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PORTSMOUTH TO KITTERY
16189B

November 17, 2020

SPECIAL PROVISION

SECTION 677 – INTELLIGENT TRANSPORTATION SYSTEMS (ITS) EQUIPMENT

Item 677.46__–Motor Vehicle Detection System (MVDS)
Item 677.465__–Motor Vehicle Detection System (MVDS) Without Pole

This Special Provision provides for installation of a new Motor Vehicle Detection System (MVDS) on an existing steel pole, new steel pole, existing overhead sign structure, new overhead sign structure, and/or existing bridge structure. All provisions of Section 677 (Intelligent Transportation Systems (ITS) Equipment – Base Specification), except as modified or changed below, shall apply.

Add to Description:

1.4 This work shall consist of furnishing, installing, and testing a high definition radar-based Motor Vehicle Detection System (MVDS) at the locations as indicated and in conformity with the lines, grades, dimensions and details shown on the Plans, all in accordance with these Specifications. The work shall also include furnishing, installing, calibrating, and testing all ancillary items needed to establish a complete, functional system including, but not limited to, cabling, mounting hardware, power supplies, power injectors, transient voltage suppression devices as recommended by the manufacturer, antennas, and programming. This work shall also include connecting the MVDS to power service and communications at the ITS equipment cabinet and all wiring, cabling, bracketing and connectors.

1.5 If the MVDS is not mounted to another ITS device or an existing support structure, such as a CCTV support pole or an overhead sign structure, the MVDS shall be installed on its own support pole and foundation. This work shall consist of furnishing and installing a steel support pole, concrete foundation, mounting hardware and associated equipment at the locations indicated and in conformity with the lines, grades, dimensions and details shown on the Contract Documents all in accordance with these Specifications.

Add to 2.1.1 Structural Integrity:

2.1.1.1 Structural Integrity – If the MVDS is installed on its own support pole and foundation, the MVDS support pole and foundation shall be designed and constructed to comply with all applicable sections of the 2015 edition of the *AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals* with all published addendums.

Add to 2.3 Technical Submittal:

2.3.9 The Owners will give no guarantee as to the completeness of the plan details and the Contractor shall be required to furnish, install, and test any other equipment and materials required to provide a complete and operational MVDS.

2.3.10 The submittal for the MVDS Support Pole and Foundation shall include the following for approval in accordance with Section 105.02:

2.3.10.1 LRFD design calculations for the wind speeds defined for the support pole signed and stamped by a Professional Engineer licensed in the State where the equipment will be installed.

2.3.10.2 Manufacturer's specifications and applicable catalog cuts for all materials and components.

2.3.10.3 Complete sets of shop drawings for the pole signed and stamped by a Professional Engineer licensed in the State where the equipment will be installed.

2.3.10.4 If not provided with the Contract Documents, the Contractor shall submit cross-section(s) and plan view(s) showing the pole(s) location, the foundation(s) and the proposed slopes plotted on cross-sections showing no interference with utilities, drainage pipes or structures and showing cofferdams with sheeting left-in-place if needed for construction of foundation.

2.3.10.5 The MVDS support pole design engineer shall design for not more than 90 percent of the total allowable deflection within the pole, allowing the balance of the allowable deflection to be due to the foundation and shall communicate with the foundation design engineer so the total deflection criteria noted in the Special Provision is met.

2.3.10.6 The submittal shall include the foundation system (i.e. drilled shaft or spread footing) that is selected for each MVDS support pole location.

2.3.10.7 The MVDS design and catalog cuts for the MVDS shall be submitted to the Owners for review and approval prior to any construction activities.

2.3.10.8 All MVDS and associated equipment and enclosures shall be listed by the Underwriters Laboratories (UL®) and shall bear the UL mark on the outside of the MVDS enclosure.

Add to Materials:

2.6 Motor Vehicle Detector System New Hampshire.

2.6.1 The MVDS shall detect moving motor vehicles along a roadway from a mounting location located adjacent to the roadway.

2.6.2 The MVDS system shall be native Ethernet or include converter equipment to convert the system to Ethernet capability.

2.6.3 The MVDS shall be specified by its manufacturer for continuous duty, non-environmentally controlled, outdoor use.

2.6.4 The MVDS shall be managed and controlled from the New England Compass ATMS and through the part-time shoulder use (PTSU) system.

2.6.5 The MVDS unit shall be operable from 10 – 24V DC dissipating not more than 15W.

2.6.6 The interface shall consist of a single MS connector which provides power to the unit, output contact closure wire pairs for each of the required detection zones and serial communication lines for programming and testing.

2.6.7 A UV-resistant cable rated for outdoor use as recommended by the MVDS manufacturer shall provide connection between the MVDS and the cabinet equipment in a continuous length. Splicing of the cable shall not be permitted. The MS connector pins must be soldered to the cable conductors and assembled and tested prior to installation and pulling of cable on site.

2.6.8 Those components of the MVDS that are housed inside the ITS Equipment Cabinet shall be field hardened and rated by their Manufacturer in accordance with the operating temperature, storage temperature, and relative humidity requirements of the NEMA TS2 Standard. The design shall be inherently temperature compensated to prevent abnormal operation. The circuit design shall include such compensation as is necessary to overcome effects due to temperature in the specified environmental range.

2.6.9 The detector unit shall be enclosed in a rugged weatherproof box and sealed to protect the unit from wind up to 90 mph, dust and airborne particles, and exposure to moisture (NEMA type 4X enclosure). The total weight of the detector unit assembly shall not exceed 5 pounds.

2.6.10 The detector unit shall have an operating temperature range of -40°F to 140°F, minimum.

2.6.11 Except as may be otherwise stated herein for a particular item, no item, component, or subassembly shall emit a noise level exceeding the peak level of 55 dBA when measured at a distance of 3 feet away from its surface.

2.6.12 The detector unit shall be resistant to vibration and shock in accordance with applicable NEMA TS 2-2003 requirements, or approved equivalent.

2.6.13 The MVDS unit shall achieve a minimum Mean Time Between Failures (MTBF) of 10 years or longer.

2.6.14 The MVDS shall provide volume, speed, and occupancy for a minimum of twelve discreet detection zones in user-defined increments.

2.6.15 The MVDS shall be capable of operational mountings up to 120 degrees left or right from vertical. The MVDS shall transmit on a frequency band of 24-24.25 GHz (K-band) or another approved spectral band.

2.6.16 The MVDS shall comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules or the appropriate Spectrum Management Authority. The MVDS shall not interfere with any known equipment.

2.6.17 The MVDS's field of view shall cover an area defined by a beam of known shape and characteristics and its maximum detection range shall be as follows:

- Elevation Beam Width 50 to 70 degrees
- Azimuth Beam Width 6 to 15 degrees
- Minimum Detection Range 6 to 250 feet

2.6.18 The MVDS shall store average interval data in non-volatile flash memory.

2.6.19 The MVDS shall have an RS-485 port and an RS-232 port, and both ports shall communicate independently and simultaneously.

2.6.20 The Contractor shall supply a serial-to-Ethernet converter such that Ethernet data is available in the control cabinet.

2.6.21 The Contractor shall supply all connecting cables required to connect the MVDS to the Ethernet Switch in the control cabinet.

2.6.22 Each MVDS shall be controlled and monitored by its own controller.

2.6.23 The MVDS controller shall be mounted in the ITS equipment cabinet.

2.6.24 The MVDS controller shall be able to receive instructions from and provide information to a computer containing MVDS control software using the Ethernet communications cable.

2.6.25 If the MVDS is not mounted to another ITS device that already has transient protection, the MVDS shall include integral transient voltage surge suppression (TVSS) to protect against transients and surges on the incoming power and data connections to the MVDS controller. The TVSS shall be a product approved by the MVDS manufacturer for use with the MVDS.

2.6.26 The MVDS support pole and all associated members shall be designed by a licensed Professional Engineer and designed and fabricated in accordance with the 2015 edition of the *AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* and NHDOT Standard Specifications Section 550, except as noted below:

Basic Wind Speed:

Basic wind speed of 130 mph (209 km/hr) shall be used as shown in AASHTO Specifications, Fig. 3-2e. The maximum-recorded wind speed in this area shall be

used as the basic wind speed if it is greater than the basic wind speed of 130 mph (209 km/hr).

Design Life: 50 Years

Fatigue Importance Category: Cantilevered Category II (Support poles with distance to roadway > height of pole)

Fatigue Importance Category: Cantilevered Category I (Support poles with distance to roadway ≤ height of pole)

2.7 Motor Vehicle Detection System Maine

2.7.1 The MVDS Unit supplied by the contractor shall be an ImageSensing Systems RTMS unit or approved equivalent.

2.7.2 The MVDS shall detect moving motor vehicles along a roadway from a mounting location located adjacent to the roadway.

2.7.3 The MVDS shall be specified by its manufacturer for continuous duty, non-environmentally controlled, outdoor use.

2.7.4 The MVDS shall be managed and controlled from the New England Compass ATMS and through the part-time shoulder use (PTSU) system.

2.7.5 The MVDS unit shall be operable from 12 – 24V DC dissipating not more than 15W.

2.7.6 Those components of the MVDS that are housed inside the ITS Equipment Cabinet shall be field hardened and rated by their Manufacturer in accordance with the operating temperature, storage temperature, and relative humidity requirements of the NEMA TS2 Standard. The design shall be inherently temperature compensated to prevent abnormal operation. The circuit design shall include such compensation as is necessary to overcome effects due to temperature in the specified environmental range.

2.7.7 The detector unit shall be enclosed in a rugged weatherproof box and sealed to protect the unit from wind up to 90 mph, dust and airborne particles, and exposure to moisture (NEMA type 4X enclosure). The total weight of the detector unit assembly shall not exceed 5 pounds.

2.7.8 The detector unit shall have an operating temperature range of -40°F to 140°F, at a minimum.

2.7.9 The detector unit shall be resistant to vibration and shock in accordance with applicable NEMA TS 2-2003 requirements, or approved equivalent.

2.7.10 The MVDS unit shall achieve a minimum Mean Time Between Failures (MTBF) of 10 years or longer.

2.7.11 The MVDS shall provide volume, speed, and occupancy for a minimum of twelve discreet detection zones in user-defined increments.

2.7.12 The MVDS shall comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules or the appropriate Spectrum Management Authority. The MVDS shall not interfere with any known equipment.

2.7.13 The MVDS's field of view shall cover an area defined by a beam of known shape and characteristics and its maximum detection range shall be as follows:

- Elevation Beam Width 50 to 70 degrees
- Azimuth Beam Width 6 to 15 degrees
- Minimum Detection Range 6 to 250 feet

2.7.14 The MVDS shall store average interval data in non-volatile flash memory.

2.7.15 The Contractor shall supply all connecting cables required to connect the MVDS to the Ethernet Switch in the control cabinet.

2.7.16 Each MVDS shall be controlled and monitored by its own controller.

2.7.17 The MVDS controller shall be mounted in the ITS equipment cabinet.

2.7.18 The MVDS controller shall be able to receive instructions from and provide information to a computer containing MVDS control software using the Ethernet communications cable.

2.7.19 If the MVDS is not mounted to another ITS device that already has transient protection, the MVDS shall include integral transient voltage surge suppression (TVSS) to protect against transients and surges on the incoming power and data connections to the MVDS controller. The TVSS shall be a product approved by the MVDS manufacturer for use with the MVDS.

2.7.20 The MVDS support pole and all associated members shall be designed by a licensed Professional Engineer and designed and fabricated in accordance with the 2015 edition of the AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals and NHDOT Standard Specifications Section 550, except as noted below:

Basic Wind Speed:

Basic wind speed of 130 mph (209 km/hr) shall be used as shown in AASHTO Specifications, Fig. 3-2e. The maximum-recorded wind speed in this area shall be used as the basic wind speed if it is greater than the basic wind speed of 130 mph (209 km/hr).

Design Life: 50 Years

Fatigue Importance Category: Cantilevered Category II (Support poles with distance to roadway > height of pole)

Fatigue Importance Category: Cantilevered Category I (Support poles with distance to roadway ≤ height of pole)

2.8 MVDS Support Poles (for independent mounting only).

2.8.1 The pole shaft shall be one-piece construction and shall conform to ASTM A595 Grade A with a minimum yield strength of 55 ksi or ASTM A572 with a minimum yield strength of 55 ksi.

2.8.2 The pole shaft and all associated ancillary members shall be steel, galvanized in accordance with the 2015 edition of the *AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* with all published addendums and NHDOT Standard Specifications Section 550, 2.9.

2.8.3 The MVDS support pole shall be designed to support a minimum of two MVDS units and radio antenna. The support pole shall be designed for the number of radio units as indicated by the Contract Documents, plus one additional unit equal to the largest unit required by the project, mounted at the same height as the highest mounted radio unit. Close consideration shall be given to the effective projected area of the MVDS equipment and radio equipment to be mounted on the pole along with the weight of attached hardware when designing the pole to meet the specified deflection performance criteria, including consideration for all possible loading combinations including wind and ice loads; and the design stresses and allowable stresses for all components which comprise the proposed structure and the additional foundation deflection. The top of the pole total deflection (pole and foundation deflection projected to the top of the pole) shall not exceed the following:

- 1 percent of pole height due to 90 MPH (non-gust) winds; and
- 1 inch due to 30 MPH (non-gust) winds.

2.8.4 The calculations shall include: a pole, base plate, and anchor bolt analysis (embedded length shall be confirmed by the Engineer designing the foundation). The pole calculations shall be analyzed at the pole base and at 5 foot pole intervals along the full height of the pole. The following information shall be provided by the Contractor at each of these locations:

- The pole's diameter, thickness, section modulus, moment of inertia, and cross-sectional area.
- The centroid, weight, projected area, drag coefficient, velocity pressure, and wind force of each trapezoidal pole segment.

- The axial force, shear force, primary moment, total moment, axial stress, bending stress, allowable axial stress, allowable bending stress, and combined stress ratio (CSR) at each elevation.

- The pole's angular and linear deflection at each location.

2.8.5 Galvanized steel weatherheads shall be factory installed in the MVDS support pole for wire access to mounted equipment as shown in the Contract Documents. No field drilling will be permitted.

2.8.6 Base plates shall conform to ASTM A36 or A572 Grade 42.

2.9 MVDS Support Pole Foundation.

2.9.1 The MVDS support pole foundation shall be designed by a licensed Professional Engineer in accordance with the 2015 *AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals* with all published addendums and the NHDOT Standard Specifications. Foundations shall be cast-in-place. No precast foundations shall be permitted. The submitted top of foundation reaction loads for the specified wind speeds shall be submitted to verify or modify the preliminary foundation design in the Contract for final design.

2.9.2 The MVDS support pole foundation shall be constructed in accordance with the requirements described in Appendix A of Book 2 - Technical Provisions for the drilled shaft option.

2.9.3 Anchor rods shall conform to the requirements of ASTM F1554 Grade 55 (minimum). Do not use ASTM A615 reinforcing steel. Galvanize the entire rod per ASTM A153. Each anchor rod shall be supplied with a minimum of two hex nuts (ASTM A563 or ASTM A194) and a minimum of two flat hardened washers (ASTM F436). Lock washers shall not be used.

2.9.4 Structural fill used within the conduit trenches shall conform to Section 508.

2.9.5 Grout shall not be used between the opening of the structure base plate and the top of the foundation. The grout on existing foundations have cracked, allowing water and salt to stay in the cracks and not dry out which has led to corrosion of the anchor rods.

2.9.6 Trenches for the conduits shall be hand dug near the proposed footing, disturbing as little soil as possible in placing of the conduits (approximately 2.4 ft. maximum down from the existing ground surface). The resulting trenches shall be backfilled with structural fill conforming to Section 508.

2.9.7 A stainless steel standard grade wire cloth (1/4" (6.4 mm) maximum opening with minimum wire diameter of AWG No. 16) shall be installed around the space between the structure base plate and concrete foundation with a 2-inch (51 mm) lap and ¾" stainless steel banding, secured in a manner that will permit its removal for maintenance. The screen is used to eliminate

debris beneath the base plate, keep animals out, and to protect electrical wires if no other base protection is provided.

2.9.8 The connection of the pole to the foundation shall be a double-nut joint moment connection. If the drilled hole method is performed and the soils are found to be unsuitable, an excavated hole shall be completed as approved by the Engineer.

2.9.9 The distance from the top of the concrete footing to the bottom of the pole base plate shall be the nut height plus 1-inch (preferred) or nut height plus the anchor rod diameter (maximum). Note the nut height equals the rod diameter.

Add to Construction Requirements:

3.12 MVDS Installation.

3.12.1 All MVDS Systems and electrical installations shall comply with the requirements specified herein, local and utility codes, and the National Electrical Code (NEC). The Contractor shall provide and install a transient voltage surge suppressor (TVSS) between the AC power mains and all MVDS equipment.

3.12.2 A preconstruction meeting with the Contractor, equipment subcontractor/vendor, Engineer, and a TMC representative shall be arranged not less than 7 days prior to the start of the MVDS installations.

3.12.3 The MVDS shall be mounted in a side-fired configuration on the proposed support structure in order to monitor the vehicles traveling along the adjacent highway. It shall be mounted on the proposed pole at the specified location using the Contractor-supplied mounting brackets.

3.12.4 If mounted to a CCTV support pole, the device shall not interfere with the raising and lowering operations of the camera lowering device or camera antenna operations.

3.12.5 The Contractor shall install the detector unit at a height above the road surface as specified by the manufacturer based on the offset from edge of travel lanes and the number of lanes being detected. The device cabling shall be routed through the support pole via the supplied weatherhead closest to the final device mounting height. A drip loop shall be provided in the device cabling.

3.12.6 The Contractor shall arrange to have a technician certified by the manufacturer of the MVDS present at the time the equipment is installed, turned-on, and calibrated.

3.12.7 The MVDS detection zones shall be set up using the manufacturer software and a laptop computer.

3.12.8 Additional Requirements for MVDS Support Poles and Foundations (when required).

3.12.9 Geotechnical services for MVDS Support Pole Foundations, when required, will be the responsibility of the Contractor.

3.12.10 The Contractor shall supply and install a grounding system to be installed at the base of the support pole. The grounding system shall consist of a series of minimum 8-foot copper ground rods connected to the support pole. A #4 AWG copper wire shall be exothermically welded to each ground rod between the support pole and the ITS equipment cabinet providing a common ground system for each terminus. A conduit through the foundation to the inside of the pole shall provide the means to connect the ground wire from the inside of the pole to the ground rod(s).

3.12.10.1 Additional ground rods shall be installed to meet the Manufacturer's recommended resistance to ground, or a maximum of 25 ohms, whichever is less.

3.12.11 The MVDS shall meet the following minimum accuracy requirements under Manufacturer defined "normal" operating conditions:

3.12.11.1 The MVDS shall record motor vehicle volume data, per lane, within 10%.

3.12.11.2 The MVDS shall record motor vehicle speed data, per lane, within 10%.

3.12.11.3 The MVDS shall record individual vehicle speeds within 5%.

3.12.11.4 The MVDS shall record motor vehicle occupancy data, per lane, within 20%.

3.12.12 The MVDS shall perform as indicated with no major malfunctions throughout the entire contract period. Malfunctions include but are not limited to: the inability of the equipment to meet the minimum accuracy requirements; the inability of the equipment to perform as designed in the weather and construction environment; or the failure of the communication system to operate with the New England Compass ATMS software.

3.12.13 The MVDS shall be fully compatible with the New England Compass ATMS software and the proposed PTSU System.

Add to Method of Measurement:

4.8 Motor Vehicle Detection System (MVDS) will be measured for payment as a unit. Where more than one unit is specified in the contract, separate item numbers will appear for each separate unit.

4.9 Support Pole and Foundation for MVDS will be measured for payment as a unit. Where more than one unit is specified in the contract, separate item numbers will appear for each separate unit. This item shall also be used for the relocation of a support pole onto a new foundation.

4.10 Flexible Liquid Tight Conduit will not be measured but shall be subsidiary to the MVDS item.

Add to Basis of Payment:

5.7 The accepted quantity of Motor Vehicle Detection System (MVDS) of the type and at the locations specified will be paid for at the contract lump sum price complete in place. Payment shall

include the MVDS detector unit, manufacturer's cables, mounting hardware, flexible conduit, Ethernet cables, testing, training, integration and any necessary transient suppression devices, and all documentation, tools, materials, incidentals, and labor necessary to provide a complete, communicating, operational system.

5.8 The accepted quantity of Support Pole and Foundation for MVDS at the locations specified will be paid for at the contract lump sum price complete in place. Payment shall include the support pole and design calculations, foundation and design calculations, grounding and bonding, and all tools, materials, incidentals and labor necessary to provide a support system for the MVDS.

Pay Items and Units:

677.46__	Motor Vehicle Detection System (MVDS)	Unit
677.465__	Motor Vehicle Detection System (MVDS) Without Pole	Unit