

Special Specification 7193

Traffic Management Maintenance



1. DESCRIPTION

Maintain, furnish, install, modify, repair, replace, or remove components of a Traffic Management System. For the purpose of this contract "restore to normal operating condition" will mean that the items will operate as intended per the original equipment manufacturer's specifications.

2. LICENSES AND CERTIFICATIONS

- 2.1. **Qualifications and Certifications for Traffic/Freeway Technicians.** The purpose of this item is to describe the qualifications and attributes of a traffic/freeway management technician. Any person employed by the Contractor who does not meet these qualifications or does not perform work in a safe manner will be removed from the project, and not be replaced without the express written approval of the Department.
- 2.1.1. **General.** A traffic/freeway management technician must be an English speaking individual who is familiar with and competent to do traffic signal and freeway management maintenance work. The technician must be capable of following wiring diagrams, and must be capable of testing and running diagnostics on various traffic systems and sub-systems. The technician must be skilled at making both soldered, crimp and terminal electrical connections. The technician must be familiar with the Department Standards and Specifications on construction methods for foundations and other construction items required by the Engineer.
- 2.1.2. **Certified "Fiber Optics Technician".** A certified Fiber Optics Technician is defined as a person that submits one of the following:
- A current and valid certification signifying successful completion of the Texas Engineering Extension Service (TEEX) course entitled, "Fiber Optic Installer Certification" and passing the associated test, or successful completion of the test only from the above mentioned course or completion and certification from the Light Brigade course "Fiber Optics 1-2-3" or equivalent course.
 - A current and valid certification signifying successful completion of the Electronics Technician Association (ETA) course entitled, "Fiber Optic Installer Certification" and passing the associated test, or successful completion of the test only from the above mentioned course or equivalent course
- 2.1.3. **Certified/Licensed "Electric Personnel".** Electrical licensing and electrical certification requirements must be in accordance with Item 7 and all applicable special provisions to Item 7.
- 2.1.4. **Certified "Copper Cable Splicer".** A certified "Copper Cable Splicer" is defined as a person that submits one of the following:
- A current and valid certification signifying successful completion of the Texas Engineering Extension Service (TEEX) course entitled, "Cable Splicing" and passing the associated test, or successful completion of the test only from the above-mentioned course or equivalent course.
 - A minimum of 5 years of experience in troubleshooting, grounding and bonding, splicing, sealing of the completed splice to prevent the entrance of moisture, and termination practices of copper cable in accordance with the Department and Bellcore's most recent specifications for both aerial and buried copper cable plants.
- 2.1.5. **Certified "Traffic Signal" Technician.** A certified "Traffic Signal" Technician is defined as a person that submits one of the following:

- A current and valid certification signifying successful completion of the International Municipal Signal Association (IMSA) course entitled, "Traffic Signal Technician Level I" and passing the associated test, or successful completion of the test only from the above-mentioned course or equivalent course.
- A minimum of 5 years of experience in trouble shooting, programming, installation and general maintenance of 170 and NEMA Traffic Signal Controllers and all other associated equipment.

2.1.6.

Certified "Freeway Management" Technician. A certified "Freeway Management" Technician is defined as a person that has a minimum of 2 years of experience on installing, repairing and general maintenance of the following Freeway Traffic Management (FTM) equipment*:

- Local Control Unit (LCU) interfaces: Gates, Vehicle loop detectors, Ramp metering, Lane control signals
- Limited Distance Modem (LDM): Configuring, Installing, Testing
- CCTV Central Equipment: Transmission system, Switching system, NTSC signal standards
- CCTV Field Equipment: Transmission system, Camera electronics, Lens interfaces
- Hub Cabinets, Buildings, Interface or communications cabinets: Back panels, Detector card racks, Surge suppressions, EMI
- DMS Signs and controllers: Installation, Repairs, Communications, Copper/Fiber Optics, General Maintenance
- VIVDS systems and cameras: Installation, Repairs, Communications, Copper/Fiber Optics, General Maintenance
- IP Based equipment-Ethernet devices, CODECS, Switches, Media Converters
- Underground Environmentally Controlled Unit Vault (ECUV)-Confined Space Training and OSHA certification.

The Signal/Freeway Management System Technician must be on the job at all times and will be the individual who either does or supervises the work, and will be the individual who completes the appropriate maintenance forms upon completion of the work. This technician should also be available twenty-four hours a day to respond to emergency calls and must have a two-hour window in which to respond and evaluate the nature of the emergency. Within this two-hour window, the technician will secure the area and ensure that the area is safe for the traveling public before leaving the location.

After the emergency has been evaluated and made safe for the traveling public, the technician will have eight hours in which to mobilize its force(s) and repair the problem. If the problem cannot be repaired due to availability of part(s) and materials, a temporary solution will be allowed in order to permit the rest of the system to continue to operate. This temporary solution must be done in a safe manner and must comply with all codes and specifications as approved by the Engineer.

3.
MATERIALS

Unless otherwise noted on the plans, the Department will only furnish Electronic Circuit Cards, Power Supplies, modems and those items listed in the General Notes. All electronic equipment and materials supplied by the Contractor will be approved by the Engineer before installation. At a minimum, the material will be in accordance with the original manufacturer's specification. All material will be new and unused. The contractor must provide three sets of submittals on items to be replaced that differ from original equipment. This includes circuit cards, lamps, video, and data communication components.

The contractor will provide all materials for preventative maintenance. Some examples could include lamps, air filters, rags, and cleaning supplies.

Assume responsibility for all materials furnished by the Department. Use material furnished by the Department for this contract only. Return unused or removed materials deemed salvageable by the Engineer to the Department upon completion of work and prior to final payment at location shown on the plans or as directed. Dispose of any material deemed not salvageable by the Engineer in accordance with

the federal, state, and local regulations. When materials are required to be furnished by the contractor, meet the material requirements of the pertinent Item for the material requirements.

Various existing items may be under warranty from the manufacturer. In the event of a failure of those items, the state will return the component(s) to the manufacturer for repair and provide the contractor with a replacement for installation. This situation will result in the contractor getting paid for troubleshooting. The state may provide electronic components to assist in troubleshooting various items.

For all material supplied by the state, the Contractor must submit either a material list on the Contractor's letterhead or a State Material Requisition Form, which must be approved by the State's Inspector. The Contractor will designate in writing the person(s) to pick up materials.

Prior to payment, all salvaged material and components will be cleaned, tagged, and returned to the locations designated by the Engineer. Otherwise, payment will not be made.

4. EQUIPMENT

Required equipment includes, but is not limited to an aerial device capable of reaching overhead work, trenching machine, boring machine, concrete saw digger boom truck, fiber optic test and repair equipment such as optical time domain reflectometer, fusion splicer, and power meters. Repair or replace equipment, tools, and machinery that, in the opinion of the Engineer, may affect the quality of work or safety.

5. WORK METHODS

Conform to the latest edition of the National Electric Code as adopted by the Texas Department of Licensing and Regulation, local utility requirements, the requirement of this item, and the pertinent requirements of the following Items:

- Item 416, "Drilled Shaft Foundations"
- Item 421, "Hydraulic Cement Concrete"
- Item 476, "Jacking Boring or Tunneling Pipe or Box"
- Item 618, "Conduit"
- Item 620, "Electrical Conductors"
- Item 622, "Duct Cable"
- Item 624, "Ground Boxes"
- Item 627 "Treated Timber Poles"
- Item 628, "Electrical Services"
- Item 656, "Foundations for Traffic Control Devices"
- Item 680, " Highway Traffic Signals"
- Item 682, "Vehicle and Pedestrian Signal Heads"
- Item 684, "Traffic Signal Cables"
- Item 685, "Roadside Flashing Beacon Assemblies"
- Item 686, "Traffic Signal Pole Assemblies (steel)"
- Item 687, "Pedestrian Pole Assemblies"
- Item 688, "Pedestrian Detectors and Vehicle Loop Detectors"

Perform the following work as directed:

- 5.1. **Barricades, Signs and Traffic Handling for Main Lanes of Freeway.** Provide, install, move, replace maintain, clean and remove these devices in accordance to the Texas Manual of Uniform Traffic Control Devices (MUTCD) and the TxDOT Traffic Control Plan Standards (TCP Standards).

- 5.2. **Barricades, Signs and Traffic Handling for Service Roads and Ramps.** Provide, install, move, replace maintain, clean and remove these devices in accordance to the Texas Manual of Uniform Traffic Control Devices (MUTCD) and the TxDOT Traffic Control Plan Standards (TCP Standards).
- 5.3. **Troubleshoot Equipment.** Repair, modify, troubleshoot, test or replace components to restore the assembly back into normal operation. The Contractor will install replacement equipment, as deemed necessary by the Engineer, to restore the Equipment to normal operation. The Contractor is to restore the system to safe operation until the Equipment can be permanently repaired.
- 5.4. **Power, Signal, Interconnect, and Communication Cable (of Type Specified).** Remove, replace, install, modify, and test Cable, and return all salvageable materials to the location designated by the Engineer. Install a replacement cable, furnished by the Contractor, and restore the cable to normal operation.
- 5.5. **Troubleshoot Power, Signal, Interconnect, and Communication Cable (of Type Specified).** Troubleshoot, Test, and modify the Cable. The Contractor must splice or replace the existing Cable, as deemed necessary by the Engineer, to restore the Cable to normal operation. Replacement will be paid separately.
- 5.6. **Graffiti Removal.** Clean, wash, and paint electronic cabinets and buildings located along the roadway of all dirt and graffiti. Contractor must attempt to chemically clean or pressure washes these structures prior to painting as directed by the engineer. While washing or painting use necessary action to prevent dirt or damage to vehicles and pedestrian. Paint will be applied as a last resort and applied in a professional manner. If only a small area requires work, paint the entire side or block, paint the area with matching colors. Spills, masking, and waste must be removed from the right of way and disposed in accordance to the manufacturers' recommendations.
- 5.7. **System Components.** Remove, replace, or install necessary components, rack or shelf mounted such as circuit cards, power supplies, modems, video mux or demux, T1 cards, OTN cards or other devices not listed as necessary to restore correct operation of equipment.
- 5.8. **CCTV Camera (including pan tilt unit).** Remove, replace, install, and test the CCTV Camera, pan tilt unit, and all accessories and return all salvageable materials to the location designated by the Engineer. Install a replacement unit, and restore the camera assembly to normal operation.
- 5.9. **CCTV Camera Controller.** Remove, replace, install, and test Camera Controller and all accessories and return all salvageable materials to the location designated by the Engineer. Install a replacement unit and restore the controller assembly to normal operation. Provide test procedures to verify controller functionality.
- 5.10. **CCTV Controller Cabinet (Ground or Pole Mount).** Remove, replace, install and test CCTV Controller Cabinet and all accessories and return all salvageable materials to the location designated by the Engineer. Install a replacement unit and restore the Controller Cabinet to normal operation.
- 5.11. **CCTV Camera Pole.** Remove, replace, modify, and install CCTV Camera Pole and all accessories and return all salvageable materials to the location designated by the Engineer. Install a replacement unit and restore the CCTV Camera Pole assembly to normal operation.
- 5.12. **Preventive Maintenance of CCTV Camera System.** Maintain, inspect, and test CCTV System. Complete and sign CCTV Preventive Maintenance Forms. Fill out these forms legibly and completely. A Department inspector will also sign each CCTV Preventive Maintenance Form. Verify proper operation thru TransVista during remote operation. In addition, the Contractor will list all materials used at this location. The Contractor will perform the following preventive maintenance at each location at least once during the term of the contract, and at approximately 6 months intervals or as directed by the engineer.
- Inspect camera-housing seals.
 - Clean windshield.
 - Inspect pan-tilt unit for proper operation.

- Inspect pan-tilt for environmental damage.
 - Inspect all cables for proper connections.
 - Inspect camera and lens (including zoom) for proper operation.
 - Clean controller cabinet exterior removing graffiti, dirt and debris. High pressure hose should not be used.
 - Inspect camera for environmental damage.
 - Adjust camera and DSP if necessary and restore to normal operation.
 - Inspect camera receiver for proper operation.
 - Inspect camera receiver for environmental damage.
 - Inspect camera receiver cable connections.
 - Inspect lightning rod assembly for proper connections.
 - Clean camera lens using lens paper or chamois. Camera lens will be cleaned of all water spots, dust and debris, and should appear streak free.
- 5.13. **Troubleshoot Microwave Detection (RVSD) System.** Test, troubleshoot, modify and repair components in the system to restore the assembly back into normal operation. Install replacement equipment, as deemed necessary by the Engineer, to restore the RVSD System to normal operation.
- 5.14. **RVSD.** Replace, install and test, and adjust RVSD to restore the assembly back into normal operation per the manufacturer guidelines and specifications. At minimum the Contractor will utilize the fiber optic transmission system as the carrier of the signal telecommunication system so that diagnostic tests can be performed at either the central building (Trans Vista), or at the field equipment site.
- 5.15. **RVSD Controller Cabinet (Ground or Pole Mount).** Remove, replace, modify, and install Controller Cabinet, and return all salvageable materials to the location designated by the Engineer. The Contractor will then install a replacement unit and restore the Controller Cabinet to normal operation.
- 5.16. **RVSD Pole.** Remove and replace RVSD Camera Pole and all accessories and return all salvageable materials to the location designated by the Engineer. The Contractor will then install a replacement unit and restore the RVSD Camera Pole assembly to normal operation.
- 5.17. **RVSD System Preventive Maintenance.** Maintain and service RVSD systems, and modify, complete, and sign RVSD system maintenance forms. A Department inspector will also sign the form. As part of the preventive maintenance, the Contractor will perform the following preventive maintenance at approximately 4-6 month intervals or as directed by the Engineer for solar powered RVSD systems:
- Inspect and clean solar array.
 - Align solar panel to south (if practical). Clean batteries, battery post, and all electrical connections.
 - Test battery charge (12.6-12.8 VDC).
 - Test charging system (per manufacturer specifications)
- 5.18. **Batteries.** Remove, replace, and install batteries. Clean and repair electrical connections to restore the system to normal operation and return all salvageable materials to the location designated by the Engineer. Unless otherwise noted, the batteries used will be 'gel cell', with type and size as specified by the Engineer.
- 5.19. **Amber or Color Dynamic Message Sign Controller.** Remove, replace, or install DMS Sign Controller and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the Controller assembly to normal operation. Provide test procedures to verify controller functionality.
- 5.20. **Equipment Cabinet.** Remove, replace, and install Equipment Cabinet and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the Cabinet assembly to normal operation.
- 5.21. **Troubleshoot Fiber Optic Cable (Multi-Mode or Single-Mode).** Test, and troubleshoot, the Fiber Optic Cable. The Contractor, at a minimum, must:

- Test the cable with an OTDR operating within the appropriate wavelengths in order to locate the fault.
- Test any optical jumpers or optical interconnects using an optical light source and power meter operating within the appropriate wavelengths.
- Locate and document where the suspect fault is.
- Documentation will be returned to TxDOT in the form of a CD or other compatible media with a personal computer format, as well as a hard copy plot of the suspect fault. The Contractor will provide the Department with the software to display the diskette information on a PC.

5.22. **Fiber Optic Cable (Multi-Mode or Single-Mode).** Remove, replace, install, and test Cable and return all salvageable materials to the location designated by the Engineer. The Contractor will then install a replacement Cable, and perform the following functions:

- Test all fiber optic cable prior to installation with an Optical Time Domain Reflectometer (OTDR) operating at 1310 nm and 1550 nm.
- Test all fiber optic cable after installation with an Optical Time Domain Reflectometer (OTDR) operating at 1310 nm and 1550 nm.
- Test all fiber optic cable with a two (2) point test using an OTDR operating at 1310 nm and 1550 nm. Provide end-to-end OTDR results in the form of a USB drive and a hard copy plot of the end-to-end tests.
- The Contractor will provide or replace any damaged fiber optic termination connector systems of fiber optic distribution bins with associated splice trays, and any auxiliary connectors or jumpers.

5.23. **Splice Fiber Optic Cable (Multi-Mode or Single-Mode).**

5.23.1. **Temporary Splicing/Repairs.**

- The Contractor will provide a quick mechanical splice configuration for splice trays, outdoor splice boxes and auxiliary jumpers, including cable dressing materials and tools required for preparing the fiber optic cable.
- This process will be provided while ordering permanent support for the fiber optic cable that is being repaired.
- All mechanical splices must be tested, with a maximum allowable loss of 0.8 dB, unless otherwise noted by the Engineer.

5.23.2. **Permanent Splicing/Repairs.**

- The Contractor will provide for replacing the faulty fiber optic cable, enclosure, splice trays, and associated cable dressing materials.
- The Contractor will provide for fusion splicing utilizing a fusion splicer with light insertion device (LID) that measures loss of the fusion splice at 1310 nm or 1550 nm, and the use of an optical power light meter (OPM) to confirm the connector/jumper losses.

5.23.3. **Testing.**

- The Contractor will provide for testing of all replaced cable and ancillary fiber optic equipment.
- This testing should consist of the use of an OTDR and Optical Power Meter and light source.
- All testing will be performed at within the appropriate wavelengths.
- The Contractor will provide end to end testing with the results recorded on a CD or other compatible electronic media and a loss plot in dB.
- The Contractor will provide all optical power meter and the results will be recorded in a loss form in dB.
- All connector loss figures must be less than: 0.03 dB for Single-Mode and Multi-Mode.
- The Contractor will provide for fusion splice loss on permanent cable to be less than: 0.03 dB for Multi-Mode or 0.03 dB for Single-Mode applications.
- The Contractor will provide all additional testing or verification and will be as directed by the Engineer.

- 5.24. **Individual Fiber.** Repair, modify, or install Individual fiber strands, and splice, terminate, or repair as needed. This item must be used in damaged pigtailed or other locations where entire cable replacement is not needed, as directed by the Engineer.
- 5.25. **HUB Cabinet.** Remove, replace, test, and install damaged HUB Cabinet and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the HUB Cabinet unit assembly to normal operation.
- 5.26. **HUB Building.** Remove, replace, test, and install HUB Building and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the HUB Building unit assembly to normal operation.
- 5.27. **HUB Building Preventive Maintenance.** The Contractor must complete and sign Preventive Maintenance Forms at each HUB Building. The Contractor will fill out these forms, legibly and completely.
- A Department inspector will also sign each Preventive Maintenance Form at the HUB Building. In addition, the Contractor must list all materials at each location. The Contractor will perform the following preventive maintenance at each location at least once during the term of the contract, and at approximately six (6) month intervals or as directed by the engineer:
 - Test fan and thermostat and adjust as necessary.
 - Replace air filter.
 - Replace or clean air conditioner filter as directed by the Engineer.
 - Clean condensers, evaporator coils, fins, and filters.
 - Lubricate AC motors in accordance with manufacturers' specifications.
 - Lubricate locks and doors as necessary.
 - Inspect building for environmental damage.
 - Remove all graffiti. High pressure water hose should not be used. Clean off all dirt and debris.
 - Dust and vacuum all components. Use an appropriate ground strap to eliminate high electrostatic voltages caused by the flow of air.
 - Test building lights for operation and replace all lamps.
 - Inspect all cables and connectors, including fiber optic patch panels. Verify cable labeling with Engineer. Replace or add labels to cables as necessary.
 - Check building for rodent and insect infestation and dispense pesticides as necessary.
 - The Contractor must check the Uninterruptable Power Supply (UPS) by performing the following functions:
 - The by-pass switch must be checked for dynamic operations.
 - The Contractor will check the UPS controller diagnostics.
 - Contractor must check the sealed batteries for leaks or out-gassing.
 - The Contractor will remove the primary power to confirm UPS back-up operations for 30 minutes and restore power. Coordinate primary power disconnect with Engineer.
 - Test pump system as per manufacturers' specifications.
 - Test De-Humidifier and air exchangers as per manufacturers' specs.
- 5.28. **HUB Cabinet Preventive Maintenance.** The Contractor must complete and sign Preventive Maintenance Forms at each HUB Cabinet. The Contractor will fill out these forms, legibly and completely. A Department inspector will also sign each Preventive Maintenance Form. In addition, the Contractor must list all materials at each location. The Contractor will perform the following preventive maintenance at each location at least once during the term of the contract, and at approximately six (6) month intervals or as directed by the engineer:
- Test fan and thermostat and adjust as necessary.
 - Replace air filter.
 - Lubricate locks and doors as necessary.
 - Inspect cabinet for environmental damage.

- Dust and vacuum all components.
 - Test cabinets light for operation and replace lamp.
 - Inspect all cables and connectors including fiber optic patch panels. Verify cable labeling with Engineer. Replace or add labels to cables as necessary.
 - Check cabinet for rodent and insect infestation and dispense pesticides as necessary.
 - Erase or eliminate all graffiti, clean cabinet exterior of all dirt and debris.
- 5.29. **Lane Control Signal (HOV support or FRWY).** Remove, replace, install, and test Signals and all accessories (to include support brackets) and return all salvageable materials to the location designated by the Engineer. Restore the Signal assembly to normal operation.
- 5.30. **Electrical Service.** Install, repair, replace, remove, or modify an electrical service assembly in accordance with Item 628, "Electrical Services" as shown on the plans or as directed.
Mount any and all of the following on an electrical service support assembly: conduit, weather head, load center, meter base, lighting protection, wiring, and associated hardware.
- 5.31. **Electrical Service Enclosure.** Replace Power Connection (excluding poles) must include removing and salvaging the existing equipment, installing new switch gear and complete electrical service enclosure as specified in the current Electrical Detail (ED) Sheets for types A, C, D, or T with electrical conductors and photocell, and making the connection to the power company service for complete power restoration.
- 5.32. **Bore Conduit (2" or 3").** Install, replace, remove, or modify conduits in accordance with Item 618, "Conduit" as shown on the plans or as directed. Use 90-degree sweep type elbow on conduits entering a ground box. The Contractor will furnish and install all conduits.
- 5.33. **Trench Conduit (2" or 3").** Install, replace, remove, or modify conduits in accordance with Item 618, "Conduit" as shown on the plans or as directed. Use 90-degree sweep type elbow on conduits entering a ground box. The Contractor will furnish and install all conduits.
- 5.34. **Above Ground Conduit (2" or 3").** Install, replace, remove, or modify conduits in accordance with Item 618, "Conduit" as shown on the plans or as directed. Use 90-degree sweep type elbow on conduits entering a ground box. The Contractor will furnish and install all conduits.
- 5.35. **Ground Box with Apron.** Install, remove, replace, or modify ground boxes in accordance with Item 624, "Ground Boxes", as shown on the plans, or as directed. Use ground box of the size and type specified. The Contractor will furnish all ground boxes.
- 5.36. **VIVDS Detector Camera.** Remove, replace, install, and test VIVDS Detector Camera and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the assembly to normal operation.
- 5.37. **VIVDS Detector Controller.** Remove, replace, repair, modify, and test VIVDS Detector Controller and all accessories and return all salvageable materials to the location designated by the Engineer. The contractor will then install a replacement unit and restore the Controller Assembly to normal operation.
- 5.38. **Transportation Management Console CPU.** Repair, replace, install, and test Console CPU and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the controller Assembly to normal operation.
- 5.39. **Transportation Management Console Monitor.** Remove, replace, repair, install, and test Console Monitor and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the Assembly to normal operation.

- 5.40. **Network Management System Diagnostics Unit CPU.** Repair, replace, install, modify, and test Network Management System Diagnostics Unit CPU and all accessories and return all salvageable materials to the location designated by the Engineer.
- 5.41. **Pedestrian Pole Foundation.** Install, replace, or remove foundations of the type specified in accordance with Item 416, "Drilled Shaft Foundations", Item 656, "Foundations for Traffic Control Devices", and as shown on the plans or as directed.
- 5.42. **DMS controller Foundation.** Install, replace, or remove foundations of the type specified in accordance with Item 416, "Drilled Shaft Foundations", Item 656, "Foundations for Traffic Control Devices", and as shown on the plans or as directed.
- 5.43. **Equipment cabinet Foundation.** Install, replace, or remove foundations of the type specified in accordance with Item 416, "Drilled Shaft Foundations", Item 656, "Foundations for Traffic Control Devices", and as shown on the plans or as directed.
- 5.44. **Signal Pole Foundation.** Install, replace, or remove foundations of the type specified in accordance with Item 416, "Drilled Shaft Foundations", Item 656, "Foundations for Traffic Control Devices", and as shown on the plans or as directed.
- 5.45. **Open Transport Network (OTN).** Remove, replace, install, and test the OTN and its associated hardware and components. Provide testing procedures to Engineer before testing. A Department inspector must be present during testing and provide written approval for acceptance of new OTN equipment.
- 5.46. **Service HAR Equipment.** All Highway Advisory Radio (HAR) will be serviced annually to include clean and service batteries, and to inspect and tighten all bolts, clamps, and related hardware. Clean the solar panel (if applicable), inspect, repair, and label all wiring and cables as directed by the engineer.
- 5.47. **Bluetooth Detector.** Remove, replace, install, and test Bluetooth Detector and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the Bluetooth Detector assembly to normal operation.
- 5.48. **Bluetooth Detector Maintenance.** Repair, replace, install, modify, and test Bluetooth Detector System and all accessories and return all salvageable materials to the location designated by the Engineer.
- 5.49. **Lane Management System.** Remove, replace, install, and test Lane Management System and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the Lane Management System assembly to normal operation.
- 5.50. **Lane Management System Maintenance.** Service, maintain, or install items in a DMS. The Contractor must complete and sign the Lane Management System Maintenance Service Forms. The Contractor will fill out these forms, legibly and completely. A Department inspector will also sign each Lane Management System Maintenance Form. In addition, the Contractor must list all materials used at this location. The Contractor will perform the following preventive maintenance at each location at least once during the term of the contract, and at approximately six (6) month intervals, for flip disk signs. Fiber optic and LED signs will be serviced annually or as directed by the engineer:
- Clean front and back of each character module window on front access type signs. On walk in signs, only clean the exterior windows with soapy water and a chamois cloth as directed by the Engineer.
 - Replace all sign lamps.
 - Replace all sign lamp reflectors including any damaged reflective modules.
 - Check hardware and mounting bolts on door light modules and photo cells.
 - Check all electrical connections and fiber bundle connections for tightness; re-tighten as necessary.
 - Test all lamp shutters. Replace faulty shutters as necessary. Shutters will be supplied by the Department unless otherwise noted.

- Test Day, Night, and Overbright brightness levels. Replace photo cells as necessary. Photocells will be supplied by the Department unless otherwise noted.
- Clean and remove dirt and debris from each component in each cabinet.
- Test sign enclosure light. Replace lamp as necessary.
- Check cabinet heater thermostat. Replace thermostat as necessary. Thermostats will be supplied by the Department unless otherwise noted.
- Check ground fault circuit breaker. Reset or replace as necessary.
- Check time clock for correct time and date. Reset as necessary.
- Check each time clock battery. Replace as necessary.
- Check controller cabinet lamp and AC power supply voltages.
- Inspect and clean pole bases and controller cabinet for insect and rodent buildup.
- Clean controller cabinet exterior, removing dirt, debris, and graffiti.
- Inspect all steel surfaces (poles, catwalks and cabinet bases) for scratches or rust and apply cold galvanizing material as necessary.
- Inspect each foundation bolt for tightness and re-tighten as necessary.
- Inspect all pull boxes and replace as necessary.

5.51. **DMS Amber or color.** Remove, replace, and install DMS Sign and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the DMS assembly to normal operation. Provide test procedures to verify controller functionality.

5.52. **DMS Amber or Color Maintenance.** Service, maintain, or install items in a DMS. The Contractor must complete and sign the Dynamic Message Sign Preventive Maintenance Forms. The Contractor will fill out these forms, legibly and completely. A Department inspector will also sign each Dynamic Message Sign Maintenance Form. In addition, the Contractor must list all materials used at this location. The Contractor will perform the following preventive maintenance at each location at least once during the term of the contract, and at approximately six (6) month intervals, for flip disk signs. Fiber optic and LED signs will be serviced annually or as directed by the engineer:

- Clean front and back of each character module window on front access type signs. On walk in signs, only clean the exterior windows with soapy water and a chamois cloth as directed by the Engineer.
- Replace all sign lamps.
- Replace all sign lamp reflectors including any damaged reflective modules.
- Check hardware and mounting bolts on door light modules and photo cells.
- Check all electrical connections and fiber bundle connections for tightness; re-tighten as necessary.
- Test all lamp shutters. Replace faulty shutters as necessary. Shutters will be supplied by the Department unless otherwise noted.
- Test Day, Night, and Overbright brightness levels. Replace photo cells as necessary. Photocells will be supplied by the Department unless otherwise noted.
- Clean and remove dirt and debris from each component in each cabinet.
- Test sign enclosure light. Replace lamp as necessary.
- Check cabinet heater thermostat. Replace thermostat as necessary. Thermostats will be supplied by the Department unless otherwise noted.
- Check ground fault circuit breaker. Reset or replace as necessary.
- Check time clock for correct time and date. Reset as necessary.
- Check each time clock battery. Replace as necessary.
- Check controller cabinet lamp and AC power supply voltages.
- Inspect and clean pole bases and controller cabinet for insect and rodent buildup.
- Clean controller cabinet exterior, removing dirt, debris, and graffiti.
- Inspect all steel surfaces (poles, catwalks and cabinet bases) for scratches or rust and apply cold galvanizing material as necessary.
- Inspect each foundation bolt for tightness and re-tighten as necessary.

- Inspect all pull boxes and replace as necessary.
- 5.53. **Field Ethernet Switch.** Replace, install, program and test Field Ethernet Switch and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the Field Ethernet Switch assembly to normal operation.
- 5.54. **Video Encoder or Video Decoder.** Remove, replace, install, program and test Video Encoder or Video Decoder and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the Video Encoder or Video Decoder assembly to normal operation.
- 5.55. **Terminal Server.** Remove, replace, install, program and test Terminal Server and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the Terminal Server assembly to normal operation.
- 5.56. **Cellular Modem.** Remove, replace, install, program and test Cellular Modem and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the Cellular Modem assembly to normal operation.
- 5.57. **12" LED Traffic Signal Lamp.** Remove replace, install, and test 12" LED Traffic Signal Lamp and all accessories and return all salvageable materials to the location designated by the Engineer. Restore the Traffic Signal Lamp assembly to normal operation.

6. MEASUREMENT

This Item will be measured as follows:

- 6.1. **Barricades, Signs and Traffic Handling for main lanes of freeway.** By the hour of time used to complete placement and removal of all barricades, signs, barriers, cones, lights, signals and other such devices necessary to handle traffic upon completion of work.
- 6.2. **Barricades, Signs and Traffic Handling for service roads and ramps.** By the hour of time used to complete placement and removal of all barricades, signs, barriers, cones, lights, signals and other such devices necessary to handle traffic upon completion of work.
- 6.3. **Troubleshoot Equipment.** By the hours of time used. All connections and other work incidental to testing the unit will be considered subsidiary to this Item. A maximum of 2 technicians must be assigned per incident.
- 6.4. **Power, Signal, Interconnect, and Communication Cable.** By the linear foot. All connections and all other work subsidiary to make a working system will be considered subsidiary to this Item.
- 6.5. **Troubleshoot Power, Signal, Interconnect, and Communication Cable.** By the hour. The maximum payment will be two hours for troubleshooting copper cable. All connections and other ancillary work to make up a working system will be subsidiary to this item.
- 6.6. **Graffiti Removal.** By the square foot structure cleaned and painted. Cleaners, paint, and labor are considered subsidiary to this item. Traffic Control, if required, will be paid separately.
- 6.7. **System Component Device.** By the each item removed, replaced or installed such as modems, Video or Data Mux, Demux, T1 cards, OTN cards shelf or rack mounted, etc.
- 6.8. **CCTV Camera (including pan tilt unit and the lens).** By each unit, complete in place.
- 6.9. **CCTV Camera Controller.** By the each unit, complete in place.
- 6.10. **CCTV Controller Cabinet (Ground or Pole Mount).** By each unit, complete in place.
- 6.11. **CCTV Camera Pole.** By each unit, complete in place and should include removing and salvaging the existing equipment.
- 6.12. **Preventive Maintenance of CCTV Camera System.** By each location each time preventive maintenance is performed.
- 6.13. **Troubleshoot Microwave Detection (RVSD) System.** By each system.
- 6.14. **RVSD.** By each unit replaced, installed, tested or adjusted.

- 6.15. **RVSD Controller Cabinet (Ground or Pole Mount).** By the complete unit in place.
- 6.16. **RVSD Pole.** By each complete unit in place. This includes all sub-assemblies such as the cabinet, controller, emitter, etc.
- 6.17. **RVSD System Preventive Maintenance.** By each time, RVSD preventive maintenance is performed.
- 6.18. **Batteries.** By each battery replaced.
- 6.19. **Amber or Color Dynamic Message Sign Controller.** By each unit, complete in place.
- 6.20. **Equipment Cabinet.** By each unit, complete in place.
- 6.21. **Troubleshoot Fiber Optic Cable (Multi-Mode or Single-Mode).** By the hours used for troubleshooting. A maximum of three hours will be charged.
- 6.22. **Fiber Optic Cable (Multi-Mode or Single-Mode).** By the linear foot.
- 6.23. **Splice Fiber Optic Cable (Multi-Mode or Single-Mode).** By each splice.
- 6.24. **Individual Fiber** will be measured by the linear foot of the type of fiber (strand number) specified by the Engineer.
- 6.25. **HUB Cabinet** will be measured by each unit, complete in place.
- 6.26. **HUB Building** will be measured by each unit, complete in place.
- 6.27. **HUB Building Preventive Maintenance,** as described herein, will be measured by each intersection each time preventive maintenance is performed
- 6.28. **HUB Cabinet Preventive Maintenance,** as described herein, will be measured by each intersection each time preventive maintenance is performed.
- 6.29. **Lane Control Signal (HOV or FRWY)** will be measured by each signal head replaced, complete in place.
- 6.30. **Electrical Service** will be measured by each unit completed in place.
- 6.31. **Electrical Service Enclosure** will be measured by each unit completed in place.
- 6.32. **Bore conduit (2" or 3")** will be measured by the linear foot of conduit installed.
- 6.33. **Trench conduit (2" or 3")** will be measured by the linear foot of conduit installed.
- 6.34. **Above ground conduit (2" or 3")** will be measured by the linear foot of conduit installed.
- 6.35. **Ground Box with Apron,** will be measured by each unit replaced.
- 6.36. **VIVDS Detector Camera** will be measured by the hours of time used for each unit, complete in place.
- 6.37. **VIVDS Detector Controller** will be measured by each unit, complete in place.
- 6.38. **Transportation Management Console CPU** will be measured by each unit, complete in place.
- 6.39. **Transportation Management Console Monitor** will be measured by each unit, complete in place.
- 6.40. **Network Management System Diagnostics Unit CPU** will be measured by each unit, complete in place.
- 6.41. **Pedestrian Pole Foundation** will be measured by each foundation of the type specified.
- 6.42. **DMS controller Foundation** will be measured by each foundation of the type specified.
- 6.43. **Equipment cabinet Foundation** will be measured by each foundation of the type specified.
- 6.44. **Signal Pole Foundation** will be measured by each foundation of the type specified.
- 6.45. **Open Transport Network (OTN)** will be measured by the lump sum.
- 6.46. **Service HAR Equipment** will be measured by the each Highway Advisory Radio (HAR) location serviced.
- 6.47. **Bluetooth Detector** will be measured by the each item replaced, shelf or rack mounted, completed in place.
- 6.48. **Bluetooth Detector Maintenance,** as described herein, will be measured by each location each time preventive maintenance is performed.
- 6.49. **Lane Management System** will be measured by the each item replaced, shelf or rack mounted, completed in place.
- 6.50. **Lane Management System Maintenance,** as described herein, will be measured by each location each time preventive maintenance is performed.
- 6.51. **DMS Amber or Color** will be measured by the each item replaced, shelf or rack mounted, completed in place.
- 6.52. **DMS Amber or Color Maintenance,** as described herein, will be measured by each location each time preventive maintenance is performed.
- 6.53. **Field Ethernet Switch** will be measured by the each item replaced, shelf or rack mounted, completed in place.

- 6.54. **Video Encoder or Video Decoder** will be measured by the each item replaced, shelf or rack mounted, completed in place.
- 6.55. **Terminal Server** will be measured by the each item replaced, shelf or rack mounted, completed in place.
- 6.56. **Cellular Modem** will be measured by the each item replaced, shelf or rack mounted, completed in place.
- 6.57. **Traffic Signal Lamp 12" LED** will be measured by the each item replaced, completed in place.
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7. PAYMENT

The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit prices bid for the various designations. These prices will be full compensation for furnishing all required material as shown on the plans, and for all labor, equipment and incidentals necessary to complete the work as specified.

Termination of Wiring, Sealing, and Protection of Utilities, Removal and Replacement of Curbs and Walks, and Preservation of Sod, Shrubbery and Trees must be considered subsidiary to various bid Items.