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### REVISION REGISTER

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MOTORWAY SYSTEMS OVERVIEW AND GENERAL REQUIREMENTS

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IC-DC-TS901

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FOREWORD

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW D&C TS901 Edition 1 Revision 0.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.
TfNSW SPECIFICATION D&C TS901

MOTORWAY SYSTEMS OVERVIEW AND GENERAL REQUIREMENTS

1 GENERAL

1.1 SCOPE

TfNSW pursues safe, sustainable and efficient use of its Motorway network including tunnels. Motorway Systems, including the Operations Management and Control System (OMCS), are tools that assist in the implementation of this vision.

The Motorway Systems specifications are intended for use in the project development, design, construction, operation and maintenance of motorways throughout NSW. The Motorway Systems specifications and referenced documents consist of normative text that describes the requirements to design, construct, operate and maintain various Traffic Management, Mechanical, Electrical, Fire and Safety systems. These requirements must be strictly followed in order to comply with the Motorway Systems specifications.

The Motorway Systems Specifications cover a broad range of technologies which are integrated to implement the functionality of the Motorway Systems and their sub-systems. Information and Communications Technology (ICT) and Systems Engineering processes form part of the Motorway Systems Specifications and must be followed to ensure successful delivery of the OMCS.

All requirements in the Motorway Systems specification documents represent minimum requirements and levels and do not preclude the Contractor from proposing higher levels of performance and functionality to achieve safe and effective Motorway operations.

1.2 RELATED SPECIFICATIONS

This Specification is a Level 1 document which forms part of the suite of TfNSW specification documents for Motorway Systems (see figure below). Other documents within the suite are:

Level 2

- D&C TS902 “Systems Engineering Processes”;
- D&C TS903 “Asset Life Cycle Management”;
- D&C TS911 “Motorway Systems - Motorway Control Centre”;
- D&C TS912 “Motorway Systems - Traffic Management and Control System”;
- D&C TS913 “Motorway Systems - Plant Management and Control System”;
- D&C TS914 “Motorway Systems - Electrical Power Supply and Distribution System”;
- D&C TS915 “Motorway Systems - Motorway Network Communications System”;
- D&C TS916 “Motorway Systems - Electronic Toll Collection System”;
- D&C TS917 “Motorway Systems - C2C Interface for Motorways”;

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Ed 1 / Rev 1
**1.3 STRUCTURE OF THE SPECIFICATION**

1.3.1 (Not Used)

1.3.2 (Not Used)

1.3.3 Schedule of HOLD POINTS

The schedule in Annexure TS901/C lists the **HOLD POINTS** that must be observed. Refer to Specification TfNSW D&C Q6 for the definition of **HOLD POINTS**.

1.3.4 (Not Used)

1.3.5 (Not Used)

1.3.6 Referenced Documents

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 2350). For convenience, the full titles are given in Annexure TS901/M.

**1.4 DEFINITIONS AND ACRONYMS**

1.4.1 Definitions

The terms “you” and “your” mean “the Contractor” and “the Contractor’s” respectively.

The following definitions apply to this Specification:
Alarm

Discrete change of data resulting in an audio/visual annunciation in the control room or the OMCS GUI display, requiring operator acknowledgement as well as input to alarm list.

The following categories are defined, not reflecting priority or criticality of the alarm:

- **Action alarm**: Alarm feature including blocking facilities intended for automatic safeguarding actions in order to protect equipment, environment or human beings.
- **Warning alarm**: Alarm without blocking facilities intended for abnormal conditions enabling operator intervention in order to prevent further escalation.
- **Fault alarm**: Alarm associated to fault or failure in the instrument and/or control device.

Availability

The time the OMCS is available. Availability is defined as the ratio of actual time for which the OMCS is able to perform a given task over total time the OMCS is expected to perform this task.

The availability A is calculated as follows: $A = \frac{MTBF}{MTBF + MOT}$

Where:

(i) **MTBF (Mean Time Between Failure)** indicates reliability for the given task;

(ii) **MTTR (Mean Time To Repair)** is the elapsed time to repair the fault. Must include the time between the system or device failure and the successful return to service including any mobilisation of repair crews and spares;

(iii) **MOT (Mean Outage Time)** indicates the time required to restore performance of the given task from failure: $MOT = MTTD + MTTR$;

(iv) **MTTD (Mean Time To Detection)** is the elapsed time from the occurrence of a failure until detection.

Back-up control system

Comprises all hardware and software necessary to maintain control when main control systems have failed, malfunctioned or are being maintained.

Contractor

The Project Company delivering the requirements or the Company that is the owner of the asset or the owner operator of the tunnel or road asset.

Device

All roadside equipment and plant equipment controlled by the OMCS.

Error

The product state or incorrect information in the system which is liable to lead a failure. In terms of consequences, error can be classified as:

- Internal
- External
- Transient
- Intermittent
- Persistent
- Permanent

Failure

Effect of an error. It is the nonconformity of behaviour of a component, subsystem or system.
Fault
A defect either in hardware, software or in the design. Fault is an identified or potential cause of an error.

Fire panel
A stand-alone system for presenting of fire alarms and system failure.

Incident Management
All field operations designed to maintain or restore conditions of road use that are as close as possible to the normal situation.

Incident Response Plan
A prepared response to an incident or planned event. An Incident Response Plan (IRP) covers predefined operator actions including implementation of the Traffic Incident Management Plan (TIMP) and field resources management.

Integrated System
A combination of computer based systems which are interconnected in order to allow common access to sensor information and/or command or control.

Motorway
The road including all:
- Open roadway sections
- Tunnel sections
- Approaches / on-ramps
- Exits / off-ramps
within the Motorway lease area.

Planned Event
A scheduled traffic incident anticipated to impact traffic operations, that has been planned for and the response prepared in advance.

Redundancy
A system with redundancy is one with duplication which prevents failure of the entire system in the event of failure of a single component.

Response
A set of actions taken by the System, with or without direct initiation from an Operator, to deal with an incident.

Responses may consist of coordinated sets of conscription of field resources and/or device settings under a Traffic Incident Management Plan or individual device settings.

Road Network Operations
All traffic management and user support activities intended to permit, improve, or facilitate the use of an existing motorway or tunnel, whatever its condition of use.
### Sydney Motorway Network

The motorway network comprising:
- Eastern Distributor
- Southern Cross Drive
- General Holmes Drive
- M5 Motorway East
- M5 South Western Motorway
- Westlink M7
- M2 Hills Motorway
- Lane Cove Tunnel
- Gore Hill Freeway
- Warringah Freeway
- Sydney Harbour Tunnel
- Sydney Harbour Bridge
- Cahill Expressway
- M1 Pacific Motorway (formerly F3 Freeway)
- M1 Princes Motorway (formerly F6 Southern Freeway)
- M31 Hume Highway (formerly F5 Freeway)
and any other Motorways which may be added in the future.

### Traffic Flow Management

Automated system response to optimise the live flow of traffic on a motorway based on data received, and the interactive management of traffic control equipment.

### Traffic Incident

An event or issue (both planned and unplanned) that has or may have an adverse impact on the traffic flow of the road network or to road user safety, requiring a response from motorway traffic operations staff.

An Incident is described in the C2C interface by a set of data defining the type of the event, the position in the network, the severity and impact on traffic and other information.

### Traffic Incident Management Plan (TIMP)

Traffic management plans that are the system generated traffic management plans, that are location specific and that can either be generated automatically or were prepared prior, and approved and programmed into the system.

### Traffic Management

Traffic control covers all measures, in respect to predetermined objectives, aimed at distributing and controlling traffic flows, in order to avoid the onset of disturbances or to reduce their impact. Traffic Management is carried out in coordination or under the control of the TfNSW and TfNSW TMC.

### Traveller Information or Driver Advisory

All measures to disseminate predictive or current information on traffic conditions and improve general conditions of motorway or tunnel use. Its general aim is safety and user comfort.

### 1.4.2 Acronyms

The following acronyms apply to this Specification:

<table>
<thead>
<tr>
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<th>Description</th>
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<tbody>
<tr>
<td>AMIS</td>
<td>Asset Management Information System</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>AS</td>
<td>Australian Standards</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>---------</td>
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<tr>
<td>AVID</td>
<td>Automatic Video Incident Detection</td>
</tr>
<tr>
<td>BCP</td>
<td>Business Continuity Plan</td>
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<tr>
<td>C2C</td>
<td>Centre to Centre</td>
</tr>
<tr>
<td>CCTV</td>
<td>Closed Circuit Television used for traffic surveillance</td>
</tr>
<tr>
<td>CMCS</td>
<td>Central Monitoring Control System</td>
</tr>
<tr>
<td>CMS</td>
<td>Changeable Message Sign</td>
</tr>
<tr>
<td>CPU</td>
<td>Central Processing Unit (computer component)</td>
</tr>
<tr>
<td>DAS</td>
<td>Driver Advisory Signs</td>
</tr>
<tr>
<td>DR</td>
<td>Disaster Recovery</td>
</tr>
<tr>
<td>DRS</td>
<td>Disaster Recovery Site</td>
</tr>
<tr>
<td>ESPD</td>
<td>Electrical Supply and Power Distribution</td>
</tr>
<tr>
<td>ETC</td>
<td>Electronic Toll Collection</td>
</tr>
<tr>
<td>FAT</td>
<td>Factory Acceptance Testing</td>
</tr>
<tr>
<td>FMS</td>
<td>Fault Management System</td>
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<tr>
<td>FRNSW</td>
<td>Fire and Rescue New South Wales</td>
</tr>
<tr>
<td>FT</td>
<td>Fault Tolerant</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>GUI</td>
<td>Graphic User Interface</td>
</tr>
<tr>
<td>HA</td>
<td>High Availability</td>
</tr>
<tr>
<td>Hi-Occ</td>
<td>High Occupancy Algorithm</td>
</tr>
<tr>
<td>IAAA</td>
<td>Identity, Authentication, Authorization and Accounting</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communications Technology</td>
</tr>
<tr>
<td>IMS</td>
<td>Incident Management System</td>
</tr>
<tr>
<td>IMS-TMC</td>
<td>the NSW Statewide Incident Management System at the TMC</td>
</tr>
<tr>
<td>I/O</td>
<td>Input / Output</td>
</tr>
<tr>
<td>IPL</td>
<td>In-Pavement Lights</td>
</tr>
<tr>
<td>IRP</td>
<td>Incident Response Plan</td>
</tr>
<tr>
<td>ISLUS</td>
<td>Integrated Speed and Lane Use Signs</td>
</tr>
<tr>
<td>ITC</td>
<td>Inspection and Test Checklists</td>
</tr>
<tr>
<td>ITP</td>
<td>Inspection and Test Plan</td>
</tr>
<tr>
<td>ITR</td>
<td>Inspection and Test Requirements</td>
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<tr>
<td>ITS</td>
<td>Intelligent Transport System</td>
</tr>
<tr>
<td>LAN</td>
<td>Local Area Network</td>
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<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
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<tr>
<td>METS</td>
<td>Motorist Emergency Telephones System</td>
</tr>
<tr>
<td>MMC</td>
<td>Motorway Management Centre</td>
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</table>
Motorway Systems Overview and General Requirements

MNCS  Motorway Network Communications System
MOT  Mean Outage Time
MoU  Memorandum of Understanding
MTBF  Mean Time Between Failures
MTTD  Mean Time To Detection
MTTR  Mean Time To Repair
NATA  National Association of Testing Authorities
NSW  New South Wales
NTP  Network Time Protocol
O&M  Operations and Maintenance
OMCS  Operations Management and Control System
OS  Operating System
PABX  Private Automatic Branch Exchange
PLC  Programmable Logic Controller
PMCS  Plant Management and Control System
RAMS  Reliability, Availability, Maintainability and Safety
RCU  Remote Control Unit
TfNSW  Transport for NSW
ROL  Road Occupancy Licence
RRB  Radio Rebroadcast
RTA  Roads and Traffic Authority (now known as TfNSW)
SAN  Storage Area Network
SAT  Site Acceptance Testing
SEMP  System Engineering Management Plan
SIT  Site Integration Testing
SWTC  Scope of Works and Technical Criteria
TfNSW  Transport for New South Wales
TIDS  Traffic Incident Detection System
TIMP  Traffic Incident Management Plan
TMC  The New South Wales Transport Management Centre at 25 Garden St, Eveleigh
TMCS  Traffic Monitoring and Control System for the Motorway
TMS  Tunnel Message Signs
TMSP  Traffic Management and Safety Plan
TMU  Traffic Monitoring Unit
UPS  Uninterruptible Power Supply
2 OMCS OVERVIEW

(a) The OMCS must support safe, effective operations and management of the Motorway to achieve the following key benefits:

(i) Improving safety for all occupants on the Motorway;
(ii) Mitigating the effects of incidents on the Motorway including the approach roads and ramps;
(iii) Safeguarding the Motorway from damage;
(iv) Improving the efficiency and productivity of the Motorway and greater Sydney Motorway Network; and
(v) Improving situational awareness on the Motorway and greater Sydney Motorway Network.

(b) The OMCS must function as a single integrated management platform providing real-time monitoring and control of all systems installed on the Motorway.

(c) The OMCS must provide all internal and external communication functions for the Motorway.

(d) From a system perspective, the OMCS must in real-time:

(i) Receive information from motorway systems including field devices (Inputs);
(ii) Analyse this information through algorithms and control logic (Processing); and
(iii) Determine an appropriate response in the form of actions and/or plans (Outputs).

<table>
<thead>
<tr>
<th>OMCS</th>
<th>INPUT</th>
<th>PROCESS</th>
<th>OUTPUT</th>
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<tbody>
<tr>
<td>AUTOMATIC DETECTION</td>
<td>e.g. Traffic loops, AVID</td>
<td>ANALYSE</td>
<td>RESPONSE</td>
</tr>
<tr>
<td>MANUAL DETECTION</td>
<td>e.g. CCTV, METS, Police reports</td>
<td>Algorithms</td>
<td>Local Plans</td>
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<tr>
<td></td>
<td></td>
<td>Control Logic</td>
<td>Tactical Plans</td>
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<td></td>
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<td></td>
<td>Strategic Plans</td>
</tr>
</tbody>
</table>

**Figure TS901.1 - OMCS System Process**

(e) The OMCS must be operated from the Motorway Management Centre (MMC).

(f) The OMCS must be capable of being operated from the Disaster Recovery Site (DRS) without degradation to performance or function.
The OMCS functions must be controllable through an integrated Graphical User Interface (GUI), which provides to the Operators:

(i) An accurate and clear representation of the Motorway layout including approaches/exits;
(ii) Real-time information to monitor all Motorway systems;
(iii) Notifications/alerts on events and incidents on the Motorway;
(iv) Quick and easy access to control Motorway systems;
(v) Quick and easy access to implement Traffic Incident Management Plans (pre-determined sequences that automatically control one or more Motorway Systems);
(vi) An Incident Management System to manage all aspects of the incidents; and
(vii) A Centre to Centre (C2C) interface to allow sharing of data and communications with the TMC and other external motorways.

The OMCS must include the following:

(i) Incident Management System (IMS);
(ii) Traffic Management and Control System (TMCS) and associated sub-systems;
(iii) Plant Management and Control System (PMCS) and associated sub-systems;
(iv) Motorway Network Communications System (MNCS) supporting infrastructure; and
(v) Electrical Power Supply and Distribution (EPSD) supporting infrastructure.

Figure 2 illustrates the OMCS conceptually and interfacing sub-systems.

The TMCS provides control and monitoring of traffic management related sub-systems. These must include, but not be limited to:

(i) Traffic Surveillance and Monitoring: CCTV, automatic traffic incident detection, vehicle detection etc;
(ii) Traffic Management: integrated speed limit & lane use signs, ramp metering, moveable medians, closure barriers etc;
(iii) Driver Advisory and Traveller Information: variable message signs, tunnel message signs, changeable message signs etc;
(iv) Communication: radio rebroadcast break-in, public address, METS, radio services such as O&M radio, NSW Government Radio Network (GRN), Police UHF etc.

The PMCS provides control and monitoring of plant systems required on the Motorway. These must include, but not be limited to:

(i) Tunnel ventilation and air quality control systems;
(ii) Drainage control systems;
(iii) Fire detection and suppression systems;
(iv) Electrical systems;
(v) Lighting systems; and
(vi) Sound Systems and Intercom Systems for Emergency Purposes.
The Tolling System is distinct from the OMCS and must be kept separated from the OMCS. The Tolling System roadside devices may share the communications (MNCS) and electrical power supply and distribution (EPSD) supporting infrastructure of OMCS. The requirement for the Tolling System is described in Specification TfNSW D&C TS916.

3 OMCS GENERAL REQUIREMENTS AND SYSTEM ARCHITECTURE

3.1 OMCS GENERAL REQUIREMENTS

(a) The OMCS must include:

(i) a Traffic Management and Control System (TMCS) to monitor and control traffic movements through the Motorway, including the approach local roads and ramps;

(ii) a Plant Management and Control System (PMCS) to monitor and control plant equipment in on the Motorway;

(iii) an Incident Management System (IMS) to manage incidents on the motorway safely and to minimise their impact, as well as reducing the possibility of secondary incidents on the Motorway;

(iv) supporting infrastructure, including a Motorway Network Communications System (MNCS) and EPSD.

(b) The OMCS must integrate the TMCS, PMCS and IMS into a single management platform that provides the following functionality for the Motorway:

(i) Video Surveillance through CCTV;

(ii) Automatic Detection of Incidents;

(iii) Monitoring of Traffic through traffic data;
(iv) Driver advisory and traveller information;
(v) Traffic Management of Incidents including:
   - Operation and management of Traffic Incident Management Plans (TIMP);
   - On-line decision support for pre-defined and automated/dynamic TIMP;
   - Incident recording and notifications;
(vi) Voice Communication and Tunnel Re-Transmission;
(vii) Tunnel Ventilation and Air Quality;
(viii) Fire Detection and Suppression;
(ix) Electrical/Power Management;
(x) Motorway Lighting;
(xi) Drainage Control;
(xii) Sound Systems and Intercom Systems;
(xiii) Reporting and Historical Data Recording;
(xiv) Alarms and Notifications; and
(xv) Centre to Centre (C2C) Interface functions.

(c) The OMCS must achieve specified availability (“up-time”) requirements.
(d) The OMCS must be able to safely continue operations in the event of component failure.

OMCS functionality and performance may gracefully be degraded to the extent of the component failure relative to the OMCS.
(e) The OMCS must incorporate fail-safe mechanisms to prevent harm/injury to personnel and damage to equipment.
(f) The OMCS design must incorporate several layers of redundancy including:
   (i) Software;
   (ii) Hardware;
   (iii) Communications; and
   (iv) Power supplies.

(g) The OMCS must be designed to allow for Smart Motorway operations in accordance with TfNSW Smart Motorway Design Guidelines.

3.2 OMCS SYSTEM ARCHITECTURE PRINCIPLES

(a) The OMCS must adhere to the following design and architecture principles:
   (i) Include systems that, for the long term, can be supported, maintained and enhanced by TfNSW. The systems must be modular, upgradeable and scalable over their foreseeable life and with minimal impact to the live systems.
   (ii) Include a scalable hardware platform to accommodate future changes, ensuring hardware can be supported and upgraded for the life of the system.
(iii) A system architecture/platform that provides redundancy of hardware, software, communications and power.

Note: As guidance, this may be achieved by, but not be limited to, one or more of the following:

(A) A virtualised environment in which software including operating systems can run with the appearance of full access to the underlying system hardware. Virtualised software applications are isolated from each other (preventing cascading software failures) and operate on a virtualised environment operating on a fault-tolerant hardware platform.

(B) A distributed control system architecture where control elements are distributed throughout the system for redundancy.

(C) A centralised control system architecture where the central controller(s)/server(s) has active standby/backup equipment with automatic failover functionality for redundancy.

(iv) Include a software platform where the software source code is a deliverable to be available without limitation to the Contractor, e.g. under software escrow agreements. This will ensure that the Contractor can support and upgrade the software for the life of the system;

(v) Include modern and proven systems developed in strict compliance to Systems Engineering methodologies and based on non-proprietary open standards and protocols (e.g. NTCIP, ISO, Modbus) that can be interfaced and integrated with other vendors plant and traffic management systems;

(vi) Include software applications which have functionality and performance that are tested against requirements with the focus on comprehensive and iterative testing regime with detailed test plans and schedules and appropriate resourcing;

(vii) Have standardisation of IT systems (e.g. servers, workstations, operating systems) across the various OMCS sub-systems where possible;

(viii) Have highest levels of mission critical reliability and security with the latest software technology such as Continuous Availability utilising Disaster Recovery Site (DRS) and distributed computing;

(ix) Include considerations of Safety in Design. Life safety (including injury, minor or severe and health) is a critical factor in motorway operations, thus the systems must be designed, fabricated, installed and tested/verified to a level where the probability of failure in the systems was to be driven to a very low and tolerable probability. The design processes in the E/E/EPS systems must account for the expected failure modes and failure rates of all components comprising the total system (AS 61508). The formal safety case evaluation processes with independent experts (and industry representatives) which would arrive at the point in the process where SIL levels are allocated for the Contractor to apply;

(x) Include components that are available from multiple sources with long term local support;

(xi) RAMS (Reliability, Availability, Maintainability and Safety) analysis must be undertaken by the Contractor for all control function elements, not just those with a Fire Life safety factor. This is intended to drive selection of high MTBF rated product. Certified MTBF and MTTR figures must be used in RAMS analysis and demonstrated to Independent Certifier;
(xii) Include equipment that is suitable for tunnel and industrial control room environments, or roadside cabinet mounted locations. Wherever possible compliance with AS or international standards must be specified to ensure consideration of factors such as:

(A) temperature rating, without dependent forced fan cooling for the full range of temperatures to be experienced in the enclosure;

(B) the effect of hydrocarbon soot on all equipment where it is subject to roadside or near roadside locations; and

(C) the effect of dust build up on the equipment and how maintenance routines must deal with it.

(xiii) OMCS must be developed using a Failure Modes, Effects and Criticality Analysis (FMECA) analysis that identified the critical items and Single Points of failure (SPOF), which would cause general widespread failure in the OMCS if any of these equipment elements failed to operate. The failure analysis must be conducted by the Contractor prior to the finalisation of the OMCS detailed design and must form part of the Design Documentation.

(xiv) Include fault-tolerance considerations in the OMCS design such that OMCS is able to continue safe operations in the event of a component failure. The intention is to ensure that any component failure is able to be isolated and prevent cascading failure onto other areas of OMCS.

(xv) Include fail-safe mechanisms in the OMCS design under the following conditions:

(A) Operator action (i.e. to prevent inadvertent or incorrect operator action);

(B) Failure of a component;

(C) Loss of power;

(D) Loss of communications.

3.3 PROVEN IMPLEMENTATION

(a) The OMCS system software must be a proven developed product deployed in similar applications with not less than two established and operational sites. Evidence and references must be made available. Obtain from vendors off-line versions of monitoring and command screens and demonstration of GIS Map based displays and contextual features of command, control and monitoring.

(b) The Contractor must obtain from the OMCS vendors the following information in respect of the software materials from server to firmware in embedded controllers in their supply:

(i) the corporate policies adopted and certified for the development of software;

(ii) the configuration management and change management processes used;

(iii) the software architecture and structure and the dependence on third party software products and associated licensing arrangements;

(iv) what computer-aided software engineering (CASE) tools, if any, are used, or how software manuals are maintained and how CASE tools build on the software documentation are available;

(v) proposed post implementation support services, assuming secure on-line access to Simulation and Development servers is provided to the Vendor software specialists;
(vi) assessment reports of performance and reliability of selected IT industry standard products, such as Operating System (OS), Relational Database Management Systems (RDBMS), data storage area networks (SAN), etc.

4 **MOTORWAY SYSTEMS SPECIFICATION SUITE**

(a) The Motorway Systems specification suite contains requirements and specifications that determine the operational performance and management of the systems and devices necessary to operate the Motorways and road tunnel infrastructure in NSW.

(b) The Motorway Systems specification document suite is organised hierarchically into 3 levels as illustrated in Figure 3.

(c) The hierarchical structure allows the functional and performance requirements of the Motorway Systems to be defined at the appropriate level.

(d) The specifications for the OMCS sub-systems such as TMCS and PMCS are located at Level 2.

(e) Device specifications, performance indicators and other relevant project documents are located at Level 3.

![Figure TS901.3 – Motorway Systems Specification Suite](image)
4.1 **LEVEL 1 – MOTORWAY SYSTEMS OVERVIEW AND GENERAL REQUIREMENTS (TfNSW D&C TS901)**

(a) This document gives an overview of Motorway Systems, including the OMCS and its components and associated general requirements.

(b) This document also describes the Motorway Systems specification document suite, its structure and relationship between the specifications.

(c) TfNSW D&C TS901 also outlines the documentation requirements that need to be provided by the Contractor at various stages of the Motorway Systems design, testing and commissioning.

4.2 **LEVEL 2 – PRINCIPAL, ENABLING AND PROCESS SPECIFICATIONS**

(a) Level 2 specifications describe the functional, operational and performance requirements of different Motorway Systems.

(b) The Level 2 specifications will reference appropriate device specifications found in Level 3. It is important to note that a specific individual Level 3 technical specification can be referenced by a number of Level 2 specifications.

(c) Based on the project, Level 2 specifications can be used in unison or on individual basis if there are pre-existing Motorway Systems already present.

(d) The Level 2 Specifications can be classified as either Enabling, Principal or Process Specifications.

(e) The Enabling Level 2 specifications describe the supporting electrical and communications infrastructure necessary to make possible the functions of other Motorway Systems. The two Enabling Level 2 specifications are:

(i) Electrical Power Supply and Distribution System (EPSD) (TfNSW D&C TS914); and

(ii) Motorway Network Communications System (MNCS) (TfNSW D&C TS915).

(f) The Principal Level 2 specifications relate to different Motorway Systems that carry out a specialized group of Motorway functions. The Principal Level 2 specification documents are summarised below:

(i) MCC Requirements Specification (TNSW D&C TS911) describes the requirements of the motorway control centre and the integration of the OMCS subsystems for operations and incident management. This Specification also states the requirements for MCC building, operator equipment, Video Wall, reliability and availability requirements for the OMCS located at the MCC and Disaster Recovery Site (DRS).

(ii) Traffic Management and Control System (TMCS) Specification (TfNSW D&C TS912) describes the requirements for various traffic management, incident detection and management systems. The requirements focus on the road side devices and also the performance of integrated control of multiple devices types from the MMC.

(iii) Plant Management and Control System (PMCS) Specification (TfNSW D&C TS913) details the requirements for the mechanical, ventilation, fire detection and suppression, safety and air quality monitoring equipment in the Tunnel. The PMCS requirements are only specified for Tunnels or for Motorways with Tunnels.

(iv) Centre to Centre (C2C) Specification (TfNSW D&C TS917) defines the interface between the OMCS located at the MCC and the NSW Transport Management Centre.
(TfNSW) allowing exchanges of information and control facilities. The C2C interface also enables the other complying or adjoining Motorway Control Centers at different motorways to exchange information.

(v) Electronic Toll Collection (ETC) Specification (TfNSW D&C TS916) is a stand-alone specification that defines the requirements specific for tolling operations. The ETC system is the only sub-system that is not integrated into the OMCS and is operated as a separate system from the OMCS. It is, however, possible for the ETC sub-system to utilize the enabling EPSD and MNCS infrastructure of the OMCS.

(vi) Road Tunnel and Underpass Lighting (RTUL) Specification (TfNSW D&C TS918) defines the requirements for lighting on the Motorway. The RTUL System must be integrated with the PMCS for monitoring and control.

(g) The Process Level 2 specifications relate to engineering processes used to support the delivery of Motorway Systems. The Process Level 2 specification documents are summarised below:

(i) Systems Engineering Process Specification (TfNSW D&C TS902) describes the requirements for systems engineering, including the processes covering technical management, technical and speciality disciplines. Tailoring provisions are also included to provide guidance on the implementation of the systems engineering requirements.


(h) The Level 2 Principal, Enabling and Process Specifications are further elaborated with the related documents below.

4.2.1 Motorway Control Centre (MCC) Specification TfNSW D&C TS911

(a) The MCC is the location where the day-to-day coordination and management of the Motorway takes place and it is the primary reason why the OMCS is implemented and utilised at the MCC.

(b) The OMCS at the MCC actions incoming and outgoing data requests from the TMC or surrounding Motorways through the C2C interface. Coordinated emergency response and overall Motorway operations are also handled within the MCC. The MCC is central to the operations of the Motorway and therefore the OMCS configuration at MCC must be High Availability and Fault-Tolerant (HA/FT).

(c) MCC Specification TfNSW D&C TS911 details the functional requirements for the MCC, including:

(i) MCC requirements;

(ii) Disaster Recovery Site requirements;

(iii) OMCS software requirements;

(iv) OMCS hardware requirements;

(v) Backup OMCS requirements;

(vi) Trainer/Simulator OMCS requirements;

(vii) Disaster Recovery OMCS requirements;

(viii) Asset Management Information System and OMCS integration requirements;

(ix) Incident Management System requirements;
(x) Fault Management System requirements;
(xi) Reporting requirements;
(xii) Communications to TfNSW TMC requirements including C2C Interface;
(xiii) Installation, Testing and Commissioning requirements for the OMCS.

4.2.2 Traffic Management and Control System (TMCS) Specification TfNSW D&C TS912

(a) TMCS Specification TfNSW D&C TS912 contains the functionality to safely and efficiently manage traffic on the motorway including:

(i) Traffic surveillance and monitoring:
   • Vehicle detection/traffic monitoring;
   • Automatic traffic incident detection;
   • CCTV;

(ii) Traffic management:
   • Variable speed and lane control;
   • Ramp management and control;
   • Queue management;
   • Over height detection and response;
   • Motorway closure;
   • Dangerous goods carrying vehicles and smokey vehicles;

(iii) Dynamic advisory signs and traveller information:
   • Variable message signs;
   • Tunnel message signs;
   • Travel time;

(iv) Voice communication and tunnel re-transmission;

(v) Interfaces to TfNSW and TfNSW TMC.

(b) Integration of the TMCS with the PMCS system is through the OMCS and defined within the MCC Specification.

(c) The TMCS specification will make reference to a number of Level 3 technical specifications, detailing sub-systems and devices, along with requirements for operating and maintaining the system.

4.2.3 Plant Management and Control System (PMCS) Specification TfNSW D&C TS913

(a) PMCS Specification TfNSW D&C TS913 includes the main functional, interface and integration requirements of the PMCS sub-systems, namely:

(i) Tunnel ventilation and air quality control systems;
(ii) Drainage control systems;
(iii) Fire detection and suppression systems;
(iv) Electrical systems;
(v) Lighting systems;
(vi) Sound systems and intercom systems for emergency purposes.

(b) Integration of the PMCS with the TMCS system is through the OMCS and defined within the MCC Specification.

(c) The PMCS Specification will make reference to a number of Australian Standards and lower level TfNSW technical specifications along with requirements for operation and maintenance of the system.

### 4.2.4 Electrical Power Supply and Distribution (EPSD) System Specification TfNSW D&C TS914

(a) EPSD System Specification TfNSW D&C TS914 covers all aspects of power supply, distribution and protection of the OMCS and its systems. The specification focuses on:

(i) High Voltage (HV) and Low Voltage (LV);
(ii) Uninterruptible Power Supply (UPS) requirements.

### 4.2.5 Motorway Network Communications System (MNCS) Specification TfNSW D&C TS915

(a) MNCS Specification TfNSW D&C TS915 covers the aspects of data and systems security, communications protocols and network architecture requirements of the OMCS and its systems. The specification mainly identifies requirements for the following:

(i) Network architecture;
(ii) Infrastructure;
(iii) Cableways;
(iv) Fibre Optic Cabling;
(v) Equipment Housings;
(vi) TfNSW Traffic Data Network.

### 4.2.6 Electronic Toll Collection (ETC) Specification TfNSW D&C TS916

(a) Specification TfNSW D&C TS916 covers the tolling functionality of road user charging, focusing on:

(i) Vehicle detection and classification;
(ii) Electronic toll collection;
(iii) Toll Violation enforcement;
(iv) Interoperability between Australian toll road operators Motorway/tunnel fibre network architecture and requirements.

### 4.2.7 Centre to Centre (C2C) Interface Specification TfNSW D&C TS917

(a) The C2C Interface Specification TfNSW D&C TS917 details the requirements to implement a data communications interface between the Motorway OMCS and other TfNSW systems located at TMC TfNSW. This interface connection allows for interoperability between the two centres.
Motorway Systems Overview and General Requirements

(b) The C2C interface enables exchange of information between the OMCS and other TfNSW systems for common purpose of effective management of traffic incidents and operations.

c) The interface also allows system components from the two systems to communicate with each other based on NTCIP standards.

d) The MMC focuses on its local road users and resources whereas the TMC and TfNSW maintain a global perspective on the entire NSW road network. This interface provides the means for the TMC, TfNSW and the MMC to coordinate to ensure safe, reliable, and efficient travel.

e) The C2C interface also enables Motorways to communicate and exchange traffic and incident data with other adjacent motorways.

(f) C2C Specification TfNSW D&C TS917 covers the interface between the two operational systems and is designed to exchange information on:

(i) Network Traffic Management;

(ii) Traveller Information;

(iii) Incident and Emergency Management.

(g) The C2C interface excludes CCTV systems interfaces, Plant management, Tolling or financial data.

4.2.8 Road Tunnel and Underpass Lighting (RTUL) Specification TfNSW D&C TS918

(a) This Specification sets out the requirements of the design, supply, installation, commissioning and spare part provision for Road Tunnel and Underpass Lighting (RTUL) to provide safe conditions for the full range of operational requirements including emergencies.

(b) RTUL Specification TfNSW D&C TS918 covers the requirements for:

(i) Materials;

(ii) Design;

(iii) Luminaire Technical;

(iv) Luminaire Installation;

(v) Lighting Photometer Control System;

(vi) Inspection and Testing;

(vii) Commissioning;

(viii) Spare Parts;

(ix) Underpass Lighting;

(x) Power Requirements.

4.2.9 Systems Engineering Processes Specification TfNSW D&C TS902

(a) The Systems Engineering Processes Specification TfNSW D&C TS902 describes the Systems Engineering process for OMCS system development and the complete system life cycle, including relationship of activities at each stage.
(b) TfNSW D&C TS902 details the Systems Engineering and Project Management processes required to design and develop the OMCS and its sub systems, including:

   (i)  Documentation;
   (ii) System Integration;
   (iii) Testing/Verification and Validation;
   (iv)  Training.

(c) The Systems Engineering management process must also be in accordance with the following standards:

   (i)  ISO/IEC 26702 (ex IEEE 1220), Systems engineering – Application and management of the systems engineering process;
   (ii)  AS (ISO) 15288, Software engineering – System life cycle processes.

4.2.10  Asset Life Cycle Management Specification TfNSW D&C TS903

(a) The asset maintenance and lifecycle guidelines and procedure for Motorway Systems are outlined in Specification TfNSW D&C TS903.

(b) TfNSW D&C TS903 details the maintenance procedures and asset life cycle management processes. These processes and procedural requirements may be subject to changes or restructuring based on the type of deed arrangements and responsibilities for asset management.

(c) The specification also provides an overview of the different types of maintenance for the effective management of motorway and tunnel assets.

(d) The Asset Management System is also an important component to ensure that assets are maintained with a comprehensive and structured approach that is based on data evidence. Asset Management System requirements are specified in MCC Specification TfNSW D&C TS911.

4.3  LEVEL 3 - DEVICE SPECIFICATIONS AND TECHNICAL DOCUMENTS

(a) Level 3 Specifications and Technical Documents include technical and performance requirements for devices that belong to the sub-systems of TMCS and PMCS as referenced in Level 2 Specifications.

(b) There are also several project and process procedures to ensure successful design and commissioning of OMCS for Motorway projects.

(c) An important aspect of the Level 3 documents is that they are subject to change due to advances in technology and releases of new innovative products into the marketplace. It is expected that existing specifications may be modified and additional specifications would be added as technology progresses, lessons learned from completed projects, updates from standards and regulations.

(d) Level 3 Specifications may also cover areas where TfNSW defines a specific technical solution.

(e) Level 3 Specifications and Technical Documents will contain documentation grouped into five sections. These sections are briefly described below.
4.3.1 Technical Specifications and Standards

(a) This contains the normative technical and performance specifications covering the sub-systems and devices that implement the functionality required in the Principal Specifications. A number of documents currently exist covering a number of sub-systems and device Specifications for the TMCS. Examples are:

(i) TfNSW TSI-SP-008 - General Requirements for the Variable Message Signs (VMS);
(ii) TfNSW TSI-SP-012 - General Requirements for Roadside Equipment Housings.

(b) The Technical Specification and Standards are very specific and contain the technical requirement for component and device level details.

4.3.2 Performance Indicators and Design Life Requirements

(a) The documents in this area contain guidelines on the performance and design life requirements of hardware product systems or technologies.

(b) The main focus of documents from this section is to provide measures of system delivery, which are required to be met, for project managers and operations managers of Motorway Systems.

4.3.3 Advice and Best Practice Notes

(a) These documents do not contain requirements. It is expected that any Advice and Best Practice Notes or Technical Notes will be considered and applied where appropriate.

(b) Advice and Best Practice Notes contain information on previous projects where similar technology or processes were used and examples of best practice use, whether these are available within the TfNSW, in Australia or internationally. These could relate to design, construction, maintenance or operational control. For example, consideration of an Asset Management System that complies with ISO 55001, Asset Management – Management Systems – Requirements.

5 DOCUMENTATION REQUIREMENTS

5.1 STAGED REQUIREMENTS FOR DOCUMENTATION

All the documentation identified in this section must be submitted to TfNSW for review by the Contractor.

5.1.1 Systems Engineering Management Plan (SEMP)

The Systems Engineering Management Plan (SEMP) and the systems engineering process must be produced in accordance with ISO/IEC 26702.

5.1.2 System Requirements Specification

A System Requirements Specification (SRS) must be produced that includes information on all:

(a) Motorway Systems and all subsystems software requirements;
(b) Motorway Systems and all subsystems hardware requirements; and
Motorway Systems and all subsystems interface requirements to external systems.

5.1.3 Phase 1 Development of Design Documentation

The Design Documentation at Phase 1 of the design development must include the following details and information, in the form of Design Documentation drawings and written documentation:

(a) Motorway Systems block diagrams;
(b) Motorway Systems cableway and other signalling cableway route designs;
(c) Motorway Systems data communication network design diagrams;
(d) Motorway Systems data communications description, including the TMC interface;
(e) Motorway Systems component breakdown descriptions;
(f) Motorway Systems overview and top level descriptions of the IMS;
(g) Motorway Systems structure of workstation control philosophy;
(h) Motorway Systems computer system software architecture and description;
(i) Motorway Systems description of Incident Management System;
(j) Motorway Systems CCTV description, including interface with the TMC;
(k) Motorway Systems display conventions including:
   (i) graphical symbol conventions;
   (ii) colour conventions;
   (iii) text conventions;
   (iv) controls conventions; and
   (v) menu structure.

5.1.4 Phase 2 Development of Design Documentation

The Design Documentation at Phase 2 of the design development must be produced prior to the actual construction or manufacture of the Motorway Systems components and must specify the functional and performance hardware and software characteristics of the Motorway systems and sub-systems.

For the computer system, the Phase 2 Design Documentation must include:

(a) functional specification;
(b) operator interface (workstation GUI);
(c) data tables for the database(s);
(d) Management Information Base (MIB) for Motorway devices.
5.1.5 Equipment Documentation

Equipment documentation for the traffic management system must be provided in full prior to its manufacture or construction. Equipment documentation must include the following:

(i) data sheets of proprietary equipment;
(ii) description of operation;
(iii) descriptive drawings;
(iv) existing technical manuals; and
(v) performance specifications.

These documents must be submitted to TfNSW as part of the Phase 2 Design Documentation:

(a) Statement verifying compliance with Specifications TfNSW TSI-SP-012 (Roadside Housings) and TfNSW TSI-SP-016 (General Requirements for Roadside Electronic Equipment).

(b) In addition, detailed specifications analysis for the equipment cabinets in control rooms and electrical substations, not just the roadside, that are not addressed by TfNSW TSI-SP-012 and TfNSW TSI-SP-016. This analysis must include cabinet arrangements, wiring standards and documentation of wiring diagrams, termination arrangements and cable schedules.

(c) Review of cabinet general arrangement during the design phase must be undertaken to ensure faults cannot arise due to the location of adjacent equipment and maintainability is addressed to ensure MTTR values are minimised.

(d) Specifications which must fully address the lower order class of equipment accompanying the prime items. These items include:
   (i) low voltage power supplies;
   (ii) communications devices;
   (iii) general auxiliary equipment;
   (iv) individual electrical components.

(e) Installation specifications which must ensure:
   (i) wiring is run in ducting and marshalled in a manner which supports maintainability and identification, with all wires numbered;
   (ii) terminations of wiring in terminals are completed as per TfNSW field specifications and are identifiable and easily located. Terminations of more than two wires to a terminal are prohibited. At all times, wiring and cabling strain must be eliminated for levels of cabling and wiring congestion at every termination;
the general arrangement of equipment cabinets must allow accessibility of all components and wiring;

there are no means of contamination of electrical and electronic equipment.

5.1.6 Test Plan

A test plan conforming to the requirements of AS 4006 must be prepared by the Contractor. The test plan must detail the overall test strategy for verifying and validating the Motorway Systems.

5.1.7 Test Specifications

Test specifications must be produced that conform to the requirements of AS 4006 and must be submitted to TfNSW and the Independent Certifier no later than 40 days prior to actual testing of the Motorway Systems or any of its sub-components.

TfNSW must be given access to any testing of the Motorway Systems or their sub-components.

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<tr>
<td>Process Held: Testing Stage.</td>
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<tr>
<td>Submission Details: Submission of the items specified in Clauses 5.1.4 to 5.1.6, including Equipment Documentation, Test Plans and Specifications.</td>
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<td>Release of Hold Point: The Nominated Authority will consider the submitted documents prior to authorising the release of the Hold Point.</td>
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5.1.8 Work-As-Executed Documentation

Submit the following work-as-executed documentation for the Motorway Systems:

(a) finalised design phase documentation;
(b) all equipment documentation;
(c) work-as-executed cableway drawings;
(d) cable schedules for the Motorway Systems;
(e) final test specifications with results and dispositions of nonconformities.

Submit also Operations and Maintenance (O&M) Manuals.

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<td>Process Held: Commissioning Stage.</td>
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<td>Submission Details: Submission of the items specified in Clause 5.1.7, Work-As-Executed documentation relating to Motorway Systems and related sub-systems, and O&amp;M Manuals.</td>
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<td>Release of Hold Point: The Nominated Authority will consider the submitted documents prior to authorising the release of the Hold Point.</td>
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ANNEXURES TS901/A TO TS901/B – (NOT USED)

ANNEXURE TS901/C – SCHEDULE OF HOLD POINTS

Refer to Clause 1.3.3.

C1 SCHEDULE OF HOLD POINTS

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<td>Testing Stage</td>
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<td>Commissioning Stage</td>
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ANNEXURES TS901/D TO TS901/L – (NOT USED)
ANNEXURE TS901/M – REFERENCED DOCUMENTS

Refer to Clause 1.3.6.

TfNSW Specifications

TfNSW D&C Q6 Quality Management System (Type 6)
TfNSW D&C TS902 Systems Engineering Processes
TfNSW D&C TS903 Asset Life Cycle Management
TfNSW D&C TS911 Motorway Systems - Motorway Control Centre
TfNSW D&C TS912 Motorway Systems - Traffic Management and Control System
TfNSW D&C TS913 Motorway Systems - Plant Management and Control System
TfNSW D&C TS914 Motorway Systems - Electrical Power Supply and Distribution System
TfNSW D&C TS915 Motorway Systems - Motorway Network Communications System
TfNSW D&C TS916 Motorway Systems - Electronic Toll Collection System
TfNSW D&C TS917 Motorway Systems - C2C Interface for Motorways
TfNSW D&C TS918 Motorway Systems - Road Tunnel and Underpass Lighting
TfNSW TSI-SP-008 General Requirements for the Variable Message Signs (VMS)
TfNSW TSI-SP-012 General Requirements for Roadside Equipment Housing
TfNSW TSI-SP-016 General Requirements for Roadside Electronic Equipment

TfNSW Smart Motorway Design Guidelines

TfNSW Smart Motorway Guidelines
TfNSW Smart Motorway Supplement for Traveller Information
TfNSW Smart Motorway Supplement for Ramp Signals
TfNSW Smart Motorway Supplement for LUMS including VSL
TfNSW Smart Motorway Design Guide Capacity and Flow Analysis
TfNSW Smart Motorway Design Guide Tunnel Traffic Management
TfNSW Smart Motorway Design Guide Traffic Monitoring and Surveillance
TfNSW Smart Motorway Design Guide Vehicle Detectors

Australian Standards

AS 4006 Software Test Documentation
AS/ISO 15288 Software engineering – System life cycle processes
ISO 55001 Asset management – Management systems - Requirements
AS 61508 Functional Safety of electrical/electronic/programmable electronic safety related systems
ISO/IEC 26702 Systems Engineering – application and management of the systems engineering process
### International Standards and References

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