SPECIAL SPECIFICATION

8468

Electronic Toll Collection System

1. Definitions.

   A. As-Built Drawings: shall mean the documents and other items referred to this special specification.
   
   B. Agency: TxDOT
   
   C. Authority: TxDOT and/or Cameron County Regional Mobility Authority.
   
   D. Authority Back Office (ABO)
   
   E. Authority Designated Representatives: person or persons authorized by the CCRMA to represent the CCRMA in all dealings with the contractor.
   
   F. Automatic Vehicle Detection (AVC): shall mean a System for automatic vehicle detection, separation and classification.
   
   G. Automatic Vehicle Identification (AVI): a system consisting of an antenna and reader installed in a toll lane and a transponder located on a vehicle for automatic identification of the transponder as it passes through the lane.
   
   H. Bill of Materials (BOM)
   
   I. Business Day: the 24 hour toll collection day from 00:00 AM to 24:00 AM.
   
   J. Business Rules: a set of rules proposed by contractor and approved by the Agency Authority that defines how the toll collection system should respond to various situations that occur in the toll lanes during the toll collection process based on business rules and policy decisions made by the Authority, as the same may be amended from time to time by written agreement of the Authority and contractor.
   
   K. Business Rules Test: A test that is conducted as part of the Prototype On-site Test that verifies the CCRMA Business Rules.
   
   L. Cameron County Regional Mobility Authority (CCRMA)
   
   M. Central Texas Regional Mobility Authority (CTRMA)
N. Communication Plan: shall mean the plan developed by the contractor to these special specifications and approved by the Authority, as the same may be amended from time to time by written agreement of the Authority and contractor.

O. Commercially Off the Shelf (COTS): hardware and software supplied by the contractor under this contract.

P. Contractor: The contractor that is contracted to design and build the Authority’s SH 550 Port Spur contract, including the communications network.

Q. ABO Server: the ABO Server for the Authority toll collection system that acts as the central depository of all toll collection data.

R. Customer Service Center (CSC)

S. Customized hardware: The toll collection hardware provided by the contractor that is designed and certified by the contractor.

T. Design Documentation: ETC System design documentation required, including the SDP, and SDDD, Master Test Plan, Interface Control Document and other documents outlined elsewhere.

U. Electronic Toll Collection (ETC): A system of integrated devices and components that permit the automatic recording of vehicle transactions through electronic media in a toll revenue collection system.

V. ETC Lane: A lane equipped with ETC equipment for cashless nonstop toll collection of vehicles operating at normal highway speeds.


X. Graphical User Interface (GUI)


Z. Operational Testing: the testing conducted after the entire Authority toll collection system is deployed to ensure to verify System reliability, accuracy, performance and audit ability.

AA. Software Development Plan (SDP)

BB. System Detailed Design Document (SDDD)

CC. Contract Acceptance Test: the final testing performed on the toll collection system before it is approved and considered acceptable to the Authority.
DD. Toll Operations and Toll Audit Departments: shall mean the CCRMA departments that oversee the toll collection operations and perform the audit functions of the CCRMA toll collection system.

EE. TeamTx: a consortium of toll agencies and authorities, principally in Texas that uses a reciprocal TransCore based AVI system with the service mark TxTag

FF. Toll Operations and Toll Audit Departments: shall mean the Authority’s departments that oversee the toll collection operations and perform the audit functions of the Authority’s toll collection system.

GG. TransCore: Third party supplier of AVI equipment.

HH. Texas Department of Transportation (TxDOT): The Texas Department of Transportation, including the Texas Turnpike Authority Division.

II. Texas Turnpike Authority (TTA): Texas Turnpike Authority Division of TxDOT.

JJ. Transponder Validation List (TVL)

KK. Violation Enforcement System (VES): Video based system located at toll lanes used to record license plate images of selected vehicles (to be defined in the Business Rules) in video form.

2. **Description.** The requirements described in this section include the system concepts, operational requirements, technical requirements and various procedures for the design, development, fabrication, programming, integration, testing, installation, implementation, and maintenance of the Authority toll collection system, including, without limitation, toll collection, and violation enforcement for the Authority toll.

The requirements are being specified on a functional level. It is the intent of these requirements to permit the contractor flexibility in the design and development of the toll collection system to reflect innovation and state-of-the-art technology for an on-line toll collection system fully capable of meeting the Authority operational and contractual requirements.

The contractor shall furnish and mobilize all required plant, equipment, and resources necessary for initiating and concluding the contract and may include such portions of the following as are required at the beginning and end of the contract:

A. Setting up at the various worksites the contractor's general plant, offices, shops, storage areas, sanitary and other facilities as required by the Specifications, by local or state law, or by regulation, the subsequent demobilization and removal from the site of said equipment, appurtenances and the like upon completion of the work

B. Obtaining necessary permits and licenses, and payment of fees
C. Coordinating design and installation activities

D. Lighting work area

E. Sampling and testing of materials

All equipment, supplies and materials furnished under this contract for the toll collection system shall be new. Materials and products that have been previously used for development work, purchased systems or items that have been salvaged or rebuilt will not be permitted to be used in connection with this contract. The contractor shall be responsible for purchasing and maintaining all equipment required for development and testing. All equipment provided by the contractor shall be multi sourced and readily available to the Authority.

The work to be performed under this contract shall include, but not be limited to, the development and implementation of Lane Systems, toll location Systems, Office System, Interface to CCRMA and other subsystems and infrastructure as may be required to meet the requirements set forth herein.

The AVI System equipment shall be compliant with the Texas Interoperability Specifications and the purchase of the AVI equipment (AVI readers and antennas) shall be coordinated with the approved AVI vendor. The CSC/VPC System shall be developed and operated by others. The contractor is responsible for interfacing with the ABO for the transfer of violation and ETC information.

The contract will include, but is not limited to, the following:

A. Development, configuration, customization, procurement, manufacturing, testing and installation of new Lane Systems, toll location Systems, and ABO System including the Security Access Systems and the Authority Maintenance On-line Management System (MOMS) hardware and software. The System provided shall meet the specification in this special specification.

B. Detailed Lane Configurations lists the number of lane equipment and peripherals that shall be installed under this contract. The contractor is responsible for providing, installing and testing all equipment.

C. Coordination with the contractor on the location and placement of the contractor equipment and peripherals, and any other design specification needs.

D. A communications backbone for the SH 550 Port Spur will be installed by the Developer. The contractor is responsible for designing, purchasing, implementing and testing all WAN and LAN that is applicable to the toll collection system. Including WiMax transceiver and antenna support (luminair pole and foundation) structure, and T-1 Interface card.
The physical system will consist of the following primary subsystems:

A. Autonomous zone controllers with violation enforcement capability and real time network connection to an ABO.

B. ABO with real time lane monitoring, data management and toll collection management capabilities, and connection to the ABO Computer System. ABO to be provided by others.

C. ABO Computer System that provides transaction and revenue reconciliation, audit and financial reporting capabilities, and connection to the CSC/VPC will be provided by others.

D. Security Access System to control and record access to toll collection related areas

E. Authority MOMS to manage equipment, and record and track equipment failures.

F. Required toll system infrastructure at designated locations including exposed conduit, and all cables and fiber between the Control Cabinets and the Lane Equipment, equipment cabinets, and emergency power, etc., at the various remote ETC toll locations.

Upon the completion of this contract the Authority toll collection system shall be fully interoperable with other Texas agencies that are part of the TeamTx.


A. Toll Collection System Hardware

The customized hardware design criteria have been broken down into several categories: general & computer enclosure, environmental, and assembly.

The assumptions listed below provide the framework for development of the contractor provided customized hardware design criteria:

1. Customized hardware

   All contractor provided computers shall be identical with the exception that pluggable modules are not included if not required by the particular lane.

2. General & Computer Enclosure

   a. The contractor shall ensure that there is a second source for all parts.
b. All replacements shall be plug compatible with no changes required; or may require cable changes to be compatible or may require minor modifications to software to be compatible.

c. All electronic components shall be installed in non-corrosive sealed enclosure.

d. The contractor shall ensure that there is adequate space (20-25% extra) within enclosure for added boards and components.

e. Where possible all peripherals shall use network architecture to communicate with the zone controller. If needed network convertors shall be used.

f. The contractor shall ensure that industry standard I/O interface modules are used in the design.

g. Spare slots shall be available to support the addition of sensors as needed.

h. All field wiring terminated on screw lugs or connectors.

i. Surge suppression for all field wiring susceptible to lightning or similar surges.

j. Speaker shall be provided for POST messages and other status.

k. Power supply shall be provided for all required internal DC voltages.

l. Separate grounding shall be provided for DC power supply, safety ground, surge suppression ground, and potentially analog ground and the contractor shall provide the design details during the design review phase.

m. Separate UPS power and unconditioned power (for ITLs, etc.) shall be available.

3. Environmental

a. The toll collection equipment to be supplied will be installed in areas exposed to a wide range of climatic conditions. In addition to the climatic conditions, the equipment will also be subjected to harsh environmental factors normally found in the operation of a toll lane, such as, but not limited to, salt air near coastlines; car, truck and bus emissions; industrial exhausts; industrial cleaners; gasoline and car lubricants; Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI); and vibrations. The equipment may be placed into operation in lanes that have no provisions for heating or cooling.
These conditions shall be taken into account in the design and selection of equipment proposed for use on this contract and the contractor is responsible for ensuring that the proposed system works accurately and reliably in such an environment or is otherwise provided with the necessary equipment and climate controls to ensure proper functioning.

b. The zone controllers should be able to operate in a sealed environment and able to support all lane hardware/software specifications of these special specification.

c. During the detailed design phase as outlined in the FHWA “V” Model, the contractor shall provide thermal calculations that prove the zone controller and other lane electronics enclosures meet the temperature specifications given above.

d. The contractor shall use the FHWA Systems Engineering Guide to develop design and testing documents.

The contractor shall use the plans and specifications to develop an abbreviated Concept of Operations (CONOPS). The CONOPS shall describe in detail the system operational concept as shown in the plans and specifications. The CONOPS shall be reviewed and approved by the Authority. The CONOPS shall serve as a basis for the operational testing plan.

The contractor shall create the CONOPS using an iterative process and deliver the final CONOPS plan as approved by the Authority.

The contractor shall create the OPS test plan using an iterative process and deliver the final OPS test plan as approved by the Authority. The duration of the operational test plans shall be 90 consecutive days of operation without errors or failures. The operational test plan shall suspend upon the detection of errors or failures. The OPS test will be restarted upon completion of repair or replacement, the 90 day period of the OPS test plan shall be restarted at zero (0) time.

The contractor shall use the plans and specifications to develop a “General Requirement Document”. The General Requirements Document shall describe in detail the high-level system requirements using the CONOPS and as shown in the plans and specification. The system general requirements shall be reviewed and approved by the Authority. The system General Requirements Document shall serve as a basis for the On-Site first installation test plan and the commissioning test plan.
The contractor shall create the General Requirements Documents using an iterative process and deliver the final General Requirements Document as approved by the Authority.

The contractor shall create the test plans using an iterative process and deliver the final On-Site first installation test plan and the final commissioning test plan as approved by the Authority.

The contractor shall use the plans, specifications and general requirements document to develop a “Detailed Design Document”, including hardware and software. The Detailed Design Document shall describe in detail the system hardware and software requirements using the plans, specifications and general requirements. The system Detailed Design Requirements shall be reviewed and approved by the Authority. The system Detail Design Document requirements shall serve as a basis for the factor demonstration test plan.

The contractor shall create the Detailed Design Document using an iterative process and deliver the final Detailed Document as approved by the Authority.

The contractor shall create the test plans using an iterative process and deliver the final factory acceptance test plan as approved by the Authority.

The contractor shall create the test plans using an iterative process and deliver the final factory acceptance test plan as approved by the Authority.

e. Interface Control Document

The contractor shall furnish the Interface Control Document as part of the Detailed Design Document that provides the requirement and describes in detail the communication interface between the ETC lane level equipment and the ABO. The communication shall include all that is necessary for start up, operation; toll collection, reconciliation and audit; MOMS health and status reports.

4. Assembly

a. The customized hardware shall be assembled and tested in the fabrication shop before being installed in the lane.

b. All customized hardware shall undergo a 72 hour burn in test before they are installed in the lanes.

c. Customized hardware assembly shall facilitate easy replacement (use of standard maintenance tools) of failed components.
5. Bill of Materials (BOM)

The contractor shall include the Bill of Materials (BOM) for all equipment and hardware supplied by the contractor to meet the specifications of this special specification. During the detailed design phase the BOM shall be finalized.

6. Spare Parts

General customized hardware design criteria are established to require the use of off-the-shelf products and support the need for the Authority to maintain and replace parts for the next ten (10) years. The contractor shall provide a spare parts list and recommended quantities for all spare parts for all hardware supplied for the toll collection system. The contractor shall also provide the suppliers and second sources for all parts and spare equipment. The contractor shall purchase under this contract an initial stock of spare parts that will be made available to the maintenance staff upon acceptance of SH 550 Port Spur.

B. Toll Collection System Software

The operating system and application software provided by the contractor shall support real time operations of the lane and shall be the latest industry standard. Where applicable, a browser based Graphical User Interface (GUI) design shall be employed. The application software shall be configurable and provide flexibility to the user to make changes. The toll collection system software shall have debug features that will assist in the trouble diagnosis of the System in the event of problems. All toll collection system software provided under this contract shall have a five (5) year warranty against software defects and deficiencies.

C. Toll System Security and Access Control Requirements

1. Identification and control of all individuals who gain access to the toll collection system data within the toll collection or CCRMA administrative computer network shall be maintained. The contractor shall not provide a backdoor access to the toll collection system, which will allow circumvention of the toll security system. Additionally, access to any cabinet or housing shall be restricted to key lock access.

2. Toll System Software Security

Access to all information on the toll collection system computer network shall be limited to designated, Agency Authority and contractor personnel and shall be password controlled. User access security including sign-on facilities, permission control, and different levels of access shall be provided for the files and directories. Specific requirements shall be developed during System design.
3. Cabinet and Housing Access

Access to all toll collection cabinets and housings shall be key lock controlled. All new cabinets and housings installed under this contract shall be access controlled using keys locks.

4. Toll System Lock Requirements

All equipment and cabinet locks for the toll collection system shall be removable and replaceable cylinder lock types. The contractor shall supply all locks, establish the keying index system for all toll collection equipment and install these locks on all toll collection equipment before installation.

The Authority shall issue all keys for all toll collection equipment locks. Contractor personnel shall utilize only assigned, individual keys, and shall not share keys with any other individuals, or make copies of any assigned keys. Contractor personnel shall immediately return all assigned keys to the Authority upon request.

D. Zone Controller

1. Hardware

Zone controllers shall be shared across ETC lanes in a fully redundant configuration. All zone controllers shall be identical with the exception that pluggable modules are not included if not required by the lane. If non-identical zone controllers are proposed, the Proposal shall clearly explain the exception. Proprietary hardware will be accepted if drawings that enable construction, repair, and modification of the hardware and rights sufficient to use the drawings for these purposes are transferred to the Authority.

2. Software

The zone controller application software shall interface with all associated lane equipment and shall be designed to support all lane operational activities. The contractor software shall be configurable and able to support the Authority operational needs without requiring changes to software. The Detailed Design Document shall clearly identify the configurable nature of the system software.

The proposed operating system should have a future upgrade path and must be supported for up to ten (10) years. The contractor shall ensure that the risk of obsolescence to the hardware is minimized through the selection of the operating system software and the peripheral hardware.

The contractor shall propose appropriate protocols and data structures to accomplish the communications required between various peripherals.
These protocols and data structures shall be fully detailed by the contractor during the design process and approved by the Authority before being implemented in the System.

The contractor shall develop the Interface Control Document (ICD) for the zone controller to interface to the Authority’s designated Back Office System.

The lane systems shall support ETC lanes as described in the associate Special Provisions. The zone controller application software shall enable the lane to receive and transmit data to all lane devices, and Authority MOMS. All messages between the zone controllers, ABO, and ABO Computer, including the Security Access System and Authority MOMS shall utilize a guaranteed transmission protocol. The contractor shall clearly identify how message transmissions between toll collection system components are guaranteed in the Detailed Design Document. All messaging shall comply with the ABO interface and Associate ICD.

The zone controller shall provide AVC and violation enforcement capabilities. The VES can be a separate computer that manages all the image capture and processing functions, camera and light controllers and communicates with zone controller.

The zone controller application software shall support all lane functions required to meet the Authority lane operation requirements. Those functions include the following:

a. Automatic Vehicle Identification (AVI) System

   The contractor shall provide an AVI system that meets the requirements of the Texas Interoperability Specifications. Buffered reads shall be processed the same as real time reads, however, such a transaction will be flagged. The zone controller shall interface with the AVI System and transmit all data received from the AVI System. The AVI System shall be capable of reporting its health to the zone controller and shall provide status when polled. The zone controller shall synchronize the AVI System time to a 100th of a second (configurable). The contractor shall be responsible for working with the AVI vendor on this interface. The zone controller shall report all tag reads; the details of the data format shall be finalized during the detailed design phase. The contractor shall be responsible for ensuring that all data elements required by the Authority to meet their operational requirements are provided.
b. Automatic Vehicle Classification (AVC) System

The contractor shall be responsible for installing the required sensors and hardware as part of the AVC System that will accurately detect vehicles traveling at stop and go up to 100 mph, and separate vehicles spaced at one (1) foot apart. The Authority will employ an axle-based classification for toll determination, and as such, reporting of axles counts (forward, reverse and net) shall be deemed sufficient. The AVC System provided shall have the ability to detect hitches and ensure that vehicles with a tow are reported as one unit. The AVC System can be a part of the zone controller however, if it is a separate unit, then the zone controller shall interface with it as a seamless System. The AVC System components shall be capable of responding to diagnostic messages and be capable of providing health status to the zone controller.

c. Violation Enforcement System (VES)

The contractor shall provide all the necessary hardware required to support the VES that meets the Authority operational requirements and is fully compatible with the Authority operations. Images shall be captured and processed per the Business Rules established by the Authority. The VES shall capture and process vehicles traveling at stop and go up to 100 mph and vehicles that are spaced at two (2) feet apart. The VES can be an integral part of the zone controller, however, if it is a separate System, then it shall be a seamless System and the contractor is responsible for the interface. If the VES is an integral part of the zone controller, then the contractor shall clearly detail how such a configuration will not degrade the performance of the Lane Configuration specifically in the ETC Lane. The VES camera shall be trigger able by network communication and discreet.

The VES shall be capable of buffering images (retaining an image until its deposition is known) to reasonable level to support multiple vehicles in the lane and the Authority Business Rules. The contractor is responsible for providing the Optical Character Recognition (OCR) software so the image quality shall be good enough to meet the VES accuracy and performance requirements. All equipment required to support OCR shall be the responsibility of the contractor. The VES components shall be capable of responding to diagnostic messages and be capable of providing health status to the zone controller.
d. Transaction Processing

The contractor shall provide complete timing diagrams depicting vehicles passing through the lane for each type of lane configuration and for each payment method type. The timing diagrams shall identify every event that occurs within the lane from the beginning of a transaction to the end. If the contractor software uses a queuing logic, this shall be described in detail. The detailed transaction processing rules shall be defined and finalized during the detailed design phase however, the following basic rules apply:

(1) At least one transaction shall be created for each vehicle and the zone controller will ensure that the transaction is complete prior to transmitting it.

(2) The zone controller shall be able to handle multiple vehicles in the toll zone and track each one accurately.

(3) The zone controller should be able to handle vehicles backing up after having passed the toll lane without creating extra vehicles.

(4) The zone controller should be able to automatically synchronize the system with the vehicles in the lane and/or the toll collector to ensure the events in the lane correspond to the transaction generated.

(5) All AVI reads transmitted by the AVI System shall be reported to the ABO Computer.

(6) The zone controller shall have the ability to flag transactions that are considered unusual.

e. Communications with the ABO

All messages generated at the lane level, including the zone controller and VES shall be transmitted to the ABO in real-time and shall be guaranteed. All messages shall be uniquely identified and validation shall be performed at the ABO to ensure that there are no missing or duplicate messages. The contractor shall provide automated means of synchronizing the lane and toll location messages in the event the zone controllers are replaced, or if communications are down or if data on the zone controller is not retrievable due to a catastrophic failure. The Business Day process shall not be considered successful if there is missing or duplicate data in the system.
f.  Time Synchronization

All zone controllers shall be synchronized either to a common time synchronization source. There shall be a second source for time synchronization if communications to the primary source is down. The zone controller shall synchronize or transmit time synchronization message with every device capable of maintaining time.

g.  Transponder Validation List (TVL)

The zone controller shall be capable of supporting the TeamTx Transponder Validation List and shall have the capability to support up to 16 million transponders per Agency. The zone controller shall be capable of accepting comprehensive (complete list once a day) and incremental (changes at least on an hourly basis) TVL and shall activate the file upon receipt. The contractor shall use the effective design to transmit the files (compress, encode, etc), store the files and use the file. Transponder validation shall occur in 50 milliseconds and the proposal shall contain the proposed logic and all exceptions to this requirement, shall be clearly explained. The format of the file shall be finalized during the detailed design phase.

h.  Toll Rate and Toll Schedules

The Toll Rate and Toll Schedule file is generated at the ABO Computer and transmitted to the Zone. The zone controller shall activate the new rates and schedule automatically on the effective day and time as identified in the file. The toll rate and toll schedules shall support the Authority toll collection operations. The zone controller shall close the current Segment of Duty (SOD) and open a new SOD automatically when the new toll rate goes into effect. The format of the files shall be finalized during the detailed design phase. The System shall have the capability to support up to 10 different toll rates and toll schedules.

i.  Configuration Files

All parameters and settings required to run the lane application shall be maintained in configuration files. Access to configuration files required to support the zone controller operations shall be controlled. The configuration files can be maintained on the ABO or downloaded along with the zone controller application file however authorized personnel shall be able to make changes to the configuration files in the field. All zone controllers shall have default configuration files that will allow the lane to boot-up automatically.
Authorized personnel shall be able to make change to parameters and settings that are defined as configurable elsewhere in these special specification and the approved design documents.

j. Monitor All Lane Equipment for Device Status

Each zone controller shall monitor itself and associated lane equipment devices for status. Serial devices, such as the AVI reader, shall be polled for status. The health of some digital devices shall be inferred from events. If a device recovers after the reporting a failure, then a recovery message shall be generated. The ABO shall determine if it has lost communication with the appropriate zone controller, and generate an alarm message. All alarm, health and recovery message shall be reported to Authority MOMS and the Real Time screen.

k. Diagnostics and Equipment Malfunction

The zone controller software shall execute periodic diagnostic checks on in-lane equipment. Intelligent peripheral devices shall be interrogated for device status on a regular basis. A device's failure to respond to a status inquiry, after a configurable number of retries shall be regarded by the zone controller software as an equipment failure. Such tests shall take place in all modes of lane operation, and the results shall be placed in each zone controller's event log.

Degraded modes of operation shall be supported based on Business Rules developed during the design process. The contractor shall ensure the proposed toll collection system continues to operate without loss of revenue or visible impact to the patron even if some components of the System fail.

l. Stand-alone Mode of Operation

The zone controller shall be capable of operating in a stand-alone mode for a minimum of thirty (30) days if communications to the ABO are down. When operating in this mode, the last files downloaded from the ABO shall be used while processing vehicles. Upon re-establishing communications with the ABO all messages shall be transmitted to the ABO without affecting the real time operations or degrading the lane operations. If any downloads were initiated while the communications was down, then these shall be re-transmitted to the zone controller to bring it up to-date.
3. Availability

The zone controller hardware shall be designed to operate without requiring any maintenance services for a minimum average time of one year. The average shall be calculated over the entire toll collection system. If the VES is a separate unit the VES hardware and software combined shall operate continuously without requiring any maintenance services for a minimum average time of one (1) year.

4. Mean Time Between Failures (MTBF)

The zone controller shall operate continuously without any manual intervention or maintenance services for a minimum average time of ninety (90) days. The average shall be calculated over the entire toll collection system. If the VES is a separate unit the VES hardware shall be designed to operate without requiring any maintenance services for a minimum average time of one-hundred and eighty (180) days.

5. ETC Lane

The contractor toll collection system shall support ETC Lane operations. The Authority will have toll facilities that have only ETC Lane, either two lanes or three lanes in each direction. In the ETC Lane configuration there are no tolls booths and patrons will have to pay their toll by establishing an account at the CSC using a transponder or a license plate. If a vehicle drives through the toll lane without a valid account, then it is considered a non-payment and will be pursued per the CCRMA Customer Contact Policy and Procedures.

The ETC Lane shall be designed in a redundant configuration where they are managed by a single primary zone controller system with a “hot standby” Secondary zone controller System operating in parallel and able to take over in the event the primary unit should fail (automatic failover). When the secondary unit detects that the primary is off-line, the secondary will assume the functions of the primary unit. Alarms messages shall be generated when such an event occurs. The contractor’s failover design shall ensure that there is no loss of revenue or transactions when one of the zone controllers fails. Only one zone controller at a time shall generate revenue transactions. The switchover from the Primary zone controller to the Secondary zone controller shall be transparent to the rest of the Systems.

The toll collection system shall be installed overhead and/or on the ground and traffic will travel through these lanes at normal highway speed. ETC Lane shall have front and rear cameras and the System shall associate the front and rear images captured to the correct non-paying vehicle.
Capability shall exist to turn off front image capture if required and the image shall not contain the images of the vehicle occupants. The vehicle tracking system shall be accurate in associating tag reads to the correct vehicles and ensuring the correct images are captured. The proposed system shall have the capability to support video tolling.

There shall be a high level of redundancy in the System that is proposed for the ETC Lane. The zone controller(s) that support the ETC Lane shall communicate to the ABO Computer. The same Business Day processing shall apply for transactions generated in ETC Lane.

a. ETC Lane Signage

Since patrons do not have an alternate means of paying the toll, early notification of the upcoming toll facility is critical thus giving them the opportunity to exit the Turnpike. The ETC Lane System shall have the ability to accommodate Value-Based pricing, and as such the patrons need to be notified of the toll they will pay if they choose to use the Turnpike.

b. ETC Lane Operations

In the event of a communication failure to the zone controller, it is very critical that the AVI System and VES have sufficient buffering capability so that transponder reads and images are saved locally until communications with the zone controller are re-established. In ETC Lanes, the AVI System buffering capability shall be 5,000 transponders per travel lane. Transponders read and images saved during this condition will be flagged. For the VES, images of every vehicle will be saved if zone controller communications is down and the VES shall be capable of buffering at least a day’s worth of images. Processing at the back office will ensure that patrons are tolled correctly.

c. Value Based Pricing

Although there are no current plans for implementation at this time, the Authority ETC Lanes shall be capable of supporting Value-Based Pricing based on time-of-day, and day-of-week; and these parameters shall be configurable.

d. Determination of Fare

Fare determination shall be performed at the lane and later adjusted at the CSC based on the transaction categorization. The ETC toll will be applied only to transponder transactions at the lane. The following rules will be applied for fare determination on ETC Lanes:
(1) If the AVC is operational, then the toll is based on number of axles for all vehicle types

(2) If AVC is degraded, then

(3) Fare is based on the tag class for transponder equipped vehicles that have a transponder class

(4) Fare is based on default of 2 axles for all other transactions

e. Saving of Images

In an ETC lane, images are critical and any loss in the images will result in lost revenue. The system shall be designed such that the VES shall be able to capture and save images even if the AVC and the zone controller are not operational. Images will be saved for the following conditions:

(1) In all cases where there is no valid transponder read, the front and rear image of all vehicles shall be saved. It is desirable that in case of front images, only images of vehicles with axles greater than two (2) be saved.

(2) Front and rear images of vehicles traversing the shoulder lane shall be captured, saved and flagged.

(3) If the VES loses communications with the zone controller, image of every vehicle shall be saved. Images saved during this condition shall be flagged.

(4) Images shall be saved even in a degraded mode of operation and such transactions shall be flagged.

f. ETC Lane Transaction Processing

These general rules shall apply when generating and processing transactions.

(1) At least one transaction shall be created for each vehicle and the zone controller shall ensure that the transaction is complete prior to transmitting it.

(2) All vehicle transactions should be assigned to a lane and toll location.
6. Authority Toll Location Hardware

   a. UPS

      All equipment at the lanes shall be on UPS and the contractor shall furnish and install an electronic interface between the ABO and the UPS to monitor the UPS performance. Software drivers shall be provided to acquire, display, store and report all parameters provided as outputs from the UPS. The UPS shall support the toll location equipment for two (2) hour and before a graceful shutdown shall send a message to the ABO that will allow for a graceful shutdown of the toll location Server. When the system is on the UPS, a notification shall be sent to the Authority MOMS.

   b. Emergency Generators Manual Switch Over and External Connector

      The contractor shall furnish and install a manual switch and external connector to be approved by Authority for connection of a portable generator at the toll location.

   c. Communications Equipment

      The Authority systems shall be connected by T-1 and WiMax communication to the ABO Server. The contractor shall work with the Design Builder in designing the overall network architecture. All LAN and WAN communications equipment shall be the state of the art and shall be provided, as necessary, to support the ABO equipment installations. The WiMax radio link shall provide a IEEE 802.11 link to adjacent ETC sites and shall be compatible with the Authority System. T-1 will be furnished by others and connected to the ETC network by the contractor.

   d. Equipment Racks

      Cabinets shall be provided with appropriate access doors, closure panels, face panels, stabilizer kit, casters, mounting and installation hardware as may be necessary to provide a complete and operational installation. All interconnection and power cabling shall be provided as necessary and shall be installed to provide a professional look. Each cabinet front shall be enclosed with a smoke, tempered glass door and key lock to shield the systems from dust. The cabinet, cabinet panels, and hardware described in this section shall be submitted to the CCRMA for approval.

7. ETC and Lane Level Computer Systems Software

      The Authority shall own all property rights, including intellectual property rights, in the software and all associated documentation developed under this contract.
a. ETC and Lane Level Operating System

The operating system for the ETC lane level system shall consist of a multi-user, multi-tasking operating system. The operating system shall fully utilize the zone controller and VES architecture and shall support all peripherals defined in these specifications. The operating system shall also support the proposed communications topology and contractor’s application software. The contractor is responsible for obtaining all licenses as required in the name of the Authority. All licenses shall be provided to the Authority for all off-the-shelf operating system software. The proposed operating system should have a future upgrade path and must be supported for up to ten (10) years. The proposed operating system should have a warranty for one (1) years after the Acceptance of SH 550 Port Spur.

The operating system shall be a proven system used widely throughout the United States for intensive database operations and should be compatible with the real time process control and other web based tools.

b. toll location Database

Complete documentation describing the proposed processes, capture, data transfer and storage concepts shall be provided in the concept of operation, sufficient to allow the Authority to review and determine compliance with the requirements of the Special Specification.

c. System Administration

Operation and monitoring of ETC and Lane Level operations shall be accomplished by means of remote system management techniques. All processes shall be automatic and failure of any process shall result in a notification to the system administrator. Alarm messages shall be created for process failures that will be routed through the Authority MOMS. System logs shall be maintained for all processes and the logs shall have sufficient information to help analyze the problem. System Administrators shall have the ability to manage user access security including sign-on facilities, permission control, and different levels of access for the files and directories.

8. General Software Functional Requirements

The ETC process control software shall include collection and storage of all transaction and status data from the lanes, processes the data to create summary data, and transfers all detail and summary data to the ABO Server. This data is also transferred to the ABO Server for auditing and reporting.
In addition to data storage and transferring, the toll system is also responsible for downloading configuration and status information to the lanes to ensure their proper operation.

It is desirable to have a single application for all subsystems of the Authority toll collection system. Depending on the access privileges and authorization levels, the required application functions will be made available. The application software shall provide functionality required by the supervisor, maintenance, and other authorized as detailed below. All applications shall use the latest state of the art technology to allow for flexibility, configurability and ease of use. A web based design shall be used and authorized users can access the application from anywhere on the network. The system shall have the ability to automate all of the toll collection related activities.

Screen designs shall use GUI and self help features shall be provided to assist the users with data enter and retrieval, and navigate through the screens. The software shall institute established data validation and user notification process to ensure correct and accurate data is entered. Where possible drop-downs and automated entry of data shall be made available.

The requirements are described here to allow the contractor to understand the Authority operations. The screen designs and report formats will be discussed, reviewed and finalized during the design review phase.

a. Data Communications and Interface Requirements

The toll location Server shall interface with various peripherals as detailed in this Special Specification. All messages between the zone controllers, toll location Servers, ABO Server, security access server, and maintenance computers shall utilize a guaranteed transmission protocol. The contractor shall identify how message transmissions between system components are guaranteed. The application software shall provide the following functionality at the toll location at a minimum.

(1) Acknowledgement and confirmation of all data sent to and received from each zone controller and the ABO Computer as to be defined in the Authority approved design documents.

(2) All messages and data received and recorded at the ETC lane level computer must be available at the ABO Computer immediately or within one hour of occurrence.

(3) Data that depends on the completion of the Business Day is transferred after the successful assignment of the Business Day.
(4) Receive transponder validation list (comprehensive and incremental), employee list, toll rate and toll schedules, lane configuration files and lane executables from the ABO Computer, and distribute them to the individual zone controllers under its jurisdiction and monitor their proper receipt in each. If not properly received and subsequently put on line by the zone controller, reinitiate the transfer and notify the Authority MOMS and ABO Computer.

(5) Maintain records of all versions of the transponder validation list, employee list, toll rate and toll schedules, lane configuration files and lane executables that it received from the ABO Computer and that were successfully downloaded to the lanes. Reports shall be made available to verify the versions and the download status.

(6) Provide self-diagnosis functions to detect and report on the status and functioning of the ETC Computer hardware devices and software applications as to be defined in the Authority approved design document. Provide the capability to automatically identify missing or duplicated data and to manually retrieve such data from its original source.

b. Data Management Requirements

The Toll System shall receive and store all data that it receives from the zone controller and the ABO Computer. Messages received from the zone controller shall also be summarized by various criteria for use by toll operations and audit personnel.

c. Receive and store data received from all other peripherals

(1) All monitoring, status and alarm messages generated from the UPS

(2) All status and alarm messages received from the toll location peripherals

(3) All status and alarm messages received from processes and tasks running on the zone controller

d. Data Security

The contractor shall ensure that master data records, once entered into the system, cannot be deleted or changed without proper security and provisions for a complete audit trail. Only authorized users are allowed access to the system and the data, and all logins and modifications shall be recorded.
e. Time Synchronization

All ABOs will synchronize with the ABO Computer. All zone controllers, maintenance computer, security access systems, VES computers and any other computer that communicates with the ABO shall synchronize their times with the ABO using off-the-shelf time synchronization software. If needed synchronization messages shall be sent to devices that do not support off-the-shelf time synchronization software.

9. Security Access System

The contractor shall provide a Security Access System for the entire toll location and all doors that require authorized access. State of the art technology should be used and the system should be integrated into the toll collection system. An initiation of this alert should be directed to the Authority Security Facility.

10. Maintenance On-line Management System (MOMS)

The contractor shall assure that the current ABO Maintenance On-line Management System (MOMS) for reporting and tracking alarm messages and maintaining equipment inventory has sufficient capacity to handle the increased data from the SH 550 Port Spur. The Authority MOMS shall support real time paging of maintenance staff and shall be configurable to meet the Authority operations requirements. Scheduling of all maintenance activities shall be done through the Authority MOMS. All spare equipment tracking and purchasing of all toll related equipment shall be done through Authority MOMS. The Authority MOMS will reside on the ABO Computer. The Authority MOMS shall be integrated into the toll collection system application software. The contractor shall work with the Authority in configuring the Authority MOMS to meet the Authority maintenance needs.

E. ABO Computer

The provided by others Back Office Server is the depository of all toll collection data. ETC transactions and non-payment are transferred to the CSC/VPC for further processing. Summarized data shall be used to generate various reports that help the auditor with the revenue and transaction reporting. The transaction data shall also be summarized by time and this data shall be used for traffic reporting and traffic analysis.

1. Verification of Business Day Status

The first step in performing the audit is a confirmation that the Business Day at the toll location has closed.
This is a confirmation that all the system data from the lanes and the toll locations have reached the host and the audit can start. Business Day status report shall be available that shows the status and indicates if there are any problems and if manual intervention is needed.

2. Audit Assignment

The Audit Supervisor shall have the ability to assign each Auditor specific toll location(s) that they need to audit. Only the toll location(s) assigned to an auditor shall be available to the Auditor for audit. Users with higher privileges can audit all Collectors.

3. ETC Reconciliation

ETC transactions are transmitted to the ABO for posts to the customer account. ETC transactions shall be batched in files and transmitted every hour or every 100,000 transactions to ensure that they are posted immediately to the CSC. The CSC shall acknowledge the receipt of each file and post the transaction to the customer account. The host shall save all acknowledgements for investigation purposes for at least one month. If the transactions belong to other interoperable agencies, then they are forwarded on to those agencies by the CSC. Every transaction transmitted to the CSC shall be reconciled back to the Authority host on a file by file basis and the ones transmitted to other agencies shall be identified. All ETC transactions shall be reconciled back to the host until they are considered closed and have reached their final state. The details of the CSC interface shall be submitted during the detailed design phase through an ICD.

4. Review of Violations Status

Reports will be available at the VPC to monitor the violations and the VPC operations and Authority shall be provided the ability to access to these reports via the host.

5. Traffic Monitoring

For the purposes of traffic reporting all transaction data shall be summarized by 15 minute intervals by payment method and vehicle class. Capability shall exist to generate traffic reports and graphs based on transaction date and these reports shall help project the traffic patterns for each toll location for a given time period. These reports are used by the toll location Supervisors and Planning Engineers while configuring the lanes.
6. Traffic Statistics

Capability shall exist to generate Traffic Statistic reports on an hourly basis or in 15 minute intervals by payment method and show the traffic volumes for each lane at a facility. Comparative graphs shall be made available that show the pattern for a week for each lane at the facility. Graphs shall be generated projecting various traffic statistics.

7. Traffic Analysis

Capability shall exist to generate Traffic Analysis reports on an hourly basis or in 15 minute intervals by vehicle type and show the usage for each lane at a facility. Various graphical presentations shall be made available that show vehicle travel patterns.

8. Toll Collection System Reports

All data entered or generated in the system shall be retrieved through reports and screens. Report and screen made available through the system and on an adhoc basis shall have various selection and sort criteria. All reports and screen shall have the capability to be printed, saved in pdf format, html format, Access, and XCEL formats. Selected reports shall be automatically generated and made available to authorized personnel at the start of the Business Day. Report requirements and designs shall be presented and finalized during the design review process. Additionally, after the deployment and implementation of the system, there may arise the need to create additional reports, and the contractor shall support such additions.

9. Problem Reporting

The host personnel shall have access to the Authority MOMS reports and can generate these at any time to observe the performance of the Maintenance contractor and also the overall performance of the system. System problems that keep a lane down for hours at a time need to be investigated.

10. ABO Management Functions Down Loaded to ETC Lane

Various administrative functions related to toll collection are performed at the host and the system shall provide the capability to authorized personnel to create and modify the required information.
11. Employee Setup and Maintenance Screen

Employee Setup and Maintenance is a critical task since the employee designations created through this system shall determine what privileges and access right each employee has. Ability shall exist to create new employees through the system or through data obtained from the other systems like the pay roll system or the human resource system. Through this screen the employees shall be designated various titles based on their roles and responsibilities (job description). As a first task, job descriptions shall be created.

This screen shall be also used to activate and inactivate employees and also terminate them. The same screen shall be used to assign user ID and PIN for access to applications. As soon as the information is saved, the Employee Identification List gets transmitted to the toll location to be send down to the lanes. As soon as it gets to the lanes, the new list shall be initiated without rebooting the lane. The same Employee Identification List shall also be used by the security access system and the Authority MOMS application.

12. Screen and Report Access

Capability shall be provided to assign privileges and access rights by job description to the toll collection system application including the security access application and the Authority MOMS application. All application access and privileges shall be controlled through one application. All the available screen and reports shall be displayed along with a listing of the job descriptions. For some screens users are only allowed to view the contents and not allowed to enter any data. For some screens the user is not allowed any access at all. Access privileges can be changed at any time, and are based on job description and are not at an individual level.

13. zone controller Executable Download

Capability shall exist to download zone controller executable and all other files required by the lane for its operations. Successful download of the files shall be verified and alarm messages generated if these files did not make it to specific lanes.

14. Non Revenue Auditing

Capability shall exist to allow authorized personnel to generate queries based on transponders and transponder range to obtain the travel details.
15. System Maintenance Screen

In order to ensure that all the processes are working and file transfers are successful, the CCRMA system maintenance person shall access the screen that verify the status of various file transfers including the files transmitted and received from the CSC/VPC. If files have to be transmitted to the lanes, this screen will show if it made it to all the lanes and what version is in use. Screens shall be available that will show all the alarms generated by the various systems including the operating system and the database.

16. System Administrative Functions

System Administrative staff at the host shall have the ability to monitor the toll location and ABO Servers and perform day to day system maintenance functions to ensure that the system is performing efficiently. Various tools shall be provided to automate the activities and all failures shall result in the notification to the Authority MOMS.

17. ETC lane and ABO Communications

Capability shall exist to allow authorized ETC lane and host personnel to communicate with each other electronically very similar to messaging. This tool shall allow for files and screens to be send among authorized personnel. Such a feature shall streamline the communication process and expedite the inquiry and investigation process.

F. Performance Requirements

The contractor shall provide a toll collection system that meets the accuracy and throughput requirements listed below at the speeds specified below for each lane type. These requirements apply to all lane types.

1. Accuracy Requirements

The contractor shall provide a toll collection system that meets the various accuracy requirements described below. During the Operational Test, the compliance to these requirements shall be verified.

a. Vehicle Detection and Association Accuracy

The system shall without exception detect vehicles and accurately associate axles and other sensor information to the vehicle with an accuracy of 99.9%.
b. Vehicle Classification Accuracy

The system shall without exception classify vehicles with an accuracy of 99.9%.

c. Tag Read and Association Accuracy

The system shall read the TxTag that is properly mounted with an accuracy of 99.9% and shall correctly associate the tag reads with the correct vehicle with an accuracy of 99.9%.

d. Image Capture Reporting Accuracy

The VES shall capture, and report an image 99.9%.

e. Transaction Reporting Accuracy

All transactions generated by the zone controllers in accordance with the above accuracy requirements shall be reported at the associated ABO and the ABO Computer with an accuracy of 100%.

* A plate shall be considered obstructed when:

(1) The vehicle has no plate.

(2) The plate is covered by dirt, snow, a trailer hitch, tailgate or some other material.

(3) The plate is damaged.

(4) The plate is blocked by something in the lane i.e. a person.

G. Transaction Throughput Requirements

The toll collection system shall have the capability to process vehicular transactions at the rate of 2200 vehicles per hour (vph) per lane.

H. Design Speeds

The system shall have the capability to process vehicles traveling at speeds between 0 to 100 mph.

A. Overview

The requirements described in this Exhibit detail the labor, materials, and support services necessary to test the Authority toll collection system during performance of the contract. The testing shall be conducted in various phases as detailed below to validate the toll collection system integrity, reliability, functionality and compliance to the requirements of this special specification, including without limitation, those set forth in Section 3.

The objective of the Authority testing plan is to ensure that the Authority toll collection system is systematically and thoroughly tested for Special Specification compliance and the system operates reliably per the Authority Toll Collection Procedures and Business Rules. The contractor shall make the best effort to test the system simulating normal traffic conditions.

The toll collection system provided by the contractor shall be integrated with the CSC/VPC and entire system shall be tested prior to opening the system to revenue collection. The contractor is responsible for all test logistics (lane closures, test vehicles, drivers, etc.) and coordination activities. The Authority and its Representatives shall only witness and approve the testing, and the contractor shall be responsible for all aspects of the testing. Approval of any aspect of testing shall not relieve the contractor’s responsibility in meeting the requirements of the contract.

B. General Testing Requirements

The contractor shall provide the Authority, for review, comment and final approval, a Master Test Plan that outlines the scope and testing concepts to be used to validate the toll collection system from initial development through installation and contract Acceptance. This Master Test Plan shall cover the factory acceptance test on-site, commissioning, live operations and acceptance testing. Once the Master Test Plan is approved in writing by the Authority, it shall then be used to compose the detailed test procedures, which shall be submitted to the Authority for review and approval by the Authority. It is essential that the contractor provide sufficient time for the submission and review of the Master Test Plan and the detailed test procedures.

After the completion of each test, the contractor shall submit to the Authority for review and approval the Test Report that documents the results of the test. The Test Report shall include the results of the test, the anomalies identified and the corrective action and any re-tests necessary to successfully complete each testing phase.
During the development of the system software, the contractor shall conduct tests or demonstrations as reasonably requested by the Authority to ensure that the toll collection system meets the functional specifications set forth in Section 3 of this Special Specification.

1. Vehicle Per Hour for ETC

The contractor shall conduct tests approved by the Authority that validate the capability of the toll collection system to process the volumes of vehicles (vehicle per hour) for the ETC lane configuration as identified in Section 3 of this Special Specification.

C. On-site Testing

The objective of this test is to verify the full functionality of the toll collection system and its compliance with the requirements of this Special Specification and approved design specifications in a controlled, on-site environment using different types of vehicles in different lane types and lane modes. All equipment provided under this Special Specification by the contractor shall be part of this test including the communications network. The ETC Location Computer(s) and the existing ABO Computer shall be installed in their final location(s). It is possible that some of the Authority toll lanes may be open to traffic in which case, testing will be conducted in a very controlled manner with proper lane closures. The contractor shall detail in the Master Test Plan the logistics of the testing.

The contractor and the Authority shall agree on a test site(s) and the contractor shall set up the lane and installing all equipment in the lane. All equipment and software that is required by Exhibit of this Special Specification shall be in place, and prior to the start of the test the contractor shall formally notify the Authority that the toll collection system is “ready” for testing. The test shall be conducted by the contractor and witnessed by the Authority. The test shall be conducted in accordance to approved test procedures and test schedule, all in accordance with the contract.

As part of this test, the Authority shall develop a compliance matrix that is reviewed and approved by the Authority, that identifies each requirement and the tests conducted that prove compliance to the contract. It is the contractor’s responsibility to ensure that each requirement is certified and/or tested for compliance.

This phase of testing is very critical to the success of the contract, as such, all anomalies shall be documented in the test report. The contractor and the Authority shall determine the corrective action required and depending on the severity of the anomaly, the status of the contract shall be determined by the Authority.
Upon the successful completion and approval of the on-site prototype testing, any further changes to the software shall be fully documented and made only with the approval of the Authority. Depending on the changes made to the toll collection system, the Authority reserves the right to request a re-test of the entire or part of the prototype testing. The objective of this is to ensure that changes to one part of the toll collection system do not have a negative ripple effect on the rest of the system.

1. Lane Operations and Functional Test

As part of this test, the various configurations of the ETC lane shall be tested.

2. Toll location Functionality

As the lane functionality is tested, the results shall be validated at the ABO. The toll location functionality shall also be demonstrated during this test. The Business Day assignment process shall be thoroughly exercised to create all types of failure to test the process. All screens will be tested for correctness, error conditions, ease of use and functionality. Reports will be generated to verify the data entered and to reconcile the transactions conducted in the lanes.

The accurate transfer of test data from each zone controller to the associated ABO, ABO Computer, and on to the CSC/VPC, shall be verified to be in compliance with the design documents. Various toll location level failure conditions as specified in this Special Specification shall be generated to test the Authority MOMS alarm and maintenance requirements.

3. ABO Functionality

All screens will be tested for correctness, error conditions, ease of use and functionality. Reports will be generated to verify the data entered at the host and the toll location, and to reconcile the transactions conducted in the lanes. Test files shall be obtained from the bank to the test the bank interface.

New employee additions, and toll rate and toll schedule creations shall be performed to verify that the data is transferred successfully to each ETC Toll Computer and then on to the lanes and the changes shall be verified by conducting transactions in the lanes. The host interface to the CSC/VPC shall be thoroughly tested and data shall be verified at the CSC/VPC. Reports shall be generated on both systems to verify the transactions, revenue and payments.

4. CSC/VPC Functionality

Various accounts shall be established at the CSC per the Authority Customer Policy and transactions generated against these accounts. The transfer of the toll rate and toll schedule to the CSC/VPC shall be tested.
Various ETC and no payment transactions shall be created in the lanes to verify the CSC/VPC compliance to the Authority Business Rules and Policy. Reports shall be generated at the host and CSC/VPC to verify the ETC and no payment transactions reconciliation. The Authority will be responsible for testing the CSC/VPC compliance.

5. Authority MOMS

The contractor shall set up the complete Authority MOMS for the Authority prior to the Prototype On-site Test. During the test the contractor shall verify the system’s compliance to the design documents. Failures shall be simulated on all equipment capable of reporting the status and the alarm messages and their tracking shall be verified through the Authority MOMS.

6. Security Access System

The contractor shall ensure that prior to the Prototype On-site Test the security access system is installed and setup for operations. The functionality of the system shall be verified during the Prototype On-site Test.

7. Specific Lane Tests

a. ETC Lane Testing

Additional testing shall be performed in the ETC lanes to simulate vehicles staggering lanes, traveling on the shoulder lanes and closely following the previous vehicle. Degraded operations in ETC lanes shall also be tested to verify the system redundancy capability.

b. Bumper to Bumper

Vehicles traveling bumper to bumper emulating rush hour traffic shall be tested in all lane configurations to verify that the toll collection system can process the vehicles accurately.

c. Varying Speed

Vehicles traveling at various speeds (stop and go to 100 mph in ETC lanes) shall be tested in all lane configurations to verify that the toll collection system can process the vehicles accurately.

d. Business Rules Test

The Business Rules test shall be conducted to verify that the toll collection system operates per the agreed upon Business Rules.
e. Out of Synchronization Scenarios

Various conditions shall be simulated to test the system’s ability to handle scenarios that put the system out of synch with the vehicle. The contractor and the Authority shall jointly develop these test conditions.

f. Various Unusual Occurrence Scenarios

The contractor with the Authority input shall identify various scenarios that can occur in a toll-collecting lane that are considered unusual such as vehicle backing up, collector post and pre classification, etc. A test shall be conducted by the contractor to identify how the toll collection system handles such scenarios.

g. Degraded Mode of Operation

The operational effect of different types of failures on the toll collection system shall be demonstrated.

D. Onsite and Commissioning Test

Upon the successful completion and approval of the Prototype On-site Test, the contractor shall be given the authorization to install the toll collection system software on the lanes that will soon open to live traffic or are already open to traffic. A commissioning test shall be conducted on each lane to validate the functionality and operational status of each lane. Every piece of in-lane equipment and its interface to the zone controller shall be verified to be fully operational. During this test the zone controller, ABO Computer and the CSC/VPC interface will be validated to ensure that the communication system is in place and the Authority toll collection system to ready for revenue collection. The installation of all equipment and software, and their operations shall be verified end to end.

E. Operational Testing

Prior to System Acceptance Test, the Converted System shall be observed in live operations by the contractor and the Authority for a minimum of one month to cover on monthly audit cycle. During this system test, accuracy, performance, reliability and auditability shall be verified. The alarms displayed on the maintenance system shall be analyzed. The contractor shall correct the anomalies and the Authority shall verify the corrections.

The objective of the operational test is to ensure that the toll collection system software and hardware functions over a period of 30 days with limited manual intervention.
It confirms that all lanes, toll locations, host and the network are sized and configured correctly and data is processed without interruption. The following requirements shall be validated during the operational test:

1. Vehicle Detection and Association Accuracy

   The contractor shall verify in a live environment and under all lane configurations that the toll collection system accurately and reliably detects vehicles and associates axles and other sensor information to the vehicle per the requirements of Section 3 of this Special Specification. The sample size and data collection methodology shall be detailed in the test procedures document.

2. Vehicle Classification Accuracy

   The contractor shall verify in a live environment and under normal traffic conditions that the toll collection system accurately classifies vehicles per the requirements of Section 3 of this Special Specification. The sample size and data collection methodology shall be detailed in the test procedures document.

3. Transponder Read and Association Accuracy

   The contractor shall verify in a live environment and under normal traffic conditions that the toll collection system reads transponders and accurately associates them to the correct vehicle per the requirements of Section 3 of this Special Specification. The sample size and data collection methodology shall be detailed in the test procedures document.

4. VES Accuracy

   The contractor shall verify in a live environment that the images captured by the toll collection system are accurate, readable and meet the specifications of Section 3 of this Special Specification. The sample size and data collection methodology shall be detailed in the test procedures document.

5. System Audit

   An entire 24-hour period worth of data shall be monitored in selected lanes, and the data collected from such lanes and ABO Computer shall be thoroughly analyzed to ensure that the Authority can conduct an audit on the toll collection system that reconciles the expected revenue to the actual revenue. If required, video tapes shall be used to help analyze the data. The test procedures shall detail the data collection and analysis methodology.

   All anomalies identified during this toll collection system audit shall be analyzed and explained by the contractor.
The Authority and the contractor shall determine the corrective action to be taken. These audits shall be repeated until the Authority is satisfied that the toll collection system meets the Authority’s functional, operational and audit requirements, however the entire toll collection system audit test shall not extend beyond 30 days.

The images of violations shall be reviewed and verified to ensure the correct image was taken. Anomalies identified shall be analyzed and explained by the contractor and corrective action determined. These tests shall be repeated until the Authority is satisfied that the toll collection system meets the contract requirements as defined in the design documents and this Special Specification.

The following items shall be verified during the 30 day operational test:

a. The software in every lane shall be verified to be the same.

b. The tag status in each lane shall be validated for a week to ensure that comprehensive Transponder Validation list is being received by every lane consistently.

c. The Authority application software including security access and Authority MOMS software shall be verified.

d. AVI logs shall be compared against the lane logs and transactions at the ABO Computer and CSC/VPC as part of the AVI accuracy test to ensure that all tags read by the AVI system are recorded and processed by each zone controller. The sample size shall be 10,000 transactions collected from separate lanes.

e. VES accuracy shall be confirmed through the evaluation of a minimum of 5000 violations transactions collected from the same lanes as used in the AVI accuracy testing.

f. The transaction framing shall be validated to ensure that tag reads are assigned to the correct vehicle.

g. Computer system lock ups, and process failures shall be investigated and recorded.

h. Failure of any programs at the ABO and ABO Computer shall be investigated and recorded.

i. The system’s ability to assign Business Days shall be verified and all Business Day failures shall be investigated.

j. The storage and archival capability of the each system shall be verified.
k. The ABO Computer’s ability to archive, purge and restore data shall be verified.

l. All transactions generated by each zone controller in accordance with the above accuracy requirements shall be reported at the ABO with an accuracy of 100% using a sample size of one 24-hour period data from one lane. The transactions shall be verified to have reached the ABO Computer and the CSC/VPC.

m. All reports that reconcile collector deposits, vault deposits, ETC, and violation transactions shall be verified and discrepancies investigated.

6. Operational Acceptance Test

At a mutually agreed day, following satisfactory completion of the above described testing as determined by the Authority, the contract Acceptance Test shall begin. The acceptance test shall be conducted on the toll collection system and is considered a requirement for contract Acceptance. During this period, the toll collection system will be allowed to operate without interruption and monitored for 30 days. Anomalies that are identified shall be classified as critical or non-critical. Depending on the severity of the anomaly, the 30-day clock may re-start. The test procedures shall detail the data analysis process. If the system failed to meet the performance and accuracy requirements of this Special Specification, then these shall be retested to be successful during the contract Acceptance Test.

The contract Acceptance Test shall be considered successfully completed when the acceptance test criteria, developed during the detailed design phase, is satisfied. Upon the successful completion of the contract Acceptance test as reasonably determined by the Authority, the contractor will be given a Provisional Acceptance for the toll collection system.

5. MANAGEMENT SYSTEM

A. Overview

The contractor shall employ a project management system that is sufficiently detailed to enable the Authority to review and ascertain that the contractor has the necessary management, staff and controls in place to meet the requirements of this Special Specification. This system shall enable the Authority to monitor the progress and quality of the work performed under on the contract this Special Specification.
B. ETC Toll Schedule

The contractor shall develop a detailed schedule that list all tasks related to the design, development, testing, installation and deployment of the Authority toll collection system in Microsoft Project format (Office 2007 or above). The schedule identifies all milestones and events starting with the Notice to Proceed through the date of Acceptance. The schedule will form the basis for all subsequent schedules and updates throughout the duration of the contract. The contract schedule shall be baselined upon approval and the contractor is required to update the contract schedule on a monthly basis. This schedule is a detailed ETC toll task schedule that is subordinate to and dependent on the roadway construction contract schedule.

C. Monthly Report

At a minimum, monthly progress meetings shall be held on or about the 20th of each month at a location designated by the Authority. Three working days prior to the meeting, the contractor shall submit monthly progress reports to the Authority. The reports shall include the following documents, when applicable:

1. A written report outlining the labor, materials and the percentage of work performed for each task in the contract schedule. Comments shall be included, where appropriate.

2. The written report shall include an analysis of all critical path tasks, potential risks associated with them and any contingency plan to circumvent a delay to those items.

3. An updated contract schedule showing proposed changes from the original approved contract schedule, if any, and showing progress from the previous month for discussion purposes. If no contract schedule change has been requested, the contractor shall so state.

4. A progress payment request, if applicable, with the monthly progress report. Progress payment requests received at other times will be held until the following month.

5. A request for contract variance or change order requests for contract schedule or monetary changes to this Special Specification shall be submitted with the monthly progress report.

6. A summary of the time devoted to the contract by each Key Staff for the immediately preceding month.

7. Change order work requests not relating to the contract schedule or monetary changes may be submitted for review at any time during the month.
D. Staffing

It is the contractor's responsibility to maintain and assign a sufficient number of competent and qualified professionals and other personnel to meet the requirements of this Special Specification. The contractor shall provide the Authority with an organization chart that identifies the contractor’s employees dedicated to this contract (the “Key Staff”). The contractor shall designate an ETC System project manager with the authority to ensure that all work performed by the contractor’s personnel and subcontractors adheres to the specifications set forth in this Special Specification and act as the single point of contact between the contractor and the Authority. The ETC project manager shall be committed to the Authority Toll Collection contract 100% of his or her time spent. Key Staff, namely technical project manager, maintenance manager, installation manager, lane software manager, and Toll System software manager, shall be committed to the project 100% of the time. The Authority reserves the right to request a form of proof that verifies the time devoted to the contract for any contractor employee. Resumes for each Key Staff shall be submitted to the Authority for approval. The Authority requires 30 days prior written notice of any proposed modifications to the organization chart, including any redeployment of any Key Staff listed thereon, and reserves the right to approve these changes.

Key Staff shall have not less than two large toll projects completed, with one project within the state of Texas, and the number of years experience in the designated role with attendant responsibilities:

1. Project ETC Manager 5 Years
2. Technical Project Manager: 3 Years
3. Installation Manager: 2 Years
4. Lane software manger 2 Years
5. Toll System software manager 5 Years

References may be requested from the contractor.

E. Communication Plan

The contractor shall submit a communications plan to the Authority for review and approval. The communications plan shall describe the communication procedures for controlling all correspondence, submittals and other communications between the contractor and the Authority. Since the contractor has to work with other vendors on this contract, the communications among the teams is very critical for the success of the contract.
1. Correspondence: Correspondence shall be identified as to originator and designated receiver.

2. Document Control: The contractor shall manage the contract correspondence through the use of Expedition or functionally equivalent software.

3. Submittals: All submittals shall be submitted as an enclosure to the contractor's submittal letter. Each submittal letter shall be limited to a single subject or item. The contractor's letter shall identify the letter itself, contract Number, contract Name, and Subject of the submittal.

4. Contract Number and contract Name: All items of correspondence, submittals and documentation shall contain the contract Number and the words "Authority Toll Collection Contract".

5. Information: No party shall be entitled to rely on any information unless it is in writing and received from the other party’s Designated Representative.

6. Change Orders: All change shall conform to the Authority normal change order process.

7. Status: The Authority or the Authority’s Designated Representative may inquire of the contractor as to the status of the contract.

8. Access to contractor Personnel: The Authority or the Authority's authorized representative who is knowledgeable in the field of work, shall have unlimited access to the Key Staff during the contractor’s performance of this contract.

F. toll collection system Design Requirements

To insure the design requirements for the Authority toll collection system is fully understood by the Authority and the contractor, a series of requirements and design review steps are specified herein.

Promptly after the execution of the contract, a meeting or a series of meetings between the contractor and the Authority will be held to evaluate the requirements of the contract and ascertain the adequacy of the contractor’s efforts in defining the Authority toll collection system requirements and to identify any areas of the contract requirements set forth in this Special Specification that must be clarified. The contractor shall provide written text, drawings, block diagrams, flow charts and/or other graphic illustrations to demonstrate the technical adequacy of its system design approach in meeting the requirements and procedures specified in this Special Specification. The submittals shall address and show compliance for the toll collection system hardware and software with quality assurance, software development, environmental, and other toll collection system requirements set forth in this Special Specification.
G. Software Design and Development Requirements

The contractor shall establish and maintain an effective software design and development program to ensure compliance with the requirements of this Special Specification. The program and procedures used to implement these requirements shall be developed by the contractor and submitted to the Authority for review and approval. This Section provides the description and guidelines for the techniques and methodologies to be employed to monitor the software development elements of this Special Specification.

Due the expedited nature of the contract there shall be only one detailed design phase to the project that will cover the system design called the System Detailed design phase. Separate review sections can be conducted for the hardware and software aspects of the toll collection system. After the detailed design phase the contract shall move into a development and demonstration phase at which time numerous demonstrations shall be conducted to present the hardware and software design to the Authority.

H. The Software Development Plan (SDP)

The contractor shall submit a SDP to the Authority that establishes the framework used for the software development of the Authority toll collection system. The SDP shall describe the software life cycle approach that emphasizes the necessary interfaces between various system development disciplines, i.e., software developers, system engineers, test engineers, Software Quality Assurance (SQA) personnel, configuration management administrator, documentation specialists, contract management staff, and software maintenance personnel. The SDP shall also include detailed information on the technical approach, problem reporting and tracking process, software configuration and change management, and other items pertinent to a complete plan for software development for the contract.

I. Software Detailed Design Review

Two weeks after the Notice to Proceed, the SDDD shall be submitted to the Authority for review and approval and shall be implemented using lane configuration and equipment layout diagrams, data flow diagrams, and module definitions that constitute the top-level hardware and software design. The SDDD shall include:

1. The specification sheets for all equipment
2. The requirements for all peripheral device interfaces and control
3. All user interfaces
4. Lane layouts, and logic and timing details
5. All operational and business rules

6. Interface Control Documents for all interfaces

7. Report and screen format

8. Computer sizing and design details

Two weeks after the submission of the SDDD, the contractor shall schedule a detailed design review session. The contractor shall conduct a walkthrough of the systems with the Authority team and address any comments the authority may have. This review process shall verify that the software design meets the requirements of the contract. After the completion of the design review, the contractor shall re-submit the SDDD for the Authority review and comment. There shall be a few iterations of the submission after which the SDDD is considered final.

J. Software Development and Walkthrough

The contractor shall conduct a series of software application walkthroughs and solicit inputs from the Authority during the development of the toll collection system. The Authority believes that such an approach will ensure that the final product will meet the Authority Contractual and operational requirements. This approach will also ensure that Authority is familiar with the product thus expediting the testing process.

K. Documentation

Detailed and accurate documentation is required to ensure that the Authority can operate and maintain the toll collection system reliably. It shall assist the Authority in understanding the toll collection system thus resulting in a better ability to perform audit and reconciliation. It shall assist the Authority in making better and more informed decisions on any changes required or Business Rules to be applied.

The SDDD shall demonstrate that the contractor understands the functional and operational requirements of the contract and has the processes and policies in place to provide a high quality and reliable product that meets the requirements of the contract.

The contractor shall provide standard commercially available documentation for third party provided hardware, software, maintenance materials, and support documentation provided under this Special Specification. The contractor shall provide comparable documentation for all other items under this Special Specification. The documentation shall include, but not be limited to, all operator's guides, installation guides, hardware reference manuals, options catalogs, user's manuals, programmer's reference manuals, maintenance manuals, technical manuals, illustrated parts breakdown and similar documents offered by the various computer manufacturers.
The contractor shall furnish, install and maintain in current update condition the following ‘primary set’ of all documentation required under this Special Specification for equipment provided by the contractor. This material shall be provided in its commercially available form or a comparable form and placed in racks or shelves to be retained at the Authority offices for the duration of this Special Specification. Additionally, a softcopy of these documents and updates to them shall be provided to the Authority, if available. Acceptable softcopy formats are Microsoft Office 2007 Suite or higher, and AutoCAD 14 or higher for prepared documentation as listed below. Soft copies of manuals may be provided in unsecured Portable Document Format (.pdf). All updated documents shall show the revisions and also include the clean document.

1. One complete set of hardware manuals for all hardware supplied under this Special Specification. These sets shall include the manufacturers’ manuals for every assembly as provided by each manufacturer.

2. One complete set of software manuals for each version of computer system supplied under this Special Specification. These sets shall include the operating system, utilities, programming languages, application software, communications software and any software purchased by the contractor for development under this Special Specification.


All contractor software provided under this contract shall be fully documented to meet the applicable coding standards. Comments shall be incorporated to enable programmers understand the code and make changes. Detailed software code documentation shall also be provided along with the As-Builts.

1. Manual Requirements

New manuals provided under this Special Specification that are not standard commercial catalogs or manuals shall meet the following requirements. Draft copies of all manuals shall be submitted to the Authority for approval, prior to final printing. Whenever possible, all data shall be printed on 8-1/2” x 11” sheets, foldouts should be 11” x 17”.

Each manual shall contain a title sheet, table of contents, list of illustrations (if applicable), list of reference drawings (if applicable) and a parts list (if applicable). All manuals with over fifty pages shall have an index.
All text, graphs and illustrations produced for the Toll Collector’s manual and any other special manuals prepared for the Authority under this Special Specification shall be produced in a Microsoft Software product. Any special software required to produce scalable typefaces or other graphs shall be provided by the contractor as part of the documentation for the manuals.

2. Audit Manual

This manual shall detail all procedures used to audit the system for ETC means of payment. It shall also include the reconciliation of transactions and revenue for each mode of payment. A complete description of all audit procedures and a non-technical description of the screens, reports, and functions shall be provided. The manual shall contain illustrations and pictorial diagrams to demonstrate the step-by-step operations required for performing the audit functions. Reports included in the submittal shall have correct and accurate data and this manual shall be used to train the auditors.


This manual shall detail the use of the system application software that serves the toll location, host, Authority MOMS and security access systems. The manual shall contain illustrations and pictorial diagrams to demonstrate the step-by-step operations required for performing functionality and navigating the screens. All usage of all reports and the data fields shall be clearly explained. This manual shall be used for training purposes.


This manual shall be prepared for a properly trained technical personnel assigned to the maintenance of the hardware within the toll collection system. This manual shall include a general description, theory of operation, operator instructions, mechanical functions, installation, test and troubleshooting procedures, preventive and corrective maintenance procedures and schedules, diagrams, schematics, layouts and parts lists required to service each piece of all contractor supplied hardware.

Standard service manuals for commercial products used for the equipment will be acceptable if they contain sufficient information to service the equipment. Large size logic diagrams and mechanical assembly diagrams do not have to be reduced or incorporated into the manuals if these drawings are provided with the manuals.
5. Support Documentation: Catalogs: Parts Lists

The contractor shall provide each manufacturer's product documentation that is delivered with specific items such as a power supply, printed circuit card, electronic module or mechanical assembly.

All material listed in the parts lists shall be identified by part number, type, model, or other descriptive nomenclature, together with the vendor’s name and manufacturer.

Second manufacturer sources shall be provided for all standard commercial components, as required elsewhere in this Special Specification.

The contractor shall furnish to the Authority all documentation available from the manufacturers associated with the computers and peripheral equipment provided. This documentation shall include instruction manuals, installation guides, parts manuals, and all other related materials. The contractor shall provide a physical layout of the computer processor and its peripherals including communications cabinets and the uninterruptible power supply cabinets.

The contractor shall provide a complete description of the toll location and ABO Computer interface including product literature and specification sheets for all major elements of the ETC toll location and ABO Computer system. The contractor shall justify the design being proposed to ensure system reliability and performance. The contractor may submit technical level brochures, specification sheets, drawings or similar documentation for the toll location and ABO Computer hardware which the contractor currently provides for other toll location and ABO Computer applications, in lieu of providing lengthy written text, if the proposed toll location and ABO Computer hardware meets the requirements of these specifications in full.

The contractor shall submit a Bill of Materials List which shall include a complete list of all hardware elements and model numbers, peripherals, cables and connectors, cabinets, hardware attachments and all else necessary to provide a total listing of items in the toll location and ABO Computer system. Product literature and specification data sheets shall be submitted for each item. For each hardware component in the toll location and ABO Computer the contractor shall include information on the manufacturer, model number and number in operation.
6. As-Built Drawings

The contractor shall provide to the Authority a complete set of as-built drawings, which shall be delivered as two (2) full-size and four (4) half-size complete sets of blue-line prints, and shall deliver the same in electronic format, for all equipment furnished under this Special Specification. The sets shall include, but not be limited to, all schematics, logic diagrams, layouts, wiring diagrams, assembly drawings, parts detail drawings for all mechanical parts designed or modified under this Special Specification and interface details so as to provide a complete record of the as-built status of the equipment.

Drawings contained in standard catalogs and manuals for commercial products do not have to be reproduced as part of the as-built drawing sets. All drawings for revisions to standard commercial assemblies or components for the equipment shall be included in the as-built drawing set. The as-built drawing set for the toll collection system architecture shall be provided.

All As-Built drawings shall contain a table of contents that shall include a listing of all drawings with headings for drawing number, drawing title, and the type of material list, wiring diagram, wire list, specification control drawing or similar categories.

7. Design Documentation

As part of the design review process, the SDP and the SDDD shall be submitted to the Authority for review and approval. After the completion of the contract Acceptance Test, the contractor shall submit the As-Built SDDD that includes all changes made during the software development and testing phase.

L. Quality Program

The contractor shall establish and maintain an effective quality program to assure compliance with the requirements of this Special Specification. The Quality Assurance Plan that details the contractor’s quality assurance program shall be submitted to the Authority for review and approval 10 working days after the Notice to Proceed.

The plan shall include the contractor’s quality assurance program through design, production, purchasing and testing of all hardware and software provided under this Special Specification. The quality assurance program shall also include, at a minimum, problem logging and tracking, follow-up tracking, and final disposition tracking during the testing and implementation. The quality control process shall ensure accurate problem description and recording, assignment of personnel, tracking of progress for corrections/revisions, and disposition of the problem throughout the design, development, testing and implementation phases of the contract.
The program shall assure adequate quality throughout all areas of this Special Specification performance; for example, design, development, fabrication, processing, assembly, inspection, test, maintenance, packaging, shipping, storage, site preparation and installation.

All supplies and services under this Special Specification, whether manufactured or performed within the contractor's plant or at any other source, shall be controlled at all points necessary to assure conformance to the requirements of this Special Specification. The program shall provide for the prevention and ready detection of discrepancies and for timely and positive corrective action. The contractor shall make objective evidence of quality conformance readily available to the Authority. The contractor shall maintain instructions and records for quality during performance of its obligations under this Special Specification for a period of five (5) years after the date of contract Acceptance.

The authority and responsibilities of those contractor personnel in charge of the design, production, testing and inspection of quality shall be clearly stated. Facilities and standards such as drawings, engineering changes, measuring equipment and the like, which are necessary for the creation of the required quality, shall be effectively managed. The program shall include effective control of purchased materials and subcontracted work. Manufacturing, fabrication and assembly work conducted within the contractor's plant shall be controlled completely by the contractor.

1. Quality Assurance Management

   The contractor's Quality Assurance Plan shall identify the organizational elements and Key Staff responsible for managing the overall quality program, and shall clearly define the related responsibilities and functions molding both policy and action. Provisions shall be made and documented for regular management review of the status and adequacy of the quality assurance plan.

2. Records

   The contractor shall maintain records or data essential to providing objective evidence of quality for the later of (i) six (6) years after contract Acceptance or (ii) the expiration or earlier termination of the Maintenance Agreement. Some examples of quality-related data: inspection and test results, records of subcontractor quality assurance programs, cost records pertinent to acceptance of nonconforming material, design reviews and walkthroughs, and the results of internal and vendor audits. Records shall be maintained in a manner that will allow for easy access and analysis of the state of the overall quality assurance plan.
The contractor shall retain these records until the expiration of the guarantee/warranty period and they shall be made available to the Authority upon the request of the Authority.

3. Drawings, Documentation and Changes

The contractor shall document and maintain procedures to assure that all engineering drawings and documentation are adequate, complete, and current. All changes shall be controlled and documented.

4. Control of Purchases

The contractor shall be responsible for assuring that all supplies, components, developmental tools, assemblies, subassemblies and services procured from subcontractors and vendors conform to the requirements of this Special Specification. The contractor's responsibility includes the establishment of procedures for the selection of qualified suppliers. In selecting qualified suppliers, the contractor shall assure that the subcontractors and vendors control the quality of the supplies and services provided.

5. Inspection and Verification

The contractor's quality program shall include requirements for inspection and verification for in-process, final assembly, unit tests and system testing of the contractor supplied systems.

a. The inspection and verification procedures (and testing procedures) shall be the basis for determining contract Acceptance or Provisional Acceptance, as applicable, or the rejection of any hardware and software. This inspection function responsibility, which includes nondestructive testing, shall not be delegated to any agency or testing laboratory without prior approval from the Authority.

b. Identification of the inspection and verification points shall be the responsibility of the contractor's engineering and software development departments.

c. The Authority reserves the right to recommend modifications or additions to the inspection or verification points. Such recommendations will be based on the audit or inspection results at the time of review of the contractor's Quality Assurance Plan or at any time during the inspection or verification action if such procedures are determined to be inadequate to ensure the quality of the contractor supplied systems.
d. Once the inspection and verification points have been established for in-process, final assembly, unit tests and system testing, then any work delivered by the contractor related to the assembly of the contractor supplied systems shall not be considered acceptable until: (a) inspection "acceptance" action as applicable has been completed, or (b) the Authority revises the requirements in writing, or (c) the Authority's corrective action for a discrepant condition is satisfactorily resolved or otherwise completed.

e. The conduct of an inspection action that has a satisfactory result will be documented by the signature of the Authority's Designated Representative.

f. The conduct of an inspection or verification action which results in a "rejection" will be documented for evaluation and corrective and preventive actions in accordance with the procedures for such actions in the contractor's Quality Assurance Plan that has been approved by the Authority. Any item that is reworked, repaired or modified must be re-inspected or re-tested.

g. Procedures for the in-process, final assembly, unit tests, system testing and test inspections or verifications for conducting these tests shall be incorporated in the contractor's quality assurance program and applicable software and testing plans and shall be submitted to the Authority for approval.

h. The status of the inspection or verification shall be maintained to preclude issue or use of materials or tests of systems, subsystems or components on which the required inspections or verifications have not been completed. Identification of status shall be accomplished by means of stamps, tags, routing cards or other control devices.

6. Handling, Storage and Delivery

   The contractor's quality program shall provide for adequate, documented handling, storage, preservation, packaging, and shipping instructions to protect the quality of products required by this Special Specification. Any unique or special requirements applicable to procured items shall be delineated in the procurement documents.

7. Inspection at Subcontractor-Vendor Facilities

   The Authority reserves the right to inspect at source supplies or services not manufactured or performed within the contractor's facility. The Authority's inspection shall not constitute acceptance, nor shall it in any way replace the contractor's inspection activity or relieve the contractor of the responsibility to furnish an acceptable end product.
M. Access to Inspection of contractor's Facilities

Upon request, the Authority or the Authority's Designated Representative who is knowledgeable in the field of work shall have access to the contractor's facilities and personnel. This access may be restricted to those portions of the facilities and personnel involved with or otherwise performing work under this Special Specification. Such access shall be for the purpose of inspecting the facilities, verifying progress, inspecting materials, work in progress, finished goods, test performance and results, etc.

N. Disaster Recovery Plan

The contractor shall provide a Disaster Recovery Plan and subsequent Disaster Recovery Procedures for the toll collection system to be reviewed and approved by Authority. Once the project is deployed and tested the contractor shall implement its Disaster Recovery solution and shall test the system accordingly.

O. Training

The contractor shall provide comprehensive training of the toll collection system. The contractor shall develop and present for Authority review and comments, the initial toll collection system training manuals and training materials, including training for toll collection, toll management, system administration, audit and reconciliation, system reporting, ad hoc reporting, security access and maintenance. Collector training shall be conducted as a “train-the-trainer” format.

Training applies to all areas of the system. The contractor shall submit a Training Plan and schedule to include System Operations, Maintenance, Administration and Disaster Recovery. The Training Plan shall detail the scope of each training session by providing detailed content and the duration of each training session, as well as timing, logistics and equipment and materials necessary to conduct hands-on interactive training.

Provide a minimum of 24 hr. of instruction to 10 designated personnel in the operation and maintenance procedures of equipment or systems installed. Provide the training during installation, testing, and integration. Provide the training through practical demonstrations, seminars, and other related technical procedures.

Furnish a training session agenda, a complete set of training material (manuals and schematics), and the names and qualifications of proposed instructors for approval 60 days before the training. Provide a training location. Provide 1 copy of the course material for each person. Provide training in the following areas of interest and as shown on the plans:

1. The “Hands-on” operation for each type of equipment.
2. Explanation of all system commands, their function and usage.
3. Required preventative maintenance procedures.

4. All equipment servicing procedures.

5. System “troubleshooting” problem identification procedures.


The ETC System implementation schedule shall include completion of the On-Site First Test Plan and Commissioning Test Plan before the roadway is opened to live traffic.

7. Measurement.

A. The ETC Specification will be measured as a “Lump Sum” for the entire system which includes all major system components installed, made fully operational, and tested in accordance with this special specification or as directed by the Engineer.

B. Detailed Lane Configuration and Major Items to be included in the Lump Sum are listed in Table 1.

8. Payment.

The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Electronic Toll Collection System”. These prices are full compensation for furnishing and/or placing, and testing all materials and equipment, and for all tools, labor, equipment, hardware, operational software package(s), supplies, support, personnel training, shop drawings, documentation, and incidentals. These prices also include any and all interfaces required for the field and remote communications links along with any associated peripheral equipment, including cables; all associated mounting hardware and associated field equipment; required for a complete and fully functional Electronic Toll Collection System.