

Master Specification

Part TUN-ITS-DC1

Tunnel Wayfinding and Positioning

September 2024



Government of South Australia
Department for Infrastructure
and Transport

Build.
Move.
Connect.

Document Information

Document Information

K Net Number:

Document Version: 1

Document Date: 30/09/2024

Document Amendment Record

Version	Change Description	Date
0	Initial issue	31/08/2023
1	Updated cover page	30/09/2024

Document Management

This document is the property of the Department and contains information that is confidential to the Department. It must not be copied or reproduced in any way without the written consent of the Department. This is a controlled document and it will be updated and reissued as approved changes are made.

Contents

Contents	3
TUN-ITS-DC1 Tunnel Wayfinding and Positioning	4
1 General	4
2 Documentation	4
3 In-Tunnel positioning system technical requirements	5
4 Control and monitoring requirements	6
5 Reliability, Design Life, and functional safety requirements	7
6 Maintainability	7
7 Verification requirements	7
8 Hold Points	8

TUN-ITS-DC1 Tunnel Wayfinding and Positioning

1 General

- a) This Master Specification Part sets out the requirements for the design, supply, installation, and commissioning of Tunnel wayfinding and positioning systems including:
 - i) the documentation requirements, as set out in section 2;
 - ii) the in-Tunnel positioning system technical requirements, as set out in section 3;
 - iii) the control and monitoring requirements, as set out in section 4;
 - iv) the reliability, Design Life, and functionality safety requirements, as set out in section 5;
 - v) the maintainability requirements, as set out in section 6;
 - vi) the verification requirements, as set out in section 7; and
 - vii) the Hold Point requirements, as set out in section 8.
- b) For the purposes of this Master Specification Part, Tunnel wayfinding and positioning systems includes the in-Tunnel positioning system.
- c) The design, supply, installation, and commissioning of the Tunnel wayfinding and positioning systems must comply with the Reference Documents, including:
 - i) for the in-Tunnel positioning system, all relevant ACMA mandatory electronic management compatibility standards;
 - ii) AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
 - iii) AS 61000.6.4 Electromagnetic compatibility (EMC), Part 6.4: Generic standards - Emission standard for industrial environments; and
 - iv) IEC 60945 Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results.

2 Documentation

2.1 Design Documentation

In addition to the requirements of PC-EDM1 "Design Management", the Design Documentation must include a report detailing the design of the Tunnel wayfinding and positioning systems, including evidence demonstrating compliance with all specified requirements of this Master Specification Part and the Contract Documents, including:

- a) all calculations including details of retransmitted global navigation satellite system (GNSS) signal strength throughout the Tunnels and in the vicinity of the Tunnel portals;
- b) availability and reliability analysis of the proposed Tunnel wayfinding positioning system devices; and
- c) evidence demonstrating that the in-Tunnel positioning system:
 - i) will provide reliable location information, as required by section 3.3c); and
 - ii) is compatible with compliant GNSS receivers and otherwise satisfies the requirements of section 3.2a), as required by section 3.2b).

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 the test documentation required by section 7c).

2.3 O&M Manual

In addition to the requirements of PC-CN2 “Asset Handover”, the O&M Manual must include the following information about each type of supplied equipment:

- a) equipment test sheets (including test results) where testing is required, including all test documentation required by section 7;
- b) a list of all critical in-Tunnel positioning system equipment, together with a recommended spare parts list, spare part and replacement part information;
- c) system fault diagnosis and repair procedures, including:
 - i) management of faults, failures and incidents;
 - ii) diagnostic procedures and diagnosis of faults and repair; and
 - iii) the replacement of faulty modules; and
- d) ACMA compliance or approval certificates.

3 In-Tunnel positioning system technical requirements

3.1 ACMA compliance

The in-Tunnel positioning system must comply with all ACMA license conditions including ensuring that all GNSS signals outside of each Tunnel portal are within ACMA license requirements.

3.2 Compatibility with GNSS compliant receivers

- a) The in-Tunnel positioning system must provide location information:
 - i) to users of commercially available, off-the-shelf smartphones and vehicle navigation systems fitted with GPS compatible GNSS receivers including:
 - A. Emergency Services; and
 - B. motorists;
 - ii) seamlessly as vehicles transition from open road to the Tunnels and vice versa, subject to the ACMA license restrictions;
 - iii) continuously as vehicles travel throughout the Tunnel environment, including any entry or exit ramps within the Tunnel environment;
 - iv) without requiring motorists or Emergency Services to install additional applications other than the applications normally used to support wayfinding and location functions; and
 - v) without requiring configuration or reconfiguration of navigation devices.
- b) As part of the Design Documentation, the Contractor must provide evidence that the in-Tunnel positioning system is:
 - i) compatible with the GNSS receivers; and
 - ii) otherwise satisfies the requirements of section 3.2a).

3.3 Location information accuracy

- a) The in-Tunnel positioning system must provide location information accurate to better than ± 35 m or to the accuracies specified in the Contract Documents.
- b) The in-Tunnel positioning system must provide location information accurate to better than ± 5 m if an enhanced capability is specified in the Contract Documents, noting that the requirements of sections 3.2a)iv) and 3.2a)v) may not apply to this enhanced capability.
- c) As part of the Design Documentation, the Contractor must provide evidence that the in-Tunnel positioning system is capable of providing reliable location information as required by section 3.3a) and section 3.3b).

3.4 Jamming, spoofing, fault monitoring and fault tolerance

- a) The in-Tunnel positioning system must be resistant to:
 - i) jamming; and
 - ii) spoofing.
- b) The in-Tunnel positioning system must utilise at least 2 geographically separated GNSS receivers.
- c) GNSS signal reliability and integrity at each in-Tunnel positioning system GNSS receiver must be actively monitored.
- d) If GNSS signal reliability or integrity is detected as unacceptable at any in-Tunnel positioning system GNSS receiver, location information from that GNSS receiver must not be used by the in-Tunnel positioning system until the discrepancy is resolved.
- e) The in-Tunnel positioning system must actively monitor each in-Tunnel positioning system GNSS receiver's calculated location using GNSS signals against its known location (based on receiver antenna location).
- f) If an unexpected location discrepancy between the calculated location and the known location is identified at any in-Tunnel positioning system GNSS receiver, location information from that receiver must not be used by the in-Tunnel positioning system until the discrepancy is resolved.

3.5 Compatibility with other Tunnel systems

The in-Tunnel positioning system must not degrade the performance of or interfere with other Tunnel systems including:

- a) other Tunnel wayfinding system equipment;
- b) voice communication systems; and
- c) communication data networks.

4 Control and monitoring requirements

- a) The in-Tunnel positioning system must be capable of being controlled and monitored through the plant monitoring and control system (PMCS).
- b) The in-Tunnel positioning system must allow the re-broadcasting of GNSS signals from any or all GNSS transmitters to be disabled and re-enabled from the PMCS.
- c) The in-Tunnel positioning system must report to the PMCS the status of:
 - i) each GNSS receiver;
 - ii) each GNSS signal retransmission device; and
 - iii) each data communication device dedicated to the transfer of information between:

- A. in-Tunnel positioning system receivers and retransmission devices; and
 - B. in-Tunnel positioning system and the PMCS.
- d) The in-Tunnel positioning system status reporting required by section 4c) must include:
- i) on, off and standby states as applicable to the individual devices;
 - ii) faults; and
 - iii) alarms.
- e) The in-Tunnel positioning system must report to the PMCS identified jamming or spoofing events including:
- i) unacceptable signal reliability or integrity degradation;
 - ii) unexpected location information discrepancies; and
 - iii) unexpected changes in the signal strength received by each GNSS receiver.

5 Reliability, Design Life, and functional safety requirements

- a) The in-Tunnel positioning system must have a Design Life which is compliant with RD-ITS-D1 “Design of Intelligent Transport Systems (ITS)”.
- b) The in-Tunnel position system must support upgrades to receive and retransmit GNSS signals from other available navigation systems (including Galileo and BeiDou).
- c) The MTBF for each in-Tunnel positioning system Line Replaceable Unit must be at least 50,000 hours.

6 Maintainability

- a) The in-Tunnel positioning system devices must be Line Replaceable Units.
- b) With respect to spare parts for the in-Tunnel positioning system devices, the Contractor must:
 - i) determine the number of spare parts required to maintain and repair the in-Tunnel positioning system for its design life; and
 - ii) supply and deliver the spare parts required to maintain and repair the in-Tunnel positioning system for at least 2 years or as specified in the Contract Documents.

7 Verification requirements

- a) The Contractor must conduct Factory Acceptance Testing of the Tunnel wayfinding and positioning system equipment in accordance with the requirements of PC-CN1 “Testing and Commissioning” prior to installation to demonstrate, as far as practical under factory test conditions, that the Tunnel wayfinding and positioning equipment and systems comply with the Contract Documents.
- b) The Contractor must conduct:
 - i) tests to verify the strength of in-Tunnel positioning system generated GNSS signals outside of each Tunnel portal are within ACMA license requirements;
 - ii) tests to verify that the in-Tunnel positioning system complies with all ACMA licence requirements including that GNSS signals outside of each Tunnel portal are below ACMA license requirements;
 - iii) Site Acceptance Testing (SAT) to verify adequate GNSS signal strength at all points within each Tunnel; and
 - iv) SAT to verify accuracy requirements at all points within each Tunnel.

- 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 7 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 in-Tunnel positioning system must not occur until this Hold Point has been released.

8 Hold Points

Table TUN-ITS-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-ITS-DC1 8-1 Hold Points

Section reference	Hold Point	Documentation or construction quality	Review period or notification period
7d)	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