DESCRIPTION:

A Queue End Warning System is necessary for monitoring the Project’s traffic flow, congestion and performance approaching the American Gateway bridge crossing from I-190. The Project’s Intelligent Transportation System (ITS) must accurately detect traffic and traffic operational conditions throughout the Project Limits, and clearly communicate relevant and useful travel information to the Users. New York State Thruway Authority is already operating an ITS network that will need to connect to the new system provided by the Contractor. The Project ITS must be compatible with such in-place system(s) that the New York State Thruway Authority is currently operating. Contractor shall coordinate the ITS planning and implementation with the New York State Thruway Authority. The Queue End Warning System functional components and design considerations consist of the following:

- Central Control System Software (referred herein as Intelligent Networks Advanced Transportation Management System or iNET ATMS)
- Occupancy and/or Speed must be accurately collected by radar sensor VDS devices
- VDS Device locations for Queue Detection are critical, usually very site specific. Site survey must be on site, during multiple days and should include traffic engineering and integration team members.
- Failure Management Design for the data collection and Failure Alarms for the field infrastructure should be accommodated sufficiently through off-the-shelf parts lists/ITS specifications
- Central Processing via an ATMS should allow flexibility for creating “Queuing Events” which will be supported through a variety of ITS dissemination methods – devices (flashers and DMS), notifications to operators and key parties
- Field Hardware processing solutions are abundant through a variety of off-the-shelf traffic controllers and off the shelf PLC devices of many types.

Queue End Warning Theory of Operation

The Queue Detection implementation is designed to utilize the persistence of low speed or high occupancy vehicle conditions to activate a flasher beacon specific static signs or DMS signs warning of congestion ahead or ‘be prepared to stop’ type messaging.

The design allows for variable combinations of individual detectors to be ‘assigned’ to the given flasher location.

Turn-on/off is governed by either detector speed or occupancy thresholds and the choice of consecutive occurrences above or below the threshold. Consideration of failed stations is also required.

A manual force on/off toggle is also included for testing and manual override purposes.
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**WORK ITEMS**
The Queue End Warning System work items shall consist of furnishing and installing, commissioning and testing a complete, operational ITS Queue End Warning System at locations indicated in the contract plans and documents. This item shall include all radar sensors, sensor mounting hardware, communications equipment, preassembled click cabinets, roadway cabinets, controllers, fittings and cabling necessary to make the sensors compatible with the control software and flashing beacons as defined in this document.

**MATERIALS:**
All materials to be furnished, assembled, fabricated or installed shall be new, per manufacturer’s specifications, corrosion resistant and in accordance with the details as shown on the plans or as specified in the contract documents.

All components fabricated from steel or cast iron shall be galvanized in accordance with NYSDOT Standard Specification Subsection 719-01 – Galvanizing and Repair Methods Type II.

**RADAR SENSORS:**
The radar sensors shall be: Wavetronix SmartSensor HD radar sensors. No product substitutions are allowed.

Radar sensors shall be a part of a complete ITS Queue End Warning System as outlined in this specification. System shall be capable of supporting four (4) Wavetronix SmartSensor HD sensors, fully integrated to control flashing beacons as defined in this document and contract plans.

Manufacturer Information:
Wavetronix LLC
78 E 1700 S
Provo, UT, United States 84606
Phone: 1-(800)734-7200
www.wavetronix.com

**FLASHING BEACONS:**
Flashing beacons shall be paid for under other contract items as shown in the plans.

**POLES:**
Poles, pole foundations, and other supporting structures shall be paid for under other contract items as shown in the plans.

**CONTROLLER:**
The controller shall be capable of providing all the necessary functions to control the Beacons on/off state based on collecting and processing VDS data at the iNET ATMS in the Traffic Management Center (TOSC/TOC).
The controller shall have the minimum specifications:

- Power: 115 VAC
- 15 AMP circuit breaker protection
- NEMA 3R aluminum or galvanized, hinged-door, powder coated (sea foam green), weathertight enclosure
- Plug-in solid state flasher (Model 204)
- Plug-in flash transfer dimming relay
- Sign light auto/test switch

**Communications Network**

Communications Network will conform to NYSTA standards including providing a connecting link to the NYSTA communication backbone network.

Furnish install and configure Ethernet routers and switches that are new and will operate in all environmental conditions experienced on the project.

The same manufacturer and model must be used for each Ethernet router and switch, with the exception that different models can be used only to supply the appropriate amount of network ports required. It is important to note that there must be extra ports available on all network switches to allow for future expansion.

The Ethernet network must be designed with redundant components and self-healing functionalities.

The SI must provide all licenses for all equipment, where required, for any software or hardware in the system in the name of the Developers.

The Ethernet network must:

- Operate at a speed of 1Gbps utilizing a gigabit network architecture. The network must dedicate bandwidth and guarantee that each end-user/device receives a full 1000 Mbps connection, as configured, enabling applications to operate reliably, and with low latency.
- Use IP Multicast Filtering through Internet Group Management (IGMP) v3 Snooping.
- Use Multiprotocol Label Switching (MPLS).
- Use Common Industrial Protocol (CIP).
- Provide remote firmware upgrade functionalities of all devices. If a TFTP upgrade methodology is used a TFTP server must be provided for such purposes.
- Have routing capabilities such with self-healing functionality such as Open Shortest Path First (OSPF).
- Provide equipment with fail safe provisions that are designed so that failures of one piece of equipment must not cause the failure of any other piece of equipment.
- Use high-performance modular Ethernet devices
- Use rack-mountable devices in industry standard racks.
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- Be modular in design such that major components may be readily replaced in the field without powering-down the equipment, (hot-swappable).
- Ensure modules are able to be inserted in any available slot without restriction.
- Have dust covers placed over all unused card slots.
- Identify all devices and assemblies with name, model number, serial number, or any other pertinent information required to facilitate equipment maintenance.
- Support LAN edge quality of service (QoS) based on IEEE 802.1p class of service (CoS), as well as port-based prioritization.
- Is capable of implementing high levels of port and console security using Media Access Control (MAC).
- Devices must have LEDs to indicate on the unit level – Power indication, Boot status, Data bus utilization. LEDs on the ports must indicate transmit/receive.
- The Ethernet network must at a minimum adhere to the following standards:
  - Institute of Electrical and Electronic Engineers (IEEE) standards governing modern 10/100/1000Mbps protocols. For example,
    802.1x support; IEEE 802.1w Rapid Spanning Tree Protocol (RSTP);
  - Institute of Electrical and Electronic Engineers (IEEE) 802.3 support;
  - IEEE 802.3 10BASE-T specification;
  - IEEE 802.3u 100BASE-TX Specification;
  - IEEE 802.3 1000BASE-X Specification;
  - IEEE 802.3x Flow Control;
  - IEEE 802.1Q Virtual Local Area Network (VLAN) Tagging;
IEEE 802.1D Spanning Tree Algorithm; and IEEE 802.1p, 802.1q. TUV, CSA, FCC and CE.

Network Switches

- Supports full-duplex operation on all ports, delivers up to 1000 Mbps on 10/100/1000 ports or 2-Gbps on 1000Base-X ports.
- Support 10/100/1000 BaseT auto-sensing ports, each delivering up to 1000 Mbps of bandwidth to individual users as required.
- Has the module slots to connect two gigabit Ethernet ports capable of delivering up to 4-Gbps aggregated bandwidth to Gigabit Ethernet backbones, Gigabit Ethernet servers, or between switches.
- Have 1000Base-X ports with a minimum Power Budget of 22 dB, Transmit power from 0 to 4.77 dBm, and Receive power from –23 to 0 dBm for site-to-site communication.
- Be able to stack up to 3 switches together using stacking functionalities. All stack units are managed as a single switch.
- Provide Ethernet switches for field sites that have a minimum of six (6) Ethernet ports that have the following features:
  a) Six (6) 10/100/1000 Base-TX RJ-45 female connector ports
  b) Automatic and user-selectable speed setting
  c) Automatic and user-selectable half/full duplex setting
  d) Drive up to 110 yards of Category 5 cable at 1000 Mbps
  e) MAC-based trunking
  f) Wire-speed switching
- Provide a minimum of two uplink single-mode fiber ports that have the following features:
  a) 1000Base-SX, -LX/LH, -ZX SFP Based ports (single/multimode fiber).
  b) Single-mode fiber optic duplex female connectors.
  c) Automatic and user-selectable half/full duplex setting.
  d) Non-blocking full wire-speed forwarding rate.
CABINETS:
Cabinets shall be preassembled click cabinets per manufacturer’s specifications. Cabinets shall be installed at each radar sensor location. Mounting location shall be as specified in contract plans. Equipment cabinets, enclosures, racks, etc must be procured, furnished, and installed with appropriate access doors, locks, closure panels, face panels, stabilizer kit, casters, mounting and installation hardware.

All field equipment controllers and electronics must be installed in equipment racks or securely installed on shelving inside NEMA 4X rated stainless steel cabinets.

All enclosures shall be outdoor watertight, NEMA 4 Type or better with an IP rating of 56 or better. The Integrator shall purchase and install the cabinets, equipment racks and roadside enclosures in accordance with the requirements of this section.

Enclosures must have adequate space for added boards and components for future expansion.

The cabinet/rack designs must consider the allowable space in the locations where the hardware is to be installed.

Conduit installation and fiber optic cable terminations to ITS cabinet locations shall be paid for under other contract items as shown in the plans.
CENTRAL SOFTWARE:
 Unless otherwise specified in the contract plans, the Contractor shall supply central control software identified as Intelligent NETworks® ATMS necessary to interface radar sensor functions remotely from the TOSC/TOC and communicate with flashing beacons.

Intelligent NETworks® ATMS is a state-of-the-art, off-the-shelf application designed to assist in the collection, dissemination and management of transportation systems and information. It uses a scalable architecture, making it adaptable for small and large scale deployments. The system is also highly customizable to meet unique end user needs.

The Intelligent NETworks® ATMS is a web-based ITS modular application in which the end user or agency selects from the desired system modules needed for their system (see figure below). In turn, the system is then sized and priced based on the modules selected, the specific feature set of these modules and the level of customization (if any) that may be required.

Product Description
A browser-based User Interface (UI) provides a feature-rich application easily accessible from the Intranet or the Internet. The unique browser windowing system empowers each user to configure and display command-and-control interfaces that meet dynamic operational needs. A highly detailed geographical map with 10 zoom levels is available at no cost, for viewing roadway information. The dynamic map updates to display real time information.

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Intelligent NETworks® ATMS Software Modules

The Queue End Warning System will require the following Intelligent NETworks® ATMS Software Modules: Map SAS, VDS, DMS, and ATM (Queue Warning)
The Intelligent NETworks® Map provides an interactive interface to the ATMS using a standard or customer-driven custom map in many GIS formats. The map allows drag and drop, pan and zoom, multiple views, zoom box, icon filtering and a dynamic legend. Delcan can generate the GIS map using image file libraries owned by Delcan or we can generate the map using customer provide GIS files (e.g. shape files).

Key Map Module capabilities include:

- Interactive map that displays current status of the roadway network and traffic field devices as color coded congestion displays
- Superior map manipulation performance and capabilities. Zoom in and out with up to 10 different zoom levels using zoom buttons and rectangle/window zoom features. Map pan in any direction with a smooth seamless transition
- Aerial photography layers available
- Set personal default map view
- Map de-clutter feature to set different icon and device viewing filtering parameters based on zoom level
- Enables easy access to field device viewers (cameras, signs, detectors, signals, ramp meters, etc.) via multiple means
- Separate device toggle layer for each type of ITS device, event or layer
- Hideable legend to allow viewing of all the system icon types, colors, statuses and definitions
- Customizable to allow the creation of new icons and layers
Intelligent NETworks®—System Administration and Security (SAS) Module

The Intelligent NETworks® System Administration and Security module is the component of the Intelligent NETworks® ATMS suite that provides the ability to manage users and groups, as well as manage the field equipment and other system parameters.

To begin using the Intelligent NETworks® system, the user must first have an account and corresponding privileges. This is done using the Intelligent NETworks® Administration module. This module allows the System Administrator to create, modify and/or delete user accounts and group accounts. Group accounts provide the access and control of most windows in the Intelligent NETworks® ATMS system. This module also provides the ability to modify the priority of a group.

System properties are accessible and configurable from the Administration module and are performed directly on the system database. Some of the system properties fields include:

- Alarm conditions for weather
- Alarm conditions for congestion
- Timezone settings
- VDS congestion thresholds
- Number of presets or tours available for CCTVs
- DMS font sizing
- Maximum/Minimum default ramp metering rates
- Timeouts for signal controllers

The Domains feature provides access to configurable properties of the system database. Some of these fields include:

- Vendor names and protocols
- Communications ports
- Report formatting features
- Event states
- Map technical definition
- System wide equipment types

Fully configurable devices and service control rights are available, which support overlapping control between centers.
**Intelligent NETworks®—Vehicle Detection System (VDS) Module**

The Intelligent NETworks® VDS module is the key roadway congestion monitoring component of the Intelligent NETworks® ATMS suite that allows users to view real time roadway traffic conditions by analyzing traffic speeds, volumes and occupancy from various VDS sensor and/or vehicle probe technologies.

The VDS module includes drivers to interface with a wide variety of different vehicle detection technologies. These include:

- Inductive Loops
- Video Image Detection Systems (e.g. Autoscope)
- Microwave Radar (e.g. EIS RTMS and Wavetronix)
- Doppler Radar (e.g. SpeedInfo)
- Magneto Resistive (e.g. Sensys Networks)
- Microloops (3M)
- Cellular Probe Data
- GPS Probe Data (Fleet Vehicles)
- Bluetooth sensors

From the Intelligent NETworks® graphical map, operators view traffic conditions via color-coded icons on segments of the roadway network. A snapshot of conditions can be observed on freeway, highways and arterial roads with user configurable speed ranges to represent congestion levels. VDS windows can be opened to view detailed statistical traffic data on a lane-by-lane basis. This includes volume, occupancy and speed information at various time increments and averaged values such as station speed (the average speed across all roadway lanes). In certain cases, vehicle classification information is shown depending on the sensor technology that is deployed.

The VDS module includes data normalization and failure management sub-processes to baseline the data values from sensor-to-sensor and technology-to-technology as well as to check the validity of data values so they may be used appropriately in system data calculations and with other Intelligent NETworks® modules.
Intelligent NETworks®—Dynamic Message Sign (DMS) Module

The Intelligent NETworks® DMS module is a comprehensive solution to managing information disseminated to the public via Dynamic Message Signs.

Using either Standardized NTCIP Center-to-Field Interfaces or native vendor interfaces, the DMS module communicates with DMS signs and places messages which inform motorists of road conditions, events or public service announcements. The DMS module offers a selection of features which allow users to easily control and configure infrastructure. Features include:

- Support for fixed and portable signs
- Configurable message libraries which include multiple user-settable categories with at least 100 messages in each category
- Complete inventory management which allows addition, deletion and modification of all DMS field infrastructure
- AMBER Alert, where users can easily send one message to all signs in the system
- A scheduler allowing users to schedule messages to one or more DMSs with selectable start and end dates/times
- A Dynamic map which displays locations of all DMS in the system, communication status and message content on the sign
- Full security which controls which users are allowed to create and send messages to the field, manage the library or maintain inventory
- Serial, Dialup and/or TCP/IP communication
- Archiving and Reporting for all messages placed on signs

The DMS module combined with other ATMS modules can offer maximum operational benefits. For example, when combined with the Vehicle Detection and Travel Times modules, motorists can be informed of travel times along a route. When combined with the Event Management module, the DMS module can be utilized to automatically warn motorists of accidents and construction.
Dynamically manages and controls traffic demand and available capacity of transportation facilities.

- Monitors system performance based on prevailing and anticipated conditions.
- Employs various ATM strategies including:
  - Variable Speed Limits (VSL)
  - Dynamic Lane Management
  - Queue End Warming (QEW)
  - Hard Shoulder Running
  - System Wide Adaptive Ramp Metering (SWARM)
  - Traffic Demand Management
  - Junction Control
  - Traffic Signal Control
  - Dynamic Pricing
The radar sensors shall be individually addressable from a PC type computer hosting the iNET ATMS. All control software shall be delivered on CD-ROM and installed on workstations as directed by the TOSC/TOC manager. The TOSC/TOC should be contacted for specifics of the communications protocols and software in place.

As part of the system design the status of the Queue End Warning System must be able to be verified at the NYSTA TOSC, the NITTEC TOC and the PBA operations center. In addition the staff at both the NYSTA TOSC and NITTEC TOC shall be able to manually override the automated flasher operation to turn the warning beacons on or off.

Four (4) sets of software shall be provided for installation in remote PC type computers. The software shall be supplied to allow the remote operator full access to all capabilities of the system. The software sets are to be turned over to the New York State Thruway Authority unless installations at specific remote sites are required by special note.

**Communications:**

Throughout the Project Limits, functional Queue Warning ITS communication components shall be provided, including the Regional ITS Backbone link and all the ITS field devices. In addition, all radar sensors shall have the capability of being addressed from a single communications link.

a) Field Devices: Contractor shall provide a communications system to all field devices such that operation is time and event driven. Sufficient conduit shall be provided to accommodate the current communication demands and a minimum 25% additional capacity.

b) Regional ITS Backbone System: Contractor shall provide a fiber optic link to the backbone communication system. This fiber optic link shall be coordinated with NYSTA.

**Conduit:**

Contractor shall recommend, with NYSTA concurrence the type, quantity, and design of the conduit above and below ground, ground boxes, and all communication cable and electrical conductors to support the ITS network and operations. No exposed conduit sections will be permitted without NTDOT approval. All sections shall have a minimum of 48” of cover over all ITS conduit except where boring is required to cross under intersections or to reach locations on the opposite side. The Contractor shall provide separate conduits for general ITS communication and general ITS power.

**POWER SYSTEMS**

Normal power will be supplied by the others.

The Normal Power Service sizes must be determined by the contractor so that others can procure and install the Electrical Service from the Power provider and install the power conduits and cables from the Service Disconnect Switch to the normal power enclosures at field equipment sites.
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Others will leave power cable coiled at the power enclosure for the contractor to connect into the Field Systems as required.

DOCUMENTATION:
Full documentation of radar sensors, cabinets, controller, auxiliary equipment, specifications and assembly details shall be provided to the Engineer for approval.

The Contractor shall provide four (4) sets of the maintenance manual for the radar sensors, digital control unit and auxiliary equipment supplied for the entire Queue End Warning System furnished. Also, four (4) complete sets of schematics of the electronics for the entire Queue End Warning System shall be provided.

Four (4) complete sets of manuals for all software, including a CD-ROM shall be provided.

CONSTRUCTION DETAILS:
The Wavetronix radar sensors and cabinets will be installed on either new and/or existing sign poles or overhead structures as shown in the contract plans.

The Contractor shall develop and deliver shop drawings which illustrate, in detail, how to mount and connect the radar sensors to the appropriate overhead structure or pole(s) as shown on the contract plans. The radar sensors, cabinets, and all auxiliary equipment shall be mounted per manufactures recommendations. The radar sensors and cabinets shall include all necessary hardware required for attachment to poles or overhead structures not included as part of the new and/or existing structure. All shop drawings shall be approved by a licensed N.Y.S. Professional Engineer.

Manufacturer shall supply testing certification demonstrating product functions are fully operational. Products shall be tested per standard NTCIP testing procedures.

INSTALLATION CERTIFICATION:
All radar sensors, controller(s), cabinet(s), conduit(s), all auxiliary equipment and mounting hardware shall be installed in accordance with manufacturer’s instructions and recommendations. To ensure the radar sensors were installed properly the Contractor shall submit to the Engineer documentation that states either a.) the manufacturer, or the manufacturer’s authorized supplier, verifies that the Contractor has been trained on the installation, operation, testing and maintenance of the equipment or b) provides documentation from the manufacturer that the installation has been inspected and approved by the manufacturer or authorized representative.

TESTING:
Test Plan:
The manufacturer shall provide a test plan, 30-days prior to each test, for review and approval by the Engineer. The test plan shall clearly identify each function and element being tested, the setup conditions, the steps to be followed during the test, and the anticipated test results. The test plan shall exercise all required functions and capabilities under this item.
Test Equipment:
The test plan shall identify all equipment required to perform the tests. This equipment shall be provided by the Contractor for the duration of the testing program. As a minimum, functional testing equipment shall include the latest version of the Device Tester for NTCIP, software by Intelligent Devices Inc, or approved equal.

Test Performance:
The test shall be coordinated with NYSTA at least three (3) weeks prior to the actual date. The Contractor shall conduct all tests, in the presence of the Engineer and/or up to two (2) other representatives. The Engineer may waive the right to witness certain tests. The utilized software shall be in recording/capturing mode while performing the test procedures.

Test Reports:
The Contractor shall maintain a complete record of each test performed including the results of the test and a record of who witnessed the test. At the completion of each test, the test documentation shall be completed and provided to the Engineer for review. This documentation shall be the basis for acceptance or rejection by the Engineer. All test reports shall be signed by the Contractor’s authorized testing representative.

Test Failure:
The unit shall be corrected or another unit substituted in its place and the test successfully repeated. The substitute unit shall have passed all other tests successfully. If any radar sensor equipment or software modifications are necessary as a result of any test or demonstration failure, full retesting for compliance with these specifications may be required and a test report shall be prepared and delivered to the Engineer prior to retesting of the equipment. The report shall describe the nature of the failure and corrective action taken. If a failure pattern, as defined by the Engineer, develops, the Engineer may direct that design and construction modifications be made to all units without additional cost to the State, other involved agencies, or extension of the contract period.

Test Specifics:

1. Design Approval Test:

Design approval tests shall be conducted by the Contractor on one or more sample equipment of each type, as approved by the Engineer, to determine if the design of the equipment meets the requirements of this specification. The tests shall be conducted in accordance with the approved test procedures. Tests shall be conducted between -35 degrees F and +165 degrees F.

In the case of standard product line equipment, the Engineer may waive the design approval tests if the manufacturer's written specifications (functional and environmental) are equal to or better than those specified herein and he so states in writing or if the Contractor provides certification by an independent testing laboratory that these design approval tests have been previously satisfactorily completed. The design approval test shall cover the following at a minimum:
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Temperature:
All functional operations of the equipment shall be successfully performed under the following conditions and in the order specified below:

The equipment shall be stabilized at 32ºF. After stabilization at this temperature, the equipment shall be operated without degradation for 2 hours.

The equipment shall be stabilized at 122ºF. After stabilization, the equipment shall be operated without degradation for 2 hours.

Relative Humidity:
All equipment shall meet is performance requirements when subjected to temperature and relative humidity of 122ºF and 70 % respectively. The equipment shall be maintained at the above condition for 48 hours. At the conclusion of the soak, within 30 minutes the equipment shall meet all of its operation requirements.

Power Variation:
The equipment shall meet all of the specified performance requirements when the input voltage is plus or minus 10 volts from the nominal value of 115 volts. The equipment shall be operated at the extreme limits for at least 15 minutes during which it shall meet all of its operation requirements.

Vibration:
The equipment shall show no degradation of mechanical structure, soldered components, plug-in components or satisfactory operation in accordance with the manufacturer's specification after being subjected to the following vibration test:

The equipment shall be secured to the (shaker) head of suitable electro-mechanical shaker in the vertical, lateral and longitudinal planes respectively. The object of the test is to vibrate the equipment in each of the three mutually perpendicular axes, in accordance with the following parameters:

- Amplitude - 0.06 “Double Amplitude” (peak-to-peak).
- Linear Acceleration (g’s) - 5 maximum.
- Linear Velocity - approximately 7 inches per second.
- Frequency - 40 Hz.
- Duration - 5 minute dwell in each axis.

If the equipment fails the design approval test, the design fault shall be corrected and the entire design approval test shall be repeated. All deliverable equipment shall be modified, without additional cost to the Authority, to include design changes required to pass the design approval tests.

2. On-Site Stand-Alone and System Performance Test:
The Contractor shall conduct approved stand-alone tests of the equipment installed in the field and at the TOSC/TOC. The tests shall, as a minimum, exercise all stand-alone (non-network) functional operations of the field equipment including TOSC/TOC equipment and software with all the equipment installed per the plans as directed by the Engineer. Approved data forms shall be completed and turned over to the Engineer as the basis for review and rejection or acceptance.

Each unit of equipment shall be operated long enough to permit equipment temperature stabilization, and to check and record an adequate number of performance characteristics to ensure compliance with the requirements of this specification. The test shall, as a minimum, exercise all the input and output functions of the unit and demonstrate all operational features.

Following successful completion of the On-Site Stand-Alone tests the entire complement of subsystems and equipment shall be integrated into one system. Interface tests shall then be performed to verify the transfer of information between field equipment elements and the TOSC/TOC.

System performance testing shall exercise all functional operations of each unit of field equipment from the TOSC/TOC, and demonstrate compliance with all contract requirements.

The tests shall include multiple combinations of functions including infrequent combinations, input validation, and stress testing. Compliance with all performance requirements shall be demonstrated. Where there are multiple units of the same item of equipment used, compliance with performance parameter requirements may be demonstrated on sample units with approval of the Engineer.

If the equipment fails the stand-alone test, it shall be corrected or another substituted in its place and the test successfully repeated.

In addition to the Stand Alone Test defined in A. above, once installed the sign controller must pass a test of the NTCIP Compliance as specified herein. The test will be performed by Thruway personnel or their designee using Intelligent Devices NTCIP testing software or another testing package. Prior to testing, the test scripts will be viewable by the Contractor and the manufacturer. During the test it is expected that the Contractor, manufacturer, and Authority’s Construction inspection firm will be present. The date, location, and time of the test will be designated by the Authority.

3. 90-Day Operational Test (Final Acceptance Test):

Following successful completion of the system performance tests, a 90-calendar day test shall be performed. The test shall start at the same time for all system elements unless a waiver is received from the Engineer.

The 90-day test will be run from the Thruway Statewide Operation Center, TSOC. Each radar sensor must successfully communicate with TOSC/TOC and flashing beacons 95% of the time during the test period. During this time the following tests, at a minimum, must occur:
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- A daily test of communicating and receiving information from radar sensors.
- A daily test of the radar sensors communication to controller to switch the flashing beacons on/off.

The purpose of the Operational Tests is to demonstrate the reliability of system equipment for a 90 day period. In the event of a failure of any contractor supplied components, or of any existing system elements that may be affected, that portion of the system shall be subjected to an additional 30 day test period. Failure shall be defined as any interruption of operation that can be contributed to the radar sensors, controller, or flashing beacons. If a failure occurs, the test shall be stopped until the failure has been resolved. If the same failure occurs three (3) times, the failure shall be resolved and the 90-day test shall begin anew.

In the event that greater than 20% of similar equipment items malfunction during the test period, the Engineer may declare a system defect and require replacement of all items of that equipment.

When a system defect is declared, the 90 day test period shall be restarted for the affected equipment after replacement.

During the Operational Test period the Contractor shall provide support for all installed equipment including problem troubleshooting and replacement of items not operating as specified. The Contractor shall maintain detailed daily records in the form of a maintenance and activity log. The log shall include the identity of equipment on which work is performed, the cost of equipment malfunction, if any, a description of the work performed, materials or special equipment used and the time required to complete the activity. The log shall contain the current test status of all equipment items. The maintenance and activity log shall be available to the Engineer upon request.

The final acceptance shall be based on the satisfactory completion of all 90-Day tests.

TRAINING REQUIREMENTS:

Contractor Training:
Prior to the installation of any specified equipment, the Contractor’s personnel shall have received training from the supplier on installation, operations, testing and maintenance of all equipment. No equipment will be accepted without detailed documentation from the equipment supplier certifying that the training has taken place.

NYSTA, NITTEc & PBA Training:
Unless otherwise specified on the contract plans, the contractor and/or radar sensor provider and/or manufacture shall be responsible for providing a one (1) day training seminar in the operations and maintenance of the radar sensors and Queue End Warning System for NYSTA, NITTEC and PBA management, engineering, operations, and maintenance personnel. The contractor shall contact the Engineer to verify the requirements and number of personnel scheduled for training. Training sessions shall be conducted at the TOSC/TOC and in the field, consisting of both classroom and “hands-on” training using installed system equipment.
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Training shall not exceed 8 hours with a maximum of sixteen students. The Contractor shall submit two copies of the course outline, training materials, and instructors’ qualifications to the Engineer for approval 30 calendar days prior to the anticipated start of training. Following approval of the material the Contractor shall submit enough copies of the course material for use by the agency staff during the training program.

The costs for instructors, course materials, handouts, etc. shall be included in the costs of this item. No separate payment for training will be made to the Contractor.

INTELLECTUAL PROPERTY RIGHTS:
The manufacturer shall allow the use of any and all of this documentation by any party authorized by the Procuring Agency for systems integration purposes at any time initially or in the future, regardless of what parties are involved in the systems integration effort.

WARRANTY:
All of the mechanical and electronic equipment specified to make the system operational and functional shall be warranted for a period of two (2) years. The warranties shall be issued to the New York State Thruway Authority by the respective manufacturer and/or system fabricator. The warranties shall cover the repair or replacement of the components or devices. Replacements shall be new units. The Authority will be responsible for removing and re-installing the component or device after the Contractor’s initial warranty period. The warranties shall be effective from the date of final acceptance of this item.

The Contractor shall comply with Subsection 105-18 of the Standard Specifications for the initial warranty period.

Nothing contained in these Special Specifications shall relieve the Contractor of the implied warranty that the equipment, system, and service provided are both first quality, fit, and merchantable for the uses intended as indicated herein.

METHOD OF MEASUREMENT:
The Queue End Warning System will be measured for payment as a complete system made functional and integrated with other ITS components per the contract documents and as shown on contract plans.

BASIS OF PAYMENT:
The unit price bid for the Queue End Warning System shall include the cost of furnishing all labor, materials, tools, software, equipment and incidentals as necessary to complete the work. This includes hardware necessary for mounting the radar sensors and cabinets to proposed mounting locations per contract documents.
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Primary sign support structures such as heavy posts, concrete foundations, bridge mount frames, and other structures supporting the sign shall be paid for under other contract items as shown on the contract plans.

Progress payment will be made as follows:

Fifty percent (50%) of the bid price of each item will be paid when it is installed.

Forty percent (40%) of the bid price will be paid upon satisfactory completion of the On-Site Stand-Alone and System Performance Test.

Ten percent (10%) of the bid price will be paid upon satisfactory completion of the 90 Day Operational Test.