DELIVERING FOR QUEENSLAND

Technical Specification

Transport and Main Roads Specifications MRTS208 Roadway Ancillary ITS Infrastructure Monitoring and Control

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Queensland Government

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1 Introduction

This Technical Specification defines the design, supply, installation, testing, commissioning, performance, documentation, training and maintenance requirements for roadway ancillary ITS infrastructure monitoring and control systems.

The scope of this Technical Specification is limited to the monitoring and control of ancillary ITS infrastructure using the Principal's traffic management system (STREAMS) through the simple device interface.

An ancillary ITS infrastructure monitoring and control system is a hardware and software system. These systems shall have Programmable Logic Controllers (PLC) or Input Output (I / O) devices to integrate sensors and actuators. These systems shall also have a communication interface to communicate with STREAMS.

This Technical Specification shall be read with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements*, MRTS201 *General Equipment Requirements* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

2 Definition of terms

The terms defined in Clause 2 of MRTS01 *Introduction to Technical Specifications* apply to this Technical Specification. Additional terminology relevant to this Technical Specification is defined in Table 2 below.

Table 2 – Definition of terms

Term	Definition
AC	Alternating Current
DC	Direct Current
DNP3	Distributed Network Protocol
HMI	Human Machine Interface
I/O	Input/Output
IPxx	Ingress Protection (IP) rating to degree "xx" as defined in AS 60529 *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989 (ED. 2.2) MOD)*
ITS	Intelligent Transport Systems
LCD	Liquid Crystal Display
LED	Light Emitting Diode

Term	Definition
PLC	Programmable Logic Controller
Principal	The State of Queensland acting through the Department of Transport and Main Roads
RPEQ	Registered Professional Engineer Queensland
RTU	Remote Terminal Unit
Standard Modbus	Industrial communication protocol developed by Modicon / Schneider Electric
STREAMS	Principals traffic management system
TCP	Transmission Control Protocol
UPS	Uninterrupted Power Supply

3 Referenced documents

The following technical documents are referenced in Table 3 of this Technical Specification. Where there are inconsistencies between this document and the referenced document, this Technical Specification shall take precedent.

Table 3 – Referenced documents

Reference	Title
AS IEC 61131.2.2014	*Programmable controllers Part 2: Equipment requirements and tests*
AS/NZS 3000	*Wiring Rules*
AS/NZS 3100	*Approval and test specification – General requirements for electrical equipment*
MRTS01	*Introduction to Technical Specifications*
MRTS50	*Specific Quality System Requirements*
MRTS91	*Conduits and Pits*
MRTS201	*General Equipment Requirements*
MRTS233	*Roadway Flood Monitoring Systems*
MRTS234	*Communications Cables*
MRTS245	*ITS Telecommunications Network (ITS TN)*

4 Quality system requirements

4.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications*.

The quality system requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

Additionally, the Hold Points, Witness Points and Milestones applicable to this Technical Specification are defined in Table 4.1. There are no Witness Points and Milestones defined.

Table 4.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
11	1. Certified electrical wiring diagram		
13	2. Inspection of the installation		
14	3. Testing and commissioning		
15	4. Documentation		

5 Functional requirements

Roadway ancillary ITS infrastructure monitoring and control systems shall be able to monitor and control the connected devices as programmed. It shall actively monitor and report back the status to the Principal's traffic management centre through the Principal's traffic management system (STREAMS).

The monitoring and control system shall be compatible with the STREAMS simple device interface that supports Standard Modbus TCP and Standard Modbus RTU protocols.

6 Operational requirements

Monitoring and control systems shall be capable of integrating to:

a) pump station

b) heavy vehicle inspection, and

c) other roadway ancillary ITS infrastructure as required under the Contract.

In addition to the requirements of this Technical Specification, the operational requirements specified in MRTS201 *General Equipment Requirements* applies.

If the IP rating of the system supplied is less than IP65, an enclosure rated to IP65 shall be supplied for the installation of the monitoring and control system. Unless otherwise specified, the installation of the system shall be inside an existing enclosure.

If the system is part of a safety critical system, it shall comply with AS IEC 61131.6:2014 in design and implementation.

6.1 Pump station

The pump station system shall support STREAMS for monitoring the following:

a) water level in pump well

b) current power source

c) pump running status

d) current status of the UPS, and

e) any other sensors as specified in the contract.

The pump station system shall raise alarms for:

a) pump failure

b) water level high, and

c) any other alarms as specified in the contract.

6.2 Heavy vehicle inspection site

The heavy vehicle inspection site system shall support STREAMS for monitoring and control, activating the relevant signs for directing the heavy vehicles to enter an inspection site. The system will normally operate by a select switch located at the inspection hut.

a) system shall have a response time of less than 50 ms for signs to respond for the select switch position.

b) system shall report back to STREAMS the following:

   i. current position of the select switch

   ii. reported status of the relevant signs of the system, and

   iii. operation status of the signs.

c) select switch and signs shall be interact directly for the operation of the system and only reported the status to STREAMS

d) system shall have one or more Changeable Message Signs and one or more static signs with conspicuity devices, and

e) A PLC or Digital Input Output device as per Clause 8 shall be used to provide the monitoring and control functionality to the site.

7 Uninterrupted Power Supply (UPS)

Where provisioned, the Uninterrupted Power Supply (UPS) shall be in accordance with MRTS213 *UPS for Roadside Devices*. The PLC and all associated control and communications equipment must be supplied from the UPS. In addition to the minimum UPS alarms defined in MRTS213 *UPS for Roadside Devices*, the following shall be also preprogrammed into the PLC for monitoring in STREAMS simple device interface:

a) UPS in bypass, and

b) battery compartment temperature.

8 Programmable Logic Controllers

8.1 General

The operational requirements defined in MRTS201 *General Equipment Requirements* apply to the PLC. Additional equipment requirements are described below. PLCs shall:

a) EMC (Electromagnetic Compatibility) of the PLCs supplied shall be suitable for installation in location in zone B as per AS IEC 61131.2:2014

b) support ethernet 10/100 to 10/100/1000 Base-T port, RJ-45 connector

c) support RS232 / 485 communication channels

d) support IPv4

e) support Modbus TCP and Modbus RTU communication protocols, supporting DNMP3 in addition to Modbus is preferred, and

f) have an internal memory of not less than 6 KB for user program and user data.

8.2 Digital Inputs and Outputs

a) Digital inputs and outputs shall be provided as directed by the scope of work. The digital inputs and outputs used shall not exceed 75% of the total inputs and outputs.

b) current sinking digital inputs shall have standard operating ranges as defined in AS IEC 61131.2:2014

c) all inputs shall have LED or LCD panel indication showing the present status of the relevant input

d) digital outputs of a.c and d.c shall be operating in the ranges defined in AS IEC 61131.2:2014

e) all outputs shall have LED or LCD panel indication showing the present status of the relevant output, and

f) electromechanical relay type outputs shall be capable of performing at least 0.3 million operations at rated full load.

8.3 Analogue Inputs and Outputs

a) analogue inputs and outputs shall be provided as per the contractual documents and as per the scope of work, and

b) analogue inputs and outputs shall be either voltage or current type and shall have the rated values and impedance as per the AS IEC 61131.2:2014.

8.4 Human Machine Interface (HMI)

a) where specified in the contract, the monitoring control system shall be supplied with a Human Machine Interface (HMI)

b) HMI shall have a minimum 7-inch daylight readable touchscreen

c) malfunction in HMI shall not impact the PLC operation, and

d) HMI shall provide warnings before the execution to the user whenever any changes to the online programme are done.

9 Sensors and actuators

9.1 Flood and water level sensors

Flood and water level sensors shall comply with requirements of the MRTS233 *Roadway Flood Monitoring Systems*.

9.2 Photometers

Photometers shall be provided as specified by the contract and as per the engineering design.

9.3 Temperature sensors

Temperature sensors shall be provided as specified by the contract and as per the engineering design.

10 Software and logic subsystems

For the proper operation of the monitoring and control system, it will be required to programme the provided hardware. These programmes shall be PLC ladder logic or similar, programming contents shall be provided with the system. A text version of the code with detailed comments shall be provided in PDF format.

a) programs shall be annotated as per industry standards to enable any future developments by other developers

b) programs shall be provided electronically in a format that is suitable to open in a program editor

c) if the Principal does not own a suitable programming and debugging tool for the supplied PLC, the contractor shall provide license software for editing and compiling PLC logic programs, and

d) the programming and debugging software shall be capable of operating on Windows 7 or later operating systems.

11 Electrical requirements

The electrical requirements defined in MRTS201 *General Equipment Requirements* apply to equipment provided under this Technical Specification.

All electrical cabling within the installation of control system shall comply with relevant requirements of MRTS91 *Conduits and Pits* and AS/NZS 3100 *Approval and test specification – General requirements for electrical equipment*.

The electrical equipment and associated wiring of the monitoring and control system shall comply with the requirements of the Electricity act and AS/NZS 3000 *Wiring Rules*.

Power supply and control wiring connections / disconnections shall be designed without requirement for personnel to be holder of an electrical license to perform this task. This will generally require the use of modular type connections.

An electrical wiring and connections diagram shall be provided with details specific to each installation. Diagrams shall have identifications for individual cables and terminations and shall be labelled accordingly in the field installation.

Detailed designs of the installation shall be signed by the Contractor’s RPEQ. They shall be submitted and approved by the Principal or their delegate for verification and acceptance. **Hold Point 1**

12 Telecommunication requirements

Communication provisions as part of the monitoring and control system shall comply with MRTS245 *ITS Telecommunications Network (ITS TN)* and MRTS234 *Communications Cables* for the network and physical cabling requirements.

The system shall be able to communicate with Principal's traffic management system, (STREAMS) via the serial port of the field processor or through the Ethernet port via Principal's telecommunication network.

The system shall communicate with STREAMS using Standard Modbus TCP or Standard Modbus RTU protocols to connect to generic driver in STREAMS called Simple device interface.

STREAMS simple device interface does not support the Enron Modbus communication protocol (Dec 2017).

While not mandatory, compatibility with the DNP3 protocol for supporting future upgrades of STREAMS is preferable.

13 Installation requirements

The installation requirements defined in MRTS201 *General Equipment Requirements* apply to work under this Technical Specification. Control and monitor system and associated equipment shall be installed according to the design documentation. The contractor shall allow access for inspecting the installation for the representative of the principal.

If installing cables in conduits, the conduit shall be sealed to prevent vermin entry. **Hold Point 2**

14 Testing and commissioning

The testing and commissioning requirements defined in MRTS201 *General Equipment Requirements* apply to work under this Technical Specification. In addition, test sheets shall demonstrate compliance with the technical requirements of this Technical Specification prior to the delivery of the equipment to the site.

The Contractor shall populate and submit a Standard Modbus Register Table showing the Standard Modbus register addresses of control, alarms and sensor variables to be read values by STREAMS. **Hold Point 3**

STREAMS Acceptance Test (SAT) certificate shall not be required as the simple device interface will be used to communicate with STREAMS.

15 Documentation

The documentation requirements defined in MRTS201 *General Equipment Requirements* apply to work under this Technical Specification. **Hold Point 4**

Additional documentation requirements relevant to this Technical Specification are defined below:

a) commissioning documents for the monitoring and control system, HMI, and STREAMS integration

b) text version of the code with detailed comments

c) a schematic layout of components, and interconnection diagram that includes system configuration settings such as IP address, subnet mask, gateway

d) system operating manuals

e) standard Modbus register table as per Clause 14

f) as constructed plans

g) electrical test certificate

h) recommendation for routine maintenance tasks, and

i) recommendation on spare parts holdings.

16 Training

The training requirements defined in MRTS201 *General Equipment Requirements* apply to work under this Technical Specification.

Additional training requirements relevant to this Technical Specification are defined below:

a) training shall be provided on programming and debugging the PLC used in the monitoring and control system.

17 Maintenance

The maintenance requirements defined in MRTS201 *General Equipment Requirements* apply to work under this Technical Specification.

18 Handover

The handover requirements defined in MRTS201 *General Equipment Requirements* apply to work under this Technical Specification.

Appendix A – STREAMS commissioning sheet

PLC Name		
Modbus Protocol		
Modbus RTU (Fill for Serial)		
	Field Processor	
	FP Port Number	
	Baud rate	
	Data bits	
	Parity	
	Stop bits	
	Modbus TCP (Fill for Ethernet)	
	IP Address	
	TCP Port	
Data Address		
Alarm / Value 1	Data Type	
	Alarm / Value Description	
	PLC Address	
	Region Type	
	Start Address	
	Count	
	Poll rate	
Alarm / Value 2	Data Type	
	Alarm / Value Description	
	PLC Address	
	Region Type	
	Start Address	
	Count	
	Poll rate	
Alarm / Value 3	Data Type	
	Alarm / Value Description	
	PLC Address	

PLC Name		
Modbus Protocol		
	Region Type	
	Start Address	
	Count	
	Poll rate	
Alarm / Value 4	Data Type	
	Alarm / Value Description	
	PLC Address	
	Region Type	
	Start Address	
	Count	
	Poll rate	