
TII492 Intelligent Transport Systems (ITS) - Equipment Supply and Installation Framework - Generation 2 - Lot 4

Volume A: Works Requirements

**Part 4: Testing and Commissioning
Specification**

June 26

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1. Scope

1.1 Introduction

This specification defines the requirements for documentation, staff training, testing and commissioning for all new ITS Equipment supplied and/or installed as part of the Framework Agreement Call-off, including the following documents:

- Project Execution Plan;
- Final Equipment Specifications;
- Manuals;
- Equipment operation manual;
- Maintenance and services manual;
- Fault reporting manual;
- Equipment hardware manual;
- Equipment software manual;
- Testing Documentation:
- Testing Specification;
- Testing Results;
- As-Built Information;
- Training;
- General Testing Requirements;
- Electrical Testing;
- Communication Testing;
- Factory Acceptance Test;
- Site Acceptance Test;
- Commissioning & ATMS / NIMS Integration; and
- Final System Acceptance.

2. Documentation Requirements

2.1 General Requirements

The Contractor shall provide all documentation in A4 format written in English and all documentations shall use standard text sizes and shall be bound with a rigid and durable cover.

The Contractor shall submit electronic copies of all documents in the form of a PDF (Portable Document Format) file.

The Contractor shall submit all drawings in AutoCAD format or alternative as appropriate.

The Contractor shall develop a logical numbering and indexing system covering all the documentation required for the contract. This is to be submitted to the Employer's Representative for review at least 28 days after the Contract Date.

Once the numbering and indexing system has been agreed by TII, it shall be implemented whereby each submitted documentation sheet shall have an unambiguous and distinct number that relates directly to the documentation index.

Schematics and diagrams shall be incorporated within the documents where appropriate to assist in ensuring a clear concise document is provided.

The Contractor shall make an initial electronic submission of each document for review by Employer's Representative.

The Contractor shall also submit a soft copy of the final version of all documents and drawings to the Employer.

Where required, an updated document shall be submitted by the Contractor in response to the Employer's Representative's comments.

The Contractor shall update and replace as necessary all manuals and documentation of equipment supplied as part of the Works for the duration of the Contract.

The Contractor shall allow adequate time allocation for the amendments and approval of documentation.

Table 1 describes the documentation submission requirements. The first draft of each document shall be supplied according to the schedule shown in the table below.

The Contractor shall provide Method Statements for works to be carried out at each site, including a description of the works, proposed timing, traffic management measures, details of disruptions to traffic, pedestrians, etc.

Table 1 Documentation submission requirements

Document	Date Required for First Draft	No. of Copies of the Reports
Project Execution Plan	Within 21 days of the Contract Date	3
Final Equipment Specifications (finalised version of the Equipment Specifications supplied in response to this Contract)	Within 21 days of the Contract Date	3

Final Work Programme (finalised version of Work Programme supplied in response to this Contract)	Within 14 days of the Contract Date	3
Document	Date Required for First Draft	No. of Copies of the Reports
Equipment Operation Manuals	14 days prior to the Contractors request for Substantial Completion of the Installation	4
Maintenance and Service Manual	14 days prior to the Contractors request for Substantial Completion of the Installation	4
Fault Reporting System Manual	14 days prior to the Contractors request for Substantial Completion of the Installation	4
Equipment Hardware Manual	14 days prior to the Contractors request for Substantial Completion of the Installation	4
Equipment Software Manual	14 days prior to the Contractors request for Substantial Completion of the Installation	4
Relevant Factory Acceptance Test (FAT) Specifications	14 days prior to FAT	3
FAT Test Results Documentation	7 days after completion of FAT	3
Relevant Site Acceptance Test (SAT) Specifications & Electrical Installation Test Certificates	14 days prior to SAT	3
SAT Test Results Documentation	7 days after completion of SAT	3
Operational Readiness Test Specifications	14 days prior to FAT	3
Operational Readiness Test Results Documentation	7 days after completion of SAT	3
As Built Drawings	7 days prior to the Contractors request for Substantial Completion of a Section	4

2.2 Project Execution Plan

The Contractor shall submit their proposed Project Execution Plan (PEP) in accordance with the timescales detailed in Table 1.

The Contractor's PEP shall cover, but not be limited to:

- Their approach to the delivery and implementation of all stages of the Contract from the Mobilisation through to Handover;
- Their governance and delivery approach relating to the management of safety, quality, risk, environmental and programme compliance;
- Their resource management, including key personnel, and subcontractor engagement;
- Their reporting schedules;

- Their project management controls for each phase of the Contract.

2.3 Final Equipment Specification

The Contractor shall supply a Final Equipment Specification (FES) in accordance with the timescales stated in Table 1 of this specification.

The Contractor's Final Equipment Specification (FES) shall describe in detail all aspects of their proposed design, including the following:

- Functional description; of each equipment type;
- How they interface with the existing system, associated systems and each other where appropriate;
- Full and detailed method statement, detailing manner in which, each element of the works (including construction, installation, commissioning and maintenance) is to be undertaken;
- Stakeholders to be involved and potential effects on existing infrastructure;
- Exhibits of proposed maintenance engineer interface screens;
- Selection menus and command options for testing and maintenance purposes;
- Methods for performing all of the system functions; and
- High-level software design for any significant software additions or modifications as and when required.

2.4 Work Programme

The Contractor shall submit a detailed programme in accordance with the Conditions.

The Contractor shall provide both a PDF of the programme and an electronic version of the same programme.

The work programme shall include, but not limited to:

- Site Mobilisation
- Long Lead Procurement Timelines
- Specialist subcontractors
- Submission of Contractor Required Submissions
- Key milestones
- Information to be provided by the Employer
- Temporary Works
- Permits and licences
- Testing and Commissioning
- Safety File and Handover

The Contractor shall show all key interface / integration requirements with other contracts, which shall include but not limited to ATMS / NIMS, MOCC, PPP / MMarC, ITS EMC and MTFO DC.

2.5 Manuals

2.5.1 General Requirement

The Contractor shall inform the Employer's Representative if any of the following manuals are combined or are not applicable to the supplied equipment, prior to the issuing of the manuals.

The Contractor shall update and replace as necessary all manuals and documentation supplied as part of the Works for the duration of the Contract. including but not limited to the following reasons:

- Modification to correct deficiencies, which have become apparent during the routine operation and maintenance of the equipment specifications; and
- Development of improvements subsequent to installation, including any, which extend the functions of the equipment specifications.

All cost incurred in updating or replacing manuals and documentation shall be borne by the Contractor.

2.5.2 Equipment Operation Manual

The Contractor shall describe in non-specialist language all procedures related to the operation of the equipment, inputs, the results of these inputs, alarms and outputs not related to inputs, including the following:

- Parameter configuration procedures;
- Hardware modifications permissible not detailed in the maintenance and service manual;
- Start-up / shut-down procedures;
- Listing of all prompts and commands including sample screens;
- Remote configuration, management and monitoring procedures;
- Software update and (re)configuration procedures; and
- Logged data retrieval procedures.

2.5.3 Maintenance and Services Manual

The Contractor shall ensure that the manual details the maintenance and service aspects of the equipment on an item-by-item basis to enable maintenance personnel to repair any faulty equipment as required, the manual shall include:

- List of equipment including part numbers;
- Routine service and maintenance procedures including recommended frequencies;
- Troubleshooting guide;
- Details of Fault diagnostic procedures, features and test sets;
- Testing procedures; and where appropriate;
- Detailed procedures for testing each item of equipment and the interaction between associated equipment and the interaction between two or more items of equipment so as to determine correct functioning;
- Warranties or guarantees for all materials and equipment installed;
- Circuit diagrams; and
- Contact details for all suppliers and sub-contractors used.

2.5.4 Fault Reporting System Manual

The Contractor shall ensure that the manual describes the fault reporting, including how to log faults and how the Contractor clears and reports cleared faults.

2.5.5 Equipment Hardware Manual

The Contractor shall ensure that the documents detail all equipment installed; as a minimum, the document shall include:

- Block diagrams illustrating the configuration of each unit of hardware;
- As built diagrams;
- A detailed technical and functional description of each item of equipment, including logic diagrams and circuit diagrams where applicable;
- Configuration diagrams illustrating the interconnection of units;
- Parts lists and wiring schedules covering all items supplied under the Contract;
- Interconnection between equipment; and
- Cross-referencing with maintenance and service manual.

2.5.6 Equipment Software Manual

The Contractor shall include the following items for all software:

- Troubleshooting guide;
- Installation procedures (in event of failure / corruption of data / upgrading of base unit);
- Maintenance and service procedures;
- All applicable licenses; and
- Non-Disclosure Agreements (where applicable).

The Contractor shall include for all software custom developed for the equipment, the following:

- Software Functional Design Documentation;
- Software Architectural Design Documentation; and,
- Hard and soft copy of all source code.

2.6 As-Built Information

The Contractor shall prepare and submit detailed as-built record drawings of the Works in accordance with Appendix 1/72 of Volume A- Part 2: Works Specification.

The Contractor shall provide a close out report for each site with respect to the provision, installation, testing and commissioning of all new ITS Equipment. The Contractor shall submit the close out report to the Employer's Representative 7 days in advance of the Contractor's request for substantial completion of the Installation.

The close-out report shall include but not limited to the following:

- As-built record drawing of the completed Works;
- Site Records;
- Testing and certificate documentation;
- All non-conformance report and completed close out documentation.

For all elements designed by the Contractor, the Contractor shall supply as built drawings which shall form part of the Safety File.

2.7 Product Documentation

Product documentation shall detail all hardware and software elements that will form part of the system and shall include the following:

- List of Applicable Standards
- Hardware Specification (including Physical, Electrical and Environmental Specification)
- Software Specification
- Product Data sheets and drawings

All product drawings shall make use of the metric range of preferred dimensions and tolerances.

3. Test Specification

3.1 General Requirements

The Contractor shall produce Test Specifications with respect to the equipment installed as part of the Works in accordance with the testing and commissioning requirements specified in Volume A - Part 4: Testing and Commissioning Specification and Volume A – Part 3: Technical Specification.

Test Specifications shall be produced for all stages of testing and shall detail for each equipment type how the equipment is tested to demonstrate compliance with the functional and operational requirements specified in Volume A – Part 4: Testing and Commissioning Specification and Volume A – Part 3: Technical Specification.

Test Specifications shall be produced for each equipment type for test stage including:

- Factory Acceptance Testing;
- Pre-Installation Testing;
- Site Acceptance Testing;
- Commissioning and Integration Testing;
- Electrical Testing;
- Communication Testing;

The Test Specifications shall include as a minimum:

- Testing procedures and method statements (including any self-certification);
- Procedure for electrical checks including PSU tests (if applicable), fan/heater tests (if applicable);
- Procedure for external checks;
- Procedure for internal checks;
- Test set up (including test equipment used);
- Calibration testing;
- Details of test to be carried out; and
- Format of test results documentation.

The Test Specifications shall be supported by flowcharts, test descriptions and expected test results.

The Contractor shall submit Test Specifications for each test stage for each equipment type in draft format to the Employer's Representative for review and comment 30 working days in advance of any tests being carried out.

The Contractor shall provide the electrical installation test certificates to the Employer's Representative for each piece of equipment prior to the Site Acceptance Test on that piece of equipment and in accordance with the timescales stated in Table 1.

3.2 Test Results Documentation

The Contractor shall submit test results in the format as agreed in the Test Specifications and include the following information:

- Details of equipment tested;
- Record of geographic address (physical location);
- Record of electronic address (if applicable);
- Record of installed equipment (including serial numbers);
- Record of test hardware equipment (including serial numbers and calibration date);
- Record of test software (including revisions);
- Test equipment layout diagram and connections (including test leads used);
- Record of results obtained;
- Record of areas of non-compliance;
- Remedial action taken or proposed for areas of non-compliance;
- Record of name, signature of test engineer and date of testing;
- Record of name, signature of witness engineer and date of witnessing.

4. Training

The Contractor shall develop and submit a Training Plan for each item of equipment for the purposes of training maintenance personnel. The training, to be provided by the Contractor in accordance with the Training Plan, shall provide the maintenance personnel with the level of knowledge and understanding of the equipment to maintain the equipment.

The Training Plan that shall be submitted shall include for but not be limited to the following modules for each item of equipment:

- Overview of the installation and equipment management tools;
- Installation of the equipment;
- Maintenance of the equipment;
- Testing and commissioning of the equipment;
- Configuration of the equipment;
- Troubleshooting for potential 'Installation' and field equipment failures;
- Operation of the equipment.

The Training Plan shall include training manuals and documentation to be used in the training.

The Training Plan shall include details of the proposed training location (within 30km of the MOCC) and duration of the module training.

The Contractor shall provide the facilities for hosting the training and the training room shall accommodate a minimum of 10 personnel.

Training, as provided by the Contractor, shall be provided within 1 month following Substantial Completion of the Installation.

The Contractor shall update the Training Plan and provide additional training sessions in response to the deployment of new equipment type and in response to software / system upgrades to all equipment [new and existing].

5. General Testing Requirements

The Contractor shall be responsible for verifying that the equipment and functionality is working to the standards required by this specification and equipment requirements as defined in Volume A – Works Requirement: Part 3: Technical Specification.

The Contractor shall ensure that all materials, components, wiring cabling and all accessories shall be suitable for unimpaired operation between the ambient temperature limits of:

- Operational Temperature Range: -20°C to +65°C
- Operational Humidity Range: 0% to 90% (non-condensing)

The Contractor shall ensure that the verification of the requirements shall be carried out by local testing at the Contractor / Sub Contractor premises of all items of equipment.

The Contractor shall ensure that all equipment shall be tested with equipment outstations individually and then jointly with the ATMS / NIMS as part of the overall integration test requirements.

The Contractor shall be responsible for certifying that all tests have been correctly carried out. The Contractor shall provide the necessary competent, experienced and qualified contractor staff to carry out tests and commissioning.

The Contractor shall test that the equipment outstations are compliant with requirement detailed in TR2130 under Environmental and Electromagnetic Compatibility (EMC).

Where equipment provided is identical to TII or European Union (EU) standard or any other national authority and has gained Statutory Type Approval from the required authority, no additional type approval shall be required.

For equipment that has not gained any Statutory Type Approval, the Contractor shall apply procedures for the Self-Certification Procedures for Statuary Approval of Traffic Control Equipment, using requirements approved by an EU member state, such as in TRG0600.

The Contractor shall provide all method statements and associated forms, records and schedules to allow a structured and verifiable means of recording tests against the requirements of the Volume A - Works Requirements - Part 3: Technical Specification and, where relevant, the manufacturer's performance claims at least 28 working days in advance of any proposed test.

The Contractor shall apply product quality assurance and verification procedures, for all outstation equipment, using requirements approved by an EU member state, such as in TR1100 Section 10.

The Contractor shall ensure that all equipment supplied shall be subjected to the following environmental tests:

- BS EN 60068-2-14: 2009 (Environmental Testing change of temperature)
- BS EN 60068-2-30: 2005 (Damp Heat Cyclic)
- BS EN 60068-2-6: 2008 (Vibration).

The environmental tests specified shall not be required if the Contractor can demonstrate that the equipment supplied, has already been tested to the Employer's Representative satisfaction.

Wherever possible, the Contractor shall cross reference individual tests in the test schedules to the clauses within this specification or relevant equipment specifications.

6. Electrical Test

The Contractor shall ensure that testing of all electrical equipment and cabling supplied under the Contract shall demonstrate that each item meets the requirements of this specification and equipment requirements defined in Volume A – Work Requirements - Part 3: Technical Specification.

The Contractor shall carry out Factory Acceptance Tests (FAT) and Site Acceptance Tests (SAT) as required in the latest edition of the National Rules for Electrical Installations, I.S. 10101:2020 by the National Standards Authority of Ireland (NSAI).

The Contractor shall undertake electrical tests two weeks prior to commencing Factory Acceptance Testing.

The Contractor shall submit details of the electrical test certificate or form proposed to record results of the tests at least 28 working days in advance of the proposed electrical test.

The Contractor shall undertake electrical tests prior to conducting the Site Acceptance Testing.

The Contractor shall ensure that any equipment directly connected to the mains supply shall undergo an insulation and insulation resistance test.

The Contractor shall ensure that within the insulation test, the mains line and neutral input terminals shall be connected together and subject to an AC supply of 1,000V 50Hz to earth for a period of one minute during which no breakdown of insulation shall occur.

During insulation and insulation resistance tests, the Contractor shall ensure that the low voltage side of any equipment, lightning arresters and mains filters shall be disconnected.

The insulation resistance test shall ensure that the insulation resistance of the complete installation is not less than 1 MOhm when tested on an AC supply of 1,000V.

The Contractor shall carry out an Earth Loop Impedance test on all equipment that is connected to a nominal 230V AC supply.

The Contractor shall carry out an Earth Leakage Circuit Breaker test on all equipment that is connected to a nominal 230V AC supply.

7. Communications

Testing of all communications equipment and cabling supplied under the Contract shall demonstrate that each item meets the requirements of this specification and equipment specifications.

The Contractor shall test all telecommunication cables as per MCG1022 and those stated in Volume A: Part 3 – Section 14 – Telecommunication Specification.

The Contractor shall also undertake End to End Testing of the communications system.

The Contractor shall carry out FAT and SAT testing of all communications equipment and cabling in accordance with this specification, with results supplied to the Employer's Representative in a format agreed 28 days prior to the commencement of testing.

The Contractor shall supply test results related to the telecommunications installation to the Employer's Representative at least eight weeks before the date of completion of works.

8. Acceptance Tests

8.1 Factory Acceptance Test (FAT)

The Contractor shall ensure that testing of all ITS systems under the Contract shall demonstrate that each system and subsystem meets the requirements of this specification and equipment requirements defined in Volume A – Work Requirements - Part 3: Technical Specification.

The Contractor shall undertake FAT on all equipment supplied in accordance with the Works Requirement and shall undertake the Contractor's own internal quality procedures.

The Contractor shall note that the Employer and Employer's Representative shall witness a FAT on one item of equipment of each unique type to be supplied as part of this contract, to ensure that it is operating correctly and in accordance with the requirements of this Specification. In the event that the sample equipment fails to meet any requirements of the Works Requirements, the Employer retains the right to cancel the Contract and bear no costs of work done before or after the cancellation of the call off.

The Employer reserves the right to attend any future testing at the Contractor's or supplier's premises. The Employer will notify the Contractor 7 days in advance of any additional visit.

The Contractor shall notify the Employer's Representative in accordance with Section 5 and that it intends to carry out FAT. Such notice shall specify the time and location of the FAT.

The duration of the FATs shall be proposed by the Contractor to allow each unique equipment type to be completely verified against the requirements of Volume A – Works Requirement - Part 3: Technical Specification.

It is not anticipated that the FATs should take more than four consecutive working days for the total tests for each element / system.

The Contractor shall notify the Employer's Representative with at least 28 working days' notice should the Contractor consider that the duration of four consecutive days too short to carry out the FAT for the total tests for each element/system.

FATs shall take place at the Contractor or suppliers' premises.

The Contractor shall provide all facilities necessary for the carrying out of FATs, which shall include at a minimum:

- office, welfare and catering/lunch facilities for hosting the FATs sessions;
- space to witness the FATs; and
- a meeting room (including projector, video, internet and telephone conference facilities) for the Employer, Employer's Representative and the Contractor Personnel to discuss the testing.

The Contractor shall allow for up to four members of the Employer's Representative to attend the FATs.

The Contractor shall cover all the Employer's and Employer's Representative expenses at cost for attending the FATs which shall include accommodation and suitable meals.

The Contractor shall note that this shall include any requirements for international travel.

The Contractor shall assume that all Employer and Employer's Representative are based in Dublin.

The Contractor shall only be expected to cover the Employer's expenses for the FAT for each type of equipment only once.

At least 28 working days in advance of the proposed FATs, the Contractor shall submit to the Employer's Representative a schedule of planned tests and the equipment that will be included within the tests.

The schedule of planned tests shall include all descriptions and expected outcomes in a format that can be followed easily.

To maximise efficiency, the schedules shall include for comments such that during the tests, the Contractor and the Employer's Representative can note the results of each or all Tests.

The Employer's Representative reserves the right to instruct tests additional to those proposed by the Contractor.

Additional tests instructed by the Employer's Representative shall be notified to the Contractor within 5 working days of the proposed start of the FATs.

The Contractor shall provide to the Employer's Representative, FAT reports documenting the results of the FAT sessions which shall include at a minimum:

- The results of all results / findings identified or reported during the undertaking of FAT Test Scripts; and
- The results of any results / findings reported during independent and ad-hoc testing.

Suitable assembly, test harnesses and necessary facilities shall be provided by the Contractor such that during the FAT the Contractor will demonstrate that the equipment will meet the requirements of the specification and demonstrate that the integration with ATMS / NIMS, AFMS and any other relevant installation identified by the Employer, will be carried out effectively. This shall not be limited to simulators and equipment to represent external interfaces.

The Contractor shall test all the requirements as defined in Volume A - Part 3: Technical Specification, the Contractor shall arrange for the testing of unexpected events such as power and communication loss.

The Contractor shall test the data retention and reinstatement of control and monitoring functions in the case of an unexpected event such as power and communications loss.

Site Acceptance Tests shall not be undertaken unless all the facilities and functions under the FATs have been successfully achieved.

The permanent connection to the Employer's system or sub systems shall not be permitted until any faults identified within the FAT have been resolved to the Employer's Representative satisfaction.

Should, in the opinion of the Employer Representative, the FAT shows an unacceptable degree of unresolved issues, the test will be cancelled and rescheduled at a time when the problems have been resolved by the Contractor

Any repeat of the FAT shall assume that the previous tests had not occurred, excepting that the Employer wishes to only re-test the facilities or functions that were not operating satisfactorily during the previous test.

The Contractor shall cover all costs for any re-tests; include all costs borne by the Employer and Employer's Representative.

Testing shall take place with at least one of each item of the equipment provided by the Contractor.

The full list of equipment to be tested shall be agreed with the Employer's Representative, 28 days after the Contract Award.

FAT certificates when signed and completed by those witnessing the tests and to the satisfaction of the Employer Representative, shall be presented electronically and physically to the Employer and the Employer's Representative.

The Contractor shall be responsible for the delivery of equipment to storage in Republic of Ireland prior to site delivery following a satisfactory completion of FAT.

8.2 Site Acceptance Test (SAT)

The Contractor shall carry out a Site Acceptance Test (SAT) for all equipment installed as part of the Works to demonstrate that the equipment meets all the requirements of the relevant specification and are suitable for operation.

The Contractor shall carry out a SAT to validate that the ITS system meets the operational needs of the Employer and shall include the interfaces to the Back Office System.

The Contractor shall forward a schedule of tests to be undertaken for the Employer's Representative review.

The Contractor shall notify the Employer's Representative 14 days in advance that they intend to carry out SATs

SATs shall include visibility tests for the some of the equipment to ensure that the performance of the equipment is not affected by day and night conditions.

The Employer and Employer's Representative shall be given the opportunity to witness all SATs.

The Contractor shall assume that each SAT shall last a maximum of 3 working days.

The Contractor shall bear the cost of the Employer and the Employer's Representative attending the Site Acceptance Tests.

The Contractor shall allow for 4 members of the Employer and Employer's Representative team to attend the SATs.

The Contractor shall propose a schedule of testing to maximise the efficiency of all personnel associated with the testing, avoiding as far as possible individual short duration tests that require specific travel to and from the test site.

The Contractor shall be responsible for the arrangement of all Temporary Traffic Management (TTM) required for the SAT in accordance with the requirements in the Volume A – Works Requirements - Part 1: General Requirements.

The Contractor shall ensure that the risk of users or the public being distracted by the testing of light or sound emitting devices is minimised.

After satisfactory completion of the SATs, the Contractor shall supply all test measurements, results and any appropriate documentation required to the Employer's Representative, together with a test certificate(s).

Additionally, the Contractor shall provide the Employer with a Pass-Over Certificate.

It is the responsibility of the Contractor to ensure that the equipment is ready for Site Acceptance Testing. In the event that any equipment fails a SAT and a further SAT needs to be performed for it,

the Contractor shall cover all the Employer's and Employer's Representative expenses for attending the additional SATs, including travel, accommodation and suitable meals.

8.3 Commissioning & Associated Service Integration

Commissioning and Integration tests shall consist of a full integrated 'end to end' test of all the equipment with the appropriate Associated Services.

The Contractor shall test and commission all new equipment to ensure that all existing systems, networks and existing equipment are commissioned in a stable and controlled manner, minimising the risk associated with connecting devices to the live network.

The Contractor shall test and commission all new equipment through a combination of phased testing, physical separation of longitudinal communications networks from existing equipment and software protection techniques.

The Contractor shall undertake the connection of new equipment on to the existing network in a phased and / or sectional manner to avoid any potential detrimental effect on the performance, operation or stability of any of TII systems and existing equipment.

The Contractor shall facilitate, and participate in as required, final Associated Service integration testing with the equipment maintenance contractor.

The assistance to be provided by the Contractor may include, but is not limited to, traffic management, test engineers and fault finding/location of any faults preventing completion of integration.

If required, the Contractor shall replace/ repair faulty equipment on the Site.

The Contractor shall undertake operational calibration of the Equipment as required to ensure that the equipment performs in accordance with the relevant design element.

It shall be the responsibility of the Contractor to ensure that all equipment that may be required to interface with the appropriate Associated Services is connected and is appropriately configured to allow the Integration to take place smoothly and efficiently.

The Contractor shall support full integration testing of the equipment when connected to Associated Services. These tests will include;

- Correct addressing of equipment on the appropriate Associated Services;
- Setting of two devices with the same address on the appropriate Associated Services to ensure neither will operate;
- Operation of the equipment by the appropriate Associated Services in a normal manner to simulate day to day operation;
- Generation of all fault types on the devices to ensure fault reporting functionality;
- Remote configuration, management and monitoring of installed equipment by the appropriate Associated Services.

8.4 Operational Readiness Testing

The Contractor shall perform such other tests as required in order to validate that the New ITS System meets the Contract requirements. Such tests shall include, but not be limited to the following:

a. Information Security Testing – this shall include penetration testing and vulnerability scanning and such other tests as may be required to demonstrate compliance with the Information security and Data Protection Schedule.

b. Failover testing – this shall include such testing as may be required to verify that the System can handle a critical failure and switch to secondary systems, be that other servers and/or infrastructure, seamlessly.

c. BC/DR testing – This shall include executing the Business Continuity/Disaster Recovery Plan, verifying the recovery of critical functions within the required timeframe and reviewing and improving the plan based on test outcomes.

d. Data migration testing – testing to verify the migration of legacy data to the New ITS System with data integrity and without data loss and that the data combines with the New ITS System data to perform the functional requirements of the New ITS System.

8.5 Substantial Completion of the Installation

The Installation Works shall not be considered to be substantially complete until the tests identified in this Part have been satisfactorily completed and the required tests certificates have been submitted to the Employer's Representative.

The Contractor shall submit the inventory of installed equipment including the attaching of a bar-coded identification tag to each item of installed equipment two weeks prior to Substantial Completion of the Installation.

The Contractor shall submit details of the proposed Bar-Code Tag system which shall be compatible with current TII ITS tagging/labelling system before they are attached to equipment to the Employer for review.

8.6 Final System Acceptance

For any systems provided as part of the Contract, Final System Acceptance shall be conferred following twenty-four months of satisfactory operation.

The availability and reliability of all the newly installed systems shall be monitored over a twenty-four month period by the Employer's Representative. Final System Acceptance will not be conferred if operational service levels or required equipment functionality are not achieved.

The equipment performance shall be assessed under the following criteria:

- Total availability of all the equipment shall be greater than 97% of the operational time per calendar month;

If the Employer's Representative is not satisfied as to the availability, reliability and functionality of any of the equipment, the above period for monitoring availability and reliability shall be extended, at the discretion of the Employer' Representative.