissioning to determine the appropriate level of luminance from the indicator lights. The lamps utilised shall be a long life lamp. Details of the lamp and dimmer control must be provided at the time of tender.

3.2.4 Type D Bollards

Fixed bollards shall be installed at the positions shown on the drawings.

3.2.5 Type E Bollards

Electrically Controlled Retractable Bollards shall be installed at access points as shown on the drawings. They shall mechanically (ie not manually) retract to finished ground or pavement level to allow vehicular traffic to pass unobstructed. The retraction method shall be by remote operation using a PLC based control system interfaced to an access control system. Operation shall be by an electro-mechanical system in which an electrical motor shall power the bollard's movement.

The bollard Contractor will be required to coordinate work with the electrical Contractor. The electrical Contractor will provide conduits from plant rooms to a location adjacent to each group of retractable bollards. The bollard Contractor must confirm the suitability of those conduits for the installation of bollard power cables, control cables, or pipes for air or hydraulic fluid. The bollard Contractor shall provide all necessary power and control cables, compressed airlines and hydraulic fluid lines necessary from the plan room to the bollards.

In the event of a power failure, all Type E Bollards must remain in the secure position. The Bollard Contractor must provide all necessary Uninterruptable Power Supplies and other equipment necessary to ensure that the Bollards are fully operational for a minimum of 10 minutes after mains power failure. If after 10 minutes the power has not been restored then the bollards shall remain in the secure position. However, during these emergency circumstances there shall be some means for maintenance or security personnel to manually lower and raise the bollards. The tenderer must provide details of this method at the time of tender. The manual operation must require the use of a key that is to be unique to the Federal Parliament House.

Signals shall be provided to the access control system to indicate whether the bollard is in the secure or insecure positions.

3.3 Impact Loading

Each type A, B, C, D and E bollard is to be designed to resist an impact loading detailed as follows.

The bollards shall meet specifications and requirements for the Commonwealth Security Construction and Equipment Committee Specification and Requirements entitled "Vehicle Barrier Systems & Perimeter Barriers for Ram Raid and Crash Protection Revision 1 dated April 2004" for a 5 tonne vehicle travelling at 40 km per hour. In other words the bollard(s) must be able to withstand a vehicle impact having a kinetic energy rating of

Kinetic Energy $= 0.5\ mv^2$
$= 0.5 \times 5000 \times (40{,}000 / 3600)^2$ J
$= 308{,}000$ J
$= 308$ kJ

3.4 Performance Criteria

A bollard shall remain in place under the impact caused by the above load criteria. Deformation shall not exceed a residual angle of inclination to the plane of impact of 30 degrees.

An impact by a 2.5 tonne vehicle travelling 10 km per hour shall not deflect or damage the bollard.

3.5 Structural Design Criteria

The structural bollard design shall be in accordance with the following design standards:

Structural Steel:

- AS4100 Steel Structures.

Structural Stainless Steel:

- AS/NZS 4673: 2001 Cold Formed Stainless Steel Structures.
- European Stainless Steel Development & Information Group Design Manual for Structural Stainless Steel.

Design and test certificates shall be submitted for the proposed bollards confirming these criteria are met.

3.6 Materials

Materials to be used in manufacture and installation of the bollards shall meet the following minimum requirements. Tenderers may submit details of bollard designs exceeding these requirements.

3.6.1 Structural Steel Components

Main structural elements of the bollards shall comply with AS 1163.

3.6.2 Structural Steel Hollow Sections

Bollard to be manufactured from grade 304 stainless steel (Euronorm X4 Cr Ni 19-11). Provide grade 316 Stainless Steel as an option (Euronorm X4 Cr Ni Mo 17-12-2). Provide a cast stainless steel cap.

3.6.3 Stainless Steel Components

The bollard Contractor shall design the bollard to meet the impact loading requirements. However as a minimum requirement:

- Main structural elements of the bollards shall comply with materials standards ASTM A312: Standard Specification for seamless and welded austenitic stainless steel pipes.
- Cold worked exposed and concealed structural elements shall be grade 316 with 0.2% proof yield stress exceeding 300Mpa.
- Non-structural elements shall be Grade 304.

3.6.4 Structural Foundations and Fixings

The Bollard Contractor shall design the concrete foundations in the ground and fixings to the building structure (as appropriate).

However as a minimum the foundations shall comply with:

- Design to AS 3600 Concrete Structures; Foundations - Grade 40 concrete.
- Reinforcement - Grade 500Mpa.

The bollard Contractor must consult with the structural engineer to determine the most suitable means for fixing bollards to the waffle slab at the Assembly Area. The Bollard Contractor shall design the fixing and guarantee that the design and final installation meets the impact rating specified.

3.7 Automatic Retractable Bollards Operation

Provide a system of self powered remote operable retractable bollards, operable individually or in sets. The operation of the bollards will be activated by signals from the access control system.

Provide retraction performance to retract to at least flush or marginally below finished pavement level and allow clear, unimpeded passage of vehicles.

Retraction speed to fully retracted from fully extended positions in not more than 3 seconds. Speed control shall be variable to allow setting after installation.

The time from fully retracted to full extension shall be not more than 3 seconds. Speed control shall be variable to allow setting after installation.

The bollards shall have duty cycle ratings at 150 operations per hour and up to 3 operations per minute.

Testing Certification - Suppliers shall demonstrate bollards are capable of a minimum of 100,000 operations between servicing.

Maintenance - All mechanical/electrical and moving parts requiring maintenance or any parts whose failure may cause breakdown of operations shall be readily accessible for repair or replacement. The tenderer must demonstrate an ability to repair bollards on site. Sufficient stock shall be carried in Canberra by the supplier to cover 15% failure of all components.

3.8 Retractable Bollards Services and Control System

Provide key lockable, wall mounted control cabinets sized to accommodate the control equipment.

Control cabinet and equipment shall be installed as close as possible to the bollards in a secure location. Plant rooms are available for these cabinets. Note that the electrical subcontractor will provide interfaces at the plant rooms (shown on the drawings) for power, access control signals (set of voltage free contacts for each bollard function), and signals (voltage free contacts) to operate the traffic indicator lights on Type C bollards. It shall be the responsibility of the bollard Contractor to make all final connections and to provide all other necessary control equipment, power, cabling and devices necessary to make the systems operate.

Bollards shall be supplied and installed complete with all necessary services for operation including:

- electrical reticulation and sub-distribution boards from the nearest isolator provided in the plant rooms as shown on the electrical drawings.
- data cabling, control cabinets, and PLC's.
- Uninterruptable Power Supply to operate the bollards for 10 minutes in the event of mains power failure and no other power being available. If pneumatic technologies are use the air receiver must be sized to allow for 10 minutes of normal operation without mains power. Similarly hydraulic systems must be designed to operate normally for 10 minutes without mains power.

A Programmable Logic Controller shall be used for normal operations of bollards. Changes to the PLC shall be via a laptop connection and software supplied by the PLC manufacturer. The PLC shall be interfaced to the existing access control system (Honeywell EBI) for all necessary functions and alarms. The interfaces shall be low level types in the form of voltage free contacts.

Variable speed drives for each motorised bollard are to be located in the control cabinet. In the case of pneumatic and hydraulic types of bollards if it is necessary to install air receivers or hydraulic equipment in the field close to bollards, it will be necessary for the bollard Contractor to install all necessary mechanical equipment (such as air receivers, hydraulic tanks etc) out of sight. This may require the construction of pits. If so then the design and construction of these pits shall be provided by the bollard Contractor. The Superintendent reserves the right to reject any design that does not meet the architect's strict aesthetic requirements for this project.

Retractable bollards must fail secure (i.e. loss of mains power or control system communications shall result in the bollards being held in the secure position). Tenderers shall indicate in their tenders how they shall achieve this requirement. Uninterruptable Power Supplies and necessary air receivers or hydraulic tanks must be provided by the Bollard Contractor to achieve this during the period between mains power failure and standby generation startup.

3.9 Electrical requirements

If an electric motor is used to directly drive the bollard it shall be suitable for frequent reliable operation. The tenderer must submit evidence of long term reliability of the drive / bollard combination offered. Internal bollard junction box, limit switches and PLC shall be 24V DC.

Electro-hydraulic or electro-pneumatic options shall be 415V 3 phase or 240 V single phase to the control panels for the pumps / air-compressors.

Provide all necessary electrical switching equipment, protection equipment, cabling and conduits in accordance with Parliament House installation Standards.

Drawings shall be provided showing:

- Connection Drawing Circuit Diagram
- Logic Diagram
- Function Description and Operating Instructions

3.10 Bollard maintenance and servicing

Provide routine service every 6 months or 100,000 cycles (which ever falls due first). Drive system and motor to be accessible through cover plate. The cover plate shall be fixed using tamper resistant screws.

3.11 Installation

Fixed and retractable bollards shall be supplied, installed, and commissioned to the set out and details shown on the drawings. Existing services shall be relocated prior to commencement of works. Bollard services are to be recorded on 'as-built' documentation for position, alignment and depth.

The bollard Contractor must confirm service locations prior to any digging.

Any damage done by the Bollard Contractor to existing services or surfaces shall be repaired or restored to the condition that existed immediately prior to the works.

During the installation of the bollards the slip roads must remain in operation. The tenderer shall price the work to take account of this.

3.12 Foundations / Connection to Existing Structure

New foundations in the ground shall be designed and constructed so as to provide load resistance 1.5 times that of the ultimate capacity of the bollards. Reinforced concrete foundations shall be used.

Inspect site during the tender period to ensure that it is possible to construct foundations in natural or filled ground where indicated on the drawings.

Where bollards are to be installed in the building structure (e.g. the waffle slab in the Assembly Area), the Contractor shall design appropriate fitments and fixings to connect bollards to such structures so as to resist 1.5 times the ultimate impact rating of the bollards.

The contractor shall obtain all necessary structural/architectural/service details of the structure at proposed connection points and design the connection members/framework in such a manner so that the structural capacity of the existing structure loaded by the connection is 1.5 times the ultimate capacity of the connection apparatus.

4. Automatic Access Controls

4.1 General

The electrical Contractor will provide remote control devices that are to be interfaced to the existing access control system. The electrical Contractor will make available signals from the access control system to operate the bollards. The interface point will be in the plant rooms shown on the electrical drawings. The incoming signals for each retractable bollard group will include:

- Up
- Down (bollard will return to up position after a vehicle passes or is not present)
- Hold down (i.e bollard will stay down until receipt of an up signal from the access control system
- Green signal for traffic indicator light
- Red signal for traffic indicator light

Signals sent from the bollard systems to the access control system shall include

- Bollard secure
- Bollard insecure
- Vehicle over safety loop

4.2 Traffic Indicators in Bollards

Type C bollards must include red and green traffic indicator lights. The lights must be at the top of the bollard and shall be used in much the same way as traffic lights. A red light shall be clearly visible to vehicle drivers when bollards are in the secure position or are moving. When the bollards are in the fully retracted position the red light shall turn off and a green indicator light shall turn on.

The red indicator light shall come on three seconds prior to the bollard commencing to rise. This time shall be adjustable between 1 and 30 seconds.

The indicator lights shall be visible for 180 degrees but most importantly must be visible to drivers of vehicles (cars, four wheel drives and vans). The red lights shall be mounted above the green lights and the apertures in the bollard (if required) for these shall be square.

The lights shall be designed with 100% redundancy such that the failure of a lamp does not adversely affect the operation of the indication.

Signals for the operation of the red or green lights will be provided by the access control system. The electrical Contractor will provide the necessary interfaces (voltage free contacts) in the plant rooms shown on the electrical drawings. The bollard Contractor shall provide final connection from the interface to the indicator light power circuit and to the indicator lights.

The bollard Contractor shall provide dimmer control equipment to enable the indicator lights to be dimmed at night. The dimmer control shall be operated by a time clock that takes into account the seasonal variations in time for dusk and dawn. Alternative means of dimmer control may be considered.

4.3 Safety Loops

Safety loops shall be provided in the slip road that detect when a vehicle is above a retracted bollard. The control systems shall be configured such that bollards shall not rise under a vehicle.

If the bollards have been lowered to the insecure position they shall remain in the lowered position until the vehicle is no longer detected. Then the bollards shall rise to th the secure position. The bollards will then not lower until a valid 'down' signal is received from the access control system.

It shall be possible to override the safety loops by way of a signal from the access control system that effectively turns the safety loops off.

The design shall minimise the likelihood of tailgating as a means of defeating the bollards. However, if a vehicle is towing a trailer, the bollards shall not rise until after the trailer is clear.

The safety loop control system shall send an alarm to the access control system if tailgating is detected or if the bollard cannot rise due to an obstruction.

4.4 Egress Loops

Egress loops are not required.

4.5 Override

It shall be possible for the access control operator to override the safety loop control system.

5. Power Supply

5.1 General

For each set of electrically controlled retractable bollards, the electrical Contractor will provide power cables to an isolator in the plant room as shown on the drawings. The bollard Contractor shall provide all necessary power distribution from the isolator to bollard control equipment, the bollards, indicator lights, compressors (if required), pumps (if required) and motors.

Unless specified elsewhere the electrical installation work by the Bollard Contractor shall comply with the following:

5.2 Wiring and Accessories

5.2.1 Quality

Pre-Completion Reports

Site tests

Insulation resistance tests to AS/NZS 3000: *Australia/New Zealand wiring rules*

- MIMS cable systems – at the time of termination; and 24 hours later.
- Other cable systems – before energisation, or for equipment with electronic components – before connection.

Cable fixing tests in relation to fire rated cabling installations.

Submissions

Cable Sizing calculations

General: If cable sizes are not given, submit load calculations and cable selections based on load current, fault current, earth loop impedance and voltage drop.

Standard: To AS/NZS 3008:1 *Cables for alternating voltages up to and including 0.6/1kV.*

Shop drawings

Submit shop drawings as listed below:-
Electrical Single Line Schematics

5.2.2 Wiring Systems

Selection

Provide the following systems for final sub-circuits:

- Plant rooms: Unsheathed cable in heavy duty UPVC conduit, on spacer blocks.

Buried in ground:

- PVC cables in heavy duty UPVC conduit.

5.2.3 Installation

Standard

Fire or mechanical damage: Classifications to AS 3013.

Handling cables

Report damage to cable insulation, serving or sheathing.

Straight-through joints

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

Cable joints

Locate in accessible positions in junction boxes.

Extra-low voltage circuits

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

Conductor colours

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

Active conductors in single phase circuits: Red.

Active conductors in polyphase circuits:

- A phase: Red.
- B phase: White.
- C phase: Blue.

Sheath for small power subcircuits: Black

Sheath for lighting subcircuits: White

Tagging

Identify multicore cables and trefoil groups at each end using stamped non-ferrous tags clipped around each cable or trefoil group.

Marking

Identify the origin of all wiring using legible indelible marking.

5.3 Power Cables

5.3.1 Selection

Conductor material

Provide cables with high conductivity multi-stranded copper cable, except for fire resisting cables.

Do no provide aluminium cables.

Standards

- Building wires and double insulated PVC/PVC cables: To AS 3147 *Electric cables – thermoplastic insulated – for working voltages up to and including 0.6/1kV.*

- Fire resisting cables: To AS 1668:*1 Fire and smoke control in multi-compartment buildings, Appendix E*, and AS 3013, *Classification of the fire and mechanical performance of wiring systems.*
- MIMS cables: To AS 3187 *Mineral insulated metal – sheathed cables.*
- Double insulated XLPE/PVC cables: To AS 3198 *Electric cables – XLPE insulated – for working voltages up to and including 0.6/1kV.*
- Busduct: To AS 3439.2
- Flexible cords: To AS 3191 *Electric flexible cords.*
- Control and protection cables: To AS 2373:1 *Electric cables for control and protection circuits – multi-core control cables.*
- AS 2373:2 *Electric cables for control and protection circuits – twisted pair control cables.*
- Appendix E, and AS 3013, *Classification of the fire and mechanical performance of wiring systems.*

Cable sizes

Sub-mains: 6mm² minimum.

Cables supplying motors: Rated as follows:

- Motors ≤150kW: 150% of motor full-load current; minimum size of 2.5 mm² for building wires and PVC/PVC, or MIMS cables.
- Motors > 15kW: 125 % of motor full-load currents.
- Control and protection circuits to AS 2373:1: 1.5mm² minimum.

Sub-circuit cables: Increase size where necessary for reasons of voltage drop or de-rating to AS 3008.1 and AS 3000.

- Lighting sub-circuits: 2.5 mm²
- General purpose power sub-circuits: 2.5 mm²
- Emergency and exit lighting sub-circuits: 2.5 mm²
- Control circuits including alarms, etc: 1.5 mm²
- Flexible cords: 30/0.25 mm²

5.3.2 Unsheathed Installation

General

Provide permanently fixed conduit enclosures assembled before installing wiring. Provide draw wires to pull in conductor groups from outlet to outlet, or use ducts with removable covers.

5.3.3 MIMS - Installation

General

Maintain manufacturer's seals until joint or termination is made. Remove moisture by heating cable ends. Install in accordance with the manufacturer's recommendations.

Seals

Temporary seals: Fit temporary seals to the open ends of cables cut and not immediately used.

Terminations: Fit termination seals at ends of cable runs as soon as the cable has been cut to length, stripped back, and the moisture driven out.

Through joints: Same fire-rating as the cable.

Sheath earthing

If MIMS cables enter metal enclosures, earth sheaths to non-ferrous plates secured to the enclosures. Where sheaths terminate at plates, fully insulate, colour code, and fix the conductors to the enclosures.

Bonding

Bond metal sheaths of single core cables in multi-phase circuits using proprietary earth bonding clips or clamps.

Separation

Separate MIMS cables from thermoplastic sheathed (TPS) cables and UPVC conduits by at least 25 mm.

Eddy currents

Arrange single core cable entries into non-ferrous metal gland plates to minimise eddy currents.

Vibration

Connections with vibrating equipment: Loop cables in a complete circle next to the point of connection.

5.4 Terminations

5.4.1 Copper Conductors

General

Other than for small accessory and luminaire terminals, terminate copper conductors to equipment, with compression-type lugs of the correct size for the conductor. Compress using the correct tool or use soldering.

Within assemblies and equipment

General: Loom and tie together conductors from within the same cable or conduit from the terminal block to the point of cable sheath or conduit termination. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

- Alternative: run cables in UPVC cable duct with fitted cover.

Identification ferrules: Provide durable numbered ferrules fitted to each core, and permanently marked with numbers, letters or both in accordance with the connection diagrams/shop drawings.

Spare cores: Identify spare cores and terminate into spare terminals, if available. Otherwise, neatly insulate and neatly bind the spare cores to the terminated cores.

5.4.2 Aluminium Conductors

Aluminium conduits are not to be used unless specifically required by the design documentation.

5.5 Wiring Enclosures and Cable Supports

5.5.1 Conduits

General

Conduit may be either steel or PVC subject to the following requirements:

- Conduit on a surface exposed to mechanical damage: Galvanised steel conduit
- Exposed external conduit: Galvanised steel or UV stabilised PVC.
- Conduit cast into concrete, run in chases or concealed areas: PVC conduit may be used. Light duty rigid PVC conduit may be used in areas where not subject to the risk of mechanical damage.
- Conduit buried in ground: Heavy duty UPVC conduit.
- Plant areas: Provide spacer blocks, minimum heavy-duty uPVC, galvanised steel where exposed to mechanical damage.

Minimum sizes

Metallic and non-metallic conduits: 20mm.

Rigid conduits

Provide straight long runs, smooth and free from rags, burrs and sharp edges. Set conduits to minimise the number of fittings. Remove sharp edges prior to drawing-in wires.

Flexible conduits

Run fixed wiring to motors and appliances requiring flexible connections in rigid conduit to a junction box adjacent to the item of equipment, and from there in flexible conduit to the equipment. Provide flexible conduit connections between 300mm and 600mm in length.

Galvanising

If installed in damp locations, galvanise mild steel wiring enclosures and support systems.

Set out

If exposed to view, install conduits truly vertical or horizontal and in parallel runs with right angle changes of direction.

Inspection fittings

Provide in accessible locations.

Draw cords

General: Provide draw cords in conduits not in use. Leave 1 m of cord coiled at each end of the run.

Material: Polypropylene cord, or insulated stranded earth wire, 2.5mm^2 minimum size.

Draw-in boxes

General: Provide draw-in boxes in accessible positions and at intervals not exceeding 30m in straight runs, and at changes of level or direction. Provide draw-in boxes no greater than 7.5 m apart for vertical lengths of conduit runs.

Underground draw-in boxes: Provide gasketted covers and seal against moisture.

Bends and elbows

Bends: Make with easy sweeps. Provide bends of 90° with a radius of not less than three times the external diameter of the conduit, without mechanical stress sufficient to cause deformation. Limit the number of 90° bends between boxes in any conduit run to 2. Solid elbows not permitted.

Conduit saddles and brackets

Space conduit saddles a maximum of 1200 mm apart for metallic conduit and 1000 mm apart for non-metallic conduit. In areas subject to high ambient temperatures or other severe duty, maximum saddle spacing for non-metallic conduit 500 mm.

Where two or more conduits are run in parallel they may be grouped. Provide suitable surface brackets where conduits cannot be fixed.

Prohibited floor slabs and face brickwork

Do not run conduits in the floor slabs of boiler rooms, plant rooms and tank rooms. Chasing will not be permitted in face brickwork. Install any conduit or wall boxes in such walls on the reverse face.

Hollow-block floors

Locate conduits in the core-filled sections of precast hollow-block type floors.

Columns

General: Do not place more than four 25mm (maximum) diameter conduits centrally in each column.

Use metal conduits running when installed horizontally in load bearing concrete columns.

Bends: Enter columns via bends with minimum radius of 150 mm.

Chasing: Do not chase columns.

5.5.2 Metallic Conduits and Fittings

Standards

Metallic conduits and fittings: AS/NZS 2053.7 or AS/NZS 2053.8.
Galvanised water pipe: Medium or heavy, to AS 1074.

Type

Screwed steel.

Corrosion protection

For steel conduits, paint ends and joint threads with zinc rich organic binder to GPC-C-29/16.

Expansion joints

General: Provide flexible couplings consisting of flexible conduit and fittings, at

- structural expansion joints; and
- in long straight runs if the ambient temperature varies by more than 40°C.

Conductivity: Maintain electrical conductivity between the two ends of rigid metallic conduit.
Movement: Provide conduit support saddles close to flexible couplings to permit free movement for expansion and contraction.

Sets and bends

Make sets and bends cold with bending machines in such a manner that there is no damage to or distortion of the conduit. In locations where it is not practicable to use sets for changes in direction, make such changes by the use of screwed fittings.

5.5.3 Non-Metallic Conduits and Fittings

Standards

Non-metallic conduits and fittings: AS/NZS 2053 Parts 2, 3, 4, 5 or 6.

Conduits in roof spaces

Locate below roof insulation and sarking: In accessible roof spaces, provide mechanical protection for light-duty conduits.

Conduits in slabs

High compression corrugated conduit, restrain at regular intervals to achieve a nominally straight run.

Category A conduit

Direct buried installations: Category A conduit, use protective cover strips and corrugated conduit.

Flexible conduit

Provide for equipment and plant subjected to vibration, required for adjustment or ease of maintenance. Ensure that the flexible conduit is of adequate length to avoid any strain on the conduit or terminations under all conditions of use.

Sets and bends

Form with a spring or other device inserted in the conduit to prevent distortion of the walls. The forming of conduit bends using heat from a naked flame or similar method which may damage or deform the conduit will not be accepted.

Associated fittings

Type: The same type and material as the conduit. Provide standard manufactured bends for all PVC conduits of larger than 25 mm diameter.

Wall boxes on UPVC conduits: For special size wall boxes not available in UPVC, provide prefabricated earthed metal boxes.

Inspection fittings

Provide inspection-type fittings only in accessible locations and where exposed to view.

Joints

Type: Cemented or snap on joints.

Expansion couplings: If encased in concrete, do not provide bellows type.

Expansion joints

Where any straight section of PVC conduit exceeds 3.8 m provide an expansion joint for each 3.5 m or part thereof along the entire length of the straight section. Install conduit clips close to expansion joints, while allowing the conduit to move longitudinally freely while expanding or contracting.

5.5.4 Ducted Wiring Enclosures

Standard

General: To AS/NZS 4296.

Ducting

Provide purpose-made ducts, skirting ducts and floor ducts, incorporating segregation where used for multiple services, and rigidly supported. Round off sharp edges and provide PVC bushes for cable entries into metallic ducting.

Accessories

General: Provide purpose-made accessories and covers to match the duct system. Provide screw-fixed covers, or clip-on covers removable only with the use of tools. Provide elbows, tees, crosses, risers and other fittings with mitred corners and no sharp edges.

Cable support: Except for horizontal runs where the covers are on top, support wiring using retaining clips at intervals of not more than 1 m.

Fixings: Provide metal-threaded type screwed into tapped holes or captive nuts. Self-tapping screws and spring-steel clip on threaded fasteners are not permitted. Screw projection into the enclosure less than 3mm. Rigidly fix and support over the entire length.

Construction

General: Use extruded aluminium, folded aluminium, sheet metal, cold rolled steel or moulded PVC, complete with detachable lids. Provide shop manufactured ducting, covers, cable retainers, bends, tees, joining pieces, blanking end plates and junction boxes.

Thickness: Provide ducting which is inherently rigid, by either

- Folded top edges for sheet product.
- Formed in the design profile for extruded product.

Installation

Installed parallel to walls, floors and ceilings. Where cable ducting pass through walls, partitions or floors, provide a fixed section of lid extending 40 mm each side of the wall or floor penetration. Align and make truly square bends, tees, joints and crossovers. Support ducts at maximum 1200 mm centres using angle brackets off walls and open side brackets where suspended.

5.5.5 Cable Supports

System

Provide a complete cable support system consisting of baskets, trays or ladders and including brackets, fixings and accessories. Fabricate brackets, racks and hangers from structural steel sections or other materials in sections of equivalent strength. Maintain earth continuity of the entire cable support system.

Manufacture

Use proprietary baskets, trays, ladders and accessories from a single manufacturer in the same application.

Cable Baskets

Materials:

- Interior. Zinc-coated steel, stainless steel, or steel with two-pack liquid coating, air drying enamel or stoving enamel finish.
- Exterior. Hot dip galvanised steel or stainless steel.
- Cuts. Shall have galvanising made good.

All accessories, supports, joints, bends, tees and radii shall be selected from the same manufacturers range of product.

Cable trays

Materials:

- Interior: Zinc-coated steel, or steel with two-pack liquid coating, air-drying enamel or stoving enamel finish.
- Exterior: Hot dip galvanised steel.
- Cuts: Shall have galvanising made good

Minimum steel thickness:

- Trays < 150mm wide: 1 mm.
- Trays > 150mm, < 300 mm wide: 1.2 mm.
- Trays > 300mm wide: 1.6 mm.
- Folded edge > 19mm deep and radiused.

Perforations: To Admiralty pattern, reverse stamping.

Accessories: Use fish plates or splines for tees, crosses and joints.

Cable ladders

General: Use 2 folded steel or extruded structural grade aluminium side rails minimum 75 mm deep with cable support rungs between the rails and complete with requisite bends, risers, tees, reducers, splicers fixing brackets, supports, hangers and the like.

Steel ladders: Galvanised.

Rung spacing: 300mm maximum.

Small cables: Run cables less than 13mm diameter in cable trays or ducts.

Structural sections:

- Angles and bars: 6.5mm minimum thickness.
- Rods: 10mm minimum diameter.

Single Spine Cable Baskets, Trays or Ladders

Provide cable trays with central supports and twin cantilevered trays to facilitate side loadings of cables.

Maximum width: 400mm each side.

Central support: Resistant to asymmetric loadings.

Fixing to building structure

General: Install parallel to walls, floors and ceiling lines. Fix supports to the building structure or fabric by means of direct fixing, hangers or brackets.

Spacing: Space supports at maximum intervals of 1.5 m for trays and 3 m for ladders.

Access

Provide a minimum of 150 mm free space above and 600 mm free space on one side of trays and ladders.

Cable fixing

Provide slats or rails suitable for fixing cable ties, strapping or saddles.

Bend radius

Provide bends with a minimum inside radius of 12 times the outside diameter of the largest diameter cable carried.

Cable protection

Provide rounded support surfaces under cables where they leave trays or ladders.

Cable strapping

Provide steel straps on MIMS cables.

Minimum clearances

Hot water pipes: 200mm.

Boilers or furnaces: 500mm.

Penetrations

Where trays or ladders pass through ceilings, walls and floors, provide neat, close fitting apertures.

Where these penetrate fire rated structures, terminate the ladders either side of the opening.

Expansion joints

Building expansion joints: Installation to resist relative movements of building sections.

5.6 Underground Services

5.6.1 General

Standards and rules

To AS 3000 and all other relevant Australian Standards and to the requirements of the Electricity Distribution Company and other relevant local authorities.

5.6.2 Cables and Conduits in Trenches

Sealing ducts and conduits

Seal buried entries to ducts and conduits using waterproof seals. Seal spare ducts and conduits immediately after installation. Seal other ducts and conduits after cable installation. Seal the ends of conduits entering the building with a weak concrete slurry to prevent moisture and vermin entry. Seal the joints of all conduits or pipes enclosing PVC/PVC and XLPE/PVC wiring with approved PVC jointing compound.

Draw wires

Arrange so that cables may be drawn out of the duct and conduit in the event of any cable failure. Install 4 mm² polypropylene draw string or 2.5 mm² galvanised steel wire in conduits for future installation of cable.

Water proofing: Provide puddle flanges around conduits where they pass into cable pits. Install bell mouth accessory on end of conduit located within wall of pits and flush with inside surface of pits on conduits > 100mm dia.

5.7 Accessories

General

Supply and install all accessories, outlets, appliances and connections complete with fixings and fastenings.

Selection: Compatible with the final interior design.

Orientation: Compatible with the final design.

Position: Make allowance for accessories to be relocated within a radius of 2 meters.

Acoustic separation: Satisfy the project requirements for acoustic separation.

Labelling: Provide proprietary labels, ie Clipsal ID mechanisms, or engraved traffolyte labels. Printed adhesive labels are not acceptable.

Construction

Face plates: High impact polycarbonate construction or metal.

Protected and weatherproof: Non-corroding metal or polycarbonate enclosures.

Location

Mounting heights: To the centre of the equipment.

Face brickwork or special finish walls: To the nearest brick, panel, tile course and mounted vertically.

Rendered brick or insitu concrete walls: Recessed horizontal in standard metal wall boxes.

Hollow block walls: Fixed direct to the blockwork.

Lightweight stud walls or demountable partitions: Directly on the panelling using proprietary fixing brackets.

Fixed furniture: Insulated and mechanically protected at the rear.

Plantrooms
Use metal clad protected type accessories.

6. Uninterruptable Power Supplies

The Bollard Contractor must provide all necessary Uninterruptable Power Supplies (UPS), air receivers, hydraulic tanks and other equipment necessary to ensure that the Bollards are fully operational for a minimum of 10 minutes after mains power failure.

6.1 Standards

General

Converters: To AS 1955.1.
Harmonics: To AS 2279, Supply Authority Requirements.
Electromagnetic Interference: To AS 1044
Battery: To AS 4029.2, AS 4029.3

6.1.1 Interpretations

Uninterruptable power supply (UPS)

Operation: Primary input supply (from mains) into a static rectifier suppling a battery. The battery supplies a static inverter supplying the clean power to the output load. The bypass supply is complete with a static switch allowing breakless transfer between the static inverter output and the bypass input supply. In the event of an invertor failure or insufficient battery reserve, the load transfers from the bypass supply automatically without a break.

Technical Parameters

Input Voltage Distortion:	THVD < 5% and TVD < THVD + (1.05 x THVD) for on site location.
Input Voltage:	415V 3 phase (nominal) -20%, +10%
Output Voltage:	415V 3 phase sinusoidal
Load current crest factor:	3:1
Output frequency:	50 Hz (nominal) ± 1%
Voltage output stability:	0 to full load ± 0.5% (Regulation)
	Balanced to 50% unbalanced load ± 1%
Transient Voltage:	50% Full load step ±8%
Performance	Loss of AC Input ±5%
	Return of AC Input ±5%
	Transfer between UPS and bypass (and vice versa) ±8%
	Recovery response time to 95% in 50ms, to nominal in 100ms
Phase Displacement:	Balanced load (all values) 120 ±1%
	50% unbalanced 120°C±3°C

6.2 Quality

6.2.1 Pre-Completion Tests

Production tests

General: Carry out the following tests and submit results. NB that tests are to be carried out using a reactive/resistive load (min 0.8 pf):

- Inrush current: Record the instantaneous peak value of inrush current at switch-on.
- Power factor (PF): Record the line-side power factor with a full load rated output at 0.8 PF lagging.
- Overload capacity tests: Comply with the *Overload capacity table*, output at 0.8 PF lagging including operation of static switch after the test period has expired.
- Battery currents (string currents where applicable) for free running discharge on full load at 0.8 PF lagging.

- Line voltage drop compensation test: Linearly increase the test current from 0 - 100% of rated output, at 0.8 PF lagging.

Systems >40 kVA: Carry out the following tests:

- Steady state output voltage regulation test with primary input within stated limits:
  - Balanced load; at no load, and at full load with 0.8 PF lagging:
    % variation from nominal voltage.
    Phase displacement.
    Crest factor ratio.
    Voltage symmetry.

  - Unbalanced load: With 25% rated load output unbalance on each phase respectively:
    % variation from nominal voltage.
    Phase displacement.
    Voltage symmetry at 50% unbalance.

- Transient output voltage regulation for both free running and rectifier on mains, with primary input within stated limits.
  - Step load change: With a change in steps of 25%, 50%, 75% and 100% rated output at 5 s intervals:
    Transient voltage % variation from nominal voltage at each step.
    Transient phase displacement at each step.
    Transient recovery time for return to steady state tolerance at each step.

- Current and Voltage waveform harmonic distortion tests:
  - Distortion (for current and voltage): At 100%, 50%, 25% and 0% of rated output, measured between phases and between each phase and neutral at the line and load terminals:
    Total harmonic distortion in a range of 1st to 65th harmonic.
    Total distortion (harmonic and non harmonic - effects of ringing, DC offset, and other voltage distortion taken into account).
    Individual harmonic distortion in a range of 1st to 65th harmonic.
    Total, and individual, background harmonic voltage distortion levels during testing.
    Provide predictions of TVD (Total Voltage Distortion) and THVD (Total Harmonic Voltage distortion) for the location proposed on site.

- Frequency regulation tests (output) with primary input within stated limits:
  - - Slew rate
  - - Regulation: For steady state 100% and 50% rated output changes, mains failure or restoration of mains and static bypass changeover, UPS to mains or mains to UPS.
    % variation from nominal frequency when synchronised to reserve.
    % variation from nominal frequency when on interval crystal control.

- Efficiency
  Provide efficiency data.

Overload capacity table

UPS rated capacity	Overload capacity test current	Duration
< 1200 VA	110% of rated output	10 min
≥ 1200 VA, < 6 kVA	125% of rated output 150% of rated output	10 min 1 min
≥ 6 kVA	125% of rated output 150% of rated output	10 min 10 s

6.2.2 Submissions

Shop drawings

Include the following:

- Test results.
- The UPS system general arrangement and layout with details of connections, circuit breakers, cable sizes, overall dimensions, weight, location of access doors, cable terminating locations, and necessary clearances.
- Functional block diagram.
- The general arrangement of the remote manual by-pass switch/cabinet, and indication/alarm panel with details of installation requirements.
- Type and rating of equipment items.
- Battery layout and associated details.
- Mean Time to Failure (M.T.F), and Mean Time to Repair (M.T.R) for the location proposed on site.

6.3 Components

6.3.1 Operation

Input

The primary power for the rectifier/charger will be provided from the main switchboard, and the rectifier/charger designed to accept input voltages over a range of +10% to - 15% from nominal, and with frequencies between ≥5% from nominal.

The input power factor due to the UPS: > 0.8 lagging when the system is operating at full load and nominal input voltage.

By-pass arrangement

Static by-pass: Provide an automatic, no-break, integral static by-pass switch with automatic reset, to transfer the load automatically to the by-pass supply when the UPS output characteristics are outside the designated limits (can be short time rated if automatically transfers to continuously rated bypass switch, without a break).

Maintenance by-pass: Provide a manual by-pass switch to manually transfer the load to the mains supply, bypassing the UPS and the static by-pass switch.

Harmonics

Input total harmonic voltage distortion: < 5% THVD, no individual harmonic > 3%. Note that further mitigation may be required at the UPS to meet Supply Distribution Company requirements at the PCC (Point of Common Coupling).

Current limiting

The rectifier/charger: Input current limiting whereby the UPS module will draw only sufficient power to drive the critical load with an additional preset maximum power level to recharge the battery. The input kVA drawn by the system is the sum of two components, that due to the critical load and that due to battery charging.

Generally limit the inrush current to 125% of the UPS rated load current.

Soft Start Up Requirement

Mains is restoration following an outage: the UPS module to initially draw less than 20% of rated input current. Over a period of approximately 15 seconds (known as walk-in-time) the input power requirements will rise to a level dictated by the power required to drive the critical load and additional preset power to recharge the batteries as described above.

Protection

Discrimination: Provide circuit breakers, both input and output, within the UPS, which fully discriminate with upstream and downstream circuit breakers (ie cascade type protection schemes not acceptable unless specifically noted), when on bypass and on inverter.
Components: Provide component protection to minimise damage and downtime in the event of component failure. Include the following as appropriate:

- Fuses.
- Circuit breakers.
- Overloads.
- Thermal sensors.

Output: Provide protection against output overload and short circuit. Ensure that output short circuits will not damage the UPS.

Safety interlocks: Provide interlocks to prevent accidental damage to the UPS during maintenance or normal operation, including any such interlocks necessary for equipment external to the UPS cubicle.

Efficiency

The efficiency of a UPS module is defined as the ratio of output kW to input kW under the following conditions.

- The module is operating at the nominally rated load and power factor.
- The battery is fully charged and floating on the system.
- The input voltage is within the specification.
- The load power factor is between unity and 0.8 lagging.

Efficiency: equal to, or greater than 92%

6.3.2 Rectifiers/Chargers

The rectifier charger: Totally solid state 12 pulse providing direct current to the inverter unit and the battery.

Waveform characteristics: 12 pulse bridge rectifier, or better, for all connected loads (eg discontinuous conduction through parallel connected phase shifted 6 pulse rectifiers is not acceptable). Use semi conductor bridge, connected to the input through a series inductance to rectify the AC input and pass through an LC inline filter connected to the DC Bus.

Control logic: Provide to effect the necessary control of the firing angles of the rectifier transistors to achieve the required output voltage and current.

Input circuit breakers

Type: Moulded case circuit breakers.

Frame size and trip rating: Sufficient to supply the full rated load to the inverter and the battery charging load.

Input current limiters

Limit input current to 125% of the full rated load current.

Battery chargers

Capacity: Restore the battery from discharge to approximately 95% charge within eight hours after mains restoration following a full battery discharge, while maintaining full inverter load.

Regulation: Voltage regulated and current limited.

After the battery is recharged: Maintain the battery at full charge until the next discharge.

Boosting: Provide boost facility for boost charging of the batteries after a prolong discharge, adjustable up to 15% of the full load rectifier current.

DC ripple: Less than 2% RMS, under all conditions.

6.3.3 Inverters

Synchronising

Synchronisation: With the static bypass line provided the static bypass line remains within +/- 0.5% or 1% (selectable) of the nominal frequency.

Internal frequency Control: When line frequency goes outside these synchronisation limits, break sync with the line and run on internal frequency control. When the line frequency returns within the limits, automatically resynchronise with the line.

Rate of change of Output frequency: Less than 0.1 Hz per second.

Free running: By manual switch, or automatically when the a.c. input supply is out of the designated tolerances. Provide controls which ensure that the a.c. input supply is stable and within tolerances for 30 s before automatic return from free running to synchronised running (ie synchronised to bypass supply).

6.4 Control and Monitoring

General
General: Provide facilities for manual control and status monitoring of the various systems within the UPS.

Local control equipment
Provide the following manual controls in an accessible location near to the UPS cabinet:

- Incoming mains isolation.
- Battery supply isolation, if batteries are not contained within the UPS enclosure.
- Manual bypass, to isolate the UPS and maintain power to connected equipment.

Local status monitoring
General: Provide indicator lights or a display.

Function: To clearly show the status of local manual controls and protection equipment, including the following:

- Incoming mains, on/off/trip.
- Battery supply, on/off/trip.
- Over temperature shut down, activated.
- System automatic bypass, activated.

Alarms
General: Provide audible and visual alarms for the following:

- Overload shutdown.
- High temperature warning.
- Over temperature shutdown.
- Battery contactor open.
- Low battery.
- D.c. overvoltage.
- Input power failed.
- Output overvoltage/undervoltage.
- Static switch on manual.
- Load on bypass.
- UPS free running.
- Fan failure.

Remote monitoring: Provide voltage-free contacts for remote alarm monitoring for each of the above.

Instrumentation
Provide instruments, displays, keypads and selector switches, including for the following for each phase:

- Output and input a.c. voltage.
- Input, output and bypass a.c. current.
- D.c. battery charge/discharge display.
- D.c. battery volt meter.
- Elapsed operating time.

6.5 Batteries

Standard
To AS 4029.2 or AS 4029.3.

General
Provide a battery system with an operating life of at least 10 years and suitable for operation of the UPS system for 20 continuous minutes at full load condition. Take into consideration the actual project conditions and apply derating as required.

Site condition: Indoor unair-conditioned space.

Provide battery cabinet.

Batteries
Sealed lead-acid, recombination type, to be rated at 25°C, relative humidity 90% (minimum).

Battery capacity
Sufficient to provide the rated output from the UPS for the designated period of support time.

6.6 Completion

6.6.1 Spares

General

Provide spare parts necessary to maintain the "mean time to repair".

Packaging

Package and label spare parts for long-term storage within the UPS room.

6.6.2 Completion Tests

General

Confirm which of the pre-completion and factory tests will need to be repeated on site, and make due allowance within the programme.

Test run the UPS system continuously connected to the test load, for at least 48 hours. Record line and load voltage, current, frequency, and temperature measurements in UPS and battery cubicles.

Test loads

General: Provide reactive test loads including all power cabling, control wiring and ancillary equipment.

Function: To achieve the kW, and kvar and load steps necessary to demonstrate and verify the designated steady state and transient conditions, including frequency and voltage responses and waveform deviation tests.

Tests

UPS system: Verify the following:

- Correct functional operation, including mains failure and return, and operation of static and remote bypass switches.
- Correct operation or indication of controls, alarms, indicators and instruments.
- Demonstrate ability of the UPS to start up from free running as the input supply is varied continuously from outside of the rectifier input tolerance range, to within the rectifier input tolerance range, and then returning to the out of tolerance condition. The UPS should not
- change to bypass unless the battery reserve is depleted.

Batteries and battery charger:

- Charge the batteries for 12 hours at 10% of the one-hour rate.
- Simulate supply failure.

Mains failure and restoration of mains:

- Static by-pass changeover test:
  - - % variation from nominal voltage to cause changeover.
  - - Time to changeover.

Performance tests: Measure the temperature rise and efficiency performance of UPS equipment during operational trials run over 8 continuous hours at rated output.

Isolating facilities tests: Demonstrate manual by-pass isolating switches and interlocking for battery and battery charger. Simulate supply failure and run UPS on battery power at rated output for the rated output support time.

Test measurements

During starting and test runs record transient and steady state no-load and full load waveforms. Record direct readings on test sheets and indicate time scales on oscillograms and chart records.

6.6.3 Maintenance

Call out

Respond to call outs for breakdowns or other faults requiring corrective maintenance. Attend on site within 24 hours of notification. Rectify faults, and replace faulty materials and equipment.

7. Lightning and Surge Protection

All control systems shall be protected against lightning and voltage surges. Unless specified otherwise, all inputs shall include 3.5 kV transformer isolation.

8. Drainage

All retractable bollards shall be designed such that any water that enters the bollard casing can be drained. Drainage pipes will be provided by a drainage contractor or the main contractor. The bollard Contractor shall provide a suitable drainage point and make the final connection to the drainage pipes located within the area as shown on the drawings.

9. Training

The bollard Contractor shall prepare and deliver three short training courses on the operation of the bollards. Training manuals shall be provided for up to 45 participants (15 at each course).

10. As Constructed Drawings

The Bollard Contractor shall submit 'as constructed' drawings in accordance with the Joint House Department's "Contractor Provided Project Documentation" Standard QAF 033.

The Bollard Contractor shall submit maintenance manuals that details maintenance requirements for each type of bollard and all items of power, control and associated equipment.

11. Commissioning

The bollard Contractor shall commission all bollards, power systems, and control systems for correct operation. Detailed commissioning tests and results shall be documented and tests witnessed by the Superintendent or his representative.

The bollard Contractor shall prepare a set of commissioning tests for the electrical Contractor to perform in relation to the access controls and alarm signals for the bollards. The bollard Contractor will be required to witness those tests and to confirm operational effectiveness.

12. Tender Submittals

12.1 Schedule of Prices and Breakdown of Tender Sum

1. All items and sections of the following summaries and schedules must be fully completed for the tender submission.
2. The brief descriptions given for any item in the summaries and schedules are not intended as complete descriptions of the items but merely as an indication of their extent. All details of the various items are given in the Specification and as shown on the Specification Drawings.
3. The sum entered against each item shall include the material/equipment, due proportion of labour, overhead charges and profit and shall represent the value of the particular item installed, complete with all accessories and set to work as part of the Contract.
4. The total tender prices shall be for the complete design, manufacturing, supply, delivery, installation, testing, commissioning, maintenance for the works (during the defects liability and warranty periods) as specified in the Specification and shown on the Specification Drawings.
5. All prices quoted/submitted shall be in **AUSTRALIAN DOLLARS and exclude GST**.
6. Upon award of the Contract, the schedule of breakdown sums shall form the basis of the progress payment claims. At the request of the Superintendent, the Contractor shall submit after award of the Contract, further detailed breakdown of these sums to facilitate submission and evaluation of the monthly progress payment claims.
7. The Principal reserves the right to Contract the successful Tenderer to perform all or some of the works specified and priced in the Schedule of Prices. The work may be staged.

Item	Description	Amount (A$)
1	**Project Overhead**	
	a) Construction Management Costs	
	b) Construction drawings, shop drawings, as-built drawings, instruction operation and maintenance manual as specified	
	c) Other costs (list)	
2.	**In accordance with the drawings and specification: Provision of Type A Bollards**	
	a) Type A Bollards	
	b) Power, air, hydraulic and control systems	
	c) Structural Footings / fixings	
	d) Other costs (list)	
3.	**In accordance with the drawings and specification: Provision of Type B Bollards**	
	e) Type B Bollards	
	f) Structural Footings / fixings	
	g) Other costs (list)	
4.	**In accordance with the drawings and specification: Provision of Type C Bollards**	
	h) Type C Bollards	
	i) Power, illumination and control systems	
	j) Structural Footings / fixings	
	k) Other costs (list)	
4.	**In accordance with the drawings and specification:**	

Item	Description	Amount (A$)
	Provision of Type D Bollards	
	a) Type D Bollards	
	b) Structural Footings / fixings	
	c) Other costs (list)	
5.	**In accordance with the drawings and specification: Provision of Type E Bollards**	
	a) Type E Bollards	
	b) Power and control systems	
	c) Structural Footings / fixings	
	d) Other costs (list)	
6.	**Training**	
	b) Security Operators	
7.	**Other Items (state items if any)**	
	a)	
	b)	
	c)	
	Total Tender Price	

Signature : _____
Full Name : _____
For and on Behalf of : _____
Date : _____

12.2 Schedule of Unit Rates

The unit rates quoted below shall be used for assessment of any variation **up or down** in the quantity of works added or deleted. These rates shall include delivery, supply, manufacture, installation, overheads costs, engineering and administration time, re-production/re-printing of shop drawings, profits, preliminaries, etc. In the event of a variation item where no rate is directly applicable, the rate shall be calculated by reference to other similar items quoted below or by means of daywork rates, whichever is more appropriate as directed by the Superintendent. All rates quoted shall be in **Australian Dollars and exclude GST**. The Principal reserves the right to use this schedule of unit rates to vary the works described in this specification.

ITEM	DESCRIPTION	Unit	RATE (A$)
1.	**Security Bollards**		
	Type A Bollard group (3 bollards) including all necessary power, controls and associated works as described in this specification.	Group of 3	
	Type B Bollard including all necessary associated works as described in this specification.	Each	
	Type C Bollard pair (2 bollards) including all necessary power, controls and associated works as described in this specification.	Pair	
	Type D Bollard including all necessary associated works as described in this specification.	Each	
	Type E Bollard including all necessary power, controls and associated works as described in this specification.	Each	
	Other Items (list)		

Signature : _____
Full Name : _____
For and on Behalf of : _____
Date : _____

12.3 Schedule of Daywork Rates

When additional works cannot be properly valued by using the Schedule of Unit Rates, the hourly daywork rates below are to be used in pricing variations carried out as dayworks. The rates shall be deemed to include all expenses and costs in respect of transport, administration, non-productive times, overtime payment, holidays, and other disbursements arising from employment of labour including all establishment costs, overheads and profit, etc.

	Labour Classification	Hourly Rate
a.	Unskilled worker	$_____
b.	Skilled Worker (e.g. Electrician, etc)	$_____
c.	Licensed Security Installer	$_____
d.	Foreman/Site Supervisor	$_____
e.	Engineer	$_____
f.	Specialist Technician	$_____
g.	Project Manager	$_____
h.	Others (specify)	$_____

When additional material/equipment are required to be supplied in the variations and these cannot be reasonably assessed by using the Schedule of Unit Rates, the Contractor shall supply these material/equipment at cost plus _____*(percentage mark up for attendance, profit, overhead, preliminaries, etc). Invoices/bills or payment receipts shall be submitted upon the request of the Superintendent to verify the actual cost of these material/equipment.

* To be filled in by the Tenderer.

Signature : _____
Full Name : _____
For and on behalf of : _____
Date : _____

12.4 Schedule of Delivery Times

The delivery times for equipment is critical to the success of the project. The tenderer must submit with his tender a schedule of delivery times (in weeks) for each item of equipment.

ITEM	DESCRIPTION	DELIVERY TIME FROM ORDER (WEEKS)
1.	**Physical Security Barriers - Bollards** Type A Bollard Type B Bollard Type C Bollard Type D Bollard Type E Bollard Power Equipment including UPS Control equipment Other Items (list)	

12.5 Non-Compliance Schedule

The Tenderer shall submit a paragraph point statement of non-compliance. The statement of non-compliance shall consist of a list of all non-complying paragraphs in this specification. Where the proposed system complies fully, such shall be indicated by stating 'fully compliant with specification'. Complying paragraphs are assumed and need not be noted.

Where the offer does not comply, but accomplishes the stated function in a manner different from that described, such shall be indicated by placing the words "comply with intent" opposite the paragraph number, followed by a full description of the deviation. Where a full description of the deviation is not provided, it shall be assumed that the offer does not comply with the paragraph in question and an "exception" is taken.

Where the offer does not offer the functionality stated, such shall be indicated by placing the word "exception" opposite the paragraph number.

Any proposal submitted which does not include a paragraph point statement of non-compliance as described herein shall be deemed non-responsive.

12.5.1 Deviations

The tenderer shall list hereunder indicating clearly, in the order of the relevant clauses, all deviations from the Specification and/or Drawings. No deviation will be accepted during the course of the Contract unless the approval of the Principal has been obtained in writing.

Clause No./ Drawing No.	Details

Signature : _____
Full Name : _____
For and on Behalf of : _____
Date : _____

12.6 Site Staff

The Tenderer is to insert below particulars of full-time staff/personnel he intends to employ for the works:

Name of Personnel	Position and Academic Qualifications	Past Experience

Note:
A. Proposed project organisation shall also be submitted.
B. Names of Licensed Installers and Professional Engineers shall be stated

Signature : _____
Full Name : _____
For and on behalf of : _____
Date : _____

12.7 Technical Summary

This technical summary is part of the Tender and must be completed at the time of tendering. Completion of this schedule shall not absolve the Tenderer of his responsibility to provide additional technical information (if required) for complete assessment of the tender.

Tenderers shall give technical data of each offered item listed below. Catalogues and technical literature shall also be submitted together with any illustrations or drawings necessary to fully describe the offer. Tenderers shall also provide details of an existing installation that is in operation and similar to the one proposed. The existing system must be in Australia.

The acceptance or otherwise of the technical data given shall in no way be deemed to relieve the Contractor of any of his obligations under the Contract.

ITEM	DESCRIPTION	TECHNICAL SUMMARY
1.	Type A Bollards as specified including all power and control equipment, and footing details.	
2.	Type B Bollards as specified, and footing details.	
3.	Type C Bollards as specified including all power and control equipment, and footing details.	
4.	Type D Bollards as specified, and footing details.	
5.	Type E Bollards as specified including all power and control equipment, and footing details.	
6.	**Description of an installation currently in operation and similar to the one proposed, in Australia. The Principal reserves the right to inspect the site nominated (subject to the owner's agreement).**	

12.8 Maintenance Summary

This maintenance summary is part of the Tender and must be completed at the time of tendering. Completion of this schedule shall not absolve the Tenderer of his responsibility to provide additional maintenance information (if required) for complete assessment of his tender.

Tenderers shall give maintenance data for each offered item listed below. Recommended service intervals shall be indicated together with recommended maintenance requirements. Mean Time Between Failure shall be indicated. Life Cycle cost estimates shall also be provided for a 10 year period and calculations for the life cycle cost shall be submitted at the time of tender.

The acceptance or otherwise of the technical data given shall in no way be deemed to relieve the Contractor of any of his obligations under the Contract.

ITEM	DESCRIPTION	MAINTENANCE SUMMARY
1.	All Type A Bollards as specified including all power and control equipment	Service Interval: Maintenance requirements: MTBF: Life Cycle Cost Estimate (provide calculations):
2.	All Type B Bollards as specified	Service Interval: Maintenance requirements: MTBF: Life Cycle Cost Estimate (provide calculations):
3.	All Type C Bollards as specified including all power and control equipment	Service Interval: Maintenance requirements: MTBF: Life Cycle Cost Estimate (provide calculations):
4.	All Type D Bollards as specified	Service Interval: Maintenance requirements: MTBF: Life Cycle Cost Estimate (provide calculations):
5.	All Type E Bollards as specified including all power and control equipment	Service Interval: Maintenance requirements: MTBF: Life Cycle Cost Estimate (provide calculations):

12.9 Particulars of Firm(s)

1. Particulars Of The Firms

1.1 Name: _____

1.2 Mailing Address:

_____

_____

Telephone No.: _____
Fax No.: _____

Person to contact: _____

1.4 Type of Company (Public/ Private/ Partnership, etc.) and Country of Registration:

_____

1.5 Certification for Quality Assurance: _____
(e.g. ISO 9000 certificate)

(Please attach a copy of the certificate, as applicable)

1.6 The Principals; names of listed Partners/ directors, major Shareholders and percentage of Shares. In the case of a public Company, give names of major shareholders or share holding company

a) _____ (%)
b) _____ (%)
c) _____ (%)
d) _____ (%)
e) _____ (%)
f) _____ (%)
g) _____ (%)
h) _____ (%)

1.7 Other Affiliations, subsidiaries or Joint Ventures (with % owned)

_____

_____

_____

_____

12.10 Particulars of Projects

Particulars of three Relevant Projects COMPLETED within the last 5 Years. At least one needs to be in Australia.

a)	Project Name:	
b)	Description (City/Country)	
c)	Cost:	
	I) Design:	A$ _____
	II) Construction:	A$ _____
	III) Maintenance:	A$ _____
d)	Percentage of Participation:	_____ %
	(If joint venture)	
e)	Commencement Date:	_____
f)	Completion Date:	_____
g)	Construction Related Award(s):	
h)	Name of Owner/Developer:	_____
i)	Name of Project Managers:	_____

Note:
Tenderers shall reproduce the above forms if more than one from is required.