**CONNECTED VEHICLE ROADSIDE EQUIPMENT**
**(REV 8-30-24)**

The following new Section is added:

## SECTION 681
## CONNECTED VEHICLE ROADSIDE EQUIPMENT

**681-1 Description.**

Furnish and install Connected Vehicle (CV) Roadside Equipment (RSE) in accordance with the Contract Documents. CV RSE includes the CV Roadside Unit (RSU) and Industrial Computer for CV Applications.

**681-2 Materials.**

Meet the following requirements:

CV RSU* ..... 995-20.3
Industrial Computer for CV Applications*..... 995-20.4
*Use products on the Department's Approved Product List (APL).

**681-3 Installation.**

Install and configure CV equipment and systems, including RSUs, in accordance with the Contract Documents, manufacturer's recommendations, and as directed by the Engineer.

RSUs must be preconfigured by the manufacturer, an authorized manufacturer's representative, or authorized personnel trained by the manufacturer to be ready for installation and operation at the locations shown in the Plans. Each RSU must be preconfigured with communication settings and a MAP file that has been developed for the locations shown in the Plans. Ensure site specific conditions including lane configuration, signal group phase assignments, allowed maneuvers, and verified location markers are addressed during MAP development and configuration of the RSU prior to installation.

Provide all equipment with the appropriate weatherproof power and communication cables, power supplies, power converters, mounting brackets, and mounting hardware according to the manufacturer's recommendations.

Ensure that equipment is mounted securely and is fully accessible by field technicians. Ensure that status indicators remain unobstructed and visible.

**681-3.1 RSU Site Registration:** Coordinate RSU site registration with the Department. Provide all information required to register RSU devices and locations with the FCC to the Engineer for review and approval. Support FCC site registration efforts until complete.

**681-3.2 Enrollment and Provisioning:** Coordinate RSU enrollment and provisioning in the FDOT Security Credential Management System (SCMS) with the Department. Provide the Department with the manufacturer, model, and quantity of RSUs requiring enrollment within sixty (60) of Notice to Proceed (NTP). Ensure each RSU is enrolled and provisioned within the Department's statewide SCMS by the manufacturer per the guidance provided at the following location https://www.fdot.gov/traffic/teo-

divisions.shtm/cav-ml-stamp/cv/maplocations/scms. RSUs must be enrolled and provisioned in the FDOT SCMS prior to installation.

**681-3.3 Network Coordination and Configuration:** The system must use existing Department and maintaining agency networks and Internet connection for data transfer between field equipment and systems, including cloud-hosted services. Ensure field devices do not allow unauthorized access to local networks from inbound Internet connections. Coordinate configuration parameters including network settings and firewall rules with the Department and local maintaining agency.

Ensure system configuration, management, and operational monitoring functions can be performed and completed through remote connection to the system using virtual private network (VPN) access to the Department's or maintaining agency's network. Coordinate and verify remote access with the Department.

Ensure all personnel follow the Department's procedure for requesting user and system access accounts to the Department's network. Failure to comply with Department rules and regulations can result in termination of access. Submit electronic configuration file backups to the Engineer following field testing. Backup files must include all configuration files, communication settings, firmware, and any other files with settings required to program a new replacement device (e.g., RSU, industrial computer, etc.). Coordinate method of file transfer with the Engineer.

**681-3.4 Cabling:** Cut all wires to their proper length before assembly. Do not double back excessive wire to take up slack. Neatly lace wires into cables with nylon lacing or plastic straps.

Secure cables and provide service loops at all connections. Secure drip loops and outdoor cables with self-locking cable ties of UV stabilized black plastic.

Use shielded twisted pair CAT6 Ethernet network cables that are compliant with the TIA-568-B standard and UL type CMX for outdoor runs.

Ensure that all unshielded twisted pair and shielded twisted pair CAT6 Ethernet network cables are compliant with the TIA-568-B standard. Ensure that all device cabling is free from defects.

Provide slack coils within cabinets and pull boxes to facilitate future re-terminations. Neatly bundle, coil, and band slack cable within storage areas using heavy duty cable ties. Label cables at all storage points and at cable termination ends using weatherproof tags.

**681-3.5 Connectorized Ends:** Securely and properly perform all field terminations using connectors recommended by the manufacturer to meet all environmental and performance requirements.

**681-3.6 Surge Protection:** Provide surge protection devices at locations as shown on the Plans and in accordance with Section 620. Ensure that all cables are protected against surges and induced voltage when entering cabinets. Ensure that all grounding clips or cables are provided and properly grounded. All grounding wires for surge protection within the cabinet shall be connected to the cabinet's grounding busbar.

If coaxial antenna cables are used, provide surge protection and grounding where cables connect to the RSU. Ensure that antenna cabling is grounded to the site ground in accordance with Section 620.

**681-4 Testing.**

**681-4.1 General:** Subject all equipment to field acceptance tests. Develop and submit a test plan for field acceptance tests to the Engineer for consideration and approval. Testing must demonstrate that CV equipment is fully functional, operational, and in accordance with the Contract Documents. The Engineer reserves the right to witness all field acceptance tests.

**681-4.2 Manufacturer Testing:** Ensure that the manufacturer has performed production testing on all RSE to verify proper operation prior to shipment, including successful enrollment of RSUs within the FDOT SCMS production environment.

**681-4.3 Field Testing:** Once the CV equipment has been installed, conduct local field acceptance tests at each field site according to the submitted test plan. Perform the following:

1. Verify that physical construction has been completed as detailed in the Plans.
2. Verify all wire and cable connections are correct and secure.
3. Verify proper voltages for all power supplies and related power circuits.
4. Connect devices to the power sources. Verify that the power LED on roadside equipment illuminates.
5. Log in to CV equipment and verify access to user interface.
6. Verify the configuration of CV equipment network interfaces.
7. Confirm the RSU can communicate with the FDOT SCMS, verify that downloaded security certificates are current, and verify automatic certificate top-offs.
8. Verify RSU data exchange to and from vehicles equipped with an OBU capable of message display.
    a. Verify MAP, SPAT, and TIM message broadcast.
    b. Verify BSM receipt and forwarding by RSU.
9. Verify local functionality of CV applications.
    a. MAP, SPAT, and TIM functionality
    b. Vulnerable Road User warning functionality
    c. Red light violation warning functionality
    d. Preemption and priority functionality

**681-5 Warranty.**

Ensure that the manufacturer will furnish replacements for any part or equipment found to be defective during the warranty period at no cost to the Department or the maintaining agency within 10 calendar days of notification. Ensure that CV equipment has a manufacturer's warranty covering defects and remote troubleshooting for a minimum of two (2) years from the date of final acceptance.

**681-6 Method of Measurement.**

The Contract unit price for each CV RSE furnished and installed, will include furnishing, placement, and testing of all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages and firmware, supplies, support, personnel training, shop drawings, documentation, connections, troubleshooting, labor, and incidentals necessary for a complete and accepted installation.

**681-7 Basis of Payment.**

Price and payment will be full compensation for furnishing all materials and completing all work as specified in this section or shown in the Plans.

Payment will be made under:

Item No. 924-681- Connected Vehicle Roadside Equipment – RSU – each.

Item No. 924-681- Connected Vehicle Roadside Equipment – Industrial Computer – each.

**CONNECTED VEHICLE ROADSIDE EQUIPMENT – MATERIALS REQUIREMENTS**
**(REV 8-30-24)**

SECTION 995 is expanded by the following new Article:

**995-20 Connected Vehicle Roadside Equipment.**

**995-20.1 General:** Meet the applicable national requirements and standards for Connected Vehicle (CV) equipment, including those listed in Table 995-11.

Table 995-11
CV Equipment Requirements and Standards

| Document Identifier | Description |
|---|---|
| CTI 4001 v01.01 (or later) | Connected Transportation Interoperability (CTI) Roadside Unit (RSU) Standard. A connected intersection-ready Standard of AASHTO, ITE, NEMA, and SAE International (available at www.ite.org). |
| CTI 4501 v01.00 (or later) | Connected Intersections Implementation Guide (available at www.ite.org). |
| ISO/TS 19091:2019 | Intelligent transport systems – Cooperative ITS – Using V2I and I2V communications for applications related to signalized intersections (ISO/TS 19091:2019) |
| IEEE 802.11-2012 (or later) | Institute of Electrical and Electronics Engineers (IEEE) Standard for Information technology--Telecommunications and information exchange between systems Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications |
| IEEE 1609.2-2022 (or later) | IEEE Standard for WAVE -- Security Services for Applications and Management Messages |
| IEEE 1609.3-2022 (or later) | IEEE Standard for WAVE -- Networking Services |
| SAE J2735 SEP2023 (or later) | V2X Communications Message Set Dictionary |
| SAE J3268 MAR2023 (or later) | Listing of Provider Service Identifiers and Associated Application Technical Reports |
| IEEE 802.3-2022 (or later) | Standard for Ethernet |
| FCC Title 47, Parts 2, 15, and 90 | Federal Communications Commission (FCC) Code of Federal Regulations (CFR) |

CV equipment shall include hardware, software, ancillary devices, and all material necessary to enable wireless V2I communications. Ensure that all assembly

hardware, including nuts, bolts, external screws and locking washers less than 5/8 inch in diameter, is Type 304 or 316 passivated stainless steel. Use stainless steel bolts, screws and studs meeting the requirements of ASTM F593. Use nuts meeting the requirements of ASTM F594. Ensure all assembly hardware greater than or equal to 5/8 inch in diameter is galvanized. Use bolts, studs, and threaded rod meeting the requirements of ASTM A307. Use structural bolts meeting the requirements of ASTM F3125, Grade A325.

CV equipment shall be FCC certified. Ensure that the FCC certification mark is displayed on an external label and that the RSU operates within the licensed frequencies of the 5.9 GHz spectrum granted by the FCC.

CV equipment shall be capable of remote firmware updates performed over the local network. Device manufacturers shall make firmware updates available to the Department and maintaining agency at no cost.

CV equipment, including RSUs, shall be capable of data sharing for third party use by systems such as the FDOT V2X Data Exchange platform and SunGuide®.

**995-20.2 Connected Vehicle Applications:** CV equipment, including RSUs, shall be capable of performing applications using the following CV messages. All CV messages shall be compliant with Society of Automotive Engineers (SAE)-J2735 and 2945/x standards including:

1. Basic Safety Message (BSM) including position, speed, heading, acceleration, and vehicle size.
2. Personal Safety Message (PSM) including user type, position, speed, and heading.
3. Signal phase and timing (SPAT) messages.
4. MAP messages that describe roadway and intersection geometry.
5. Traveler information messages (TIM).
6. Signal request messages (SRM)
7. Signal status messages (SSM)

**995-20.3 Roadside Unit (RSU):** The RSU shall be a commercially available production device that provides information and supports public safety operations in a V2I/V2X communication environment. The RSU shall be enrolled and provisioned in the current Florida Department of Transportation Security Credential Management System (FDOT SCMS) by the manufacturer.

The RSU shall support C-V2X operation including direct communication mode without using base stations.

RSUs shall be interoperable with FDOT APL approved Advanced Transportation Controller (ATC) traffic signal controllers.

The RSU shall support web-based user access through a Graphical User Interface (GUI) that provides secure access for device configuration, operation, and maintenance.

The RSU shall be provided with an application programming interface (API) or similar documented interface to the Department at no additional cost. The RSU interface shall allow data exchange with third party systems (e.g., providing a data feed of all messages broadcast and received by the RSU).

The RSU shall automatically recover from a power failure within one minute once power is restored. Ensure that all programmable settings are restored to their previous configurations and that the system resumes proper operation.

**995-20.3.1 Antennas:** Ensure that antennas are provided for all radio frequency (RF) connectors on the RSU. The RSU shall be provided with omni-directional antennas supplied by the RSU manufacturer and tested with the device to meet FCC requirements.

**995-20.3.2 Ports and Connectors:** The RSU shall include all necessary ports and connectors for a complete weatherproof assembly. All ports shall be legibly and permanently marked designating their intended use. All labels shall be weather resistant.

**995-20.4 Industrial Computer for CV Applications:** Provide an industrial computer with a current Linux operating system to serve as a CV application platform. The industrial computer shall provide a platform for hosting and executing CV applications and other software. The industrial computer shall be provided with CV applications including:

1. An application that accepts I/O logic data and produces SAE J2735 compliant TIMs for broadcast by the RSU (e.g., School Zone Warning TIM when associated beacons are active, Advanced Rail Crossing Notification when gates are actuated).

2. An application that can be configured to receive source data from a specified address (i.e., IP and port number) and forward that data to multiple configurable destination addresses.

The industrial computer must automatically recover from power failure within one minute after power is restored. All applications hosted on the industrial computer shall automatically start using their previous configuration and resume proper operation. The industrial computer shall have sufficient processing power, memory, and storage to provide the computing power required for CV applications.

**995-20.4.1 Communications:** The industrial computer shall include a minimum of one Ethernet communications interface that provides a 10/100/1000 Base TX connection. All unshielded twisted pair/shielded twisted pair network cables and connectors shall comply with TIA 568.

The industrial computer shall include 2 universal serial bus (USB) interfaces for standardized connection and communication between other devices and peripherals.

**995-20.5 Configuration and Management:** CV equipment shall be provided with all hardware, software, configuration tools and software licenses required for local and remote configuration, operation, and management including access to all user-programmable features as well as health and status monitoring, event logging, and diagnostic utilities. Configuration and management functions shall be password protected.

**995-20.6 Mechanical Requirements:** CV equipment shall be permanently marked with manufacturer name or trademark as well as part number and serial number. Ensure that the markings are visible after installation.

Do not use self-tapping screws on the exterior of the assembly.

All parts exposed to the elements shall be made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

The dimensions of the industrial computer shall allow installation in a traffic cabinet.

**995-20.7 Electrical Requirements:** The RSU shall be provided with a power over ethernet (PoE) injector. Powered ports on the PoE injector shall meet the requirements set forth in IEEE 802.3. The PoE injector shall operate using a nominal input voltage of 120VAC. If the PoE injector requires nominal input voltage other than 120VAC, furnish the appropriate voltage converter. The industrial computer shall operate on a nominal voltage of 120VAC. Supply an appropriate voltage converter for industrial computers that require operating voltages other than 120VAC.

**995-20.8 Environmental Requirements:** Meet the environmental requirements of CTI 4001. The RSU, mounting hardware, and any other related material that is exposed to the environment shall be designed for 150 mph wind speeds and meet the requirements of the Department's Structures Manual.