

**CITY OF SAN ANTONIO, TEXAS
GOVERNING SPECIFICATIONS**

All City of San Antonio Standard Specifications for Construction, 2008 edition, and Special Specifications applicable to this project are identified as follows:

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ITEM 689

RECTANGULAR RAPID FLASHING BEACONS (RRFB)

689.1. Description. Furnish and install solar powered Rectangular Rapid Flashing Beacons (RRFB), as directed by the Engineer, in accordance with all plans and specifications.

689.2. Materials. Furnish new materials in accordance with the following requirements:

A. Cabinet. Unless otherwise approved by the Engineer, provide cabinets manufactured of 0.125" sheet aluminum. The nominal outside dimensions of each cabinet must be 14 inches wide by 16 inches high by 12 inches deep with the door closed. All dimensions may be plus or minus 3 inches. Provide a one (1) compartment type cabinet with a neoprene gasket seal for a weather seal. Provide wire screened insect proof louvers on each side for ventilation. Provide louvers that are designed to not allow any rain to enter the cabinet. Provide two screened insect proof drain holes on the bottom of the cabinet. The door must be a single unit with a continuous piano hinge riveted to the door and the cabinet. The door must incorporate a neoprene gasket which, when closed, forms a snug weather tight seal. Unless approved otherwise, the door lock shall be a standard police lock, reinforced with a steel plate. Provide a minimum of one brass key with each cabinet. The keyhole shall have a metal keyhole cover, to prevent the entry of water and dust and allow easy access.

Equip each cabinet with the necessary rigid mounts for a 4 inch ID pole with a 4.5 inch OD pole clamp. All necessary hardware for proper mounting shall be included. Provide a wiring diagram and schematics for the cabinet assembly.

B. Control Panel. Provide a control panel containing the electronics (circuit breaker, surge protection device, flasher, and a 120 VAC to 12 VDC power supply) mounted in the cabinet using bolts. Design the control panel for quick and easy removal. The back panel and flashing beacons must be connected through a main wiring harness via a circular pin connector (CPC) or other approved method. All modular components must be connected in such a manner that they are easily removed for replacement or maintenance.

1. Circuit Breaker. Provide a single pole thermal circuit breaker installed on the "line" or service side of the cabinet. The circuit breaker must be rated for 20 Amps at 120 Volts AC. The breaker must be a Square "D" QUO 150 Series, GE THQC 1150L, Westinghouse QC1050, or equivalent.

2. Flasher. The flasher must be solid state, 2 circuit device which controls the flashing sequence of the beacon. It must be capable of operating at up to 40 Watts per circuit over a range of 11.4 VDC to 30 VDC. The flasher must provide the flash rate as required below. The flasher will be capable of operating in a temperature range of -30 degrees F and +165 degrees F.

3. Surge Protection Device. Unless approved otherwise, provide a suitable surge protection device (SPD) capable of protecting up to 120 VAC, 60 amp service, have no follow current, respond in 5 nanoseconds, and will allow automatic recovery. The SPD must have a

minimum peak surge current rated for 10kA/mode/phase total. (Example: Edco SPA-100T, Hesco HE100.) The surge arrester will be of a size adequate to fit the enclosure. It will operate from -30° F to +165° F.

4. **Countdown Timer.** Provide either a countdown timer with a time delay relay adjustable from 1 second to 100 hours, or provide a system that provides the countdown timer function required for proper operations. The time delay relay (or function) will operate from -30°C to +60°C.
5. **Wireless Communications.** RRFB must be capable of operating hardwired or through wireless communications. When wireless communications are required, all associated units (i.e. on the opposite sides of the road as well as the unit in the median (when included) will communicate wirelessly. The radio transmitter and receiver will use an unlicensed frequency. The wireless communication system will work to ensure that the lights will flash for a period that will allow pedestrians to safely cross the street. The amount of time will be determined by the engineer. The initiation of the signal for the flashers to commence flashing will be by pedestrian push button. Each time a pedestrian pushes a button, the countdown timers will reset to the preset count down time; thus allowing the beacons to flash for a full cycle for this pedestrian. The radio will consist of a frequency hopping spread spectrum transceivers operating in the non-licensed 900 MHZ frequency range and at a maximum 1 watt transmit power in accordance with Part 15.247 FCC rules. The radio will operate with an input of 10-30 VDC and from -30 degrees F to + 140 degrees F.
6. **Hardwired Systems.** When required by the plans, the system must be capable of operation using one cabinet mounted at a location shown on the plans. Conductor for the 12 VDC circuits to the RRFB's and pushbutton detector must be as required in the plans.

C. Rectangular Rapid Flashing Beacon (RRFB) Light Bar. The RRFB must comply with FHWA Interim Approval Memorandum dated July 16, 2008. The light bar will contain a minimum of three rectangular rapid flashing beacon indications, 1 on each side, and 1 rectangular rapid flashing beacon on the end that is visible to pedestrians in the cross walk per direction. Each of the two yellow indications of an RRFB shall have 70 to 80 periods of flashing per minute and must have alternating, but approximately equal, periods of flashing light emissions and dark operation. "During each of its 70 to 80 flashing periods per minute, the yellow indications on the left side of the RRFB shall emit two slow pulses of light after which the yellow indications on the right side of the RRFB must emit four rapid pulses of light followed by a long pulse" as specified by the FHWA. The beacons as a minimum must be approximately 5 inches wide x 2 inches high. The light bar must provide an additional side mounted LED array on the end facing the pedestrian crosswalk. The light bar will operate with an input of 10-14 VDC.

The LEDs used in the light bar must meet the SAE J595 requirement for peak luminous intensity (candelas) for Class 1 over the 10 -14 VDC range. The vendor must submit third party certification that the LEDs have been tested and certified as Class 1.

The RRFB light bar will be assembled and wired as a unit. It will consist of a mounting bracket, a bottom shell that attaches to the mounting bracket, and a housing unit. The housing may consist of a top shell that attaches to the bottom shell. Mount the housing to the pole with U-bolts.

D. Pole and Base. Unless specified otherwise, the pole will be a schedule 40 spun aluminum 4" ID (4.5" OD) x 16' H. Provide a pole cap with the pole. Provide a pedestal pole base in accordance with DMS-11140, "Pedestal Pole Base". If available with the base provided include

a pole collar assembly. Provide pedestal pole bases from manufacturers prequalified by the department.

- E. Sign.** Up to two (2) sets of signs will be supplied with each pole. Unless required otherwise, each set of signs will include (1) W11-2 pedestrian sign (30 inch X 30 inch or 36 inch X 36 inch as required) and (1) W16-7p arrow placard (24 inch X 12 inch or 30 inch X 18 inch as required). A W11-15 bicycle/pedestrian sign (30 inch X 30 inch or 36 inch X 36 inch as required) or an S1-1 school Xing sign (30 inch X 30 inch or 36 inch X 36 inch as required) can be substituted at discretion of engineer. Provide sign sheeting as required on the plans. Sign mounting hardware for the signs will be included. Advance warning signs are included only when LED's are included in the sign face as specified on the Plans or by the Engineer. If LED's are included in the Advance Sign sign face, the flash period for the Advance Sign shall be based on the flash time for the RRFB light bar. This means that the flash will either be simultaneous, or through advance features, the flash period for the Advance Sign will be programmable to correspond with the RRFB light bar. Otherwise, Advance Warning Signs per Item 531 "Signs" will be furnished along with appropriate mounting hardware.
- F. Pedestrian Push Button.** Mount a pedestrian push button on the pole to activate the flashing beacons. The button will be an ADA compliant push button with the plaque on the push button reading "PUSH BUTTON TO TURN ON WARNING LIGHTS".
- G. Drilled Shaft.** Unless specified otherwise, the drilled shaft foundation will be 24" and follow the TxDOT TS-FD Standard and the City of San Antonio standard specification 656 "Foundations for Traffic Control Devices".
- H. Electrical Conductors.** Item 620 "Electrical Conductors"
- I. Traffic Signal Cables.** Item 684 "Traffic Signal Cables"

689.3. Construction.

- A. Fabrication.** Provide poles and bases in accordance with Item 687, "Pedestal Pole Assemblies." Provide mild steel anchor bolts in accordance with Item 449, "Anchor Bolts." Use galvanized bolts, nuts, and washers.
- B. Galvanizing.** Galvanize all fabricated parts in accordance with Item 445, "Galvanizing." Repair galvanizing for any steel part or member damaged in assembly, transit, or erection, or for any steel part or member welded after galvanizing, in accordance with Item 445.3.D, "Repairs."
- C. Installation.** Install foundations in accordance with Item 656, "Foundations for Traffic Control Devices." Unless otherwise shown on the plans, stake the assembly locations for verification by the Engineer.

Install pole, breakaway base, connectors, wiring, signal beacons, sign, and foundation as shown on the plans or as directed. Install the flasher controller assembly as shown on the plans. Install watertight breakaway electrical fuse holders in all line and neutral conductors at the breakaway base. Use established industry and utility safety practices to erect assemblies near overhead or underground utilities. Consult with the appropriate utility company prior to beginning such work.

D. Electrical Requirements.

- 1. Electrical Services.** Make arrangements for electrical services and install and supply materials not provided by the utility company as shown on the plans. Unless otherwise shown on the plans, install 120-volt, single-phase, 60-Hz AC electrical service.
- 2. Conduit.** Install conduit and fittings of the sizes and types as shown on the plans. Conduit of larger size than that shown on the plans may be used with no additional compensation, providing that the same size is used for the entire length of the conduit run. Extend conduit in concrete foundations 2 to 3 in. above the concrete. Seal the ends of each conduit with silicone caulking or other approved sealant after all cables and conductors are installed.
- 3. Wiring.** Unless otherwise shown on the plans, furnish stranded No. 12 AWG XHHW conductors. Install above-ground cables and conductors in rigid metal conduit, except for span wire suspended cables and conductors, drip loops, and electrical wiring inside signal poles. Make power entrances to the flasher cabinet assembly through underground conduit. Wire each installation as shown on the plans and as required for proper operation.

Attach ends of wires to properly sized self-insulated solderless terminals. Attach terminals to the wires with a ratchet-type compression crimping tool properly sized to the wire. Place pre-numbered identification tags of plastic or tape around each wire adjacent to wire ends in the cabinet assembly, RRFB light bars, and pedestrian push button terminals.

Splices will not be permitted except as shown on the plans, unless the Engineer approves each individual splice in writing. Make all allowed splices watertight.

- 4. Grounding and Bonding.** Ground and bond conductors in accordance with the NEC. Ensure the resistance from the grounded point of any equipment to the nearest ground rod is less than 1 ohm.

E. Preservation of Sod, Shrubbery, and Trees. Replace sod, shrubbery, and trees damaged during the Contract.

F. Removal and Replacement of Curbs and Walks. Obtain approval from the Engineer before cutting into or removing walks or curbs not shown on the plans to be removed or replaced. Restore any curbs or walks removed equivalent to original condition after work is completed, to the satisfaction of the Engineer.

G. Test Period. Operate completed RRFB installations continuously for at least 30-days in a satisfactory manner. If any Contractor-furnished equipment fails during the 30-day test period, repair or replace that equipment. This repair or replacement will start a new 30-day test period. Replace materials that are damaged or have failed prior to acceptance. Replace failed or damaged existing system components when caused by the Contractor. The Department will relieve the Contractor of maintenance responsibilities upon passing a 30-day performance test of the RRFB system and acceptance of the contract.

689.4. Measurement. This Item will be measured by each rectangular rapid flashing beacon installed.

689.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Installation of Rectangular Rapid Flashing Beacons,” of the type specified:

- Single sided RRFB
- Back-to-Back RRFB

Advance warning signs shall be paid for either as a warning sign, per Specification 531 “SIGNS” ..., for plain warning signs. 531 Bid Items for W11-2 or W11-15 or S1-1 will be paid for as specific bid items or under Item 531.59 “Special Sign.” When Advance Warning Signs with LED’s in the Sign Face are specified by the Plans or Engineer, they will be paid for as:

- Advance Warning Signs w/ LED’s in Sign Face, these signs can be W11-2, W11-15, or S1-1, as specified on the Plans or by the Engineer.

This price is full compensation for furnishing, installing and testing the completed installation, including complete control cabinet(s) with associated equipment, pedestrian push buttons, rectangular rapid flashing beacon light bar(s), pedestal poles, solar panels, cabling, transformer bases, mounting hardware; preservation and replacement of damaged sod, shrubbery and trees; removal and replacement of curbs and walks; equipment, labor, tools and incidentals.

689.6. BID ITEM:

Item 689.1 – Install Rectangular Rapid Flashing Beacon Assembly (single sided) – per each

Item 689.2 – Install Rectangular Rapid Flashing Beacon Assembly (back to back) – per each

ITEM 696

RADAR VEHICLE DETECTION DEVICES (RVDD)

696.1. DESCRIPTION: *Furnish and install Radar Vehicle Detection Devices (RVDD), including: Radar Advance Detection Devices (RADD) and/or Radar Presence Detection Devices (RPDD) to detect vehicles on a roadway via processing of radar electromagnetic waves and provides detector outputs to a traffic signal controller or similar device.*

696.2. DEFINITIONS

- A. RADAR:** Radio detection and ranging. High frequency electromagnetic energy waves used to detect, identify, and determine the range, direction, and/or speed of an object such as a motor vehicle.
- B. Radar Vehicle Detection Device (RVDD):** Device that emits electromagnetic waves and senses return waves from passing and/or approaching vehicles. The RVDD shall be spatially monostatic; the transmitter and receiver shall be located on the same sensor device.
- C. Radar Advance Detection Device (RADD):** Device that accurately and continuously detects, tracks, and identifies speed of approaching vehicles simultaneously to an intersection in the selected direction of travel. The RADD is capable of detection as described in section 696.3.A. The RADD shall maintain detection of a vehicle moving within 100 ft. to 500 ft. from the device as programmed by the user.
- D. Radar Presence Detection Device (RPDD):** Device that accurately and continuously detects and tracks approaching vehicles simultaneously to an intersection in the selected direction of travel. The RPDD is capable of true presence detection as described in section 696.3.B. The RPDD shall maintain detection of a vehicle moving or stopped within a programmed detection zone set up by the user.
- E. Interface Module:** Device that interfaces with the cabinet detector rack allowing for contact closure to occur on a selected detector channel.
- F. Communications Link:** The communications connection between the RVDD processor unit and a local area network (LAN) or laptop computer.
- G. Detection Accuracy:** The measure of the basic operation of a detection system (shows detection when a vehicle is in the detection zone and shows no detection when there is not a vehicle in the detection zone).
- H. Passage Detection:** The ability of a vehicle detector to detect the passage of a vehicle moving through the zone of detection and to ignore the presence of a vehicle stopped within the zone of detection.
- I. Presence Detection:** The ability of a vehicle detector to sense that a vehicle, whether moving or stopped, has appeared in its zone of detection.
- J. Delay Timing:** When selected, applies delayed contact closure to the associated detector channel input. When a vehicle is detected by the RVDS, the delay timing must time out before contact closure is removed from the associated detector channel.

- K. Extension Timing:** When selected, applies additional contact closure to the associated detector channel input. When a vehicle is no longer detected within a detection zone, extension timing must time out before contact closure is removed from the associated detector channel.

696.3. FUNCTIONAL CAPABILITIES

A. Radar Advance Detection Device (RADD) Capabilities and Requirements

1. The RADD shall provide passage detection and contact closure to the interface module for vehicles approaching the intersection (the unit).
2. The RADD shall provide vehicle detection, tracking, and speed of moving vehicles approaching an intersection at a range of 100 feet to 500 feet from the radar sensor.
3. The RADD system software shall be capable of creating multiple detection zones within the detection range and applying conditional logic to the detection zones, allowing contact closure to occur only when logic conditions are achieved by the RADD. The user shall be able to apply logic gating such as: “and”, “or” to a detection zone from the software GUI provided with the system. Conditional logic programming will allow the user to control when contact closure occurs to the detector rack interface module.
4. The RADD system software shall be capable of minimum and maximum speed settings to create a desired speed range for contact closure to the detector channel. Vehicles detected within the minimum and maximum speed settings will apply contact closure to the assigned detector channel input.
5. Detection accuracy will be determined by the detection of any moving vehicle or cluster of vehicles within a defined detection zone and within the minimum and maximum speed parameters programmed for the detection zone. With four (4) detection zones programmed, each zone 100 feet in length, a minimum of 95% detection accuracy shall be required for each zone. Detection zones will be set up between 100 feet and 500 feet. Conditional logic for each zone shall be set up in the “or” gate position allowing for contact closure to occur when vehicle speed conditions are met in the detection zone.
6. The RADD shall be capable of delay timing as defined in 696.2.J of this specification. As a minimum the user shall be able to program and select extension timing from 0-25 seconds in one/tenth (0.1) second increments from the GUI provided with the RVDS system.
7. The RADD shall be capable of extension timing as defined in 696.2.K of this specification. As a minimum the user shall be able to program and select extension timing from 0-25 seconds in one/tenth (0.1) second increments from the GUI provided with the RADD system.
8. The RADD shall be capable of adjusting the extension time automatically based on speed of a moving vehicle.

B. Radar Presence Detection Device (RPDD) Functional Capabilities and Requirements

1. The RPDD shall provide presence detection and contact closure to the interface module for vehicles approaching an intersection. Presence detection shall operate as defined in 696.2.I of this specification.
2. The RPDD shall, as a minimum detect vehicles within a 100 feet, 90 degree cone of detection from the sensor. Stop bar radar units shall be able to detect vehicles in 10 lanes of detection. The number of lanes used and detection zones shall be set up and selected from the GUI.
3. The RPDD shall be able to assign up to 4 detector outputs per unit and capable of using 2 or 4 channel interface modules to the detector rack.
4. The RPDD shall be able to distinguish and omit wrong way traffic from activating an assigned detector output.
5. The RPDD shall as a minimum, maintain a detection accuracy of 95% for each detection zone set-up on the GUI.

696.4. MATERIALS: Provide components necessary for RVDD installation. A RVDD shall consist of the following components: Radar sensor (1), detector rack interface module (1), power and surge protection panel or module (1), and all associated equipment required to set up and operate in a field environment including software, serial and Ethernet communications ports, cabling, electrical connectors, and mounting hardware.

A. RVDD Interface Module

1. The RVDD interface module must comply and operate with NEMA TS-2 Type 1 detector rack or Type 170/2070 input file.
2. The RADD shall be capable of 16 contact closure inputs to the detector rack. The user shall be able to assign each contact closure to an associated detector channel. The contact closure shall occur through the interface modules or controller module plugged into the rack.
3. All components of the RVDD housed in the controller cabinet shall be rated to operate in a temperature range from -34°C to +74°C (-30°F to +165°F) at 0 percent to 95 percent relative humidity, non-condensing.
4. The RVDD shall provide a “fail safe” operation that triggers when communication between the radar vehicle sensor and the interface module is broken. 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 reestablished between the interface module and the radar vehicle sensor.
5. The RVDD shall be capable of either “pulse mode” or “presence mode” operation. In the pulse mode, when a vehicle is detected and conditional logic is satisfied, contact closure will occur for approximately 125 ms. In the presence mode, contact closure will occur for as long as a vehicle is detected and conditional logic programming is satisfied.

B. RVDD Sensor

1. The RVDD shall be able to operate in all types of weather conditions including: rain, snow, sleet, ice, fog, and wind blown dust. The RVDD shall be able to operate normally and with no degraded performance when the radar vehicle sensor is encased in a 1/2 inch ice.
2. The RVDD shall be rated to operate in a temperature range from -34°C to 60°C (-30°F to 140°F) at 0 percent to 95 percent relative humidity.
3. The RVDD shall comply with all applicable Federal Communications Commission (FCC) requirements. The manufacturer will provide documentation of compliance with FCC specifications. Each RVDD will be FCC certified under CFR 47, Part 15, Section 15.245 as a field disturbance sensor or Section 15.249 as an intentional radiator. This certification will be displayed on an external label on each device according to the rules set forth by the FCC.
4. The RVDD shall maintain frequency stability without the use of manual tuning elements by the user.

C. Power and Surge Protection

1. Lightning and surge protection will be provided for power connections and communications links to the RVDD meeting or exceeding EN 61000-4-5 class specifications.

D. Software and Communication Requirements

1. The RVDD system software shall utilize a GUI that runs in a Microsoft Windows Mobile and Microsoft Windows XP environment or newer Microsoft operating system. The GUI shall graphically illustrate vehicle movement and directionality when detection is achieved by the RVDD. The software shall be capable of auto configuration upon set up of the RVDD.
2. Programmed parameters from the GUI to the sensor shall be stored in non-volatile memory devices such as Flash RAM or EEPROM within the sensor. The RVDD shall not rely on batter backup or the use of a super capacitor to retain memory.
3. The RVDD shall provide a RS232 serial communications link allowing the user to interface with a laptop computer and operate the GUI. The RS232 serial port shall be full duplex and will support true RTS/CTS hardware handshaking for interfacing to various communications devices.
4. The RVDD shall provide an Ethernet communications link allowing the user to interface the system and operate the GUI via a LAN and using TCP/IP protocol.
5. The RVDD firmware shall be upgradeable by external, local, or remote download via serial or Ethernet ports.
6. The serial and Ethernet communications ports as a minimum will support the following baud rates: 9600, 19200, 38400, 57600, and 115200. The user shall be able to select the desired baud rate from the GUI.
7. The operator shall be able to save configurations settings to a file or reload the configurations settings to the RVDD from a saved file using the GUI.
8. The RPDD software shall allow for a virtual connection option so that the software can be used without connecting to an actual sensor.

E. 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 back shell 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 of this jacket shall be within the back shell's cable O.D. range to ensure proper weather sealing. The back shell 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:

1. Radar Advance Detection Device (RADD) Cabling

- a. Shielded, twisted pairs with a drain wire
 - b. Nominal Capacitance Conductor to Conductor @ 1 KHz \leq 26 pF/Ft
 - c. Nominal Conductor DC resistance at 20°C (68°F) \leq 15 ohms/1000 Ft
 - d. Single continuous run with no splices allowed.
- If communication is conducted over the RS-485 bus, the communication cable can be terminated only at the two farthest ends of the cable and the operational baud rate and cable lengths shall not exceed the following limits:

Baud Rate*	Cable Length
115.2 Kbps	300 ft
57.6 Kbps	600 ft
38.4 Kbps	800 ft
19.2 Kbps	1000 ft
9.6 Kbps	2000 ft

**Note: These represent Maximum data rates. The data rate used should be the minimum data rate required for operation.*

- e. RVDS supplied shall use 24 VDC, the power cable shall meet the following specifications:
 - Two shielded, twisted pairs with two drain wires connected in parallel
 - Nominal capacitance conductor to conductor @ 1 KHz \leq 26 pF/Ft
 - Nominal conductor DC resistance @ 20°C (68°F) \leq 15 ohms/1000
 - The cable length shall not exceed 600 ft.
- f. If a cable length of 600 ft to 2,000 ft is required, the power cable shall meet the following specifications:
 - 10 AWG conductor size/gauge

- Two conductor count
- Stranded Cable Type
- Bare Copper Material
- 600 Volt Range
- 90°C Temperature Rating
- PVC/Nylon insulation material
- PVC jacketing material
- 40 Amps per conductor

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

2. Radar Presence Detection Device (RPDD) Cabling

- a. The RS-485 conductors shall be a twisted pair.
- b. The RS-485 conductors shall have nominal capacitance conductor to conductor of less than 71 pF/Ft at 1 KHz.
- c. The RS-485 conductors shall have nominal conductor DC resistance of less than 16.5 ohms/ (304.8 m) at 20°C (68°F).
- d. The power conductors shall be one twisted pair with nominal conductor DC resistance of less than 11.5 ohms/ (304.8 m) at 20°C (68°F).
- e. Each wire bundle or the entire cable shall be shielded with an aluminum/Mylar shield with a drain wire.
- f. The cable O.D. shall not exceed 0.4 inches.
- g. The cable length shall not exceed 2,000 ft (609.6 m) for the operational baud rate of RS-485 communications (9.6 Kbps).
- h. The RVDS shall use 24 VDC and the cable length shall not exceed 500 ft (182.9 m).
- i. Both communication and power conductors can be bundled together in the same cable as long as the above-mentioned conditions are met.

696.5. EQUIPMENT: Provide the machinery, tools, and equipment necessary for proper prosecution of the work. All machinery, tools, and equipment used shall be maintained in a satisfactory and workmanlike manner.

696.6. CONSTRUCTION: Install RVDD in accordance with the details shown on the plans and the requirements of this item

A. Manufacturing and Testing

1. The internal electronics of the RVDD shall utilize automation for the surface mount assembly. The RPDD shall comply with the requirements set forth in IPC-A-610C Class 2 and the RADD with the requirements in IPC-A-610C Class 3, Acceptability of Electronic Assemblies.
2. The RVDD shall undergo a rigorous sequence of operational testing to ensure product functionality and reliability. Testing shall include the following:
 - a. Functionality testing of all internal sub-assemblies
 - b. Unit level burn-in testing of duration 48 hours or greater
 - c. Final unit functionality testing prior to shipment.

B. Installation and Training

1. When requested by COSA personnel or purchasing agency, the supplier of the RVDD shall supervise the installation and testing of the radar equipment.
2. If requested by COSA personnel or purchasing agency, up to two days of training shall be provided to personnel of COSA in the operation, setup, and maintenance of the RVDD. Instruction and materials shall be provided for a maximum of 20 persons and shall be conducted at a location selected by COSA. COSA or purchasing agency shall be responsible for the cost of training.
3. Instruction personnel are required to be certified by the equipment manufacturer. The User's Guide is not an adequate substitute for practical, classroom training and formal certification by an approved agency.
4. Formal levels of factory authorized training are required for installers, contractors, and system operators. All training must be certified by the manufacturer.

C. Warranty, Maintenance, and Support

1. The RVDD shall be warranted to be free of defects in material and workmanship for a period of 5 years from date of shipment from the supplier's facility. 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. This warranty does not apply to products damaged by accident, improper operation, abuse, serviced by unauthorized personnel or unauthorized modification.
2. If a RVDD fails with no visible or physical damage to any electronic/electrical component of the system or its wiring, then the unit is considered to have failed under normal operating conditions. A blown fuse or surge protection device failure shall be considered to have failed under normal operating conditions. Acts-of-God will not be accepted as excusable unit failures of the RVDD system.

3. Repair or full replacement will be required if a RVDD fails to operate as specified under normal operating conditions. Repaired or replaced components of the RVDD will be provided at no cost to COSA. The replaced or repaired units will inherit the remainder of the failed unit's warranty.
4. 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.
5. Ongoing software support by the supplier shall include firmware updates for the RVDD processor unit and external software needed to set up and operate the RVDD system. These updates shall be provided free of charge during the warranty period. The update of the RVDD software shall be tested and approved by COSA before installation.
6. The supplier shall maintain a program for technical support and software updates following expiration of the warranty period. This program shall be made available to COSA in the form of a separate agreement for continuing support.
7. The supplier shall maintain an adequate inventory of parts to support maintenance and repair of the radar system.

696.7. MEASUREMENT: This item will be measured as each RADD or RPDD installed, tested, and made operational including the radar sensor, detector rack interface module, processor units, power and surge protection panel or module, software, serial and Ethernet communication ports, electrical connectors and mounting hardware.

The RVDD communication and power cable(s) will be measured by the linear foot of the cable type furnished (RADD or RPDD)

696.8. PAYMENT: The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for each item listed in Section 696.9, "Bid Items". These prices are full compensation for furnishing, placing, and testing all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages, supplies, support, personnel training, shop drawings, documentation, and incidentals. A power cable meeting the specifications outlined in Section 696.4 "Materials" shall be included with communication cable and is considered subsidiary to the price of the communication cables.

These prices also include any and all interfaces required for the field and remote communications links along with any associated peripheral equipment, including cables; all associated mounting hardware and associated field equipment; required for a complete and fully functional RVDD system.

696.9. BID ITEMS:

Item 696.01 - Radar Advance Detection Device (RADD) – per each

Item 696.02 - Radar Presence Detection Device (RPDD) – per each

Item 696.03 - Radar Advance Detection Device (RADD) Communication and Power Cable – per linear foot

Item 696.04 - Radar Presence Detection Device (RPDD) Communication and Power Cable – per linear foot

Item 696.12 - Install Radar Detection Device – per each

Item 696.14 - Install Radar Communications Cable – per linear foot

SPECIAL SPECIFICATION 633

BATTERY BACKUP SYSTEM FOR TRAFFIC SIGNAL

633.1. DESCRIPTION:

Furnish, fabricate, assemble or install a Battery Backup System (BBS) for traffic signal including rack mounted power inverters, battery charger, electronic controls, bypass switch, charging management system, battery cables and connectors; and all wiring, hardware and incidentals necessary to form a complete battery backup system including batteries and externally mounted battery case.

633.2. MATERIALS: Furnish new materials in accordance with these specifications, the details shown on the plans, and the following standards:

1. UL 1778 (Underwriter Laboratories) Standard for UPS Equipment.
2. CSA 22.2 (Canadian Standards Association - CUL Equipment).
3. IEC (International Electro-technical Commission) Semiconductor Converter Standards.
4. ISO 9001 Quality Assurance program.
5. IEEE 587, ANSI C62.41/C62.45 Category A&B for Lightning/Surge Protection.

A. General.

The BBS supplier shall provide and install the BBS and the associated components, to be utilized to provide emergency power for the traffic control systems, and associated equipment in the event of a utility power failure, or when the utility power is beyond the "normal" voltage and frequency parameters as programmed within the BBS. The BBS shall be a line-interactive type and provide voltage regulation and power conditioning when using utility power. The transfer from utility power to battery power, and vice versa, shall not interfere with the normal operation of the traffic controller, or any other peripheral devices within the traffic controller assembly. The BBS shall be equipped with a programmable front panel display to allow status of real time events occurring in the power system. The BBS shall be equipped with an RS-232 data port and an Ethernet SNMP interface that can be utilized for programming the flashing mode timer, monitoring the BBS system, and transferring status and event data to a laptop computer, or a remote central location. The BBS shall be equipped with dry contacts that can provide the following monitoring features: 1) Battery On, 2) Low Battery, 3) General alarm, to Indicate out of range line frequency, low output voltage, no temperature probe, overload, batteries not connected, high temperature, low temperature, and BBS failure. The BBS shall be fully compatible with incandescent and LED traffic signal control equipment, pedestrian signals, and camera systems. The BBS shall consist of a rectifier, batteries, solid-state inverter, and wrap around maintenance bypass switch/automatic transfer switch. The wrap around maintenance bypass switch shall allow the removal and replacement of the BBS module without disruption to the traffic signal control equipment. Supplier must have manufactured BBS systems for traffic control applications for 10 or more years.

B. System Description.

1. Components.

The BBS system shall consist of the following major equipment:

- a. BBS Module.
 - i. Insulated Gate Bipolar Transistor (IGBT) Inverter, or other technology to limit THD current and voltage to 3% or less.
 - ii. Diode Bridge + IGBT DC/DC Rectifier.

- iii. Digital Signal Processor (DSP) using Pulse Width Modulation (PWM)
- b. Battery system.
- c. Battery protective and disconnect device.
- d. Maintenance bypass switch/automatic transfer switch

2. Mode of Operation.

The BBS shall be designed to operate continuously at rated capacity as an on-line, automatic reverse transfer system in the following modes:

- a. **Normal.** The inverter continuously supplies AC power to the critical load. The rectifier converts a utility AC power source to regulated DC power which then serves as the inverter input and, simultaneously, as a float charge input to the storage battery. The BBS provides voltage regulation and power conditioning when using utility power.
- b. **Emergency.** In the event of a utility AC power failure, or over voltage, the inverter shall derive its input from the system battery, therefore providing uninterrupted power to the critical load. This transition shall be accomplished in 65 milliseconds or less. The BBS or external relay shall indicate loss of utility power and energize an external lamp mounted on the BBS cabinet.
- c. **Recharge.** Subsequent to restoration of utility AC power, the rectifier shall automatically reactivate and provide DC power to the inverter, simultaneously recharging the system battery. The automatic transfer switch will provide automatic switching from battery power to utility power. This occurs automatically and without interruption to the critical load, with a 65 millisecond or less re-transfer time.
- d. **Maintenance Bypass.** The BBS system shall be equipped with an external MBS to allow safe and reliable maintenance of the BBS. The maintenance bypass switch shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service per UL 1778, Section 48 "Back-feed protection Test". The upstream back feed voltage from the bypass switch shall be less than 1 volts AC for the protection of the traffic technician.
- e. **Return to Utility Power, Under voltage.** Upon restoration of utility power, the BBS shall return to the utility power source when the source voltage exceeds 105 volts for more than 30 seconds. Over voltage-The BBS shall return to utility power source when the utility power source has been restored to below 128 volts for more than 30 seconds. The time delay to initiate the return to utility power shall be field programmable from 3-10-30 and 50 seconds. Transition time from BBS back to utility shall be no more than 65 milliseconds.
- f. **BBS Failure.** Upon failure or loss of BBS, the automatic transfer switch will isolate the BBS from the system, and provide power from the utility source (if available). An external alarm will be provided to indicate loss of BBS, or BBS failure.

3. Submittals.

- a. **Submittals shall include:**
 - i. System configuration with single-line drawings.

- ii. Functional relationship of equipment including weights, dimensions, and heat dissipation.
- iii. Descriptions of equipment to be furnished, including deviations from these specifications.
- iv. Detailed layout of customer power and control connections.
- v. Detailed installation drawings including all terminal locations delivery.

b. Submittals upon BBS delivery shall include:

- i. Shop Drawings. Submit system configurations with single line diagrams, detailed layout of power and control connections, dimensional data and detailed installation drawings including all terminal locations.
- ii. Product Data. Provide product data for BBS and battery including catalog sheets and technical data sheets to indicate electrical performance, BBS type, battery type, detailed equipment outlines, weight, dimensions, control and external wiring requirements, heat rejection and air flow requirements.
- iii. Owners and technical manual.
- iv. Complete set of specifications for all electronic components.
- v. Test Report. Submit a copy of factory and field test reports as applicable.

4. Environmental Conditions.

- a. The BBS shall be capable of withstanding any combination of the following external environment conditions without mechanical damage, electrical failure or degradation of operating characteristics.
 - i. Operating ambient temperature: -40 degrees C to +74 degrees C (-40 degrees F to 165 degrees F).
 - ii. Non-operating and storage ambient temperature: -40 degrees C to +70 degrees C (-40 degrees F to 158 degrees F).
 - iii. Operating relative humidity: 5% to 95 %, non-condensing.
 - iv. Recommended operating relative humidity: 30 % to 95%.
 - v. Operating altitude: Sea level to 2700 meter (9000ft).
- b. **Audible acoustical noise.** Noise generate by the BBS, when operating under full rated load, at a distance of one meter from any BBS operator surface, shall not exceed 55 dB as measured on the A scale of a standard sound level meter at slow response.
- c. **Input surge withstand capability.** The BBS shall be in compliance with IEEE C62.4 1/C62.45 Category A & B.

5. Warranty. The BBS manufacture shall warrant to the original end user that the Battery Backup System shall be free from defects in material and workmanship under normal use and service for a period of thirty six (36) months from the date of installation.

6. Quality Assurance. The BBS manufacture shall fully and completely test the system to assure compliance with the specifications, before shipment.

C. Product.

1. Electric Characteristics. The BBS shall have the following characteristics:

a. The BBS shall be capable of withstanding any combination of the following external environment conditions without mechanical damage, electrical failure or degradation of operating characteristics.

- i. Operating ambient temperature: -40 degrees C to +74 degrees C (-40 degrees F to 165 degrees F).
- ii. Non-operating and storage ambient temperature: -40 degrees C to +70 degrees C (-40 degrees F to 158 degrees F).
- iii. Operating relative humidity: 5% to 95 %, non-condensing.
- iv. Recommended operating relative humidity: 30 % to 95%.
- v. Operating altitude: Sea level to 2700 meter (9000ft).

b. BBS Output Capacity

- i. A. BBS shall be capable of supporting a nominal 2 kVA. load at rated power factor.
- ii. Power factor-variable, 30-100%

c. Battery Capacity

- i. 2 Hours of Full Operation, and 2 hours Minimum at Red Flashing.

d. AC Input

- i. Nominal input voltage: 120V.
- ii. Number of phase: 1 phase, 2 wire, plus ground.
- iii. Voltage range: 90 volts to 135 volts
- iv. Frequency: 60Hz
- v. Wave Shape: Sine Wave
- vi. Power factor: 0.98 typical at 100% load.

e. AC Output

- i. Nominal output voltage: 120V, +/- 10% in line mode.
- ii. Nominal output voltage: 120 V, +/- 6%, back up mode.
- iii. Output Frequency: 60Hz, +/- 5% in line mode, and back up mode.
- iv. Number of phase: 1 phase, 2 wire, plus ground.
- v. Waveform Output: Sinusoidal
- vi. BBS Efficiency at Nominal Line Voltage: 98%
- vii. BBS Efficiency in Back up Mode: 84%
- viii. Step Load Response: Full recovery in ½ cycle @ 50% change with a resistive load.
- ix. Output voltage and current harmonic distortion: 1. 3% maximum with a resistive load.

f. DC Input and Battery

- a) Voltage: 12.0V DC Nominal.
- b) Voltage Ripple (normal operation): less than 2% of DC voltage.

- g. Efficiency-(84% or Greater)**
- h. BBS Protection.** The BBS shall indicate an overload warning with a flashing alarm LED when the load is between 95% and 105% of the rated output of the BBS. The BBS shall shutdown, and the fault LED shall turn ON, after two minutes of operation in back up mode when the load is between 106% and 115% of the rated output for the BBS, and the fault LED shall turn ON. The fault LED shall clear when the overload is removed and the utility line power returns. The BBS shall shutdown and the fault LED shall turn ON, after one minute of operation in back up mode when the load is greater than 115% of rated output. The fault LED shall clear when the overload is removed and the utility line power returns. The BBS shall disable the back up mode function when operating in line mode if the load exceeds 115% of the rated output for the BBS. The BBS shall display an alarm LED if the battery ambient temperature is greater than 75 degrees Centigrade and disable the back up mode function. The alarm shall clear when the battery ambient temperature is less than 70 degrees Centigrade. The BBS shall display a fault when operating in back up mode and shutdown the inverter if the internal temperature is greater than 110 degrees Centigrade. The fault shall clear when the utility power returns and the internal temperature is less than 90 degrees Centigrade. The BBS shall have output over-voltage protection to electronically shutdown the BBS if the output voltage exceeds 132 volts a.c. The BBS shall disable the battery charger and display an alarm LED if the battery voltage exceeds 59 volts d.c. for two seconds. The alarm shall be cleared and the charger enabled when the battery voltage drops to less than 57 volts D.C. The BBS shall display an alarm LED to indicate the BBS ventilation fan is enabled but not turning.

2. Components. BBS module shall be comprised of the following:

- a. Hybrid Converter Section.** AC input, converter input contactor, converter input fuse, input harmonic filter, and hybrid converter utilizing:
 - i. High Power Diode Bridge Rectifier**
 - a) General.** A high power diode bridge rectifier converts the utility AC input power into regulated DC power that serves as the inverter input and also as dc charge power to the system battery through the chopper/booster. An AC reactor and capacitor shall filter the harmonic content of rectifier input.
 - b) Input Over-Current Protection.** BBS input circuit breaker, converter input contactor, and the input current limit control shall provide rectifier protection against excessive input overload conditions.
 - c) Step Load Change Operation (0-100%).** In the occurrence of a 100% step load change, the BBS Module inverter shall draw power only from the rectifier to provide the required load demand. The charger/booster shall not be utilized and the system batteries will not be cycled at any time during a step load change.
 - ii. Charger/Booster**
 - a) General.** The charger/booster utilizes solid state Pulse Width Modulation (PWM) controlled Insulated Gate Bipolar Transistors (IGBT)
 - b) Battery Charge Current Limit.** Battery charging will be temperature compensated to maximize battery life. The battery charger current of the BBS shall be user programmable for 3, 6, and 10 amps. The battery

charger current default setting for the BBS shall be 6 amps. The battery charger in the BBS shall turn OFF when the battery temperature is 50 degrees Centigrade. (122 degrees Fahrenheit) The battery charger will have a maximum float voltage of 56 volts D.C.

- c) DC Input Protection. The DC input circuit shall be protected by a DC circuit breaker. The DC circuit breaker allows complete interruption of DC current and isolation of the BBS Module DC input and the battery system.

The DC Circuit Breaker shall be provided as standard equipment.

- d) Ripple Voltage. The DC (battery) bus RMS ripple voltage shall be less than 2% of the BBS nominal DC voltage level at 100% load. This shall provide for maximum battery life.
- e) Charging Equalization. The charging system shall be equipped with a charging management system that shall spread the charge voltage equally across the batteries. The battery charging management system shall compensate for batteries with varied internal resistances, and provide a final balance of +/-100 mV maximum between any two batteries in the string. The battery charging system shall be designed to CSA C22.2 NO. 107.1 and UL 1778 Standards for safe unattended operation.

iii. Batteries

- a) General. The individual batteries shall be 12 volt D.C., and shall be easily replaced and commercially available as "off the shelf" items. The batteries shall be electrically configured to provide a 48 volt, D.C. system. Batteries shall be provided with quick disconnect terminals and a polarized keyed battery cable for easy field installation. The batteries shall be sized to accommodate 4 hours of run time as specified previously.
- b) Battery Type. The batteries shall be "gel cell" Valve Regulated Lead Acid (VRLA) specifically designed for outdoor use. The batteries shall be designed for "Float Service" to provide 100% out-of-box runtime capacity. The batteries shall have silver alloy positive plates. The batteries shall have a five year full replacement, non-prorated warranty. Absorbed glass mat (AGM) batteries shall not be utilized.

b. Operation/Display Panel

The BBS module shall be provided with a control/indicator panel. The panel shall be on the front of the BBS module. Controls, meters, alarms and indicators for operation of the BBS module shall be on this panel. The panel display will indicate current battery charge status, various input/output voltages, power output, battery temperature, date, time, and settings of the various field programmable relays. All control, programming, maintenance and inquiry shall be accessible via the keyboard on the face of the BBS module without the need for the use of external equipment, or computer. The BBS shall be equipped with an event log that stores up to 100 events, date and time stamped. The events shall be date and time stamped. The event log shall be retrievable via the RS 232 interface, or from the LCD screen.

- i. Communication. The BBS shall have, as standard equipment, an RS 232 smart port as well as an SNMP Ethernet port allowing the user to interface the BBS status information to a host computer. Any necessary software for enabling communication to the device over the network shall be provided.

- ii. Service Functions
 - a) The BBS shall be capable of performing a self test, locally from the BBS front panel LCD, or remotely via the communication interface. The duration of the self test shall be programmable.
 - b) The BBS shall be capable of performing a battery test to determine the integrity of the battery system.

3. Mechanical Design.

a. Cabinet Structure (Enclosure)

- i. The enclosure shall be .125" thick, aluminum alloy, grade S052-H32, rated as NEMA 3R. The cabinets shall be provided with three point latching systems, a thermostatically controlled fan kit, door lock, continuous piano hinges for doors, and the appropriate louver openings for ventilation. The cabinets shall be constructed to allow a pad-mounted type installation, and capable of being mounted directly adjacent to the existing traffic controller panels.
- ii. The BBS shall be installed in a rack mounted configuration, with heavy-duty structures meeting with NEMA standard for floor mounting.
- iii. The cabinet shall be equipped with an exterior, weather rated lamp that will be utilized to indicate when normal utility power is not available at the control cabinet. The lamp shall be visible from the street in order to allow service technicians to identify a power loss at the cabinet, and shall be protected to avoid vandalism. Incandescent lamps shall not be utilized.

- b. Serviceability. The BBS shall have front access for all servicing adjustment and connections only for maintenance or service. Side access or rear access shall not be accepted. The BBS shall be designed such that its rear can be pressed against the existing traffic controller cabinet.

633.3 CONSTRUCTION

1. Site Preparation.

The UPS provider shall prepare the site for installation of the equipment.

2. Installation.

- a. The BBS shall be set in place, wired and connected in accordance with the approved installation drawings and owners/technical manual delivered with equipment. The BBS enclosure will be provided as a stand-alone, pad mounted cabinet that can be mechanically affixed to the existing traffic controller cabinet.
- b. The equipment shall be installed in accordance with local codes and manufacturer's recommendation.

3. Field Quality Control.

- a. The equipment shall be checked out and started by a customer support representative from the equipment manufacturer. Visual and mechanical inspection of electrical installation, initial BBS startup and operational training shall be performed. A signed service report shall be submitted after equipment is operational.

- b. The following inspection and test procedures shall be performed by field service personnel during the BBS startup:
 - i. Visual Inspection
 - a) Ensure that shipping members have been removed.
 - b) Ensure that interiors are free of foreign materials, tools and dirt.
 - c) Check for damage (dents, scratches, frame misalignment, damage to panel devices, etc)
 - d) Check doors for proper alignment and operation.
 - ii. Mechanical inspection
 - a) Check all the power wiring connections for tightness.
 - b) Check all the control wiring connections for tightness.
 - iii. Electrical Inspection
 - a) Check input and bypass for proper voltage.
 - b) Check battery for proper voltage and polarity
 - iv. Start-up
 - a) Energize the BBS.
 - b) Check the DC output voltage and inverter output voltage.
 - c) Check the inverter output voltage on battery operation.
 - d) Perform manual transfers and returns.
 - e) Perform auto transfers.

633.4 MEASUREMENT: This Item will be measured as each Battery Backup System furnished, installed, and tested, including the enclosure cabinet, cabinet mounted BBS components, batteries, and cabling between cabinet and batteries. All components will be furnished, installed, and tested.

633.5 PAYMENT: The work performed and materials furnished in accordance with this Item, and measured as provided under “Measurement” will be paid for at the unit price bid for “Battery Backup System” as specified. This price is full compensation for all equipment, cables and connectors, documentation, and testing; and for all labor, materials, training, warranties, and incidentals necessary to complete the work.

633.6 BID ITEM:

Item 633.1 - Battery Backup System - per each

SPECIAL SPECIFICATION 6007

REMOVING TRAFFIC SIGNALS

6007.1 DESCRIPTION:

This item governs the removal, storage, and salvage of traffic signals.

6007.2 CONSTRUCTION:

Traffic signals must remain in operation during construction until their removal as directed. The Contractor will not be responsible for maintenance of the signals during this period of operation.

Remove existing electrical services, pedestal poles, strain poles, mast arm pole assemblies, luminaires, signal heads, controllers, cables, and other accessories. Remove materials so that damage does not occur. Remove and store items designated for reuse or salvage at locations shown on the plans or as directed.

Remove abandoned concrete foundations to a point 2 ft. below final grade. Backfill hole with material equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local regulations.

6007.3 MEASUREMENT:

This Item will be measured as each signalized intersection removed. A signalized intersection is a group of signals operated by a single controller.

6007.4 PAYMENT:

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Removing Traffic Signals." This price is full compensation for removing the various traffic signal components; removing the foundations; disposal of unsalvageable material; hauling; and equipment, labor, tools, and incidentals.

6007.5 BID ITEM:

Item 6007.01 – Removing Traffic Signals – per each

SPECIAL SPECIFICATION 8100

ITS TRAFFIC MONITORING CAMERA

8100.1 DESCRIPTION:

Furnish and install Intelligent Transportation Systems (ITS) Traffic Monitoring Cameras to allow remote monitoring of traffic flows and incidents on arterial streets, intersections, and highways.

8100.2 MATERIALS: Provide components necessary for ITS Traffic Monitoring Camera installation. A ITS Traffic Monitoring Camera installation shall consist of the following components: digital IP camera unit (1), surge protection equipment (1), and all associated equipment required to set up and operate in a field environment including software, Ethernet communications ports, cabling, electrical connectors, and mounting hardware.

Cameras should include all outdoor enclosures and mounting hardware for installation on a standard traffic signal pole. Cameras must support standard definition video with minimum 36X optical zoom, H.264 MJPEG multi-streaming, Day/Night switching and be manufactured to support installation in harsh weather environments. Cameras shall be capable of panning 360° and tilting 180°. No separate encoder shall be required to transmit video to remote location. Cameras must support at a minimum RTP, RTSP, UDP, TCP, IP, IGMPv2, ICMP, ARP protocols. Camera control shall support ONVIF, Pelco-D, or COHU protocols.

8100.3 CONSTRUCTION: Install ITS Traffic Monitoring Camera in accordance with the details shown on the plans and the requirements of this item.

A. Manufacturing and Testing

The ITS Traffic Monitoring Camera shall undergo a rigorous sequence of operational testing to ensure product functionality and reliability

B. Installation and Training

1. When requested by COSA personnel or purchasing agency, the supplier of the ITS Traffic Monitoring Camera shall supervise the installation and testing of the radar equipment.
2. If requested by COSA personnel or purchasing agency, up to two days of training shall be provided to personnel of COSA in the operation, setup, and maintenance of the ITS Traffic Monitoring Camera. Instruction and materials shall be provided for a maximum of 20 persons and shall be conducted at a location selected by COSA. COSA or purchasing agency shall be responsible for the cost of training.
3. Instruction personnel are required to be certified by the equipment manufacturer. The User's Guide is not an adequate substitute for practical, classroom training and formal certification by an approved agency.
4. Formal levels of factory authorized training are required for installers, contractors, and system operators. All training must be certified by the manufacturer.

C. Warranty, Maintenance, and Support

1. The ITS Traffic Monitoring Camera shall be warranted to be free of defects in material and workmanship for a period of 2 years from date of shipment from the supplier's facility. 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. This warranty does not apply to products damaged by accident, improper operation, abuse, serviced by unauthorized personnel or unauthorized modification.
2. If an ITS Traffic Monitoring Camera fails with no visible or physical damage to any electronic/electrical component of the system or its wiring, then the unit is considered to have failed under normal operating conditions. A blown fuse or surge protection device failure shall be considered to have failed under normal operating conditions. Acts-of-God will not be accepted as excusable unit failures of the ITS Traffic Monitoring Camera.
3. Repair or full replacement will be required if an ITS Traffic Monitoring Camera fails to operate as specified under normal operating conditions. Repaired or replaced components of the ITS Traffic Monitoring Camera will be provided at no cost to COSA. The replaced or repaired units will inherit the remainder of the failed unit's warranty.
4. 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.
5. Ongoing software support by the supplier shall include firmware updates for the ITS Traffic Monitoring Camera and external software needed to set up and operate the ITS Traffic Monitoring Camera. These updates shall be provided free of charge during the warranty period. The update of the ITS Traffic Monitoring Camera software shall be tested and approved by COSA before installation.\
6. The supplier shall maintain a program for technical support and software updates following expiration of the warranty period. This program shall be made available to COSA in the form of a separate agreement for continuing support.
7. The supplier shall maintain an adequate inventory of parts to support maintenance and repair of the ITS Traffic Monitoring Camera system.

8100.4 MEASUREMENT: This item will be measured as each ITS Traffic Monitoring Camera installed, tested, and made operational including the digital IP camera unit, surge protection equipment, and all associated equipment required to set up and operate in a field environment including software, Ethernet communications ports, electrical connectors, and mounting hardware.

The communication and power cable(s) will be measured by the linear foot of the cable type furnished.

8100.5 PAYMENT: The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for each item listed in Section 8001.6, "Bid Items". These prices are full compensation for furnishing, placing, and testing all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages, supplies, support, personnel training, shop drawings, documentation, and incidentals.

These prices also include any and all interfaces required for the field and remote communications links along with any associated peripheral equipment, including cables; all associated mounting hardware and associated field equipment; required for a complete and fully functional ITS Traffic Monitoring Camera.

8100.6 BID ITEMS:

Item 8001.1 – ITS Traffic Monitoring Camera – per each

Item 8001.2 - ITS Traffic Monitoring Camera Cable – per linear foot

SPECIAL SPECIFICATION 8101

ITS COMMUNICATION EQUIPMENT

8101.1 DESCRIPTION:

Furnish and install Intelligent Transportation Systems (ITS) communication equipment to allow remote connections to the IP-based traffic equipment at the signalized intersection.

8101.2 MATERIALS: Provide components necessary for ITS Communications Equipment installation.

A Wireless Access Point shall consist of the following materials:

Component	Vendor	Part No.	Description	Unit	Qty.
ITS Wireless Access Point	CISCO	AIR-CAP1552E-A-K9	802.11 N Outdoor Mesh AP, FCC Cfg	EA	1
	CISCO	AIR-ANT2547V-N	2.4 GHz 4 dBi/5 GHz 7 dBi dual band omni antenna	EA	3
	CISCO	AIR-CORD-R3P-40NA	Aironet 1520 Series AC Power Cord, 40 ft, N. Amer Plug	EA	1
	CISCO	AIR-ACCPMK1550	1550 Series Pole Mount Kit	EA	1
	WAGO	51011139	3.0 A DIN Rail Mount Pluggable Thermal Circuit Breaker	EA	1

An ITS Ethernet Switch shall consist of the following materials:

Component	Vendor	Part No.	Description	Unit	Qty.
ITS Ethernet Switch	CISCO	WS-C2955S-12	Cisco IE 2000 Series Switch with 8 10/100Base-T Ethernet ports fixed configurations with compact form factor • 2x Gigabit Combo ports, SFP (100MB)	EA	1
	CISCO	STK-RACKMNT-2955	19 IN RACK MOUNT KIT	EA	1
	CISCO	PWR-IE50W-AC	Expansion Power Module for Cisco switches, DIN-Rail Mount, compatible with PWR-IE3000-AC	EA	1
	WAGO	51011139	3.0 A DIN Rail Mount Pluggable Thermal Circuit Breaker	EA	1

The following cables shall be supplied:

Component	Vendor	Part No.	Description	Unit	Qty.
Communications Power Cable	GRAYBAR	VNTC 16-3-R10K-BED	27331A 01010000 BELDEN (Pwr Cable)	LF	VAR*
Communications Ethernet Cable	GRAYBAR	7919A 01001000	IND ETH 5E4P24 HLD (Ethernet Cable)	LF	VAR*

8101.3 CONSTRUCTION: Install ITS Communication Equipment in accordance with the details shown on the plans and the requirements of this item.

- The contractor shall provide two 6 ft. Ethernet patch cords for each switch that is installed.
- The contractor shall provide strain relief for all network patch cords and network communications cables in the cabinet.
- The contractor shall demonstrate possession and knowledge of use of network termination tools and process. The contractor shall prepare network terminations and connections and notify city/engineer for testing of communications. The contractor is responsible for providing fully functioning wireless communication system in a timely manner.
- The contractor shall install and orient wireless access point (AP) communication device as specified by ITSD. The contractor shall relocate, modify AP position and orientation as required to provide suitable signal strength for reliable communications. AP device should be oriented with antennas in a plane that is nominally 45 degrees to the center line of the roadway. The AP device is to be connected to port 1 on the Ethernet switch.
- If wireless communication equipment is provided by the contractor, the equipment shall be delivered to the COSA Traffic Management Center four (4) weeks in advance of traffic signal operation for testing and programming.

8101.4 MEASUREMENT: This item will be measured as each ITS Communication Equipment installed, tested, and made operational including the wireless AP, Ethernet switch, and all associated equipment required to set up and operate in a field environment including Ethernet connections, electrical connectors, and mounting hardware.

The power cable and Ethernet cable will be measured by the linear foot of the cable type furnished.

8101.5 PAYMENT: The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for each item listed in Section 8101.6, "Bid Items". These prices are full compensation for furnishing, placing, and testing all materials and equipment, and for all tools, labor, equipment, hardware, shop drawings, documentation, and incidentals.

These prices also include any and all interfaces required for the field and remote communications links along with any associated peripheral equipment, including cables; all associated mounting hardware and associated field equipment; required for a complete and fully functional ITS Communication Equipment.

8101.6 BID ITEMS:

Item 8001.1 – ITS Wireless Access Point – per each

Item 8001.2 – ITS Wireless Ethernet Switch – per each

Item 8001.3 - ITS Communications Power Cable – per linear foot

Item 8001.4- ITS Communications Ethernet Cable – per linear foot

SPECIAL PROVISIONS

All work shall conform to the 2008 Edition of the “Standard Specifications for Construction” published by the City of San Antonio as modified by these Special Provisions.

No direct payment shall be made for the following specification items. Contractor shall include cost of these items in various other bid items:

- 100.1 Mobilization
- 100.2 Insurance and Bond
- 101.1 Preparing Right-of-Way
- 530.1 Barricades, Signs, and Traffic Handling
- 540 Temporary Erosion, Sedimentation and Water Pollution Prevention and Control

The City will pay additional mobilization accordingly for the following situations:

1. If the final task order cost plus additional mobilization fee does not surpass \$10,000, then the total bid price for mobilization will be applied.
2. In the event where the final task order construction cost plus the additional mobilization fee is greater than \$10,000, the additional mobilization fee will be adjusted so that the total project cost is \$10,000.

ITEM 101. PREPARING RIGHT-OF-WAY

The Contractor shall be responsible for obtaining all permits required to complete the task order.

ITEM 308. DRILLED SHAFTS AND UNDER-REAMED FOUNDATIONS

An additional 2” schedule 40 PVC stub out shall be installed at each pole foundation. Stub outs shall be one-foot in length and appropriately capped below grade for future use. This shall be subsidiary to the bid items.

The use of the “rock” bid items will be at the discretion of the City.

Section 308.7 is amended with the following bid items:

Item 308.30 – Drilled shafts (30 in. diameter) – per linear foot

Item 308.36 – Drilled shafts (36 in. diameter) – per linear foot

Item 308.48 – Drilled shafts (48 in. diameter) – per linear foot

Item 308.130 – Drilled shafts (30 in. diameter in rock) – per linear foot

Item 308.136 – Drilled shafts (36 in. diameter in rock) – per linear foot

Item 308.148 – Drilled shafts (48 in. diameter in rock) – per linear foot

ITEM 502. CONCRETE SIDEWALKS

The installation of curb ramps shall be in compliance with the Texas Department of Transportation “PED-12 PEDESTRIAN FACILITIES – CURB RAMPS” standard.

Section 502.7 is amended with the following bid items:

Item 502.21 – TxDOT Type 1 Curb Ramp – per each

Item 502.22 – TxDOT Type 2 Curb Ramp – per each

Item 502.24 – TxDOT Type 4 Curb Ramp – per each

Item 502.25 – TxDOT Type 5 Curb Ramp – per each

Item 502.41 – TxDOT Type 21 Curb Ramp – per each

Item 502.42 – TxDOT Type 22 Curb Ramp – per each

Item 502.54 – Cast in Place Detectable Warning Surface (not tied to new ramp) – per each

ITEM 530. BARRICADES, SIGNS & TRAFFIC HANDLING

The Contractor shall be responsible for setting and removing all barricades and temporary traffic control devices.

ITEM 531. SIGNS

The Contractor shall provide the signs, supports, and all the necessary hardware for mounting. This item is used for ground mounted signs only. Signs shown on the plans to be mounted are the mast arm are to be provided by the Contractor subsidiary to ITEM 680.

Section 531.7 is amended with the following bid items:

Item 502.98 – Remove existing ground mounted sign and post – per each

Item 502.99 – Install new ground mounted sign and post – per each

ITEM 533. CLEANING AND REMOVAL OF PAVEMENT MARKINGS AND MARKERS

Removal of existing pavement markings will be measured by the linear foot of lane line including any conflicting markers or by each symbol or word removed. Payment shall be according to the quantities measured for each bid item. This item is only used for removal of markings that are not being replaced. Removal of markings being replaced by new markings is subsidiary to the bid items in ITEM 535.

Section 533.6 is amended with the following:

Bid items for this item are only to be used when removing existing markings that are not being replaced by new markings.

Item 533.2 – Remove existing 4 inch pavement marking – per linear foot

Item 533.6 – Remove existing 8 inch pavement marking – per linear foot

Item 533.10 – Remove existing 24 inch pavement marking – per linear foot

Item 533.12 – Remove existing single arrow pavement marking – per each

Item 533.14 – Remove existing double arrow pavement marking – per each

Item 533.16 – Remove existing word pavement marking – per each

ITEM 535. HOT APPLIED THERMOPLASTIC PAVEMENT MARKINGS

Section 535.7 is amended with the following bid items:

Item 535.30 – Install Median Nose Pavement Marking – per square foot

Item 535.31 – 24 inch wide yellow line – per linear foot

ITEM 600. TRAFFIC SIGNAL GENERAL CONDITIONS

All work shall comply with the City of San Antonio Right of Way Ordinance and the Utility Excavation Criteria Manual.

Trenches for the electrical service conduit left overnight for the purpose of inspection by the utility company shall be adequately covered or platted and barricaded with reflective standard barricades equipped with warning flashers or as directed by the Engineer. Any reusable backfill material shall be removed and stored off-site until the utility company approves the conduit installation. Payment for this work will be made under “Conduit (Open Trench)”.

Any other trenches left overnight as well as any foundations that do not have poles sitting on them or any other such hazard to the public shall be adequately covered and barricaded with reflective standard barricades equipped with warning flashers or as directed by the Engineer. This work will not be paid directly and is considered subsidiary to applicable items specified for the project.

ITEM 618. CONDUIT

Proposed conduit shown under existing street pavement and driveways shall be installed by horizontal, directional bore. No trenching or conventional jacking or drilling shall be permitted except as allowed by the Engineer.

Conduits installed under roadways, driveways, or any other areas where it is possible for vehicles to drive presently or with future development shall be placed at a minimum depth of 30 inches.

The Contractor shall place warning tape in all trenches where new conduit is placed. All warning tape shall be placed at a depth of 6 to 8 inches below final grade. Conduit warning tape shall be a 4 mil inert plastic film specially formulated for prolonged use underground. All tape shall be highly resistant to alkalis, acids, and other destructive agents found in soils. Tape shall have a continuous printed message warning of the location of underground conduits. The message shall be in permanent ink specifically formulated for prolonged underground use and shall bear the words “caution – electric line buried below”, or other such approved phrase, in black letters on a yellow or red background.

Conduit installed from the electrical service source to the meter pedestal or cabinet shall be paid under item 618.03, “Conduit (Open Trench)”, per linear foot of the type and size required by the utility company. The bid price shall be full compensation for the electrical wiring, covering and barricading the trench, off-site storing of backfill material and any other incidentals required for a safe environment while the conduit is being inspected by the utility company.

The use of the “rock” bid items will be at the discretion of the City.

ITEM 624. GROUND BOXES

All other ground boxes and covers shall be provided and installed by the Contractor.

The installation of the traffic signal ground box in new controller cabinet foundation shall be subsidiary to item 655.01, Type 332 Controller Foundation.

ITEM 628. ELECTRICAL SERVICES

Upon receipt of the electrical permit for each intersection, the Contractor shall email a scanned copy to Marc Jacobson at marc.jacobson@sanantonio.gov.

The Contractor shall supply and install the address in permanent numbers and letters to the street side of the service enclosure. Said address shall also be recorded and given to the City Inspector for the City’s records.

The City of San Antonio will work with CPS Energy to establish the electrical service at each location. City of San Antonio will establish meter addresses and pay for CPS Energy construction to get service to each location. The Contractor shall be responsible for paying all fees and obtaining the permits required by the Development Services Department to install and inspect the electrical service. Trenches for the electrical service conduit left overnight for the purpose of inspection by the utility company will be paid under item 618.03, “Conduit (Open Trench)”.

Section 628.7 is amended with the following bid items:

Item 628.21 – Electrical Service Disconnect (i.e. shut off with no meter) – per each

ITEM 633. BATTERY BACKUP SYSTEM FOR TRAFFIC SIGNAL

The Contractor shall furnish and install Battery Backup Systems that meet the requirements of the Special Specification for Item 633 that is listed in the previous section.

ITEM 655. CONTROLLER FOUNDATION AND PEDESTAL POSTS

The foundation for new traffic signal controller cabinet assembly shall not include an in-ground battery-box.

ITEM 680. INSTALLATION OF HIGHWAY TRAFFIC SIGNALS

The project shall consist of furnishing and installing all materials and equipment required for a complete traffic signal installation. Upon project completion, fully operational traffic signal systems will be required. Items required but not shown on the plans are the responsibility of the Contractor and shall be subsidiary to the applicable bid item.

Permanent traffic signs will be provided by the Contractor. Contractor shall install all permanent signs mounted on signal equipment, as shown on the plans. The Contractor shall provide all necessary hardware for mounting. In accordance with item 680, the cost of installing these signs shall be subsidiary to this same item. Ground mounted signs will be paid for under item 531.

The controller cabinet, traffic signal controller, and anchor bolts shall be provided by and installed by the Contractor.

The Contractor shall demonstrate to the Engineer's satisfaction that the field wiring is properly installed and labeled. Only then, the Contractor shall install the controller assembly on the completed foundation. City forces will connect the field wiring to the controller, set up, and turn on the controller.

Until the project is completed and accepted, the Contractor will be responsible for the maintenance of the traffic signals. The Contractor shall ensure that all elements of the traffic signals remain in operation at his expense. The Contractor shall complete any repairs to the traffic signals within four hours after notification. The City of San Antonio shall retain the responsibility of the operation of the traffic signals.

The locations shown on the plans for signal pole foundations, controller foundations, conduit and other items may be varied to meet local conditions, subject to prior approval by the Engineer. The Contractor shall be responsible for adjustments in project construction, which may be necessary because of conflict with utilities.

Final adjustment of heads, as required by the Engineer, shall be done by the Contractor and shall be subsidiary to the various bid items.

All traffic signal equipment, including span wire, installed shall maintain a minimum clearance of 3' radius from neutral overhead electrical lines and 10' radius from primary overhead electrical lines. Additional clearance requirements shall be as directed by the electrical utility company.

ITEM 681. TEMPORARY TRAFFIC SIGNALS

Additional vehicular signal heads, mounting assemblies, and back plates required shall be provided and installed by the Contractor. Reconfiguration of vehicle signal heads shall be as directed by the City.

ITEM 682. VEHICLE AND PEDESTRIAN SIGNAL HEADS

Vehicular and pedestrian signal heads and mounting assemblies and back plates shall be provided and installed by the Contractor.

ITEM 684. TRAFFIC SIGNAL CABLES

All proposed signal cable shall be #14 a.w.g. solid copper.

ITEM 685. FLASHING BEACON ASSEMBLIES

The Contractor shall provide the Solar Powered School Zone Flasher Assemblies, pedestal pole for roadside mounted installations, traffic signal pole assemblies for mast arm installations, signs and signal heads as shown on standard TS-MASF-14 "Mast Arm Mounted Solar Powered School Flasher Assembly or TS-RSSF-14 "Roadside Pole Mounted Solar Powered School Flasher Assembly."

For mast arm installations, the contractor will be paid for providing and installing the traffic signal pole assembly and for the pole's foundation under the appropriate bid items.

Upon project completion, fully operational flashing beacon system will be required. Items required but not shown on the plans are the responsibility of the Contractor and shall be subsidiary to the applicable bid item.

ITEM 686. TRAFFIC SIGNAL POLE ASSEMBLIES (STEEL)

Traffic signal poles and mast arms shall be provided and installed by the Contractor.

For each task order, one item 686.100 will be included to cover the cost of the freight to deliver the poles.

Section 686.7 is amended with the following bid items:

Item 686.100 – Freight charges for delivery of mast arm poles –per each task order

Item 686.124 – Install 24’ Tall Single Mast Arm with 24’ Mast Arm and 9’ ILSN arm – per each

Item 686.128 – Install 24’ Tall Single Mast Arm with 28’ Mast Arm and 9’ ILSN arm – per each

Item 686.132 – Install 24’ Tall Single Mast Arm with 32’ Mast Arm and 9’ ILSN arm – per each

Item 686.136 – Install 24’ Tall Single Mast Arm with 36’ Mast Arm and 9’ ILSN arm – per each

Item 686.140 – Install 24’ Tall Single Mast Arm with 40’ Mast Arm and 9’ ILSN arm – per each

Item 686.144 – Install 24’ Tall Single Mast Arm with 44’ Mast Arm and 9’ ILSN arm – per each

Item 686.148 – Install 24’ Tall Single Mast Arm with 48’ Mast Arm and 9’ ILSN arm – per each

Item 686.155 – Install 24’ Tall Single Mast Arm with 55’ Mast Arm and 9’ ILSN arm – per each

Item 686.160 – Install 24’ Tall Single Mast Arm with 60’ Mast Arm and 9’ ILSN arm – per each

Item 686.165 – Install 24’ Tall Single Mast Arm with 65’ Mast Arm and 9’ ILSN arm – per each

Item 686.224 – Install 30’ Tall Single Mast Arm with 24’ Mast Arm, luminaire arm with luminaire, and 9’ ILSN arm – per each

Item 686.228 – Install 30’ Tall Single Mast Arm with 28’ Mast Arm, luminaire arm with luminaire, and 9’ ILSN arm – per each

Item 686.232 – Install 30’ Tall Single Mast Arm with 32’ Mast Arm, luminaire arm with luminaire, and 9’ ILSN arm – per each

Item 686.236 – Install 30’ Tall Single Mast Arm with 36’ Mast Arm, luminaire arm with luminaire, and 9’ ILSN arm – per each

Item 686.240 – Install 30’ Tall Single Mast Arm with 40’ Mast Arm, luminaire arm with luminaire, and 9’ ILSN arm – per each

Item 686.244 – Install 30’ Tall Single Mast Arm with 44’ Mast Arm, luminaire arm with luminaire, and 9’ ILSN arm – per each

Item 686.248 – Install 30’ Tall Single Mast Arm with 48’ Mast Arm, luminaire arm with luminaire, and 9’ ILSN arm – per each

Item 686.255 – Install 30’ Tall Single Mast Arm with 55’ Mast Arm, luminaire arm with luminaire, and 9’ ILSN arm – per each

Item 686.260 – Install 30’ Tall Single Mast Arm with 60’ Mast Arm, luminaire arm with luminaire, and 9’ ILSN arm – per each

Item 686.265 – Install 30’ Tall Single Mast Arm with 65’ Mast Arm, luminaire arm with luminaire, and 9’ ILSN arm – per each

ITEM 687. PEDESTAL POLE ASSEMBLIES

All materials shall be provided and installed by the Contractor. The Contractor shall be responsible for drilling and pouring the foundation.

ITEM 688. PEDESTRIAN DETECTORS AND VEHICLE LOOP DETECTORS

Pedestrian push button and signs shall be provided and installed by the Contractor.

ITEM 693. INTERNALLY LIGHTED STREET NAME SIGN ASSEMBLIES

Internally lighted street name signs shall be provided and installed by the Contractor as directed by the Engineer.

Section 693.7 is amended with the following bid items:

Item 693.6 – Install 6’ Wide Double Sided ILSN sign – per each

Item 693.8 – Install 8’ Wide Double Sided ILSN sign – per each

ITEM 695. EMERGENCY VEHICLE TRAFFIC SIGNAL PRIORITY CONTROL SYSTEM

Emergency vehicle preemption detectors, mounting hardware, and cable shall be provided and installed by the Contractor as directed by the Engineer.

ITEM 696. RADAR VEHICLE DETECTION DEVICES (RVDD)

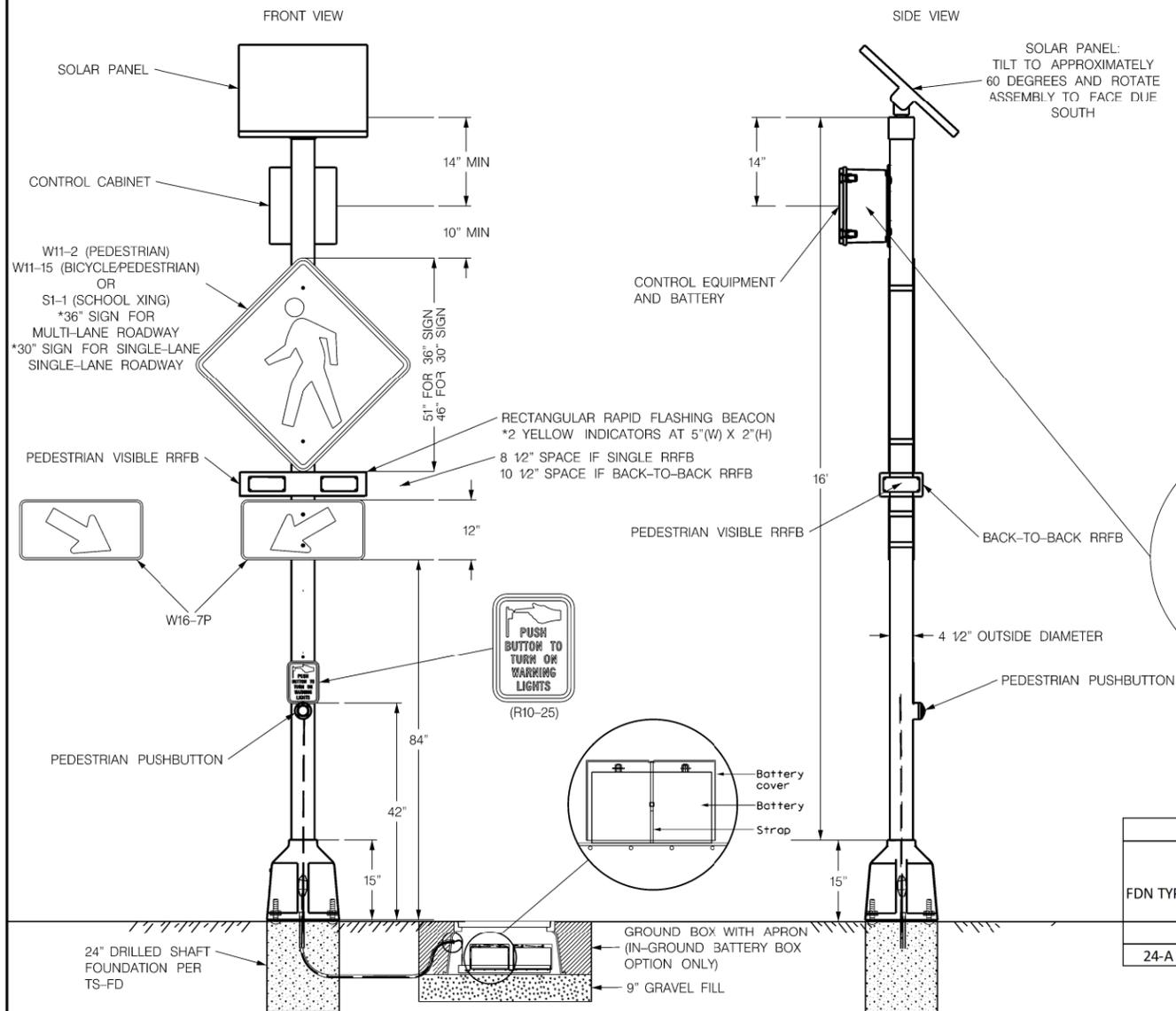
The Contractor shall furnish and install all radar vehicle detectors, mounting hardware, and cable unless noted in the task order as directed by the Engineer.

ITEM 802. TREE PRUNING

Tree pruning shall be done in accordance with the Branch Pruning and Branch Clearance Details of the City of San Antonio Tree Protection Details.

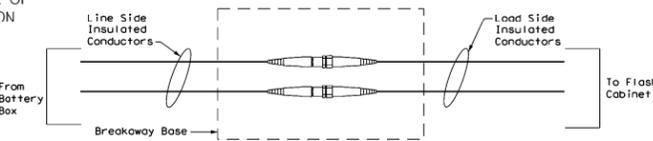
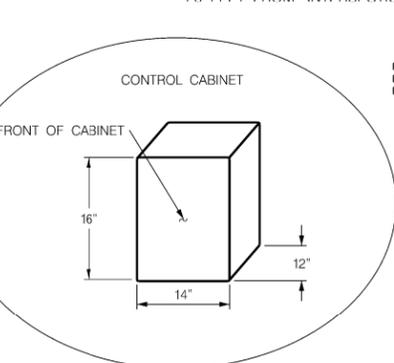
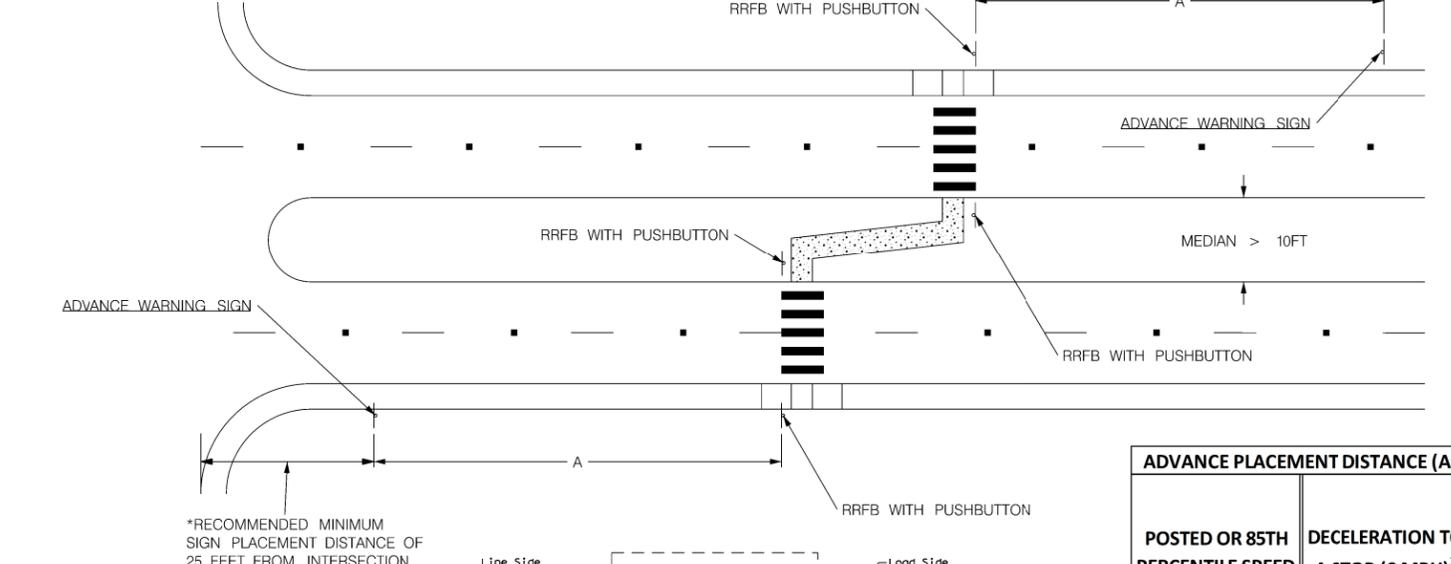
NOTES:

- RECTANGULAR RAPID FLASHING BEACONS (RRFB) SHOULD ONLY BE CONSIDERED AT MARKED CROSSWALKS WHERE THE CROSSING IS NOT CONTROLLED BY A TRAFFIC CONTROL DEVICE SUCH AS A TRAFFIC SIGNAL OR STOP SIGNS. RRFB PROVIDES FOR THE IMPROVEMENT OF SAFETY OF CROSSWALKS WHEN TRAFFIC SIGNALS DO NOT MEET WARRANTS, AND SHOULD ONLY BE USED WITH SIGNS AND PAVEMENT MARKINGS TO WARN AND CONTROL TRAFFIC AT LOCATIONS WHERE PEDESTRIANS ENTER OR CROSS A STREET.
- ALL OF THE FOLLOWING CONDITIONS MUST BE MET BEFORE RRFB CAN BE CONSIDERED:
 - AN ESTABLISHED CROSSWALK WITH ADEQUATE VISIBILITY, MARKINGS AND SIGNS
 - A POSTED SPEED LIMIT OF 40 MPH OR LESS (DOES NOT INCLUDE SCHOOL SPEED ZONES)
 - 20 PEDESTRIANS OR MORE CROSSING IN ONE HOUR
 - LOCATION DEEMED AS A HIGH RISK AREA (E.G. SCHOOLS, SHOPPING CENTERS, ETC.)
 - CROSSWALK IS MORE THAN 300 FT. FROM AN EXISTING, TRAFFIC CONTROLLED PEDESTRIAN CROSSING
- RRFB ARE USER-ACTUATED AMBLER LEDs THAT SUPPLEMENT WARNING SIGNS. A RRFB CONSIST OF TWO RAPIDLY AND ALTERNATELY FLASHED RECTANGULAR YELLOW INDICATORS HAVING LED-ARRAY BASED PULSING LIGHT SOURCES.
- RRFB SIGNAL INDICATIONS SHALL NOT BE DIMMED DURING DAYTIME CONDITIONS AND THE LIGHT OUTPUT FROM THE RRFB SIGNAL INDICATIONS MUST MEET THE SAE J595 REQUIREMENTS FOR PEAK LUMINOUS INTENSITY FOR CLASS 1 AT ALL TIMES DURING DAYLIGHT HOURS 4(09)-24(I) - DIMMING OF RRFBs DURING DAYTIME HOURS, INTERIM APPROVALS VALID UNDER THE 2009 MUTCD.
- RRFB FLASH PATTERN PER COSA SPECIFICATION FOR RECTANGULAR RAPID FLASHING BEACON (RRFB).
- RRFB FLASH DURATION SHALL BE SUFFICIENT FOR PEDESTRIAN CROSSING TIME AS THAT OUTLINED IN CHAPTER 4 OF THE TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (TMUTCD).
- RRFB LIGHT INTENSITY SHALL MEET THE MINIMUM SPECIFICATIONS OF SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) STANDARD J595 DATED JANUARY 2005. SAE J595 CLASS 1 YELLOW LED LIGHTS ARE TO BE USED FOR RRFBs UNDER 1A-11 4(09)-17(I) - RRFB LIGHT INTENSITY, INTERIM APPROVALS VALID UNDER THE 2009 MUTCD.
- ORIENT SOLAR PANEL FOR OPTIMUM EXPOSURE TO SUNLIGHT (FACE TO THE SOUTH). PRIOR TO INSTALLATION THE LOCATION SHOULD BE CHECK TO ENSURE THERE IS NO OVERHEAD OBSTRUCTION THAT WOULD BLOCK THE SOLAR PANEL FROM RECEIVING FULL SUNLIGHT. UNLESS SPECIFIED ELSEWHERE, MOUNT A MINIMUM OF 14' ABOVE GRADE. THE NOMINAL OUTSIDE DIMENSIONS OF EACH CABINET MUST BE 14" WIDE BY 16" HIGH BY 12" INCHES DEEP WITH THE DOOR CLOSED. ALL DIMENSIONS MAY BE PLUS OR MINUS 3".
- PEDESTAL POLE FOUNDATION SHALL BE DESIGNED PER THE TXDOT STANDARD SPECIFICATIONS 2004, TS-FD, 24-A (ITEM 656). ENSURE THE MATERIALS AND CONSTRUCTION METHODS USED CONFORM TO THE REQUIREMENTS OF ITEM 656.
- IF MEDIAN EXCEEDS 10 FEET IN WIDTH, A "Z-CROSSING" OR "STAGGERED CROSSING" IS PREFERRED.
- IF ROADWAY DOES NOT HAVE MEDIAN, TWO BACK-TO-BACK RRFB WILL NEED TO BE IMPLEMENTED AT CROSSWALK.

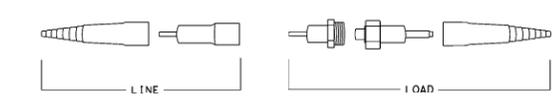


- ADVANCE WARNING SIGN (TYP)
 1. 36" W11-2 (PEDESTRIAN)
 OR
 2. S1-1 (SCHOOL XING)
 OR
 3. W11-15 (BIKE/PEDESTRIAN)
 (LEDS WITHIN SIGN FACE ARE OPTIONAL)

*RECOMMENDED MINIMUM SIGN PLACEMENT DISTANCE OF 25 FEET FROM INTERSECTION



NON-FUSED BREAKAWAY ELECTRICAL CONNECTORS



NON-FUSED BREAKAWAY ELECTRICAL CONNECTORS EXPLODED VIEW

ADVANCE PLACEMENT DISTANCE (A)	
POSTED OR 85TH PERCENTILE SPEED	DECELERATION TO A STOP (0 MPH) ¹
20 MPH	100 FT ²
25 MPH	155 FT
30 MPH	200 FT
35 MPH	250 FT
40 MPH	305 FT

1 TYPICAL CONDITION IS THE WARNING OF A POTENTIAL STOP SITUATION. THE DISTANCES ARE BASED ON THE 2011 AASHTO POLICY, EXHIBIT 3-3, STOPPING SIGHT DISTANCE, PROVIDING A PRT OF 2.5 SECONDS, A DECELERATION RATE OF 11.2 FEET/SECOND².

2 THE MINIMUM ADVANCE PLACEMENT DISTANCE IS LISTED AS 100 FEET TO PROVIDE ADEQUATE SPACING BETWEEN SIGNS.

3 RRFB SHOULD NOT BE USED FOR ROADWAYS WITH SPEED LIMITS EXCEEDING 40 MPH.

FDN TYPE	DRILLED SHAFT DIA	REINFORCING STEEL		EMBEDDED DRILLED SHAFT			ANCHOR BOLT DESIGN			FOUNDATION DESIGN LOAD		
		VERT BARS	SPIRAL & PITCH	LENGTH - FT			ANCHOR BOLT DIA	Fy (ksi)	BOLT CIR CIA	ANCHOR TYPE	MOMENT K-FT	SHEAT KIPS
				TEXAS CONE PENETROMETER N BLOWS/FT	10	15						
24-A	24"	4- #5	#2 AT 12"	5.7	5.3	4.5	3/4"	36	12 (3/4)"	1	10	1

NOVEMBER 2013
 CITY OF SAN ANTONIO
 DEPARTMENT OF PUBLIC WORKS

TRAFFIC SIGNAL STANDARDS
SOLAR POWERED RECTANGULAR RAPID FLASHING BEACON (RRFB)

DRWN. BY:	DSGN. BY:	CHKD. BY:	DATE:
% SUBMITTAL	PROJECT NO.:	SHEET NO. OF	

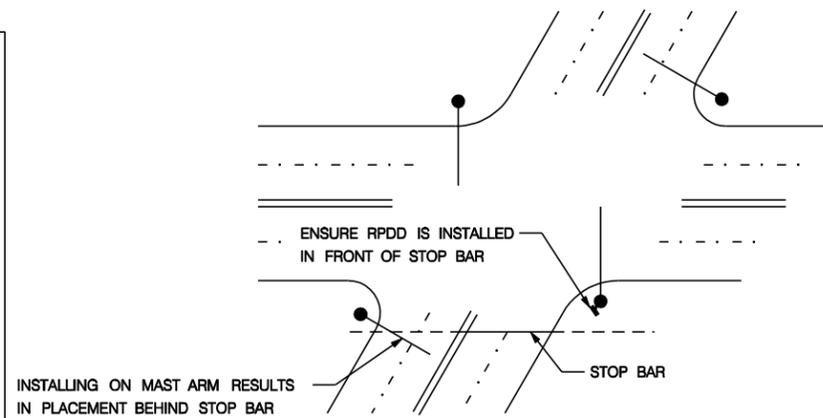
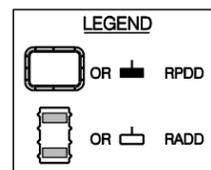
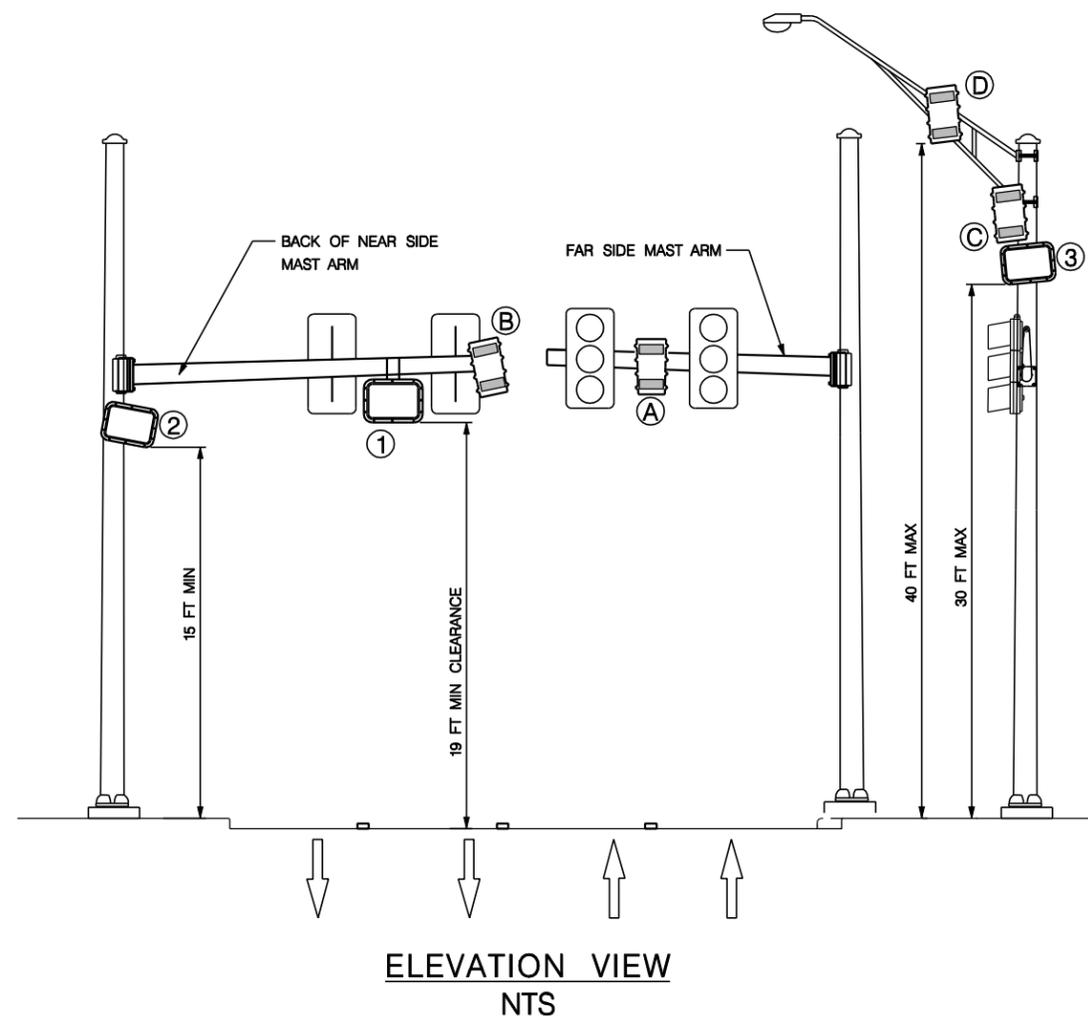
MOUNTING LOCATIONS

PRESENCE (RPDD)

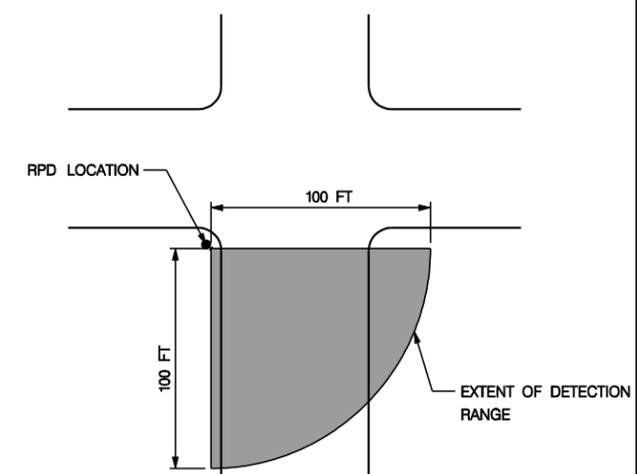
- ① PREFERRED PLACEMENT FOR MAST ARMS. MOUNT ON AND BELOW MAST ARM ON NEAR SIDE OF STREET.
- ② PREFERRED PLACEMENT FOR TIMBER POLE OR STRAIN POLE INSTALLATIONS. MOUNT AS HIGH AS POSSIBLE TO A MAXIMUM OF 30 FT ON TIMBER OR SPAN WIRE POLES. ON MAST ARM POLES, MOUNT BELOW CONNECTION OF MAST ARM TO A MINIMUM OF 15 FT.
- ③ ALTERNATE PLACEMENT LOCATION. MOUNT AS HIGH AS POSSIBLE TO A MAXIMUM OF 30 FT TO PREVENT OCCLUSION OF THE LEFT TURN LANES. THIS PLACEMENT TO BE USED ONLY IF RPDD CANNOT BE MOUNTED IN THE PREFERRED PLACEMENT LOCATIONS.

ADVANCE (RADD)

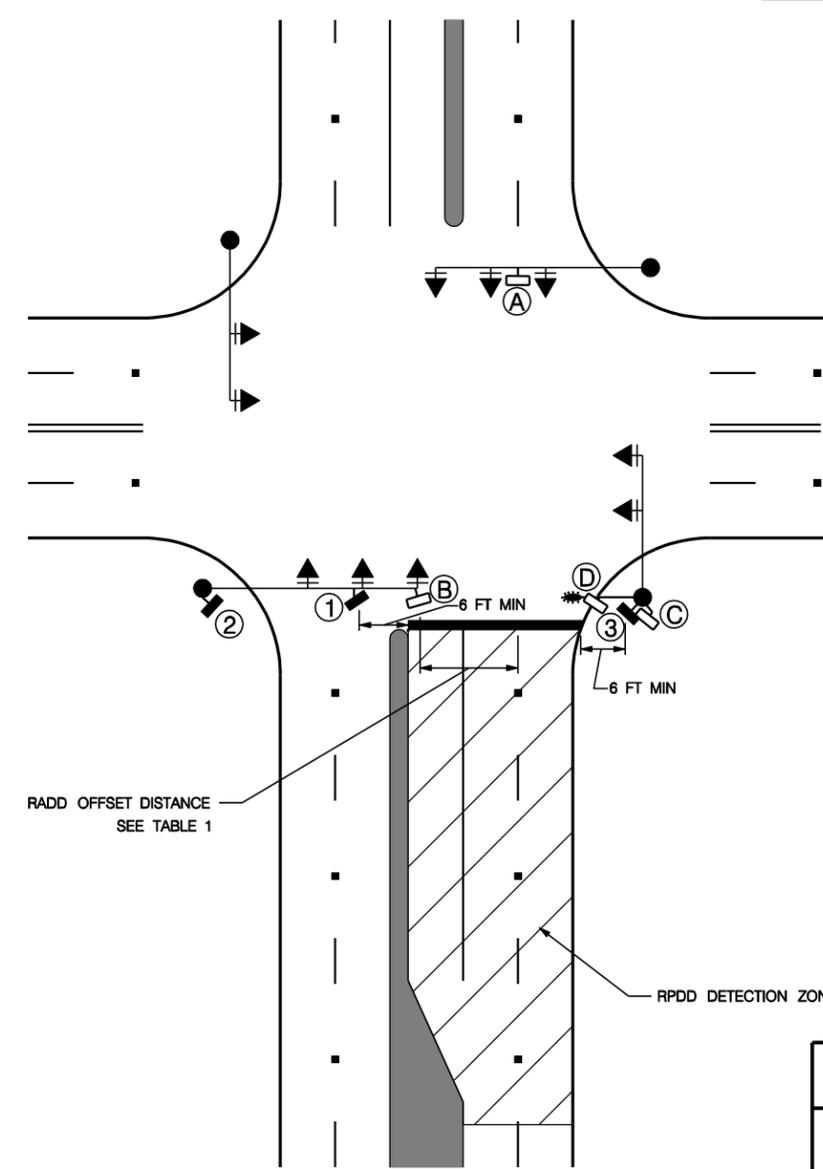
- Ⓐ PREFERRED PLACEMENT FOR MAST ARMS. ALIGN RADD WITH CENTER OF TRAVEL LANES.
- Ⓑ ALTERNATE PLACEMENT FOR MAST ARMS. MOUNT ON BACK SIDE OF OPPOSING MAST ARM.
- Ⓒ TIMBER OR STRAIN POLE PLACEMENT. MOUNT ON NEAR SIDE POLE.
- Ⓓ ALTERNATE TIMBER OR STRAIN POLE PLACEMENT. MOUNT LUMINAIRE ARM ON NEAR SIDE POLE WITH A MAXIMUM 40 FT MOUNTING HEIGHT.



SKewed INTERSECTION RPDD PLACEMENT
NTS



TYPICAL RPDD DETECTION RANGE
NTS



PLAN VIEW
NTS

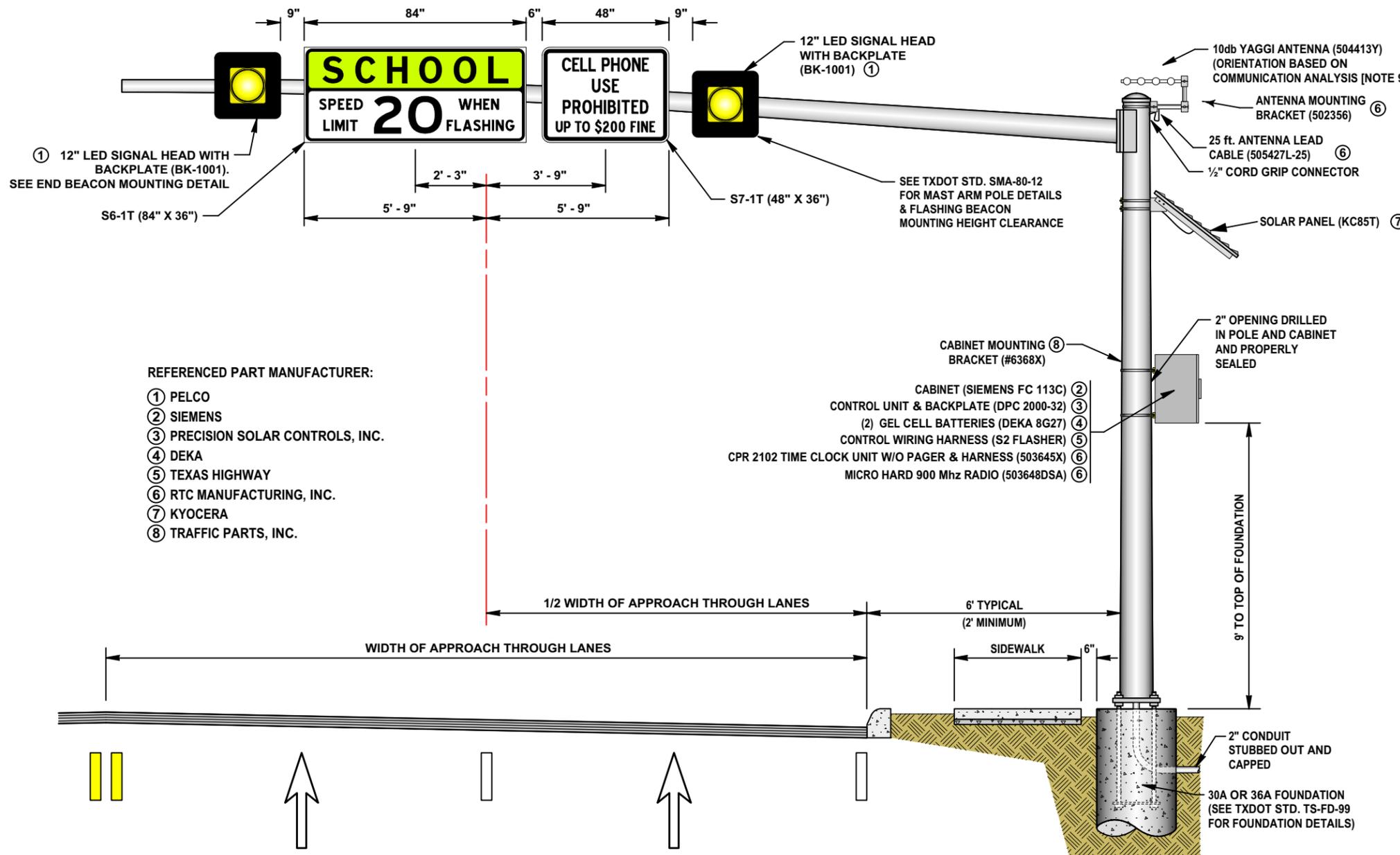
- NOTES:**
- 1) A MINIMUM 6 FT HORIZONTAL OFFSET MUST BE MAINTAINED BETWEEN THE RPDD AND THE DETECTION ZONE
 - 2) THE RPDD SHALL BE MOUNTED SUCH THAT AT LEAST 20 FT ALONG THE FARTHEST LANE TO BE MONITORED IS WITHIN THE FIELD OF VIEW OF THE RPDD
 - 3) AIM RPDD AT THE CENTER OF THE LANES TO BE MONITORED, APPROXIMATELY 50 FT FROM THE RPDD UNIT
 - 4) MOUNT RPDD SO THAT ITS FIELD OF VIEW IS NOT OCCLUDED BY POLES, SIGNS, OR OTHER STRUCTURES
 - 5) RADD MOUNTING HEIGHT SHALL NOT BE LESS THAN 17 FT OR GREATER THAN 40 FT. RADD MOUNTING LOCATION SHALL HAVE A MAXIMUM 50 FT LATERAL OFFSET FROM CENTER OF TRAVEL LANES TO BE MONITORED

APRIL 2010

CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

TRAFFIC SIGNAL STANDARDS
**RADAR PRESENCE DETECTOR (RPDD)
AND RADAR ADVANCE DETECTOR (RADD)
PLACEMENT**
SHEET 1 OF 1

% SUBMITTAL	PROJECT NO.:	DATE:
DRWN. BY: DNM	DSGN. BY: DNM	CHKD. BY: GDG
SHEET NO.:		OF

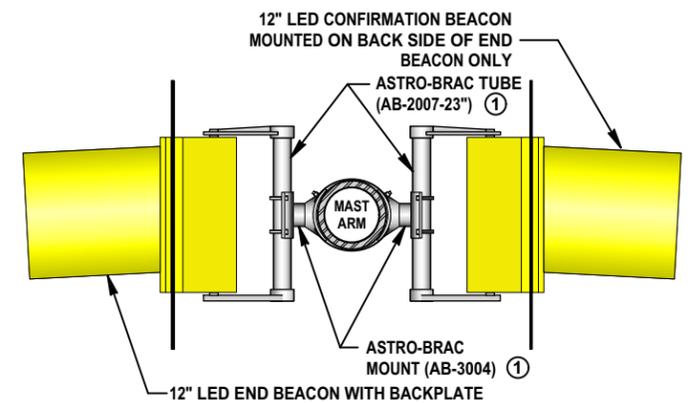


GENERAL NOTES

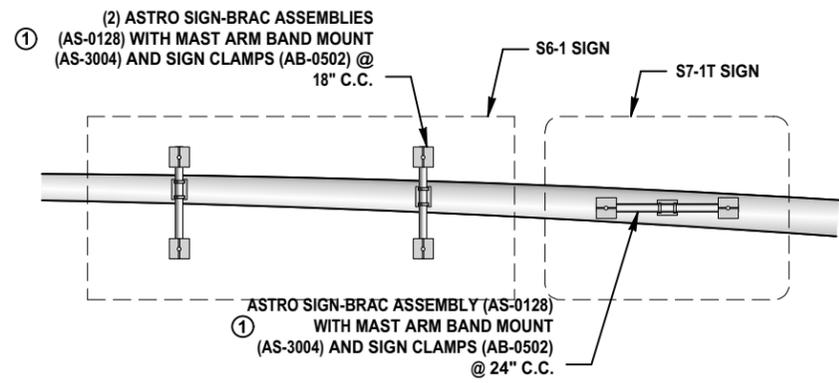
- ① SPEED LIMIT LEGEND SHALL BE AS SPECIFIED BY THE ENGINEER.
- ② MAST ARM LENGTH SHALL BE LONG ENOUGH TO PROVIDE SIGN PLACEMENT AND BEACON SPACING AS INDICATED. FOUNDATION WIDTH AND DEPTH WILL DEPEND ON MAST ARM LENGTH USED. REFER TO SHEET TS-FD-99 FOR FOUNDATION INFORMATION.
- ③ A CONFIRMATION BEACON WITH BACKPLATE SHALL BE PROVIDED ON THE BACK SIDE OF THE MAST ARM OPPOSITE THE OUTERMOST FRONT FACING BEACON.
- ④ SOLAR PANEL SHALL BE ORIENTED TO PROVIDE THE MAXIMUM EXPOSURE TO THE SUN.
- ⑤ MANUFACTURER'S NAMES AND PRODUCT NUMBERS ARE PROVIDED FOR REFERENCE ONLY. EQUIVALENT PRODUCTS MAY BE USED WITH APPROVAL FROM THE ENGINEER.
- ⑥ MAST ARM SCHOOL FLASHER TO BE USED FOR MULTI-LANE ROADWAYS AND ROADWAYS WITH POSTED SPEEDS GREATER THAN 35 MPH. FOR OTHER LOCATIONS THE ROADSIDE FLASHER ASSEMBLY SHOULD BE USED.
- ⑦ THE WIRING FOR THE BEACONS SHALL BE A THHN/THWN #16 AWG STRANDED CONDUCTOR WITH THE FOLLOWING COLOR ASSIGNMENTS:
LAMP + = WHITE
LAMP 1 = BLUE (LEFT FRONT BEACON)
LAMP 2 = YELLOW (RIGHT FRONT BEACON)
LAMP 3 = GREY (REAR BEACON)
- ⑧ THE CONTRACTOR SHALL COIL AN EXTRA 12 INCHES OF WIRING AT THE BEACONS AND THE CABINET
- ⑨ THE CONTRACTOR SHALL FURNISH A FULLY OPERATIONAL SCHOOL FLASHER COMMUNICATIONS SYSTEM. ADDITIONAL COMMUNICATIONS REPEATER STATIONS AND/OR MASTER RADIOS MAY BE REQUIRED IN ORDER TO ENABLE COMMUNICATIONS FROM THE SCHOOL FLASHER LOCATION BACK TO THE TRAFFIC MANAGEMENT CENTER. A COMMUNICATIONS ANALYSIS SHOULD BE COMPLETED BY CONSOLIDATED TRAFFIC CONTROLS, INC. ((817) 265-3421) TO DETERMINE WHICH ADDITIONAL COMPONENTS ARE REQUIRED.

REFERENCED PART MANUFACTURER:

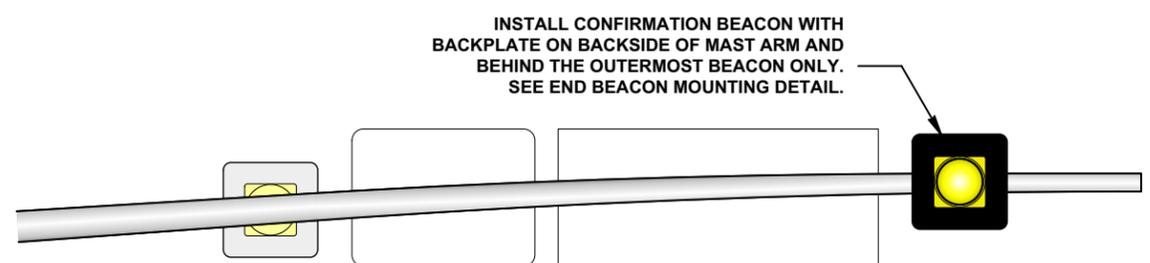
- ① PELCO
- ② SIEMENS
- ③ PRECISION SOLAR CONTROLS, INC.
- ④ DEKA
- ⑤ TEXAS HIGHWAY
- ⑥ RTC MANUFACTURING, INC.
- ⑦ KYOCERA
- ⑧ TRAFFIC PARTS, INC.



END BEACON MOUNTING DETAILS



FRONT VIEW SIGN MOUNTING DETAIL



REAR VIEW CONFIRMATION BEACON DETAIL



CITY OF SAN ANTONIO
TRANSPORTATION AND CAPITAL IMPROVEMENTS
TRAFFIC MANAGEMENT

TRAFFIC SIGNAL STANDARDS

**MAST ARM MOUNTED
SOLAR POWERED SCHOOL
FLASHER ASSEMBLY**

DRWN: MSJ	APVD: DPW	DATE: 10/08/07	TS-MASF-15 (SHEET 1 OF 1)
RVSD: MAB	APVD: DPW	DATE: 04/04/12	
RVSD: MSJ	APVD: TCI	DATE: 09/22/15	

SCHOOL RELATED SIGNS



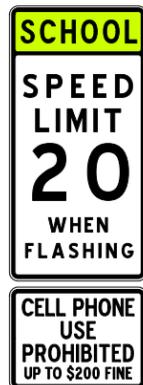
S1-1
36" x 36"
(DIAMOND GRADE FLUORESCENT YELLOW GREEN)



SW16-9P
24" X 12"
(DIAMOND GRADE FLUORESCENT YELLOW GREEN)



SW16-7P
24" X 12"
(DIAMOND GRADE FLUORESCENT YELLOW GREEN)



S5-1
24" x 48"
(DIAMOND GRADE FLUORESCENT YELLOW GREEN)
(HIGH INTENSITY WHITE)

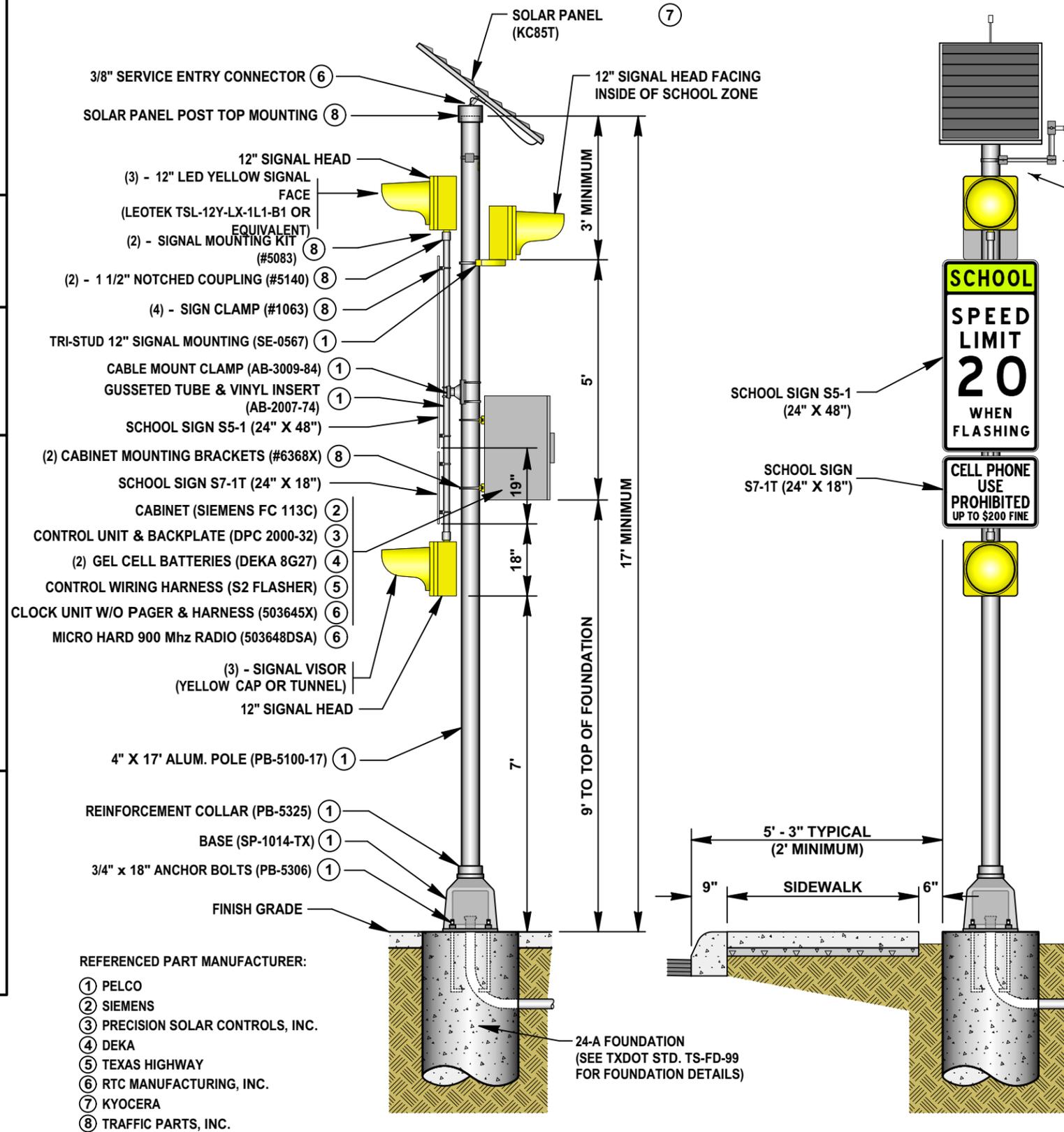


S7-1T
24" x 18"
(HIGH INTENSITY WHITE)



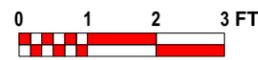
S5-2aTP
24" x 10"
(HIGH INTENSITY WHITE)

R2-1
24" x 30"
(HIGH INTENSITY WHITE)



REFERENCED PART MANUFACTURER:

- ① PELCO
- ② SIEMENS
- ③ PRECISION SOLAR CONTROLS, INC.
- ④ DEKA
- ⑤ TEXAS HIGHWAY
- ⑥ RTC MANUFACTURING, INC.
- ⑦ KYOCERA
- ⑧ TRAFFIC PARTS, INC.



SIDE VIEW

FRONT VIEW

- 10db YAGGI ANTENNA (504413Y) (6)
(ORIENTATION BASED ON COMMUNICATION ANALYSIS [NOTE 9])
- ANTENNA MOUNTING BRACKET (502356) (6)
- 25 ft. ANTENNA LEAD CABLE (505427L-25) (6)

GENERAL NOTES

1. SPEED LIMIT LEGEND SHALL BE AS SPECIFIED BY THE ENGINEER.
2. IF FOUNDATION ENCLOSES ON ADJACENT SIDEWALK, TOP OF FOUNDATION SHALL MATCH SIDEWALK ELEVATION COMPLETELY. SIDEWALK SECTION SHALL BE REPLACED AS NECESSARY. REFER TO SHEET TS-FD-99 FOR FOUNDATION INFORMATION.
3. A CONFIRMATION BEACON SHALL BE PROVIDED ON THE BACK SIDE OF THE POLE AS SHOWN.
4. SOLAR PANEL SHALL BE ORIENTED TO PROVIDE THE MAXIMUM EXPOSURE TO THE SUN.
5. MANUFACTURER'S NAMES AND PRODUCT NUMBERS ARE PROVIDED FOR REFERENCE ONLY. EQUIVALENT PRODUCTS MAY BE USED WITH APPROVAL FROM THE ENGINEER.
6. ROAD SIDE SCHOOL FLASHER TO BE USED FOR NON-MULTI-LANE ROADWAYS AND ROADWAYS WITH POSTED SPEEDS OF 35 MPH OR LESS. FOR OTHER LOCATIONS THE MAST ARM FLASHER ASSEMBLY SHOULD BE USED UNLESS DIRECTED OTHERWISE BY THE CITY.
7. THE WIRING FOR THE BEACONS SHALL BE A THHN/THWN #16 AWG STRANDED CONDUCTOR WITH THE FOLLOWING COLOR ASSIGNMENTS:
 LAMP + = WHITE
 LAMP 1 = BLUE (TOP FRONT BEACON)
 LAMP 2 = YELLOW (BOTTOM FRONT BEACON)
 LAMP 3 = GREY (REAR BEACON)
8. THE CONTRACTOR SHALL COIL AN EXTRA 12 INCHES OF WIRING AT THE BEACONS AND THE CABINET
9. THE CONTRACTOR SHALL FURNISH A FULLY OPERATIONAL SCHOOL FLASHER COMMUNICATIONS SYSTEM. ADDITIONAL COMMUNICATIONS REPEATER STATIONS AND/OR MASTER RADIOS MAY BE REQUIRED IN ORDER TO ENABLE COMMUNICATIONS FROM THE SCHOOL FLASHER LOCATION BACK TO THE TRAFFIC MANAGEMENT CENTER. A COMMUNICATIONS ANALYSIS SHOULD BE COMPLETED BY CONSOLIDATED TRAFFIC CONTROLS, INC. ((817) 265-3421) TO DETERMINE WHICH ADDITIONAL COMPONENTS ARE REQUIRED.

CITY OF SAN ANTONIO
TRANSPORTATION AND CAPITAL IMPROVEMENTS
TRAFFIC MANAGEMENT

**TRAFFIC SIGNAL STANDARDS
ROADSIDE POLE
MOUNTED SOLAR
POWERED SCHOOL
FLASHER ASSEMBLY**

DRWN: MSJ	APVD: DPW	DATE: 10/08/07	TS-RSSF-15 (SHEET 1 OF 1)
RVSD: MAB	APVD: DPW	DATE: 04/04/12	
RVSD: MSJ	APVD: TCI	DATE: 09/22/15	