

Master Specification Part TUN-COM-DC1

Tunnel Voice Communications Systems

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TUN-COM-DC1 Tunnel Voice Communications Systems

1 General

- a) This Master Specification Part sets out the requirements for design, supply, installation and testing and commissioning of Tunnel voice communications systems including:
 - i) the documentation requirements, as set out in section 2;
 - ii) the radio rebroadcast (RRB) system requirements, as set out in section 3;
 - iii) the Tunnel telephony system requirements, as set out in section 4;
 - iv) the installation requirements, as set out in section 5;
 - v) the environmental requirements, as set out in section 6;
 - vi) the control and monitoring requirements, as set out in section 7;
 - vii) the Hold Point requirements, as set out in section 8; and
 - viii) the verification requirements and records, as set out in section 9.
- b) For the purposes of this Master Specification Part, Tunnel voice communications includes the following subsystems:
 - i) RRB system for the rebroadcast of commercial and community radio stations;
 - ii) RRB system for the rebroadcast of digital audio broadcast radio stations;
 - iii) RRB system for the rebroadcast of South Australian government radio network (SA GRN);
 - iv) Tunnel maintenance radio system;
 - v) Tunnel public address (PA) system;
 - vi) Tunnel motorist emergency telephone system (METS); and
 - vii) plant maintenance telephone system.
- c) This Master Specification Part does not apply to the Tunnel fire phone system which is addressed by TUN-FIRE-DC1 "Tunnel Fire Detection and Suppression Systems".
- d) The design, supply, installation and testing and commissioning of the Tunnel voice communications systems must comply with the Reference Documents, including:
 - i) AS 1428.5 Design for access and mobility, Part 5: Communication for people who are deaf or hearing impaired;
 - ii) AS 2700 Colour standards for general purposes;
 - iii) AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
 - iv) AS/NZS 3013 Electrical installations - Classification of the fire and mechanical performance of wiring system elements;
 - v) AS/NZS 4295 Analogue speech (angle modulated) equipment operating in the land mobile and fixed services bands in frequency 29.7 MHz to 1 GHz;
 - vi) AS/NZS 4768 Digital radio equipment operating in land mobile and fixed services bands in the frequency range 29.7 MHz to 1 GHz;
 - vii) AS 60529 Degrees of protection provided by enclosures (IP Code);
 - viii) AS/CA S004 Voice frequency performance requirements for Customer Equipment;

- ix) AS/CA S009 Installation requirements for customer cabling (Wiring Rules);
 - x) AS/ACIF S040 Requirements for Customer Equipment for use with the Standard Telephone Service - Features for special needs of persons with disabilities;
 - xi) ACMA RALI: LM 6 Management of Bi-Directional amplifiers in the land mobile service in the frequency range 29.7 to 520 MHz;
 - xii) ETS 300 086 Radio Equipment and Systems, Land mobile group - Technical characteristics and test conditions for radio equipment with an internal or external RF connector intended primarily for analogue speech;
 - xiii) IEC 60268 Sound system equipment - Part 16: Objective rating of speech intelligibility by speech transmission index;
 - xiv) IEC 62262 Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code);
 - xv) TIA 102 Project 25 Two-Slot TDMA Overview, TSB-102.BBAA (Mar 2010) Land mobile Communications Standards (APCO/Project 25);
 - xvi) TIA TSB-88.1 Wireless Communications Systems - Performance in Noise-And Interference-Limited Situations, Part 1: Recommended Methods for Technology Independent Performance Modelling; and
 - xvii) relevant Attorney-General Department (AGD) requirements.
- e) References within this Master Specification Part to “control centre” or “control centres” must include all of the Department’s traffic management centres, including:
- i) Traffic Management Centre (TMC); and
 - ii) Backup Traffic Management Centre (BTMC).

2 Documentation

2.1 Design Documentation

In addition to the requirements of PC-EDM1 “Design Management”, the Design Documentation must include the calculated signal strength and coverage details of the SA GRN voice network as required by section 3.3i).

2.2 Quality Management Records

In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include:

- a) evidence of Australian Communications and Media Authority (ACMA) licensing, as required by section 3.1e); and
- b) records of all test activities completed pursuant to section 9, as required by section 9c).

3 Radio rebroadcast system requirements

3.1 General

- a) The Contractor must liaise with the AGD and the Traffic Management Centre to identify the site-specific requirements of the SA GRN system.
- b) RRB systems must be provided to receive radio broadcasts available outside the Tunnel and re-transmit the radio broadcasts within the Tunnel, including:

- i) the SA GRN where the AGD identifies that the rebroadcasting from an existing SA GRN base station is required on the site;
- ii) commercial and community radio stations including all radio stations broadcasting in the AM and FM bands available in the following licence areas as published by the ACMA:
 - A. Adelaide RA1;
 - B. Adelaide Foothills RA1; and
 - C. Adelaide SW RA1; and
- iii) all digital audio broadcast (DAB+) radio stations available in the Adelaide metropolitan area, on the following multiplexes:
 - A. 9A Adelaide multiplex;
 - B. 9B Adelaide multiplex; and
 - C. 9C national multiplex for Adelaide.
- c) References within this Master Specification Part to “commercial radio stations” must include all commercial radio stations, all community radio stations and all DAB+ radio stations as required by section 3.1b)iii).
- d) RRB systems required by section 3.1a) must be:
 - i) in accordance with the standards and requirements of ACMA; and
 - ii) licensed by ACMA accordingly.
- e) Evidence of the ACMA licensing required in section 3.1d)ii) must be submitted as part of the Quality Management Records.

3.2 Commercial radio station rebroadcast

- a) For every radio station rebroadcast required by section 3.1b), the quality of the commercial radio reception within all parts of each Tunnel carriageway must be equivalent to the quality of radio reception outside of the Tunnel at natural ground level.
- b) The quality of radio reception required by section 3.2a) excludes radio reception disruption effects due to heterodyning caused by dual signal reception at the Tunnel entrance and exit transition zones.
- c) The RRB system required by section 3.1b) must include:
 - i) input signal interfaces for each radio station;
 - ii) signal transmission equipment for each radio station;
 - iii) antenna systems to propagate the radio signals in the Tunnels;
 - iv) all associated RRB system cabling; and
 - v) the capacity to transmit at least an additional 10 radio stations in the future.
- d) The RRB system required by section 3.1b) must include a “break-in” facility that enables the over-ride of all commercial radio reception within the Tunnel with:
 - i) an operator’s real-time voice communications; and
 - ii) playback of pre-recorded messages.
- e) The “break-in” facility required by section 3.2d) must:
 - i) allow the selection of the “break-in” to commercial RRB in either carriageway or both carriageways of the Tunnel; and
 - ii) have the voice signal be at a level that is audible across the general range of in-vehicle radio settings.

- f) The RRB system required by section 3.1b) must transmit all messages using the Audinate DANTE protocol.
- g) The RRB system required by section 3.1b) must integrate with existing headend facilities at each of the control centres.

3.3 SA GRN

- a) The system for the rebroadcast of the SA GRN as required by section 3.1b)i) must:
 - i) provide digital trunk radio and paging which caters for:
 - A. the South Australian Metropolitan Fire Service (SAMFS);
 - B. South Australian Police Service (SAPOL);
 - C. South Australian Ambulance Service (SAAS); and
 - D. State Emergency Service (SES); and
 - ii) be connected to the uninterruptible power supply (UPS) supported LV power system in accordance with TUN-ME-DC2 "Tunnel Power Systems".
- b) Where the AGD identifies that new SA GRN base stations are required, the Contractor must provide:
 - i) dedicated equipment space in an appropriate Tunnel facility for the base station equipment, which is fire-separate from other Tunnel areas;
 - ii) antenna systems, including associated amplification and repeating devices if required, for SA GRN radio and paging in the coverage area; and
 - iii) connection points to the antenna systems required by 3.3b)ii) for the SA GRN base station equipment at locations agreed with the AGD.
- c) The coverage area of the SA GRN for the Tunnel must include:
 - i) outside all Tunnel portals including Tunnel approaches;
 - ii) within all Tunnel carriageway areas;
 - iii) within all egress passageways;
 - iv) within all electrical equipment rooms (EERs);
 - v) within all plant and equipment rooms;
 - vi) within all HV and LV switch rooms;
 - vii) within all Tunnel maintenance areas; and
 - viii) areas required by the Contract Documents.
- d) The area reliability (AR) for the SA GRN voice network within all areas required by section 3.3c) must be minimum 95%.
- e) The delivery audio quality (DAQ) of the SA GRN voice network required by section 3.3c) must be "DAQ 4", which is defined as "Speech easily understood. Little noise or distortion".
- f) Mobile radio coverage must be provided when the antenna of the mobile radio terminal is located at vehicle roof level 1.2 m above the finished surface.
- g) Portable radio coverage must be provided when the portable radio terminal is located in a swivel case on a belt at hip level 0.7 m above the finished surface.
- h) Page message communications must provide channel performance criterion (CPC) of minimum 99% message success rate (MSR) for messages of up to 160 characters to pagers mounted on body at 1.0 m above the finished surface.

- i) The calculated signal strength and coverage details of the SA GRN voice network must be submitted as part of the Design Documentation.

3.4 Maintenance radios

- a) 2-way digital maintenance radio systems must be provided within Tunnels for maintenance purposes.
- b) The maintenance radio system required by section 3.4a) must have radio signal coverage:
 - i) outside all Tunnel portals including Tunnel approaches;
 - ii) within all Tunnel carriageway areas;
 - iii) within all egress passageways;
 - iv) within all EERs;
 - v) within all plant and equipment rooms;
 - vi) within all HV and LV switch rooms; and
 - vii) within all associated Tunnel maintenance areas.
- c) Digital maintenance radio systems must be designed and installed to achieve the performance requirement in 3.3d), 3.3f), and 3.3g).

3.5 Public address system

- a) PA systems must be provided in:
 - i) all areas of the Tunnel carriageways;
 - ii) the Tunnel portals; and
 - iii) all egress passageways.
- b) The PA system required by section 3.5a) must be capable of independently addressing zones including:
 - i) at each Tunnel carriageway portal inbound traffic direction;
 - ii) at each Tunnel carriageway portal outbound traffic direction;
 - iii) within each Tunnel carriageway; and
 - iv) within each egress passageway.
- c) The PA system required by section 3.5a) must:
 - i) be designed to meet a speech transmission index greater than 0.6 “good” as defined in IEC 60268 Sound system equipment - Part 16: Objective rating of speech intelligibility by speech transmission index;
 - ii) be designed with the speakers capable of sustaining operation at a sound pressure of 100 dB(A) towards a listener height of 1.6 m above the finished surface level with no less than 3 dB amplifier power reserve;
 - iii) have audio quality such that all messages are intelligible during operation and emergency conditions, including operation of the Tunnel ventilation system, with background noise levels up to 90 dB(A);
 - iv) have speaker locations and speaker performances selected to provide clarity of output under the influence of echoes, sound reflections and the effects of adjacent speakers;
 - v) ensure that the audio is free from hum, noise and electrical and radio frequency interference;

- vi) have automatic output gain control on PA amplifiers with configurable minimum output gain and gain increment to adjust output volume automatically according to the ambient noise level;
 - vii) set the output gain control to its maximum limit if the ambient noise input for automatic gain control has failed;
 - viii) have tuneable propagation delay to prevent excessive reverberation within the Tunnel;
 - ix) be capable of tuning and pre-setting of volume levels so that messages played in multiple zones are played at an appropriate volume for that zone;
 - x) preclude the setting of any zone volume to “zero” at any point in the system;
 - xi) be able to be operated remotely from the control centres;
 - xii) transmit all messages using the Audinate DANTE protocol; and
 - xiii) integrate with the RRB system to provide break-in facilities to broadcast PA messages on the RRB rebroadcast radio stations.
- d) The PA system speakers, bracketry, fixings, and fasteners must be designed to meet the Tunnel environment, including:
- i) exposure to aggressive groundwater;
 - ii) discharge from the fire suppression system; and
 - iii) exposure to the wash-down process.
- e) The PA system required by section 3.5a) must:
- i) be connected to the UPS supported LV power system in accordance with TUN-ME-DC2 “Tunnel Power Systems”; and
 - ii) have cabling within the Tunnel and egress passageways in accordance with WS52W of AS/NZS 3013 Electrical installations - Classification of the fire and mechanical performance of wiring system elements.
- f) Operation of the PA system in a Tunnel carriageway must automatically break into the RRB system broadcast of the same Tunnel carriageway.
- g) The PA system must monitor the following system parameters in real-time and generate alarms when a fault is detected:
- i) status of all PA amplifiers;
 - ii) status of all network audio break in/out devices;
 - iii) input status of all PA amplifiers and all network audio break in/out devices; and
 - iv) output load and output line integrity of PA amplifiers.

3.6 Message recording and playback

A message recording facility must be provided with the capability to:

- a) digitally record at least 24 voice messages for rebroadcast of at least 30 seconds per message;
- b) import digitally pre-recorded messages in common audio file formats; and
- c) select and playback digitally pre-recorded messages via the RRB system and PA system.

4 Tunnel telephony system requirements

4.1 General

- a) Tunnel telephone systems must be provided in Tunnels, including:

- i) METS; and
- ii) plant maintenance telephone system.
- b) The Tunnel telephone systems required by section 4.1a) must:
 - i) use voice-over-IP (VOIP);
 - ii) be compatible with following network protocols:
 - A. DHCP and static IP;
 - B. RFC 3261 session initiation protocol (SIP); and
 - C. SNMP (v3 or later) monitoring protocol;
 - iii) be compatible with the following audio codecs:
 - A. G.711 (A/μ);
 - B. G.722; and
 - C. G.729 (A/B);
 - iv) support PoE compliant with IEEE 802.3af, IEEE 802.3at, or IEEE 802.3bt;
 - v) transmit over the PMCS communications network;
 - vi) be provided with dedicated IEEE 802.1Q VLAN for the:
 - A. METS telephone system; and
 - B. plant maintenance telephone system;
 - vii) have quality of service (QoS) provision on the network to maintain the following network parameters within the recommended limits of the system vendor end-to-end under operation conditions:
 - A. network latency;
 - B. network jitter;
 - C. packet loss;
 - D. prioritised bandwidth, including Layer 2 overhead, for audio transmission; and
 - E. prioritised bandwidth, including Layer 2 overhead, for call control traffic; and
 - viii) utilise telephone networks operated by commercial telecommunication carriers as the interface between the Tunnel telephone systems and the control centres.

4.2 Control centre operator interface

- a) The Tunnel telephone systems must be provided with a control centre operator interface to initiate or receive calls from:
 - i) METS;
 - ii) plant maintenance telephone system;
 - iii) the Principal's internal telephone network; and
 - iv) telephone networks operated by commercial telecommunication carriers.
- b) The control centre operator interface required by section 4.2a) must:
 - i) include a desktop operator console with:
 - A. a handset;
 - B. the ability to connect a headset; and

- C. a hands-free speakerphone;
- ii) include a software interface on each operator workstation;
- iii) include queuing functionality to manage incoming calls to the control centres;
- iv) prioritise calls received from METS;
- v) include call management functions including:
 - A. call holding and resume;
 - B. mute and unmute;
 - C. call direct transfer;
 - D. call back to recent incoming and outgoing caller ID; and
 - E. multi-party phone call initiation and pickup;
- vi) provide full-duplex voice communications that enable all parties in the voice call to be heard clearly and simultaneously;
- vii) display the status of all calls, including the calls active, calls on hold and calls waiting;
- viii) provide the following alerts to annunciate incoming calls:
 - A. visual alert; and
 - B. audible alert;
- ix) enable an operator to manage calls in the queue including:
 - A. attend a call;
 - B. place calls on hold; and
 - C. return to any call in the queue;
- x) alert the operator of subsequent incoming calls as required by section 4.2b)viii) when the operator is attending another call; and
- xi) provide the option for the operator to silence the audible alert required by section 4.2b)x).

4.3 Motorist emergency telephone system (METS)

4.3.1 General

- a) A METS must be provided within Tunnels.
- b) The METS required by section 4.3.1a) must have end point devices:
 - i) that support both incoming and outgoing calls; and
 - ii) allow the control centre operator to disconnect the call remotely.
- c) METS end point devices required by section 4.3.1b) must:
 - i) be provided in each egress passageway of the Tunnel;
 - ii) be provided at locations and height in compliance with DDA requirements;
 - iii) have visual signage for hearing augmentation systems provided adjacent to the METS end point devices in accordance with AS 1428.5 Design for access and mobility, Part 5: Communication for people who are deaf or hearing impaired; and
 - iv) have an “Emergency telephone” sign indicating the location of the METS end point device provided in accordance with TUN-FIRE-DC2 “Tunnel Evacuation Systems”.
- d) METS end point devices with handsets must:

- i) be zero-button type with auto-dial on handset lift;
 - ii) automatically initiate a call to the control centre within 2 seconds of the handset being lifted from the handset holder;
 - iii) disconnect the call when the handset is returned to the handset holder;
 - iv) allow the control centre operator to disconnect the call remotely even when the handset is not returned to the handset holder; and
 - v) be fitted with vandal-resistant stainless steel flexible cord that is anchored within the handset casing and end point device casing.
- e) METS end point devices without handsets must:
- i) be provided with a vandal-resistant push button for call initiation;
 - ii) initiate a call to the control centre via a call button on the front of the device within 2 seconds of the call button being pressed; and
 - iii) disconnect the call when then the control centre operator terminates the call.
- f) The METS end point devices required by section 4.3.1b) must:
- i) be B23 Bright Blue in accordance with AS 2700 Colour standards for general purposes;
 - ii) be vandal-resistant with an impact protection rating of IK10 in accordance with IEC 62262 Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code); and
 - iii) be provided with at least 2 voltage free contact outputs for interfacing with other systems.
- g) The METS end point devices required by section 4.3.1b) must perform self-testing for the following:
- i) microphone or speaker fault;
 - ii) handset lift switch or call button fault; and
 - iii) SIP registration error or system configuration error.

4.3.2 Acoustic requirements

- a) The METS end point devices required by section 4.3.1b) must:
- i) comply with AS/CA S004 Voice frequency performance requirements for Customer Equipment;
 - ii) include acoustic echo cancellation;
 - iii) have output volume suitable for the Tunnel environment with background noise level up to 90 dB(A);
 - iv) include remotely-configurable output volume;
 - v) include microphones with noise attenuation capability that is suitable for the Tunnel environment with background noise level up to 90 dB(A); and
 - vi) include T-switch magnetic induction loop facility for hearing aid devices.
- b) The T-switch magnetic induction loop facility required by section 4.3.2a)vi) must:
- i) activate automatically when a call is initiated;
 - ii) de-activate automatically when the call is disconnected; and
 - iii) comply with the performance requirements of AS/ACIF S040 Requirements for Customer Equipment for use with the Standard Telephone Service — Features for special needs of persons with disabilities.

4.3.3 Call annunciation

- a) Upon receiving an incoming call, METS end point devices required by section 4.3.1b) must:
 - i) produce a ring tone and continue to produce the ring tone until the call is answered; and
 - ii) provide a visual indication on the METS end point device to indicate an incoming call.
- b) The ring tone to annunciate incoming call required by section 4.3.3a)i) must have sound pressure level of not less than 80dBA at 1 m distance.
- c) The visual indication of an incoming call required by section 4.3.3a)ii) must be visible from any point where the METS end point device is visible.

4.4 Plant maintenance telephone system

4.4.1 General

- a) A plant maintenance telephone system must be provided within each plant or equipment room with Tunnels, including:
 - i) all EERs;
 - ii) all plant and equipment rooms;
 - iii) all HV and LV switch rooms; and
 - iv) all associated Tunnel maintenance areas.
- b) The plant maintenance telephone system required by section 4.4.1a) must:
 - i) support both incoming and outgoing calls from:
 - A. other plant maintenance telephones; and
 - B. the control centres;
 - ii) include standard keypads on each telephone to allow dialling outgoing calls;
 - iii) include an LCD screen on each telephone;
 - iv) display the number being dialled or an incoming call ID;
 - v) include speed dial functions on each telephone;
 - vi) have the speed dial destination name displayed on the LCD screen; and
 - vii) include full-duplex and hands-free speakerphone.
- c) The plant maintenance telephone system required by section 4.4.1a) must have call management functions including:
 - i) call holding and resume;
 - ii) mute and unmute;
 - iii) call direct transfer;
 - iv) call back to recent incoming and outgoing caller ID; and
 - v) multi-party phone call initiation and pickup.

4.4.2 Acoustic requirements

- a) The plant maintenance telephone system required by section 4.4.1a) must include:
 - i) acoustic echo cancellation;
 - ii) dynamic noise reduction to attenuate the background noise from plant equipment;

- iii) silence suppression that is capable of detecting voice activity and suspend outgoing voice transmission when there is no voice activity for a configurable period of time;
 - iv) automatic gain control to regulate the audio volume; and
 - v) T-switch magnetic induction loop facility for hearing aid devices.
- b) The T-switch magnetic induction loop facility required by section 4.4.2a)v) must:
- i) activate automatically when a call is initiated;
 - ii) de-activate automatically when the call is disconnected; and
 - iii) comply with the performance requirements of AS/ACIF S040 Requirements for Customer Equipment for use with the Standard Telephone Service - Features for special needs of persons with disabilities.

4.5 Mobile phone network

- a) The Contractor must install, configure, test and commission one or more telecommunication networks to ensure that all mobile telecommunication services commercially available within the Adelaide metropolitan area continue to be provided to motorists, Emergency Services (see section 3.3a)i)) and maintenance personnel on an uninterrupted basis within the Tunnel and Tunnel dive structures on Tunnel approaches.
- b) The Contractor must ensure that the mobile telecommunications networks and all associated Carrier Equipment have at all times sufficient capacity to service all expected voice and data telecommunications traffic within the Tunnel and dive structures, including an appropriate allowance for peak loading that may occur during motorway incidents.
- c) The Contractor must meet the requirements of each Lead Carrier related to the installation, configuration, commissioning, testing, operation and maintenance of the Carrier Equipment of that Lead Carrier as necessary to provide the mobile telecommunications services and, as a minimum, provide to each Lead Carrier:
 - i) a distributed antenna system that is suitable for that purpose and complies with the Lead Carrier's reasonable requirements and all applicable Laws and standards;
 - ii) a multi-carrier combiner for at least 4 carriers (or as otherwise specified by the Lead Carrier);
 - iii) a system that is suitable for multi-carrier deployment across all telecommunications carriers' operating bands;
 - iv) portal antennas to provide handover coverage to and from the outdoor networks and the mobile telecommunications networks operating within the Tunnel and dive structures; and
 - v) reliable power supply for equipment critical to the operation of the mobile telecommunications network.
- d) The Contractor must provide all Mobile Service Providers with such access to the Tunnel, Tunnel facilities and dive structures as required to enable them to install, configure, test and commission any equipment they require within the Tunnel, Tunnel facilities and dive structures to facilitate the delivery of mobile telecommunications services.

5 Installation requirements

- a) The METS end point devices must be installed in accordance with manufacturer's instructions to maintain designed ingress protection (IP) level and vandal resistance.
- b) All cabling within the Tunnel and egress passageways must comply with WS52W of AS/NZS 3013 Electrical installations - Classification of the fire and mechanical performance of wiring system elements.

6 Environmental requirements

- a) All active equipment must be installed within enclosures with ingress protection in accordance with AS 60529 Degrees of protection provided by enclosures (IP Code) as follows:
 - i) IP42 for enclosures located within EERs or computer equipment rooms (CERs);
 - ii) IP65 for enclosures located outdoor or equipment within the Tunnel or the egress passageway; and
 - iii) IP66 for any enclosures located where it may be subjected to high pressure washing during Tunnel wall cleaning or within the zone of the deluge system.
- b) Enclosures located within the Tunnel must be fabricated from 316 stainless steel.
- c) METS end point devices must:
 - i) be designed to be in Tunnel environment including:
 - A. ambient air temperature range of 0°C to 40°C; and
 - B. relative humidity up to 90%; and
 - ii) maintain the IP rating required by section 6a) at all times including when protective handset covers are in the opened position.

7 Control and monitoring requirements

- a) The RRB system required by section 3.1a) must integrate with the PMCS for status monitoring including:
 - i) monitoring of each service to be rebroadcast;
 - ii) the presence of all AM, FM and DAB+ retransmissions from off air decoders located in the Tunnels;
 - iii) the presence of the SA GRN voice network at each location required by section 3.3c);
 - iv) status of all RRB amplifiers; and
 - v) status of RRB server.
- b) The PA system required by section 3.5a) must integrate with the PMCS for status monitoring including:
 - i) status of all PA system amplifiers; and
 - ii) status of PA server.
- c) The Tunnel telephony system required by section 4 must integrate with the PMCS for status monitoring including:
 - i) status of all METS end point devices required by section 4.3.1g);
 - ii) status of all plant maintenance telephones; and
 - iii) status of Tunnel telephone system servers.

8 Hold Points

Table TUN-COM-DC1 8-1 details the review period or notification period, and type (documentation or construction quality) for each Hold Point referred to in this Master Specification Part.

Table TUN-COM-DC1 8-1 Hold Points

Section reference	Hold Point	Documentation or construction quality	Review period or notification period
9d)	Completion of testing and provision of detailed testing report and records evidencing that all ACMA licence requirements have been satisfied	Documentation	10 Business Days review

9 Verification requirements and records

- a) Testing and commissioning procedures and documentation must comply with the requirements of PC-CN1 “Testing and Commissioning”.
- b) In addition to the verification requirements of PC-EDM6 “Systems Engineering Management” and PC-CN1 “Testing and Commissioning”, the Contractor must conduct:
 - i) tests to verify that the RRB system complies with all ACMA licence requirements;
 - ii) tests to verify that the strength of RRB system signal strength outside of each Tunnel portal are within ACMA license requirements; and
 - iii) Site Acceptance Testing (SAT) to verify adequate radio signal strength and coverage for:
 - A. commercial radio stations required by section 3.1b)ii) at all Tunnel carriageway locations;
 - B. SA GRN voice network at all coverage locations required by section 3.3c); and
 - C. maintenance radio at all coverage locations required by section 3.4b).
- c) The Contractor must supply to the Principal, records of all test activities completed, as part of the Quality Management Records.
- d) The completion of testing required by this section 9 to the Principal’s satisfaction, and the preparation of and submission to the Principal of a detailed testing report and records evidencing that all ACMA license requirements have been complied with, constitutes a **Hold Point**. Ongoing operation of the RRB system must not occur until this Hold Point has been released.