

**Texas Department of Transportation  
Toll Operations Division**

**Volume II  
Technical Provisions for  
Statewide Toll System Integration and Maintenance**

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DRAFT



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ATTACHMENT B	Existing Hardware List
ATTACHMENT C	Existing Software List
ATTACHMENT D	Existing Toll Operations Standard Operating Procedures

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## **Section 1 GENERAL REQUIREMENTS**

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### **1.1 GENERAL**

This document provides certain information relating to, and requirements applicable to, the Work. This document shall be interpreted as provided in the Agreement. Initially capitalized terms not otherwise defined in the body of these Technical Provisions shall have the definitions set forth in Exhibit A of the Agreement. References to Exhibits shall mean Exhibits to the Agreement, unless otherwise specified. References to Sections contained herein shall mean Sections of these Technical Provisions, unless otherwise specified. References to Attachments shall mean Attachments to these Technical Provisions, unless otherwise specified.

### **1.2 SCOPE**

Integrator is responsible for the completion of all Work in accordance with the requirements of the Contract Documents. Any revisions to the criteria or requirements of these Technical Provisions included in Integrator's Proposal may be implemented only if approved in writing by TxDOT and incorporated into the Contract Documents. Acceptance of Integrator's Proposal, and/or award of the Agreement, shall not serve as written approval for deviations from these Technical Provisions. Following execution of the Agreement, Integrator may propose revisions hereto only in accordance with the Agreement. Unless expressly stated otherwise, no provision contained herein which states that Integrator may propose revisions shall be construed to allow Integrator to implement any revisions without TxDOT's prior written approval. TxDOT, in its sole discretion, shall have the right to accept or reject any Integrator-proposed revisions to the criteria or requirements of these Technical Provisions.

### **1.3 BACKGROUND**

TxDOT currently operates approximately 103 center lane (493 main lane) miles of toll roads in the State of Texas. The toll roads include a combination of electronic, manual cash, and automatic coin machine collection (the "TxDOT Toll Collection System"). The TxDOT Toll Collection System interfaces with the TxDOT Customer Service Center (CSC) located in Austin, TX. Further information concerning the TxDOT Toll Collection System, the CSC, the systems that TxDOT is implementing to operate the CSC, the interface between the TxDOT Toll Collection System and the CSC, is provided in Attachment A.

#### **1.3.1 Central Texas Turnpike System (CTTS) - Austin Area**

The Central Texas Turnpike System (CTTS) consists of three tolled facilities - Loop 1, SH 130 and SH 45 N in the Austin, Texas area - which includes a total of seven (7) mainline toll plazas and forty-five (45) ramp toll plazas. In the current configuration, the CTTS consists of 148 toll equipped lanes plus a communication infrastructure, equipment for facility operations and a System Host Computer located at the TxDOT CSC. The CTTS is a fully integrated Toll Collection System and includes three modes of collection: electronic toll collection (ETC), automatic coin machine (ACM) and attended toll collection (ATT). The current configuration for the CTTS is as follows:

- a. 14 ATT lanes with ETC12 ACM lanes
- b. 22 ACM lanes with ETC
- c. 9 ATT lanes with ACM and ETC
- d. 59 Dedicated ETC lanes
- e. 32 Open Road Toll lanes

All mainline and ramp toll plazas are linked by a fiber optic communications network. Each tolled lane utilizes a Lane Controller that controls the sensing equipment in the lane, processes transaction data, generates equipment alarms and sends them to the associated Plaza Host Computer (PHC), which in turn reports to the CTTS Host Computer located at the CSC.

#### 1.3.1.1 CTTS Operations

All cash collection operations are provided by Others under Contract with TxDOT.

#### 1.3.1.2 CTTS Maintenance

The CTTS was designed and maintained by a toll systems integrator currently under contract with TxDOT. The existing integrator maintains all system equipment including, but not limited to, the following:

- a. Lane Controllers;
- b. ETC Subsystem and Equipment;
- c. Image Capture Subsystem and Equipment;
- d. Cash Collection Subsystem and Equipment, including ACMs;
- e. Digital Video Audit System (DVAS);
- f. Maintenance Online Monitoring System (MOMS);
- g. Reporting;
- h. Plaza Host Computers; and
- i. CTTS Host Computer.

The CSC and CTTS operations staff coordinate with the existing CTTS integrator on any maintenance issues through the use of the TxDOT Helpdesk. The Helpdesk creates tickets which interface with the CTTS MOMS.

#### 1.3.2 Statewide Open Road Tolling System (ORTS) - Austin Area, Tyler, Laredo

The Statewide Open Road Tolling System (ORTS) consists of four tolled projects – SH 45 Southeast (SE) in Austin, Cameron Entrance and Exit Ramps on SH 130 in Austin, Loop 49 in Tyler, and Camino Colombia Toll Road (CCTR) in Laredo - which includes a total of 4 mainline toll gantries and 10 ramp toll gantries. In the current configuration, the ORTS consists of 20 toll equipped lanes (not including tolled shoulders), communication and power infrastructure, and 2 Project Host Servers

(PHS) located at the TxDOT CSC. Three ORTS tolled projects are currently in design or implementation – SH 99 in Baytown, the DFW Connector Managed Lanes in Grapevine, and Loop 49 Phase 3A and 5 in Tyler - which includes an additional total of 6 mainline toll gantries and 2 ramp toll gantries. The ORTS is a fully integrated Toll Collection System and only includes the ETC mode of collection.

Within each toll facility, the mainline and ramp toll gantries are linked by a fiber optic communications network, with the exception of CCTR. CCTR's mainline roadside toll equipment utilizes a wireless, line of sight, connection from the mainline toll gantry to a decommissioned toll plaza, where the connection to the CSC is made through a commercial T1 line at the toll plaza. The Loop 49 network connects to the CSC via a commercial T1 line. SH 45 SE network connects to the CSC via fiber optic line to the SH 130 fiber backbone. The Cameron Entrance and Exit Ramps on SH 130 connects to the CSC via fiber optic line to the SH 130 fiber backbone. The SH 99 and DFW Connector projects will also connect to the CSC via commercial T1 lines.

Each Toll Zone utilizes a Toll Zone Controller which monitors and operates the vehicle detection and classification equipment, image capture and processing equipment, ETC equipment, processes transaction data, generates equipment alarms and sends them to a Project Host Server (PHS) located at the CSC.

#### 1.3.2.1 ORTS Operations

No cash collection exists on the ORTS.

#### 1.3.2.2 ORTS Maintenance

The ORTS was designed and maintained by a toll systems integrator currently under contract with TxDOT. The existing integrator maintains all system equipment including, but not limited to, the following:

- a. Toll Zone Controllers;
- b. ETC Subsystem and Equipment;
- c. Image Capture Subsystem and Equipment;
- d. Power and Emergency Generators;
- e. Commercial Network Service and Communications Equipment;
- f. MOMS;
- g. Reporting; and
- h. PHSs.

Local TxDOT Districts currently provide Level 1, or first response, and preventative maintenance to the Loop 49 and CCTR projects. The Beaumont TxDOT District is scheduled at the end of this year to provide Level 1 maintenance for SH 99 upon commencement of tolling.

The local District staff coordinates with the existing ORTS integrator on all Level 1 maintenance and preventative aspects of the aforementioned projects through the use of MOMS ticket generation and management. Raytheon provides the District staff with all required maintenance tools, procedures, and training.

## **1.4 PROJECT DESCRIPTION**

The Project shall include the development, infrastructure design coordination, construction, implementation and system testing of one or more Project Segments, and the maintenance of the Project Segments. At TxDOT's discretion, the local TxDOT District may elect to provide Level 1 maintenance for a Project Segment.

TxDOT shall order and pay for one Project Segment from the Integrator under the Agreement, and shall have the right to order more than one Project Segment. At TxDOT's discretion, the Integrator shall also assume all CTTS and ORTS tolled lane maintenance.

## **1.5 NEW SYSTEM INTEGRATION**

Integrator shall manage, plan, execute, and control all aspects of the Work. Integrator shall coordinate and report to TxDOT all activities with other Persons that are directly or indirectly impacted by the Work. In addition, Integrator shall document and report all Work in accordance with the Contract Documents.

### **1.5.1 Units of Measurement**

The design and construction of the Work shall be completed and documented in English units of measure.

### **1.5.2 Project Segment Configuration Types**

The types of tolled road segments that TxDOT may elect to have developed under the Agreement and that Integrator's system design shall meet the requirements as described herein. Where geometry of the roadway is described, the anticipated worst case for the Tolling Zone equipment has been listed.

[insert proposed roadway cross sections here]

## **1.6 TxDOT RESPONSIBILITIES**

TxDOT will provide the following:

- a. Contract manager and point-of-contact;
- b. Project and contract oversight and management;
- c. CTTS and ORTS related equipment as detailed in Attachments B - Hardware Equipment List and Attachment C – Software;
- d. Network, phone communications;
- e. TxDOT toll facilities and maintenance access driveways;

- f. Existing MOMS access;
- g. Reasonable access to facilities and equipment, as needed;
- h. Workshops at specified mainline CTTS facilities to store primary response spare parts and primary response maintenance technicians;
- i. Lane closure notification procedures for tolled lanes;
- j. Infrastructure design including toll gantries, sign support structures, roadside enclosures and pads, maintenance access areas, electrical transformers and generators, and generator pads;
- k. Inspection of work: on the system, components, parts, materials, equipment or other items to ensure that the system conforms to the requirements of this Agreement, to verify progress, or for any other reason that TxDOT deems appropriate;
- l. Construction materials and methods testing; and
- m. Contract administration, perform periodic audits or field reviews as needed.

#### 1.6.1 Toll Related Subsystems Maintained by Others

The following is a list of those Subsystems maintained by other TxDOT Others and is not included in the Scope of Work:

- a. CSC operations and maintenance;
- b. Phone and data network (LAN and WAN) configuration and operations (CTTS Only);
- c. Voice Over Internet Protocol (VOIP) hardware configuration and operations Intelligent Voice Recognition (IVR) Phone System;
- d. Facility Maintenance including, but not limited to, power, cabling, wiring, structures, Roadways, HVAC (CTTS only);
- e. Power (including uninterruptible power supplies) and Emergency Generators Maintenance and Operations (CTTS Only); and
- f. Roadway Maintenance

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## Section 2 DELIVERY REQUIREMENTS

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### 2.1 PROGRAM DELIVERY

The following section outlines the requirements that shall be followed for delivery of the program and Project Segments. The following requirements shall be implemented following execution of the Agreement and shall be reviewed and updated by the Integrator annually within 30 days following the anniversary date of the Agreement. Any updates shall be distributed to TxDOT for review and approval.

In the event that program and project submittal delivery schedules or testing requirements conflict, the Integrator shall identify these submittals for discussion during the Program Initiation Conference. An example includes if a Notice to Proceed (NTP) is issued immediately following the execution of the Agreement causing the program and project initiation Sections to overlap. The Integrator and TxDOT will mutually agree on the submittals to be required of Integrator for that Work.

#### 2.1.1 Program Initiation

Immediately following execution of the Agreement by TxDOT, the Integrator shall perform such Work, as described below:

1. Prepare and deliver the draft program management plan (PMP) and submit to TxDOT within 30 Days of execution of the Agreement;
2. Develop a detailed Critical Path Method schedule for the development and testing the System, and submit to TxDOT within 30 Days of execution of the Agreement. Upon addition of the one or more Project Segments or maintenance work, the Integrator shall revise and update the schedule to include the entire scope of Work;
3. Schedule and participate in the Program Initiation Conference within 45 days of execution of the Agreement;
4. Develop Quality Management Plan and submit to TxDOT within 60 Days of execution of the Agreement;
5. Develop subcontracting plan and submit to TxDOT within 60 Days of execution of the Agreement;
6. Participate in meetings and presentations with TxDOT, consultants, and others as requested by TxDOT and required by this Agreement. The Integrator's attendance at such meetings and presentations may require travel at the Integrator's expense within Texas or to states contiguous to Texas; and
7. Provide technical support, presentation materials, Work cost information, and reports for meetings and presentations as may be requested by TxDOT.

## 2.1.2 Program Management

This Section defines the performance requirements and criteria for the management and administration of all Work. Integrator is responsible for management of the Work and coordination of all the activities required to complete the Work in accordance with the Contract Documents.

### 2.1.2.1 Performance Requirements

Integrator shall be responsible for management of the planning, execution, and control of all aspects of the Work. Integrator shall also be responsible for coordinating its activities with TxDOT, TxDOT's Design Engineer, and other entities who are directly or indirectly impacted by the Work. Integrator shall be responsible for documenting and reporting all Work in accordance with the requirements of the Contract Documents.

Integrator's management approach shall provide all components of an effective and efficient management system, including communication and reporting; documentation of Work; supervision of Work personnel and activities; all tools, facilities and materials; environmental protection and mitigation; safety of Work personnel, motorists and the general public; and any other management elements needed to produce and document a high-quality, safe, efficient and operable product that minimizes environmental and traffic impacts.

### 2.1.2.2 Program Criteria

#### 2.1.2.2.1 Management Goals

Integrator shall perform in a manner consistent with the goals and direction of TxDOT and the requirements of the Contract Documents. The primary management goals are to provide the public with a Project that meets the requirements of the Contract Documents and is completed on time and at a fair cost, with as little impact on the environment as possible. Integrator shall maintain open and continuous communications with TxDOT. The Parties shall continually look for Project betterment opportunities. The staff at all levels should continually look for opportunities to improve efficiency while at the same time meeting the goals and requirements of the Contract Documents.

Integrator shall provide TxDOT a Project Organization Chart that is a graphic representation of the hierarchy and indicates functional areas of responsibility for the Key Personnel, as described in the Section 2.1.2.2.2. Integrator shall empower all levels of its organization to meet Project goals and Integrator's obligations.

Integrator shall submit a Key Personnel directory that includes the following information: name, title (with respect to the Work), office address and location, e-mail address, office telephone numbers, fax number, and cellular/pager number(s). The directory shall be updated throughout the course of the Work.

#### 2.1.2.2.2 Key Personnel

Key Personnel are the individuals from Integrator's organization who are functionally responsible for each of the following TxDOT activities:

- a. Program Manager
- b. System design manager
- c. Installation manager
- d. System test manager
- e. Maintenance manager
- f. Transition manager
- g. Quality manager

Integrator shall present a detailed qualification summary of work history for each individual Integrator designates as Key Personnel. TxDOT will review and provide Integrator with a written approval of this individual participation on the Project prior to his or her start of Work.

The detailed qualification summary of work history for each individual shall indicate that:

- a. The person is experienced in their appropriate field;
- b. The work history is relevant to the assigned area of responsibility; and
- c. The individual holds the appropriate professional licenses and certifications in the State of Texas.

Integrator shall also supply:

- a. An acknowledgment that each individual designated by Integrator in a Key Personnel function/title for which the Agreement requires liquidated damages, actually carries the required amount of liquidated damages should they be removed from the proposed organization chart;
- b. Professional references for each Key Personnel individual; and
- c. A detailed resume for each Key Personnel individual.

With the exception of the quality manager, Integrator shall notify TxDOT at least 30 Business Days in advance of replacing any Key Personnel and shall submit the names and qualifications of the proposed replacement(s) to TxDOT for prior written approval. TxDOT shall be allowed to interview replacements, if TxDOT so desires. TxDOT shall have the right to reject, in its sole discretion, any proposed replacement.

Integrator shall not replace the QM without prior written approval by TxDOT. Integrator's request to replace the QM shall name a proposed replacement manager, include his/her qualifications and include a statement that he/she will be available fulltime within 30 Business Days.

#### 2.1.2.3 Communication Plan

##### 2.1.2.3.1 General

Integrator shall establish a Communication Plan necessary to control all facets of the Work and maintain communications with TxDOT and Governmental Entities, including other local or regional emergency response agencies or entities as approved by TxDOT.

#### 2.1.2.3.2 Meetings and Coordination

Integrator shall meet with TxDOT or its designee during periods when work is underway. Meetings shall be weekly during periods of construction or installation, bi-weekly during periods of design or development and quarterly at all other times. In addition to the periodic meetings, Integrator and TxDOT will meet as needed to discuss Project-related or long-term strategy issues. These meetings will be held with TxDOT and/or its designee to discuss Work progress, issues, and planned Work for all phases of Work. Integrator and TxDOT will jointly develop the agenda for these meetings and Integrator shall be responsible for providing meeting facilities unless directed otherwise by TxDOT.

#### 2.1.2.3.3 Meeting Minutes

Integrator shall keep minutes of all Project related meetings and distribute copies of the draft minutes to TxDOT participants within five (5) Business Days after the meeting date. Final meeting minutes incorporating any comments by TxDOT shall be submitted to TxDOT within five (5) Business Days after receipt of TxDOT's approval or comments on such draft meeting minutes, as applicable. Integrator shall be responsible for the distribution of final TxDOT-approved meeting minutes to appropriate parties. Excluded from this requirement are internal meetings between Integrator's team members.

At a minimum, all meeting minutes shall contain a complete list of attendees (including their affiliations and telephone numbers), descriptions of issues discussed, any decisions made, direction given, remaining open issues and action items (including identification of the party responsible for follow up and the target date for resolution).

#### 2.1.2.3.4 Protocol for Emergencies

In emergencies affecting the safety or protection of persons, the Work or property at the Project Site or adjacent thereto, Integrator shall immediately act to prevent and mitigate threatened damage, injury or loss. Integrator shall give TxDOT prompt written notice if Integrator believes that any significant changes in the Work or variations from the Contract Documents have been caused by such emergencies or damage or are required as a result thereof.

#### 2.1.2.4 Software Development Plan

A detailed Software Development Plan shall be prepared and submitted to TxDOT. This plan shall indicate all elements of the software development process and shall include, but not be limited to, the following:

- a. Software Development Schedules;
- b. Software Development Tools;
- c. Assignments to Subcontractors;

- d. Programming Languages;
- e. Software Development Quality Control and Quality Assurance;
- f. Software Testing Plan;
- g. Software Documentation Plan; and
- h. Software Management Plan.

A complete program of software testing shall be defined as part of the Software Development Plan. The Integrator's testing plan shall include a summary of test procedures, dates and equipment to be used for each particular test. The Software Development Plan shall include a description of documentation to be provided for application programs, as well as incorporating standards to be followed and sample documentation, where available.

#### 2.1.2.5 Configuration Management Plan

The Integrator shall develop and provide a Configuration Management Plan for the review and approval by TxDOT to be adhered to throughout the duration of this project.

A method of configuration management shall be utilized in order to efficiently and accurately track and monitor the progress and changes that occur in all areas of this project.

At a minimum the Configuration Management Plan shall address the following areas:

- 1) Configuration Control
  - a) Requirements Management
  - b) Deviation and specification change requests
  - c) Data Management
  - d) Configuration Audits
    - i) Functional
    - ii) Physical
  - e) Approval Requirements for Installed Systems
  - f) Testing Requirements for installed systems
- 2) Configuration Status Accounting
  - a) Document Control and the Library Function
  - b) Approved Documents
  - c) Revision History for Documents
  - d) Physical Item Content
  - e) Physical Item Where Used
  - f) Status of Changes

- g) Changes by Product/Serial Number
- h) Results of Configuration Audits
- i) Configuration Management Accounting (As Designed, As Built, As Delivered)
- j) Mod Status of Installed Systems

#### 2.1.2.6 Maintenance Plan

The Integrator shall submit to TxDOT a detailed Maintenance Plan. The plan shall include maintenance staffing and administration, high level dispatch procedures, communication requirements, preventive maintenance techniques, schedules, and support from outside maintenance service (for example, computer manufacturers), final maintenance equipment list and other details as may be appropriate for inclusion in the Maintenance Plan.

If maintenance procedures require any lane closures these shall only be undertaken after TxDOT has approved the lane closure and Integrator shall be responsible for maintenance of traffic.

The Maintenance Plan shall include procedures to be used from the first use of the Tolling System through completion of the Operations and Warranty Period(s). The Plan shall address, but shall not necessarily be limited, to the following:

- a. Standards and General Procedures;
- b. Equipment Maintenance;
- c. Software Maintenance;
- d. Tools;
- e. Spare Parts and Inventory Control;
- f. Maintenance On-line Maintenance System;
- g. Corrective/Predictive Maintenance Procedures;
- h. Preventative Maintenance and Schedules;
- i. Support Services:
- j. Personnel:
- k. Staff Location,
- l. Staff Qualifications;
- m. Training;
- n. Maintenance Facilities/Workshop(s);
- o. Maintenance Records;
- p. Failure Tracking and Corrective Action;
- q. Maintenance of Traffic and Lane Closure Procedures;
- r. Reliability and Maintainability Analysis and Calculation;

- s. Spare Parts Inventory Levels; and
- t. Maintenance Activity Reports.

The Integrator shall include in the Maintenance Plan a list of all major items, tools, and equipment necessary for diagnosis, repair, testing, and corrective, preventive, and predictive maintenance of the system. This list shall describe the specific function of each device, and the approximate quantity required for a comprehensive and effective maintenance program. It shall also include a Maintenance Vehicle Inventory referencing the minimum tool allotment, on board spares, and type of vehicle per technician. The Maintenance Plan shall be updated annually and provided in an electronic format acceptable to TxDOT, if required and requested by TxDOT, to reflect the agreed to changes, if any.

All on-call or active technician leads are required to carry an Integrator supplied cell phone and a laptop computer. Supervisory personnel and managers are also required to carry a cell phone to ensure an immediate, open line of communication at all times. The Integrator shall provide TxDOT with a list of employees and their associated cell phone numbers, and update that list any time there is a change.

#### 2.1.2.7 Warranty Management Plan

The Integrator shall be responsible for managing all equipment warranties. The Integrator shall supply a list of all equipment covered by third party warranties including the period of time covered by said warranties.

#### 2.1.2.8 Business Continuity and Disaster Recovery Plan

The Integrator shall develop a high-level Business Continuity and Disaster Recovery Plan. The Integrator shall prepare the draft Business Continuity and Disaster Recovery Plan and submit to TxDOT within thirty (30) Days of the Critical Design Review. The Business Continuity and Disaster Recovery plan shall include the following:

- a. Business continuity procedures that shall be implemented to fulfill all requirements of the Work in case of fire, theft, natural disaster, technical difficulty, workforce problems or other disruption of business.
- b. A disaster recovery plan for recovery of the data for this service shall be maintained in case of fire, theft, natural disaster, or technical difficulty. The Integrator shall be responsible for all cost of the disaster recovery plan. The disaster recovery plan may include the transfer of this service to a subcontractor as approved in writing by TxDOT.

#### 2.1.2.9 Program Initiation Conference

The Program Initiation Conference will be coordinated and moderated by TxDOT. The conference should last no more than one Business Day. The purpose of the conference shall include, but not be limited to:

- a. Introduce key personnel of the Integrator, TxDOT, and TxDOT's consultants;

- b. Review the overall project design as based on the Integrator's proposal and TxDOT requirements;
- c. Review key aspects of the project management plan, the quality management plan, the initial project schedule;
- d. Review the preliminary requirements trace matrix and discuss any exceptions; and
- e. Any early project coordination.

The Integrator shall cooperatively develop an agenda for the Program Initiation Conference with TxDOT. The Integrator shall develop and deliver a presentation and any documentation to support the review of the proposal and aspects of the work to be performed by the Integrator.

### 2.1.3 Program Scheduling

#### 2.1.3.1 General

The Integrator shall develop, submit, and update a Program Schedule(s) for the Work. The Program Schedule shall be based upon the Critical Path Method (CPM) for planning, scheduling, and progress reporting of Work.

Integrator shall be responsible for the adequacy of its Program Schedule and to manage its resources to meet the requirements of the Contract Documents, including TxDOT reporting and invoicing requirements.

During the course of the Work under the Contract, TxDOT may issue NTP for multiple overlapping Project Segments that would result in these efforts running concurrently. Integrator shall present Project Schedules for multiple simultaneous projects in both individual project and rolled up views within the Program Schedule so that cost commitments and resource loading can be reviewed both individually and globally.

The Program Schedule submittal shall clearly and individually define the progression of the Work within the applicable time frame by using separate Project activities, including but not limited to:

- a. All Work components, including management, administration, and quality assurance activities;
- b. Documentation development and delivery;
- c. System design and testing; and
- d. Integrator milestones;

#### 2.1.3.2 Definition and Function

The planning, design, construction and completion of the Work shall be undertaken and completed in accordance with the most recent Project Schedule approved by TxDOT. The Program Schedule is defined as the initial schedule submitted with the Proposal, the approved Baseline Schedule or the most recently approved revised resource loaded schedule, which has been updated by the most

recently approved Monthly Schedule Update(s), as applicable. The Program Schedule shall be used by the Parties for planning and monitoring the progress of the Work.

The Initial Program Schedule shall show in detail the Integrator's work activities for the first ninety (90) days after execution of the Agreement with all remaining Work being represented by phase level summary activities such that they cumulatively indicate all Work. The Initial Program Schedule shall be updated on a monthly basis while the Baseline Schedule is being developed and approved.

#### 2.1.3.3 Milestones

The schedule logic shall reflect a Critical Path from execution of the Agreement through completion of the Work. Project completion milestones shall be established in the Program Schedule, but shall not exceed the time limits established in the Agreement. Integrator shall produce a Critical Path network of all activities that are not open-ended.

#### 2.1.3.4 Float

2.1.3.5 All float contained within the Program Schedule ("Float") shall be considered a Program resource available to either TxDOT, Integrator, or both, as needed to achieve the scheduled completion deadlines. All Project Float shall be shown on the Program Schedule on each schedule path.

#### 2.1.3.6 Activities

The Program Schedule shall divide the Work into activities with appropriate logic ties to show Integrator's overall approach to the planning, scheduling, and execution of the Work. All Work shall be represented by cost and resource-loaded Project activities. The duration and logical relationships of any activities (or summaries at phase level) shall be based on the actual duration and relationships anticipated. Integrator shall not use calendar dates or constraints to logically begin or complete any activity unless calendar dates are shown in the scope of work or other Contract Documents.

#### 2.1.3.7 Prohibition

2.1.3.8 No unspecified milestones, constraints, Float suppression techniques, or use of activity durations, logic ties, and/or sequences deemed unreasonable by TxDOT, shall be used in the Program Schedule. Milestones

Each milestone shall be separately identified, conform to the scheduling requirements set forth in the Contract Documents, and be assigned a "finish no later than" constraint date.

#### 2.1.3.9 Early and Late Dates

Early dates shall be based on proceeding with the Work exactly on the date when the corresponding Agreement time commences. Late dates shall be based on completing the Work required for an Integrator milestone exactly as specified by the corresponding Agreement time, even if Integrator anticipates early completion.

#### 2.1.3.10 Activity Durations

Project activity durations shall be in units of whole working days. Durations shall be established from the Work Breakdown Structure (WBS) of the Work, as described in Section 2.1.3.12.

#### 2.1.3.11 Activity Identification

Integrator shall use standard and consistent Project activity identification numbers, textual descriptions, and codes in all Program Schedule submittals, in a manner acceptable to TxDOT. Each Program Schedule submittal shall be clearly identified. Resubmissions of a Program Schedule shall use the same revision number as the original submission individually identified by a sequential appended letter (A, B, etc.), as an indication of a revised version.

#### 2.1.3.12 Work Breakdown Structure (WBS)

Integrator shall establish a Work Breakdown Structure (WBS) in accordance with this Section. There shall be clearly identifiable linkage between the Price Proposal and Integrator-designated activities, and phases represented in the Program Schedule, the Initial Program Schedule, and subsequent Monthly Plan Updates. Integrator shall notify TxDOT of any changes in activity or limits as part of its Monthly Plan Updates and revised Program Schedules, and explain the reasons for the changes.

The WBS for each work element shall indicate the duration, timing, and logical relationship to other work elements, including relationships to activities other than the parent activity of the particular work element. Activity durations shall be no longer than sixty (60) Days, unless otherwise accepted by TxDOT. Activities for all scheduled submissions shall be presented in the greatest detail possible. For purposes of the Initial Program Schedule, the sixty (60) Day requirement will not be specifically enforced. It is, however, anticipated that Initial Program Schedule submission will result in very few activities that exceed the sixty (60) Day limit. The WBS for each activity shall be defined in terms of work elements reflecting the types of Work as shown in the Price Forms.

Activities shall be broken down minimally to work elements. All Work shall be broken down to similar manageable work elements. For Utility Adjustment Work, if Work is not shown as an activity itself, such Work shall be shown as a work element, where applicable. For mobilization activities or work elements, Integrator shall provide a list of Work items that are included in each activity or work element.

#### 2.1.3.13 Schedule Revisions

As it becomes necessary to modify the Program Schedule to reflect changes to the WBS, work sequences, or to further subdivide the necessary labor, equipment, and materials, the Integrator shall request changes to the Program Schedule and submit such requested changes in writing to TxDOT for approval. No changes to the Program Schedule shall be made without the prior written approval of TxDOT. Until TxDOT approves a change, all Program Schedule submittals shall be tracked against the previously approved Program Schedule. Accepted revisions will be incorporated into the Program Schedule at the next monthly schedule update.

Revised Program Schedule submittals shall include a comprehensive listing of all activities added or deleted along with a complete listing of all logic and activity changes, and any change in the allocation of a Price among activities. All changes in the Program Schedule must be fully described in an accompanying narrative.

Once TxDOT approves a revised Program Schedule, it shall become the Program Schedule of record and be used as the basis for subsequent programmatic Monthly Schedule Update(s) as discussed in Section 2.1.4.1.

## 2.1.4 Progress Reporting

### 2.1.4.1 Monthly Progress Reports

Commencing in the first full month after issuance of NTP, Integrator shall submit a Monthly Progress Report for TxDOT's review. The Monthly Progress Reports shall be submitted by the 10<sup>th</sup> of each month for Work which occurred during the preceding month. The Monthly Progress Report shall contain a format mutually agreeable between TxDOT and the Integrator.

The Monthly Progress Report shall include Integrator's detailed schedule for executing the Work and all information and reporting required for the Program Schedule, and shall include only resources actually available to Integrator. The Monthly Progress Reports shall minimally include the following current Work data:

- a. Progress for the current period for all Project activities.
- b. Actual start and actual finish dates of Work, percentage complete, and Days remaining for Work in-progress.

The Monthly Progress Reports shall reflect updated progress to the status date, forecast finish for in-progress Project activities, and reforecast early dates and late dates for remaining Project activities, but shall otherwise contain no changes in Project activity durations, logic ties, or restraints without approval from TxDOT. It shall also incorporate and fully specify all appropriate information from prior approved Program Schedules. An electronic copy of the Program Schedule file used for the monthly schedule update shall be submitted to TxDOT with the Monthly Progress Reports.

The Monthly Progress Reports shall include additional, separate, filtered list of Project activities and work elements including, but not limited to:

- a. Coordinating with and accomplishing Work associated with the Civil contractor;
- b. Bar chart schedule sorted by segment or section indicating the physical status of all activities as of date of the update;
- c. Design Document submittals for the forthcoming period;
- d. 30 day look ahead report on all TxDOT Approvals required;

The schedule shall be accompanied by a progress report describing progress made that period; plans for forthcoming period; all potential delays and problems; their estimated effect on the Program Schedule and overall completion, and whether on, ahead of or behind schedule.

TxDOT will review the Monthly Schedule Update(s) for consistency with Integrator's WBS and the current approved Program Schedule and for conformance with the Contract Documents. Integrator shall correct any deficiencies and resubmit its Monthly Progress Reports. TxDOT will withhold payments from the Integrator until the Monthly Progress Report changes have been made to the satisfaction of TxDOT. TxDOT will notify Integrator of corrections required within five (10) Business Days of receipt of the proposed Monthly Progress Reports.

TxDOT will use these updates to manage its activities to be responsive to Integrator's Program Schedule, and to measure Integrator's performance with respect to its plan for accomplishing the Work.

#### 2.1.4.2 Delays

Integrator shall identify and promptly report to TxDOT all Program Schedule and progress delays during the prosecution of the Work. Integrator shall promptly take appropriate action to develop a Recovery Schedule whenever a Recovery Schedule is required under Section 4.5 of the Agreement. Integrator shall submit a Recovery Schedule, when required, to accompany the next Monthly Schedule Update(s) immediately following the identification of such Program Schedule delays.

#### 2.1.4.3 Incorporation of Changes

Changes in the Program Schedule that extend the any Milestone shall require a TxDOT-approved Change Order and shall be subject to the requirements of the Agreement - Section 13. Upon review and acceptance by TxDOT of a proposed Change Order affecting the Program Schedule and/or a Recovery Schedule, such Project activities shall be incorporated into the current Program Schedule as a revised Program Schedule submittal. These submittals shall be due within 10 Business Days of TxDOT's approval of the Change Order or Recovery Schedule. If it is necessary to revise the Program Schedule, Integrator shall also prepare and submit an associated revised Maximum Payment Curve for inclusion in the Change Order covering the revision(s) to the Program Schedule.

### 2.1.5 Project Records

#### 2.1.5.1 General Requirements

Integrator shall be responsible for documentation of all Work activities.

This Section is general in nature and applies to all Work activities. For specific documentation requirements related to a specific Work component, see the pertinent subsections of these Technical Provisions and the Agreement.

#### 2.1.5.2 Format Requirements

All Work files shall be maintained in an electronic format as indicated in Section 2.1.7. Hard copy format shall be available upon request by TxDOT or if specified elsewhere herein.

#### 2.1.5.3 Data Backup

All Project related electronic files shall be partially backed up daily and fully backed up weekly. Any backup media shall be stored in a secure area off site that has been mutually agreed upon in writing by the Integrator and TxDOT.

#### 2.1.5.4 Documentation

Integrator shall submit all Documentation and Plans in the English language.

Integrator shall submit Documentation and Plans for TxDOT review and approval in sufficient time for a minimum of two iterations of review/ Integrator revision to be completed and still adhere to the schedule. TxDOT will endeavor to expeditiously review submitted documents but the Integrator should plan for a minimum TxDOT review time of ten (10) business days. Multiple simultaneous submittals may extend TxDOT's review times. Approval of documents shall not relieve or limit the Integrator's responsibility to provide systems in full compliance with the Technical Provisions. If corrections or improvements are requested, the Integrator shall resubmit the Documentation and Plans until such time as it is fully acceptable. Any need for re-submittal shall not be seen as a cause for delay in completing the project in accordance with the schedule requirements.

Deviations from the Technical Provision requirements that may be contained within Integrator submitted documents, even though the document may be approved by TxDOT, shall not have the effect of modifying Contract requirements. Only specific requests to TxDOT from the Integrator for waivers or specification change that are formally approved by TxDOT shall void or change requirements in the Contract.

##### 2.1.5.4.1 Toll System Documentation

The list below is intended to, at a minimum, list the submittals that are applicable to the Program. In the event that Integrator and TxDOT cannot come to an agreement on the list of mandatory submittals, the following list shall be provided:

- a. Program Management Plan;
- b. Configuration Management Plan;
- c. Quality Management Plan;
- d. Software Development Plan;
- e. Safety and Health Plan;
- f. Software Specification;
- g. Preliminary Design Documentation;

- h. Detailed Design Documentation;
- i. Maintenance Plan;
- j. Master Test Plan; and
- k. Test Procedures.

#### 2.1.5.4.2 System Design Submittal Process

The Integrator shall prepare Submittals for the System implemented under the Agreement. All submittals shall be subject to the review and approval of TxDOT.

TxDOT will work with Integrator to review as many submittals as it can with its staff limitations; however, at TxDOT's sole discretion, it may limit the number of submittals, re-submittals, and formal reviews that Integrator may make per week.

#### 2.1.5.4.3 Communication and Submittal Documentation

Integrator shall maintain at all times at Integrator's office, at a minimum, one (1) complete set of:

- a. Subcontracts;
- b. Calculations;
- c. Reports;
- d. Plans;
- e. Communications;
- f. Minutes of meetings;
- g. Review comments;
- h. Change Orders and Claims;
- i. Insurance policies, correspondence and terms;
- j. Toll System Design Documents; and
- k. Software Source Code (in escrow).

#### 2.1.5.4.4 Document Control Verification

Monthly or more often if directed by TxDOT, TxDOT's appointed representative will review Integrator's document control performance. A certification sheet shall be developed by Integrator (subject to the approval of TxDOT) which shall be filled out monthly by the QM and included with each Draw Request, in accordance with the Agreement.

#### 2.1.5.5 Design Changes

Integrator or TxDOT may initiate design changes. Design changes may occur either on items, elements, or phases undergoing installation or after Final Design. In order to process these types of changes, Integrator shall submit, when the problem or change occurs, a Request for Information (RFI) for TxDOT's approval.

All design changes submitted under the RFI procedure shall undergo the same quality management plan (QMP) checks as the original design, as defined in Section 2.1.6.

The Integrator staff responsible for the original design shall approve design changes during testing and installation, or design changes to Final Design Documents in writing.

#### 2.1.6 Quality Management

Integrator is required to develop a quality program including System Design, Software Development, Installation and Testing of Software and Equipment and procedures that follow all the elements indicated in this Section.

The objective of the QMP is to place the responsibility for the quality of all services related to the design of the tolling system by Integrator, facilitate installation of the tolling system by Integrator, and allow TxDOT to fulfill its responsibilities of exercising due diligence in overseeing the Toll System Services processes and products.

Integrator shall prepare a QMP for TxDOT's review and approval. The QMP shall outline the internal QC and QA procedures to be followed by the Integrator during the preparation of all Work for a Project Segment, Software Development, Installation and Testing. The Integrator's QMP shall be independently certified to comply with ISO 9001.

##### 2.1.6.1 Development of QMP

The QMP shall ensure that all Toll System Design Documents are prepared in accordance with generally accepted practices for these types of services and the Contract Documents. Software design and development quality practices for the project shall follow a standard for Software Quality Assurance such as IEEE Std 730.1-1995, Guide for Software Quality Assurance Plans. Additionally, the QMP shall describe and include the following:

- a. Specific QC and QA procedures, including all required forms and checklists, shall be specified for preparing, verifying and checking all Toll System Services products to ensure that they are independently checked and back-checked in accordance with generally accepted practices for these types of services and the requirements of the Contract Documents.
- b. The level, frequency and methods of checking the adequacy of the Toll System shall be described for all Toll System Design Documents.
- c. Procedures shall be described for coordinating Toll System Services performed by different individuals in the same area, or in adjacent areas or related tasks to ensure that conflicts, omissions or misalignments do not occur among design or installation document or between the drawings and the specifications. This shall also include the coordination of the review, approval, release, distribution and revision of documents involving such parties.
- d. Procedures shall: (1) ensure that Integrator personnel are familiar with all the provisions of the Contract Documents concerning their respective responsibilities; (2) provide for the education, training and certification, as appropriate, of personnel

performing activities affecting or assessing the quality of the Work to assure that such personnel achieve and maintain reasonable proficiency; and (3) ensure that the Work is performed according to the QMP, generally accepted practices for these type of services and the Contract Documents.

- e. Procedures shall be established for meeting documentation requirements; the filing of design criteria, reports and notes, and supporting materials needed during the Final Design; and the specific responsibilities of personnel to satisfy these requirements. All Toll System Design Documents shall be maintained, organized and indexed by Integrator and copies made available to TxDOT, upon its request.
- f. No design Work shall commence until TxDOT has provided written approval of the QMP. Any design Work performed prior to TxDOT's approval, may not be reimbursed by TxDOT. In the event that the proposed QMP is unacceptable to TxDOT, Integrator shall modify and resubmit an acceptable plan. Once the plan is approved, Integrator shall not revise any portion of the QMP without the prior written approval of TXDOT.
- g. Procedures to control the handling, storage, shipping, cleaning and preservation of materials and equipment to prevent damage or deterioration.
- h. Procedures to ensure that conditions adverse to quality, such as failures, malfunctions, deficiencies, defective material and equipment, deviations and other Nonconforming Work are promptly identified and corrected. The procedures shall ensure that the cause of the condition is determined and corrective action taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition and the corrective action taken shall be documented and reported to TxDOT in writing and to appropriate levels of Integrator's management to ensure corrective action is promptly taken.
- i. Measures to control the receipt and issuance of documents, such as instructions, procedures, training manuals and drawings, including changes thereto, which prescribe activities affecting quality. These measures shall ensure that approved documents, including authorized changes thereto, are reviewed for adequacy and approved for release by authorized personnel of Integrator and are distributed to and used at the location where the prescribed activity is performed. Changes to documents shall be reviewed and approved by the same organizations that performed the original review and approval unless TxDOT consents, in writing, to another responsible organization.
- j. Procedures and personnel to be used to assure that specified instrumentation is installed and monitored in accordance with applicable specifications.
- k. The form and distribution of certificates of compliance.

#### 2.1.6.2 Quality Manager

Integrator shall assign a quality manager (QM) who shall be responsible for quality oversight of the System Design, Software Development and the Installation of Software and Equipment (Toll System Services) and the detailed review process for the System Design and Software Development. The QM shall not be involved with direct scheduling or production activities and shall report directly to Integrator's management team. The QM shall see that the methods and procedures contained in the approved QP are implemented and followed by Integrator design staff

in the performance of the Work. The individual designated as QM must have demonstrated experience and capabilities to provide this role and is subject to the approval of TxDOT.

The individual designated as QM must have demonstrated experience and capabilities to provide this role, is subject to the approval of TxDOT and shall report and coordinate all issues directly with Integrator's Program Manager and TxDOT. In the event the QM, in consultation with the Integrator's Program Manager and TxDOT, is unable to reach satisfactory resolution of issues pertaining to the quality of Professional Services products, the QM shall provide written notification to the Integrator's board of directors and TxDOT outlining the concerns, actions taken in attempt to correct the concerns, and provide a recommendation as to the suggested course of action. TxDOT shall then be responsible for resolving the concerns with the Integrator.

#### 2.1.6.3 Quality Certification

Prior to submitting a package to TxDOT for review, the QM shall certify that the package has been through the applicable QC processes defined in the QMP and satisfies the QMP standards. The QM shall certify that each Final Design package meets the QMP standards for the Toll System Services included in the submittal.

#### 2.1.6.4 Inspection and Testing Requirements

The QA staff shall perform inspection and testing as defined in the QMP and the various Test Plan submittals. The results of all QA testing will be provided to TxDOT.

TxDOT will perform oversight inspection and may conduct verification testing. The OVT will be established at TxDOT's sole discretion to verify the accuracy of:

- a. The procedures and techniques of the and testing;
- b. The equipment used by the QA staff's personnel; and
- c. The QA staff's test results.

At all points in performance of the Work at which specific inspections or approvals by TxDOT are required by the Contract Documents, the sole discretion of TxDOT, or applicable Law, Integrator shall not proceed beyond that point until TxDOT has completed such inspection or approval or waived its right to inspect or approve, which waiver must be in writing.

As part of TxDOT's oversight role, all materials and each part or detail of the Work may also be subject to inspection and testing by TxDOT. Such inspection does not make such person a party to the Agreement or a beneficiary of any of the rights and obligations there under, nor will it change the rights and obligations of Integrator or TxDOT under the Contract Documents.

#### 2.1.6.5 Reporting, Record Keeping, and Documentation

Integrator shall maintain installation workmanship and materials quality records of all inspections and tests performed per the approved QMP. These records shall include factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, deviations, and/or causes for

rejection; proposed remedial action; and corrective actions taken. These records shall cover both conforming and defective or deficient features, and shall include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the contract. These records shall be furnished to TxDOT in format and content as specified in the QMP. The specific Integrator inspection and testing records required for the contract shall include, but are not necessarily limited to, the following:

- a. Quality control inspection reports and process control material sampling/testing results, and control charts, shall be submitted to TxDOT within twenty-four (24) hours following the inspection or test.
- b. The Quality staff shall maintain, electronically, a daily log of all inspections performed for both Integrator and Subcontractor operations in a format acceptable to TxDOT, and transmitted to TxDOT daily. The daily inspection reports shall identify inspections conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed. The responsible technician and supervisor shall sign the daily inspection reports. The results of the daily inspections shall be provided to TxDOT in an electronic format within twenty-four (24) hours after the work shift. These daily inspection reports shall document the Day's events, activities, and discussions in a format consistent with the requirements of the current TxDOT Contract Administration Handbook for Construction Projects.

#### 2.1.6.6 Source Inspection

TxDOT may, in its sole discretion, inspect the production of all material or the manufacture of products at the source of supply.

TxDOT shall have free entry at all reasonable times to such parts of the plant relating to the manufacture or production of materials. TxDOT shall assume no obligation to inspect materials at the source of supply, but will perform inspections at times and frequencies that TxDOT determines are in its own best interest.

#### 2.1.6.7 Access to Testing Facilities by TxDOT and Others

TxDOT reserves the right to check testing equipment, procedures, and techniques for compliance with TxDOT and AASHTO test methods, equipment requirements and calibration standards. TxDOT also reserves the right to access any testing facilities agencies, and, at no additional cost to TxDOT, to witness the testing and verify compliance of the testing procedures, testing techniques and test results.

#### 2.1.6.8 Integrator Installation and Testing Scheduling and Notice to TxDOT

Integrator shall notify TxDOT in writing at least 14 Days prior to commencing planned fabrication, installation and testing activities, to allow TxDOT to schedule its resources. Integrator shall give TxDOT at least 21 Day written notice for fabrication and testing-related activities occurring more than 60 miles from the Project. In each case, Integrator shall describe the specific locations at which the fabrication and testing activities shall occur, as well as a general description of the activities to take place.

Failure to provide TxDOT with adequate notice as specified above may result in TxDOT withholding a portion of Integrator's Milestone Payment(s).

#### 2.1.6.9 As-Built Documents

As a condition to Final Acceptance, Integrator shall provide to TxDOT the Work's record drawings consisting of a full size film positive set of reproducible drawings and two sets of electronic files of final plans ("As-Built Documents") depicting all the final completed Work, including all changes.

The QM shall sign and date the title sheet of the As-Built Documents to certify that the Work was completed in accordance with the plans, the Contract Documents, the Governmental Approvals and applicable Law.

#### 2.1.7 Software Requirements

Design documentation (including in-process, final and as-built) shall be submitted to TxDOT electronically, as indicated below.

##### 2.1.7.1 General Guidelines

Integrator shall acquire as needed, use, and maintain for all Work the software as specified in this section. Integrator shall use the current version of the specified software.

Integrator, at TxDOT's request, will update their software programs throughout the term of the Agreement within six months of release of a software update, or earlier if mutually agreed to by the parties so as to ensure that Integrator and TxDOT are always using compatible software versions.

Data files for the applications included in Section 2.1.7 shall reside on the Integrator's file server.

Integrator shall utilize the software tools defined in its Proposal and Software Development Plan. For files that shall be submitted to TxDOT for review or archival, the Integrator shall utilize the file types that are compatible with TxDOT as defined below:

##### 2.1.7.2 Scheduling

- a. Microsoft Project

##### 2.1.7.3 Word Processing and Spreadsheets

- a. Microsoft Word
- b. Microsoft Excel

##### 2.1.7.4 Scanned Documents

Scanned documents shall be provided in Portable Document Format (PDF), and shall be fully searchable. All final document submittals shall be combined into a single ".pdf" file for documentation purposes.

#### 2.1.7.5 Communication Management

Work data shall be shared between Integrator and TxDOT. Implementation details shall be arranged after issuance of NTP. At a minimum, data sharing shall accommodate the following TxDOT requirements:

- a. Design submittals shall be accompanied with electronic representations of the plan sheets on standard CD-R or DVD-R media.
- b. Integrator shall also make the submittals available to TxDOT via a secure web site or through Bentley ProjectWise.
- c. Integrator shall provide TxDOT with procedures and software, if necessary, for accessing the submittals on the web site and shall include user ID's, passwords and web site address. The web site shall be segregated into PDF files and actual design data files. PDF and data files shall be well organized and easy to locate. Integrator will maintain the web site in such a manner that it is up-to-date with the latest plan, design, and installation file data.
- d. TxDOT shall have access to all design data files for auditing purposes, as requested by TxDOT.
- e. Integrator shall also provide access to plans, specifications, and pertinent Work data that are "released for installation".

#### 2.1.7.6 E-mail Guidelines

Integrator may use its existing e-mail system, however, mail messages should be formatted as plain text rather than using rich text or HTML. Sensitive or confidential materials shall not be sent via e-mail.

#### 2.1.8 Over-the-Shoulder Reviews

Over-the-shoulder reviews are examinations made by TxDOT during the performance of the Work by Integrator's staff. Over-the-shoulder reviews will consist mainly of checks to assess whether the requirements and design criteria of the Contract Documents are being followed and whether Integrator's QMP activities are being undertaken in accordance with the approved QMP. The reviews may, at TxDOT's sole discretion, include, but not be limited to, review of drawings, electronic files, calculations, reports, specifications and other relevant information. Over-the-shoulder reviews may be of progress prints, computer images, draft documents, working calculations, draft specifications or reports, or other products. It is the intent of these reviews to check for concept, level of detail, design criteria, and fatal flaws. While these reviews may not routinely include detailed calculation or drawing reviews, TxDOT retains the right to perform detailed reviews of any item at any time. For specific review items, the over-the-shoulder review shall consist of an exchange of electronic files between Integrator's staff and TxDOT. Integrator will revise the products to TxDOT's satisfaction to address all comments/concerns raised by TxDOT.

Integrator shall maintain, and furnish to TxDOT upon request, a written record of all over-the-shoulder reviews. The written record shall include:

- a. A list of the participants in attendance for each review or visit;
- b. Description of the items covered and discussed;
- c. Description identifying discrepancies and comments noted as well as a report on corrective actions taken or planned; and
- d. Description identifying follow-up action items, due dates, the party responsible for action items requiring resolution, and time constraints for resolution.

Integrator shall also maintain, and furnish to TxDOT upon request, a written record of QC and Toll System review efforts. A summary of the QC and Toll System review efforts shall be included with the Monthly Progress Reports as more specifically detailed in Section 2.1.4.1.

### 2.1.9 Coordination with Others

#### 2.1.9.1 Integrators

There are several other Integrators working with TxDOT on the CTTS and ORTS. Some of these are directly related to the work being done by the Integrator and some are not, but the Integrator shall cooperate and coordinate activities where appropriate to ensure a successful project delivery. Examples of other Integrators are: Toll System Operator, Customer Service Center Operator, etc.. The Integrator shall take whatever steps TxDOT's deems necessary to accommodate this requirement.

#### 2.1.9.2 Civil Roadway Contractors

The civil roadway contractor shall be contracted to a local TxDOT District to construct the facility where the Toll System will be installed. The Integrator shall cooperate and coordinate the Toll System installation with civil roadway contractor constructing the facility. TxDOT will assist the Integrator in coordination with the local District for access to utilities, plans, scheduling, and the Project site. The Integrator shall cooperate with any roadway maintenance crews, landscape maintenance crews, and miscellaneous construction work at the Project site.

#### 2.1.9.3 TxDOT's Design Engineer

The Design Engineer is contracted to TxDOT to design and prepare the civil design plans for the Toll Zone infrastructure associated with each Project Segment. The Design Engineer will also manage and provide construction oversight of the Integrator's installation, including System verification testing and implementation. The Integrator shall provide to the Design Engineer physical specifications including gantry height and spacing, conduit layouts and sizes, electrical requirements, roadside cabinet requirements, and maintenance access needs. The Integrator shall cooperate and coordinate with the Design Engineer throughout the term of the Agreement for all aspects of Program and Project Delivery, where appropriate and in accordance with the Project Schedule.

## 2.2 PROJECT DELIVERY

### 2.2.1 Project Initiation

Immediately following issuance of the NTP by TxDOT for a Project Segment, Integrator shall perform such Work, as it deems advisable:

- a. Develop subcontracting plan and submit to TxDOT within 30 Days of NTP;
- b. Prepare, update and finalize the PMP and submit to TxDOT within 30 Days of NTP;
- c. Develop a detailed Critical Path Method schedule for the development, implementation and testing of the open road Tolling System for the Project Segment, and submit to TxDOT within 30 Days of NTP;
- d. Schedule and participate in the Project Initiation Conference within 45 days of NTP; and
- e. Develop Quality Management Plan and submit to TxDOT within 60 Days of NTP.
- f. Develop Transition Plan and submit to TxDOT within 60 Days of NTP, as necessary.

#### 2.2.2 Toll System Documentation

Following issuance of an NTP, Integrator and TxDOT will agree on the Toll System design submittals to be required of Integrator for that Work. Notwithstanding the submittals listed in the previous Section, the list below is intended to, at a minimum, include the submittals which are applicable to the Project Segment. In the event that Integrator and TxDOT cannot come to an agreement on the list of mandatory submittals, the following list shall be provided:

- a. Project Schedule;
- b. Installation Plan;
- c. Maintenance Plan (update);
- d. Maintenance Service Manuals;
- e. Test Procedures (update);
- f. Test Reports;
- g. Safety and Health Plan (update);
- h. Civil Construction Quality Plan;
- i. As-Built.

#### 2.2.3 Installation Plan

The Integrator shall submit a revised Installation Plan identifying the approach for installation and covering the major elements of the installation for the Project Segment. The Installation Plan shall also include all applicable FCC Licenses required for the System.

The Installation Plan will be the master document from which the elements of the System will be installed. The Installation Plan shall include and define, at a minimum, the following items:

- a. A description of the proposed installation detailing installation activities for all phases of the Work.
- b. Coordination with TXDOT to maximize on lane closures and minimize traffic delays.

- c. Managing delivery and staging of the System.
- d. Any special or unique installation requirement.
- e. Requirements for lane closures or other maintenance or traffic requirements.
- f. Installation operations shall be conducted in a manner and sequence that assures the least interference with traffic, with due regard to the location of detours and provisions for handling traffic.

#### 2.2.4 Safety and Health Plan

Integrator shall take all reasonable precautions and be solely responsible for the safety of, and shall provide protection to prevent damage, injury, or loss to, all persons and property that would reasonably be expected to be affected by the Work, including but not limited to, individuals performing Work, employees of TXDOT and their consultants and invitees, and members of the public.

The Integrator shall adhere to all applicable safety standards and guidelines for working on or around construction zones, energized equipment, active roadways, and a maintenance environment, including but not limited to the following:

- a. TXDOT safety procedures and guidelines
- b. Texas State Department of Labor and Industries
- c. OSHA
- d. NFPA
- e. Any other local, state, or Federal ordinance, procedure, or guideline that provides for a safe operation and working environment.

#### 2.2.5 Maintenance Plan

The Integrator shall submit to TxDOT an updated Maintenance Plan as per the Project Segment scope. Refer to Section 2.1.2.6 for more information.

#### 2.2.6 Toll Collector Manual

The Integrator shall submit to TxDOT a Toll Collector Manual upon development of a new cash collection system. The Toll Collector Manual shall include a non-technical, full set of standard operating procedures for use of all Integrator provided hardware and software to be used for operation of a Manual toll booth and Segment of Work close out. The manual shall include diagrams, graphics, and instructions.

The draft Toll Collector Manual shall be delivered no later than 120 days following NTP.

#### 2.2.7 Toll Supervisor Manual

The Integrator shall submit to TxDOT a Toll Supervisor Manual upon development of a new cash collection system. The Toll Supervisor Manual shall include a non-technical, full set of standard

operating procedures for use of all Integrator provided hardware and software to be used for operation of ACM and ETC toll booths and Segment of Work opening, close out, and reconciliation. The manual shall include diagrams, graphics, and instructions.

The draft Toll Supervisor Manual shall be delivered no later than 120 days following NTP.

#### 2.2.8 Computer Workstation Manual

The Integrator shall submit to TxDOT a Computer Workstation Manual upon development of a new cash collection system. The Computer Workstation Manual shall include a non-technical, full set of standard operating procedures for use of all Integrator provided workstation hardware and software to be used for administering the Cash and Vault Management System (CVMS). The manual shall include diagrams, graphics, and instructions. One version of the manual shall be developed for the Toll Collector's use, one version of the manual shall be developed for the Toll Supervisor's use, and one version of the manual shall be developed for an Auditor's use.

The draft Computer Workstation Manual shall be delivered no later than 120 days following NTP.

#### 2.2.9 Project Scheduling

##### 2.2.9.1 General

The Integrator shall develop, submit, and update a Project Schedule(s) for each Project Segment. The Project Schedule shall be based upon the Critical Path Method (CPM) for planning, scheduling, and progress reporting of Work. Refer to Section 2.1.3 for additional scheduling requirements.

Each Project Schedule submittal shall clearly and individually define the progression of the Work within the applicable time frame by using separate Project activities, including but not limited to:

- a. All Work components, including management, administration, and quality assurance activities;
- b. Integrator milestones;
- c. Interfaces with entities pursuing or undertaking work, such as that of the Utilities and Governmental Entities;
- d. Identification of planned dates of start of construction and Early Start of Construction on any Project activity or phase of the Work;
- e. Material and equipment procurement and delivery to the Project Site or storage locations;
- f. Maintenance of traffic activities; and
- g. System Acceptance, Final Acceptance of and any changes in Project activities included in the designated Work, with an explanation of the reasons for the change.

## 2.2.9.2 Definition and Function

The Initial Project Schedule shall show in detail the Integrator's work activities for the first 90 days after NTP with all remaining Work being represented by phase level summary activities such that they cumulatively indicate all Work. The Initial Project Schedule shall be updated on a monthly basis while the Baseline Schedule is being developed and approved.

## 2.2.10 Upgrade of Existing Systems

### 2.2.10.1 General

At any time before or upon the expiration of the CTTS and/or ORTS contracts, TxDOT may require the Integrator to provide an upgrade or replacement of system hardware and software. An example may include adding an additional OCR engine at the roadside or converting the CTTS to a cashless system. This work would include the upgrade efforts and maintenance of the upgraded System.

It is envisioned that any upgrade will be issued under a Project Segment Supplement. The Project Segment Supplement will describe in detail the required scope of services and any appropriate system documentation.

Toll collection and normal operations shall continue during the system upgrade. The main line and ramp plazas shall retain the same infrastructure with the exception of any changes the Integrator makes at the Integrator's cost.

### 2.2.10.2 System Design and Installation

Any design and installation efforts required for an upgrade would adhere to the design and installation requirements as set forth within this document. The Integrator shall ensure that any upgrade efforts shall not adversely affect revenue collection for any other Project Segment or System both current and future.

### 2.2.10.3 Transition of Software, Hardware, and Maintenance Activities

#### 2.2.10.3.1 Transition Plan

In preparation of transitioning to any CTTS/ORTS upgrade, the Integrator shall prepare and submit a Transition Plan. The Transition Plan shall detail the required efforts, processes, resources and timeframe for transitioning the upgrade and maintenance services. The Transition Plan shall describe how the Integrator will ensure continuous operations of revenue collection consistent with the Project Segment Scope of Work.

#### 2.2.10.3.2 Transition Coordination

In accordance with the Transition Plan the Integrator shall participate in coordination with the existing System Integrators, TxDOT and or its representative(s).

#### 2.2.10.3.3 Training

For upgrades on the CTTS, the Integrator shall develop and implement a training program for toll collection staff. The training program shall include familiarizing staff with the hardware and software appropriate for each position. The training shall include the use of the manuals as described in Sections 2.2.6, 2.2.7, and 2.2.8. The training shall occur both in a classroom setting and in a hands-on environment. A “Train the Trainer” course shall occur first with staff designated by TxDOT. Separate classes shall be held for each distinct role. All training shall be completed no later than 30 Days before revenue collection begins.

#### 2.2.11 FCC Licenses

The Integrator shall perform radio frequency surveys at the proposed tolling locations before applying for any FCC Licenses. The Integrator shall perform all efforts required to apply for and receive FCC Licenses for the System.

#### 2.2.12 Final Acceptance

As a condition of Final Acceptance for a Project Segment, Integrator shall deliver one (1) electronic copy of all documents to TxDOT that have not already been submitted in their final, approved version. Organization of electronic files shall be in a format acceptable to TxDOT.

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## Section 3 INFRASTRUCTURE REQUIREMENTS

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### 3.1 TOLLING ZONE INFRASTRUCTURE

#### 3.1.1 Tolling Zone Design

The Tolling Zone design shall be provided by TxDOT's Design Engineer in coordination with input from the Integrator.

#### 3.1.2 Codes, Standards and Specifications

Unless otherwise specified herein, the Work shall be governed by TxDOT Standards, policies, and specifications, with all addenda, supplements, and revisions thereto. The latest version of the above standards, policies, manuals and specifications shall be used unless otherwise specified. When standards and criteria have not been provided under this document, the following hierarchy of standards will apply:

- a. Agreement specified criteria;
- b. American National Standards Institute (ANSI);
- c. American Society for Testing and Materials (ASTM);
- d. Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA);
- e. Institute of Electrical and Electronic Engineers (IEEE);
- f. National Electrical Contractors Association (NECA);
- g. National Fire Protection Association (NFPA) National Electric Code (NEC);
- h. National Electrical Manufacturers Association (NEMA);
- i. Occupational Safety and Health Act (OSHA);
- j. Underwriters Laboratories (UL); and
- k. Applicable local public agency standards.

Unless specified elsewhere in the Agreement, the Project specifications shall conform to the current TxDOT Standards.

For non-roadway related Work, Integrator shall obtain and ensure adherence of design to the applicable standards, criteria, and codes of the applicable owner of the non-roadway related improvement.

#### 3.1.3 Utilities

When not provided by the civil roadway contractor, the Integrator shall be responsible for bringing the necessary Utilities and power lines to the ROW as defined for each Project Segment. Integrator shall be responsible for obtaining all Utility installations, hook-ups and service extensions that are required and necessary to service and operate the System for each Project Segment. Integrator shall be

responsible for the supply and installation of all cabling conduit, trenching, and equipment, as necessary, to take power and communications from the utility access point(s) to the individual equipment items installed at the Tolling Zone.

Integrator shall install all Utilities, power lines and service extensions underground.

Integrator shall include Utility Owners in the partnering procedure to be implemented as a part of the Project. As a guideline, Integrator is encouraged to follow the "Utility Cooperative Management Process" (the Process) as provided in the Coordinated Solutions of Utility Conflicts in Transportation Projects, published by Texas Engineering Extension Service, Texas A&M University System.

Integrator shall keep Utility Owners well informed of Integrator's construction schedules and of changes which affect their Utilities, as well as giving Utility Owners sufficient time to notify their customers of any potential impacts to service.

Integrator shall cooperate with Utility Owners to the extent that such cooperation is consistent with Integrator's obligations pursuant to the Agreement and the Work. Integrator shall act diligently in maintaining a positive relationship with the Utility Owners.

The Integrator shall maintain responsibility for the billing and payment of all utilities until System Acceptance is complete. At such time, the Integrator shall coordinate with TxDOT to turn over all utility responsibility and billing.

Work performed on the CTTS at existing toll facilities shall already include power and communications. The Integrator shall connect to these existing utilities at their current termination points. The Project Segment Supplement shall define the demarcation point of power and communications and the method of termination.

#### 3.1.4 Network Communications

Access to communications for the Tolling Zones to communicate with authorized remote facilities shall be supplied by TxDOT somewhere within the roadway Final ROW. For facilities where a fiber backbone already exists, Integrator shall be responsible for connecting to the communications access point and for supply and installation of communication cables and equipment to bring communication to the Tolling Zone as well as for providing and installing communication cables and equipment within the Tolling Zone. This work includes all conduit, cables, and equipment. All other communications access required for Integrator's proposed system shall be the responsibility of the Integrator. This shall include coordinating the provision and connection to a leased commercial line.

#### 3.1.5 Design Coordination

##### 3.1.5.1 Toll Gantries

Integrator shall coordinate with the Design Engineer to develop a design for a suitable set of gantries to accommodate the proposed Tolling Zone. Integrator shall present to TxDOT for review and approval the tolling gantry concept for the Project Segment. Except as required to address site specific conditions, Integrator shall use standardized tolling gantries for like project implementations.

### 3.1.5.2 Emergency Generator

The Integrator shall coordinate with the Design Engineer to develop a design for an Emergency Generator for back-up power in the event of a utility outage including the generator pad. The electrical generator may be powered by diesel, natural gas or propane. The generator's fuel system shall use preservatives or other methods to keep the fuel in good working order for a minimum period of five years. The generator's fuel tank shall be sized to run under full load for a minimum of 48 hours. Emergency power generators shall be the self-starting type and incorporate automatic switching gear such that upon loss of utility power, generators begin operation and supply power for all operations before UPS power ends. Thus, continuous operation of the Tolling Zone shall be possible, regardless of power outages.

The electrical output of the emergency generator shall be rated to support a 3-lane x 3-lane configuration with 33% power growth at the Tolling Zones, at a minimum. Generator's rated output shall consider derating for high and low temperatures and elevations which may be present at the installed locations.

### 3.1.5.3 Roadside Electronics Housing

The Integrator shall coordinate with the Design Engineer to develop a design for roadside electronics housings. Tolling Zone controllers and other roadside electronics shall be housed in NEMA 4X, or similar, dust-tight and watertight enclosures. The housing shall be a secure, heated and air conditioned enclosure. The use of a roadside cabinet for individual locations will be determined through mutual agreement between the Integrator and TxDOT.

All cabinets and housings shall be fitted with required gaskets, grommets, and filters to prevent the entry of dust, dirt, smoke, moisture or other contaminants from entering the enclosures in accordance with the application in which the equipment is employed.

### 3.1.5.4 Dynamic Toll Pricing Signs

The Integrator shall coordinate with the Design Engineer to develop a design for sign support structures to support full dynamic toll pricing signs or hybrid static/dynamic toll pricing signs. In the event that hybrid static/dynamic toll pricing signs are used, the Integrator shall coordinate with the Design Engineer regarding only the design of the dynamic aspect of the signs and associated power and communications to the signs. Refer to Section 3.2 for more information.

### 3.1.5.5 Static Signs

Typically the static signs approaching and surrounding the toll zone will not be included in a Project Segment's scope of work; however, local TxDOT Districts may choose to include the signs in the civil roadway contract. In the event that this work is not included in the civil roadway contract, the Project Segment shall include this scope of work. The Integrator shall coordinate with the Design Engineer for the placement of the static signs, as necessary.

### 3.1.5.6 Utilization of Existing Facilities

The Integrator shall coordinate with the Design Engineer to develop a plan for utilizing existing structures following direction by TxDOT to upgrade the CTTS cash collection system. To the extent possible, the Integrator shall utilize existing structures and facilities for design and installation.

## 3.2 ADVANCE TOLL SIGNING

### 3.2.1 Dynamic Toll Pricing Signs

In coordination with the civil roadway contractor and the Design Engineer, Integrator shall develop, procure and install dynamic toll pricing signs within the Final ROW for the Project. The scope of the Work for dynamic toll pricing signs includes: (i) determination of dynamic display schematics and specifications, (ii) determination of sign locations, and (iii) installation of new signs.

General criteria to be used by Integrator in determination of dynamic toll pricing sign locations for the Project will be as follows:

- a. On Project Segments that include a variable pricing component;
- b. At all locations preceding a variably priced segment of the Project.

Integrator shall coordinate with the Design Engineer a layout indicating the locations of all dynamic toll pricing signs

The specific design and message(s) to be included on the dynamic toll pricing signs shall be determined during the sign design process by TxDOT, the Design Engineer, and coordinated with the Integrator.

### 3.2.2 Static Signs

In the event that static signage is included within the Integrator's Scope of Work, the following section shall apply.

In coordination with the Design Engineer, Integrator shall procure or manufacture and install all guide, warning, regulatory and TxTag signs pertaining to the Work that are within the existing Project Segment right-of-way and are in accordance with the current TxDOT standards and the TMUTCD. The scope of the sign procurement and installation pertaining to the Work may include: new sign installations located along the proposed Project (including signs required at the Tolling Zones), modification or relocation of existing signs located along the proposed Project, new signs and/or replacement signs on existing roadways, and guide signs in accordance with these Technical Provisions. This work may include trailblazer signs.

Integrator shall cooperate with the roadway contractor for the Project Segment and shall perform the Work in a manner that minimizes disruption to the construction of the roadway by the roadway contractor.

### 3.3 STRUCTURAL CONNECTIONS

#### 3.3.1 Codes, Standards and Specifications

Unless otherwise specified, the Design Engineer's design shall be governed by the standards, policies, and specifications listed below with all addenda, supplements, and revisions thereto. In the event of conflicting requirements, the following hierarchy of standards will apply:

- a. Agreement specified criteria;
- b. TxDOT;
- c. AASHTO Standards;
- d. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals;
- e. AASHTO Guide Design Specifications for Bridge Temporary Works;
- f. FHWA Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines, Demonstration Project 82 Ground Improvement;
- g. TxDOT Standard Specifications for Construction of Highways, Streets and Bridges ("TxDOT Standards"); and
- h. Applicable State and local building codes.

#### 3.3.2 Shop and Working Drawings

Integrator's designers shall review, approve, authorize and confirm any methods or procedures requiring submittals to the Division of Bridges and Structures, which are enumerated in the current TxDOT Standards.

The Integrator shall generate shop and working drawings as necessary to clearly define, control, and install the Work. These working drawings shall be sent to TxDOT for review and approval. Working drawings requiring signing and sealing per current TxDOT Standards shall be signed and sealed by a qualified Registered Professional Engineer, prior to being issued for installation.

Integrator shall coordinate the preparation, submittal and review of all such shop and working drawings.

Shop and working drawings for the Work shall include structural steel fabrication plans, anchor bolt layouts, shop details, erection plans, equipment lists and any other information specifically required by the QM or current TxDOT Standards. Any procurement or fabrication of materials without approved shop drawings shall be solely at Integrator's own risk. Under no circumstances may Integrator commence fabrication of any bridge superstructure elements without approved shop drawings.

Shop and working drawings and calculations for overhead signs, temporary support systems, and other temporary Work that describe the methods of installation proposed to be used for the Work shall be prepared by Integrator in accordance with the QP. TxDOT will not review or regularly receive copies of these submittals unless it specifically requests such documents. Receipt of submittals for temporary

Work by TxDOT shall in no way constitute approval of the planned Work or impose any liability upon TxDOT.

Approved shop or working drawings shall be provided to TxDOT at least five (5) Business Days prior to the start of any Work detailed by those drawings. Any deviations from approved shop or working drawings shall require that Integrator submit revised drawings back to TxDOT, for their approval as outlined above.

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## Section 4 TOLL SYSTEM REQUIREMENTS

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### 4.1 GENERAL REQUIREMENTS

#### 4.1.1 Hardware Requirements

##### 4.1.1.1 System Life

The system design shall ensure a ten (10) year minimum Service Life. Equipment shall be designed, fabricated, and tested to ensure that it operates satisfactorily without material degradation for a minimum of ten years. Expendable and consumable materials and supplies will not be included in this requirement.

##### 4.1.1.2 New Equipment

All equipment, supplies, and materials for this system shall be new and unused, when installed. Materials and products which have been previously used for development work, leased systems, or any other type of used equipment, will not be permitted.

##### 4.1.1.3 Modular Design

Modular Design principles are preferred to be used throughout the system, and may be defined as the packaging of components together in replaceable units according to the function they perform and by using standardized hardware and components to achieve flexibility of use and to facilitate maintenance. Replaceable and repairable modules shall be used whenever possible to simplify troubleshooting, reduce downtime, and reduce operational and maintenance costs. Components shall be designed to ensure in-lane calibration and operational verification is minimized.

##### 4.1.1.4 Accessibility

All assemblies, subassemblies, and modules shall be readily accessible for removal, testing or replacement without extensive removal of other modules or assemblies. Components shall be located so that there is visibility and access for the use of hand tools and standard test probes where maintenance is required.

##### 4.1.1.5 Circuit Protection

Components and devices which are susceptible to damage upon failure of the regulating element within a power supply shall be protected by means of an over-voltage protective circuit. All fuses shall be mounted with retention devices at both ends. All fuse types shall contain visual indicators to indicate a blown fuse. The Integrator's design and recommendations shall conform to the applicable lightning protection, surge, and transient protection standards, such as NFPA-78, IEEE Std 587, and UL-1447, as they apply to each area of protection.

#### 4.1.1.6 Housings and Cabinets

The material and finish for new housings and cabinets shall be environmentally resistant to outdoor highway environments with wide temperature fluctuations and heavy use of salt. A minimum of ten (10) years service without additional painting or repairs is required. All cabinets and housings shall be fitted with required gaskets, grommets, and filters to prevent dust, dirt, smoke, moisture or other contaminants from entering the enclosures in accordance with the application in which the equipment is employed.

#### 4.1.1.7 Hardware

All mounting hardware, bolts, nuts, studs, washers, brackets, screws, hinges, and others shall be new and shall be constructed of non-corrosive material, and of a design to perform their respective functions for the specified ten (10) year system life.

#### 4.1.1.8 Fabrication

All chassis, attachments, and hardware shall be fabricated from corrosion and rust resistant materials, or properly plated to achieve corrosion and rust resistance. For those housings and cabinets requiring locked covers, there shall be no exposed hardware visible or accessible from the outside. The covers shall fit flush with the main body of the housing with no exposed gaskets or seals visible when the cover is closed.

#### 4.1.1.9 Stainless Steel Materials

The provision and fabrication of all stainless steel materials used in the system shall conform to current ASTM requirements. All welds shall be thoroughly cleaned to remove all oxide scale. Discoloration resulting from the welding process shall be removed from all external surfaces. All grinding, polishing and buffing shall be in accordance with the requirements of the material used.

### 4.1.2 Applicable Codes

All work for this Contract shall be in conformity with the current requirements of the following:

- a. National Electrical Contractors Association (NECA);
- b. Occupational Safety and Health Act (OSHA);
- c. National Fire Protection Association (NFPA) National Electric Code (NEC);
- d. National Electrical Manufacturers Association (NEMA);
- e. Institute of Electrical and Electronic Engineers (IEEE);
- f. Applicable Electronic Industries Association (EIA) Standards for Interface and Intercommunication; and
- g. Underwriters Laboratories (UL).

### 4.1.3 Equipment Diagnostic and Self-Test Requirements

Diagnostics shall operate automatically to detect all malfunctions and failures and to report such failures to the MOMS system at the time of occurrence. Diagnostic Software shall be provided to evaluate all aspects of the Tolling Zone operation including communications.

#### 4.1.4 Electrical Requirements

Integrator shall facilitate access to Utility electrical power for all parts of the Tolling System up to and within the roadway Final ROW. Integrator shall be responsible for connecting to the utility power and for supply and installation of power cables and equipment to bring power to the Tolling Zone as well as providing and installing cables and equipment to distribute power within the Tolling Zone.

Integrator shall provide equipment for filtering, conditioning, and distribution of line power to all necessary Tolling Zone equipment. Integrator shall provide an Uninterruptible Power Supply (UPS) as well as emergency backup generator power for each Tolling Zone. The design may utilize a single generator for more than one Tolling Zone. The Integrator shall provide appropriate switching hardware to provide for continued uninterrupted operation of the Tolling Zone spanning an interruption of utility power until emergency generators come on-line and utility power is restored. In addition, generators, UPS, and line power shall be integrated into the system such that when generators become operational and/or line power returns, the UPS shall switch to charging operations while still protecting UPS-powered equipment and providing filtered power to designated equipment.

The UPS shall supply sufficient power so that no data is lost or altered due to the power failure for a minimum period of sixty (60) minutes and shall allow regular operation of all system equipment as required to keep the following functional capabilities fully operational during the power failure:

- a. Vehicle detection, ETC tag read capability and transaction processing;
- b. Video image capture capability;
- c. Variable pricing capability including the speed/traffic detection equipment and pricing subsystem(s);
- d. Cash collection capability;
- e. Violation Signals (for Managed Lanes);
- f. Automatic Vehicle Classification (AVC) capability; and
- g. Communications within the Tolling Zone as well as communications to systems external to the Tolling Zone such as the dynamic sign displays and pricing capability.

All tolling system equipment, excluding dynamic toll pricing signs, shall be powered by systems backed up by the emergency generator. In addition, generators and line power shall be integrated into the system such that when generators become operational and/or line power returns, the UPS shall switch to charging operations while still protecting powered equipment and providing filtered power to designated equipment.

Generator power shall come on-line within five minutes after utility power is lost. When utility power is restored, use of utility power shall resume automatically.

The UPS shall be self-monitoring and shall provide operational status, fully charged, charging, depleted, and system failure messages to the MOMS system. UPS should contain SNMP management cards. UPS should send traps to notify Key Personnel of outages or faults.

Complete diagnostic reporting of the power systems, UPS, and backup generators shall be available via the maintenance monitoring function of the Integrator's System.

#### 4.1.5 Capacity and Data Retention

Tolling Zone capacities and data retention capabilities shall be sufficient to meet the operational requirements of the Contract Documents.

In the event that any part of the communications between the various system components (such as a Tolling Zone and the external computer systems with which it communicates) is interrupted, Tolling Zone components shall be designed to run independently, recording all necessary toll operations data for extended periods.

The Tolling Zone shall be able to operate for at least 30 days without communications to external computer systems. During such time, all toll transaction data and images and other data normally communicated to external systems shall be saved for later transfer, when the communications link is restored.

In addition, the Tolling Zone controllers shall be able to read from and write to a portable device, data which would be normally conveyed via communications link. This device shall then serve as the transfer medium for data to and from the external computer systems.

The tag status file shall provide the status for all toll tags issued in Texas and in future other states as well. The system shall be configured to utilize a tag status file as large as 100,000,000 tags. Each Tolling Zone controller shall be able to determine tag status for a transponder account status database of at least 100,000,000 transponders.

In the event transaction and image data cannot be transmitted to the CSC as required for a period of longer than one day (24 hours), the Integrator shall transfer transaction and image data to the CSC at least daily by other means until normal processes can be restored. In the event the tag status files cannot be transmitted to the PHS as required for a period of longer than one day (24 hours), the Integrator shall transfer tag status files to the PHS at least daily by other means until normal processes can be restored. Refer to Section 4.3.5 for more information.

Integrator shall maintain indicative averages (which may include historical or other relevant information) for a minimum of the previous 180 days (or such lesser period if less than 180 days of Dynamic Mode have elapsed), broken out by direction to at least every hour during non-Peak Periods and every half hour during Peak Periods, of Base Toll Rates on the Managed Lanes or as otherwise approved by TxDOT.

#### 4.1.6 Environmental Requirements

The Integrator shall thoroughly investigate all environmental factors that may affect the operation, reliability, and life of the system to be provided under this Contract and shall select equipment that is

appropriate for operation in the environment or shall take adequate steps to protect the equipment from the environment.

The Tolling Zone equipment shall be capable of meeting NEMA 4X or MIL-STD-810 standards to perform under the environmental conditions typically associated with any Work location.

The Integrator shall provide certified results from prior testing by the manufacturer or an approved independent test lab to satisfy the environmental qualification requirement. For equipment that is to be installed in an environmentally controlled housing or building, catalog cut sheets showing environmental operating requirements will be acceptable.

#### 4.1.7 Lightning Protection

The following specifications and standards of the latest issue form a part of this specification:

- a. Underwriters Laboratories, Inc., (UL) Installation Requirements for Lightning Protection Systems, UL 96A
- b. Underwriters Laboratories, Inc., Lightning Protection Components, UL 96

#### 4.1.8 Time of Day/Date Control and Synchronization

All processing hardware, computer terminals, and any other device whose operation involves current date and time data for system functionality shall have automatic synchronization features such that all equipment time and date parameters are within necessary synchronization to provide full time correlation with all Tolling Zone events. Synchronization shall ensure that the date/time of every element of the system be within 0.1 seconds of the Master Clock.

The System shall use Coordinated Universal Time (UTC) that is synchronized to within one second of UTC established by <http://nist.time.gov>. The Integrator shall design the Tolling System to receive time updates and ensure that the current time is downloaded to the Tolling Zone controllers.

System Date and Time functions shall automatically account for time zone (Texas has two time zones), standard time/daylight saving time changes and for leap years.

## 4.2 TOLL SYSTEM DESIGN

### 4.2.1 Project Initiation Conference

No later than forty-five (45) Calendar Days following issuance of the NTP, the Integrator shall participate in a Project Initiation Conference with TxDOT. The conference will be coordinated and moderated by TxDOT. The conference should last no more than three (1) Business Days. The purpose of the conference shall include, but not be limited to:

- a. Introduce key personnel of the Integrator, TxDOT, and TxDOT's consultants;
- b. Review the overall project design as based on the Integrator's proposal and TxDOT requirements;

- c. Review key aspects of the project management plan, the Quality Management Plan, the initial project schedule;
- d. Review the preliminary requirements trace matrix and discuss any exceptions; and
- e. Any early project coordination.

The Integrator shall cooperatively develop an agenda for the Project Initiation Conference with TxDOT. The Integrator shall develop and deliver a presentation and any documentation to support the review of the proposal and aspects of the work to be performed by the Integrator.

#### 4.2.2 Preliminary Design Phase

The Preliminary Design Phase shall include the coordination and development of the Preliminary Design Documentation (PDD). This design phase shall apply any relevant feedback and critical input received at the Project Initiation Conference into the development of a PDD. The PDD shall include a high level overview of the Integrator's design, system interfaces, and any design issues and risk mitigation. The PDD shall act as a confirmation of the Integrator's further understanding of the project design and delivery requirements. The PDD shall be a pre-cursor to the System Design Document (SDD). An approved PDD will be used as a guideline for the discussions held during a Preliminary Design Review (PDR). The PDR shall be a workshop held between Integrator and TxDOT staff, and shall be used to further coordinate and advance the Integrator's system design.

##### 4.2.2.1 Preliminary Design Documentation

The Preliminary Design Documentation (PDD) shall include detailed information on schedule, organization, technical approach, methodology, risk mitigation and other issues related to a complete plan for software development. The topics for the PDD shall include, but shall not necessarily be limited to, the following:

- a. Schedule;
- b. Organization;
- c. Methodology;
- d. Overall System Architecture;
- e. Requirements for each System or Subsystem;
- f. Any Project specific quality management;
- g. Software Development Plan;
- h. Integrator Organization;
- i. Installation Plan;
- j. Examine and Assess Alternatives, where appropriate, for Each Subsystem or Component;
- k. Assess Design Issues and Associated Risk;
- l. Risk Mitigation; and

m. Status of environmental testing for system components.

In addition the Integrator shall address and show compliance with quality assurance, reliability, maintainability, software development and other system requirements. Hardware concept drawings and preliminary level engineering specifications shall be submitted during this review.

#### 4.2.2.2 Preliminary Design Review

The Integrator shall conduct a Preliminary Design Review (PDR). The PDR shall be a formal presentation to TxDOT covering the preliminary plan for design and development of the Software and Hardware. The PDR shall include Integrator representatives from the major systems and subsystems. The PDR presentation shall last no more than one (1) Business Day.

Topic for the PDR should include, but not be necessarily be limited to the major sections included in the PDD.

#### 4.2.3 Detailed Design Phase

The Detailed Design Phase shall include the coordination and development of the Detailed Design Document (DDD). This design phase shall apply any relevant feedback and critical input received during the PDR and any interim design workshops/webinars into the development of a DDD. The DDD shall be based off of the PDD layout and content.

The initial draft DDD will be used as a guideline for the discussions held during a Critical Design Review (CDR). The CDR shall be a workshop held between Integrator and TxDOT staff, and shall be used to discuss and finalize the Integrator's System design. Based on input from the CDR, a Final Approved draft DDD will be submitted by the Integrator for final review by TxDOT. Once approved the DDD will be used as the basis for development of the System.

##### 4.2.3.1 Detailed Design Documentation

The Integrator shall provide functional narrative text, system and subsystem block diagrams, data flow diagrams, data structure diagrams, schematics and any other graphic illustrations to demonstrate the technical adequacy of the system design approach and compliance for system hardware and software with quality assurance, reliability, maintainability, software development, and other requirements of these specifications.

The Detailed Design Document (DDD) shall be reviewed at the Detailed Design Review. The DDD is the extension of the Contract Documents, the Proposal, and the approved PDR document. It shall include such detail as block diagrams, screen layouts, report formats, software design, testing procedures, operational procedures, and other pertinent design documentation. A list of equipment for each function along with a description of its role shall be provided. Any equipment listed in the DDD that has not been listed in the Price Sheet or supplemental price sheets shall be accompanied by the equipment specifications. Such equipment shall be provided at no increased cost to TxDOT.

The topics to be discussed in the DDR shall include at least but not limited to the following:

- 3) Compliance Trace Matrix
- 4) Document Requirements and Explanation, including:
  - (a) Tolling Zone Design
    - (i) Functionality
    - (ii) System Function Flow Chart – Each Tolling Zone Type
    - (iii) Hardware, Specifications and Integration
  - (b) Project Host Server
  - (c) ETC Subsystem
  - (d) Speed Detection Subsystem
  - (e) Cash Collection Subsystem
    - (i) Manual Lane Collections
    - (ii) ACM Lane Collections
  - (f) AVC Subsystem
  - (g) Image Capture Subsystem
  - (h) Variable Pricing Subsystem
  - (i) Trip Management Subsystem
  - (j) Dynamic Toll Pricing Signs
  - (k) Network Communications
  - (l) Maintenance Functionality
    - (i) MOMS
    - (ii) Maintenance Service and User Interface
  - (m) Software / Database Design
    - (i) Software Specification
    - (ii) OS
    - (iii) Programming Language
    - (iv) Version Management
  - (n) Reports

- (o) Performance Standards
  - (i) Capacities
  - (ii) Degraded Modes of Operations
  - (iii) Vehicle Speed
  - (iv) System availability calculations
- (p) Environmental Testing Results

#### 4.2.3.2 Critical Design Review

The Integrator shall conduct a Critical Design Review (CDR). The CDR shall be a formal presentation to TxDOT covering DDD on how the design and development of the Software and Hardware meet all project delivery, functional, and performance requirements. The CDR shall also include information on identified risks and the associated mitigation, and review the quality assurance methods that will verify and screen the implementation of the designed System. The CDR shall include Integrator representatives from the major systems and subsystems. The CDR presentation shall last no more than one (1) Business Day.

Topic for the CDR should include, but not be necessarily be limited to, the major sections included in the DDD.

### 4.3 FUNCTIONAL REQUIREMENTS

#### 4.3.1 Functional Capabilities

The Tolling System developed under this contract shall have the following functional capabilities:

- a. The system shall detect vehicles passing through the Tolling Zone either on the traffic lanes or on the shoulder and shall generate an ETC or image based toll transaction;
- b. The system shall correctly read the tag and produce a toll transaction for vehicles carrying properly mounted valid, working tag that pass through the Tolling Zone;
- c. The system shall capture image(s) of the front license plate and image(s) of the rear license plate for vehicles passing through the Tolling Zone;
- d. The system shall capture image(s) of the front license plate and image(s) of the rear license plate, but is not required to generate an ETC transaction or classify the vehicle, for vehicles traveling in the reverse direction (applies only for road configurations that do not incorporate a median or barrier separation between opposing directions of travel) or for vehicles that are traveling on the shoulder as they traverse a Tolling Zone;
- e. For those transactions that result in image capture, the transaction record shall indicate the reason the image capture occurred;
- f. The system shall accurately classify vehicles passing through the Tolling Zone, either according to the number of axles on the vehicle or according to vehicle shape (height, width and length) as approved by TxDOT;

- g. For every vehicle the system shall accurately assign the toll due based on the measured classification of the vehicle and the pricing in effect at that particular time of day for the AVC measured vehicle class;
- h. The system shall communicate with the TxDOT provided CSC Host, which is the reference to the central computer system that supports the account management functions;
- i. The system shall communicate with the CSC Host system to receive the tag status file; and
- j. The system shall communicate with the CSC Host system to send toll transactions and images.
- k. The system shall communicate with the CSC Host system to receive tag / plate association data.
- l. The system shall measure and record vehicle speeds
- m. The system shall include the capability to calculate the toll price on a variable basis, based on user configurable parameters
- n. The system shall include the capability to display the current toll rates on dynamic message signs

#### 4.3.2 Communication

The Integrator's Tolling Zone controller shall be designed to meet all performance requirements while communicating with the CSC Host system either directly or via an Integrator provided intermediary computer system. To the extent possible, all communication based links shall operate at a minimum 1Gbps.

#### 4.3.3 Message Formats/Protocols

Necessary message formats and communication protocol for communicating with TxDOT's CSC Host are provided in Attachment A.

#### 4.3.4 Maintenance Online Management System

Integrator shall provide a MOMS for all new Project Segments as part of the Work under this Contract. The MOMS shall allow for monitoring and reporting of equipment failures within the entire set of Tolling Zones that may be procured under the Agreement. The MOMS shall be the primary point for TxDOT staff to verify system performance compliance. MOMS shall contain all relevant data required to identify and track maintenance activities, parts usage, personnel and time. Also, MOMS shall be the mechanism to record all maintenance communications from TxDOT or TxDOT representative for maintenance related requests (i.e. maintenance calls for corrective maintenance, system failures, etc) via Help Desk, email or phone.

The MOMS shall be the focal point for all Tolling System maintenance activities including routine preventive and corrective maintenance, real-time monitoring, repair calls, report generation, etc. The intent of MOMS is to provide a user-friendly "dashboard" of information that can be used with little to no training. At a minimum, the MOMS shall be capable of providing the following information:

- a. Current Tolling Zone operational status;

- b. Failure and/or malfunction location;
- c. Failure and/or malfunction description (w/ priority level);
- d. Spare parts inventory quantity and control;
- e. Part and equipment description (including part number and serial number);
- f. Record of last maintenance activity for a part entered by maintenance staff;
- g. Record of last preventive and corrective maintenance activity for a part as entered by maintenance staff; and
- h. Historical system information/report generation.
- i. Initiation individual or party

The Integrator shall track all work orders in MOMS. The MOMS shall provide a status report of all work orders even if work is performed remotely. In addition, The MOMS system shall track staff times utilized for various tasks via the work orders.

For corrective maintenance purposes, the MOMS shall track all response times and repair times. System event or failure notifications may be initiated through a phone answering service, 24 hours a day, 7 days a week, 365 days per year which then contacts the appropriate technician or the maintenance Integrator.

The MOMS system shall operate from a relational database and provide extensive reporting capabilities. Maintenance categories are configurable to allow TxDOT at no expense to TxDOT flexibility in defining reporting requirements that are available through MOMS. The MOMS provides for tracking preventive maintenance activities and provides the ability to be used as a predictive maintenance analysis tool. TxDOT will have direct access to the MOMS database through the all system reports, and the Integrator shall have all maintenance activity data entered within 24 hours time after the maintenance activities have occurred.

No separate tracking system shall be utilized.

#### 4.3.4.1 Failure Detection and Reporting

The MOMS shall be designed with the ability to generate work orders with no human intervention. Work order formats and specifications shall be determined during the design process and approved in writing by TXDOT, or their designated representative. The MOMS shall provide for generating a minimum of four (4) different types of work orders, including ad hoc, preventive, corrective and emergency maintenance. The work order shall record the source of the work order, either as automatically triggered by MOMS monitoring, or the person reporting the failure (Integrator's maintenance technician or TXDOT staff member), or both. The MOMS shall also provide the capability to build ad hoc work orders for unusual maintenance activities. In addition, a work order shall include, but not be limited to, the following information:

- a. Date/Time of work order generation;
- b. Date/Time/Location of repair or maintenance call;

- c. Work order number (sequential); and
- d. Failure or malfunction description.

The MOMS shall also provide the capability to generate blank work orders for repairs or malfunctions not directly reported by the MOMS. Blank work orders shall still be generated for the sequential list maintained in MOMS.

The MOMS shall allow both automatic and manually activated paging of technicians once a work order has been generated.

The MOMS shall be designed to accommodate the assignment of priority levels for each failure type. MOMS shall assign an initial priority level to each failure but shall provide for manual override by Integrator or TXDOT personnel to account for aspects that impact severity level and MOMS cannot assess. The paging process shall check to determine the assigned active technician and update the dispatch grid to include the new service call. MOMS shall monitor the disposition of service calls and shall generate a page to the maintenance technician and/or the maintenance manager for any work order not responded to or repaired within the required time.

#### 4.3.4.2 System Monitoring

The MOMS shall report the status and performance of all levels of the System equipment in real-time. The MOMS shall monitor all System equipment provided by the Integrator under the Project Segment. The performance monitoring shall be accessible from any workstation on the TxDOT WAN, or via VPN access, provided the user has the proper access level. The performance monitoring function shall allow the user to select and observe the status and/or performance of several pre-defined portions of the System. The following is a breakdown of the various levels, and, at a minimum, the degree of information required to be displayed for each level:

- (a) Project Host Server/Plaza Host Computer
- (b) Managed Lane Server (if separate)
- (c) Tolling Zone level components;
- (d) All equipment statuses for:
  - (i) Status of all Tolling Zone applications;
  - (ii) Tolling Zone identification (ID);
  - (iii) Tolling Zone location (Plaza, Tolling Zone ID);
  - (iv) Tolling Zone overall operation status (operational/degraded);
  - (v) Current operational status of each major subsystem; and
  - (vi) Status of Tolling Zone communications link.

#### 4.3.4.3 Availability Tracking

The MOMS shall track and calculate the availability of the Tolling Zone by function as defined in Section 4.3.17. The calculations shall be performed automatically whenever Availability report is run. The availability report shall take into account the number of installed Tolling Zones and the length of outages affecting the particular Tolling Zone function. The availability report shall be provided both for individual Project Segments and for user selectable groups of Project Segments. The availability report shall be provided for user selectable time intervals.

#### 4.3.4.4 Remote Access

The MOMS shall be designed with the capability to allow technicians and other users to access the MOMS network over the internet. Technicians or maintenance staff shall typically utilize this function while off-site or to log-in and close out a work order. Remote access shall be designed to utilize typical remote access connection tools typically found on laptop computers.

#### 4.3.4.5 Inventory/Spare Parts Control

The Integrator shall provide a fully integrated spare parts inventory control subsystem or functionality as part of the MOMS. This function shall be integrated with the Work Order generation function which shall automatically update and maintain the system and spare parts inventory based on Work Orders and technicians recording of parts used during work order closeout. The Integrator shall fully document the procedures, controls, software applications and facilities intended to be used to process and track the spare parts inventory.

Spare parts control and monitoring shall be administered and reported through the MOMS only.

##### 4.3.4.5.1 Project Segment Spare Parts Inventory

As part of the Integrator's maintenance activities inventory reports shall be provided to TxDOT on a monthly basis. Additionally TxDOT shall also have access to these reports at any time via the MOMS:

- a. Inventory listing of all spare parts and components in inventory by location including all storage facilities.
- b. Spare parts usage report.

The inventory of spare parts and components shall be accurate and auditable through MOMS throughout the term of the purchase order. As part of the tracking process, all parts shall be encoded with a parts list number and Serial number. The inventory function shall keep track of warranty information for parts used and provide information to receive warranty reimbursements when required.

The Integrator shall be responsible for providing fully assembled and tested spare parts and components to replenish those that are used in the maintenance process. The Integrator shall replace all parts and components used during the term of the purchase order at no cost to TxDOT,

and shall turn over to TxDOT at the end of the purchase order a full spare parts inventory. Upgrades to and replacements of hardware shall be the financial responsibility of the Integrator

The Integrator, based on experience and analysis, shall closely monitor the need for spare parts and components. This should include the identification of parts that are no longer available, those that are obsolete, etc. Purchasing, shipping, testing, and maintenance of spare parts is to be provided at no expense to TxDOT.

TxDOT reserves the right to approve any changes of the spare parts and components inventory during the term of the purchase order of the purchase order.

All spare parts shall be maintained in good operating condition at all times. The Integrator shall provide suitable storage facilities for all spare parts and components.

#### 4.3.4.5.2 Substitution of Parts and Equipment

The Integrator may substitute for parts, components and equipment upon written approval from TxDOT for each specific substitution. The Integrator shall provide documentation on any parts prior to substitution.

#### 4.3.4.5.3 Quality Control and Assurance

The Integrator shall assure that all parts, components equipment, materials and other items purchased for use in the system are new whenever practical. All parts and repairs shall be of good quality and designed to reliably carry out their functions within the system and meet the requirements of this purchase order.

### 4.3.5 Tolling Zone Controller(s)

The Integrator shall furnish and install Tolling Zone controllers for every Tolling Zone implemented under the Agreement. The Tolling Zone controller shall be designed to provide very high reliability and availability. Subsystem maintenance messages shall be generated and sent to the maintenance on-line management system (MOMS) when any of these Tolling Zone operational changes of operational unit occur.

The Tolling Zone controller shall be capable of controlling all lane equipment, components, and subsystems that constitute the Tolling Zone equipment complement. The Tolling Zone controller shall also be capable of real-time data communications with the TxDOT provided remote computer system across a wide area network (WAN).

The Tolling Zone controller shall provide diagnostics on the performance of the Tolling Zone equipment as well as on its own performance and capacities. It shall be possible to remotely reset the Tolling Zone controller in the event of a malfunction or partial shutdown.

The Tolling Zone controller shall be designed to support the performance requirements that are summarized in Section 4.3.16.

If communications at the Tolling Zone are interrupted, after Tolling Zone site communications are restored, the system shall automatically upload all stored transactions, images, toll rates schedules and traffic data, and maintenance messages to the Project Host Server (PHS) that it is interfaced to, and verify that they were successfully transferred.

In the event of an extended communications failure, the Tolling Zone controller shall be designed to operate in a stand-alone mode such that stored data, which would usually be sent to the Customer Service Center Host or MOMS server, can be copied to removable media or to a laptop computer. This shall include all Tolling Zone lane information and transaction data from the Tolling Zone controller, transponder status files, toll rate schedules and related ETC operational data that can be transferred to the Tolling Zone controller.

The Tolling Zone controller shall be able to continue to operate indefinitely in a stand-a-lone mode if the essential data is manually transferred on a periodic basis via laptop computer, or other media device as described above.

Tolling Zone controllers shall record and maintain detailed logs to support maintenance and troubleshooting activity. System activity logs shall be available, via telnet, secure socket shell (SSH), web-server, or other approved method, for at least 30 days, without adversely affecting the normal operation of the Tolling Zone controller. Logs shall include, as a minimum:

- a. Chronologic list of events from sensors involved in building toll transactions, each date and time stamped. The list shall include events from vehicle sensors, ETC readers, and all other input, and output devices such as employee login/logout communication status changes, subsystem performance changes (e.g. system degradation).
- b. Chronologic list of system events including, tag file database updates, employee access authorization matrix updates, toll table updates, employee subsystem access (i.e., login/logout), software updates.

#### 4.3.6 ETC Tag Reading

TxDOT requires that all systems deployed in Texas shall be interoperable. TxDOT currently uses the TransCore eGo Plus tag on its CTTS and ORTS projects. The Integrator shall provide and integrate the ETC readers and antennas that are compatible with the ATA protocol compatible tags. During the term of the Agreement, TxDOT may change protocols or standards. The Integrator will coordinate with TxDOT to upgrade the System and meet any changes needed for different protocols or standards.

The ETC subsystem shall read the tag in every vehicle in the tolled lane but shall not record tags in vehicles traveling in adjacent free lanes, and traveling in the opposite direction through the Tolling Zone. The system shall create one and only one transaction for each vehicle passage through the Tolling Zone.

#### 4.3.7 Image Capture

Image capture subsystem shall be installed to capture front and rear license plate images in every Tolling Zone traffic lane and in adjacent shoulders. The image capture subsystem shall include, but not be limited to, high speed cameras including an environmentally protected housing, lens, high speed

shutter, and filter (as needed), image capture trigger device(s), supplemental lighting, wires, cables and connectors, image processing software and hardware with lane equipment and network or server interfaces, mounting brackets, plates and components. These equipment and materials shall be designed, procured, integrated, installed, and tested to receive a signal and/or message when a vehicle passes through the tolling zone without a transponder. The image capture subsystem shall capture digital images of the vehicle's front and rear license plates. The number of images shall be as needed to ensure the capture of one or more readable license plate images. The system shall forward for human review no fewer than three (3) front images and three (3) rear images for each vehicle and the readability success rate shall be judged from the images forwarded.

The system shall be capable of capturing readable images of all license plates including motorcycle plates. The images and related transaction data shall be transmitted to an Optical Character Recognition (OCR) capability where the images are processed to acquire the plate number and jurisdiction of issue.

All image transactions involving lanes operating with defective equipment at the time of the transaction shall code the transaction as to the type of equipment malfunction.

The Integrator shall locate the image capture system cameras at certain angles and implement the image capture trigger process to minimize the capture of vehicle occupants.

#### 4.3.7.1 Optical Character Recognition

The OCR subsystem shall be provided to receive, process, and store images sent from connected cameras or from the Tolling Zone controller. It may be an element of the Tolling Zone controller or a separate standalone system. The OCR image processor shall OCR the images before storing and forwarding them to the Customer Service Center Host. The OCR subsystem may be located at each of the Tolling Zones or at a remote location.

The OCR process shall produce one OCR value including both plate number and jurisdiction of issue for all types of license plates including motorcycle plates. The OCR process shall be capable of reading plate fonts for plates issued by Texas and by all its contiguous neighbor states.

The OCR subsystem shall be capable of error logging and shall contain diagnostic software to report errors/failures to the MOMS to facilitate the response to problems encountered by the image capture system.

#### 4.3.7.2 Cameras

The number of cameras provided, camera orientation, and camera resolution shall be sufficient to support the image capture and OCR requirements. Camera housings and cabling shall be designed to meet environmental requirements.

The likelihood of capturing a full-plate image for each image transaction shall be maximized by ensuring that adjacent camera views overlap sufficiently and that image sets from both of two adjacent cameras are captured whenever the vehicle position straddles their field of view.

#### 4.3.7.3 Image Trigger

A reliable and accurate means of triggering the capture of images of the front and rear license plates of the vehicle shall be provided. The trigger device selected shall be capable of supporting the capture of vehicle images for vehicles traveling at any speed and/or for vehicles that are in a single lane or straddle adjacent lanes or travel (or straddle) the roadway shoulder. Components of the AVC system may be used to trigger Tolling Zone image transactions if the required performance of the AVC is provided. If a standalone image processor is implemented, in addition to interfacing with the Tolling Zone controller, the trigger shall interface directly with the image processor to support capture of the license plates of passing vehicles when communication with the Tolling Zone controller fails.

#### 4.3.7.4 Supplemental Illumination

Supplemental lighting shall be provided, if the Integrator deems necessary, to improve lighting deficiencies experienced at various times in the Tolling Zone lanes and enhance the quality of the captured image for OCR processing. Any supplemental lighting that the Integrator chooses to install shall be deployed within the current right-of-way of each Project Segment and shall not cause light pollution at Tolling Zones that are in close proximity to neighborhoods.

Image capture system lighting design shall avoid blinding or otherwise impairing the vision of approaching motorists (cameras for front plate capture) and departing the Tolling Zone (cameras for rear plate capture). The image capture system lighting design shall consider traffic in adjacent lanes and roads as well as traffic traveling in the opposite direction, where applicable. The preferred solution for the supplemental lighting is high speed, high intensity, pulsed or flashed light energized only when images are taken and for only the duration needed to capture images. The lighting design shall incorporate automatic intensity adjustment of the light source based on ambient light if and as needed to assure uniform quality of captured images and successful OCR processing.

The image capture system design shall incorporate provisions to actively monitor the status of the supplemental light source (working/not working) and report failures through to the MOMS system in a timely manner.

#### 4.3.8 Automatic Vehicle Detection and Classification

The system shall accurately classify vehicles passing through the Tolling Zone, either according to the number of axles on the vehicle or according to vehicle shape (height, width and length). On a case-by-case basis, TxDOT shall determine the method of vehicle classification to meet the regional or project specific needs.

Sensors and other necessary equipment shall be installed in the pavement or above all lanes, to automatically measure vehicle class and assess the proper toll. This equipment shall also enable the system to correctly associate payment and AVC class with the vehicle transaction so as to process properly paid vehicles and violators and avoid over or under charging vehicles because of an incorrect association of AVC.

The AVC classification data shall be used to assign the correct toll for that particular transaction. If the AVC equipment experiences degradation in performance that prevents the vehicle classification data from being used for toll rate assignment, the transaction record shall be flagged as such.

In-pavement devices comprising the AVC subsystem shall not experience any change or degradation of performance from temperature variations, weather conditions and/or from water collecting on the roadway surface.

The AVC subsystem shall accurately classify vehicles at speeds ranging from 5 mph up to and including 100 mph. If vehicles are traveling below 5 mph, the AVC system shall still attempt to classify the vehicle and pass the information along to the Tolling Zone controller even though there is no requirement to classify vehicles in this speed range.

The Tolling Zone controllers shall periodically determine the operational status of the AVC subsystem and if a device has failed, is failing or is degrading in its expected performance level, the controller shall report the status and nature of the failure.

#### 4.3.9 Cash Collection Subsystem

##### 4.3.9.1 AVC – Collector Classification

The AVC Subsystem shall classify vehicles as they pass through the Toll Zone. The AVC Subsystem shall log both the in-lane vehicle classification and any classification performed by the Collector in a Manual lane. The Collector shall have the ability to classify a vehicle in the Manual lane via visual inspection before the vehicle exits the Toll Zone. In a Manual and ACM lane, the AVC Subsystem shall default to a configurable vehicle class at the cash payment point within a Toll Zone.

##### 4.3.9.2 Collector Terminal

The Collector Terminal acts as the interface for the Collector to the Zone Controller. A Collector Terminal shall be installed at each Manual lane. The Collector shall have the capability of specifying aspects of all transaction types at the cash payment point including classification and payment type through the use of the Collector Terminal. The Collector Terminal shall administer the receipt actions, lane status, and the canopy light status.

The Integrator shall install an off-the-shelf Collector Terminal. The Collector Terminal shall utilize a touch-sensitive display screen. The touch screen shall meet NEMA 4X standard to be water, oil and dust proof. Touch screens shall be of a type such that toll collectors either wearing gloves or not wearing gloves shall be able to activate the screen. The touch screen shall include a non-glare surface. The Collector Terminal shall include adjustable display functions including contrast and brightness.

The Collector Terminal shall be an ergonomically adjustable flat panel screen not smaller than fifteen (15) inches diagonally. The Collector Terminal shall be VESA MIS-D 100 compliant. The Collector Terminal panel shall be adjustable to at least an angle of 30 degrees in all horizontal and vertical directions. The Collector Terminal shall be adjustable to at least 8 inches up and down.

The design of the interface displayed on the screen of the Collector Terminal shall be developed during the Preliminary Design Phase and finalized during the Detailed Design Phases of the Work. The design shall be approved by TxDOT. Refer to Sections 4.2.2 and 4.2.3 for more information. The Collector Terminal interface design shall allow the Collector to meet all business rules and standard operating procedures to be provided by TxDOT during the Preliminary Design Phase. At a minimum, the interface shall include the following:

- a. Collector ID;
- b. Time (local);
- c. Lane Status (i.e., Open, Closed, Emergency, Maintenance);
- d. Lane Error Code;
- e. Canopy Light Status;
- f. Traffic Light Status;
- g. Toll Fare and Customer Feedback Display (i.e., the rate or message displayed on the Collector Terminal shall be mirrored here);
- h. Transaction Type (i.e., Cash, ETC, Non-revenue, etc.);
- i. Vehicle Classification;
- j. Status of Transaction (i.e., No Vehicle, Vehicle, Closed);
- k. ETC Transponder ID/Status;
- l. Keypad/keyboard; and
- m. Typical keys for processing transactions and operating a lane.

Under normal operating conditions, the Collector Terminal shall maintain operating status until an explicit shutdown, restart, or standby command is given.

Operation of the Collector Terminal shall influence the toll rate or messages displayed on the Toll Rate and Customer Feedback Display.

#### 4.3.9.3 In-lane Receipt Printer

An In-lane Receipt Printer shall be installed inside each Manual lane and interface with the Collector Terminal. The In-lane Receipt Printer shall:

- a. print a receipt or receipts upon command via the Collector Terminal;
- b. be separate from any other device and no larger than 4" wide by 12" long;
- c. allow for the replacement of paper without the use of any tools;
- d. include anti-jam capabilities;
- e. include LED(s) to indicate printer status (on/off) and error status;
- f. include an on/off switch;

- g. be capable of printing no more than 40 characters per line and 300 horizontal lines per receipt;
- h. only partially cut the receipt so that is held in place until removed;
- i. print a cash receipt within 2 seconds of the specified command. All other receipts shall be printed within 7 seconds of the specified command.

The information displayed on the receipt shall be System configurable via a separate configuration file.

#### 4.3.9.4 Toll Fare and Customer Feedback Display

A display shall be installed at each Manual and ACM toll booth for displaying the toll fare and message text. The display shall display text on an LED display no larger than 8 inches by 4 inches. The display shall be controlled by the Collector Terminal and display the toll fare amount and other to be determined messages.

The display shall include a reading angle of 50 degrees with a minimum viewing distance of 15' in all weather and sunlight conditions.

#### 4.3.9.5 Automatic Coin Machines

Automatic Coin Machines (ACM) shall be installed at all ACM ramp plaza lanes. The ACMs shall include a dual vault system allowing for fail over during operations when one vault becomes full or malfunctions.

The ACM shall validate the paid cash fare with the vehicle classification as recorded in the lane or by a Collector in the lane. The ACM's physical dimensions shall fit within the existing cutout of the toll booths. The ACM shall be capable of accepting all United States (US) coin currency including the penny, nickel, dime, quarter, half dollar, and dollar. All other currency shall be immediately rejected.

The ACM shall be interfaced with the Collector Terminal, when necessary. The ACM shall be operated remotely and locally by either an internal control panel or the Collector Terminal. The ACM shall create, log, and transmit status data for all actions related to the collection, sorting, and depositing of cash into the vaults. Vaults used within an ACM shall have an automatic locking mechanism which prohibits access to the cash within the vault without proper credentials (or key(s)).

The ACM shall estimate the filled status of the vault as a percent of total and time/transactions to become full. The ACM shall monitor and log the total amount of coins per denomination that were received, including the rejected coins.

Vault access, removal, and replacement shall be logged through the use of a keypad or proximity reader. Vault access shall be controlled through the use of user roles and permissions.

#### 4.3.9.6 Lane Status Sign (Canopy Light)

A Lane Status Sign shall be installed above each ETC, Manual, and ACM lane. The Lane Status Sign shall include both green and red LED lights. The Lane Status Sign shall be capable of displaying a red "X" or a green down arrow for various types of lane statuses. The Lane Status Sign shall be operated remotely and locally by the Collector Terminal. The Lane Status Sign shall be capable of displaying a user configurable, default display if communications to the sign are lost. The default display shall be either of the two available options mentioned above.

The Lane Status Sign shall include a minimum viewing angle of 35 degrees with a minimum viewing distance of 1000' in clear and dry weather conditions during sunlight hours.

#### 4.3.9.7 Transaction Notification Light

A Transaction Notification Light shall be mounted downstream from the toll booth to notify the customer of the validity of the transaction payment. The Transaction Notification Light shall include both green and red lights. The Transaction Notification Light shall be capable of displaying either a green or red light to notify the customer if the full toll fare was received via cash or ETC.

The Transaction Notification Light shall include a minimum viewing angle of 15 degrees with a minimum viewing distance of 15' in all weather and sunlight conditions. The Transaction Notification Light shall be positioned so that the customer can view the light as the vehicle location notifies the Zone Controller that the transaction is complete.

#### 4.3.10 Cash and Vault Management System

Integrator shall provide a Cash and Vault Management System (CVMS) for all new cash Project Segments as part of the Work under this Agreement. The CVMS shall manage and reconcile the cash transactions from the main line and ramp plaza lanes. The CVMS shall manage and track ACM vault inventory and cash collected as reported by the Bank Depository service. The CVMS design shall allow the plaza staff to meet all business rules and standard operating procedures as described in Attachment D.

The CVMS shall organize Toll Collector cash transactions into a Collector Segments of Work. The CVMS shall organize the ACM transactions into Vault Segments of Work. A beginning of a Segment of Work shall be defined as when a Collector logs into a Manual lane or an ACM's vault is inserted and entered into service. The ending of a Segment of Work shall be defined as when a Collector logs out of the lane or an ACM's vault is removed from service and/or subsequently removed from the ACM.

Some transactions do not receive payment in the lanes, such as non-revenue transactions. The CVMS shall reconcile these non-payments into the Segments of Work.

The CVMS shall interface with the coin and bill counters in the main line plaza count room. The CVMS shall log all loose cash and coin totals counted and deposited as associated with a Collector's location of work and shift.

The CVMS shall create a summarized deposit manifest to include all lane cash deposits from the period following the previous bank deposit. The CVMS shall include the capability to add vault inventory, vault cash totals, Collector cash deposit totals, and cash transfer data from the Depository Bank. The CVMS shall include the capability to reconcile cash totals between vault cash totals, Collector cash deposits, and cash transfers from the Depository Bank.

#### 4.3.10.1 Coin and Bill Counters

Coin and Bill Counters shall be purchased to match or be compatible with the existing equipment in a main line plaza count room. Refer to Appendix B for hardware listing. The Coin and Bill Counters shall be installed inside each Count Room at a main line plaza and interface with the CVMS and Count Room Receipt Printer.

#### 4.3.10.2 Count Room Receipt Printer

A Receipt Printer shall be installed inside each Count Room at a main line plaza and interface with the CVMS, Coin Counter, and Bill Counter. The Count Room Receipt Printer shall:

- a. print manifests of a Collector's count drawer total;
- b. print a receipt or receipts upon command via the CVMS;
- c. be separate from any other device and no larger than 4" wide by 12" long;
- d. allow for the replacement of paper without the use of any tools. The Receipt Printer shall include anti-jam capabilities;
- e. include LED(s) to indicate printer status (on/off) and error status;
- f. include an on/off switch;
- g. be capable of printing no more than 40 characters per line and 300 horizontal lines per receipt;
- h. only partially cut the receipt so that is held in place until removed;
- i. print a manifest receipt within 2 seconds of the specified command. All other receipts shall be printed within 7 seconds of the specified command.

The information displayed on the receipt shall be System configurable via a separate configuration file.

#### 4.3.10.3 Computer Workstations

Computer Workstations shall be installed in each main line plaza and interface to the CVMS. One workstation shall be installed for the Supervisor's use, one workstation shall be installed for the Collector's use in printing manifests and closing their Segment of Work, one workstation shall be installed for an Auditor's use, and one shall be installed for management and tracking of the ACM vaults. The workstations shall all be identical in hardware and software. Five additional workstations shall be provided to offsite operations and auditing staff at locations to be named at a later date.

#### 4.3.11 Toll Management Console

An interface shall be included that allows for real-time equipment and transaction reporting. The purpose of this interface is to provide a console that can be used by toll operations personnel for access of historical and real-time data for equipment, security, and transaction collection. The console shall provide, at a minimum, the following information:

- 1) Lane location/ID;
- 2) Lane type;
- 3) Collector ID;
- 4) Current lane status;
- 5) Vault status;
- 6) Previous transaction data;
- 7) Current transaction data; and
- 8) Status of lane/plaza communications link.

Generally the console will be used for oversight of cash collection operations, however the console shall also be capable of providing information from ETC lanes. The console shall have the ability, based on user roles and permissions, to perform limited remote maintenance actions such as resetting/rebooting Toll Zone controllers, the Toll Rate and Customer Feedback Displays, Lane Status Signs, Transaction Notification lights, and ACMs. The console shall have the capability to change the vault being used by an ACM.

The console shall interface with the video security system and Proximity Reader subsystem to view video and facility access control. The interface and functionality shall be developed and approved by TxDOT through the design phases of the Work.

#### 4.3.12 Project Host Server

The Integrator shall design, develop and implement a Project Host Server (PHS) that shall serve as a data conduit device to store and transfer data to/from the Tolling Zones and to/from the CSC Host. The interface between this server and the CSC Host shall be according to the Interface Control Document (ICD) that is presented in Attachment A. Databases within the PHS shall exist as relational databases.

##### 4.3.12.1 Transaction Collection

The PHS shall aggregate transaction data received from all Tolling Zones on an associated Project Segment.

#### 4.3.12.2 Trip Building

Based on individual transactions created at each Toll Zone, the System shall be capable of creating single and or multiple trips by compiling transactional information.

Trip formation shall take into account single Toll Zone transactions constituting a single trip or multiple sequential Toll Zone transactions constituting a single trip.

The System shall have the capability of identifying when there is a missing Toll Zone transaction between sequential transactions and determine whether or not there should be a single trip built or multiple trips.

The System shall contain logic with configurable parameters for discerning single or multiple trips.

#### 4.3.12.3 Toll Rates

The PHS shall assign applicable toll rates for each vehicle passage through a Tolling Zone.

Toll rates shall be based on the following parameters, using a modifiable rate table or series of tables:

- a. Day of the week,
- b. Time of day,
- c. Vehicle class,
- d. Account type,
- e. Tolling Zone location; and
- f. Direction of travel.

Depending on the specific requirements set forth in the Project Segment Supplement the Integrator may be required to provide Variable tolling under variety of methods such as fixed, Schedule (time-of-day) Mode or Dynamic Mode pricing.

Fixed pricing applies a single toll price per vehicle classification that is not intended to change on a regular basis. Schedule Mode applies separate, static toll rates for a configurable time period. Dynamic Mode shall apply separate, distinct toll rates based on various configurable parameters including managed and general-purpose lane traffic data, time of day, and day of week.

The rate table(s) shall accommodate separate, distinct toll rates for a minimum of fifty (50) holidays per year.

Up to ten (10) vehicle classes shall be accommodated by the rate table(s) for tolling purposes.

When shape based classification is used, the toll structure shall be based on five vehicle classes: a) motorcycles; b) passenger cars and light weight trucks; c) bus, unibody truck, tractor trailers; d) reserved; e) reserved.

The PHS shall readily support rate changes via an effective date that specifies the date and time after which the old rate tables are no longer used and the new tables go into effect.

A user-friendly mechanism facilitating the update and download of modified, updated or new rate tables for use during Schedule Mode and parameters for use during Dynamic Mode shall be provided.

Access to the rate tables and Dynamic Mode parameters for the purpose of modification or update shall be controlled via security mechanisms, which preclude unauthorized access.

In Schedule Mode each vehicle shall be charged a toll based in accordance with the latest published base toll rate schedule. In Dynamic Mode each vehicle will be charged a toll based on the toll rate displayed on the Dynamic Toll Pricing Sign at a specified proximity to the Toll Zone.

#### 4.3.12.3.1 Schedule Mode

The requirements set forth in this Section shall apply while in Schedule Mode.

The Integrator shall be responsible for the development of the Schedule Mode rate table based on historical trend data and or traffic forecasting reports (provided by others). The System shall be designed to apply toll rates from a pre-defined toll rate table in an effort to control traffic volumes in the Managed Lanes.

Not later than 90 days before the beginning of revenue collection, Integrator shall prepare and submit to TxDOT for review and comment a schedule showing the base toll rate for each separately priced Segment and direction for each hour of the week during non-Peak Periods and for each half hour of the week during Peak Periods in the format set forth in Table X below (the “Base Toll Rate Schedule”). Separate tables shall be implemented for each direction of travel. Separate pairs of tables shall be provided for up to 50 holidays.

**Table 1. Sample Segment Base Toll Rate Schedule**

[insert table here]

Integrator shall maintain indicative averages (which may include historical or other relevant information) for a minimum of the previous 180 days (or such lesser period if less than 180 days of Schedule Mode have elapsed), broken out by direction to at least every hour during non-Peak Periods and every half hour during Peak Periods, of Base Toll Rates on the Managed Lanes or as otherwise approved by TxDOT.

#### 4.3.12.3.2 Dynamic Mode

Under Dynamic Mode the System shall be capable of automatically adjusting toll rates based on reaction to traffic demand in both the GP and or Managed Lanes. The dynamic pricing subsystem shall be designed with configurable parameters to accommodate setting changes by the user.

As part of the System the Integrator shall develop a dynamic pricing algorithm. The algorithm shall be clearly represented in the Preliminary and Detail Designs.

#### 4.3.12.3.2.1 Price Determination

Depending on the specific Project Segment requirements, the System shall be capable of determining rates based on traffic data received from the GP and the Managed Lanes. For example, in some cases it may be required that Dynamic Mode utilizes only the traffic data from the managed lanes in an effort to determine price and subsequently control volume.

#### 4.3.12.3.2.2 Travel Time Adjustment

The toll rate applied to toll transactions or trips shall be calculated based on the toll that was in effect at the time when the motorist would have seen the toll displayed on the Dynamic Message Sign prior to entering the Managed Lanes. In order to estimate when that would have occurred the System shall assign a user configurable travel time or “grace period” to account for the elapsed time between entry point and the tolling zone. If the Tolling Zone passage occurs during a period of rising tolls the grace period shall be subtracted from the time of detection at the tolling zone and if during a period of declining tolls the grace period shall be ignored.

#### 4.3.12.4 Managed Lane Traffic Data

The System shall be capable of receiving real-time traffic data from both the General Purpose (GP) and or Managed Lanes. Depending on the Project Segment specifics the Integrator may be required to also provide the traffic detection subsystem(s) in the GP and or Managed Lanes for the purpose of determining speed, volume or traffic density. The Integrator shall also be prepared to work with TxDOT or local ITS entities in using existing traffic detection devices.

The Integrator shall design the System to collect traffic data from the GP and Managed Lanes in real time and use the traffic data to determine the appropriate rate to be used, rate override or other action such as closure or restriction to the managed lane(s).

#### 4.3.13 Managed Lane Violation Signal

A lane violation signal shall be provided and installed on the downstream end of the gantry(s) over each toll lane. The violation signal shall be visible only from downstream of the gantry. The signal shall be a white light that flashes for an adjustable period each time a vehicle passes below based on user configurable criteria.

The signal shall be sufficiently bright for viewing at a distance of fifty (50) feet.

#### 4.3.14 Dynamic Toll Pricing Signs

The dynamic toll pricing signs shall be managed by a sign controller that may be integrated directly with the dynamic toll pricing sign unit or remotely located at the roadside. In either case the controller shall be protected in a weather-hardened enclosure. The dynamic toll pricing sign controller shall communicate with the System via a communications network utilizing the National Transportation Communications for ITS Protocol (NTCIP) standard sets or, if allowed by TxDOT, Transmission Control Protocol/Internet Protocol (TCP/IP). The interface shall support the transmission of message data as well as system status.

The Light Emitting Diode (LED) panel shall also include the ability for the sign to report to the System what is being displayed by interrogating the sign pixels. When the System calculates a toll rate for an entry point, the rate shall be communicated to the dynamic toll pricing sign controller utilizing the IP address for that dynamic toll pricing sign controller. The dynamic toll pricing sign controller shall send the display message to the LED panel. The panel shall interrogate itself and report back to the sign controller that the requested message is being properly displayed. The dynamic toll pricing sign controller shall then relay this information back to the System PHS.

In addition to reporting what is being displayed on the sign at the time of the rate change, the dynamic toll pricing sign shall be polled by the System at regular intervals (at least every 30 seconds) and shall in turn poll the LED panel and return the message being displayed for confirmation that the correct rate is being displayed.

The panel shall include an automatic feature that measures the ambient light and adjusts the intensity of the LEDs to be visible under all light conditions (full sun to full dark). In order to minimize the “halo” effect of certain colors, the LED color shall be amber.

In the event of communication failure the dynamic toll pricing sign shall have the ability to display default base toll rates using an internal predefined time of day schedule. The dynamic toll pricing sign shall have a configurable parameter to define when a communication failure has occurred.

Integrator shall provide a dynamic toll pricing sign ICD for any supplied dynamic toll pricing sign.

#### 4.3.15 Security

In some instances TxDOT may direct that a replicate MOMS computer is to be provided for a Project Segment. In those instances in which a MOMS is provided specifically for a Project Segment, the users of that system shall only be able to access information that pertains to that particular Segment.

Ownership and operational responsibility for individual Road Segments will vary. Access to MOMS information shall be controlled in accordance with the user’s Project Segment affiliation as well as assigned work role and the access privileges allocated to that role. Capability shall be provided to restrict access to any subset of the Road Segments and for each Project Segment to assign one or more of four (4) possible roles for that Project Segment to an individual. Access to MOMS information shall require entry of the user’s identification and password from which the system shall retrieve the user’s assigned Project Segment and role(s). TxDOT staff shall determine personnel access levels to MOMS.

##### 4.3.15.1 Data Security

All System user access shall be logged. All actions conducted by System Administrator(s) shall be logged. The System shall restrict access to all Toll Zone Controller and PHS applications to Authorized Users that shall be configurable by System Administrators. Remote access shall be password protected to prevent unauthorized users from gaining access to the System. The remote access mechanism shall be installed and maintained in accordance with TxDOT IT security requirements.

#### 4.3.15.2 Physical Security

For new installations, all roadside equipment, subsystems or components shall be access controlled by physical means. Access to all roadside enclosures shall be recorded automatically and be reported to the MOMS. The data reported shall include, but not be limited to, shelter and enclosure status, user (if card access), date, time of entry and exit, and any applicable alarm conditions.

#### 4.3.15.3 Video Security

##### 4.3.15.3.1 Digital Video Recording Subsystem

A DVR subsystem shall be installed at each main line plaza that oversees or manages location where cameras are located. The DVR subsystem shall be viewable in both real-time (live) and for review of archived video. The DVR subsystem shall allow for playback of up to four archived video feeds at recorded compressed data rates and up to 16 live feeds at optional higher compressed data rates. The DVR subsystem shall be capable of pause, jump ahead, jump back, fast forward, rewind, slow forward, and slow rewind playback functions. The DVR server shall be rack mounted at a main line toll plaza. The DVR subsystem shall be IP addressable and utilize Ethernet communications.

##### 4.3.15.3.2 Cameras

Cameras shall be installed outside all toll booths and inside and outside mainline toll plazas for purposes of security assessment. The cameras shall utilize existing power and communications, when possible.

A camera shall be positioned near all Proximity Reader locations, capable of viewing the entrance and exit through the secure location. The cameras shall be IP addressable and utilize Ethernet communications. The cameras shall be capable of operating 24 hours a day, 7 days a week to record their field of view. The cameras shall record at a minimum of 720p resolution with h.264/MPEG-4 Part 10 compression.

The cameras shall record data to the Digital Video Recording (DVR) subsystem.

#### 4.3.15.4 Proximity Reader Subsystem

The Integrator shall install a Proximity Reader Subsystem in conjunction with the cash collection system. Proximity Readers shall be installed at all ramp and main line access points that currently have controlled access. The Proximity Reader subsystem shall include a central security server that manages the user roles and permissions and provides real-time monitoring and authentication of current users and logs of historical user access. The Proximity Reader Subsystem server shall be rack mounted at a main line toll plaza.

The Proximity Readers shall be capable of reading current badges issued for use on the CTTS. The Proximity Readers located at toll booths shall be integrated into the Zone Controller. The Proximity Readers located at toll booths shall be capable of providing user authentication preceding user permission controlled actions such as logging on or off and changing lane status.

The Proximity Readers shall not interfere with any ETC operations and any other nearby wireless frequency operations such as cellular phone use or wireless internet routers. The Proximity Readers shall not require FCC licensing.

The Integrator shall provide all proximity cards and instant card printing equipment and services to support user access. The Integrator shall provide all identification badge photo taking equipment.

#### 4.3.16 Performance Requirements

The system shall be designed to support the performance requirements summarized below in Table 2. System Performance Requirements throughout the vehicle speed range of 0 to 100 mph with the exceptions of vehicle classification and image capture which shall be 5 to 100 mph.

**Table 2. System Performance Requirements**

REQUIREMENT DESCRIPTION		PERFORMANCE LEVEL <sup>(1)</sup>
<b>Group A Performance Requirements (Vehicle detection, ETC tag read capability and transaction processing)</b>		
VEHICLE DETECTION AND REPORTING		
1.	Success rate of detection of vehicles passing through the Tolling Zone and producing a resulting toll-transaction or violation transaction record, expressed as a percent.	≥99.8 %
ETC READ ACCURACY		
2.	Tag Read Success Rate expressed as the percentage of vehicles carrying a properly mounted tag whose passage beneath the antenna produces a correct read.	≥99.95 %
3.	Incorrect Violation Image Capture expressed as a percentage of vehicles carrying a properly mounted tag whose passage beneath the antenna results in the capture of a set of violation images	≤0.2%
4.	Reporting an ETC- read of a tag in a vehicle traveling in an adjacent un-tolled lane or in a vehicle in the opposed direction of travel.	≤0.2%
ETC TRANSACTION PROCESSING SPEED REQUIREMENTS		
5.	Peak ETC Transaction Processing (per lane over a period of 15 seconds)	2 per second
6.	Per hour ETC Transaction Processing (per lane over 1 hour)	2400
<b>Group B Performance Requirements- Video image capture capability</b>		
IMAGE CAPTURE		
7.	Success rate of capturing a human readable plate <sup>(2)</sup> image (both plate number or state of issue are discernable) of a vehicle expressed as the percentage of vehicles with an unobstructed plate <sup>(3) (4)</sup> .	≥98%
8.	Success rate of correctly correlating images to a vehicle's transaction record for both front and rear plates.	≥97%

**Table 2. System Performance Requirements**

REQUIREMENT DESCRIPTION		PERFORMANCE LEVEL <sup>(1)</sup>
IMAGE CAPTURE PROCESSING AND SPEED REQUIREMENTS		
9.	Peak Image Sets Capture (per lane per second over a period of 5 seconds)	2 per second
10.	Per hour ETC Transaction Processing (per lane over 1 hour)	1000
<b>Group C- Automatic Vehicle Classification (AVC) capability</b>		
AVC ACCURACY		
11.	Percentage Correct Determination of Vehicle Class for group of vehicles, no more than 70% of which are passenger cars, expressed as the percentage of vehicles correctly classified, based on TxDOT's adopted classification scheme.	≥98.0%
12.	Avoid recording a single vehicle as two or more vehicles, expressed as a success rate in percent.	≥99.5%
<b>Group D- Optical Character Recognition (OCR)</b>		
OCR		
13.	Success rate in obtaining an OCR plate extraction that matches one plate image per transaction for plates that are human readable and unobstructed <sup>(3)</sup> <small>(4) (5) (6)</small>	≥85%
14.	Percentage of reported OCR results that are incorrect <sup>(7)</sup>	≤1%
<b>Group E DATA Transmission and Processing Requirements</b>		
Data Transmission and Processing		
15.	Success rate in transmitting, receiving and processing all system data, including ETC transactions, images, MOMS messages, equipment diagnostic messages, tag status files, all other data that is required to collect, operate and monitor the tolling system and all other data that is required under the Contract Documents.	≥99.99%
Dynamic Message Sign Requirements - Display of Base Toll Rate		
16.	Success rate of displaying the correct Schedule or Dynamic Mode Base Toll Rate on the Dynamic Message Sign.	≥99%

Notes

- (1) The specified performance levels apply to vehicles that are traveling closely together (i.e. platooning) as well as for individual vehicles.
- (2) Includes plate numbers and jurisdiction of motorcycle plates.
- (3) Success rate for tractors pulling trailers is based on the front plate only.
- (4) A license plate shall be judged obstructed when one or more of the following conditions prevent the reading of the plate number:
  - The vehicle either has no plate or it is not mounted in the legally required position;
  - The plate is covered by dirt or snow;
  - The plate is unreadable because of damage to the plate such as being bent or broken;

- The license plate is blocked by an object carried by the violating vehicle (such as a plate frame, overhanging cargo or a trailer towing ball);
  - The license plate is blocked by something in the lane such as a person or another vehicle; or
  - Severe weather conditions such as heavy snow or dense fog block the vehicle image.
- (5) OCR success shall be defined as follows:
- For plates issued by Texas, the plate numbers and jurisdictions are correctly identified and reported;
  - For all motorcycle license plates and vehicles with license plates that are issued by States that are contiguous to Texas (Oklahoma, Louisiana, New Mexico, Arkansas, and Mexico States that border Texas), only the plate numbers are correctly identified and reported and State jurisdictions that are reported shall not be reported incorrectly; and
  - All other jurisdictions that are not listed above are not calculated as part of the OCR percentage requirement.
- (6) The OCR success rate shall be judged on a single presented result for the vehicle.
- (7) The percentage of incorrectly reported OCR results shall apply to all plate types of all jurisdictions.
- (8) Those time intervals where the speed reduction is beyond the control of the system will be omitted from the calculation.

#### 4.3.17 System Availability

The required levels of availability are presented below.

**Table 3. Tolling Zone Functional Availability Requirements**

FUNCTIONAL AVAILABILITY	MINIMUM PERCENT AVAILABILITY
Group A- Performance Requirements- Vehicle detection, ETC tag read capability and transaction processing	≥99.96%
Group B- Performance Requirements- Video image capture capability	≥99.50%
Group C- Automatic Vehicle Classification (AVC) capability	≥98.00%
Group D- OCR	≥96.00%
Group E – Managed Lane Dynamic Pricing System	≥99.90%
Group F – Dynamic Toll Rate Sign Displays	≥95.00%
Group H – Cash and Vault Management Software	≥99.00%

Notes:

- (1) For allocation of performance requirements to Groups see [Table 2. System Performance Requirements](#)
- (2) Tolling Zone percent availability for a performance capability is defined by the ratio of the unit-hours that the Tolling Zone operates while satisfying the performance requirements for that function to the total hours of operation for the Tolling Zone.

## 4.4 SYSTEM TESTING

The testing program for the first Project Segment is to be more thorough and test all requirements whereas future Project Segment testing shall test an applicable set of the requirements adequate to verify that the installation has been done correctly and any minor differences between the previous Project Segment System(s) do not adversely impact the Tolling System's ability to satisfy requirements.

The Integrator shall demonstrate through the process of tests that the System provided by the Integrator is in compliance with the requirements set forth in this document and its functionality complies with the operational requirements and the Final Approved SDD. Where possible, tests shall be conducted in an "end-to-end" manner so that results may be tracked through each possible level of the System. For example, the impact of parameter changes observed in the behavior of the lane systems or results of tests that are conducted in the lanes shall be tracked at the PHS.

The Integrator shall only conduct testing after performing a test readiness review and submitting the review to TxDOT for review and approval. TxDOT in its sole discretion will give approval for testing to begin.

The Integrator shall provide access to test data during testing. This may include raw and processed transaction data, MOMS output, and reports. TxDOT shall arrange for reports of any transmitted test Transactions and video images to be processed by the CSC and provide to the Integrator.

Testing shall include, but not be limited to, the following:

- a. ETC Transaction Generation Test
- b. Video Transaction Processing Test
- c. Collector Interface Test
- d. Customer Feedback Display Test
- e. Cash Collection Processing Test
- f. Vehicle Classification Test
- g. Vehicle Detection and Separation Test
- h. Image Capture and OCR Test
- i. Load Testing
- j. MOMS Functional Test
- k. Component Monitoring and Diagnostics Test
- l. Availability Tracking Test
- m. Remote Access Test
- n. Inventory Control
- o. Maintainability Test

- p. Reliability and Maintainability Analysis
- q. Storage Capacity Analysis
- r. Tolling Zone Controller Initialization/Time Update Test
- s. Transponder Status File Test
- t. UPS Operation and Backup Power Test
- u. Communication Failure Test
- v. Tolling Zone Controller Operational Test
- w. Project Host Server Test

With the exception of the FAT, SAT, the Commissioning Test, the Integrator shall utilize live, uncontrolled traffic when testing the performance of the System. Test vehicles may be mixed into the Live Traffic and the results may be part of the sample data.

#### 4.4.1 Change Management

When changes to the System occur due to, but not limited to, Change Order(s) and/or incorporation of different versions of software/hardware that may impact system functionality and or testing before or during the test process, TxDOT may require all or part of the Master Test Plan and applicable test Procedures shall also be updated to reflect the changes, and the applicable test be performed again, if necessary.

The Integrator shall provide, within reason, access to test data during testing. This may include transaction data, MOMS output, reports, TxDOT shall arrange for reports of any transmitted test Transactions and video images to be processed by the CSC and provided to the Integrator.

Upon TxDOT's request of any retest, the applicable Test Procedures shall be updated to reflect the changes within twenty-one (21) Calendar Days. If the applicable test has been completed and a test report submitted to TxDOT, the original test outcomes shall be logged, reset and new test outcomes shall be included within or amended to the test report. Previous approval of the test report may be rescinded by TxDOT if the new test does not meet the expected outcome.

#### 4.4.2 Test Review Board

A formal structure shall be defined detailing the organizations and personnel participating in the testing and the roles and responsibilities assumed by each organization. Part of that formal structure shall include a Test Review Board (TRB) consisting of the Integrator's system test manager, the Integrator's Project QM team representatives, and TxDOT representatives who will review test results and test anomaly reports. The TRB has the authority to request the system test manager to repeat a test. In general, the system test manager will complete all testing activities as per the Test Procedures unless directed otherwise by the TRB.

#### 4.4.3 Test Plan

The Integrator shall prepare a detailed Test Plan for testing all components of the Project and the fully functional system. This document shall include plans for functional testing and performance testing, as applicable, during the Factory Acceptance Test (FAT), System Acceptance Test (SAT), Commissioning Test, Operational Test, and Performance Audit. Deficiency tracking, priorities and regression testing shall all be addressed in the Test Plan.

The Test Plan shall provide a matrix listing each requirement and how that requirement is to be tested or demonstrated, by inspection, analysis, or test. For those requirements that are to be verified through testing, the matrix shall outline the particulars such as the conditions of the test and the number of test runs planned in addition to the method of verification.

Tentative dates for conducting the various tests shall be included in the test plan, as submitted by the Integrator. Reasonable modifications to these dates may be permitted during the course of the Work provided a written request for such changes is made at least two weeks prior to the revised test date.

The Test Plan shall define the following:

#### 4.4.3.1 Environmental Certification

The process for certifying that each item of Tolling Zone equipment satisfies the environmental requirements in Section 4.1.6 - Environmental Requirements. This is to be accomplished either by providing documentation for tests previously performed or conducting environmental testing to certify the equipment item.

#### 4.4.3.2 Factory Acceptance Testing (FAT)

The Integrator will perform the FAT, which shall include testing of the hardware, software and various subsystems that will be provided by the Integrator. These tests will be conducted at the Integrator's facility using the Integrator's test facility. The purpose of the FAT is to internally verify the system requirements prior to the on-site System Acceptance Test, as practical. To minimize the risk of later discovery of problems, the FAT tests will, as much as possible, be performed as an integrated system rather than as independent subsystems, using a representative system slice of the tolling hardware and integrated software that is assembled and connected using the WAN and LAN configured for the actual production system. TxDOT, and/or its representatives, reserve the right to witness and participate in the Factory Acceptance Testing.

#### 4.4.3.3 Site Acceptance Testing (SAT)

The Integrator shall perform a SAT that includes a series of baseline test procedures to demonstrate functionality of the roadside System, in an unambiguous fashion. The intention of SAT is to validate functionality of each installed Toll Zone once it is installed. SAT validation may be performed on a zone by zone basis prior to full system integration.

All roadside functional requirements of the System, excluding external interfaces, are to be validated during the SAT. Conditions of the test shall include items such as lighting, type of vehicle, and the speed and movement of the vehicles through the Toll Zone (left to right, straddling lanes, vehicle speed, and mix of vehicles with and without tags).

#### 4.4.3.4 Commissioning Test

Commissioning Testing shall demonstrate full “end-to-end” functionality of the System including any and all external interfaces to the Project, including the CSC and other interfaces as required, and performance of that interface (load testing).

Commissioning Tests shall occur only after all SAT testing has been completed and approved. Commissioning Testing shall be performed on the installed production system in the field using a combination of controlled test vehicles (for functionality testing) and Live Traffic (for performance/load testing). The purpose of the Commissioning Testing is to verify that the System and all interfaces are complete and ready for revenue collection.

#### 4.4.3.5 Operational Test

The Operational Test shall define procedures for evaluating the System in a real world environment over a 30 day period. The Operational Testing is to be conducted and evaluated by Integrator and observed by TxDOT. The Operational Testing Procedures shall include but not necessarily be limited to the following:

- a. Review of recorded transaction data to identify any patterns that suggest erratic or faulty system behavior. Such indications may prompt further analysis or investigation.
- b. Review of MOMS and other maintenance data to identify reliability problems.
- c. Controlled testing through the insertion of test vehicles into real traffic.

#### 4.4.3.6 Performance Audit

The Performance Audit shall define controlled test procedures for evaluating the System on an annual basis to ensure that system reliability and accuracy has not degraded over time and the Tolling System continues to satisfy the functional and performance requirements. Procedures should be similar to those defined for Operational Testing. The Integrator shall also incorporate selected TxDOT ad hoc tests into the Performance Audit test procedures.

#### 4.4.4 Test Procedures

Integrator shall prepare detailed Test Procedures for all tests with respect to the functional requirements detailed in this document. The Test Procedures shall cover the following, at a minimum:

- a. Test explanation and purpose;
- b. Test set-up;
- c. Entry and Exit Criteria;
- d. Step-by-step procedures for controlled tests;
- e. Pass/Fail acknowledgement;
- f. Expected results for each step;
- g. Signature block(s); and

#### h. Mapping to requirements.

The test plan shall show when all requirements listed in the Compliance Trace Matrix are being tested or demonstrated or verified by inspection or analysis.

Testing operations shall be conducted in a manner and sequence that assures the least interference with traffic, with due regard to the location of detours and provisions for handling traffic. The procedures shall detail the test environment, all interconnections, the configuration and all settings for each test.

The approved Test Procedures shall be submitted 14 Calendar Days prior to the commencement of the actual test. This will allow for TxDOT to review the documents in detail prior to the event.

#### 4.4.5 Test Scheduling

The Integrator shall give TxDOT at least a 21 Calendar Day written notice for any testing-related activities occurring more than 60 miles from the Project. The Integrator shall notify TxDOT in writing at least 14 Calendar Days prior to commencing planned testing activities for all other testing, to allow TxDOT to schedule its resources. The times and locations of testing that are scheduled to occur at TxDOT roadways and facilities shall be mutually agreed upon by both TxDOT and the Integrator prior to the testing notification.

Each notification shall include a written description of the specific time and locations at which the testing activities shall occur, as well as general description of the activities to take place.

Failure to provide TxDOT with adequate notice as specified above may result in TxDOT withholding a portion of the Integrator's Milestone payment(s). Further, if any delay in testing is experienced due to failure to provide adequate notice, the Integrator shall be held solely responsible for any subsequent delay in the Project schedule.

#### 4.4.6 Test Conduct

Specific assumptions regarding the test conditions shall be described with each planned test. In the event that abnormal test conditions are encountered during execution of a test, the Test Director, with the approval of the TRB, will determine the adjustments that must be made to the test results, or direct that the test be repeated.

All reported test anomalies will be investigated and verified to be repeatable if possible. An anomaly will then become a "failure event" to be recorded and tracked. Problem tracking will identify the progress of problem verification, resolution, system changes or procedure changes, equipment adjustments, (if necessary), regression testing, and closure.

The Project QM team will maintain a list of the open and ongoing problems. All members of the TRB will have access to the problem tracking list. The problem tracking list and status will be reviewed on a regular basis by the TRB.

#### 4.4.7 Test Readiness Review

The conduct of the testing is preceded by a Test Readiness Review. Prior to the conduct of the test, the Integrator shall place all installed hardware and software items under configuration control.

The Test Readiness Review shall include at a minimum:

- a. Identification of the installed hardware and software configuration
- b. Identification of the test assets, personnel and documentation
- c. Review of the Test Procedures
- d. Review of outstanding system or test anomalies
- e. Identification of the roles and responsibilities of the test participants

#### 4.4.8 Test Reporting

The Integrator shall submit a written report documenting the results for all tests performed and comparing them to the expected results. The test report shall include all applicable test data utilized to verify the outcome of the test in an appendix to the report. A log of modifications to the System, including software and hardware, during each test shall be maintained in the test report. Any revision to a test report or subsequent test report (such as the SAT following the FAT), shall include all applicable software and hardware versions and revision logs from the previous report.

Upon Acceptance of the successful completion of each test report by TxDOT, the Integrator shall be given the authorization to move forward in the testing schedule.

#### 4.4.9 System Changes and Modifications

When changes to the System occur due to, but not limited to, Change Order(s) and/or incorporation of different versions of software/hardware that may impact system functionality and or testing before or during the test process, TxDOT may require all or part of the Test Plan and applicable test Procedures shall also be updated to reflect the changes, and the applicable test be performed again, if necessary.

The Integrator shall provide, within reason, access to test data during testing. This may include transaction data, MOMS output, reports, TxDOT shall arrange for reports of any transmitted test Transactions and video images to be processed by the CSC and provided to the Integrator.

Upon TxDOT's request of any retest, the applicable Test Procedures shall be updated to reflect the changes within twenty-one (21) Calendar Days. If the applicable test has been completed and a test report submitted to TxDOT, the original test outcomes shall be logged, reset and new test outcomes shall be included within or amended to the test report. Previous approval of the test report may be rescinded by TxDOT if the new test does not meet the expected outcome.

#### 4.4.10 CSC Interface Coordination

The Integrator shall coordinate with the CSC provider to test and integrate the ICD. This may include an initial kick-off meeting, additional coordination meetings, the exchange of both simulated and system-generated transaction and transponder data, etc. The Integrator shall be responsible for scheduling and directing all exchange of data under the direction of TxDOT.

#### 4.4.11 Access to Testing Facilities by TxDOT and Others

TxDOT reserves the right to check testing equipment, procedures, and techniques for compliance with TxDOT and AASHTO test methods, equipment requirements and calibration standards. TxDOT also reserves the right to access the testing facilities of the independent testing agencies, at no additional cost to TxDOT, to witness the testing and verify compliance of the testing procedures, testing techniques and test results.

#### 4.4.12 System Tests

##### 4.4.12.1 Factory Acceptance Test (FAT)

The tests to be performed shall be according to internal plans and procedures of the Integrator and shall be witnessed by the Integrator's quality control staff. It is the responsibility of the Integrator to ensure best practices are being utilized to test with perceptiveness and thoroughness. Issues and problems uncovered during Factory Acceptance Testing which result in a design or process change shall be reported to TxDOT. While intended as an internal test TxDOT reserves the right to review all plans, procedures and data generated from the Internal Factory Acceptance Test.

Integrator shall produce a working model of the dynamic pricing calculation engine that demonstrates the capability of the chosen toll setting calculations to set tolls in accordance with the Work. The working model will simulate the toll-setting process by accepting simulation data where each record represents one one-minute time increment and will contain speeds and traffic-counts for each of traffic sensors. The working model will output the varying base toll rates by the input simulation data. The working model need not operate in real time and need not be implemented in the same programming language, hardware, or operating system as the operational toll system. The working model should incorporate a computer-screen or window that provides an illustration of the actual implementation. Such an illustration should display current settings of agency-set parameters, manual override tools, indicators of system operating state, current simulated input data, resulting base toll rates, etc.

##### 4.4.12.1.1 FAT Report

Within fourteen (14) Calendar Days of successful completion of the FAT, the Integrator shall submit a FAT Report, which describes the results of the FAT.

The Report shall document the test activities, including any redlined copy of the test procedures, and test results, including screen-shots and reports, punch list and shall include a narrative explaining the activities and results.

The FAT Report shall be approved and accepted by TxDOT prior to commencement of the next project milestone.

##### 4.4.12.2 System Acceptance Test (SAT)

The SAT shall be conducted to verify that all functional elements of the roadside equipment and any related components provided and installed by the Integrator under this Contract are in

conformance with TxDOT's technical and operational requirements specified in this document and the Approved SDD.

During the SAT, the processing of transactions shall verify that no information is missing and validate related business rules for the data (i.e., automatic operations in the application to check for duplicates). Exceptions shall be flagged and provisions to modify Transactions as data errors are detected shall be provided.

The SAT shall include, but are not limited to, correlation testing of platoons of closely spaced vehicles, classification of various vehicle sizes, vehicles changing lanes, straddling, vehicles driving in the shoulder, and some vehicles with and some without tags to verify that the System correctly identifies and captures images of the vehicles without Transponders. This identification shall be accomplished without recourse to the use of license plate numbers of the test vehicles.

For any System installation that includes full width tolling, the Integrator shall perform a primary SAT at the Toll Zone with the largest number of lanes utilizing ETC antennas and photo transaction cameras. The intent of this primary SAT is to include test procedures that simulate the most complex testing in-lane environment. All other Toll Zones may be tested with a reduced set of test procedures mutually agreed upon by TxDOT and the Integrator.

For any System installation that includes Managed Lane tolling, the Integrator shall perform a primary SAT at a Toll Zone where the general-purpose lane is separated from the toll lane by four (4) feet or less. The intent of this primary test is to include test procedures that validate how the System will respond when general-purpose vehicles travel near or straddle the outside of the Toll Zone. All other Toll Zones shall be tested with a reduced set of test procedures mutually agreed upon by TxDOT and the Integrator.

TxDOT shall be allowed to witness the testing, and the Integrator shall have the responsibility to perform the testing. The testing shall provide sufficient confidence to TxDOT, in its sole determination, that the Integrator's installed System meets TxDOT operational requirements, standard and performance criteria, and is ready for Operational Testing.

If there are any failures or anomalies in conducting any test step, the Integrator shall take the necessary corrective action and the test shall be repeated. In the case that corrective action is undertaken by the Integrator, it shall perform any necessary regression testing to ensure that such corrective action has not adversely affected the system's ability to pass previously conducted test steps. If necessary this process shall continue until success is achieved.

The Integrator shall provide the required support personnel and any necessary test vehicles and test equipment (e.g. test transponders). Testing shall be conducted in accordance with the Project Schedule, the Final Approved Test Plan, and Final Approved SAT Procedures.

#### 4.4.12.2.1 SAT Report

Within fourteen (14) Calendar Days of successful completion of the Commissioning Test, the Integrator shall submit a SAT Report, which describes the results of the test including a punch list of any outstanding items or issues.

The SAT Report shall document the test activities, including any redlined copy of the test procedures, and test results, including screen-shots and reports, and shall include a narrative explaining the activities and results.

#### 4.4.12.3 Commissioning Test

Commissioning Testing shall be conducted to verify that all functional elements of the System, its components and all external interfaces provided and installed by the Integrator under this Contract are in conformance with TxDOT's technical and operational requirements specified in this document, the Approved SDD, and the applicable ICD.

The Integrator shall coordinate with TxDOT and its designees, including the CSC and other external entities, in order to perform any required test procedure of the Commissioning Test to verify and validate the successful transfer of any required web services and file transfer data, including but not limited to both transponder and image based transactions from the PHS to any other system to which it must be interfaced to, including the CSC.

The PHS interface to the CSC shall be tested in accordance with the accepted ICD.

TxDOT shall be allowed to witness the testing, and the Integrator shall have the responsibility to perform the testing. The testing shall provide sufficient confidence to TxDOT, in its sole determination, that the Integrator's installed System meets TxDOT operational requirements, standard and performance criteria, and is ready for both revenue collection and Operational Testing.

The Integrator shall provide the required support personnel and any necessary test vehicles and test equipment (e.g. test transponders). Testing shall be conducted in accordance with the Project Schedule, the Final Approved Test Plan, and Final Approved Commissioning Test Procedures.

##### 4.4.12.3.1 Commissioning Test Report

Within seven (7) Calendar Days of successful completion of the Commissioning Test, the Integrator shall submit a Commissioning Test Report, which describes the results of the Commissioning Test including a punch list of any outstanding items or issues identified during the test performance.

The Commissioning Test Report shall document the test activities, including any redlined copy of the test procedures, and test results, including screen-shots and reports, and shall include a narrative explaining the activities and results.

#### 4.4.12.4 Operational Test

The operational test shall be a 90 day evaluation period after the entire Project Segment has been installed and integration tested during which the system will be observed as to its functional and performance characteristics.

The Integrator shall operate the System for 30 consecutive Calendar Days within the 90 day Operational Test period showing the System meets performance requirements without degradation

in performance. During the 30 day period, the System and each applicable performance requirement shall be analyzed on a daily basis to determine and quantify the level of performance and to confirm that the performance has not deviated from the minimum system performance requirements.

In the event of a failure or major degradation in performance, TxDOT, at its discretion, may stop the test until a correction or resolution has been achieved. Depending on the severity of the failure or degradation in performance TxDOT, at its discretion, may elect to restart the test in its entirety beginning at day 1 of the test or restart from the day it was originally stopped. If the System performance degrades more than 1/4 of the total allowable performance tolerance for a specific requirement within the test period, even if it remains within performance thresholds, the Integrator shall demonstrate the cause of the degradation.

The Operational Test shall include a statistically valid sample size of traffic. The sample size determination shall take into consideration margin of error, confidence rate, population size, and the response distribution. The analysis method and estimated sample size outcome shall be submitted to TxDOT for approval within the Test Procedures.

The testing shall provide sufficient confidence to TxDOT, in its sole determination, that the Integrator's installed System meets the functional requirements, standards and performance criteria. This shall include meeting all exit criteria as established in the test procedures.

Testing shall be conducted in accordance with the Project Schedule, the Final Approved Test Plan, and Final Approved Operational Test Procedures.

#### 4.4.12.4.1 Operational Test Report

Within 15 days after the Operational Test has been successfully completed Integrator shall submit a report of the results. The report shall include but shall not be limited to the following:

- a. An summary of the overall test results highlighting the general conclusions of the testing and any problems found and corrected; and
- b. An appendix containing the test results and data used in evaluating the system's operational performance.

#### 4.4.12.5 Performance Audit

On an annual basis beginning within 30 days of the Maintenance Anniversary, the Integrator shall conduct a Performance Audit for each operational Tolling Zone to verify that system reliability and accuracy has not degraded over time and the Tolling System continues to satisfy the functional and performance requirements that are presented in the system design documentation and all other Contract Documents. The maintenance Integrator shall utilize a third party Integrator to perform the Performance Audit.

The Audit shall utilize System transaction data, reports, and MOMS data for at least the 30 days preceding the Performance Audit for the analysis. In addition, controlled tests shall be conducted by utilizing test vehicles mixed with live traffic. TxDOT may choose to perform ad hoc operational

testing as part of the Performance Audit. A Performance Audit will be deemed successful by TxDOT if it is determined that the audit shows that the system requirements presented herein are met.

#### 4.4.12.5.1 Performance Audit Report

Within fifteen (15) days after the Performance Audit has been completed Integrator shall submit a report of the results from the test period as defined in Section 4.4.12.4.1. The report shall include but shall not be limited to the following:

- a. A summary of the overall test results highlighting the general conclusions of the testing and any problems found and corrected; and
- b. An appendix containing the test results and data used in evaluating the system's operational performance.

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## **Section 5 SYSTEM INSTALLATION**

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### **5.1 TOLLING ZONE INSTALLATION**

The Tolling Zone installation shall be performed in accordance with the drawings provided by TxDOT's Design Engineer.

### **5.2 CODES, STANDARDS AND SPECIFICATIONS**

Unless otherwise specified herein, the Work shall be governed by TxDOT Standards, policies, and specifications, with all addenda, supplements, and revisions thereto. Refer to Section 3.1.2 for more information.

For non-roadway related Work, Integrator shall obtain and ensure adherence of installation to the applicable standards, criteria, and codes of the applicable owner of the non-roadway related improvement.

### **5.3 CIVIL CONSTRUCTION QUALITY PLAN**

Integrator shall be responsible for the quality of the Work. Project quality will be enhanced through the daily efforts of all the workers involved with the Work, supported by Integrator's Civil Construction Quality Plan (CQP) and TxDOT's oversight. Integrator's CQP shall consist of quality control and quality acceptance. See Section 2.1.6 for more information.

Integrator's quality control program shall include the internal procedures used by Integrator and Subcontractors that will ensure that the Work is delivered in accordance with the Agreement, project drawings and specifications. This involves the active participation of the entire work force in working to achieve "Quality" initially and to reduce/eliminate re-work. The CQP shall require that the Integrator and Subcontractors designate an individual on each crew to be responsible for performing daily field inspections of their own Work and for preparing a daily QC report to document the inspection performed. The CQP shall also require that a systematic approach to the Work be established by defining the processes, procedures, and documentation requirements to be used.

Integrator's CQP shall include auditing of records, documentation, procedures, and processes to verify compliance with the Agreement and approved CQP. The CQP shall also include spot checks on construction alignment and grades in accordance with the requirements contained in the current TxDOT Survey Guide.

TxDOT's oversight includes:

- a. QA material and supplies testing, authority to stop portions of Work if the Work is not being implemented correctly and in a safe manner, at the sole discretion of TxDOT; and
- b. Audits of Integrator's records to confirm that Integrator is performing in accordance with the requirements of the approved CQP.

## **5.4 CONSTRUCTION REPORTING, RECORD KEEPING, AND DOCUMENTATION**

Integrator shall provide TxDOT with specific construction schedule activities including location and planned quantities on a weekly basis to enhance coordination of the Integrator staff and TxDOT activities. The Integrator shall maintain, electronically, a daily log of all inspections performed for both Integrator and Subcontractor operations in a format acceptable to TxDOT, and transmitted to TxDOT daily. The daily inspection reports shall identify inspections conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed. The responsible technician and/or supervisor shall sign the daily inspection reports. The results of the daily inspections shall be provided to TxDOT in an electronic format within twenty-four (24) hours after the work shift. These daily inspection reports shall document the Day's events, activities, and discussions in a format consistent with the requirements of the current TxDOT *Contract Administration Handbook for Construction Projects*.

## **5.5 SOURCE INSPECTION**

TxDOT may, in its sole discretion, inspect the production of all material or the manufacture of products at the source of supply.

TxDOT shall have free entry at all reasonable times to such parts of the plant relating to the manufacture or production of materials. TxDOT shall assume no obligation to inspect materials at the source of supply, but will perform inspections at times and a material is included within the Price.

## **5.6 PLANT INSPECTION**

TxDOT will perform the inspection at all approved steel structure fabrication plants, pipe manufacturing plants, commercial pre-cast pre-stressed and non-stressed concrete products plants and any job site pre-stressed concrete plants. These costs will be deducted from Integrator's Milestone Payments. Contractor always remains responsible for the quality process; TxDOT participation, if it occurs, does not relieve Integrator of its quality process responsibilities.

Plant inspections will not be required for commercial off the shelf (COTS) electronic equipment.

## **5.7 MATERIALS ON PROJECT SITE**

Material that is excavated and does not meet specifications for the Work shall be removed as excess material from the Final ROW and disposed of offsite by Integrator. Such removal and disposal of excess material is included within the Price.

## **5.8 USE OF EXISTING INFRASTRUCTURE**

To the extent possible, the Integrator shall utilize existing structures and facilities for design and installation. The Integrator shall maintain existing operations in toll booths and in main line toll plazas where vehicle traffic and employee operations are active. The Integrator shall coordinate with existing operations staff at the toll plazas to ensure disruption of revenue collection is kept to a minimum, when possible.

## **5.9 REMOVAL OF OBSOLETE HARDWARE**

The Integrator shall turn over all obsolete hardware to TxDOT at a location dictated by TxDOT. Typically this shall be located at a local TxDOT District Maintenance yard in the vicinity of the Work. The delivery of all obsolete hardware shall occur no later than Final Acceptance. All obsolete hardware from TxDOT facilities shall be preserved in the condition as when removed until turned over to TxDOT. All existing hardware shall continue in operating status until removed or the lane decommissioned at the approval of TxDOT. The Integrator shall provide a list of equipment removed from operation including type of equipment and all discernable make, model, and serial numbers.

## **5.10 NON-CONFORMANCE**

Integrator shall identify, document and report to TxDOT all instances of Work that have not been constructed with the strictest adherence to the approved drawings and specifications and with the requirements of the Contract Documents, the Governmental Approvals and applicable Law. This reporting shall be in the form of a Non-Conformance Report (NCR) as described below and shall be submitted to TxDOT in writing within twenty-four (24) hours of Integrator obtaining knowledge of the same. Integrator shall simultaneously send a copy of each NCR to Integrator's QA staff.

Integrator shall maintain a log of all NCRs and submit this log to TxDOT as requested. Each NCR shall be numbered sequentially, given a brief description, a status and, if it is not closed, an expected date for closure. TxDOT will not grant Final Acceptance for any element that has an outstanding NCR. All NCRs must be closed following mutual agreement of the Integrator and TxDOT.

TxDOT shall have the authority to require the removal of any Nonconforming Work should either of them not agree with the remedial actions set forth by Integrator in any given NCR. TxDOT shall also retain the right to write its own NCRs based on their respective observance of the Work. NCRs generated by TxDOT shall require the same review and ultimate closure by Integrator as an NCR prepared by Integrator. TxDOT reserves the right, in its sole discretion, to accept nonconforming work, and/or to make cost adjustments for Integrator work that, although not in conformance with plans and specifications, Contract Documents, the Governmental Approvals or applicable Law, is nevertheless permitted by TxDOT to remain in place.

Refer to Section 5.6 of the Agreement for information on the Integrator's obligation to uncover non-conforming work.

## **5.11 SAFETY AND HEALTH MANAGEMENT**

Integrator shall comply with all applicable OSHA requirements and standards.

The Integrator shall provide their personnel with all required safety equipment and instruct personnel to observe all safety policies, rules and requirements at all times, including, but not limited to, wearing hard hats, safety shoes, goggles, etc.

Integrator shall follow the Safety and Health Plan as described in Section 2.2.4.

## **5.12 MAINTENANCE DURING WORK**

Integrator shall be responsible for maintenance and repairs to any portion of the Work completed and opened to traffic until System Acceptance is issued in accordance with the Section 20.1 of the Agreement and the requirements in this Section. Work includes routine maintenance (such as litter pickup, mowing, repair of third party damaged traffic control and safety devices, etc), responding to emergencies and operational problems, and inspections and repairs required on an "as needed" basis or as directed by TxDOT until issuance of Final Acceptance. TxDOT reserves the right to perform such work as it deems necessary with its own forces, and/or to enter into special contracts for the maintenance of specific items. If said work is undertaken by TxDOT as a result of failure by Integrator to perform (or to begin to perform such work) within ten (10) Business Days of discovery of the need for the work, then TxDOT may deduct the cost of doing so from any payments due or to become due to Integrator and/or to obtain reimbursement from Integrator for such cost (plus interest thereon at the maximum rate allowable under applicable Laws). Housekeeping and Maintenance of the ROW

Throughout all phases of construction, including suspension of Work, and until Final Acceptance, Integrator shall keep the Final ROW and the site clean and free from rubbish and debris. Integrator shall prevent spillage on haul routes. Integrator shall remove any such spillage immediately and the area shall be cleaned.

Integrator shall not discharge smoke, dust, or any other air contaminants into the atmosphere in such quantity as will violate applicable Law or Governmental Approvals or will otherwise be considered a nuisance to adjoining property.

If Integrator defaults or neglects to maintain the Work free from accumulation of waste and rubbish as set forth above or otherwise fails to comply with use of Project Site and clean-up procedures required by the Contract Documents, and fails within a twenty-four (24) hour period after receipt of oral notice to commence and continue correction of such default or neglect with diligence and promptness, TxDOT may after such twenty-four (24) hour period, immediately, without prejudice to other remedies TxDOT may have, correct such deficiencies. In such case, TxDOT shall deduct from payments then or thereafter-due Integrator, the cost of correcting such deficiencies plus interest at the maximum rate allowed under Law. If payments then or thereafter-due Integrator are not sufficient to cover such amounts, Integrator shall pay the difference to TxDOT on demand.

## **5.13 PROTECTION OF SURFACE WATERS AND FLOOD PLAINS**

Integrator shall keep construction material away from drainage structures, creeks and flood plain areas. Integrator shall not allow rubbish or contaminants of whatever nature to be deposited in the above mentioned waterways. Should any such item be found in the above-mentioned waterways, Integrator shall immediately remove them at its own expense.

## **5.14 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE**

Public and private property shall be preserved at all times by Integrator. Integrator shall restore any damaged or injured property to a condition at least equal to that existing before the damage or injury occurred. The repair, restoration, rebuilding, or making good such damage or injury shall be at no

additional cost to TxDOT and Integrator shall not be entitled to a time extension in connection therewith.

## **5.15 LIMITATIONS OF IMPLEMENTATION OPERATIONS**

Implementation operations shall be conducted in a manner and sequence that assures the least interference with traffic, with due regard to the location of detours and provisions for handling traffic.

Fourteen (14) Days written notice shall be given to TxDOT before night Work is started and will only be allowed if adequate lighting is provided for performing satisfactory inspection and safe construction operations. Integrator shall be responsible for coordinating all nighttime activities with the affected stakeholders.

Failure to provide TxDOT with adequate notice or to perform nighttime activities as specified above may result in TxDOT withholding a portion of Integrator's Milestone Payments.

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## **Section 6 MAINTENANCE OF TRAFFIC DURING INSTALLATION**

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Integrator shall coordinate Traffic Control and Sequencing Plans that will minimize impacts to the current level-of-service on all roadways open to traffic during the construction of the Work, such plans to be approved in advance by TxDOT. The Traffic Control and Sequencing Plans shall be prepared in accordance with applicable TxDOT and TMUTCD standards. Integrator will be responsible for coordinating the review of the Traffic Control and Sequencing Plans with TxDOT and applicable Governmental Entities.

Prior to any installation, Integrator shall prepare Traffic Control and Sequencing Plans for the installation activities being performed. The Traffic Control and Sequencing Plans prepared by Integrator shall be reviewed by TxDOT prior to the commencement of any construction.

Integrator shall implement and maintain the Traffic Control and Sequencing Plans throughout the installation phase of the Work, including adjustments to the Traffic Control and Sequencing Plans as necessary to assure the safe movement of traffic and pedestrians through the work zone.

Integrator shall provide a full-time Traffic Control Coordinator throughout the duration of the construction phase of the Work. The Traffic Control Coordinator shall cooperate with TxDOT and TxDOT's Roadway Contractor. Revisions to the Traffic Control and Sequencing Plans during construction will be developed by the engineer-of-record and reviewed and approved by TxDOT.

Integrator shall provide TxDOT with the name of the Traffic Control Coordinator along with a 24-hour phone number where the Traffic Control Coordinator can be reached at all times.

TxDOT is very sensitive to the maintenance of traffic during peak periods. TxDOT will establish a lane closure notification procedure and will coordinate the necessary lane closure with the necessary MOT Integrator. However, payment for these closures shall be the responsibility of the CTTS maintenance Integrator except for one lane closure per EETC zone per calendar year for annual Open Road preventative maintenance

The Integrator shall address lane-closing procedures and scheduled closures during off peak times, including nights and weekends in the Maintenance Plan. For express lanes, TxDOT will establish a procedure whereby TxDOT or another TxDOT Integrator, or both, will coordinate the lane closure. Closures for preventive and preemptive maintenance shall require advanced notification and scheduled during minimal traffic periods to mitigate interference with the traveling public. All closures will require TxDOT approval so that public notification can be achieved. There will be an immediate response by TxDOT for emergency maintenance lane closures as determined by TxDOT.

MOT lane closures are only required for ORT zones.

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## **Section 7 SYSTEM MAINTENANCE**

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### **7.1 GENERAL**

Unless otherwise specified in a Project Segment Supplement, the Integrator shall provide full System maintenance services under the initial Warranty Period followed by a period of 1 year. Maintenance services shall commence upon Final Acceptance and will end as defined in the Agreement.

System maintenance shall be provided by the Integrator for each Project Segment covering the following four (4) categories:

- a. Preventative Maintenance;
- b. Predictive Maintenance;
- c. Corrective/Emergency Maintenance; and
- d. Software Maintenance.

### **7.2 PREVENTIVE MAINTENANCE**

The Integrator shall develop a preventive maintenance schedule designed to ensure the System maintains the performance and availability requirements set forth in this document. The Integrator shall schedule and perform preventative maintenance in accordance with manufacturers' suggested procedures and performance intervals, and experience accomplished specifically to prevent faults from occurring. Preventive Maintenance may include, but not be limited to testing, measurement, adjustment, cleaning and parts replacement.

The Integrator shall include a comprehensive Preventive Maintenance program for this project. The program shall be based on component manufacturers' suggested procedures, performance intervals and experience. The manufacturers' suggested procedures and specifications shall be provided to TxDOT as an attachment to the Maintenance Plan. The program shall contain a complete schedule of proposed preventive maintenance procedures and time frames. The program shall also include reporting methods and mechanism to be used to administer the program.

The Integrator shall submit a Monthly Maintenance Report on all preventive maintenance activities. The monthly report shall include a comparison of scheduled versus actual preventive maintenance activities and any corresponding statistical analysis. The Integrator shall also provide a schedule for the upcoming preventive maintenance activities on a monthly basis.

As part of the preventive maintenance process, based on experience and analysis, the Integrator shall develop parameters to be used to identify, in the early stages, potential problems and actions to be taken to mitigate or prevent potential System issues.

### **7.3 PREDICTIVE MAINTENANCE**

During the course of the Maintenance term the Integrator shall continually track and analyze equipment failure and degradation rates in order to predict and modify maintenance service schedules. This analysis shall be based on both the manufacturer's data and historical data accumulated during the maintenance period.

The Monthly Maintenance Report shall describe any analyses performed and any subsequent changes or modifications in maintenance activities.

End of life, as defined by the manufacturer, subsystem replacement past the initial Warranty Period, or past extended warranty periods, for equipment is the financial responsibility of TxDOT.

### **7.4 CORRECTIVE/EMERGENCY MAINTENANCE**

The Integrator shall repair any hardware or software component after a failure has occurred, either as a whole or in part. The Integrator shall maintain a staff of trained personnel of sufficient quantity and quality to ensure that repairs can be performed 24 hours a day, every day of the year.

Via the MOMS the Integrator shall maintain an around-the-clock dispatching operation to accommodate emergency maintenance service calls. Repairs that require a lane closure or taken out of service must be coordinated with either the plaza supervisor and TxDOT, or TxDOT's designated representative. The Integrator shall track all service calls and related maintenance tasks performed by their staff via the MOMS.

### **7.5 MAINTENANCE SERVICE MANUAL**

The Integrator shall develop a Maintenance Service Manual for technical personnel assigned to the maintenance of the Tolling System. This manual shall include a general description, theory of operation, operator instructions, detailed electrical/electronic logic circuit analysis, mechanical functions, installation, test and trouble-shooting procedures, preventive and corrective maintenance procedures. The Maintenance Manual shall also contain diagrams, schematics, layouts and parts lists required to service each component and circuit board utilized in the System.

The Maintenance Service Manual will be used primarily by the Integrator's maintenance staff but shall be provided to TxDOT in the event TxDOT should at some point decide to take over the maintenance responsibility for the system. This comprehensive document shall provide complete detailed technical descriptions of maintenance operations including, but not limited to, the following:

- a. Preventive Maintenance Schedule;
- b. Troubleshooting Techniques;
- c. Corrective Measures, both temporary and permanent;
- d. Maintenance Techniques;
- e. Location and availability of support services for all major components;
- f. Point-to-point component wiring schematics and logic signal flows; and

- g. Assembly and disassembly drawings, including exploded view drawings.

Standard service manuals for unmodified commercial products used in the System shall be acceptable if they contain details and accurate information in order to properly service the specific toll collection equipment supplied under this Agreement. Large size diagrams and mechanical assembly diagrams do not have to be reduced or incorporated into the manuals if these drawings are delivered with the manuals.

Five (5) copies of a Maintenance Service Manual shall be provided to TxDOT for each Project Segment procured under the Agreement. Maintenance Manuals shall be delivered to TxDOT prior to the commencement of toll collection equipment operations.

## **7.6 SPARE PARTS**

The Integrator shall provide, and maintain an inventory of all spare parts required to maintain the complete System. The initial inventory shall be a complete complement of spare parts. The Integrator shall maintain a reserve stock of spare parts and equipment located within adequate proximity to support each Project Segment. The Integrator shall include a list and quantity of spare parts to maintain optimal System performance and availability. This shall be included within the Spare Parts and Inventory Control of the Maintenance Plan as described in Section 2.1.2.6. Inability to complete repairs or other maintenance activities due to the lack of timely availability of spare parts shall not relieve the Integrator of its maintenance obligations.

The Integrator shall maintain via MOMS a comprehensive, accurate, and auditable spare parts and equipment inventory at a system.

Spare Parts inventory is the property of TxDOT and will be transferred to TxDOT following the End of Maintenance Term as described in Section 7.16.

## **7.7 MAINTENANCE FACILITIES/WORKSHOP**

The Integrator shall be responsible for the provision of a maintenance office(s) and work facilities equipped and capable of supporting the overall maintenance program under this Agreement and for each Project Segment System. The facility(s) shall house spare parts, documentation, communications, shipping and receiving, and personnel necessary to maintain the entire system.

## **7.8 MAINTENANCE RECORDS**

The Integrator shall maintain current and accurate records for all system maintenance work. The records shall be organized and managed by a computerized data and information management system as part of MOMS. All system equipment and hardware maintenance events detected and/or recorded by maintenance staff shall be recorded on the MOMS database.

All records are the property of TxDOT and, as such, TxDOT has the right to review and retrieve data and records at any time either electronically or physically. TxDOT shall have access to Integrator's database where the maintenance records are stored through available system provided reports.

The MOMS database shall include, but shall not be limited to, location, equipment nomenclature, serial number, name, date, technician ID, type of failure, date-time of failure, date-time of response to the site and date-time time returned to service, preventive maintenance work, scheduled work, work repair code, failure and repair history, and statistical data on MTBF and MTTR. Additionally the MOMS shall also record any service call initiator information such as name, time/date of call and contact information.

System failure and repair records shall be used as part of the process to calculate System availability for each Project Segment Toll Zone, Lane, Plaza and subsystem or component.

## **7.9 MONTHLY MAINTENANCE REPORT**

The Integrator shall provide a Monthly Maintenance Report to TxDOT. TxDOT reserves the right to review the maintenance records and data base files for compliance with system performance requirements.

For every monthly maintenance payment period the Integrator shall prepare a report (“Maintenance Report”) that tracks malfunctions, the times that malfunctions were recorded, the time the technician responded to and the time the technician completed the repair. The report shall also provide the percent availability figures for the month.

The Monthly Maintenance Report shall also include a summary of corrective and emergency maintenance activities undertaken and statistical analysis including average of all Response and Repair Times.

## **7.10 MEAN TIME TO RESPOND AND REPAIR**

All response and repair time calculations shall be based upon the notification time and completion time. Notification is defined as any of the following; TxDOT or TxDOT representative verbal communication, MOMS messaging, TxDOT Help Desk email or phone calls to maintenance Back Office and Operations Help Desk.

### **7.10.1 Mean Time to Respond**

Regardless of failure or event type the Integrator shall adhere to an average response time of no longer than two (2) hours including weekends and holidays.

The Integrator shall either be on-site or be logged in to the system through remote access to assess the problem within the specified response time 24 hours per day, 7 days a week, 365 days per year.

### **7.10.2 Mean Time to Repair**

Repair times shall be assigned based on priority level. Priority levels are based upon impact to revenue. The following are the defined of priority levels per equipment type.

	PRIORITY LEVEL	REPAIR TIME REQUIREMENT
Equipment failures that directly affect the accurate collection and reconciliation of tolls	1 <sup>(i)</sup>	2 hours
Equipment failures that indirectly affect the accurate collection and reconciliation of tolls	2 <sup>(ii)</sup>	4 hours
Equipment failures that do not affect the accurate collection and reconciliation of tolls	3 <sup>(iii)</sup>	12 hours

Examples of equipment failures per priority levels are defined below:

- (i) ETC, AVC, ACM, image capture, Collector Terminal, CVMS, Toll Zone Controllers and all related software applications
- (ii) DVAS, Transaction Notification Light, Toll Fare and Customer Feedback Display, Lane Status Sign, computer workstations, Receipt Printers, Bill Counter, Coin Counter, communications, power generation and supply, and all related software applications
- (iii) Video security, and proximity reader subsystem

The total response and repair time shall be measured from the exact time that the problem is first reported to the Integrator until the equipment is brought back online and is functioning at full capacity. This shall not occur until any maintenance of traffic equipment is completely removed and the lane(s) are back in operating condition.

## 7.11 WORK LIMITATIONS

The Integrator shall be limited in the type of work activities that may be conducted the Integrator shall not make physical modifications to TxDOT facilities. Some examples of this would be modifications to the toll islands, structural modifications, certain electrical wiring and additional cuts in the pavement.

## 7.12 INSPECTION OF WORK AND MATERIAL

TxDOT reserves the right, at any time without any notification, to inspect work areas such as the Maintenance Workshop, the Maintenance Test Facility and the Spare Parts Inventory Storage Facility.

- a. TxDOT may at any time inspect work on the system, components, parts, materials, equipment or other items to ensure that the system conforms to the requirements of this purchase order, to verify progress, or for any other reason that TxDOT deems appropriate. Such inspections may occur at any site where work is being conducted.

- b. TxDOT reserves the right to reject any work, components, parts, equipment, materials or other items that do not conform to the requirements of the purchase order or work order. Rejected work, components, parts, equipment or materials shall be replaced with conforming units at no cost to TxDOT.

#### 7.12.1 ICD Compliance

Integrator shall ensure that the System software is current and compliant with latest ICD(s). This includes all current and future updates to the ICD(s). It is noted that this requirement only refers to software updates and not hardware upgrades to the system.

### 7.13 MAINTENANCE REPORTS

The Integrator shall communicate with TxDOT on activities being undertaken, progress being made, statistical analysis, recommendations, potential problem areas and other timely topics. The Integrator shall communicate to TxDOT by means of periodic reports to document the status of the system and the work of the Integrator. The following is a list of some of the required reports to provide a reference point for the Integrator.

In the Maintenance Plan, the Integrator shall provide a sample report for each, with an explanation of what the report accomplishes. The Integrator may accommodate certain reporting requirements with a combined report on various components, as long as the report makes sense and provides the data and analysis that TxDOT is requesting. TxDOT shall approve the combination of any reports.

All reports are due to TxDOT by the 15th day of the month following the reporting period. The required reports include, but are not limited to:

- (a) System Availability Report (Monthly, Quarterly, Annually) - Report shall show availability of each lane per calendar month
- (b) Status Report on Adherence to the Maintenance Plan (Semi annually, Annually) - Report shall reflect adherence to maintenance plan outline with respect to Response /Repair times and lane Availability
- (c) Preventive Maintenance Schedule (Monthly) - Report to reflect all scheduled PMs for upcoming two months
- (d) Preventive Maintenance Activities (Monthly) - Report shall show actual activities performed and compare to scheduled activities.
- (e) Preventive Maintenance Status Report (Quarterly, Annually) - Report shall show status of plan & any appropriate statistical analysis
- (f) Predictive Maintenance Report (Semi-Annually) - Report shall show status of main components, expected life, replacement analysis, etc.
- (i) Report shall show status of main components, expected life, replacement analysis, etc.

- (ii) MTBF Analysis – Component Mean Time Between Failure. Using historical project data compared to component manufacturer MTBF
- (g) Corrective Maintenance Activity Report (Monthly) - Report shall include monthly activities (including monitoring activities) and cumulative analysis to include all response and repair times
- (h) Response Time Report; Detailed and Summary Average (Monthly) - Report shall include detailed Response times for all maintenance activities and shall report the mean time to respond for the entire calendar month.
- (i) Repair Time Report; Detailed and MTTR (Monthly) - Report shall include detailed Repair times for all maintenance activities and shall report the mean time to repair for the entire calendar month
- (j) Statistical Comparison of Response & Repair Time to Contractual Requirements - Report shall include any repair and response times that fail to meet the contractual requirements. Reason for failure to meet response and/or repair time was shall be included.
- (k) Quarterly Comprehensive Maintenance Activity & Report - Report to include summary of all maintenance activity.
- (l) Spare Parts Inventory (Monthly) - Inventory Listing by part description, part number, Total Quantity, Quantity per Status, Value and Location
- (m) Parts Usage & Lead Time Analysis - Recommended increases or decreases in levels of various components; Identification of parts no longer available and how the equipment can be maintained (i.e., rebuild parts, substitute parts, replace equipment, etc.). This information should be accompanied with the costs associated with each alternative.

Availability, performance, average repair, response, and time between failures shall be calculated automatically within MOMS when the reports are run.

## **7.14 MAINTENANCE OF EXISTING SYSTEMS**

### **7.14.1 General**

The Integrator shall be aware that either at the conclusion of the current maintenance terms, or earlier if so decided by TxDOT, TxDOT may require the Integrator to provide continued maintenance of the CTTS and/or the ORTS.

It is envisioned that any requirement for maintenance of existing systems will be issued under a Project Segment Supplement. The Project Segment Supplement will describe in detail the required scope of services, the current condition of the System, available spare parts, current Bill of Materials (BOM) and any appropriate system documentation.

### **7.14.2 Transition of Maintenance Activities**

#### 7.14.2.1 Transition Plan

In preparation of transitioning to CTTS/ORTS Maintenance, the Integrator shall prepare and submit a Transition Plan. The Transition Plan shall detail the required efforts, processes, resources and timeframe for transitioning maintenance services. The Transition Plan shall be submitted two (2) months following issuance of NTP.

#### 7.14.2.2 Transition Coordination

In accordance with the Transition Plan the Integrator shall participate in coordination with the existing System Integrators, TxDOT and or its representative(s).

### 7.14.3 System Monitoring

The Integrator shall use the existing MOMS to monitor and analyze the existing toll systems and the Integrator's maintenance activities.

#### 7.14.3.1 Response Time

Regardless of failure or event type the Integrator shall adhere to a response time of no longer than two (2) hours including weekends and holidays. Response times shall not exceed an average of 1 hour during peak periods in ACM and ATT lanes. Peak periods shall be determined prior to issuance of the Project Segment Supplement and be included in the updated Maintenance Plan.

#### 7.14.3.2 Repair Time

The Integrator shall follow all applicable Repair Time requirements as defined in Section 7.10.2; however, the repair times shall not be averaged and will be applied as defined in the table within Section 7.10.2.

#### 7.14.3.3 Functional Availability

The Integrator shall be responsible for meeting all functional availability requirements as set forth in Section 4.3.17.

#### 7.14.3.4 Performance Requirements

The Integrator shall be responsible for meeting all performance requirements as set forth in Sections 4.3.16.

### 7.14.4 Existing Spare Parts Inventory

It is the responsibility of the Integrator to maintain a level of spare parts in order to ensure optimum system uptime. The current Spare Parts Inventory is the property of TxDOT and will be handed over to the Integrator for use and tracking following transition of maintenance on the existing CTTS and ORTS. Refer to Section 7.6 for more information.

### 7.14.5 CTTS Maintenance Facilities/Workshops

Primary response spare parts and primary response maintenance technicians assigned to the CTTS shall be deployed locally at specified plaza locations provided by TxDOT at no cost to the Integrator for the use of the facilities.

## **7.15 DECOMMISSIONING**

For a variety of reasons TxDOT may elect to decommission a portion of, subcomponent or System in its entirety. Similar to the format of a Project Segment Supplement TxDOT will issue authorization to the Integrator to decommission a System. Under decommissioning efforts the Integrator shall be responsible for all necessary work to fully remove the physical System infrastructure as well any other System modification (i.e. MOMS, ICD updates, etc.)

The Integrator shall ensure that any decommissioning efforts will not adversely affect revenue collection for any other Project Segment or System both current and future.

## **7.16 END OF MAINTENANCE TERM**

The Integrator shall be responsible to satisfy the following conditions in order for TxDOT to declare the end of any Maintenance Term on a Project Segment. Integrator shall not be released from their maintenance obligations until each of the below described conditions are met to the satisfaction of TxDOT and this is documented in writing by the appropriate TxDOT representative.

### **7.16.1 Inspection**

A detailed inspection will be performed by TxDOT staff and the Integrator shall provide reasonable support for the inspection;

### **7.16.2 End of Maintenance Term Transition Plan**

In preparation of completing the Maintenance Term the Integrator shall prepare and submit an End of Maintenance Term Transition Plan. The End of Maintenance Term Transition Plan shall detail the required efforts, processes, resources and timeframe for transitioning maintenance services. The End of Maintenance Term Transition Plan shall be submitted six (6) months prior to completion of the Maintenance Term.

### **7.16.3 Transitioning Support**

In accordance with the Transition Plan the Integrator shall provide the necessary training, coordination and transfer of maintenance responsibility to TxDOT and or its representative(s).

### **7.16.4 Maintenance Records**

Integrator shall provide to TxDOT all current and historical maintenance records, equipment and software support contact information, outstanding equipment and second source software warranty paperwork, service records, and other relevant documentation to the satisfaction of TxDOT;

### **7.16.5 Spares Parts, Components, Tools**

Integrator shall transfer to TxDOT all spare parts, components, boards, tools, and other spare parts to TxDOT. The spare parts and components will be cross-referenced with MOMS to ensure that all parts and components are transferred to TxDOT;

#### 7.16.6 Passwords

Integrator shall provide all system passwords, user names, and other access and system security information to TxDOT;

#### 7.16.7 Training

Integrator shall provide maintenance training to designated TxDOT staff to the satisfaction of TxDOT;

#### 7.16.8 Manuals and Drawings

Integrator shall provide revised, fully updated versions of all maintenance manuals, current Maintenance Plan, installation drawings, as-built drawings, and other relevant documentation to the satisfaction of TxDOT; and

#### 7.16.9 Spare Equipment Repair

Integrator shall repair all spare equipment, to the satisfaction of TxDOT.

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ATTACHMENT A

CUSTOMER SERVICE CENTER/TOLL MANAGEMENT SYSTEM INTERFACE CONTROL  
DOCUMENT

[to be included in Final RFP]

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ATTACHMENT B

EXISTING HARDWARE LIST

[to be included in Final RFP]

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ATTACHMENT C  
EXISTING SOFTWARE LIST  
[to be included in Final RFP]

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ATTACHMENT D

EXISTING TOLL OPERATIONS STANDARD OPERATING PROCEDURES

[to be included in Final RFP]

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