1. **Description.** This Item shall govern for furnishing and installing a microwave vehicle detection (MVD) system as shown in the plans and as detailed in the Special Specifications. Include all equipment required to interface with a Local Control Unit (LCU) under this pay item.

2. **Materials.** Provide the microwave vehicle detection system as a complete system from a single manufacturer. Furnish a complete system, including, but not limited to, the following:
   
   A. Microwave Vehicle Detection (MVD) transmitter/receiver device.
   
   B. Communications interface and cabling for a Spread-spectrum radio link between the MVD and the local control unit.
   
   C. Solar power photovoltaic array, regulator, batteries and distribution system to power MVD and spread-spectrum radio transmitter.
   
   D. Pole mountable cabinet power distribution and radio transmitter.

3. **Equipment.**
   
   A. **General Requirements.**
      
      1. Furnish all equipment and component parts new, of the latest design and manufacture, and in an operable condition at the time of delivery and installation. Supply all parts that are of high quality workmanship.
      
      2. Design the units such as to prevent reversed assembly or improper installation of connectors, fasteners, etc. Design each item of equipment to protect personnel from exposure to high voltage during equipment operation, adjustments, and maintenance.
      
      3. Design the Mean Time Between Failures (MTBF) of the Microwave Vehicle Detector unit, operating continuously in their application, for 10 years or longer.
      
      4. Provide equipment that is modular in design, such that it can be easily replaced in the field.
      
      5. Clearly identify each unit with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.
6. Coat printed circuit boards with a clear-coat moisture and fungus resistant material (conformal coating).

7. Make external connection for communications and power by means of a single military style multi-pin connector, keyed to preclude improper connection.

8. Furnish equipment capable of continuous operation over a temperature of -35°F to 165°F and relative humidity from 0% to 95% - non-condensing.

B. Microwave Vehicle Detection Unit.

1. Functional Requirements.

   a. **Capabilities.** Supply a unit that functions as a true presence detector, which can provide presence, volume, lane occupancy, and speed information on up to 8 discreet detection zones. Make this information available to MVD communication handler via serial communications lines.

   b. **Transmission.**

      (1) Transmit on a frequency band of 10.525 GHz ±25 MHz or another approved spectral band. Comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules or the appropriate Spectrum Management Authority. No interference with any known equipment is allowed.

      (2) Maximum transmitter power is 10 milliwatts.

   c. **Area Coverage.** Design the sensor’s field of view to cover an area defined by an oval shaped beam with its maximum detection range as follows:

      (1) Elevation Beam Width - 45 degrees

      (2) Azimuth Beam Width - 15 degrees

      (3) Range - 10 to 200 ft.

   d. **Detection Zones.**

      (1) Provide a minimum of eight detection zones per unit. Allow the range limits of each zone to be user defined in 7-ft. resolution.

      (2) Minimum acceptable presence accuracy from overhead mount is 95% in a single detection zone.

      (3) Minimum acceptable accuracy in detection and magnitude of speed is 95% from the overhead mount.

      (4) Minimum acceptable presence accuracy from side-fired mount shall be 90% in multiple detection zones. Minimum acceptable accuracy in detection, volume, occupancy, and magnitude of speed is 90% from a side-fired mount.
Include surge protection in accordance with IEEE Standard C62.41 - 1980 Category C.

Supply detectors that are resistant to vibration in accordance with IEC 68-2-30 (Test FC), NEMA TS-1 (Section 2.1.12), or approved equivalent.

Supply detectors that are resistant to shock in accordance with IEC 68-2-27 (Test EA), NEMA TS-1 (Section 2.1.13), or approved equivalent.

2. Power Requirements.
   a. Design the detector to operate at 10 to 30 VDC. Maximum allowable normal power consumption is 8 watts.
   b. Design the equipment so that operation is not affected by the transient voltages, surges and sags normally experienced on commercial power lines. Install a grounding system for each MVD installation. Check the local power service to determine if any special design is needed for the equipment. Include any extra cost in the bid price of this item.
   c. Design the equipment such that failure of the one unit of equipment will not cause failure of any other unit of equipment. Provide automatic recovery from power failure within 5 sec. of resumption of power. Supply a monitoring circuit for the transceiver that will

3. Mechanical Requirements.
   a. Enclose the microwave vehicle presence detector in a rugged weatherproof enclosure and sealed to protect the unit from wind up to 90 mph, dust and airborne particles, and exposure to moisture (NEMA type 3R enclosure). The maximum overall dimensions of the box, including fittings, are 8-in. x 10-in. x 6-in. Maximum total weight of the microwave vehicle presence detector is 5 lb.
   b. Construct the mounting assembly of all painted steel, stainless steel, or aluminum construction, with the ability to support a load of up to 20 lb. Incorporate a ball joint or other approved mechanism in the mounting assembly that can be tilted in both axes, then locked into place, to provide the optimum area of coverage.
   c. Coat printed circuit boards with a clear-coat moisture and fungus resistant material (conformal coating).
   d. Make external connection for communications and power by means of a single military style multi-pin connector, keyed to preclude improper connection.
   e. Furnish a detector that is capable of continuous operation over a temperature range of -35°F to 165°F and relative humidity from 0% to 95% - non-condensing.

1. **Functional Requirements.**
   
a. **Capabilities.**
   
   (1) Adequately size the solar power system to provide all power required for continuous operation of the MVD unit and the spread spectrum transmitter.

   (2) Furnish a photovoltaic array, voltage regulator, and battery system designed and supplied to operate as a complete system.

   (3) Design the system voltage to be a nominal 12 VDC or 24 VDC as recommended by the system supplier.

   (4) Include an automatic solid state regulator to provide the voltage and current within the operating range recommended for the batteries and powered equipment.

   (5) Supply a system capable of operating the MVD and transmitter during all months of the year and all weather conditions at the project location.

   (6) Size the battery system to operate the MVD and transmitter system continuously for 5 days without solar support after a full charge.

   (7) Furnish lead acid type batteries in non-spill containers.

   (8) Size the solar power system to be capable of operating the MVD and transmitter system while simultaneously charging the battery system to full charge during January daylight conditions.

   (9) Provide fused protection for the batteries, regulator, and powered equipment, as shown on the drawings.

b. **Mounting Requirements.**
   
   (1) Mount the photovoltaic array on a pole as shown on the drawings.

   (2) Install the power distribution and radio transmitter in a pole mounted cabinet as shown on the drawings.

   (3) Install batteries inside a Battery Ground Box as shown on the drawings.

   (4) Equip the cabinet with separate compartments for power distribution and the radio system. Provide compartments with a single door with weather seals for the radio section and ventilation for the power distribution.

   (5) Mount radio antenna as required for proper operation of the radio system.

D. **Battery Ground Box.**

   1. Install battery ground boxes such that it will be possible to install and accommodate up to 4 batteries measuring 10 in. X 13.5 in. X 8 in. (H X L X D).
2. Permanently mark all battery ground boxes and covers either by impress or by permanent ink, with manufacturer's model number and manufacturer's name or logo.


4. Provide battery ground boxes that meet the following requirements:
   a. Manufacture battery ground box cover and cover ring from polymer concrete reinforced with continuous strands of woven or stitched borosilicate fiberglass cloth. Fabricate the polymer concrete from catalyzed polyester resin, sand and aggregate, with a minimum compressive strength of 11,000 psi. Polymer concrete containing chopped fiberglass or fiberglass reinforced plastic is not acceptable.
   b. Manufacture battery ground box walls from fiberglass reinforced plastic reinforced with continuous strands of woven or stitched borosilicate fiberglass cloth. Fabricate the fiberglass reinforced plastic from catalyzed polyester resin, lightweight filler and reinforced with woven roving, with a minimum compressive strength of 7,500 psi.
   c. Minimum inside dimensions are (width x length x depth): 15 1/4 in. x 28 1/4 in. x 14 1/2 in.
   d. Foot the bottom edge of box or extension with a minimum 1 1/2 in. flange.
   e. Design battery ground boxes to withstand 600 lb. per sq. ft. applied over the entire sidewall with less than 1/4 in. deflection per foot length of box. Provide ground boxes and covers that withstand a test loading of 20,000 lb. over a 10 in. by 20 in. area centered on the cover with less than 1/2 in. deflection. Provide battery ground boxes and covers that meet Western Underground Standards 3.6. Supply certification by an independent laboratory or sealed by a Texas-Licensed Professional Engineer.
   f. Supply covers of 2 in. thick polymer concrete. Provide all stainless steel hardware. Secure cover with two 1/2 in. stainless steel bolts. Supply self-retaining bolts that withstand a minimum of 70 ft-lbs. torque and have a minimum 750 lb. straight pull out strength. Supply nuts that are floating and provide a minimum of 1/2 in. movement from the center of the nut. Supply covers that are skid resistant, with a minimum 0.5 coefficient of friction. Provide covers that are interchangeable between manufacturers and conforming to the dimensions shown herein. Unless otherwise approved by the Engineer, legibly label each cover with, "Traffic Signals Danger High Voltage" in minimum 1 in. letters.
   g. Equip each battery ground box with predrilled holes to accept 3/8 in. stainless steel rods. Install the holes 1 1/2 in. (± 1/4 in.) above the bottom edge of the box along the length of the box at 3 1/2 in. centers beginning 4 1/2 in. from the edge of the box.
h. Provide a minimum of seven 3/8 in. stainless steel rods threaded on both ends, equipped to be inserted in the predrilled holes to serve as a rack sufficient to accommodate up to four batteries. Secure the rods in place utilizing 3/8 in. stainless steel (s.s.) nuts and 3/8 in. X 1 in. s.s. flat washers.

i. Supply two 3/16 in. plastic sheets measuring a nominal 6 in. x 24 in. which are to be placed on the secured rods upon which the batteries (supplied by others) are to be set.

j. Provide a minimum of four battery "bell jars" and respective tie down straps. These bell jars are inverted over the batteries and strapped to the batteries.

k. If a conflict occurs between these specifications and the State’s standard plan sheet ED (13) “Electrical Details Ground Boxes/Battery Box”, then ED (13)-03 shall supersede the specifications.

5. Battery Ground Box Construction Methods.

a. Set battery ground boxes on a 9 in. (minimum) bed of coarse No. 1 aggregate as defined by Item 421. Install gravel in place prior to setting box and cap all conduits. Remove any gravel or dirt in conduit.

b. Construct an apron encasing the battery ground box including concrete and reinforcing steel, subsidiary to the ground box. Reinforcing steel may be field bent. Concrete for aprons is considered miscellaneous concrete for testing purposes. Cast aprons in place.

c. Cut any holes in the sidewall of battery ground boxes using a round hole saw or other method approved by the Engineer.

E. Equipment Cabinet (MVD) (Pole Mount). House the equipment inside a NEMA 3R rated outdoor enclosure. Provide cabinets that are furnished fully wired that meet the following requirements:

1. Material. Constructed from 5052-H32 sheet aluminum alloy or Type 304 stainless steel.

2. Finish. Supply cabinets with all surfaces clean, free of holes or blemishes, without burrs, contain a smooth natural finish and with exterior corners rounded. Provide cabinets with a natural mill finish.

3. Cabinet Mounting. Design the method of attachment to support the weight of the cabinet and installed equipment, plus 10%.

4. Equipment Mounting. Equip the cabinet with all shelves, brackets and racks required for the installation of the equipment.

5. Print Holder. Provide a plastic envelope in each cabinet to hold prints. Attach the envelope to the inside of the cabinet door.
6. **Shape.** Design the cabinet with a slope on the top to prevent the accumulation of snow and water along its top surface.

7. **Door.** Provide a door that is a minimum of 80 percent of the front surface area of the cabinet. Double flange the cabinet door opening on all sides. Provide a door restraint that is capable of locking at the 135 degree position. Furnish a door gasket that forms a weather tight seal between the cabinet and the door.

8. **Locking.** Provide a provision for padlocking the cabinet when the door is closed. Design all cabinets to be tamper proof.

9. **Circuit Breakers.** Supply circuit breakers that are rated at 277 VAC, magnetic hydraulic trip free, UL listed and of the ampere rating as required by the connected load. If there are multiple breakers in the cabinet, label each breaker to identify the equipment being fed by the circuit. Submit all proposed labeling to the Engineer for approval.

10. **Duplex Receptacle.** Install one ground fault interrupter duplex receptacle that is 15 Amp, 120 VAC and a NEMA 5-15R.

11. **Lighting.** Mount a fluorescent fixture inside the top front portion of the transmitter cabinet. Install a door-activated switch to turn the cabinet light on when the front door is opened.

4. **Construction.** For equipment design and construction, utilize the latest available techniques with a minimum number of parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality.

   A. Furnish all electronic components in compliance with Special Specification, “Electronic Components”.

   B. For all external screws, nuts, and locking washers, use stainless steel. No self-tapping screws are allowed unless specifically approved by the Engineer.

   C. Fabricate all parts of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.

   D. Protect all materials used in construction from fungus growth and moisture deterioration.

   E. Separate all dissimilar metals by an inert dielectric material.


6. **Measurement.** This Item will be measured as each unit, complete in place.

7. **Payment.** The work performed and material furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for
“Microwave Vehicle Detection Assembly”, “Equipment Cabinet (MVD) (Pole Mount)”, “Solar Power Assembly”, and “Solar Power Assembly Batteries”. This price is full compensation for furnishing and installing detector units; conductor cable; traffic management system interface and cabling materials; testing; and materials, equipment, labor, tools, and incidentals.