Special Specification 6025
Radar Presence Detection Device

1.   DESCRIPTION

Furnish and install radar presence detection devices (RPDD) as shown on the plans.

The RPDD must continuously detect stationary vehicles, including motorcycles.

An RPDD detects vehicles by transmitting electromagnetic radar signals through the air. The signals bounce off vehicles in their paths and part of the signal is returned to the RPDD. The returned signals are then processed to determine traffic parameters.

2.   MATERIALS

2.1.   **General Requirements.**

2.1.1.   **Sensor Outputs**. The RPDD shall transmit real-time presence data from up to 10 lanes, depending on mounting location and lane widths.

The RPDD shall support a minimum of eight detection zones.

The RPDD shall support a minimum of eight detector channel outputs and have user-selectable channel assignments.

The RPDD shall use 'OR' or 'AND' logic gates to map a single zone to multiple channel outputs, and shall have channel output extend and delay functionality.

The RPDD algorithms shall mitigate detections from wrong-way or cross traffic.

The RPDD system shall have fail-safe mode capabilities for contact closure outputs if communication is lost. Contact closure will occur on all programmed detector channels associated with the interface module when the fail safe is triggered and will remain in this state until communication is re-established between the interface module and the radar vehicle sensor.

2.2.   **Detectable Area**.

2.2.1.   **Detection Range**. The RPDD shall be able to detect and report presence in lanes with boundaries as close as 6 ft. (1.8 m) from the base of the pole on which the RPDD is mounted. The RPDD shall be able to detect and report presence in lanes located within the 140 ft. (42.7 m) arc from the base of the pole on which the RPDD is mounted.

2.2.2.   **Field of View**. The RPDD shall be able to detect and report presence for vehicles within a 90 degree field of view.

2.2.3.   **Lane Configuration**. The RPDD shall be able to detect and report presence in up to 10 lanes.

The RPDD shall be able to detect and report presence in curved lanes and areas with islands and medians.

2.3.   **System Hardware**. Unless otherwise shown in the plans, use one RPDD corner radar per approach to be detected.

2.3.1.   **Preassembled Backplate**. Each RPDD shall have a traffic cabinet preassembled backplate with the following:

- AC/DC power conversion
- Surge protection (Lightning and surge protection will be provided for power connections and communications links to the radar RVDS meeting or exceeding EN 61000-4-5 class specifications.)
- Terminal blocks for cable landing
- Communication connection points

The preassembled backplate for the RPDD shall be a cabinet side mount or rack mount.

2.3.2.   **Contact Closure Input File Cards**. The RPDD shall use contact closure input file cards with 2 or 4 channel capabilities.

The contact closure input file cards for the RPDD shall be compatible with industry standard detector racks.

2.3.3.   **Cabling**. The cable end connector shall meet the MIL-C-26482 specification and shall be designed to interface with the appropriate MIL-C-26482 connector. The connector backshell shall be an environmentally sealed shell that offers excellent immersion capability. All conductors that interface with the connector shall be encased in a single jacket, and the outer diameter (O.D.) of this jacket shall be within the backshell's cable O.D. range to ensure proper sealing. The backshell shall have a strain relief with enough strength to support the cable slack under extreme weather conditions. The cable shall conform to the following specifications:

- The RS-485 conductors shall be a twisted pair.
- The RS-485 conductors shall have nominal capacitance conductor to conductor of less than 71pF/Ft at 1 Khz.
- The RS-485 conductors shall have nominal conductor DC resistance of less than 16.5 ohms/(304.8 m) at 68°F (20°C).
- The power conductors shall be one twisted pair with nominal conductor DC resistance of less than 11.5 ohms/(304.8 m) at 68°F (20°C).
- Each wire bundle or the entire cable shall be shielded with an aluminum/mylar shield with a drain wire.
- The wire shall be a single continuous home-run cable with no splices allowed and terminated only in the junction box provided by the manufacturer and in the traffic signal cabinet at the other end.

The cable O.D. shall not exceed 0.4 inches.

The cable length shall not exceed 2000 ft (609.6 m) for the operational baud rate of RS-485 communications (9.6 Kbps).

If 12 VDC is being supplied for the RPDD then the cable length shall not exceed 90 ft. (27.4 m).

If 24 VDC is being supplied for the RPDD then the cable length shall not exceed 500 ft. (182.9 m).

Both communication and power conductors can be bundled together in the same cable as long as the above-mentioned conditions are met.

2.4.   **Radar Design**. The RPDD shall be designed with a matrix of radars.

2.4.1.   **Frequency Stability**. The circuitry shall be void of any manual tuning elements that could lead to human error and degraded performance over time.

All transmit modulated signals shall be generated by means of digital circuitry, such as a direct digital synthesizer, that is referenced to a frequency source that is at least 50 parts per million (ppm) stable over the specified temperature range, and ages less than 6 ppm per year. Any upconversion of a digitally generated

modulated signal shall preserve the phase stability and frequency stability inherent in the digitally generated signal.

The RPDD shall not rely on temperature compensation circuitry to maintain transmit frequency stability.

The bandwidth of the transmit signal of the RPDD shall not vary by more than 1% under all specified operating conditions and over the expected life of the RPDD.

2.4.2.   **Antenna Design**. The RPDD antennas shall be designed on printed circuit boards.

The vertical beam width of the RPDD at the 6dB points of the two-way pattern shall be 65 degrees or greater.

The antennas shall cover a 90 degree horizontal field of view.

The sidelobes in the RPDD two-way antenna pattern shall be -40dB or less.

2.4.3.   **Resolution**. The RPDD shall transmit a signal with a bandwidth of at least 245 MHz, which provides for a resolution of 2 feet.

2.4.4.   **RF Channels**. The RPDD shall provide at least 8 RF channels so that multiple units can be mounted in the same vicinity without causing interference between them.

2.4.5.   **Verification**. The RPDD shall have a self-test that is used to verify correct hardware functionality.

The RPDD shall have a diagnostics mode to verify correct system functionality.

2.5.   **Physical Properties**. The RPDD shall not exceed 4.2 lbs. (1.9 kg) in weight.

The RPDD shall not exceed 13.2 in. by 10.6 in. by 3.3 in. (33.5 cm x 26.9 cm x 8.4 cm) in its physical dimensions.

All external parts of the RPDD shall be ultraviolet-resistant, corrosion-resistant, and protected from fungus growth and moisture deterioration.

2.5.1.   **Enclosure**. The RPDD shall be enclosed in a Lexan, Makrolon, or other approved polycarbonate material.

The enclosure shall be classified "f1" outdoor weatherability in accordance with UL 746C.

The RPDD shall be classified as watertight according to the NEMA 250 Standard.

The RPDD enclosure shall conform to test criteria set forth in the NEMA 250 standard for type 4X enclosures. Test results shall be provided for each of the following type 4X criteria:
- External Icing (NEMA 250 clause 5.6)
- Hose-down (NEMA 250 clause 5.7)
- 4X Corrosion Protection (NEMA 250 clause 5.10)
- Gasket (NEMA 250 clause 5.14)

The RPDD shall be able to withstand a drop of up to 5 ft. (1.5 m) without compromising its functional and structural integrity.

The RPDD enclosure shall include a connector that meets the MIL-C-26482 specification. The MIL-C-26482 connector shall provide contacts for all data and power connections.

2.6.   **Power**. The RPDD shall consume less than 10 W.

The RPDD shall operate with a DC input between 9 VDC and 28 VDC.

2.7. **Communication Ports**. The RPDD shall have two communication ports, and both ports shall communicate independently and simultaneously.

The RPDD shall support the upload of new firmware into the RPDD's non-volatile memory over either communication port.

The RPDD shall support the user configuration of the following:
■ Response delay
■ Push port

The communication ports shall support at least a 9600 bps baud rate.

3. CONSTRUCTION

3.1. **Manufacturing**. The internal electronics of the RPDD shall utilize automation for surface mount assembly, and shall comply with the requirements set forth in IPC-A-610C Class 2, Acceptability of Electronic Assemblies.

The RPDD shall undergo a rigorous sequence of operational testing to ensure product functionality and reliability. Testing shall include the following:
■ Functionality testing of all internal sub-assemblies
■ Unit level burn-in testing of duration 48 hours or greater
■ Final unit functionality testing prior to shipment

Test results and all associated data for the above testing shall be provided for each purchased RPDD by serial number, upon request.

3.2. **Configuration**.

3.2.1. **Auto-Configuration**. The RPDD shall have a method for automatically defining traffic lanes, stop bars and zones without requiring user intervention. This auto-configuration process shall execute on a processor internal to the RPDD and shall not require an external PC or other processor.

The auto-configuration process shall work under normal intersection operation and traffic conditions and may require up to ten vehicles to pass through each lane to complete.

3.2.2. **Manual Configuration**. The auto-configuration method shall not prohibit the ability of the user to manually adjust the RPDD configuration.

The RPDD shall support the configuring of lanes, stop bars and detection zones in 1-ft. (0.3-m) increments.

3.2.3. **Windows Mobile®-Based Software**. The RPDD shall include graphical user interface software that displays all configured lanes and the current traffic pattern using a graphical traffic representation.

The graphical interface shall operate on Windows Mobile, Windows XP and Windows Vista in the .NET framework.

The software shall support the following functionality:
■ Operate over a TCP/IP connection
■ Give the operator the ability to save/back up the RPDD configuration to a file or load/restore the RPDD configuration from a file
■ Allow the backed-up sensor configurations to be viewed and edited

- Provide zone and channel actuation display
- Provide a virtual connection option so that the software can be used without connecting to an actual sensor
- Local or remote sensor firmware upgradability

3.3.   **Operating Conditions**. The RPDD shall maintain 95% accuracy of performance in all weather conditions, including rain, freezing rain, snow, wind, dust, fog and changes in temperature and light, including direct light on sensor at dawn and dusk.

The RPDD shall be capable of continuous operation over an ambient temperature range of -40°F to 165.2°F (-40°C to 74°C).

The RPDD shall be capable of continuous operation over a relative humidity range of 5% to 95% (noncondensing).

3.4.   **Testing**.

3.4.1.   **FCC**. Each RPDD shall be Federal Communications Commission (FCC) certified under CFR 47, Part 15, section 15.249 as an intentional radiator.

The FCC certification shall be displayed on an external label on each RPDD according to the rules set forth by the FCC.

The RPDD shall comply with FCC regulations under all specified operating conditions and over the expected life of the RPDD.

3.4.2.   **NEMA TS2-2003 Testing**. The RPDD shall comply with the applicable standards stated in the NEMA TS2-2003 Standard. Third party test results shall be made available for each of the following tests:

- Shock pulses of 10g, 10 ms half sine wave
- Vibration of 0.5 Grms up to 30 Hz
- 300 V positive/negative pulses applied at one pulse per second at minimum and maximum DC supply voltage
- Cold temperature storage at -49°F (-45°C) for 24 hours
- High temperature storage at 185°F (85°C) for 24 hours
- Low temp, low DC supply voltage at -29.2°F (-34°C) and 10.8 VDC
- Low temp, high DC supply voltage at -29.2°F (-34°C) and 26.5 VDC
- High temp, high DC supply voltage at 165.2°F (74°C) and 26.5 VDC
- High temp, low DC supply voltage at 165.2°F (74°C) and 10.8 VDC

3.5.   **Support**. The RPDD manufacturer shall provide both training and technical support services.

3.5.1.   **Training**. The manufacturer-provided training shall be sufficient to fully train installers and operators in the installation, configuration, and use of the RPDD to ensure accurate RPDD performance.

The manufacturer-provided training shall consist of comprehensive classroom labs and hands-on, in-the-field, installation and configuration training.

Classroom lab training shall involve presentations outlining and defining the RPDD, its functions, and the procedures for proper operation. These presentations shall be followed by hands-on labs in which trainees shall practice using the equipment to calibrate and configure a virtual RPDD. To facilitate the classroom presentation and hands-on labs, the manufacturer-provided training shall include the following items:

- Knowledgeable trainer or trainers thoroughly familiar with the RPDD and its processes.
- Presentation materials, including visual aids, printed manuals and other handout materials for each student.

■ Computer files, including video and raw data, to facilitate the virtual configuration of the RPDD.

■ Laptop computers or Windows CE handheld devices with the necessary software, and all necessary cables, connectors, etc.

■ All other equipment necessary to facilitate the virtual configuration of the RPDD.

Field training shall provide each trainee with the hands-on opportunity to install and configure the RPDD at roadside. Training shall be such that each trainee will mount and align the RPDD correctly.

3.5.2. **Technical Assistance**. Manufacturer-provided technical support shall be available according to contractual agreements, and a technical representative shall be available to assist with the physical installation, alignment, and auto-configuration of each supplied RPDD. Technical support shall be provided thereafter to assist with troubleshooting, maintenance, or replacement of RPDDs should such services be required. During the warranty period, technical support shall be available from the supplier via telephone within 4 hours of the time a call is made by a user, and this support shall be available from factory certified personnel or factory certified installers. Ongoing software support by the supplier shall include firmware updates for the RPDD processor unit and external software needed to set-up and operate the RPDD system. These updates shall be provided free of charge during the warranty period. The update of the RPDD software shall be tested and approved by the engineer before installation.

3.6. **Documentation**. RPDD documentation shall include an instructional training guide and a comprehensive user guide as well as an installer quick-reference guide and a user quick-reference guide.

The RPDD manufacturer shall supply the following documentation and test results at the time of the bid submittal:

■ FCC CFR 47 certification (frequency compliance)

■ IED 6100-4-5 class 4 test report (surge)

4. WARRANTY

The RPDD system will be warranted to be free from material and workmanship defects for a period of five (5) years from the date of installation. During the warranty period, the supplier shall repair with new or refurbished materials, or replace at no charge, any product containing a warranty defect or fails to operate properly after installation provided the product is returned FOB to the supplier's factory or authorized repair site. Product repair or replaced under warranty by the supplier will be returned with transportation prepaid

5. MEASUREMENT

The radar presence detector will be measured as each detector furnished, installed, and made fully operational.

The radar presence detector communication cable will be measured by the linear foot of cable furnished installed and made fully operational.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for under the unit bid price for "Radar Presence Detector" or "Radar Presence Detector Communication Cable." This is full price for furnishing, installing, and establishing a connection to each RPDD. Any tools or incidentals needed to accomplish this will not be paid for separately, but will be considered subsidiary to this bid Item.