

Master Specification Part TUN-FAC-DC1

Requirements for Tunnel Facilities

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TUN-FAC-DC1 Requirements for Tunnel Facilities

1 General

- a) This Master Specification Part sets out the requirements for the design, supply, installation and testing and commissioning of equipment and systems for Tunnel facilities including:
 - i) the documentation requirements, as set out in section 2;
 - ii) the application of requirements, as set out in section 3; and
 - iii) the technical requirements, as set out in section 4.
- b) For the purposes of this Master Specification Part, Tunnel facilities includes:
 - i) below ground and above ground rooms housing equipment which are associated with the operations and maintenance of Tunnels and Tunnel systems, including:
 - A. HV switch gear;
 - B. LV switch gear;
 - C. ITS equipment cabinets;
 - D. PMCS equipment cabinets (remote I/Os, PLCs, etc.);
 - E. Tunnel electrical switchboards;
 - F. fire control equipment;
 - G. computer equipment, communications equipment, PA equipment and RRB equipment;
 - H. UPS equipment and batteries;
 - I. pump plant;
 - J. ventilation plant control equipment, including motor control centres; and
 - K. any Tunnel equipment requiring temperature, humidity, dust, or water ingress protection from the Tunnel environment;
 - ii) egress passageways; and
 - iii) above ground compounds containing plant or equipment associated with the Tunnel.
- c) This Master Specification Part does not apply to rooms or facilities at the Traffic Management Centre (TMC) or Backup Traffic Management Centre (BTMC).
- d) The design, supply, installation and testing and commissioning of equipment and systems for Tunnel facilities must comply with the Reference Documents, including:
 - i) AS/NZS 1158.3.1 Lighting for roads and public spaces, Part 3.1: Pedestrian area (Category P) lighting - Performance and design requirements;
 - ii) AS 1324.1 Air filters for use in general ventilation and airconditioning, Part 1: Application, performance and construction;
 - iii) AS 1657 Fixed platforms, walkways, stairways and ladders - Design, construction and installation;
 - iv) AS 1668 The use of ventilation and air conditioning in buildings;
 - v) AS 1670 Fire detection, warning, control and intercom systems — System design, installation and commissioning;
 - vi) AS/NZS 1680 Interior and workplace lighting;

- vii) AS 1768 Lightning protection;
- viii) AS 1940 The storage and handling of flammable and combustible liquids;
- ix) AS 2067 Substations and high voltage installations exceeding 1 kV a.c.;
- x) AS/NZS 2201.1 Intruder alarm systems, Part 1: Client's premises - Design, installation, commissioning and maintenance;
- xi) AS 2220 Emergency warning and intercommunication systems in buildings;
- xii) AS/NZS 2293 Emergency lighting and exit signs for buildings;
- xiii) AS 2344 Limits of electromagnetic interference from overhead a.c. powerlines and high voltage equipment installations in the frequency range 0.15 MHz to 3000 MHz;
- xiv) AS 2444 Portable fire extinguishers and fire blankets — Selection and location;
- xv) AS 2676 Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings;
- xvi) AS 2890.2 Parking facilities, Part 2: Off-street commercial vehicle facilities;
- xvii) AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
- xviii) AS/NZS 3013 Electrical installations — Classification of the fire and mechanical performance of wiring system elements;
- xix) AS/NZS 3500 Plumbing and Drainage;
- xx) AS/NZS 4282 Control of the obtrusive effects of outdoor lighting;
- xxi) AS 4775 Emergency eyewash and shower equipment;
- xxii) AS 11801 Information technology - Generic cabling for customer premises;
- xxiii) AS/NZS 14763.2 Information Technology - Implementation and operation of customer premises cabling, Part 2: Planning and installation;
- xxiv) IEC 60297 Mechanical structures for electronic equipment - Dimensions of mechanical structures of the 482,6 mm (19 in) series;
- xxv) AS 60529 Degrees of protection provided by enclosures (IP Code);
- xxvi) AS/NZS 60598.1 Luminaires, Part 1: General requirements and tests;
- xxvii) AS/NZS IEC 60839.11 Alarm and electronic security systems, Part 11: Electronic access control systems;
- xxviii) IEC 62262 Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code);
- xxix) AS/NZS 62386 Digital addressable lighting interface;
- xxx) AS/CA S009 Installation requirements for customer cabling (Wiring Rules);
- xxxi) ANSI/IEEE STD 80 Guide for Safety in AC Substation Grounding;
- xxxii) AGRT Part 2: Planning, Design and Commissioning;
- xxxiii) SafeWork SA Managing noise and preventing hearing loss at work Code of Practice;
- xxxiv) SafeWork SA Managing the work environment and facilities Code of Practice; and
- xxxv) National Construction Code (NCC).

2 Documentation

2.1 Design Documentation

In addition to the requirements of PC-EDM1 “Design Management”, the Design Documentation must include the access control system details and the written agreement with the Principal’s security and emergency management team, as required by section 4.4c).

2.2 Construction Documentation

In addition to the requirements of PC-CN3 “Construction Management”, the Construction Documentation must include details of the supplier of the contamination control mats required by section 3.5.1e).

3 Application of requirements

3.1 General

- a) Tunnel facilities housing:
 - i) HV equipment must comply with the requirements of section 3.2;
 - ii) LV equipment must comply with the requirements of section 3.3;
 - iii) ventilation plant control equipment, including motor control centres, must comply with the requirements of section 3.3;
 - iv) ITS equipment cabinets must comply with the requirements of section 3.4;
 - v) PMCS equipment cabinets, PLCs or network equipment must comply with the requirements of section 3.4;
 - vi) Tunnel electrical switchboards must comply with the requirements of section 3.4;
 - vii) fire control equipment must comply with the requirements of section 3.4;
 - viii) computer equipment, communications equipment, RRB equipment and PA equipment must comply with the requirements of section 3.5;
 - ix) UPS equipment and batteries must comply with the requirements of section 3.6; and
 - x) pump plant must comply with the requirements of 3.7.
- b) Egress passageways must comply with the requirements of section 3.8.
- c) Tunnel monitoring facilities must comply with the requirements of section 3.9.
- d) Above ground compounds containing plant or equipment associated with the Tunnel, including the following, must comply with the requirements of section 3.10:
 - i) HV substations;
 - ii) water treatment plants; and
 - iii) water storage and pump plant.
- e) Corridors and stairwells interconnecting Tunnel facilities must comply with the requirements of section 3.11.
- f) Any underground Tunnel facility housing equipment that requires control of temperature, humidity, dust, or water ingress that is not prescribed in section 3.1a) must comply with the requirements of section 3.12.
- g) Where a Tunnel facility contains multiple equipment types that are described in section 3.2 to section 3.7, the more stringent requirements must be complied with.

- h) Ablution and handwashing facilities in accordance with section 4.10 must be provided within the proximity of computer equipment rooms (CERs).
- i) For Tunnels < 1000 m in length, ablution and handwashing facilities in accordance with section 4.10 must be provided at one of the Tunnel portals at a minimum.
- j) For Tunnels ≥ 1000 m in length, ablution and handwashing facilities in accordance with section 4.10 must be provided at each of the Tunnel portals.
- k) A summary of the application of the requirements of this section 3 is included in Appendix 1 Summary of application of requirements.

3.2 HV equipment rooms

- a) For the purposes of the provision of fire detection and suppression systems, HV equipment rooms must be treated as “primary plant rooms” in accordance with TUN-FIRE-DC1 “Tunnel Fire Detection and Suppression Systems”.
- b) HV equipment rooms must:
 - i) comply with the requirements of section 4.1;
 - ii) be sealed against dust and water in accordance with the requirements of section 4.2;
 - iii) have fire suppression systems and smoke detection systems in accordance with the requirements of section 4.3;
 - iv) be provided with doors and access control in accordance with the requirements of section 4.4;
 - v) have CCTV coverage in accordance with the requirements of section 4.5;
 - vi) be provided with mechanical ventilation in accordance with the requirements of section 4.6;
 - vii) be provided with air conditioning in accordance with the requirements of section 4.7;
 - viii) have lighting provided in accordance with the requirements of section 4.8.3;
 - ix) have lighting control in accordance with the requirements of section 4.8.4;
 - x) have emergency lighting and illuminated exit signs provided in accordance with the requirements of section 4.8.6;
 - xi) have cable basements in accordance with the requirements of section 4.9; and
 - xii) have an intruder detection system in accordance with the requirements of section 4.13.
- c) HV equipment rooms with HV power systems from alternative supplies must have each HV power system provided with fire separation from other HV power systems in accordance with TUN-FIRE-DC3 “Tunnel Fire Engineering”.
- d) HV equipment rooms must be provided with arc venting suitable for the HV switchgear.
- e) HV equipment rooms with auxiliary DC power supplies (including backup batteries) must be provided with:
 - i) appropriate ventilation arrangements to manage the potential corrosive and or explosive gas emissions from the batteries during charging in accordance with AS 2676 Installation, maintenance, testing and replacement of secondary batteries in buildings; and
 - ii) emergency eyewash and safety shower in accordance with AS 4775 Emergency eyewash and shower equipment where vented cells are used.
- f) HV equipment rooms must be provided with condensate drains in accordance with AS/NZS 3500 Plumbing and drainage, and discharge to any of the following:
 - i) an evaporative tray if specified by the manufacturer of the condensate drain;

- ii) drip tray;
 - iii) a sanitary drainage system by way of a tundish or self-sealing device; or
 - iv) a surface water drainage system.
- g) The evaporative tray required by section 3.2f)i) and drip tray required by section 3.2f)ii) must not be installed above HV switchgear.
- h) HV equipment rooms must have a wall-mounted whiteboard outlining single line diagrams and electrical schematics.

3.3 LV switchrooms

- a) For the purposes of the provision of fire detection and suppression systems, LV switchrooms must be treated as “primary plant rooms” in accordance with TUN-FIRE-DC1 “Tunnel Fire Detection and Suppression Systems”.
- b) LV switchrooms must:
- i) comply with the requirements of section 4.1;
 - ii) be sealed against dust and water in accordance with the requirements of section 4.2;
 - iii) have fire suppression systems and smoke detection systems in accordance with the requirements of section 4.3;
 - iv) be provided with doors and access control in accordance with the requirements of section 4.4;
 - v) have CCTV coverage in accordance with the requirements of section 4.5;
 - vi) be provided with mechanical ventilation in accordance with the requirements of section 4.6;
 - vii) be provided with air conditioning in accordance with the requirements of section 4.7;
 - viii) have lighting provided in accordance with the requirements of section 4.8.3;
 - ix) have lighting control in accordance with the requirements of section 4.8.4;
 - x) have emergency lighting and illuminated exit signs provided in accordance with the requirements of section 4.8.6; and
 - xi) have an intruder detection system in accordance with the requirements of section 4.13.
- c) LV switchrooms must be provided with condensate drains in accordance with AS/NZS 3500 Plumbing and drainage, and discharge to any of the following:
- i) an evaporative tray if specified by the manufacturer of the condensate drain;
 - ii) drip tray;
 - iii) a sanitary drainage system by way of a tundish or self-sealing device; or
 - iv) a surface water drainage system.
- d) The evaporative tray required by section 3.3c)i) and drip tray required by section 3.3c)ii) must not be installed above LV switchgear.
- e) LV switchrooms must have a wall-mounted whiteboard outlining single line diagrams and electrical schematics.

3.4 Electrical equipment rooms

- a) For the purposes of the provision of fire detection and suppression systems, electrical equipment rooms (EERs) must be treated as “secondary plant rooms” in accordance with TUN-FIRE-DC1 “Tunnel Fire Detection and Suppression Systems”.

- b) EERs must:
 - i) comply with the requirements of section 4.1;
 - ii) be sealed against dust and water in accordance with the requirements of section 4.2;
 - iii) have fire suppression systems and smoke detection systems in accordance with the requirements of section 4.3;
 - iv) be provided with doors and access control in accordance with the requirements of section 4.4;
 - v) have CCTV coverage in accordance with the requirements of section 4.5;
 - vi) be provided with mechanical ventilation in accordance with the requirements of section 4.6;
 - vii) be provided with air conditioning in accordance with the requirements of section 4.7;
 - viii) have lighting provided in accordance with the requirements of section 4.8.3;
 - ix) have lighting control in accordance with the requirements of section 4.8.4;
 - x) have emergency lighting and illuminated exit signs provided in accordance with the requirements of section 4.8.6; and
 - xi) have an intruder detection system in accordance with the requirements of section 4.13.

3.5 Computer equipment rooms

3.5.1 General

- a) For the purposes of the provision of fire detection and suppression systems, CERs must be treated as “primary plant rooms” in accordance with TUN-FIRE-DC1 “Tunnel Fire Detection and Suppression Systems”.
- b) CERs must:
 - i) comply with the requirements of section 4.1;
 - ii) be sealed against dust and water in accordance with the requirements of section 4.2;
 - iii) have fire suppression systems and smoke detection systems in accordance with the requirements of section 4.3;
 - iv) be provided with doors and access control in accordance with the requirements of section 4.4;
 - v) have CCTV coverage in accordance with the requirements of section 4.5;
 - vi) be provided with mechanical ventilation in accordance with the requirements of section 4.6;
 - vii) be provided with air conditioning in accordance with the requirements of section 4.7;
 - viii) have lighting provided in accordance with the requirements of section 4.8.3;
 - ix) have lighting control in accordance with the requirements of section 4.8.4;
 - x) have emergency lighting and illuminated exit signs provided in accordance with the requirements of section 4.8.6; and
 - xi) have an intruder detection system in accordance with the requirements of section 4.13.
- c) Where the fire suppression system required by section 3.5.1b)iii) is a gaseous system, the discharge nozzles must be designed with sound pressure levels and resonance that will not impact the operation of mechanical hard disk drives within computer equipment in CERs.
- d) Contamination control mats, also known as “tacky mats” or “sticky mats”, must:

- i) be provided at the entrance to each CER with:
 - A. at least 30 tear-off layers; and
 - B. of a minimum size of 900 mm x 1200 mm;
 - ii) be located such that any person entering or leaving the CER must step on the mat to remove contaminants from the soles of their shoes; and
 - iii) not be located in a general walk-way area where they may be walked on unnecessarily.
- e) Details of the contamination control mats and their suppliers must be included with the Construction Documentation.

3.5.2 Equipment racks

- a) CER equipment racks must:
 - i) be MFB S2005 or Rittal DK 5514.110 network server cabinets;
 - ii) be 45RU, 800 mm width and 1200 mm depth; and
 - iii) have integral vertical cable ducts (MFB P/N 03311-01) down both sides of the cabinet, front and rear.
- b) The front mounting rails of equipment racks must be recessed into the cabinet to provide at least 150 mm clearance between the door and the front of the mounted equipment.
- c) Equipment racks must be fitted with double vented doors front and rear.
- d) Each equipment rack must be fitted with a telescopic shelf which satisfies the following:
 - i) the shelf must be 450 mm deep;
 - ii) rated to at least 45 kg (evenly distributed); and
 - iii) installed at a height of between 1,000 mm and 1,100 mm above floor level.
- e) Equipment racks must be fitted with a switchable internal light mounted in the rear of the rack at the top.
- f) Horizontal cable management facilities must be provided above and below each piece of equipment where cables are connected (front and rear).
- g) Appropriate front-to-rear horizontal cable management between the vertical cable management ducts must be installed in at least 2 locations on both sides of each rack.
- h) All cabling within the racks must be routed via the internal cable management systems.
- i) Cable management systems must not be filled to more than 50% capacity when all cables and equipment have been installed.

3.5.3 Equipment rack power provision

- a) Each equipment rack must have power supplied from at least 2 separate dedicated circuits and be labelled accordingly.
- b) Each circuit must not exceed 80% of its rated capacity in total when at peak design load.
- c) Power load must be balanced across phases.
- d) Equipment rack power distribution units (PDUs) must:
 - i) be managed, network-connected devices; and
 - ii) provide for remote monitoring and control of connected equipment via:
 - A. a secure web-based interface; and
 - B. simple network management protocol.

- e) Managed PDUs must provide the following control functions:
 - i) remote control of individual power outlets, including:
 - A. power off;
 - B. power on; and
 - C. automated power-cycle functions;
 - ii) the ability to define groups of outlets to be controlled together on the same PDU or across PDU's on the same network segment; and
 - iii) the ability to define power-up sequences of individual outlets or groups of outlets, such that equipment can be powered up in a defined, controlled sequence after a planned or unplanned total power loss.
- f) All PDUs must be clearly labelled with the circuit ID to which they are connected.
- g) Power connection must be via captive power cords to prevent unintentional dislodging.
- h) Each rack must have left and right side mounted vertical power rails at the rear.

3.5.4 Telecommunications cabling

- a) All ethernet cables within CERs must comply with the following colour coding scheme:
 - i) green: generic TrafficNet ethernet segment;
 - ii) purple: iSCSI network connections;
 - iii) yellow: router to router (or firewall) connections that do not pass a TrafficNet boundary;
 - iv) orange: serial connections (RS232/RS422/RS485) over Cat 5/6;
 - v) pink: video applications (including digital video or analog video over Cat 5/6 (where applicable));
 - vi) black: crossover cables;
 - vii) blue / grey: not to be used for TrafficNet;
 - viii) red: fire alarm systems and equipment only; and
 - ix) other colours: only by arrangement with the Principal's authorised TrafficNet representative.
- b) All ethernet cables must be made to length whenever possible.
- c) Connectors must be fitted with suitable strain relief to prevent stressing of the terminations within the connectors.
- d) All interconnectivity between racks must be achieved using a structured cabling arrangement based on:
 - i) a minimum category 6 cabling designed, installed and tested in accordance with the requirements AS 11801 Information technology - Generic cabling for customer premises; and
 - ii) the requirements of AS/CA S009 Installation requirements for customer cabling (Wiring Rules).
- e) One equipment rack must be dedicated as a "distribution frame" or "patch bay" rack for ethernet cabling.
- f) All structured cabling entering or exiting the CER or interconnecting racks must terminate in the ethernet cabling rack required by section 3.5.4e).
- g) One equipment rack must be dedicated as a "distribution frame" or "patch bay" for optical fibre.

- h) All optical fibre structured cabling entering or exiting the CER or interconnecting racks must terminate in the optical fibre rack required by section 3.5.4g).
- i) Telecommunications cables must be labelled in accordance with the requirements of RD-ITS-C3 "Telecommunications Cabling".

3.5.5 Cable routing

- a) All cabling entering or leaving racks must be via an overhead cable ladder.
- b) Cable ladders must be installed at 450 mm above the cabinets along the axis of the cabinet bay or row.
- c) Transverse cable ladders (perpendicular to the cabinet row) must be installed 900 mm above the cabinets.
- d) Cable ladders must not be filled to more than 75% capacity.
- e) Vertical cable ladder extensions must be installed between:
 - i) longitudinal and transverse ladders; and
 - ii) longitudinal sections and each rack.
- f) Cable management and cable ladder bend radii must be designed and supplied to ensure cable manufacturer's specified minimum bend radius is not violated.

3.6 UPS equipment rooms

- a) For the purposes of the provision of fire detection and suppression systems, UPS equipment rooms must be treated as "primary plant rooms" in accordance with TUN-FIRE-DC1 "Tunnel Fire Detection and Suppression Systems".
- b) UPS equipment rooms must:
 - i) comply with the requirements of section 4.1;
 - ii) be sealed against dust and water in accordance with the requirements of section 4.2;
 - iii) have fire suppression systems and smoke detection systems in accordance with the requirements of section 4.3;
 - iv) be provided with doors and access control in accordance with the requirements of section 4.4;
 - v) have CCTV coverage in accordance with the requirements of section 4.5;
 - vi) be provided with mechanical ventilation in accordance with the requirements of section 4.6;
 - vii) have lighting provided in accordance with the requirements of section 4.8.3;
 - viii) have lighting control in accordance with the requirements of section 4.8.4;
 - ix) have emergency lighting and illuminated exit signs provided in accordance with the requirements of section 4.8.6; and
 - x) have an intruder detection system in accordance with the requirements of section 4.13.

3.7 Pump plant rooms

- a) For the purposes of the provision of fire detection and suppression systems, pump plant rooms must be treated as "primary plant rooms" in accordance with TUN-FIRE-DC1 "Tunnel Fire Detection and Suppression Systems".
- b) Pump plant rooms must:
 - i) comply with the requirements of section 4.1;

- ii) have fire suppression systems and smoke detection systems in accordance with the requirements of section 4.3;
 - iii) be provided with doors and access control in accordance with the requirements of section 4.4;
 - iv) have CCTV coverage in accordance with the requirements of section 4.5;
 - v) have lighting provided in accordance with the requirements of section 4.8.3;
 - vi) have lighting control in accordance with the requirements of section 4.8.4;
 - vii) have emergency lighting and illuminated exit signs provided in accordance with the requirement of section 4.8.6; and
 - viii) have an intruder detection system in accordance with the requirements of section 4.13.
- c) Pump plant rooms located underground must be sealed against dust and water in accordance with the requirements of section 4.2.
- d) Pump plant rooms must be provided with:
- i) corridors with adequate width and height for easy maintenance, removal, and replacement of equipment without the need for dismantling of equipment, including the use of motorised lifting machinery;
 - ii) overhead lifting beams and hoists for the removal of pumps in accordance with TUN-ME-DC1 "Tunnel Hydraulics Treatment and Pumping"; and
 - iii) acoustic attenuation on all walls and ceiling where the pump plant room is adjacent to or near occupied rooms such that the noise transmitted to the occupied rooms does not exceed 85 dB(A) in accordance with the SafeWork SA Managing noise and preventing hearing loss at work Code of Practice.

3.8 Egress passageways

- a) Egress passageways, including longitudinal egress passageways, must:
- i) comply with the requirements of section 4.1;
 - ii) have fire suppression systems and smoke detection systems in accordance with the requirements of section 4.3;
 - iii) have CCTV coverage in accordance with the requirements of section 4.5;
 - iv) have ventilation provided in accordance with TUN-ME-DC7 "Ventilation Design";
 - v) have lighting provided in accordance with the requirements of section 4.8.2;
 - vi) have lighting control in accordance with the requirements of section 4.8.4; and
 - vii) have emergency lighting and illuminated exit signs provided in accordance with the requirements of section 4.8.6.
- b) When the egress passageway lighting switches on, an alarm for the lighting being switched on must be presented in the PMCS.
- c) The general purpose outlet required by section 3.8a)i):
- i) may be a single socket outlet; and
 - ii) must be rated IP 66 in accordance with AS 60529 Degrees of protection provided by enclosures (IP Code).
- d) Egress passageways must be provided with:
- i) motorist emergency telephone systems (METS) and signage in accordance with TUN-COM-DC1 "Tunnel Voice Communications Systems"; and

- ii) PA system in accordance with TUN-COM-DC1 "Tunnel Voice Communications Systems".

3.9 Tunnel monitoring facilities

- a) Tunnel monitoring facilities must:
 - i) be sealed against dust and water in accordance with the requirements of section 4.2;
 - ii) be provided with doors and access control in accordance with the requirements of section 4.4;
 - iii) have CCTV coverage in accordance with the requirements of section 4.5, with the exception of section 4.5a)ii);
 - iv) be provided with mechanical ventilation in accordance with the requirements of section 4.6;
 - v) be provided with air conditioning in accordance with the requirements of section 4.7;
 - vi) have lighting provided in accordance with the requirements of section 4.8.1;
 - vii) have lighting control in accordance with the requirements of section 4.8.4;
 - viii) have emergency lighting and illuminated exit signs provided in accordance with the requirements of section 4.8.6;
 - ix) be provided with parking facilities in accordance the requirements of section 4.12;
 - x) include cable management systems to ensure cables are managed to ensure appropriate segregation and safe routing;
 - xi) be fire separated from other facilities in accordance with TUN-FIRE-DC3 "Tunnel Fire Engineering"; and
 - xii) have an intruder detection system in accordance with the requirements of section 4.13.
- b) Tunnel monitoring facilities must be provided with:
 - i) a minimum of 3 operator workstations with each workstation comprising:
 - A. 2 24" monitors (minimum size); and
 - B. next unit of computing (NUC);
 - ii) video wall comprising:
 - A. 2 no. 42" monitors (minimum size) that are wall mounted;
 - B. next unit of computing (NUC); and
 - C. CCTV console with joystick;
 - iii) keyboard, video and monitor (KVM) switch to enable display of any workstation windows to the video wall;
 - iv) RRB and PA system microphone and control console;
 - v) telephone connected to telephone networks operated by commercial telecommunication carriers; and
 - vi) plant maintenance phone in accordance with TUN-COM-DC1 "Tunnel Voice Communications Systems".
- c) The operator workstations required by section must 3.9b)i) must have:
 - i) electric height-adjustable desks to enable ergonomic work positions;
 - ii) ergonomic and height-adjustable operator chairs;

- iii) 2 monitors with minimum size of 24" display;
 - iv) NUC; and
 - v) keyboard and mouse.
- d) General purpose outlets must be provided for the operator workstations:
- i) rated to 10A with residual current device (RCD) protection at the distribution board; and
 - ii) with sufficient quantity to enable workstation devices to be powered without the need for additional power boards or the use of double adaptors.
- e) In addition to the general purpose outlets required for the operator workstations required by section 3.9d), Tunnel monitoring facilities must be provided with at least 2 wall mounted double general purpose outlets rated to 10A with RCD protection at the distribution board.
- f) Within the proximity of the Tunnel monitoring facilities, the following must be provided:
- i) meeting room to accommodate at least 8 people;
 - ii) drinking water in accordance SafeWork SA Managing the work environment and facilities Code of Practice;
 - iii) ablution and handwashing facilities in accordance with section 4.10;
 - iv) change rooms, showers and personal storage facilities in accordance with section 4.11; and
 - v) eating facilities in accordance SafeWork SA Managing the work environment and facilities Code of Practice.

3.10 Above ground compounds

- a) Above ground compounds containing plant or equipment associated with the Tunnel must be provided with:
- i) palisade security fencing around the perimeter to prevent unauthorised access to the plant or equipment in accordance with RD-BF-C4 "Supply and Installation of Fencing and Gates";
 - ii) gates and access control in accordance with section 4.4;
 - iii) CCTV coverage in accordance with section 4.5;
 - iv) lighting at the gate with motion-sensor;
 - v) task lighting at the plant or equipment appropriate for the operation and maintenance of that plant or equipment in accordance with AS/NZS 1680.5 Interior and workplace lighting, Part 5: Outdoor workplace lighting;
 - vi) security lighting of the compound;
 - vii) maintenance parking facilities in accordance with section 4.12 within the compound; and
 - viii) intruder detection systems in accordance with the requirements of section 4.13.
- b) The gate required by section 3.10a)ii) must be provided with security flood lighting that is activated by motion sensor with:
- i) user configurable lux and sensor sensitivity to prevent erroneous activation; and
 - ii) user configurable "on" time.
- c) The lighting of the compound required by section 3.10a)vi) must have control and monitoring in accordance with the requirements of section 4.8.5.

3.11 Corridors and stairwells interconnecting Tunnel facilities

- a) For the purposes of the provision of fire detection and suppression systems, corridors and stairwells interconnecting Tunnel facilities must be treated as “secondary plant rooms” in accordance with TUN-FIRE-DC1 “Tunnel Fire Detection and Suppression Systems”.
- b) Corridors and stairwells interconnecting Tunnel facilities must be provided with:
 - i) smoke detection in accordance with the requirements of section 4.3;
 - ii) mechanical ventilation in accordance with the requirements of section 4.6;
 - iii) lighting in accordance with the requirements of section 4.8.1;
 - iv) lighting control in accordance with the requirements of section 4.8.4; and
 - v) emergency lighting and illuminated exit signs in accordance with the requirements of section 4.8.6.

3.12 Other underground Tunnel facilities

- a) For the purposes of the provision of fire detection and suppression systems, underground Tunnel facilities must be treated as “secondary plant rooms” in accordance with TUN-FIRE-DC1 “Tunnel Fire Detection and Suppression Systems”.
- b) Underground Tunnel facilities housing equipment that requires control of temperature, humidity, dust, or water ingress that is not prescribed in section 3.1a) must:
 - i) comply with the requirements of section 4.1;
 - ii) be sealed against dust and water in accordance with the requirements of section 4.2;
 - iii) have fire suppression systems and smoke detection systems in accordance with the requirements of section 4.3;
 - iv) be provided with doors and access control in accordance with the requirements of section 4.4;
 - v) have CCTV coverage in accordance with the requirements of section 4.5;
 - vi) be provided with mechanical ventilation in accordance with the requirements of section 4.6;
 - vii) be provided with air conditioning in accordance with the requirements of section 4.7;
 - viii) have lighting provided in accordance with the requirements of section 4.8.1;
 - ix) have lighting control in accordance with the requirements of section 4.8.4;
 - x) have emergency lighting and illuminated exit signs provided in accordance with the requirements of section 4.8.6; and
 - xi) have an intruder detection system in accordance with the requirements of section 4.13.

4 Technical requirements

4.1 General

Each Tunnel facility must be provided with the following:

- a) plant maintenance phone in accordance with TUN-COM-DC1 “Tunnel Voice Communications Systems”;
- b) at least one wall mounted double general-purpose outlet (DGPO) rated to 10A with RCD protection at the distribution board; and

- c) doors of adequate width and height for easy maintenance, removal, and replacement of equipment without the need for dismantling of equipment.

4.2 Dust and water ingress sealing

- a) Tunnel facilities must be finished and sealed to prevent ingress of dust, grime and carbon particles:
 - i) under doors; and
 - ii) from cable access ducting.
- b) Tunnel facilities must be finished and sealed to prevent ingress of water and moisture through:
 - i) walls;
 - ii) floors;
 - iii) ceilings; and
 - iv) under doors.
- c) Tunnel facilities must have concrete sealed using a durable polyurethane or equivalent coating which meets the requirements of TUN-FIRE-DC3 "Tunnel Fire Engineering".

4.3 Fire suppression systems and smoke detection

- a) Tunnel facilities must be fire separated from other areas and have a fire resistance level (FRL) the greater of:
 - i) the level determined in accordance with TUN-FIRE-DC3 "Tunnel Fire Engineering"; or
 - ii) 120/120/120.
- b) Tunnel facilities must be provided with the following in accordance with TUN-FIRE-DC1 "Tunnel Fire Detection and Suppression Systems":
 - i) fire detection systems;
 - ii) fire suppression systems; and
 - iii) portable fire extinguishers suitable for the equipment within the Tunnel facility.
- c) Tunnel facilities must have each smoke detection system in accordance with TUN-FIRE-DC1 "Tunnel Fire Detection and Suppression Systems":
 - i) fully integrated with the Fire Control System (FCS);
 - ii) configured as a separate smoke detection zone within the FCS; and
 - iii) configured separately from the egress passageway smoke detection zone where the Tunnel facility's entry is from the egress passageway.
- d) Where the fire suppression system required by section 4.3b)ii) is a gaseous system, an air exhaust system must be provided for pressure relief venting and gas purging mechanical systems.
- e) The air exhaust system required by section 4.3d) must:
 - i) maintain the dust seal requirements of section 4.2; and
 - ii) maintain the fire separation requirements of TUN-FIRE-DC3 "Tunnel Fire Engineering".

4.4 Doors and access control

- a) The entry doors to Tunnel facilities must:
 - i) be self-closing;

- ii) open 180 degrees;
 - iii) include latches to allow the door to be retained in the fully opened position;
 - iv) provided with switches for monitoring of when the door is not in the closed position by the PMCS;
 - v) be controlled by an electronic access control system in accordance with AS/NZS IEC 60839.11 Alarm and electronic security systems, Part 11: Electronic access control systems; and
 - vi) be provided with key operated over-ride of the access control system.
- b) The access control system required by section 4.4a)v) must be:
- i) agreed with the Principal's security and emergency management team;
 - ii) supplied from Tunnel essential power supplies with UPS backup; and
 - iii) interfaced with the operators' dispatch console to enable remote door release.
- c) The access control system details and the written agreement with the Principal's security and emergency management team must be submitted with Design Documentation for approval.
- d) Where electric door strikes are used, the electric door strikes must be fail-secure type that remain in the locked position when the door strikes lose electrical power or communications.
- e) The failure of access control system in a fire separated space within a Tunnel facility must not affect the normal function of the access control system outside of the fire separation.
- f) The access control system must include remote monitoring of the health status of the system and its components on a central control and monitoring platform managed by the Principal's security and emergency management team.

4.5 CCTV coverage

- a) Tunnel facilities must be provided with:
- i) fixed CCTV camera coverage of the entry point to the Tunnel facility; and
 - ii) 100% CCTV coverage of the interior of the Tunnel facility fitted with equipment.
- b) CCTV cameras must be in accordance with RD-ITS-S5 "Imaging Equipment".
- c) The video images from the CCTV camera at the entry point to the Tunnel facility required by section 4.5a)i) must be displayed to an operator upon the Tunnel facility door being opened.

4.6 Mechanical ventilation

- a) Below ground Tunnel facilities must:
- i) have ventilation provided in accordance with TUN-ME-DC7 "Ventilation Design"; and
 - ii) not use air drawn from the Tunnel carriageway for forced ventilation.
- b) All above ground Tunnel facilities must be provided with mechanical ventilation with air pressurisation to prevent ingress of dust and dirt into the rooms in accordance with AS/NZS 1668 The use of ventilation and air-conditioning in buildings.
- c) The above ground Tunnel facilities' mechanical ventilation with air pressurisation required by section 4.6b) must include:
- i) wall mounted fans;
 - ii) user replaceable filters; and
 - iii) dampers.
- d) The wall mounted fan required by section 4.6c)i) must:

- i) be rated to pressurise the room to prevent ingress of dust and dirt;
- ii) be easily maintained and replaced; and
- iii) interface to the PMCS for control and monitoring, including:
 - A. reporting its status (on / off / fault); and
 - B. operate remotely from the PMCS (start / stop).
- e) The dampers required by section 4.6c)iii) must:
 - i) maintain the fire separation in compliance with TUN-FIRE-DC3 “Tunnel Fire Engineering”;
 - ii) be easily maintained and replaced;
 - iii) be provided with limit switches to indicate:
 - A. the fully open position; and
 - B. the fully closed position;
 - iv) provide a 4-20mA analogue output to provide the damper position across the full travel range; and
 - v) interface to the PMCS for control and monitoring, including:
 - A. reporting its status (open / closed / in transition / fault); and
 - B. operate remotely from the PMCS (open / close).

4.7 Air conditioning

- a) Tunnel facilities must be provided with redundant split system air conditioning in accordance with AS/NZS 1668 The use of ventilation and air-conditioning in buildings.
- b) Air intake using vitiated Tunnel air must not be used for air conditioning within Tunnel facilities.
- c) The air conditioning system required by section 4.7a) must:
 - i) have redundancy through the use of at least duty and standby split systems;
 - ii) have both duty and standby systems individually rated for the size of the room and the heat load produced by the equipment installed therein;
 - iii) be able to maintain user configurable room temperatures between 20°C and 27°C during normal operation; and
 - iv) maintain room humidity between 30% and 50%.
- d) The duty and standby split systems required by section 4.7c)ii) must:
 - i) have load sharing to maintain even wear and tear on each split system;
 - ii) start the standby split system in the event the duty split system fails; and
 - iii) report the status of each system to the PMCS.
- e) The air conditioning compressor units must be rated for operation within the Tunnel environment, including dust, aggressive atmosphere and high pressure Tunnel washing.
- f) All Tunnel facilities provided with air conditioning must be provided with:
 - i) an instrument independent of the air conditioning system for the monitoring of the room temperature; and
 - ii) an instrument independent of the air conditioning system for the monitoring of the room humidity.

- g) The instruments required by section 4.7f) must integrate with the PMCS to:
 - i) allow the monitoring of the Tunnel facility temperature;
 - ii) allow the monitoring of the Tunnel facility humidity; and
 - iii) report its status including faults.
- h) Air conditioning equipment must be easily accessible for maintenance and replacement without interference to traffic or other plant and equipment.

4.8 Lighting

4.8.1 General lighting

- a) Each Tunnel facility must be provided with general lighting in accordance with AS/NZS 1680 Interior and workplace lighting.
- b) Tunnel facility general lighting required by section 4.8.1a) must:
 - i) be provided with linear type luminaires;
 - ii) be in accordance with the requirements of section 4.8.8;
 - iii) be designed with the maintenance factor or light loss factor determined in accordance with AS/NZS 1680.4 Interior and workplace lighting - Maintenance of electric lighting systems;
 - iv) be controlled and monitored by the PMCS via a wired digital lighting control protocol that complies to AS/NZS 62386 Digital addressable lighting interface;
 - v) not require specialist input to configure prior to installation; and
 - vi) reconnect to the communications and power buses with no reprogramming of the system required to identify and integrate the new luminaire.
- c) Where a presence detection sensor is required, the sensor must:
 - i) be high-sensitivity type that have more than 1000 infrared detecting zones or utilise 2 different detection technologies in conjunction; and
 - ii) have an impact resistance rating not less than the impact rating of the general lighting luminaires in the same space.

4.8.2 Egress passageway lighting

- a) The egress passageway lighting requirements of this section 4.8.2 must be applied to all egress passageways.
- b) Each egress passageway must be provided with general lighting:
 - i) in accordance with the requirements of section 4.8.1; and
 - ii) designed to achieve an average illuminance level not less than 160 lux and an illuminance uniformity (minimum to average) greater than 0.3.
- c) Presence detection sensors must be provided to egress passageways to detect presence of an occupant in all areas within the egress passageway.
- d) The presence detection sensors required by section 4.8.2c) must interface to the PMCS to:
 - i) provide status of the sensors; and
 - ii) provide status of the detection of occupants in the egress passageway.

4.8.3 Plant and electrical equipment room lighting

- a) Plant and electrical equipment rooms must be provided with general lighting:

- i) in accordance with the requirements of section 4.8.1; and
- ii) with an illuminance assessment which meets the following requirements:
 - A. lighting level required by AS/NZS 14763.2 Information Technology - Implementation and operation of customer premises cabling, Part 2: Planning and installation, in the facilities housing equipment cabinets conforming to IEC 60297 Mechanical structures for electronic equipment - Dimensions of mechanical structures of the 482,6 mm (19 in) series;
 - B. 160 lux average on the vertical plane at 1 m above floor finished level (AFFL) on the front face of the equipment, in the facilities other than 4.8.3a)ii)A;
 - C. spacing of the vertical calculation grid is not larger than 0.2 m; and
 - D. illuminance uniformity greater than 0.7; and
- iii) designed to minimise discomfort glare from:
 - A. the luminaires; and
 - B. veiling reflection from any highly reflective surfaces on surrounding equipment.
- b) Luminaires for plant and electrical equipment rooms must be subject to a unified glare index (UGR) assessment in accordance to following requirements:
 - i) maximum point UGR less than 22;
 - ii) calculation grid to be placed at 1.5 m AFFL and 0.6 m in front of the accessible faces (with door) of the switchboards, control panels, remote I/O panels, and communication cabinets; and
 - iii) calculation grid spacing no larger than the spacing used for the illuminance calculation in the same room.
- c) Presence detection sensors must be provided to plant and electrical rooms to detect presence of an occupant in all areas within that room.
- d) The presence detection sensors required by section 4.8.3c) must interface to the PMCS to:
 - i) provide status of the sensors; and
 - ii) provide status of the detection of occupants in that room.

4.8.4 Lighting control and monitoring

- a) All Tunnel facilities lighting required by sections 4.8.1, 4.8.2 and 4.8.3 must:
 - i) be individually controlled and monitored from the PMCS via a digital lighting control protocol that complies to AS/NZS 62386 Digital addressable lighting interface;
 - ii) be switched remotely from the PMCS; and
 - iii) transition from full luminosity to off when switched off in the following sequence:
 - A. 50% dimmed for the first 2 minutes;
 - B. 25% dimmed for the next 2 minutes; and
 - C. powered off thereafter.
- b) All Tunnel facilities lighting required by sections 4.8.1 and 4.8.3 must be switched locally from within the Tunnel facility.
- c) The lighting in each egress passageway as required by section 4.8.2 must:
 - i) be switched on automatically when the egress passageway door is opened;
 - ii) stay continuously lit until switched off remotely;

- iii) be able to be switched remotely from the PMCS; and
- iv) transition in accordance with the requirements of section 4.8.4a)iii) when switched off.

4.8.5 Outdoor lighting

- a) Above ground compounds containing plant or equipment associated with the Tunnel must be provided with outdoor lighting, including:
 - i) security lighting around the perimeter of each Tunnel facility;
 - ii) gate flood lighting at each entrance gate;
 - iii) outdoor workplace lighting for plant and equipment;
 - iv) carpark lighting for outdoor parking facilities; and
 - v) where required in Contract Documents, architectural and landscape lighting.
- b) Security lighting required by section 4.8.5a)i) must:
 - i) cover areas that are 2m from the boundary of the associated facility;
 - ii) achieve average horizontal illuminance of not less than 5 lux and point minimum horizontal illuminance of not less than 2 lux within the coverage area; and
 - iii) be controlled automatically by ambient light level sensors with user configurable triggering level to continuously light the areas during night time.
- c) Gate flood lighting required by section 4.8.5a)ii) must:
 - i) cover areas within 2m from each side of entrance gates;
 - ii) achieve average horizontal illuminance of not less than 20 lux and point minimum horizontal illuminance of not less than 8 lux within the coverage area; and
 - iii) be controlled automatically by motion sensors with:
 - A. user configurable triggering ambient light level;
 - B. user configurable “on” time; and
 - C. user configurable motion sensitivity.
- d) Outdoor workplace lighting required by section 4.8.5a)iii) must:
 - i) be provided in accordance with AS/NZS 1680.5 Interior and workplace lighting, Part 5: Outdoor workplace lighting; and
 - ii) be controlled by manual switches within the vicinity of the task areas served by the workplace lighting.
- e) Carpark lighting required by section 4.8.4a)iv) must:
 - i) be provided in accordance with AS/NZS 1158.3.1 Lighting for roads and public spaces, Part 3.1: Pedestrian area (Category P) lighting - Performance and design requirements; and
 - ii) be controlled automatically by ambient light level sensors with user configurable triggering level to continuously light the areas during night time.
- f) Architectural and landscape lighting required by section 4.8.5a)v) must:
 - i) comply with PR-LS-D1 “Landscape and Urban Design”;
 - ii) be provided aesthetically in accordance with the architectural design and landscape design;
 - iii) use mechanical and vandal-resistant fixing or mounting for the luminaires;

- iv) not use adhesive fixing or mounting for the luminaires; and
- v) be removable for maintenance and without damaging luminaires and mounting surfaces.
- g) The design and installation of all outdoor lighting must comply with AS/NZS 4282 Control of the obtrusive effects of outdoor lighting.
- h) Outdoor lighting required by section 4.8.5 must be provided with remote switching from PMCS in user-configurable logical switching group via a digital lighting control protocol.
- i) Outdoor lighting required by section 4.8.5 must be provided with continuous fault monitoring from PMCS for individual luminaire via a digital lighting control protocol.

4.8.6 Emergency lighting and illuminated exit signs

- a) Tunnel facilities must be provided with emergency lighting system in accordance with AS/NZS 2293 Emergency lighting and exit signs for buildings.
- b) The emergency lighting system for Tunnel facilities must include following as a minimum:
 - i) emergency egress lighting;
 - ii) internal-illuminated exit signs; and
 - iii) any other lighting system required for maintaining visibility under the failure of artificial lighting systems for normal operation.
- c) In addition to the requirements of section 4.8.6a):
 - i) emergency lighting in egress passageways must have a minimum point horizontal illuminance of not less than the lighting level for safety movement as required by AS/NZS 1680.0 Interior lighting, Part 0: Safe movement; and
 - ii) emergency lighting in Tunnel facilities housing electrical switchboards, communications and control equipment, plant or motors must:
 - A. provide minimum point horizontal illuminance of not less than 10% of the minimum point horizontal illuminance required for the normal lighting in the facility;
 - B. provide minimum point horizontal illuminance not less than 15 lux; and
 - C. have illuminance uniformity (minimum to maximum) not less than 0.1.
- d) Emergency lighting systems in Tunnel facilities must have emergency power sources from centrally supplied systems in accordance with AS/NZS 2293 Emergency lighting and exit signs for buildings.

4.8.7 Automatic testing and monitoring facilities

- a) Automatically operated testing and monitoring facilities must be provided to emergency lighting systems required by 4.8.6a) in accordance with AS/NZS 2293 Emergency lighting and exit signs for buildings.
- b) The automatically operated testing and monitoring system required by 4.8.7a) must:
 - i) be implemented as part of PMCS;
 - ii) utilise a digital lighting control protocol that complies to AS/NZS 62386 Digital addressable lighting interface;
 - iii) monitor the operational status of the emergency luminaires and exit signs;
 - iv) monitor the operational status of electrical circuits and communication paths associated with emergency luminaires and exit signs;
 - v) monitor the operational status of emergency power sources for emergency luminaires and exit signs;

- vi) perform automatic function test and duration test on emergency luminaires, exit signs, and emergency power sources for emergency lighting systems, in accordance with AS/NZS 2293 Emergency lighting and exit signs for buildings;
 - vii) perform function test and duration test on emergency power sources as part of the UPS routine tests if UPS for essential power supply is used as the emergency power source for emergency luminaires and exit signs;
 - viii) record results from the test required by 4.8.7b)vi) in accordance with AS/NZS 2293 Emergency lighting and exit signs for buildings;
 - ix) store the test results within the Common Data Environment in accordance with PC-EDM5 “Digital Engineering”;
 - x) automatically re-address luminaires for emergency lighting system after luminaire replacement;
 - xi) allow emergency lighting luminaires to be grouped logically in any user-configurable combination for the purposes of testing; and
 - xii) enable initiation of testing of all luminaires within the logical groups required by section 4.8.7b)xi).
- c) Each logical group of emergency lighting luminaires must have a user-configurable means for test initiation via SCADA, including:
- i) manual initiation of testing by an operator; and
 - ii) automatic initiation of testing on a periodic basis with a user-configurable time interval compatible with the routine testing requirements of AS/NZS 2293 Emergency lighting and exit signs for buildings.
- d) The operator must be able to enable or disable automatic initiation of testing on a periodic basis for a logical group of emergency lighting luminaires.
- e) The operator must be able to select any combination of logical groups of emergency lighting luminaires and initiate manual testing for all selected groups with a single action.
- f) Manual initiation of testing for any logical group of emergency lighting luminaires configured with automatic initiation of testing on a periodic basis must reset the time period until the next automatic initiation of testing is triggered for the logical group.
- g) Testing of any logical group must not impact the operation of any other logical group not being tested.

4.8.8 Supply of luminaires for tunnel facilities

- a) Luminaires for lighting, emergency lighting, and illuminated exit signs must:
- i) have LEDs as light sources;
 - ii) have an impact resistance rating not less than IK08 for areas with restricted access in accordance with IEC 62262 Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code);
 - iii) have an impact resistance rating not less than IK10 for areas accessible to the general public in accordance with IEC 62262 Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code);
 - iv) be provided with vandalism-resistant mounting accessories if the luminaires are installed in areas that is accessible to the general public;
 - v) have an ingress protection rating not less than IP65 in accordance with AS 60529 Degrees of protection provided by enclosures (IP Code); and
 - vi) be fitted with drivers that:
 - A. comply with AS/NZS 62386 Digital addressable lighting interface;

- B. are certified to DiiA DALI-2 program; and
 - C. are certified to DiiA DALI+ program if alternative wired system for digital lighting control is used.
- b) Luminaires for lighting in tunnel facilities required by section 4.8.1, 4.8.2, and 4.8.3 must have:
- i) a luminous efficacy which is greater than 110lm/W;
 - ii) a correlated colour temperature equal to 4000K;
 - iii) a colour rendering index greater than 80;
 - iv) a standard deviation colour matching (SDCM) rating not greater than 3;
 - v) a L90 B10 lifespan not less than 50,000 hours; and
 - vi) LSZH materials throughout where the luminaire is used in underground Tunnel facilities.
- c) Luminaires for outdoor lighting required by section 4.8.5, except architectural and landscape lighting, must have:
- i) a luminous efficacy which is greater than 110lm/W;
 - ii) a correlated colour temperature equal to 4000K;
 - iii) a colour rendering index greater than 80;
 - iv) a SDCM rating not greater than 3;
 - v) a L90 B10 lifespan not less than 80,000 hours;
 - vi) upward light ratio of 0% measured in accordance to AS/NZS 4282 Control of the obtrusive effects of outdoor lighting;
 - vii) luminaire housing constructed with die-cast aluminium, or extruded aluminium, or stainless steel; and
 - viii) luminaire optics covered with impact-resistant safety glasses.
- d) Luminaires for architectural lighting and landscape lighting required by section 4.8.5 must have:
- i) a luminous efficacy which is greater than 110lm/W for white light luminaire, including colour changing luminaires in white light mode, with correlated colour temperature between 2200K to 6700K;
 - ii) a luminous efficacy which is greater than 60lm/W for colour changing luminaire in red, green, and blue (RGB) mode;
 - iii) a SDCM rating not greater than 3;
 - iv) a L90 B10 lifespan not less than 80,000 hours in all colour modes;
 - v) luminaire housing constructed with die-cast aluminium, or extruded aluminium, or stainless steel; and
 - vi) luminaire optics covered with impact-resistant safety glasses.
- e) Luminaires for emergency lighting systems required by section 4.8.6 must have:
- i) light sources with L90 B10 lifespan not less 100,000 hours for maintained type luminaires; and
 - ii) light sources with L90 B10 lifespan not less 50,000 hours for non-maintained type luminaires.

4.9 Cable basements

Where cable basements are used in Tunnel facilities, cable basements must:

- a) not be a confined space;
- b) have safe access;
- c) have sufficient height to accommodate the bend radii of cables; and
- d) facilitate safe and easy installation and maintenance of cables, ladders and supporting structures.

4.10 Ablution and handwashing facilities

- a) Ablution and handwashing facilities in accordance with SafeWork SA Managing the work environment and facilities Code of Practice must be provided where maintenance or operations personnel are likely to work on a regular basis, including:
 - i) toilets; and
 - ii) hand washing facilities.
- b) The ablution and handwashing facilities required by section 4.10a) must have the greater of:
 - i) numbers of toilets to accommodate the anticipated number and gender of the workforce based on the Tunnel facility; and
 - ii) a minimum of one unisex toilet.

4.11 Change rooms, showers and personal storage

- a) The following facilities must be provided where maintenance or operations personnel are likely to work on a regular basis in accordance with SafeWork SA Managing the work environment and facilities Code of Practice:
 - i) change rooms;
 - ii) shower facilities; and
 - iii) personal storage.
- b) The change rooms, shower facilities and personal storage facilities required by section 4.11a) must be provide with quantities and sized to be the greater of:
 - i) the anticipated number and gender the of workforce based on the Tunnel facility; and
 - ii) a minimum of:
 - A. one change room with personal storage facilities for at least 8 workers; and
 - B. one shower facility.

4.12 Maintenance parking facilities

- a) Above ground Tunnel facilities must be provided with parking facilities for commercial vehicles in accordance with AS 2890.2 Parking facilities, Part 2: Off-street commercial vehicle facilities.
- b) The parking facilities required by section 4.12a) must:
 - i) be sealed for all weather use; and
 - ii) accommodate the following vehicles as defined in AS 2890.2 Parking facilities, Part 2: Off-street commercial vehicle facilities:
 - A. one small rigid vehicle; and
 - B. one medium rigid vehicle.
- c) The parking facilities required by section 4.12a) must be provided with lighting that is:
 - i) in accordance with AS/NZS 1158 Lighting for roads and public spaces;

- ii) controlled in accordance with the requirements of 4.8.4; and
 - iii) continuously lit lighting during night time.
- d) The parking facilities required by section 4.12a) must be provided with
- i) full and continuous CCTV coverage; and
 - ii) CCTV cameras in accordance with RD-ITS-S5 “Imaging Equipment”.

4.13 Intruder detection system

- a) Tunnel facilities must be provided with an electronic intruder detection system.
- b) The intruder detection system required by section 4.13a) must be:
- i) in accordance with AS/NZS 2201.1 Intruder alarm systems, Part 1: Client’s premises - Design, installation, commissioning and maintenance;
 - ii) agreed with the Principal’s security and emergency management team; and
 - iii) provided with facility to be monitored by the State Protective Security Branch of SAPOL.
- c) The intruder detection system required by section 4.13a) must have an interface with the access control system to automatically:
- i) disarm the intruder detection system upon an authorised entry to the Tunnel facility via the access control system;
 - ii) arm the intruder detection system upon the exit of an authorised entry; and
 - iii) arm the intruder detection system if the exit of an authorised entry is not detected for 4 hours.
- d) The intruder detection system must be supplied from Tunnel essential power supplies with UPS backup.
- e) The intruder detection system must include remote control and monitoring of the system and its components from a central control and monitoring platform managed by the Principal’s security and emergency management team, including:
- i) monitoring of the health status of the intruder detection system; and
 - ii) remote arming / disarming of the intruder detection system and detection zones.
- f) The intruder detection system required by section 4.13a) must have an interface with the operators’ dispatch console to enable remote arming / disarming of each of the intruder detection system zones.
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5 Appendix 1 Summary of application of requirements

Table TUN-FAC-DC1 5-1 sets out a summary of the application of the requirements to each type of Tunnel facility.

Table TUN-FAC-DC1 5-1 Verification requirements

Facility	General requirements	Dust and water ingress weal	Primary plant room ⁽⁷⁾	Secondary plant room ⁽⁷⁾	Portable extinguisher	Access control	CCTV coverage	Mechanical ventilation	Air conditioning	General lighting	Emergency lighting	Outdoor lighting	Cable basements	Ablution and handwashing	Change rooms and showers	Parking facilities	Intruder detection system	Comments
HV equipment rooms	Y	Y	Y	-	Y	Y	Y	Y ⁽¹⁾	Y	Y	Y	-	Y	-	-	-	Y	a) Arc venting. b) Ventilation for batteries. c) Eyewash and safety shower if vented cells are used. d) Evaporative tray, drainage. e) Whiteboard with SLDs and electrical schematics.
LV switchrooms	Y	Y	Y	-	Y	Y	Y	Y ⁽¹⁾	Y	Y	Y	-	- ⁽²⁾	-	-	-	Y	a) Evaporative tray, drainage. b) Whiteboard with SLDs and electrical schematics.
Electrical equipment rooms	Y	Y	-	Y	Y	Y	Y	Y ⁽¹⁾	Y	Y	Y	-	-	-	-	-	Y	
Computer equipment rooms	Y	Y	Y ⁽³⁾	-	Y	Y	Y	Y ⁽¹⁾	Y	Y	Y	-	-	- ⁽⁴⁾	-	-	Y	
UPS equipment rooms	Y	Y	Y	-	Y	Y	Y	Y ⁽¹⁾	-	Y	Y	-	-	-	-	-	Y	
Pump plant rooms	Y	-	Y	-	Y	Y	Y	-	-	Y	Y	-	-	-	-	-	Y	a) Wide / high corridors and doors. b) Over head lifting beams provided. c) Acoustic attenuation.
Egress passageways	Y ⁽⁵⁾	-	-	Y	-	Y	Y	-	-	Y	Y	-	-	-	-	-	-	Also equipped with METS and PA.
Tunnel monitoring facilities	- ⁽⁶⁾	Y	-	-	Y	Y	Y	Y	Y	Y	Y	-	-	Y	Y	Y	Y	a) 2 operator workstations. b) Meeting room for 8 people. c) Drinking water and eating facilities.

Facility	General requirements	Dust and water ingress weal	Primary plant room ⁽⁷⁾	Secondary plant room ⁽⁷⁾	Portable extinguisher	Access control	CCTV coverage	Mechanical ventilation	Air conditioning	General lighting	Emergency lighting	Outdoor lighting	Cable basements	Ablution and handwashing	Change rooms and showers	Parking facilities	Intruder detection system	Comments
Above ground compounds	-	-	-	-	-	Y	Y	-	-	-	-	Y	-	-	-	Y	Y	a) Perimeter chain link security fencing. b) Lighting at gate with motion sensor. c) Task lighting (AS/NZS 1680.5) at equipment. d) Security lighting of the compound.
Corridors and stairwells interconnecting Tunnel facilities	-	-	-	-	-	-	-	-	-	Y	-	-	-	-	-	-	-	
Other Tunnel facilities	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	-	-	-	-	-	-	Y	

Table notes:

- (1) Vitiated air is not to be used for cooling.
- (2) Cable basements may be used by the Contractor.
- (3) Gaseous nozzles to be acoustically treated to reduce impact on mechanical computer equipment.
- (4) Ablutions must be within the vicinity of CER.
- (5) Single GPO only.
- (6) Operator phone and maintenance phones provided on workstations. Sufficient number of GPOs to support workstation equipment.
- (7) The fire detection and suppression systems must be provided in accordance with TUN-FIRE-DC1 "Tunnel Fire Detection and Suppression" based on the classification of primary plant room and secondary plant room required by TUN-FIRE-DC1 "Tunnel Fire Detection and Suppression" and this Master Specification Part.