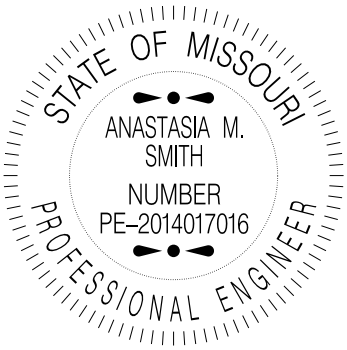
Job No.: J6Q3227E
Route: Various
County: Various

JOB SPECIAL PROVISIONS TABLE OF CONTENTS (ROADWAY)

(Job Special Provisions shall prevail over General Special Provisions whenever in conflict therewith.)

Job No.: J6Q3227E
Route: Various
County: Various



THIS SHEET HAS BEEN SIGNED, SEALED AND DATED ELECTRONICALLY.

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 W. CAPITOL AVE.
JEFFERSON CITY, MO 65102
Phone 1-888-275-6636

If a seal is present on this sheet, JSP's have been electronically sealed and dated.

JOB NUMBER: J6Q3227E
VARIOUS COUNTIES, MO
DATE PREPARED: 08/02/2021

ADDENDUM DATE:

Only the following items of the Job Special Provisions (Roadway) are authenticated by this seal: All

Job No.: J6Q3227E
Route: Various
County: Various

JOB
SPECIAL PROVISION

A. General - Federal JSP-09-02G

1.0 Description. The Federal Government is participating in the cost of construction of this project. All applicable Federal laws, and the regulations made pursuant to such laws, shall be observed by the contractor, and the work will be subject to the inspection of the appropriate Federal Agency in the same manner as provided in Sec 105.10 of the Missouri Standard Specifications for Highway Construction with all revisions applicable to this bid and contract.

1.1 This contract requires payment of the prevailing hourly rate of wages for each craft or type of work required to execute the contract as determined by the Missouri Department of Labor and Industrial Relations and requires adherence to a schedule of minimum wages as determined by the United States Department of Labor. For work performed anywhere on this project, the contractor and the contractor's subcontractors shall pay the higher of these two applicable wage rates. State Wage Rates, Information on the Required Federal Aid Provisions, and the current Federal Wage Rates are available on the Missouri Department of Transportation web page at www.modot.org under "Doing Business with MoDOT", "Contractor Resources". Effective Wage Rates will be posted 10 days prior to the applicable bid opening. These supplemental bidding documents have important legal consequences. It shall be conclusively presumed that they are in the bidder's possession, and they have been reviewed and used by the bidder in the preparation of any bid submitted on this project.

1.2 The following documents are available on the Missouri Department of Transportation web page at www.modot.org under "Doing Business with MoDOT"; "Standards and Specifications". The effective version shall be determined by the letting date of the project.

General Provisions & Supplemental Specifications

Supplemental Plans to July 2021 Missouri Standard Plans
For Highway Construction

These supplemental bidding documents contain all current revisions to the published versions and have important legal consequences. It shall be conclusively presumed that they are in the bidder's possession, and they have been reviewed and used by the bidder in the preparation of any bid submitted on this project.

B. Contract Liquidated Damages

1.0 Description. Liquidated Damages for failure or delay in completing the work on time for this contract shall be in accordance with Sec 108.8. The liquidated damages include separate amounts for road user costs and contract administrative costs incurred by the Commission.

2.0 Period of Performance. Prosecution of work is expected to begin on the date specified below in accordance with Sec 108.2. Regardless of when the work is begun on this contract, all work shall be completed on or before the date specified below. Completion by this date shall be in accordance with the requirements of Sec 108.7.1.

Notice to Proceed: January 3rd, 2022
Completion Date: December 31st, 2022

2.1 Calendar Days. The count of calendar days will begin on the date the contractor starts any construction operations on the project.

Job Number	Calendar Days	Daily Road User Cost
J6Q3227E	N/A	$1,800

3.0 Liquidated Damages for Contract Administrative Costs. Should the contractor fail to complete the work on or before the completion date specified in Section 2.0, or within the number of calendar days specified in Section 2.1, whichever occurs first, the contractor will be charged contract administrative liquidated damages in accordance with Sec 108.8 in the amount of **$750** per calendar day for each calendar day, or partial day thereof, that the work is not fully completed. For projects in combination, these damages will be charged in full for failure to complete one or more projects within the above specified completion date or calendar days.

4.0 Liquidated Damages for Road User Costs. Should the contractor fail to complete the work on or before the completion date specified in Section 2.0, or within the number of calendar days specified in Section 2.1, whichever occurs first, the contractor will be charged road user costs in accordance with Sec 108.8 in the amount specified in Section 2.1 for each calendar day, or partial day thereof, that the work is not fully completed. These damages are in addition to the contract administrative damages and any other damages as specified elsewhere in this contract.

C. Work Zone Traffic Management

1.0 Description. Work zone traffic management shall be in accordance with applicable portions of Division 100 and Division 600 of the Standard Specifications, and specifically as follows.

1.1 Work Zone Specialist (WZS). The Traffic Management Plan shall name an individual, either employed by the contractor or hired by the contractor, to act as the Work Zone Specialist (WZS) throughout the entirety of the project. Any change in personnel for the WZS shall be submitted in written form to the engineer. This individual will be a trained Work Zone Specialist in accordance with Standard Specifications Section 616.3.3 and will be directly involved with daily traffic management and traffic management planning. It will be the responsibility of the WZS to coordinate daily traffic management with the engineer. The WZS shall maintain daily contact with the engineer either on-site or via telecommunication.

1.2 Maintaining Work Zones and Work Zone Reviews. The WZS shall maintain work zones on a daily basis to ensure safety to the traveling public and the workers; this includes long term work zones that have devices and/or roadway conditions that need to be maintained. If the engineer or a designated MoDOT employee (identified at the preconstruction meeting) notifies the WZS of any safety or traffic delay concerns in the work zone, the WZS shall promptly inspect and work to provide a solution to correct the situation. The WZS shall have personnel reviewing traffic control devices daily and any temporary lane drop traffic control devices for initial set up and during the operation. Missing, damaged or over-turned traffic control devices shall typically be corrected without the need for direction by the engineer. The WZS is responsible to assure all traffic control devices are maintained in accordance with EPG

standards. The WZS is responsible to ensure the work zone is operated within the hours specified by the engineer and will not deviate from the specified hours without prior approval of the engineer. The WZS is responsible to manage work zone delay in accordance with these project provisions. The WZS and engineer shall submit one joint weekly technical review of work zone operations identifying any concerns present and the corrective actions taken. Reviews may be subjected to unannounced inspections by the engineer to corroborate the validity of the ratings. The engineer and WZS will be notified of the results.

1.3 Work Zone Conflict Resolution. Any conflict resolution shall be in accordance with Standard Specifications Section 616.4. Failure to make corrections on time may result in the engineer suspending work. The suspension will be non-excusable and non-compensable regardless if road user costs are being charged for closures.

2.0 Traffic Management Schedule.

2.1 Traffic management schedules shall be submitted to the engineer for review prior to the start of work and prior to any revisions to the traffic management schedule. The traffic management schedule shall include the proposed traffic control measures, the hours traffic control will be in place, and work hours.

2.2 The traffic management schedule shall conform to the limitations specified in Sec 616 regarding lane closures, traffic shifts, road closures and other width, height and weight restrictions.

2.3 The engineer shall be notified as soon as practical of any postponement due to weather, material or other circumstances.

2.4 In order to ensure minimal traffic interference, the contractor shall schedule lane closures for the absolute minimum amount of time required to complete the work. Lanes shall not be closed until material is available for continuous construction and the contractor is prepared to diligently pursue the work until the closed lane is opened to traffic.

2.5 Traffic Congestion. The contractor shall, upon approval of the engineer, take proactive measures to reduce traffic congestion in the work zone. The contractor shall immediately implement appropriate mitigation strategies whenever traffic congestion reaches an excess of 10 minutes to prevent congestion from escalating to 15 minute or above threshold. If disruption of the traffic flow occurs and traffic is backed up in queues of 15 minute delays or longer, then the contractor shall immediately review the construction operations which contributed directly to disruption of the traffic flow and make adjustments to the operations to prevent the queues from reoccurring. Traffic delays may be monitored by physical presence on site or by utilizing real-time travel data through the work zone that generate text and/or email notifications where available. The engineer monitoring the work zone may also notify the contractor of delays that require prompt mitigation. The contractor may work with the engineer to determine what other alternative solutions or time periods would be acceptable.

2.5.1 Traffic Safety.

2.5.1.1 Recurring Congestion. Where traffic queues routinely extend to within 1000 feet of the ROAD WORK AHEAD, or similar, sign on a divided highway or to within 500 feet of the ROAD

WORK AHEAD, or similar, sign on an undivided highway, the contractor shall extend the advance warning area, as approved by the engineer.

2.5.1.2 Non-Recurring Congestion. When traffic queues extend to within 1000 feet of the ROAD WORK AHEAD, or similar, sign on a divided highway or to within 500 feet of the ROAD WORK AHEAD, or similar, sign on an undivided highway infrequently, the contractor shall deploy a means of providing advance warning of the traffic congestion, as approved by the engineer. The warning location shall be no less than 1000 feet and no more than 0.5 mile in advance of the end of the traffic queue on divided highways and no less than 500 feet and no more than 0.5 mile in advance of the end of the traffic queue on undivided highways.

3.0 Work Hour Restrictions.

3.1 Except for emergency work, as determined by the engineer, and long term lane closures required by project phasing, all lanes shall be scheduled to be open to traffic during the five major holiday periods shown below, from 12:00 noon on the last working day preceding the holiday until 6:00 a.m. on the first working day subsequent to the holiday unless otherwise approved by the engineer.

Memorial Day
Labor Day
Thanksgiving
Christmas
New Year's Day

3.1.1 Independence Day. The lane restrictions specified in Section 3.1 shall also apply to Independence Day, except that the restricted periods shall be as follows:

12:00 noon July 1, 2022 – 6:00 a.m. July 5, 2022

3.2 The contractor shall not perform any construction operation on the roadway, including the hauling of material within the project limits, during restricted periods, holiday periods or other special events specified in the contract documents.

3.3 The contractor is advised that MoDOT has 24/7 operations with staff on board to verify the contractor's emergency work at night and on weekends. The contractor is also advised that MoDOT has state holidays which may or may not have MoDOT staff on duty for the day. The contractor shall notify the SL ITS staff at least one business day in advance of the state holiday to see if there is staff available to verify the work being done. The contractor shall not perform any work that will impact the ITS network if there is no ITS staff available to verify the network's operation except during emergency work. The state holidays are listed as follows:

New Year's Day
Martin Luther King, Jr. Day: Third Monday in January
Lincoln's Birthday
Washington's Birthday: Third Monday in January
Truman's Birthday
Memorial Day: Last Monday in May
Juneteenth
Independence Day & July 5th
Labor Day: First Monday in September

Columbus Day: Second Monday in October
Veteran's Day
Thanksgiving Day: Fourth Thursday in November
Christmas Day

3.4 Ramp Closures. The contractor shall close ramps specified in the JSP – Wrong Way Alert Systems Preventative Maintenance, Software and Recertification for the following hours as needed to complete that work:

10:00 p.m. to 5:00 a.m., Monday through Sunday

3.4.1 The contractor shall not close multiple ramps of the same interchange unless approved by the Engineer. The contractor shall also not close consecutive ramps along a corridor in a given direction unless approved by the Engineer.

3.5 The contractor shall not alter the start time, ending time, or a reduction in the number of through lanes of traffic or ramp closures without advance notification and approval by the engineer. The only work zone operation approved to begin 30 minutes prior to a reduction in through traffic lanes or ramp closures is the installation of traffic control signs. Should lane closures be placed or remain in place, prior to the approved starting time or after the approved ending time, the Commission, the traveling public, and state and local police and governmental authorities will be damaged in various ways, including but not limited to, increased construction administration cost, potential liability, traffic and traffic flow regulation cost, traffic congestion and motorist delays, with a resulting cost to the traveling public. These damages are not easily computed or quantified. Therefore, the contractor will be charged with liquidated damages specified in the amount of **$250 per 15 minute increment** for each 15 minutes that the temporary lane closures are in place and not open to traffic in excess of the limitation as specified elsewhere in this special provision. It shall be the responsibility of the engineer to determine the quantity of unapproved closure time.

3.5.1 The said liquidated damages specified will be assessed regardless if it would otherwise be charged as liquidated damages under the Missouri Standard Specification for Highway Construction, as amended elsewhere in this contract.

4.0 Detours and Lane Closures.

4.1 When a changeable message sign (CMS) is provided, the contractor shall use the CMS to notify motorists of future traffic disruption and possible traffic delays one week before traffic is shifted to a detour or prior to lane closures. The CMS shall be installed at a location as approved or directed by the engineer. All messages planned for use in the work zone shall be approved and authorized by the engineer or its designee prior to deployment.

4.2 At least one lane of travel, through the use of flaggers, shall be maintained at all times except for brief intervals of time required when the movement of the contractor's equipment will seriously hinder the safe movement of traffic. Periods during which the contractor will be allowed to interrupt traffic will be designated by the engineer.

5.0 Basis of Payment. No direct payment will be made to the contractor to recover the cost of equipment, labor, materials or time required to fulfill the above provisions, unless specified elsewhere in the contract document. All authorized changes in the traffic control plan shall be provided for as specified in Sec 616.

D. Emergency Provisions and Incident Management

1.0 The contractor shall have communication equipment on the construction site or immediate access to other communication systems to request assistance from the police or other emergency agencies for incident management. In case of traffic accidents or the need for police to direct or restore traffic flow through the job site, the contractor shall notify police or other emergency agencies immediately as needed. The area engineer's office shall also be notified when the contractor requests emergency assistance.

2.0 In addition to the 911 emergency telephone number for ambulance, fire or police services, the following agencies may also be notified for accident or emergency situation within the project limits.

Missouri Highway Patrol	636-300-2800

2.1 This list is not all inclusive. Notification of the need for wrecker or tow truck services will remain the responsibility of the appropriate police agency.

2.2 The contractor shall notify enforcement and emergency agencies before the start of construction to request their cooperation and to provide coordination of services when emergencies arise during the construction at the project site. When the contractor completes this notification with enforcement and emergency agencies, a report shall be furnished to the engineer on the status of incident management.

3.0 No direct pay will be made to the contractor to recover the cost of the communication equipment, labor, materials or time required to fulfill the above provisions.

E. Project Contact for Contractor/Bidder Questions

All questions concerning this project during the bidding process shall be forwarded in writing to the project contact listed below.

Stacey Smith, Project Manager
St. Louis District
1590 Woodlake Dr.
Chesterfield, MO 63017

Telephone Number: 314-453-5084
Email: Anastasia.Smith@modot.mo.gov

All questions concerning the bid document preparation can be directed to the Central Office – Design Office at (573) 751-2876.

F. Temporary Traffic Control

1.0 Description. All work necessary to maintain safe and efficient traffic flow through the work areas shall be provided by the contractor. This will include furnishing, relocating, and removing

temporary traffic control devices, truck mounted attenuators and equipment, and the removal and relocation or covering and uncovering of existing signs and other traffic control devices in accordance with the contract documents or as directed by the engineer.

2.0 Work requirements. Work shall be in accordance with Sec 616, Sec 612, and the contract plans.

3.0 Method of Measurement. The quantities shown on the plans shall be considered an estimate and may be subject to change based on field conditions. This work will not be measured for payment, but will be considered a lump sum unit. Any Value Engineering proposals to the temporary traffic control will not be paid for through value engineering but will be covered under 616-99.01, Temporary Traffic Control, lump sum.

4.0 Basis of Payment.

4.1 Partial payments will be made as follows:

(a) The first partial payment will be made when five percent of the original contract amount is earned. This payment will be the lesser of 50 percent of the contract price for the item of temporary traffic control or 5 percent of the original contract price.

(b) The second partial payment will be made when 50 percent of the original contract amount is earned. This payment will be the lesser of 25 percent of the original contract price for the item of temporary traffic control or 2.5 percent of the original contract price.

(c) The third partial payment will be made when 75 percent of the original contract amount is earned. This payment will be the lesser of 20 percent of the original contract price for the item of temporary traffic control or 2 percent of the original contract price.

(d) When the engineer has accepted the contract for maintenance in accordance with Sec 105, the remaining contract price for the item of temporary traffic control will be paid.

(e) The above partial payment schedule may be adjusted by the engineer if proof of invoices submitted by the contractor demonstrate additional temporary traffic control costs were incurred earlier than the above proposed schedule. The total payment for temporary traffic control will not exceed the bid amount for Temporary Traffic Control, lump sum, unless covered by a cost change order as referenced in the following Section 4.3.

4.1.1 For the purposes of this provision, the term “original contract price” will be construed as the total dollar value of the construction items (excluding temporary traffic control) of the original contract.

4.2 Temporary traffic control will be paid for at the contract lump sum price for Item 616-99.01, Temporary Traffic Control. No direct payment will be made for the following:

(a) Incidental items necessary to complete the work, unless specifically provided as a pay item in the contract.

(b) Installing, operating, maintaining, cleaning, repairing, removing or replacing traffic control devices.

(c) Covering and uncovering existing signs and other traffic control devices.

(d) Relocating temporary traffic control devices, including permanent traffic control devices temporarily relocated, unless specifically included as a pay item in the contract.

(e) Providing trim-line channelizers.

(f) Worker apparel.

(g) Flaggers, pilot vehicles, and appurtenances at flagging stations.

(h) Furnishing, installing, operating, maintaining, and removing construction-related vehicle and equipment lighting.

(i) Construction and removal of temporary equipment crossovers, including restoring pre-existing crossovers.

4.3 Any additional work deemed necessary by the engineer that requires temporary traffic control and is not covered by the contract plans will be included in the cost change order for the additional work. However, if the added work is required in a stage where temporary traffic control is already in place, no additional traffic control pay will be allowed in this case.

G. Contractor Requirements

1.0 Description. The contractor shall have a qualified and competent staff to coordinate, communicate, and perform this specialized work. The contractor shall furnish all equipment necessary to perform the work described in this contract.

2.0 Staffing Requirements. The contractor will submit a written list of key staff members to the engineer two (2) weeks prior to the preconstruction meeting for review. When approved, the contractor will be required to use staff as submitted. Key staff may only be substituted through a written request by the contractor and written approval by the engineer. In the event of staff turnover of key staff members, the contractor shall replace the respective staff with an individual with substantially equivalent experience and meeting the respective qualifications described below. The engineer will have final approval on the acceptability of all staff working on the project.

2.1 The contractor's staffing submittal shall include resumes of key staff that clearly provide supporting documentation in meeting the requirements described below and describe maintenance experience on specific projects. At a minimum, the resumes shall include:

- Educational background, including any degrees and/or certifications, and the institution and year for which they were received.
- A brief description of similar projects that the individual was involved with. The description should include: project name, agency, agency contact, contract cost, date(s) of services, and a short narrative of services provided.

- Availability of staff described as a percentage of working hours in a typical work week.

2.2.1 Key Staff submittal shall, as a minimum, list a project manager, lead field communication technician, lead electrician, and lead field hardware technician.

2.3 Minimum Requirements of Project Manager. As required to maintain the system properly, the contractor shall provide an on-site professional project manager for administration of the maintenance and remedial maintenance or repair services of the ITS hardware. The project manager shall provide technical expertise, direction, and strategies regarding all aspects of ITS hardware maintenance, operation, and/or improvements.

The project manager shall:

- Have a minimum of five (5) years of experience managing similar work.
- Be available (in person and via phone/email) to the engineer twenty-four (24) hours a day, seven (7) days a week
- Participate in bi-weekly coordination meetings with the Commission, and other contract personnel

2.4 Minimum Requirements of Lead Field Communications Technician. The individual, or individuals, assigned to this role will provide the Commission with technical communication repair services.

The lead field communications technician shall:

- Have experience in DWDM networks
- Have experience in wireless communication network maintenance
- Either show successful completion of one (1) three-day course in fiber optic splicing from a major manufacturer of fiber optic cable/equipment (such as Corning, AT&T, Lucent etc.) Or be certified as a fiber optic technician by the Fiber Optic Association, Inc. (Boston, MA)
- Have a minimum of two (2) years of experience in the installation of digital and analog data communication systems, within the last five (5) years.

2.5 Minimum Requirements of Lead Electrician. The individual, or individuals, assigned to this role will provide the Commission with field ITS hardware electrical repair services.

The lead electrician shall:

- Be a licensed electrician in the State of Missouri.

2.6 Minimum Requirements of Lead Field Hardware Technician. The individual, or individuals, assigned to this role will provide the Commission with field ITS hardware technical repair services.

The lead field hardware technician shall:

- Have experience in the installation and maintenance of Closed Circuit Television (CCTV) camera assemblies and video switches, including:
    - Controller cabinets
    - Camera housings, and
    - Camera pressurization systems
- Have experience in Dynamic Message Sign (DMS) installation and maintenance
- Have a minimum of two (2) years of experience in the installation, integration, maintenance, and operations of ITS equipment, within the last five (5) years.

- Have experience with the various vehicle detection systems (including microwave, radar, non-intrusive, and Bluetooth technologies)
- Have been certified by MoDOT's ITS device manufacturers.

3.0 Required Equipment. The contractor shall furnish all equipment and tools necessary to complete the work required in this contract, including equipment for field maintenance work and communications for the project. This equipment will remain the property of the contractor throughout the project and after its conclusion. The contractor will also be responsible for all maintenance, repairs, and calibration (including firmware updates) needed to keep the equipment in proper working condition.

3.1 Communication and Coordination Equipment. At least one member of the contractor work crew shall be available by telephone at all times while working on the project. The phone numbers shall be furnished to the engineer for use in the project communications

3.2 Maintenance Equipment. The contractor shall be required to possess, buy upon award, lease or rent any equipment or tools necessary for this project. While it is the contractor's responsibility to determine what equipment is necessary, a partial list of anticipated equipment includes:

- Fiber optic cable fusion splicers
- Fiber optic Optical Time Domain Reflectometer
- Fiber optic cable power meter
- Radar speed gun (or other speed measuring device)
- Bucket truck
- Backhoe
- Cable pulling tension meter
- Cable pulling pulleys
- Pole erection crane or truck

The contractor shall submit an equipment list to the engineer two (2) weeks prior to preconstruction meeting.

4.0 Basis of Payment. No direct payment shall be made for compliance with this provision.

H. Coordination with MoDOT SLITS Staff

1.0 Description. Any work that will impact the existing communications network and devices must be coordinated with the St. Louis District's ITS staff. This includes removal and replacement of any existing communications equipment, and changes to power sources or disconnects. Minor modifications to the existing communications network can have significant impacts on the system and operation of other ITS and traffic signal systems.

2.0 Contact. Initial contact must be made at least seven (7) calendar days before work that may impact the existing communications network commences. Contact SL ITS staff utilizing the SL ITS Contact list given at pre-construction meeting or via email at **SLITS@modot.mo.gov**. The engineer shall be notified prior to making contact with ITS staff.

3.0 The ITS and signal networking devices located within the St. Louis District are a crucial part of the traffic operation system. It is imperative that downtime be kept to a minimum when adding, removing, or modifying any existing ITS and signal networking devices. This may

require the contractor to perform work that will affect existing network devices during the nighttime and/or weekend hours, at the discretion of the engineer. Allowable timeframes for this work will be subject to the need for ITS devices in the area to be used to manage other traffic impacting work zones.

3.1 Prior to beginning work on any item, the contractor shall verify with the engineer that operations, such as cutting an existing cable or unplugging existing connectors, will not adversely impact the functionality of the other devices in the system. In the event that the work will disconnect other devices from the system, the engineer shall advise the contractor how to proceed. Mitigations efforts may include splicing the cable in an adjacent pull box prior to beginning the work or requiring the work to be done on an expedited schedule to minimize the impacts. Splicing or other mitigation efforts shall be compensated for using the standard pay items on this contract, unless considered **out of scope work** by the engineer.

4.0 Basis of Payment. No direct payment shall be made for compliance with this provision.

I. Coordination with Other Projects

1.0 Description. Other contracts (that increase or decrease field equipment quantities, expand the communication network, and/or develop/integrate software device drivers to control additional equipment) may be awarded, ongoing, and/or completed during the life of this maintenance contract. The contractor shall be responsible for coordinating with the engineer and other project representatives, efforts related to these other contracts to ensure that access to field devices is not the cause of construction delays or claims.

The coordination required under this section will consist primarily of ensuring that communications systems are adjusted to account for planned disruptions or existing communications infrastructure.

2.0 Basis of Payment. No direct payment shall be made for compliance with this provision.

J. Utilities

1.0 The Contractor shall be aware there are numerous utilities present along the routes in this contract. It is the inherent risk of the work under this contract that the contractor may encounter these utilities above and/or below the ground or in the vicinity of any given job order which may interfere with their operations. The contractor expressly acknowledges and assumes this risk even though the nature and extent is unknown to both the contractor and the Commission at the time of bidding and award of the contract. The effect in cost or time of the presence of utilities above, below or in the vicinity of the contractor's work under this contract shall not be compensable. If a utility is determined to be in conflict with the proposed work the contractor shall contact the engineer to determine a course of action.

1.1 Missouri Standard Specification Book for Highway Construction, Section 105 Control of Work, 105.7 Cooperation with Utilities: Contractor shall adhere to all specifications.

K. Scope of Work

1.0 Description. Job J6Q3227E is a ITS maintenance project where the contractor will perform the required maintenance work listed Section 0003. When the contractor is doing the required maintenance work, it is expected the contractor will find additional repairs needed on the ITS system. The contractor shall inform the SL District ITS Group of the repair work needed and, if the SL District ITS Group agrees, an Online Maintenance System ticket will be issued authorizing the contractor to do the repair work. The contractor may also be asked to preform additional ITS repairs as requested by the SL District ITS Group. Section 0003 of the bid items contains the required work of this project while Section 0002 contains bid items that are expected to be needed for the additional repair work. The contractor shall bid the items in Section 0002 with the knowledge that each item may or may not be needed on this project and the quantity of the item may be many times larger than listed in the bid item list. The following is a list of job special provisions, which detail the requirements that apply to the two types of work for this project:

Required Maintenance Work – Section 0003:

JSP M	Install MoDOT Furnished IP-addressable Power Strip
JSP N	Remove and Replace Node Cabinet Air Conditioner System
JSP O	Wireless Solar Cabinet Assemblies
JSP Q	Preventative Maintenance
JSP R	Preventative Maintenance with Repairs
JSP T	ITS Pull Box Lid Replacement
JSP U	Device Cabinet Plan Verification
JSP CC	Wrong Way Alert Systems Preventative Maintenance

Repair Work – If Necessary – Section 0002:

JSP P	Conduit Connections to Cabinets
JSP S	Remedial Maintenance
JSP V	Split Duct Conduit Repair
JSP X	Out of Scope Work and Repairs
JSP AA	MoDOT Buried Cable Drivable Delineator Post
JSP DD	Pad-Mounted Power Supply
JSP EE	ITS Pull Box
JSP FF	Fiber Optic Cable Installation

The contractor shall coordinate all ITS Preventative Maintenance and MoDOT Online Maintenance System Ticket repair work with SL ITS Group via an email to SLITS@modot.mo.gov at least one business day prior to any work.

2.0 Basis of Payment. No direct payment shall be made for compliance with this provision.

L. Online Maintenance System

1.0 Description. MoDOT St. Louis District has an online maintenance system tool to monitor routine operation of all Intelligent Transportation System (ITS) devices in the District. It provides the ability to issue and track MoDOT work orders, plan preventive- and corrective-maintenance, and manage device inventories.

Use of the online maintenance system will be required by the Contractor to manage MoDOT work orders issued by local district staff for both emergency and standard maintenance. Access to the system by the Contractor will be via office computers and portable computer devices capable of accessing the system from most every location in the plans.

The Contractor will be required to attend all available necessary trainings provided by MoDOT and use this tool during the entire contract period. The contractor shall use the online maintenance system tool to report time and date of arrival, and resolution details. MoDOT work order will be closed by MoDOT staff after verification of completed work.

2.0 Basis of Payment. No direct payment shall be made for compliance with this provision.

M. Install MoDOT Furnished IP-Addressable Power Strip

1.0 Description. The contractor shall install the Commission furnished and programmed IP-Addressable Power Strip(s) in the ITS and/or Signal Cabinets as shown of the plans.

2.0 Installation Requirements. The contractor shall mount the power strip on the back side of the ITS Type 7 ITS cabinet and on the left side panel of the signal cabinet above the detector panel attached to 2 DIN rails, with the power cable facing away from the door. The hardwire interconnect panel, if present, should be removed to make room. A plastic wire tie shall secure any transformer packs plugged into this unit. The power source shall be hardwired to cabinet auxiliary breaker with no plug in to any cabinet outlet allowed.

3.0 Acceptance Testing. The Contractor shall contact MoDOT St. Louis ITS staff to verify remote communication to the power strip upon installation and while still on-site. They also shall provide a list of devices and designated port assignments to the ITS group so they can update that port description in the Power Strip software.

4.0 Basis of Payment. Measurement and payment for Power Strip Installation includes installation. testing, grounding, and all miscellaneous hardware required for a safe, fully operational Power Strip. Payment will be made as follows:

Item Number	Unit	Description
910.99-02	Each	Install MoDOT Furnished IP-addressable Power Strip

N. Remove and Replace Node Cabinet Air Conditioner System

1.0 Description. The contractor shall remove the existing Node Cabinet Air Conditioner System, dispose of it properly and install a new Air Conditioner System at locations approved by the SLITS group. The contractor shall submit to the SLITS group any location where the air condition system needs to be replaced so that the SLITS group can verify before approving the change.

1.2 Qualified Personnel. This work shall be performed by licensed HVAC (Heating, Ventilation and Air Conditioning) staff. The contractor shall submit their HVAC contractor contact information and a copy of their license to the MoDOT Engineer for review and approval prior to any work.

2.0 Materials.

2.1 The contractor shall submit the new air conditioner specifications, operation and maintenance manuals to the MoDOT Engineer and SLITS Group via an email to SLITS@modot.mo.gov for review and approval.

3.0 Construction Requirements.

3.1 The contractor shall remove all existing Node Cabinet Air Conditioner parts and dispose of them properly.

3.2 There shall be no sun shield on the side on which the air conditioner is mounted.

3.3 The contractor shall mount an air conditioner on the cabinet's sidewall next to the door hinges. It shall use a closed loop cooling system that does not exchange air with the outside. It shall have the following features:

- **Maximum dimensions:** The unit shall not exceed the dimensions of the sidewall. The unit shall not add more than 12 inches to the cabinet width.
- **Cooling capacity:** 6,000 BTU/hour.
- **Hot gas bypass valve:** To regulate cooling and prevent evaporator coil freezing during periods of low heat load and low ambient air temperature.
- **Intake location:** Top.
- **Solid-state electronic noise suppressor:** To minimize EMI/RFI interference.
- **Thermostat:** Adjustable in the range of 70 degrees F (20 degrees C) to 140 degrees F (60 degrees C) to activate cooling. Unit turn-off shall be 7 degrees F (4 degrees C) below the turn-on temperature. Mounting of the unit shall be such that setting changes can be made from one of the door openings.

3.4 Provide a separate circuit and breaker for the air conditioner, and provide a delay-on relay or other protection to ensure that, if a short power outage occurs while the unit is running, the breaker is not tripped when the power is restores and the unit tries to restart while pressurized.

3.5 Provide two contact closure temperature alarms. The high temperature sensor shall be adjustable in the rage of 20 degrees C to 60 degrees C. The low temperature sensor shall be adjustable in the range of 5 degrees F (-15 degrees C) to 40 degrees F (5 degrees C).

4.0 Acceptance Testing. The new Air Conditioner Unit shall run for 15 calendar days prior to acceptance. If for any reason any of the new A/C Unit fails or stops working, it shall be the contractor's responsibility to make necessary repairs or replace the entire A/C Unit and allow it to run another 15 days prior to final acceptance.

5.0 Basis of Payment. Measurement and payment for Remove and Replace Node Cabinet Air Conditioner System includes all labor, equipment and materials necessary to comply with the requirements of this provision. Payment will be made as follows:

Item No.	Type	Description
910-99.02	Each	Remove and Replace Node Cabinet Air Conditioner System

O. Wireless Solar Cabinet Assemblies

1.0 Description. The contractor shall replace the existing solar power system cabinet assemblies as noted on the plans. These existing solar power systems are located at wireless Ethernet repeater sites. The work consists of furnishing and installing the new cabinet assemblies where applicable and testing the existing solar powered Ethernet bridge repeaters for proper operations and communications. This work shall be scheduled to be completed in conjunction with normal annual maintenance for each solar powered location.

2.0 Materials.

2.1 The contractor shall field verify each site and submit their proposed cabinet and battery cut-sheets and specifications for each site and devices to the engineer for review and approval.

2.2 Pole-Mounted Component Cabinet. This cabinet is to house the Ethernet bridge radio power injectors, the battery bank and solar charge controller. The cabinet shall be 3 mm aluminum with stainless steel hardware. The enclosure shall have a #2 Corbin lock. It shall have a NEMA 3R rating. Vents shall be located to ensure good convective airflow over all electronic components. Vents shall have replaceable air filters. The cabinet shall include mounting hardware appropriate to the type of pole on which it is hung. The shop drawing submittal shall include a scale drawing showing the layout of the equipment in the cabinet. The drawing shall demonstrate that all the proposed equipment will fit in the cabinet and that all connections, indicators, and controls are visible and accessible.

3.0 Work Requirements. If the cabinet assembly is to be replaced, the contractor shall remove the existing cabinet assembly from the pole while preserving the existing equipment and wiring for installation in the new cabinet. Install the new cabinet assembly with the new banding and reinstall the existing equipment. Test for proper system charging and communication link operation as described in Section 4.0.

4.0 Acceptance Testing. The Contractor shall test the individual wireless links and wireless network connections to confirm they are working. Also, confirm after 14 days that the wireless links continue to work and that the batteries are fully charged. A wireless link is defined as being between two Ethernet bridge radios.

4.1 Wireless Link Test Procedure. The contractor shall develop a wireless link and wireless network connection testing procedure that follows the Internet Engineering Task Force developed RFC 2544 protocol. The procedure must be approved by the engineer. The test procedures must determine the throughput of each individual wireless link and for each wireless network connection.

4.2 Wireless Link Acceptance. A wireless link and network connection will be accepted as complete when testing results demonstrate and document that each installed wireless link the throughput meets or exceeds 22 Mbps 90% of the time. The contractor shall provide all equipment and personnel needed to safely conduct the tests. Arrange for the engineer's representative to witness the tests.

4.3 Burn-In Period Acceptance. Once the wireless link testing has been accepted by the engineer, the burn-in period will begin. The burn-in period extends for at a minimum 14 days. After the burn-in period has ended, test the battery charge level and confirm the wireless links

are still functioning. Test each battery bank charge level. Arrange for the engineer's representative to witness the tests. To confirm the wireless links are working, coordinate with St. Louis District ITS staff to demonstrate that ITS devices connected to the network using the wireless link can be communicated with.

5.0 Basis of Payment. Measurement and payment for wireless solar cabinet assembly includes removal of the existing items, installation of complete cabinet assembly, cables, grounding, cables, testing, and all miscellaneous hardware required for a safe, fully operational wireless assembly. Payment will be made as follows:

Item No.	Type	Description
910-99.02	Each	Wireless Solar Cabinet Assembly Replacement

P. Conduit Connections to Cabinet

1.0 Description. The contractor shall provide and install a putty or caulk material as approved by the Engineer which seals any conduit connection entering a signal or ITS cabinet at those locations where the existing sealing material is missing or has been damaged.

2.0 Basis of Payment. No direct payment shall be made to provide and install the putty or caulk material used to seal conduit connections to existing cabinets.

Q. Preventative Maintenance

1.0 Description. The contractor shall perform Preventative Maintenance (PM) on ITS devices, cabinets, communication equipment, and any additional ITS hardware identified within this section (including cleaning).

1.1 Schedule. The contractor shall develop a schedule detailing the dates for which each device will have its preventative maintenance performed. The engineer will provide the contractor with the previous year's preventative maintenance schedule four (4) weeks prior to preconstruction meeting. The contractor shall develop a schedule that ensures the minimum frequency of preventative maintenance per device is maintained. The contractor shall submit the schedule to the engineer by the preconstruction meeting. Deviation from the proposed schedule of more than one (1) week may be allowed with prior approval from the engineer. The engineer reserves the right to alter the proposed schedule. The engineer also reserves the right to order additional maintenance visits of problematic ITS devices as needed by increasing the quantity paid for at the contract unit price.

1.2 The contractor shall provide all equipment and materials necessary to comply with the requirements of this provision.

1.3 Detailed preventative maintenance procedures, including checklist of tasks to be performed, per ITS device and cabinet shall be developed by the contractor. The contractor shall be responsible for performing all procedures in accordance with the manufacturer's recommendations. The contractor shall submit checklists per each device to the engineer by the preconstruction meeting for review and approval.

2.0 Items.

2.1 CCTV Cameras. All preventative maintenance shall be done in accordance with the manufacturer's recommended procedures. The contractor will need to provide a bucket truck in order to access the cameras. This item shall also include PM of its associated field cabinet, in accordance with Section 2.2 of this provision. For each camera assembly, the following items of work shall be performed:

2.1.1 General Cleaning. The contractor shall thoroughly clean the outside of each camera dome assembly. The contractor shall apply a rain repellent coating to the outside of the lower dome, per the coating manufacturer's instructions. The coating must be recommended by its manufacturer for clear acrylic. Upon completion, the camera assembly shall be neat and clean in appearance.

2.1.2 General Inspection. The contractor shall inspect each camera assembly for general condition, including cables and wires, connectors, cameras, pan-tilt units, power supplies, surge protectors, CCTV pole access panels and any other equipment contained within each enclosure. All bolts and screws in the cameras and controller will be checked and tightened. Any access panel screws that are broken/stripped/missing shall be replaced or repaired by the contractor.

2.1.3 Operational Integrity Checks. The contractor shall, at a minimum, check the following functions during each preventative maintenance inspection:

- Check all local functions, such as pan, tilt, zoom, focus
- Check operation of auto-iris and adjust as necessary
- Check camera dome pressure and compare to manufacturer's specifications
- Recharge camera dome per manufacturer's recommendations
- Once the cameras are re-installed and prior to leaving the CCTV site, the contractor shall contact SL ITS or TMC Staff in order to verify proper operation (including pan/tilt/zoom, preset functions, and CCTV description).

2.1.4 Frequency. The contractor shall perform preventative maintenance on each CCTV camera once every calendar year.

2.2 Field Cabinets. All preventative maintenance shall be done in accordance with the manufacturer's recommended procedures. Care shall be taken to prevent damaging components or cabling within or near the cabinet. The contractor shall trim grass and brush back for a five (5) foot radius around each cabinet and remove and debris from around and on top of the cabinet base. The contractor shall, upon inspection of the field cabinet, lubricate the locking mechanism, hinges, and door locking arm mechanism in accordance with manufacturer specifications. If any lock covers are missing, the Contractor shall place tape over the keyhole.

2.2.1 General Cleaning. The contractor shall thoroughly clean each cabinet, including vacuuming loose dirt and debris. All enclosures will be cleared of any dirt or debris, and conduits shall be plugged with duct seal to prevent rodents and such from entering. The contractor shall wipe down all accessible equipment areas, racks, and shelves contained within the cabinet. Upon completion, the cabinet shall be free of all debris, rodents, pests, and animal waste, and shall be neat and clean in appearance.

2.2.2 Cabinet Filter Replacement. The contractor shall replace cabinet filters and vacuum out dust particles from the screens and filter holders. This includes cleaning of louvers and screens covering filter holder.

2.2.3 Pest Control and Damage Repair. The contractor shall remove any old ant bait containers and install a new bait container in each field cabinet after the General Inspection and cleaning.

2.2.4 General Inspection. The contractor shall inspect each cabinet for general condition, including condition of cables and wires, conduit duct seal integrity, heaters processors, power supplies, cabinet lights, fans, doors, locks, shelves, din rails, and communications panels or equipment contained within each cabinet. The contractor shall also inspect the integrity of the cabinet identification plaque. Any broken or damaged field cabinet components shall be documented in the Preventative Maintenance Report and repaired. If the repairs are deemed significant by the engineer, the repairs shall be dealt with as described for **out of scope work.** Preventative maintenance shall include the replacement of any burned-out or broken light bulbs found.

2.2.5 Operational Integrity Checks. The contractor shall check and record incoming power supply voltages, and verify landings of twisted-pair communication cable (where applicable). Any detectors not functioning shall be reported to the engineer.

2.2.6 Frequency. The contractor shall perform preventative maintenance on each field cabinet at the same time as its associated ITS device.

2.3 Communication Node Field Cabinets. All preventative maintenance shall be done in accordance with the manufacturer's recommended procedures. Care shall be taken to prevent damaging components or cabling within or near the cabinet. The contractor shall trim grass and brush back for a five (5) foot radius around each cabinet and remove any debris from around and on top of the cabinet base. The contractor shall, upon inspection of the field cabinet, lubricate the locking mechanism, hinges, and door locking arm mechanism in accordance with manufacturer specifications. If any lock covers are missing, the Contractor shall place tape over the keyhole.

2.3.1 General Cleaning. The contractor shall thoroughly clean each cabinet, including vacuuming loose dirt and debris. All enclosures will be cleared of any dirt or debris, and conduits shall be plugged with duct seal to prevent rodents and such from entering. The contractor shall wipe down all accessible equipment areas, racks, and shelves contained within the cabinet. Upon completion, the cabinet shall be free of all debris, rodents, pests, and animal waste, and shall be neat and clean in appearance.

2.3.2 Cabinet Filter Replacement. The contractor shall replace cabinet filters and vacuum out dust particles from the screens and filter holders. This includes cleaning of louvers and screens covering filter holder.

2.3.3 Pest Control and Damage Repair. The contractor shall remove any old ant bait containers and install a new bait container in each field cabinet after performing general cleaning.

2.3.4 General Inspection. The contractor shall inspect each cabinet for general condition, including condition of cables and wires, conduit duct seal integrity, heaters processors, power

supplies, cabinet lights, fans, doors, locks, shelves, din rails, and communications panels or equipment contained within each cabinet. The contractor shall also inspect the integrity of the cabinet identification plaque. Any broken or damaged field cabinet components shall be documented in the Preventative Maintenance Report and repaired. If the repairs are deemed significant by the engineer, the repairs shall be dealt with as described for **out-of-scope work.** Preventative maintenance shall include the replacement of any burned-out or broken light bulbs found.

2.3.5 Operational Integrity Checks. The contractor shall check and record incoming power supply voltages, and verify landings of twisted-pair communication cable (where applicable). Any detectors not functioning shall be reported to the engineer.

2.3.6 Frequency. The contractor shall perform preventative maintenance on each Communication Node Cabinet once every calendar year.

2.4 Air Conditioning Units. Currently A/C units are only installed at Communication Node Field Cabinets. All preventative maintenance shall be done in accordance with the manufacturer's recommended procedures. Work under this item shall include removing the A/C unit's panel to provide access to the interior. Preventative Maintenance of HVAC shall be performed once between March 1st and May 15th, and again from July 1st to September 15th, unless otherwise directed by the engineer.

2.4.1 General Cleaning. The contractor shall thoroughly clean the internal components and external surface of each A/C unit, and all enclosures will be cleared of any dirt or debris. Any paint or graffiti markings on the exterior shall be cleaned off and/or remove. Upon completion, the a/c unit shall be free of all debris, rodents, pests, and animal waste, and shall be neat and clean in appearance.

2.4.2 Air Conditioning Filter Replacement. The contractor shall replace the A/C filter during each preventative maintenance visit.

2.4.3 General Inspection. The contractor shall inspect each A/C unit for general condition, including condition of the cables and wires, panels, or components contained within each cabinet.

2.4.4 Operational Integrity Checks. The contractor shall check and ensure operation of the A/C unit including a diagnostics check of the entire A/C unit. This shall include the checking for proper refrigerant levels and filling, if necessary.

2.4.5 Frequency. The contractor shall perform preventative maintenance on each Air Conditioning Unit twice, within the time period stated above.

2.5 Dynamic Message Signs (DMS). All preventative maintenance shall be done in accordance with the manufacturer's recommended procedures. Care shall be taken to prevent damaging components or cabling within the enclosure. The contractor will need to provide a bucket truck in order to access the signs. This item shall also include PM of its associated field cabinet, in accordance with Section 2.2 of this provision. For each DMS, the following items of work shall be performed:

2.5.1 General Cleaning. The contractor shall thoroughly clean the DMS. The enclosures shall be cleared of any dirt and debris, any paint or graffiti markings on the exterior shall be cleaned

off and or removed, and all accessible interior equipment areas, racks and shelves shall be wiped down. Upon completion, the enclosure shall be free of all debris, rodents, pets and animal waste, and shall be neat and clean in appearance. The plexi-glass display cover shall be cleaned, inside and outside, and a water repellant solution shall be applied in accordance with its manufacturer's specifications.

2.5.2 Filter Maintenance. If the DMS' manufacturer recommends replacing the filters, the contractor shall replace its filter. If the DMS' manufacturer recommends cleaning and re-using the filters, the contractor shall clean and reinstall the filters. The contractor shall also vacuum out dust and particles from louvers and screens covering filter holders and before reinstalling cleaned filters or installing new filters.

2.5.3 General Inspection. The contractor shall inspect each location for general condition, including condition of cables and wires, power supplies, connectors, and communication panels or equipment contained within each DMS enclosure. The contractor shall also inspect operation of doors and lights.

2.5.4 Structural Inspection. The contractor shall visually inspect the structure for apparent cracks or defects, including the DMS mounting hardware. Wherever readily accessible, the contractor shall check that nuts and bolts are not loose. Repair or replace damaged grout or rodent mesh at base of sign.

2.5.5 Operational Integrity Checks. The contractor shall check and record voltages on all power supplies, and verify that all equipment appears to be operating properly. Contractor shall also perform a diagnostic on sign display per manufacturer's specifications. Any equipment not functioning properly shall be reported to the engineer. All enclosures shall be checked at this time and air handling devices shall be tested.

2.5.6 Frequency. The contractor shall perform preventative maintenance on each DMS once.

2.6 Wireless Communication Links. This work shall include the testing, adjusting/calibrating, and preventative maintenance of wireless communication links, both licensed and unlicensed. All preventative maintenance shall be done in accordance with the manufacturer's recommended procedures. Care shall be taken to prevent damaging components or cabling. The existing wireless links are in the 900MHz range, the 4.9 GHZ range and the 5 GHz range.

2.6.1 General Cleaning. The contractor shall inspect the general condition of the wireless equipment, including antenna and other external mounted equipment, paying particular attention to wiring harnesses and connectors.

2.6.2 Signal Testing. The contractor shall conduct path alignment tests and check antenna alignment from ends, measure antenna gain, measure link throughput, document background signals on similar frequencies, and measure the Voltage Standing Wave Radio. For all 4.9 gig links, the contractor shall report to engineer any links that do NOT provide 22 MB per second. The contractor shall perform site survey to determine if any foliage from trees or structure installations has encroached on the clear line of sight between radio links. If encroachment has occurred, the contractor shall document encroachment and either perform tree trimming remediation efforts or report to the engineer any structure installations.

2.6.3 Equipment Adjustments. The contractor shall perform the necessary adjustments, including adjustments to the antenna alignment to maximize available throughput and maintain the strongest possible signal.

2.6.4 Frequency. The contractor shall meet the requirements of Section 2.6 for all complete wireless communications links, including equipment at both ends of the link, a minimum of once calendar year.

2.7 Non-Intrusive Vehicle Detector Stations. This work shall include the inspection, preventative maintenance and minor remediation of each detector and assembly. All preventative maintenance shall be done in accordance with the manufacturer's recommended procedures. This item shall also include PM of its associated field cabinet, in accordance with Section 2.2 of this provision.

The contractor shall perform the following items of work for each detector and assembly:

- Check integrity of cables and connectors
- Check, test and calibrate the vehicle detectors using the testing method submitted to and approved by the engineer.
- Re-aim the detectors as needed
- Visually inspect electrical path to ground

2.7.1 Testing Procedure - Microwave Sensors. A detailed procedure and documentation template shall be prepared and submitted to the engineer for approval. At a minimum, the vehicle detector testing shall be conducted with a radar speed gun and a laptop computer connected to the remote traffic sensor unit. A five (5) minute sample of manually counted traffic volumes shall be taken for each lane and compared to the recorded volume detected by the unit. A variance exceeding five percent (5%) shall be considered a failure and require re-aiming and/or calibrating the detector and re-testing. Additionally, spot speeds shall be recorded from radar gun observations and compared to the observed speed detected by the detector and observed on the laptop. A variance exceeding ten percent (10%) shall be considered a failure and require re-aiming and/or calibrating the unit and retesting.

2.7.2 Testing Procedure - Bluetooth Sensors. A detailed procedure and documentation template shall be prepared and submitted to the engineer for approval.

2.7.3 Frequency. The contractor shall meet the requirements of Section 2.7 for all Non-intrusive Vehicle Detectors and their assemblies a minimum of once per 1-year period.

2.8 Uninterruptible Power Supplies (UPS). This work shall consist of the inspection and preventative maintenance for each UPS assembly located at Node Cabinets. All preventative maintenance shall be done in accordance with the manufacturer's recommended procedures. For each UPS assembly, the following items of work shall be performed:

2.8.1 General Cleaning. The contractor shall thoroughly vacuum any dust and debris from the UPS cabinet. Upon completion, the UPS cabinet shall be neat and clean in appearance.

2.8.2 General Inspection. The contractor shall visually inspect all components for damage, defects, corrosion or signs of abnormal wear.

2.8.3 Operational Integrity Checks. The contractor shall, at a minimum, check the following functions during each preventative maintenance inspection:

- Inverter is properly programmed and functioning correctly,
- Battery condition is operating properly and within manufacturer's specifications,
- All line and load terminals are snug on switch panel,
- All applicable control wiring connectors are properly terminated in UPS cabinet,
- Battery harness connections are properly connected,
- Components are properly grounded and connections are snug,
- Batteries are properly labeled in numerical order,
- Software version is current,
- UPS cycles properly on power loss and power return field test,
- Fan is operational and vented louvers are clear of dust and debris,
- Tamper evident lock is installed on rear access door,
- Batteries checked for proper voltage according to the manufacturer,
- Address all active fault warnings,
- Conduit openings are properly sealed, and
- Warning label is affixed on the power supply.

2.8.4 Frequency. The contractor shall meet the requirements of Section 2.9 for all UPS assemblies a minimum of once per calendar year.

2.9 Solar Power System This work shall consist of inspecting and performing preventative maintenance of the solar power systems used to power some Non-Intrusive Vehicle Detection Stations (Microwave) locations.

2.9.1 Construction Methods. All preventative maintenance shall be done in accordance with the manufacturer's recommended procedures. For each Solar Power System assembly in the contract, the following items of work shall be performed:

2.9.2 General Cleaning. The Contractor shall thoroughly vacuum any dust and debris from the Solar Power System cabinet. Upon completion, the Solar Power System cabinet shall be neat and clean in appearance.

2.9.3 General Inspection. The Contractor shall visually inspect all components for damage, defects, corrosion, or signs of abnormal wear.

2.9.4 Operational Integrity Checks. The Contractor shall, at a minimum, check the following functions during each preventative maintenance inspection:

- Inverter is properly programmed and functioning correctly,
- Battery conditioner is operating properly,
- All line and Load terminals are snug on switch panel,
- All applicable control wiring connectors are properly terminated in Solar Power System cabinet,
- Battery harness connections are properly connected,
- Components are properly grounded and connections are snug,
- Batteries are properly labeled,
- Ensure there is plenty of ventilation in the battery enclosure,

- Each battery cells should be clean before removing any filter caps for maintenance. To clean the cells, use either a brush to remove dry materials and/or a rag dipped in a solution of baking soda and water and thoroughly squeezed out,
- Solar Power System cycles properly on power loss and power return field test,
- Fan is operational and vented louvers are clear of dust and debris,
- Tamper evident lock is installed on rear access door,
- Batteries checked for proper voltage according to the manufacturer,
- Address all active fault warnings,
- Conduit openings are properly sealed,
- Warning label is affixed on the power supply.

2.9.5 Frequency. The contractor shall meet the requirements of Section 2.10 for all Solar Power Systems a minimum of once per calendar year.

3.0 Structural Defects. The contractor shall visually inspect the ITS device's pole, concrete base, and mounting hardware for signs of abnormal wear, such as cracks, significant rust, missing or broken anchor bolts, or other signs of weakness. If a structural defect or abnormal wear is noticed through this work, the contractor shall submit documentation directly to the engineer to highlight the structural issues noted, within 24 hours of the inspection.

4.0 Verification and Modification of Communication Drawings. The engineer will provide the contractor with access to the as-built communication drawings for each device to be maintained on this contract. For each device the contractor performs preventative maintenance on, the contractor shall verify the accuracy of the current communication diagram. If a discrepancy is discovered, the contractor shall notify the SLITS Group with the as-is device names and fiber tube and strands colors in their daily reports and shall modify the electronic copy of the diagram for that device location and submit the revised electronic file to the engineer. This does not include the Node or the signal cabinets when the contractor does not perform a Preventative Maintenance check. Updated drawings shall be submitted electronically, in color, for both Visio and PDF formats, within fourteen (14) days of the inspection.

5.0 Documentation. The contractor shall use the location documentation, including inventory and wiring diagrams to verify that all equipment is documented and the correct models and serial numbers are recorded. All information gathered under this item shall be submitted to the engineer as outlined in JSP Z – Documentation and Reporting. This report shall document all items checked, verified and if repairs were made, including filters replaced. The make, model and serial number of the ITS devices, communication equipment, and other included hardware shall be noted.

5.0.1 CCTV cameras. The contractor shall note the initial and final camera dome pressures upon completion of a recharge, if necessary.

5.0.2 Vehicle Detectors. The documentation prepared and filed for this work shall also include a tabular summary comparing observed speeds and volumes with detected speeds and volumes.

5.0.3 Organization of Records. Reports for devices and cabinets inspected under this item shall be organized in an electronic format, sorted by location ID in ascending order, and delivered to the engineer as outlined in JSP Z – Documentation and Reporting.

6.0 Materials. The contractor shall procure and maintain an inventory of contractor furnished ITS spare parts necessary to complete the requirements of this job special provision. The contractor shall also maintain an inventory of Commission-furnished equipment necessary to complete the requirements of this job special provision. See JSP X – Out of Scope Work and Repairs for more details.

7.0 Method of Measurement. Measurement for preventative maintenance of the devices listed above shall be per each.

8.0 Basis of Payment. Payment for furnishing the labor, materials, and equipment necessary to inspect, test, clean, perform minor repairs (calibrations, re-aim, etc.), and perform any other preventative maintenance to the devices/systems listed above, as recommended by the manufacturer, shall be paid for by the contract unit price for:

Item Number	Item Description	Unit
910-99.02	PM DMP, Assembly, Poles, Foundation, and Cabinet	EA
910-99.02	PM CCTV Camera, Assembly, Pole, & Field Cabinet	EA
910-99.02	PM Communication Node Field Cabinet	EA
910-99.02	PM Air Conditioning Units for Node Cabinets	EA
910-99.02	PM DMS, Assembly, Pole, Foundation & Field Cabinet	EA
910-99.02	PM Solar Power System	EA
910-99.02	PM Communication Link and Assembly	EA
910-99.02	PM Uninterruptible Power Supply (UPS) for Node Cabinets	EA
910-99.02	PM Non-Intrusive Vehicle Detector Stations (Microwave)	EA
910-99.02	PM Uninterruptible Power Supply & Assembly	EA

R. Preventative Maintenance with Repairs

1.0 Description. The contractor shall perform preventative maintenance as outlined in the JSP Q – Preventative Maintenance for any needed repairs on ITS devices, cabinets, communication equipment, and any additional ITS hardware listed below:

- CCTV Camera, Assembly, Pole, and Field Cabinet
- DMS, Assembly, Pole, Foundation, and Field Cabinet
- DMP, Assembly, Pole, Foundation, and Field Cabinet
- UPS for Node Cabinets
- Solar Power Systems

2.0 Materials. The contractor shall procure and maintain an inventory of contractor furnished ITS spare parts necessary to complete the requirements of this job special provision. The contractor shall also maintain an inventory of Commission-furnished equipment necessary to complete the requirements of this job special provision. See JSP X - Out of Scope Work & Repairs for more details.

3.0 Method of Measurement. Measurement for preventative maintenance and repairs of the devices listed above shall be per each.

4.0 Basis of Payment. Payment for furnishing the labor, materials, and equipment necessary to inspect, test, clean, perform minor repairs (calibrations, re-aim, etc.), and perform any other preventative maintenance and repairs to the devices/systems listed above, as recommended by the manufacturer, shall be paid for by the contract unit price for:

Item Number	Item Description	Unit
910-99-02	PM with Repairs – MoDOT approved DMP, Assembly, Pole, Foundation, & Field Cabinet	EA
910-99-02	PM with Repairs – MoDOT approved CCTV Camera, Assembly, Pole, & Field Cabinet	EA
910-99-02	PM with Repairs – MoDOT approved CCTV	EA
910-99-02	PM with Repairs – MoDOT approved CCTV Device Server	EA
910-99-02	PM with Repairs – MoDOT approved CCTV Encoder	EA
910-99-02	PM with Repairs – MoDOT approved CCTV cables and wires	EA
910-99-02	PM with Repairs – MoDOT approved CCTV connectors	EA
910-99-02	PM with Repairs – MoDOT approved CCTV surge protector	EA
910-99-02	PM with Repairs – MoDOT approved CCTV power supply	EA
910-99-02	PM with Repairs – MoDOT approved CCTV pole access panel	EA
910-99-02	PM with Repairs – MoDOT approved IP addressable power strip	EA
910-99-02	PM with Repairs – MoDOT approved DMS Pixel board	EA
910-99-02	PM with Repairs – MoDOT approved DMS Driver board	EA
910-99-02	PM with Repairs – MoDOT approved DMS power supply	EA
910-99-02	PM with Repairs – MoDOT approved DMS fan	EA
910-99-02	PM with Repairs – MoDOT approved DMS controller	EA
910-99-02	PM with Repairs – MoDOT approved DMS LCA	EA
910-99.02	PM with Repairs – MoDOT Solar Power System	EA

S. Remedial Maintenance

1.0 Description. This work should include the repair of field components that have been damaged by storms, vehicle collisions, construction activities, or other unanticipated events. Major relocations or system upgrades shall not be considered part of this work. All work under this provision shall be done in accordance with the current Missouri Standard Specifications for Highway Construction.

1.1 The process for repairs shall be initiated when the engineer or the engineer's representative, issues the contractor a MoDOT Online Maintenance System work order. The contractor shall conduct an initial diagnosis, report to the engineer the diagnosis and recommend a solution with associated costs. With the engineer's approval, the contractor shall implement an appropriate repair. The contractor shall check for new MoDOT Online Maintenance System work orders on a daily basis.

1.1.1 The contractor shall inform the engineer when the work has been completed for each MoDOT Online Maintenance System work order. However, the MoDOT Online Maintenance System work order shall not be closed or considered complete, until the engineer or engineer's representative has verified that the malfunction has been corrected. If the engineer does not

concur that the problem has been resolved, the MoDOT Online Maintenance System work order shall be so noted and returned to the contractor.

1.1.2 MoDOT Online Maintenance System work orders, location histories, and inventory information shall be maintained in electronic format by the contractor. These records and logs shall be provided to the engineer as requested.

1.2 The contractor shall furnish all equipment and materials necessary to comply with the requirements of this provision unless stated otherwise.

2.0 Response Time. The engineer, or the engineer's representative, shall determine whether or not a malfunction is critical to the operation of the St. Louis District's ITS system.

2.1 Critical System Repairs. The contractor shall be available to respond, diagnose, and repair critical system failures/malfunctions on a twenty-four (24) hours per day, seven (7) days per week, three hundred sixty five (365) days per year schedule. The engineer may notify the contractor of critical system failures/malfunctions during and outside normal business hours and on holidays. The contractor shall provide a 24/7 central telephone number to be used by the engineer to notify and report critical system failures/malfunctions. The contractor shall be required to respond onsite with the appropriate crew, equipment and material; make the site safe; and perform an initial diagnosis within 4 hours of notification. The contractor shall recommend an appropriate repair to the engineer. If approved by the engineer, the contractor shall make the necessary repair to the system within the timeframe as described in the provision below as maximum allowable time for completion or as approved by the engineer.

2.1.1 Types of system malfunctions that would be considered critical may include, but shall not be limited to:

- Loss of communication with a node cabinet
- Fiber Optic Cable break in MoDOT's network backbone
- Device malfunctions during critical operations.

2.2 Non-Critical System Repairs. The engineer shall notify the contractor of non-critical system failures/malfunctions during normal business hours. The contractor shall be required to respond onsite with the appropriate crew, equipment and material; make the site safe; and perform an initial diagnosis within 24 hours of notification. The contractor shall recommend an appropriate repair to the engineer. If approved by the engineer, the contractor shall make the necessary repair to the system within the timeframe as described in the provision below as maximum allowable time for completion or as approved by the engineer.

2.3 Notification shall be defined as when the contractor receives a call or email with the MoDOT Online Maintenance System work order from the engineer, or the engineer's representative. The contractor is required to immediately reply to the engineer's phone calls or emails to verify receipt of notification.

3.0 Standard Repair Items.

3.1 Remove CCTV Camera & Assembly. The contractor shall remove the existing camera, camera dome, pan/tilt unit, device server, and all cables and connectors from the pole. The existing camera controller assembly in the cabinet shall be disconnected from the camera communication/power cables and the cables shall be removed from the cabinet. The contractor shall only remove the camera controller or CODEC from the cabinet if directed by the engineer.

All items, removed by the contractor, shall remain the property of the Commission and shall be put into storage by the contractor for use as maintenance spare parts, reinstalled or disposed of as directed by the engineer.

3.1.1 Once removal has begun, the contractor shall be responsible for the condition of all equipment. Compensation for equipment damaged shall be deducted from the contract. The contractor may request of field meeting with the engineer, or the engineer's representative, at the site to inspect the equipment prior to removal.

3.1.2 The contractor shall have a maximum of four (4) hours to complete the requirements of this provision.

3.2 Install CCTV Camera & Assembly. This work shall consist of installing a Commission-furnished closed circuit television (CCTV) camera and assembly, or salvaged camera and assembly, on a metal pole and install a Commission-furnished power supply and surge protection in a nearby cabinet. The pole and cabinet will be existing or shall be paid for separately. This work also requires the contractor to provide cables connecting the camera to the equipment in the cabinet and to ground, provide an air terminal, set up the camera assembly and test for proper operation.

3.2.1 Qualified Personnel. The Commission's agreement with the camera assembly manufacturer obligates the manufacturer to train the Commission's installation contractors in the unpacking, assembling, mounting, positioning, connecting to the communication network, set up and testing of the camera and assembly. The training is free to the contractor and is conducted at the jobsite. The contractor shall not perform any work until the manufacturer has certified the contractor as qualified. Only personnel who have been trained by the manufacturer shall participate in the camera and assembly installation, setup and testing. The engineer or the engineer's representative shall be present to observe the training.

Contractors certified under a previous Commission contract shall not need to be trained a second time, but only personnel who received the training shall participate in the camera assembly installation and testing.

3.2.2 Support During Installation. The Commission's agreement with the camera assembly manufacturer obligates the manufacturer to provide both on-site and remote factory support.

3.2.3 Materials. Camera assembly, mounting bracket, power supply and surge suppressors will be provided by the Commission or salvaged and refurbished from a previous installation.

The contractor shall acquire cables for power, video, and camera control from the camera's manufacturer or shall use salvaged and refurbished cables from a previous installation.

The contractor shall provide stainless steel bands to affix the mounting bracket to the new or existing pole. The banding shall be 1-inch wide and 0.044-inch thick stainless steel.

The contractor shall provide an air terminal that is solid copper at least 5/8 inch in diameter. The top of the rod shall be tapered to a point. The bottom of the rod shall be flattened and bolted to the pole using at least three stainless steel bolts

3.2.4 Construction Requirements. The dome shall be installed so that the pole does not block the camera's view of traffic.

The air terminal shall be installed on the opposite side of the pole from the dome. The contractor shall position the rod to project a minimum of five feet above the highest point of the pole, and attach it to the pole with bolts passing through the wall of the pole and bond the air terminal to the top of the pole. The contractor shall apply a copper-based conductive sealant between the rod and the pole before tightening the bolts. The pole itself shall be the ground conductor.

The bottom of the pole shall be connected to one or more ground rods using a bare, solid AWG # 6 copper wire. The contractor shall use exothermic welding for all ground wire connections, except the connection to the pole, which shall use the pole's grounding lug. The contractor shall use a device that measures resistance to ground using the three-point fall-of-potential method and shall test the resistance from the air terminal to ground. If the resistance between the air terminal and ground exceeds 8 ohms, the contractor shall add more ground rods to achieve this requirement. The contractor shall perform all work related to the installation of the air terminal in accordance with NFPA 780.

The contractor shall terminate all the cables on surge protectors, install the Commission-furnished power supply in the cabinet, and connect the camera power circuit to the power supply.

The contractor shall be responsible for restricting the camera's field of view, if necessary, so that a user cannot use the cameras to look in the windows of dwellings or view residential property, as long as the restriction does not interfere with the use of the camera for traffic management purposes. Prior to creating these restrictions, the contractor shall submit to the engineer a written description of the proposed restrictions to be installed at each camera, and the proposed method of achieving them. The restrictions shall be constructed such that it shall not be possible for an operator to override them without intervention by his or her supervisor. Affixing a mask to the inside of the clear dome shall be an acceptable method to achieve this. If there are situations in which there is a conflict between the need to protect privacy and the need to manage traffic, the contractor shall advise the engineer. The contractor shall revise the field of view restrictions as directed by the engineer.

The contractor shall apply a rain repellent coating to the outside of the lower dome, following the coating manufacturer's instructions. The coating must be recommended by its manufacturer for clear acrylic.

The contractor shall configure the CCTV camera and CODEC, including appropriate IP addresses, as directed by the engineer to function properly within the existing communications scheme.

3.2.5 Acceptance Testing. Upon delivery of a shipment of new or refurbished camera assemblies, the manufacturer's representative shall conduct a visual inspection and test of the camera assemblies to check for manufacturing defects and shipping damage. The camera assembly shall be powered during this testing, and tests shall follow procedures developed by the manufacturer and approved by the engineer. The engineer will witness this testing and the contractor may witness this testing if he or she chooses. The manufacturer shall be responsible for replacing all defective units uncovered by this testing.

After installing the camera assembly, the contractor shall test it using the same procedures as the manufacturer's representative used when the camera assemblies were delivered. In

addition, demonstrate that the agreed upon viewing restrictions have been implemented. Also, use a device that measures resistance to ground using the three-point fall-of-potential method to demonstrate that the resistance from the air terminal to ground does not exceed 8 ohms. If the installed camera assembly fails to operate properly, and the problem cannot be fixed by changing the wiring or setup parameters, the camera assembly will be deemed defective and the contractor shall return it to the manufacturer for replacement. Except for costs borne by the manufacturer under his warranty agreement, the cost of replacement shall be borne entirely by the contractor.

3.2.6 The contractor shall have a maximum of four (4) hours to complete the requirements of this provision.

3.3 Remove Camera Pole. The work shall consist of removing an existing camera pole, after the existing camera and assembly, including cabinet, is removed from pole. The poles may be mounted and bolted to a concrete foundation or previously damaged to an extent that it has been knocked over and is laying adjacent to the foundation. Each pole, removed by the contractor, shall remain the property of the Commission and shall be put into storage by the contractor for use as maintenance spare parts, reinstalled or disposed of as directed by the engineer.

3.3.1 Once removal has begun, the contractor shall be responsible for the condition of all equipment. Compensation for equipment damaged shall be deducted from the contract. In lieu of a field meeting to determine the condition of the pole prior to its removal, the contractor may photograph the pole to document pre-existing damage prior to beginning work. Any damage, without sufficient documentation, shall be assumed to be caused by the contractor and the contractor will be responsible for the damages.

3.3.2 The contractor shall have a maximum of four (4) hours to complete the requirements of this provision.

3.4 Install Salvaged Camera Pole. The work shall consist of installing a salvaged camera pole on an existing or a new concrete foundation.

The contractor shall perform the following:

- Install the camera pole on a new or existing foundation as directed by the engineer.
- Check the plumb of the pole and adjust as necessary.
- Tighten the anchor bolts to the torque specified by the manufacturer of the pole.

3.4.1 Installation or repair of a concrete foundation shall be considered out of scope work and shall be compensated for through methods described in other articles of this contract.

3.4.2 The contractor shall have a maximum of four (4) hours to complete the requirements of this provision.

3.5 Install New CCTV Pole (60 feet) and Lowering System.

3.5.1 Description. The camera lowering system shall be designed to support and lower a standard closed circuit television camera, lens, housing, PTZ mechanism, cabling, connectors and other supporting field components without damage or causing degradation of camera operations. The camera lowering system device and the pole are interdependent; and thus,

must be considered a single unit or system. The lowering system shall consist of a pole, suspension contact unit, divided support arm, and a pole adapter for attachment to a pole top tenon, pole top junction box, conduit mount adapter and camera connection box. The divided support arm and receiver brackets shall be designed to self-align the contact unit with the pole center line during installation and insure the contact unit cannot twist under high wind conditions. Round support arms are not acceptable. The camera-lowering device shall withstand wind forces of 100 mph with a 30 percent gust factor using a 1.65 safety factor. The lowering device manufacturer, upon request, shall furnish independent laboratory testing documents certifying adherence to the stated wind force criteria utilizing, as a minimum effective projected area, the actual EPA or an EPA greater than that of the camera system to be attached. The camera-lowering device to be furnished shall be the product of manufacturers with a minimum of 3 years of experience in the successful manufacturing of camera lowering systems. The lowering device provider shall be able to identify a minimum of 3 previous projects where the purposed system has been installed successfully for over a one-year period of time each.

The lowering device manufacturer shall furnish a factory representative to assist the electrical contractor with the assembly and testing of the first lowering system onto the pole assembly. The manufacturer shall furnish the applicable DOT engineer documentation certifying that the electrical contractor has been instructed on the installation, operation and safety features of the lowering device. The contractor shall be responsible for providing applicable maintenance personnel “on site" operational instructions.

3.5.2 Suspension Contact Unit. The suspension contact unit shall have a load capacity 200 lbs. with a 4 to 1 safety factor. There shall be a locking mechanism between the fixed and moveable components of the lowering device. The movable assembly shall have a minimum of 2 latches. This latching mechanism shall securely hold the device and its mounted equipment. The latching mechanism shall operate by alternately raising and lowering the assembly using the winch and lowering cable. When latched, all weight shall be removed from the lowering cable. The fixed unit shall have a heavy duty cast tracking guide and means to allow latching in the same position each time. The contact unit housing shall be weatherproof with a gasket provided to seal the interior from dust and moisture.

The prefabricated components of the lift unit support system shall be designed to preclude the lifting cable from contacting the power or video cabling. The lowering device manufacturer shall provide a conduit mount adapter for housing the lowering cable. This adapter shall have an interface to allow the connection of a contractor provided conduit and be located just below the cable stop block at the back of the lowering device. The Contractor shall supply internal conduit in the pole as required by the Engineer. The only cable permitted to move within the pole or lowering device during lowering or raising shall be the stainless steel lowering cable. All other cables must remain stable and secure during lowering and raising operations.

The female and male socket contact halves of the connector block shall be made of thermosetting synthetic rubber known as Hypalon. The female brass socket contacts and the male high conductivity brass pin contacts shall be permanently molded into the Hypalon body.

The current carrying male contacts shall be 1/8 inches in diameter. There shall be two male contacts that are longer than the rest which will make first and break last providing optimum grounding performance. The number of contacts shall be 14 and the camera mounted thereto, shall be capable of performing all of its necessary functions on 14 contacts or less.

The current carrying female contacts shall be 1/8 inches I.D. All of the contacts shall be recessed 0.125" from the face of the connector. Cored holes in the rubber measuring 0.25" in diameter and 0.125" deep molded into the connector body are centered on each contact on the face of the connector to create rain-tight seals when mated with the male connector.

The wire leads from both the male and female contacts shall be permanently and integrally molded in the Hypalon body. The current carrying and signal wires molded to the connector body shall be constructed of #18/1 AWG Hypalon jacketed wire.

The contacts shall be self-wiping with a shoulder at the base of each male contact so that it will recess into the female block, thereby giving a rain-tight seal when mated. The electrical contact connector must meet Mil Spec Q-9858 and Mil Spec I-45208.

3.5.3 Lowering Tool. The camera-lowering device shall be operated by use of a portable lowering tool. The tool shall consist of a lightweight metal frame and winch assembly with cable as described herein, a quick release cable connector, an adjustable safety clutch and a variable speed industrial duty electric drill motor. This tool shall be compatible with accessing the support cable through the hand hole of the pole. The lowering tool shall attach to the pole with one single bolt. The tool will support itself and the load assuring lowering operations and provide a means to prevent freewheeling when loaded. The lowering tool shall be delivered to the applicable DOT engineer upon project completion. The lowering tool shall have a reduction gear to reduce the manual effort required to operate the lifting handle to raise and lower a capacity load. The lowering tool shall be provided with an adapter for operating the lowering device by a portable drill using a clutch mechanism. The lowering tool shall be equipped with a positive breaking mechanism to secure the cable reel during raising and lowering operations and prevent freewheeling. The manufacturer shall provide a variable speed, heavy-duty reversible drill motor and a minimum of one lowering tool plus any additional tools required by plan notes. The lowering tool shall be made of durable and corrosion resistant materials, powder coated, galvanized, or otherwise protected from the environment by industry-accepted coatings to withstand exposure to a corrosive environment.

3.5.4 Materials. All pulleys for the camera lowering device and portable lowering tool shall have sealed, self-lubricated bearings, oil tight bronze bearings, or sintered- oil impregnated, bronze bushings. The lowering cable shall be a minimum 1/8-inch diameter stainless steel aircraft cable with a minimum breaking strength of 1740 pounds with (7) strands of 19 wire each.

All electrical and video coaxial connections between the fixed and lowerable portion of the contact block shall be protected from exposure to the weather by a waterproof seal to prevent degradation of the electrical contacts. The electrical connections between the fixed and movable lowering device components shall be designed to conduct high frequency data bits and one (1) volt peak-to-peak video signals as well as the power requirements for operation of dome environmental controls.

The interface and locking components shall be made of stainless steel and or aluminum. All external components of the lowering device shall be made of corrosion resistant materials, powder coated, galvanized, or otherwise protected from the environment by industry-accepted coatings to withstand exposure to a corrosive environment.

The camera junction box shall be cast ZA-12 (12% aluminum and 88% zinc) and weigh a minimum of 50 LBS to insure stability of camera during the raising and lowering operation. The

camera junction box shall have 2 fully gasketed doors to prevent water intrusion. The bottom of the camera junction box shall be equipped with a condensation/moisture exit system.

The Camera Manufacturer shall provide weights and/or counterweights as necessary to assure that the alignment of pins and connectors are proper for the camera support to be raised into position without binding. The lowering unit will have sufficient weight to disengage the camera and its control components in order that it can be lowered properly.

The Camera Manufacturer shall provide the power and signal connectors for attachment to the bare leads in the pole top and/or camera junction boxes.

Either the Camera Manufacturer or the Lowering Device Provider shall provide a mounting flange sufficient for mounting the respective camera assembly to the bottom of the Camera connection box.

3.5.5 Camera Lowering System Steel Pole

Design. Design shall be in accordance with the 2001 AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals." Minimum Loading requirements shall be based on an isotach wind velocity for the area of installation according to 2001 AASHTO isotach wind chart with a 1.3 gust factor.

Shop Drawings are required and shall include details of the hand holes, cable inlets, and pole cap, as well as fasteners and hardware required for the lowering device. Calculations showing that the pole meets the requirements of the AASHTO specifications shall be submitted with the shop drawings, and calculations shall be signed and sealed by a Professional Engineer registered in the State of Missouri.

Fabricator. The Fabricator shall be certified under Category I, "Conventional Steel Structures" as set forth by the American Institute of Steel Construction Quality Certification Program. Proof of this certification will be required to ensure that the fabricator has the personnel, organization, experience, procedures, knowledge, equipment, capability and commitment to fabricate quality pole structures.

Welding. All welding shall be in accordance with Sections 1 through 8 of the American Welding Society (AWS) D1.1 Structural Welding Code. Tackers and welders shall be qualified in accordance with the code. Tube longitudinal seam welds shall be free of cracks and excessive undercut, performed with automatic processes, and be visually inspected. Longitudinal welds suspected to contain defects shall be magnetic particle inspected. All circumferential butt-welded pole and arm splices shall be ultrasonically or radiographically inspected.

Material Certifications. All materials and products shall be manufactured in the United States of America, and comply with ASTM or AASHTO specifications. Mill certifications shall be supplied as proof of compliance with the specifications.

Performance Calculations. The pole shall be designed to support the specified camera and accessories. Close consideration must be given to the effective projected area of the complete lowering system and camera equipment to be mounted on the pole along with the weight when designing the pole to meet the specified deflection performance criteria. The pole top deflection shall not exceed one inch in a 30-mph (non-gust) wind. The calculations shall include a pole,

base plate, and anchor bolt analysis. The pole calculations shall be analyzed at the pole base, at 5-ft. pole intervals/segments and at any other critical pole section. At each of these locations, the following information shall be given:

The pole's diameter, thickness, section modulus, moment of inertia, and cross sectional area.

The centroid, weight, projected area, drag coefficient, velocity pressure, and wind force of each pole segment.

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

The pole's angular and linear deflection.

Pole Shaft. The pole shaft shall conform to ASTM A595 Grade A with a minimum yield strength of 55 ksi or ASTM A572 with a minimum yield strength of 65 ksi. The shaft shall be round, 12-sided or 16 sided with a four inch corner radius, have a constant linear taper of 0.14 in/ft, and contain only one longitudinal seam weld. Circumferential welded tube butt splices and laminated tubes are not permitted. Longitudinal seam welds within 6 inches of complete penetration pole to base plate welds shall be complete penetration welds. The shaft shall be hot dip galvanized per the requirements of the contract documents.

Winch Hand Hole. The hand hole opening shall be reinforced with a minimum 2-inch wide hot rolled steel rim. The minimum outside dimension shall be 6 inches x 27 inches. The handhole shall have a tapped hole for mounting the portable winch thereto as shown on the drawings. Unless otherwise required, the bottom lip of this handhole shall be a minimum of 30 inches from the pole base.

Pole Top Tenon. The pole shall have a custom plate mounted tenon that allows the field modification of the arm/camera orientation up to 360 degrees. With this design the DOT engineer can make slight orientation modifications to the camera mount to allow optimum viewing in case of future road development, change in terrain or a change in the viewing needs priority. The tenon shall have mounting holes and slot as required for the mounting of the camera-lowering system. The tenon shall be of dimensions necessary to facilitate camera lowering device component installation. For details, see applicable drawings.

Cable Supports / Electrical Cable Guides and Parking Stand (Eyebolts). Top and bottom electrical cable guides shall be located within the pole aligned with each other as referenced in the drawings. One cable guide shall be positioned 2 inches below the handhole and the other shall be positioned 1 inch directly below the top of tenon. Two parking stands shall be positioned a maximum of 2.75 inches below the top of the handhole and located at 90 and 270 degrees from the handhole.

Base Plate. Base plates shall conform to ASTM A36 or A572 Grade 42. Plates shall be integrally welded to the tubes with a telescopic welded joint or a full penetration butt weld with backup bar. Plates shall be hot dip galvanized per the requirements of the contract documents.

Anchor Bolts. Anchor bolts shall conform to the requirements of ASTM F1554 Grade 55. The upper 12 inches of the bolts shall be hot dip galvanized per ASTM A153. Each anchor bolt shall

be supplied with two hex nuts and two flat washers. The strength of the nuts shall equal or exceed the proof load of the bolts.

3.5.6 The contractor shall have a maximum of four (4) hours to complete the requirements of this provision.

3.6 Dynamic Message Sign (DMS)

3.6.1 Qualified Personnel. The Commission's agreement with the DMS manufacturers obligates the manufacturers to train the Commission's installation contractors in the unpacking, assembling, mounting, positioning, connecting to the communication network, set up and testing of the DMS. The training is free to the contractor and is conducted at the jobsite. The contractor shall not perform any work until the manufacturer has certified the contractor as qualified. Only personnel who have been trained by the manufacturer shall participate in the DMS assembly repair and testing. The engineer or the engineer's representative shall be present to observe the training.

Contractors certified under a previous Commission contract shall not need to be trained a second time, but only personnel who received the training shall participate in the DMS assembly repair and testing.

3.6.2 Support During Installation. The Commission's agreement with the DMS manufacturers obligates the manufacturer to provide both on-site and remote factory support.

3.6.3 Materials. DMS parts, including but not limited to fans, logic control assemblies, LED matrix modules, temperature sensor assembly, power supply assembly, photo sensor assembly, power surge protectors, and driver boards will be provided by the Commission or salvaged and refurbished from a previous installation.

The contractor shall acquire cables for power from the DMS's manufacturer or shall use salvaged and refurbished cables from a previous installation.

3.6.4 Construction Requirements. Once repairs are completed, the contractor shall inspect each location for general condition, including condition of cables and wires, power supplies, connectors, and communication panels or equipment contained within each DMS enclosure, check and record voltages on all power supplies, and verify that all equipment appears to be operating properly. Contractor shall also perform a diagnostic on sign display per manufacturer's specifications. Any equipment not functioning properly shall be immediately repaired and reported to the engineer.

3.6.5 Acceptance Testing. Upon completion, contractor shall contact the TMC staff to post test-messages onto the DMS. Contractor shall verify readability of the messages and report the findings to the engineer.

3.6.6 The contractor shall have a maximum of four (4) hours to complete the requirements of this provision.

3.7 Remove Field Cabinet (Single or Dual). This work shall consist of removing a controller cabinet, and internal component assembles. The cabinet may be single or dual size cabinets used for various ITS devices, including detector stations, DMS, CCTV control and communications, and communication nodes.

The contractor shall remove existing equipment and evaluate components to determine what may be salvaged for immediate reuse or placement into the spare parts inventory. This evaluation may include functional testing of the equipment. Whenever possible, the original cabinet and communications equipment shall be salvaged for reuse at the location or for placement into the spare parts inventory.

3.7.1 The removal of the concrete base foundation, if necessary, shall be considered out of scope work and shall be compensated for through methods described in another provision of this contract.

3.7.2 The contractor shall have a maximum of forty-eight (48) hours to complete the requirements of this provision.

3.8 Install Salvaged Field Cabinet (Single or Dual). This work shall consist of installing a salvaged controller cabinet on a new or existing concrete foundation (or a new or existing pole). This item shall be paid for two separate pay items: 1) Single cabinets used for detector stations, DMS, and CCTVs; and 2) Double cabinets used for communications nodes.

The contractor shall be responsible for all connectors and terminators, communication/power cables, cable management, equipment necessary to move the populated field cabinet, bolts and washers. All connectors, wire, terminators, bolts, and washers shall be new. Installation shall include connecting internal component assemblies and power connections and integrating the assemblies into the existing communications system.

3.8.1 Installation or repair of a concrete foundation shall be considered out of scope work and shall be compensated for through methods described in another provision of this contract.

Furnishing and installing cable outside of the cabinet shall NOT be considered part of this work. It may be paid for under another pay item or it may be considered out of scope work. Again, out of scope work shall be compensated for through methods described in another provision of this contract.

3.8.2 Construction Methods. The contractor shall install a salvaged cabinet on a new, existing, or modified concrete foundation (or a new or existing pole). Installation shall include making all power connections between the cabinet and local utility connections; and furnishing, installing and connecting all cables between devices within the cabinet.

The contractor shall make all power connections to the cabinet in accordance with requirements of the local power utility and any applicable state codes.

The contractor shall make all detector cable and communications cable connections in the cabinet to provide the required operation. The engineer shall provide the existing wiring diagrams to the contractor. The contractor shall make all traffic signal cable connections and electrical wire connections to the processor assembly cabinet.

All signal current carrying neutral conductors shall terminate on a neutral strip mounted in the cabinet. The neutral bus shall be isolated from the cabinet and equipment ground. It shall terminate at the neutral lug ultimately attached in the meter pedestal.

The equipment grounding strip shall be isolated from the cabinet and current carrying neutral. The cabinet current carrying neutral shall terminate at the current carrying neutral ground lug in the meter pedestal or breaker pedestal.

Existing wiring to the existing, modified, or new concrete control cabinet base shall be reused, if possible, unless directed otherwise by the engineer. Wiring includes bonding wires, conductors, and detector lead-in cable.

The contractor shall make all connections between the field cabinet, the devices within, and among the devices.

The contractor shall demonstrate the functionality and accuracy of the vehicle detector, CCTV, DMS, and/or wireless communication equipment connected to the salvaged field cabinet. For CCTVs and DMS's, the contractor shall coordinate with the Gateway Guide operators to test the CCTV's pan-tilt, iris, and video functionality and the DMS' display functionality capabilities through the Advanced Transportation Management System (ATMS) software.

3.8.3 The contractor shall have a maximum of forty-eight (48) hours to complete the requirements of this provision.

3.9 Install new ITS Cabinets (Type 1, 2, 5 or 7). This work shall consist of furnishing and installing new cabinets and base adapters.

3.9.1 Materials.

3.9.1.1 All cabinets shall include a grounding system. Connection to ground must be bare, solid AWG # 6 copper wire or equivalent bonding strap.

3.9.1.2 All powered cabinets shall be wired for three-wire 240/120 volt AC service. Provide a lightning arrestor designed to protect 120/240 VAC split phase breaker panels. The protector shall use metal oxide varistors as the protective elements. The response time shall be under five nanoseconds and the maximum surge current shall be at least 40,000 amps. The clamping voltage shall not exceed 400 volts. The device shall protect line-to-line and line-to-neutral.

3.9.1.3 Provide an additional surge protector just for the circuits powering the communication and traffic management equipment (excluding the dynamic message sign, which has its own surge protectors). This shall be a filtering, two-stage surge protector. Install it on the load side of the appropriate breaker. The protector shall provide radio frequency noise filtering and be capable of protecting equipment drawing a total of at least 10 amps. If the maximum load on the circuit exceeds 10 amps, the contractor shall split the load among multiple circuits, each with a surge protector. The protector shall clamp both the main line and the main neutral at 250 volts, both relative to each other and relative to the cabinet ground. The response time shall be such that the voltage never exceeds 250 volts. The surge protector shall suppress surges of up to 20,000 amps.

3.9.1.4 All circuit breakers shall be molded case units with quick-make, quick-break, trip-free mechanism, and with a minimum interrupting capacity of 10,000A (RMS Symmetrical). The circuit breakers shall be of fixed trip type and UL listed. Circuit breakers shall be listed on the latest Qualified Products List QPL-W-C-375 maintained by the Defense Supply Center.

3.9.1.5 All doors shall have cabinet identification labels displaying the cabinet identifier. The

engineer will provide a list of the identifiers for each location, as well as the format for the labels.

3.9.1.6 All seams shall be continuously welded and ground smooth.

3.9.1.7 All fasteners must be stainless steel.

3.9.1.8 All cabinets shall have a natural aluminum finish, free from blemishes.

3.9.1.9 Provide terminal blocks for all conductors entering the cabinet. Except for blocks used for coaxial cable, the blocks shall be the barrier type with nickel-plated brass screw terminals and solid backs. Terminal blocks for conductors carrying more than 60 volts must be covered by a clear acrylic shield.

3.9.1.10 All cabinet doors shall have locks keyed to match MoDOT's other Gateway Guide cabinets.

3.9.2 Type 7 Cabinet.

3.9.2.1 Provide a single door, NEMA 3R, aluminum cabinet. The aluminum shall be at least 0.188 inches thick, except that the door and top need be only 0.125 inches thick. The cabinet shall be approximately 36 inches high, 20 inches wide, and 17 inches deep. The cabinets shall be designed for pole mounting (with the back against the pole). The cabinet shall have a three-point door latch. It shall also have provision for padlocking. The door hinge shall be continuous and shall be affixed by nuts and bolts that are concealed when the door is closed.

3.9.2.2 The cabinet shall be equipped with the following:

- **Rack:** For mounting 19-inch equipment. The mounting rails must have holes of the EIA standard size and spacing for the entire height of the cabinet.
- **Mounting panels:** For terminal blocks, breakers, surge protectors, and other small items on the back and side walls.
- **Terminal blocks:** For all conductors entering the cabinet. Except for blocks used for coaxial cable, the blocks shall be the barrier type with nickel-plated brass screw terminals and solid backs. Each terminal shall be clearly and permanently labeled on a contiguous surface using silk screening or other approved method. Terminal blocks for conductors carrying more than 60 volts must be covered by a clear acrylic shield.
- **Fluorescent light:** Controlled by a door switch.
- **Duplex ground fault interrupt outlet:** For use by technicians.
- **Thermostatically controlled fan and heater:** The fan shall move 100 CFM through vents at the top of the cabinet. The air intake shall be through louvers in the door, and the air shall pass through a replaceable filter as it enters the cabinet. The heater shall use at least 250 watts and shall be designed to prevent accidental contact with dangerous heat or voltage.
- **Electrical distribution system:** Consisting of two 15 amp main circuit breakers, one for each side of the split phase service. One of the main breakers shall serve the communication and traffic management equipment in the cabinet. Provide at least four outlets on this circuit. The second main breaker shall power auxiliary devices in the cabinet, such as the fan, heater, light, and GFI outlet.

If the cabinet feeds power to other cabinets, the contractor shall provide two separate branch circuits for each of the other cabinets (one circuit for communication and traffic management equipment and the other circuit for the remaining devices). The contractor shall equip those branch circuits with 15 amp breakers.

If the cabinet feeds power to a DMS, the contractor shall provide a pair of breakers connected in parallel with the 15 amp main breakers. The capacity of the breakers shall be as recommended by the manufacturer of the sign, but no larger. The arrangement shall provide three-wire, 240/120 service to the sign and shall allow a technician to disconnect power to the sign while leaving the cabinet operational, and vice versa. The contractor shall clearly label the cabinet breakers as "CABINET ONLY" and the sign breakers as "SIGN ONLY."

- **Sunshield:** On the top.
- **Mounting brackets:** Stainless steel U-bolts and any other mounting hardware needed.

3.9.3 Type 2 Cabinet.

3.9.3.1 Provide a cabinet meeting the requirements for a Model 334 cabinet in the latest edition of Transportation Electrical Equipment Specifications published by Caltrans, except as specified in these special provisions. The manufacturer must be on the Missouri Department of Transportation's Traffic Operations Approved Products List for Type 170 controller cabinets and racks.

3.9.3.2 Components described in Chapter 6 Section 4 of Transportation Electrical Equipment Specifications are not required, nor are police panels. The following components are required:

- **Sunshields:** On all four sides and the top.
- **Housing 1a or 1b, Mounting Cage 1, and Service Panel #1.**
- **Rack-mounted, slide out shelf with storage tray:** Mounted immediately above the fiber optic patch panel enclosure.
- **Mounting panel:** For terminal blocks, surge protectors, and other small items on a sidewall.
- **Terminal blocks:** For all conductors entering the cabinet. Except for blocks used for coaxial cable, the blocks shall be the barrier type with nickel-plated brass screw terminals and solid backs. Each terminal shall be clearly and permanently labeled on a contiguous surface using silk screening or other approved method. Terminal blocks for conductors carrying more than 60 volts must be covered by a clear acrylic shield.
- **Two interior fluorescent lights:** One above each door switch. Each door shall have a door switch. When either door is opened, both lights shall light.
- **Door switch:** On each door, permitting the door status to be monitored remotely. If this is the same switch used to control the lights, then there must be separate, electrically isolated contacts for detecting an open door.
- **Duplex ground fault interrupt outlet:** For use by technicians.
- **Thermostatically controlled fan and heater:** The fan shall move 100 CFM through vents at the top of the cabinet. The air intake shall be through louvers in the door,

and the air shall pass through a replaceable filter as it enters the cabinet. The heater shall use at least 400 watts.

- **Base adapter:** The base adapter has three functions. It raises the cabinet a foot above the foundation, making it easier for a technician to work in the lower part of the cabinet. Also, it provides a place where a little slack cable can be stored, so that slack is not taking up space in the equipment rack. Most of the slack at a cabinet should be stored in the adjacent pull boxes. In addition, it provides a raceway between adjacent cabinets on the same foundation.

The base adapter shall be a hollow aluminum box one foot high, 30 inches wide, and 30.25 inches deep (the same depth as the cabinet). It shall have a cutout opening centered in the top 15 inches wide and 21 inches deep, matching the opening in the bottom of the cabinet. It shall have a similar cutout on the bottom, directly below the top cutout.

Around the top cutout shall be four punched holes that match the anchor bolt holes in the cabinet. Provide bolts, nuts, washers, and lock washers to bolt the cabinet to the base adapter through these holes. Around the bottom cut out shall be four punched holes that also match the anchor bolt holes in the cabinet.

Construct the adapter so that it does not sag under the weight of the fully loaded cabinet. Any internal members must not obstruct cables going from the cabinet to adjacent cabinets, nor to the conduits below. Construct the adapter of the same material used for the cabinet and give it a matching finish. All seams shall be continuously welded and ground smooth.

When multiple cabinets are installed on the same foundation, provide two close nipple four-inch galvanized rigid metallic conduit fittings and four sealing lock washers for the fittings.

- **Anchor bolts, nuts, and washers:** For installation in a concrete foundation.
- **Electrical distribution system:** Type 1 and Type 2 cabinets may be installed singularly, or in groups of two on a common foundation, or adjacent to an existing cabinet. Provide breaker panels for all single Type 1 or Type 2 cabinets and for one cabinet of a group of new cabinets that share a common foundation. The circuit breaker panel shall be 120/240 volt, split phase, equipped with a solid neutral. The panel shall be UL listed.

Equip the panel with 50 amp main breakers and branch circuit breakers. Branch circuits shall have 15 amp breakers unless the load requires a larger breaker. One or more branch circuits shall serve the communication and traffic management equipment in the cabinet. Connect that circuit to the second stage of the surge suppressor and to at least eight outlets for the equipment. A second branch circuit shall power auxiliary devices in the cabinet, such as the fan, heater, light, and GFI outlet. If the cabinet feeds power to other cabinets not on the same foundation, the contractor shall provide two 15 amp branch circuits for each of the other cabinets.

Type 1 and Type 2 cabinets without breaker panels shall be powered from the breaker panel in another cabinet on the same foundation. The power wiring shall pass from one cabinet to the other through the base adapters.

3.9.3.3 Insulate the cabinet on all four sides, top and doors with a double layer of polyethylene air-bubble sheet, laminated on both sides with aluminum foil. Use aluminum tape on all edges of the insulation for protection from damage and to improve adhesion to the surface. The insulation

shall have a thermal resistance of greater than R-7, a vapor resistance permeability of 0.006 or better, and a NFPA Class A, UBC Class 1 fire resistance or better.

3.9.3.4 The contractor shall mount an air conditioner on the cabinet's sidewall next to the door hinges. It shall use a closed loop cooling system that does not exchange air with the outside. It shall have the following features:

- Maximum dimensions: The unit shall not exceed the dimensions of the sidewall. The unit shall not add more than 12 inches to the cabinet width.
- Minimum cool capacity: 6000 BTU/hour.
- Hot gas bypass valve: To regulate cooling and prevent evaporator coil freezing during periods of low head load and low ambient air temperature.
- Intake location: Top
- Solid-state electronic noise suppressor: To minimize EMI/RFI interference.
- Thermostat: Adjustable in the range of 70 degrees F (20 degrees C) to 140 degrees F (60 degrees C) to activate cooling. Unit turn-off shall be 7 degrees F (4 degrees C) below the turn-on temperature. Mounting of the unit shall be such that setting changes can be made from one of the door openings.

There shall be no sun shield on the side on which the air conditioner is mounted.

3.9.3.5 Provide a separate circuit and breaker for the air conditioner and provide a delay-on relay or other protection to ensure that if a short power outage occurs while the unit is running, the breaker is not tripped when the power is restored and the unit tries to restart while pressurized.

3.9.3.6 Provide two contact closure temperature alarms. The high temperature sensor shall be adjustable in the range of 20 degrees C to 60 degrees C. The low temperature shall be adjustable in the range of 5 degrees F (-15 degrees C) to 40 degrees F (5 degrees C.)

3.9.4 Type 1 Cabinet.

3.9.4.1 A Type 1 cabinet shall be the same as a Type 2 cabinet, except that the Type 1 Cabinet will not ventilated, insulated, or air-conditioned.

3.9.5 Type 5 Cabinet.

3.9.5.1 The contractor shall provide a single door, NEMA 4 X aluminum cabinet, complete with mounting panel, patch panel, terminal block and hardware for pole mounting. The walls, sides, top and bottom shall be at least 0.08 inch thick. The door shall be at least 0.1 inch thick. The cabinet shall be approximately 24 inches high, 20 inches wide and 8 inches deep.

3.9.5.2 The patch panel shall have one position for every out of pavement vehicle detector assembly connected to the cabinet. The panel shall permit connecting a notebook computer to the detector for setup and troubleshooting. The panel shall be designed for shielded Category 5E cables, and shall include provision for grounding the shields of the connected cables.

3.9.5.3 The terminal block shall connect the power cable coming from the underground to the power cable coming from the detector. It shall be a barrier block with a nickel-plated brass screw terminal and a solid back.

3.9.6 Construction Requirements.

3.9.6.1 Raceway between Cabinets. Where multiple Type 1, Type 2, and existing cabinets share a foundation, install the base adapters snugly against one another and flush. Between each pair of adjacent base adapters (including base adapters on existing cabinets), punch two holes in the base adapter walls, each just big enough for a four-inch close nipple. Install close nipples in the holes and secure them with a sealing lock washer one each side. These two nipples shall be used to run power and communication cables from one base adapter to the next. After all the cables have been installed, stuff fiberglass insulation material into the nipples that connect to the air conditioned cabinets, so as to minimize the leakage of chilled air.

3.9.6.2 Base Adapter and Cabinet Installation. Prior to bolting the base adapter to the foundation, apply silicone sealant to the mating surface of the adapter to prevent water from seeping between the adapter and foundation. Likewise, prior to bolting the cabinet to the base adapter, apply silicone sealant to the mating surface of the cabinet to prevent water entry. Sealant shall be applied on both the inside and outside joints between the foundation, base, and cabinet. Ensure that the cabinet is plumb, using shims if necessary, and ensure that it is properly aligned with the front edge of the base adapter.

3.9.6.3 Pole Mounted Cabinets. Securely fasten pole-mounted cabinets to their poles using mounting brackets as indicated in the plans.

3.9.6.4 Bonding and Grounding. Bond pole-mounted cabinets to the pole and ensure that the pole is connected to a ground rod. Connect base-mounted cabinets directly to a ground rod.

3.9.6.5 Wire Management. Use spiral wrap to guide and protect bundles of wires and cables. Affix the spiral wrap to the wall of the cabinet or vertical member of the rack, and keep power and signal cables separated.

3.9.7 Acceptance Testing.

Develop a proposed test procedure for the cabinets and submit it to the engineer for approval. It shall include visual inspection, testing of lights, fan, heater, power outlets and alarm sensors. It shall also include a test in which each branch circuit is shorted to the cabinet wall to confirm that the breaker trips. Revise the proposed test procedure until it is acceptable to the engineer.

Provide all equipment and personnel needed to safely conduct the tests, arrange for the engineer's representative to witness the tests, and give the engineer a report documenting the result of every visual inspection and test. Include a summary indicating whether the cabinet passed every test. The cabinet must pass every test to be accepted.

If the cabinet fails, correct the problems and arrange for a new test. If the test of the breakers reveals breakers that do not trip, the resistance to ground is too high; lower the resistance by adding more ground rods and improving the connections in the ground system.

3.9.8 Documentation. Prior to purchasing the cabinets, provide five sets of complete shop drawings, layout drawings, catalog cuts, and schematics. For the air conditioner, provide an operations/maintenance/ manual that includes a complete parts listing. The layout drawings shall be dimensioned drawings showing the proposed location of all equipment for each cabinet. The drawings shall demonstrate that all the equipment will fit, and that all controls, connections, and other service points are readily accessible. It should also demonstrate that incoming

conductors reach surge suppressors as soon as they enter the cabinet. Lay out all cabinets that have the same equipment in the same way and submit a single drawing for all like cabinets. Revise the layout as instructed by the engineer and resubmit the drawings until they are accepted.

After installation, provide one reproducible 22 inch X 34 inch and two prints of the cabinet wiring diagram for each cabinet. The diagrams shall be nonproprietary. They shall reflect as-built conditions and shall identify all circuits in such a manner as to be readily interpreted. The diagrams shall be placed in a heavy duty, clear plastic pouch and attached to the inside of the front cabinet door. The pouch shall be of such design and material that it provides adequate storage and access to the wiring diagram.

3.9.9 Guarantee. All items covered by this specification shall carry a two-year manufacturer's warranty from the date of acceptance against any imperfections in workmanship or materials.

3.9.10 The contractor shall have a maximum of forty-eight (48) hours to complete the requirements of this provision related to installation of cabinets and acceptance testing.

3.10 Remove Wireless Communication Equipment. This work shall consist of removing wireless communication equipment, including radio, antenna cable, antenna, and any mounting hardware dedicated to the wireless communication system. The wireless communication equipment may consist of 900 MHz unlicensed spread spectrum radios or 4.9 GHz licensed Ethernet bridges.

This item shall be paid per each (radio, antenna and cable) removed. Removal of both half ends of a wireless communication link shall considered 2 units of "Remove Wireless Communication Equipment."

3.10.1 The contractor shall carefully remove and salvage the transmitter/receiver from the controller cabinet for re-use/reinstallation, remove the antenna cable and antennae, and deliver to the Traffic Management Center (TMC). The contractor shall give the Gateway Guide staff twenty-four (24) hours notification prior to the delivery. Prior to removing each assembly, the contractor may request, in writing to the engineer, that the equipment be tested for functionality and inspected to determine condition. Once removal has started, the contractor shall be responsible for any damage to the equipment including in this provision or adjacent equipment that is damaged during the removal process.

3.10.2 The contractor shall have a maximum of forty-eight (48) hours to complete the requirements of this provision related to the removal of wireless communication equipment noted within this section.

3.11 Install Spread Spectrum Wireless Communication Equipment. This work shall consist of installing new Commission-Furnished or salvaged 900 MHz spread spectrum radios and their assembly in new or existing ITS cabinets, including traffic signal cabinets.

The Commission shall furnish the radios and antennas, including power supplies and cables.

The contractor shall install Commission Furnished spread spectrum radios on structures as directed by the engineer. The installations shall be considered complete after the contactor has successful tested the system and notifies the engineer. The contractor shall furnish and install the following, as required:

- Communication cables (Category 5E patch cords, coax patch cords, and short serial cables). Provide outdoor cabling to the pole or structure-mounted radios.
- Coaxial antenna cable up to one hundred (100) feet in length.
- Stainless steel bands to affix the radio mounting bracket to the pole. The banding shall be 1-inch wide and 0.044-inch thick stainless steel.
- Surge protection for all copper communication cables entering from other cabinets (excluding cabinets on the same foundation as the one in which the surge protector would be installed). The protector shall be UL certified as Category 5 and UL497B listed.
- Proper ground for the shields of the cables coming from other cabinets.

3.11.1 The contractor shall have a maximum of twenty-four (24) hours to complete the requirements of this provision.

3.12 Install Wireless Ethernet Bridge Communication Equipment. This work shall consist of installing new Commission Furnished or salvaged wireless Ethernet bridge communication equipment in new or existing ITS cabinets, including existing traffic signal cabinets.

The Commission shall furnish the wireless Ethernet bridges and power injectors, including power cables.

The contractor shall install Commission furnished wireless Ethernet bridges on structures as directed by the engineer and connect the devices to power communications and ground. The installations shall be considered complete after the contactor has successful tested the system and notifies the engineer. The contractor shall furnish and install the following, as required:

- Communication cables (Category 5E patch cords, coax patch cords, and short serial cables). Provide outdoor cabling to the pole or structure-mounted radios.
- Coaxial antenna cable up to one hundred (100) feet in length.
- Stainless steel bands to affix the radio mounting bracket to the pole. The banding shall be 1-inch wide and 0.044-inch thick stainless steel.
- Surge protection for all copper communication cables entering from other cabinets (excluding cabinets on the same foundation as the one in which the surge protector would be installed). The protector shall be UL certified as Category 5 and UL497B listed.
- Proper ground for the shields of the cables coming from other cabinets.

3.12.1 Any work to acquire or modify a license for operation of the wireless Ethernet bridge shall be considered out of scope work and shall be done by others or by the contractor. If done by the contractor, this out of scope work shall be compensated for through methods described in another provision of this contract.

3.12.2 The contractor shall have a maximum of twenty-four (24) hours to complete the requirements of this provision.

3.13 Remove and Install Cable in Conduit. This work shall consist of removing old cables, installing new cables in an existing conduit network, and terminating the cable at the device. The contractor shall replace the existing cables with similar cables, or otherwise specified by the engineer.

3.13.1 Materials. All necessary cable shall be furnished and installed by the contractor. The contractor shall be responsible for providing all equipment and tools necessary to complete this item of work. The installation of a new pull rope for the purport of installing new cables in existing conduit shall be considered incidental to the work.

3.13.2 Construction Methods. All cables shall be installed per current MoDOT standards and specifications. All conductors shall be terminated or capped. Old cables and material shall be removed and disposed of by the contractor.

Splicing shall only be permitted underground only in pull boxes and only in proper and approved enclosures at locations approved by the engineer. The wire or cable ends shall not be left uncovered or submerged in water. Any such condition observed shall constitute grounds for rejection of an entire length of cable and/or wire. All electrical connections and splices shall be made with approved pressure or compression type fittings.

Tape shall be covered with a liberal coating of an electrical varnish or sealant providing flexible protection from oil, moisture, and corrosion. This electrical coating shall be approved by the engineer.

The contractor shall verify the number of conductors and the gauge of wire required in the cable runs and shall submit the cable arrangements to the engineer for approval. Conductor totals shall be verified by the engineer.

An extra six (6) ft of cable length shall be provided by the contractor for all cables entering each pull box. This loop of cable shall be in addition to the amount needed to reach from the entrance conduit raceway end to the opening in the existing conduit raceway.

3.13.3 Personnel. All electrical work shall be performed by a licensed electrician or under the onsite supervision of a licensed electrician. The contractor shall provide the engineer with documentation of the status as licensed electricians prior to the start of work.

3.13.4 Duration. The contractor shall have a maximum of twenty-four (24) hours to complete the requirements of this provision.

To complete the requirements of this provision, the contractor shall have a maximum of twenty-four (24) hours per MoDOT Online Maintenance System work order created, if the work doesn't exceed the following:

- 1000 LF of Cable, 8 awg
- 500 LF of Cable, 6 awg
- 100 LF of Cable, 4 awg
- 100 LF of Cable, 2 awg
- 500 LF of Cable, 1/0 awg
- 100 LF of Cable, 2/0 awg
- 250 LF of Cable, 14 awg
- 250 LF of Video Coaxial Cable
- 200 LF of CAT5E Outdoor Rated Cable

3.14 Install Fiber Optic Cable, Fusion Splices, Splice Enclosures, Terminations, Rack Mounted Interconnect Center. This work shall consist of installing, splicing and terminating fiber optic cables.

3.14.1 Materials.

3.14.1.1 Cable. Fiber optic cable shall be loose tube, single mode dielectric cable. The cable shall be listed in the latest edition of the Rural Utilities Service (RUS) List of Materials Acceptable for Use on Telecommunications Systems of RUS Borrowers, category oc-d-F, and shall have a short-term tensile rating of at least 600 lbs. The cable sheath shall have length markings in feet, and shall indicate that the unit of measure is feet. The cable shall have an operating temperature range of -40º C to 70º C.

All fibers shall be suitable for transmission using both 1310 nm and 1550 nm wavelengths. Attenuation shall not exceed 0.35 dB/km and 0.25 dB/km for 1310 nm and 1550 nm signals, respectively.

The cables shall be constructed with twelve fibers per tube.

3.14.1.2 Splice Tray. Splice trays shall be 11.7" long, 3.9" wide, and 0.2" tall. They shall be aluminum with clear plastic covers, designed for outdoor use. Each shall accommodate 24 fusion splices. The trays shall have a black powder coat finish. The trays shall have both perforations for cable ties and crimpable metal tabs for buffer tube strain relief.

3.14.1.3 Connector. Connectors shall be ST compatible, with ceramic ferrules. They shall be suitable for use in traffic cabinets and shall be designed for single mode fibers.

3.14.1.4 Rack-Mounted Splice Enclosure. The enclosure shall have brackets and all other hardware required for rack mounting in an EIA standard 19-in. equipment rack. However, alternate forms of mounting will be permitted if more practical at a particular location. The enclosure shall take up no more than five rack units (1¾ inch each) in the cabinet. It shall be made of powder-coated aluminum.

The enclosure shall have provisions for cable strain-relief. It shall have hinged front and rear doors.

The enclosure shall include splice trays as specified in Sec 2.2 of this provision. The contractor shall provide enough splice trays for all the splices made in the enclosure. The enclosure shall include a splice tray holder with capacity for 22 trays. It shall be mounted on a sliding shelf inside the enclosure so that individual trays can be removed from the enclosure without disturbing the other trays or removing the enclosure itself from the cabinet.

3.14.1.4 Rack-Mounted Interconnect Center. An interconnect center is a splice enclosure that has a patch panel built into one of its walls. Within the interconnect center, fibers in cables are spliced to pigtails and the pigtails are plugged into the patch panel from the inside. This allows jumper cables (not part of the interconnect center) to plug into the patch panel from the outside, connecting the fibers to equipment in the cabinet or to other fibers on the patch panel. Within an interconnect center, some fibers may be spliced to the corresponding fiber in a mating cable, rather than to a pigtail. Still other fibers may be coiled, unterminated.

The enclosure shall have brackets and all other hardware required for rack mounting in an EIA standard 19-in. equipment rack. It shall take up no more than three rack units (1¾ inch each) in the cabinet. It shall have front and rear doors. It shall be made of powder-coated aluminum.

The enclosure shall hold at least four splice trays meeting the requirements of Sec 2.2 of this provision. Provide enough trays for all splices made in the interconnect center. The enclosure's patch panel shall have at least 24 positions, compatible with the connectors specified in Sec 2.3 of this provision. It shall have provisions for cable strain relief and for connector labeling.

3.14.2 Construction Requirements.

3.14.2.1 Cable Installation. Prior to installation, perform such tests as indicated in Sec 4.0 of this provision to confirm that the cable is in good condition and complies with the specifications. Any defects found after installation will be deemed the fault of the contractor.

Install the cable such that the optical and mechanical characteristics of the fiber are not degraded. Do not violate the minimum bend radius or the maximum tension, both during and after installation.

Before any cable installation is performed, provide the engineer with four copies of the cable manufacturer's recommended maximum pulling tensions for each cable size. These pulling tensions shall be specified for pulling from the cable's outer jacket. Also, provide a list of the minimum allowable cable bending radius and the cable manufacturer's approved pulling lubricants. Only those lubricants approved by the cable manufacturer will be permitted.

If the cable is pulled by mechanical means, use a clutch device to ensure the allowable pulling tension is not exceeded. Also, attach a strain gauge to the pulling line at the cable exit location, and at a sufficient distance from the take-up device, such that the strain gauge can be read throughout the entire cable pulling operation.

Do not leave the let-off reel unattended during a pull, in order to minimize the chance of applying excess force, center pull, or back feeding.

Use an approved lubricant, in the amount recommended by the cable manufacturer, to facilitate pulling the cable. After the cable has been installed, wipe the exposed cable in a pull box, junction box, or cabinet clean of cable lubricant with a cloth before leaving the pull box, junction box, or cabinet.

In every intermediate pull box, store 30 feet of slack fiber optic cable for every cable that passes through the pull box. Additional slack storage, as indicated on the plans, is required in designated pull boxes. At cabinet locations, where cable runs from the pull box directly to an equipment cabinet, store 60 feet of slack fiber optic cable in the pull box. Additionally, treat the cable returning from the cabinet to the pull box as a separate cable, and store 60 feet of slack for these links. Store slack cable neatly on the walls of the pull box using racking hardware acceptable to the engineer.

Seal the fiber optic cable ends to prevent the escape of the filling compound and the entry of water.

3.14.2.2 Splicing. Splice all optical fibers, including spares, to provide continuous runs. Splices shall be allowed only in equipment cabinets except where shown on the plans.

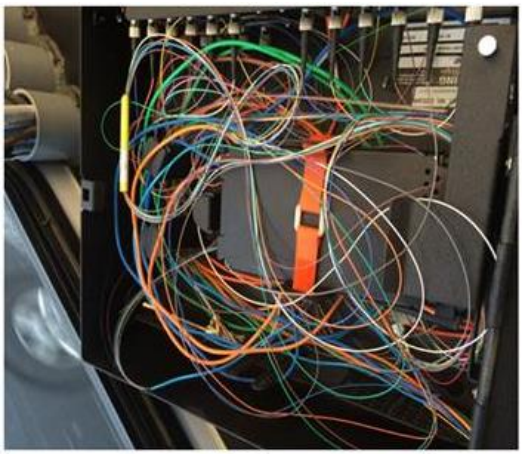
Make all splices using a fusion splicer that automatically positions the fibers using either the Light Injection and Detection (LID) system or the High-resolution Direct Core Mounting (HDCM) system. Provide all equipment and consumable supplies.

Secure each spliced fiber in a protective groove. Completely re-coat bare fibers with a protective room temperature vulcanizing (RTV) coating, gel or similar substance, prior to insertion in the groove, so as to protect the fiber from scoring, dirt or microbending.

Prior to splicing to a fiber installed by others, measure and record the optical loss over that fiber. See Sec 4.0 of this provision.

Use a different splice tray for each buffer tube color. If an enclosure contains multiple buffer tubes of the same color, but none of the fibers in one of the tubes are spliced to fibers in other tubes of the same color, use a separate splice tray for that tube.

3.14.2.3 Termination. Terminate fibers by splicing them to factory-made pigtails. Cap all connectors that are not connected to a mating connector.



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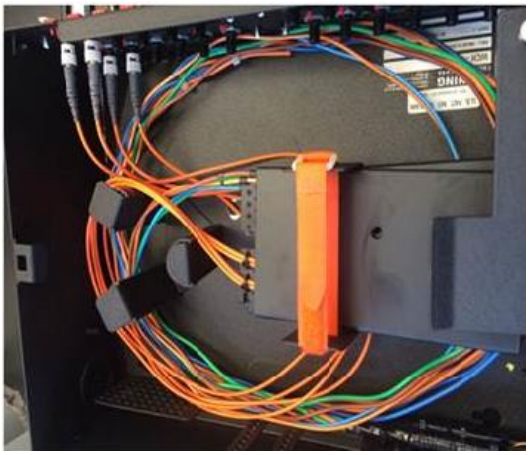


Acceptable

3.14.3 Acceptance Testing

3.14.3.1 General. Test the fiber after installation, including all splicing and termination, is complete. Note, however, that this test procedure involves measuring the loss of fiber installed by others before splicing to it. For each fiber optic link, including spare fibers, determine whether the optical loss is within the limits permitted by these specifications. A link is a continuous segment of fiber between one connector (or unterminated end) and another connector (or unterminated end). When testing links that do not have connectors on both ends, use a mechanical splice to attach a pigtail to the unterminated fiber for the duration of the test.

3.14.3.2 Test Procedure. For each fiber link, follow this procedure:

(a) If the link includes fiber installed by others, use an optical loss test set to measure and record the optical loss over that portion of the link before it is spliced to new fiber.

(b) Calculate the maximum allowable loss for the completed link, both at 1310 nm and at 1550 nm. Use the following formula:

Maximum link loss = Measured loss over portion installed by others
+ (Fiber length in km) x (0.35 for 1310 nm and 0.25 for 1550 nm)
+ (Number of fusion splices) x (0.05)

+ (Number of mechanical splices [for temp. connection]) x (0.3)
+ (Number of connections) x (0.5)

Provide this calculation to the engineer along with the test results.

(c) Calibrate an optical loss test set and provide evidence satisfactory to the engineer that the set produces accurate results at both wavelengths. This can be a demonstration that the set correctly measures the loss of a test fiber whose loss is known.

(d) Use the test set to measure the loss of the link under test. Record the result at both 1310 nm and 1550 nm. Arrange for the engineer or his representative to witness these tests.

(e) If the measured loss exceeds the calculated maximum, use an optical time domain reflectometer and other test equipment to troubleshoot the link. Take whatever corrective action is required, including cable replacement, to achieve a loss less than the calculated maximum.

3.14.3.3 Test Result Documentation. Prepare a diagram showing all of the links tested in this project. For the portions installed in this project, show the equipment cabinets, splices, and pigtails. On each line representing a link, show the maximum allowable loss and the actual loss. The actual loss shall be the one measured after all corrective actions have been taken. Submit 5 copies of this diagram to the engineer, along with the calculations for the maximum allowable loss. Submit the diagrams and calculations in an electronic format acceptable to the engineer.

3.14.4 Documentation. Provide the engineer mark-ups of the plans, neat and legible, illustrating as-built versions of the splice and connection diagrams that are contained in the plans.

3.14.5 Certifications. The fiber optic cable shall be factory certified to meet the requirements in this specification. In addition, the manufacturer shall certify that the fiber optic cable has a life expectancy of 20 years.

3.14.6 Guarantee. All items covered by this specification shall carry a two-year manufacturer's warranty from the date of acceptance against any defects in workmanship or materials.

3.14.7 To complete the requirements of this provision, the contractor shall have a maximum of twenty-four (24) hours per MoDOT Online Maintenance System work order created, if the work doesn't exceed the following:

- 1000 LF of 24-Strand Single Mode Fiber Optic Cable
- 1000 LF of 72-Strand Single Mode Fiber Optic Cable
- 250 LF of 6-Strand Multi Mode Fiber Optic Cable
- 500 LF of 18 SM / 6 MM Fiber Optic Cable
- 96 EA of Fiber Optic Fusion Splice, Single Mode
- 18 EA of Fiber Optic Fusion Splice, Multi-Mode
- 2 EA of Fiber Optic Splice Enclosure
- 96 EA of Fiber Optic Termination
- 1 EA of Rack Mounted Interconnect Center

3.15 Conduit. This work shall consist of furnishing and installing conduit either as a replacement for a damaged section of conduit, as a new installation, or for re-routing the conduit run. The same size and type of conduit shall be replaced or repaired, unless otherwise directed by the engineer.

3.15.1 Materials. All materials shall be furnished by the contractor for this time. All electrical conduits shall have a U.L. label on each length being delivered and/or used at the project construction site.

Nonmetallic conduit and fittings shall be HDPE SDRII electrical conduit conforming to the requirements of the Underwritters' Laboratories Standard for Rigid Nonmetallic Conduit, UL 651, for Schedule 40 heavy wall type or Schedule 80 extra-heavy wall type.

All nonmetallic conduits, which will be installed in an exposed location when in place and completed, shall be Schedule 80 conduit.

3.15.2 Construction Methods. The conduit shall match the size and type of conduit being repaired or replaced, unless otherwise directed by the engineer. Conduit repairs or replacements shall be performed in such a way as to avoid interruption to the operation of the Gateway Guide system. This may mean rerouting data or video temporarily or repairing conduit with a "split duct" to avoid the need to remove an existing live cable. Each run of conduit shall be of one size for its entire length from access point to access point. Access points shall be considered a pull box, junction box, and/or base of cabinet.

The contractor may elect to substitute a larger diameter conduit than the existing conduit run, if approved by the engineer. However, any additional cost shall be at the contractor's expense and no adjustment in compensation shall be allowed.

Standard electrical conduit fittings shall be used. All nonmetallic conduit shall be capped or plugged immediately after installation and shall remain capped or plugged until installation of wire or cable.

End bells shall be installed on all nonmetallic raceway points before installation of wire and/or cable. Nonmetallic conduits shall be reamed to eliminate internal sharp edges before installation of end bells.

3.15.3 The contractor shall have a maximum of seventy-two (72) hours to complete the requirements of this provision for *trenched* conduit, if the MoDOT Online Maintenance System work order does not exceed the following:

- 50 LF of 1-in Conduit, Trenched
- 500 LF of 2-in Conduit, Trenched
- 100 LF of 3-in Conduit, Trenched
- 100 LF of 4-in Conduit, Trenched

The contractor shall have a maximum of fourteen (14) days to complete the requirements of this provision for *pushed* conduit, if the MoDOT Online Maintenance System work order does not exceed the following:

- 50 LF of 1-in Conduit, Pushed
- 1000 LF of 2-in Conduit, Pushed

- 50 LF of 3-in Conduit, Pushed
- 50 LF of 4-in Conduit, Pushed

Maximum time to complete the work described in Section 3.14 shall include the time necessary to locate utilities (**maximum 48 hours**). In the event a utility is in conflict with the proposed work, the engineer shall extend the maximum time for completion for the contractor for the amount of time necessary for the utility conflict to be resolved.

3.16 Twisted Pair Splice. The contractor shall perform mechanical splices as directed by the engineer. This work shall consist of splicing together 25-pair cable, 12-pair cable, 6-pair cable, 3-pair cable, or 2-pair data communication cable end-to-end.

3.16.1 Materials. The contractor shall provide all equipment and materials necessary to perform data communication cable splices. The type of twisted-pair splice enclosures used by the contractor shall be approved by the Engineer.

3.16.2 Construction Methods. Splices shall only be made at approved locations, such as new or existing underground pull boxes, as directed by the engineer.

Prior to performing the twisted-pair splices, the contractor shall test the twisted-pair cable from break point to the nearest cabinets upstream and downstream from the break point. This test shall be conducted to ensure that no damage to the cable exists as a result of the break. If test indicates the cable is damaged beyond the break point, the contractor shall notify the engineer prior to performing the splice.

The contractor shall obtain adequate cable necessary to perform the splice from nearby pull boxes. Upon completion of the splice, the cable slack required to perform the splice shall be pulled back to the nearby pull boxes.

End-to-end splicing shall be performed as per manufacturer instructions for the supplied twisted-pair splice enclosure units. The contractor shall splice together the applicable size twisted-pair cables pair-for-pair between the two cables. The connection shall be soldered. Solder shall be electrical multi-flux core. The solder connections shall be half loop taped with an approved rubber high voltage tape. Each connection shall than be half loop taped with an approved vinyl electrical tape and insulated from each other before placement in the splice kit. Each connection shall then be coated with an approved electrical varnish approved by the engineer and allowed to dry. After drying, the splice kit shall be installed in accordance with the manufacturer's instructions.

The contractor shall conduct tests on the spliced cables. The test results shall be documented and provided to the engineer for approval. The contractor shall furnish all equipment, appliances, and labor necessary to test the spliced communications cable between the processor assembly cabinets. The following tests shall be successfully performed following terminations:

- The continuity of each pair shall be measured. Each pair shall show a resistance of not more than 8 ohms per 1,000 feet of conductor. The resistance shall be measured with a meter having a minimum input resistance of 20,000 ohms per volt.
- The insulation resistance between conductors, and between each conductor; ground and shielding shall be measured using a megger. The resistance shall be infinity.

Should any cable fail to meet the test parameters or should any testing reveal defects in the splice, the cable shall be re-spliced at the contractor's expense. The new cable shall then be re-tested as specified above.

The contractor shall also submit documentation to the engineer indicating location of splice, type of repair performed, and footages to determine field location to the nearest pull box / communications vault or other landmark as approved by the engineer.

3.16.3 The contractor shall have a maximum of twenty-four (24) hours to complete the requirements of this provision.

3.17 Furnish and Install Pullboxes. This work shall consist of the contractor furnishing and installing preformed pull boxes (Class 1-5) and preformed ITS pull box (Type 1, 2 or 5) with concrete aprons as shown in plans at locations as directed by the engineer.

3.17.1 The contractor shall have a maximum of seventy-two (72) hours to complete the requirements of this provision per MoDOT Online Maintenance System work order.

Maximum time to complete the work described in Section 3.16 shall include the time necessary to locate utilities (**maximum 48 hours**). In the event a utility is in conflict with the proposed work, the engineer shall extend the maximum time for completion for the contractor for the amount of time necessary for the utility conflict to be resolved.

3.18 Remove Non-Intrusive Vehicle Detector Pole. This work shall consist of removing an existing non-intrusive traffic detector pole from an existing foundation. The existing poles may have also fallen off their foundations or have been knocked over. The contractor shall salvage and store the existing pole, unless otherwise directed by the engineer. If the detector pole is not to be replaced, the contractor shall also be required to remove the foundation to below ground level.

The existing remote traffic detector, mounting bracket, field cabinet, and all cables and connectors shall be removed from the pole and compensated for under a separate pay item. The pole shall be unbolted from the foundation and lowered, if necessary. The existing remote traffic detector power and communication cables shall be disconnected and removed. All items, removed by the contractor, shall remain the property of the Commission and shall be put into storage by the contractor for use as maintenance spare parts, reinstalled or disposed of as directed by the engineer.

3.18.1 Once removal has begun, the contractor shall be responsible for the condition of all equipment. Compensation for equipment damaged shall be deducted from the contract. The contractor may request of field meeting with the engineer, or the engineer's representative, at the site to inspect the equipment prior to removal.

3.18.2 The contractor shall have a maximum of four (4) hours to complete the requirements of this provision.

3.19 Install Salvaged Non-Intrusive Vehicle Detector Pole. The work shall consist of installing a salvaged non-intrusive detector pole on an existing of new concrete foundation. The contractor shall be responsible for anchor bolts, nuts and washers.

The contractor shall perform the following:

- Install the camera pole on a new or existing foundation as directed by the engineer.
- Check the plumb of the pole and adjust as necessary.
- Tighten the anchor bolds to the toque specified by the manufacturer of the pole.

3.19.1 Installation or repair of a concrete foundation shall be considered out of scope work and shall be compensated for through methods described in other articles of this contract.

3.19.2 The contractor shall have a maximum of four (4) hours to complete the requirements of this provision.

3.20 Furnish & Install Non-Intrusive Vehicle Detector Pole. The work shall consist of installing a new non-intrusive detector pole on an existing or new concrete foundation. The contractor shall be responsible for anchor bolts, nuts and washers.

The contractor shall perform the following:

- Install the camera pole on a new or existing foundation as directed by the engineer.
- Check the plumb of the pole and adjust as necessary.
- Tighten the anchor bolds to the toque specified by the manufacturer of the pole.

3.20.1 Installation or repair of a concrete foundation shall be considered out of scope work and shall be compensated for through methods described in other articles of this contract.

3.20.2 The contractor shall have a maximum of four (4) hours to complete the requirements of this provision.

3.21 Remove Non-Intrusive Vehicle Detector Assembly. The work shall consist of removing a non-intrusive vehicle detector and assembly from an existing pole. Non-intrusive vehicle detector assemblies shall be existing on existing poles. The existing pole may be erect and in use, fallen, or knocked over. The existing detector controller assembly in the cabinet shall be disconnected from the detector communication/power cables and the cables shall be removed from the cabinet. All items, removed by the contractor, shall remain the property of the Commission and shall be put into storage by the contractor for use as maintenance spare parts, reinstalled or disposed of as directed by the engineer.

3.21.1 Once removal has begun, the contractor shall be responsible for the condition of all equipment. Compensation for equipment damaged shall be deducted from the contract. The contractor may request of field meeting with the engineer, or the engineer's representative, at the site to inspect the equipment prior to removal.

3.21.2 The contractor shall have a maximum of four (4) hours to complete the requirements of this provision.

3.22 Install New or Salvaged Non-Intrusive Vehicle Detector Assembly. This work shall consist of installing a Commission-furnished non-intrusive vehicle detector and assembly, or salvaged non-intrusive vehicle detector and assembly, on a metal pole and install a Commission-furnished power supply and surge protection in a nearby cabinet. The pole and cabinet will be existing or shall be paid for separately. This work also requires the contractor to

provide cables connecting the detector to the equipment in the cabinet and to ground, provide an air terminal, set up the detector assembly and test for proper operation.

3.22.1 Qualified Personnel. The Commission's agreement with the detector manufacturer obligates the manufacturer to train the Commission's installation contractors in the unpacking, assembling, mounting, positioning, connecting to the communication network, set up, and testing of the detectors. The training is free to the contractor, and is conducted at the jobsite. The contractor shall not perform any work until the manufacturer has certified the contractor as qualified. Only personnel who have been trained by the manufacturer shall participate in the detector installation, setup, and testing. A Commission representative will be present to observe the training.

Contractors certified under a previous Commission contract need not be trained a second time, but only personnel who received the training shall participate in the detector installation and testing.

3.22.2 Support During Installation. The Commission's agreement with the detector manufacturer obligates the manufacturer to provide both on-site and remote factory support.

3.22.3 Materials. Detector, mounting bracket, cable connector (detector end), power supply, and communication interface panel will be provided by the Commission.

The contractor shall provide outdoor cabling in accordance with the detector manufacturer's recommendations. Communication cabling shall be shielded. Cables connecting to the detector shall be stranded and shall be of a gauge compatible with the Commission-furnished connector. Communication cable connecting a Type 5 cabinet to a Type 7 cabinet shall be shielded Category 5 cable. Power cable connecting a Type 5 cabinet to a Type 7 cabinet shall be two-conductor, 14 AWG.

The contractor shall provide stainless steel bands to affix the mounting bracket to the pole. The banding shall be 1-inch wide, 0.044-inch thick, stainless steel.

3.22.4 Construction Requirements. The contractor shall install the detector in accordance with the manufacturer's recommended procedure for side-fired installation. The contractor shall take care to install it at the recommended height, and note that the recommended mounting height is relative to the road surface, not the base of the pole. The contractor shall strap the detector's mounting bracket to the pole with metal bands so that it faces the detection zones shown on the plans.

The contractor shall install the power and communication cables between the cabinet and detector. If the detector and cabinet are mounted on the same pole, the pole shall constitute the raceway, except where the cables leave the pole to make connections. The contractor shall use the Commission-furnished connector to connect the cables to the detector. If two separate cables are used for power and communication, the contractor shall use silicone sealant at the point where the two cables enter the connector to prevent the entry moisture and bugs.

The contractor shall aim and lock the detector to provide the coverage area required for one detection zone per lane.

Using the set-up software from the detector manufacturer, the contractor shall set up the detection zones and operating parameters. The set up shall include speed calibration using

measured reference speeds. The contractor shall provide all equipment needed for the setup work, such as a radar gun, software, computer, tools, and cables. When the detector is operating properly and has passed its acceptance test, the contractor shall deliver the values of all the detector's operating parameters to the engineer in printed or computer-readable form.

3.22.5 Acceptance Testing. Upon delivery of a shipment of detectors, the manufacturer's representative and the engineer will conduct a visual inspection and test of the detectors to check for manufacturing defects and shipping damage. The detector shall be powered during this testing, and tests shall follow procedures developed by the manufacturer and approved by the engineer. The installation contractor may witness this testing if he or she chooses. The manufacturer shall be responsible for replacing all defective units uncovered by this testing.

After installing the detector, the contractor shall test it using procedures developed by the contractor and approved by the engineer. These tests shall include confirmation of the accuracy of counts and average speed in each lane. Both results shall be within ten percent of independently measured values during a 15-minute period. The test will be witnessed by the engineer. If the installed detector fails to operate properly and the problem cannot be fixed by changing the setup parameters, the detector shall be deemed defective and the contractor shall return it to the manufacturer for replacement. Except for costs borne by the manufacturer under his warranty agreement, the cost of replacement shall be borne entirely by the contractor.

3.22.6 The contractor shall have a maximum of four (4) hours to complete the requirements of this provision.

3.23 Remove In-Pavement Wireless Sensors. This work shall consist of removing an in-pavement sensor from the pavement. The sensor shall be reinstalled, relocated, salvaged or disposed as directed by the engineer. This work shall also include repairing the pavement surface.

The contractor shall remove each in-pavement wireless sensor in accordance with the manufacturer's specifications. The contractor shall exercise reasonable care in the handling of the equipment during removal. Should any of the equipment be damaged by the contractor's negligence, it shall be replaced at the contractor's expense.

3.23.1 Repair of Pavement Surface. For concrete surfaces, the hole shall be completely filled with an approved rapid set concrete patching material. The rapid set concrete patching material shall be shall be from the qualified listing of approval products list available from the engineer or as approved by the engineer. For asphaltic surfaces, the hole shall be patched with an approved commercial mix in accordance with the current Missouri Standard Specifications for Highway Construction or as approved by the engineer.

3.23.2 The contractor shall have a maximum of four (4) hours to remove a maximum of five (5) sensors and complete the requirements of this provision.

3.24 Install In-Pavement Wireless Sensors. This work shall consist of installing a Commission-furnished or salvaged in-pavement wireless vehicle detector into the pavement.

The contractor shall install each in-pavement wireless sensor in accordance with the manufacturer specifications. The sensor unit shall not extend above the top of the pavement. A factory-certified representative from the manufacturer shall be available for on-site assistance during installation.

3.24.1 The contractor shall have a maximum of four (4) hours to install each sensor and complete the requirements of this provision.

3.25 Remove Access Point or Wireless Repeater. This work shall consist of removing an access point or wireless repeater and mounting hardware. For access point removals only, this work may also require removing the communication cable and sealing any cable access holes as directed by the engineer.

The contractor shall remove each access point or wireless repeater according to the manufacturer's specifications. The contractor shall exercise reasonable care in the handling of the equipment during removal. Should any of the equipment be damaged by the contractor's negligence, it shall be replaced at the contractor's expense.

3.25.1 The contractor shall have a maximum of four (4) hours to remove each access point or wireless repeater and complete the requirements of this provision.

3.26 Install Access Point or Wireless Repeater. This work shall consist of installing a Commission-furnished or salvaged access point or a wireless repeater, including mounting hardware. For access point installations only, this work shall also include the installation of communication cable from access point to field cabinet (Ethernet switch) which may include drilling cable access holes as directed by the engineer.

The contractor shall install each access point or wireless repeater in accordance with the manufacturer's specifications. A factory certified representative from the manufacturer shall be available for on-site assistance during installation

3.26.1 The contractor shall have a maximum of four (4) hours to install each access point or repeater and complete the requirements of this provision.

3.27 Install Trace Wire. This work shall consist of installing trace wire inside existing conduits that may either be empty spares or include other cables. The trace wire allows for an alternate method of locating facilities where magnetic locate tape has been damaged or destroyed.

3.27.1 Materials. The contractor shall provide a No. 12 AWG, XLP insulated stranded copper, 600 VAC, blue tracer wire. Installation of new pull rope for the purpose of installing the new cables in existing conduit shall be considered incidental to construction.

3.27.2 Construction Methods. The contractor shall install the trace wire in conduits as directed by the engineer. Separate runs of tracer wire shall be connected at each pull box, as approved by the engineer, so that the locator is able to energize the wire at one pull box and locate all conduits in that location.

3.27.3 The contractor shall have a maximum of five (5) days to install each sensor and complete the requirements of this provision.

3.28 Removal of Solar Power System. This work shall consist of removal of Solar Power System components. The Contractor shall tag each part with the location and date of removal and test the removed components for any salvageable parts, which all parts shall remain the property of the Commission and delivered and put into storage by the Contractor, or used as maintenance spare parts, reinstalled, or disposed of as directed by the engineer.

3.28.1 Once removal has begun, the Contractor shall be responsible for the condition of all equipment. Compensation for damaged equipment shall be deducted from the contract. The Contractor may request a field meeting with the engineer, or the engineer's representative, at the site to inspect the equipment prior to removal.

3.29 Install of Solar Power System. This work shall consist of installing a Contractor-furnished Solar Power System and all of its components on an existing metal pole and/or nearby ITS device cabinet. The pole and cabinet will be existing structures or shall be paid for separately.

3.29.1 The installed Solar Power System and all of its components shall be tested for proper functionality. After a successful test of newly installed Solar Power System, the Contractor shall check for and confirm proper operation and network connectivity of the ITS device using the installed power system.

3.29.2 The Contractor shall have a maximum of forty eight (48) hours to complete the work described in this provision.

3.30 Remove Uninterruptible Power Supply (UPS) System. This work shall consist of the removal of the Node UPS systems and all of their components. The Contractor shall tag each part with the location and date of removal and test the removed components for any salvageable parts, which all parts shall remain the property of the Commission and delivered and put into storage by the Contractor, or used as maintenance spare parts, reinstalled, or disposed of as directed by the engineer.

3.30.1 Once removal has begun, the Contractor shall be responsible for the condition of all equipment. Compensation for damaged equipment shall be deducted from the contract. The Contractor may request a field meeting with the engineer, or the engineer's representative, at the site to inspect the equipment prior to removal.

3.30.2 Install Uninterruptible Power Supply (UPS) System. This work shall consist of installing Commission furnished components that are part of the existing Node UPS systems. These components may include but are not limited to 120 V Inverter with Ethernet port, Universal Automatic Transfer Switch with Bypass, Universal Automatic Generator Switch, 48V Battery charge management system, gel cell batteries, and any other additional hardware necessary to bring the UPS unit to its intended operation.

3.30.3 The contractor shall have a maximum of twenty four (24) hours to complete the work described in this provision once the equipment is made available.

4.0 Modification of Network/Communication Drawings. The engineer will provide the contractor with access to the as-built communication drawings for each device to be maintained on this contract. For each device the contractor repairs or modifies, the contractor shall verify the accuracy of the current communication diagram. If there is a discrepancy, the contractor shall modify the electronic copy of the diagram for that device location and submit the revised electronic file to the engineer. Updated drawings, in color, for both Visio and PDF formats, shall be submitted electronically within fourteen (14) days of the repair.

5.0 Basis of Payment. Payment for furnishing the labor, materials, and equipment necessary to install (including any testing necessary to ensure functionality and accuracy) or to remove

(including the costs necessary to salvage, store and refurbish or dispose of as directed by the engineer) the devices/systems listed above, including modification to communication drawings, shall be paid for by the contract unit price for:

Item Number	Item Description	Unit
910-99.02	Install Solar Power System	EA
910-99.02	TB1-17 Aluminum Base for RTMS Pole	EA
910-99.02	Sensys Repeater Pole Base Aluminum Square	EA
910-99.02	Pedestal Base for Sensys Repeater Pole	EA
910-99.02	TB3-17 Aluminum Base for RTMS Pole	EA
910-99.02	Remove Solar Power System	EA
910-99.03	Conduit, High-Density Polyethylene, 2 in., Pushed	LF
910-99.03	Conduit, High-Density Polyethylene, 2 in., In Trench	LF
910-37.00	CCTV Camera Assembly, Installed	EA
910-52.00	Conduit, 2 in, Rigid, In Trench	LF
910-52.01	Conduit, 3 in, Rigid, In Trench	LF
910-52.02	Conduit, 4 in, Rigid, In Trench	LF
910-72.01	Conduit, 3 in, Rigid, Pushed	LF
910-72.02	Conduit, 4 in, Rigid, Pushed	LF
910-83.52	Fiber Optic Cable, 24-Strand, 18 SM, 6 MM	LF
910-99.02	MoDOT Buried Cable Drivable Delineator Post	EA
910-99.02	F&I Camera Pole (60ft) and Lowering System	EA
910-99.02	F&I Fiber Optic Fusion Splice, SM	EA
910-99.02	F&I Fiber Optic Fusion Splice, MM	EA
910-99.02	F&I ITS Pull Box, Class 1	EA
910-99.02	F&I Non-Intrusive Vehicle Detector Pole	EA
910-99.02	F&I Type 1 ITS Cabinet	EA
910-99.02	F&I Type 2 ITS Cabinet	EA
910-99.02	F&I Type 5 ITS Cabinet	EA
910-99.02	F&I Type 7 ITS Cabinet	EA
910-99.02	Fiber Optic Splice Enclosure	EA
910-99.02	Fiber Optic Termination	EA
910-99.02	Install In-Pavement Wireless Sensors	EA
910-99.02	Install Non-Intrusive Access Point & Assembly	EA
910-99.02	Install Non-Intrusive Vehicle Detector Assembly	EA
910-99.02	Install Non-Intrusive Wireless Repeater	EA
910-99.02	Install Salvaged Field Cabinet (Single)	EA
910-99.02	Install Salvaged Field Cabinet (Dual)	EA
910-99.02	Install Salvaged Camera Pole	EA
910-99.02	Install Salvaged Non-Intrusive Vehicle Detector Pole	EA
910-99.02	Install Spread Spectrum Wireless Communication Equipment	EA
910-99.02	Install Wireless Ethernet Bridge Communication Equipment	EA
910-99.02	Rack Mounted Interconnect Center	EA
910-99.02	Remove Camera Pole	EA
910-99.02	Remove CCTV Camera & Assembly	EA
910-99.02	Remove Communication Node Field Cabinet (Single Cabinet)	EA
910-99.02	Remove Communication Node Field Cabinet	EA

	(Double Cabinet)	
910-99.02	Remove In-Pavement Wireless Sensors	EA
910-99.02	Remove Non-Intrusive Access Point & Assembly	EA
910-99.02	Remove Non-Intrusive Vehicle Detector Assembly	EA
910-99.02	Remove Non-Intrusive Vehicle Detector Pole	EA
910-99.02	Remove Non-Intrusive Wireless Repeater	EA
910-99.02	Remove Wireless Communication Equipment	EA
910-99.03	Conduit, 2 in., Rigid, Pushed	LF
910-99.03	F&I Cable in Conduit, #14 wire, variable conductors	LF
910-99.03	F&I Cable in Conduit, #8 wire, variable conductors	LF
910-99.03	F&I Cable in Conduit, #6 wire, variable conductors	LF
910-99.03	F&I Cable in Conduit, #4 wire, variable conductors	LF
910-99.03	F&I Cable in Conduit, #2 wire, variable conductors	LF
910-99.03	F&I Cable in Conduit, #1/0 wire, variable conductors	LF
910-99.03	F&I Cable in Conduit, #2/0 wire, variable conductors	LF
910-99.03	F&I Cable in Conduit, CAT5e Outdoor Rated Cable	LF
910-99.03	F&I Cable in Conduit, Video Coaxial Cable	LF
910-99.03	F&I Fiber Optic Cable, 24-Strand SM	LF
910-99.03	F&I Fiber Optic Cable, 72-Strand SM	LF
910-99.03	F&I Trace Wire	LF
910-99.02	Remove UPS system assembly	EA
910-99.02	Install UPS system assembly	EA
910-99.02	Remove UPS power inverter	EA
910-99.02	Install UPS power inverter	EA
910-99.02	Remove UPS battery monitor	EA
910-99.02	Install UPS battery monitor	EA
910-99.02	Remove UPS battery	EA
910-99.02	Install UPS battery	EA
910-99.02	Remove UPS Automatic Transfer Switch	EA
910-99.02	Install UPS Automatic Transfer Switch	EA
910-99.02	Remove UPS Automatic Generator Switch	EA
910-99.02	Install UPS Automatic Generator Switch	EA

5.1 When a call-out or MoDOT Online Maintenance System work order requires specific detailed analytical or investigative measures in the field, or necessitates advanced diagnostics in excess of those typically needed for an ITS repair and in excess of those described in section 5.2, specialized equipment or evaluations may be needed at the location prior to completing the repair or installation. Payment for Advanced Diagnostics will be made under:

Item Number	Item Description	Unit
910-99.02	Advanced Diagnostics	EA

This shall be considered full payment for furnishing the labor, materials, and equipment necessary to install and/or perform the work necessary to complete the above mentioned work. If payment is made for Advanced Diagnostics, no payment will be made for Troubleshooting as it pertains to the call-out or MoDOT Online Maintenance System work order that was issued.

5.2 In the event that the malfunction is repairable by a simple resolution, such as re-setting or re-booting a device, or re-setting a tripped electrical breaker, the repair work shall be considered

complete. Payment for furnishing the labor necessary to inspect and diagnosis the malfunction shall be paid for the **fixed unit price** for:

Item Number	Item Description	Unit	Unit Price
910-99.02	Troubleshooting	EA	$200.00

T. ITS Pull Box Lid Replacement

1.0 Description. The contractor shall furnish and replace the damaged round ITS pull box lids as noted on this contract.

2.0 Materials.

2.1 ITS Pull Box Lid. The contractor shall field measure the lid diameter and confirm the pull box manutacturer. Based on the field review, the contractor shall submit their proposed round pull box lid cutsheets per MoDOT Specifications to the SLITS group via an email to SLITS@modot.mo.gov for review and approval.

3.0 Construction Requirements.

3.1 The contractor shall replace the damaged round ITS pull box lids per a MoDOT SLITS group Online Maintenance System ticket. The lid bolts shall not be installed but shall be left in the pull box.

3.2 The pull box lid shall meet all applicable requirements in Section 1062 (Pull and Junction Boxes) of the Missouri Standard Specifications for Highway Construction.

6.0 Basis of Payment. Measurement and payment for this pay item includes, field verification the lid size, firnishing and installing the round ITS pull box lids, in addition to all necessary materials and equipment to complete this task. Payment will be made as follows:

Item No.	Type	Description
910-99.02	Each	ITS Pull Box Lid Replacement (32 Inch Diameter)
910-99.02	Each	ITS Pull Box Lid Replacement (40.5 Inch Diameter)

U. Device Cabinet Plan Verification

1.0 Description. The contractor shall verify and correct the fiber optic cable and device connection plans inside the existing MoDOT ITS device cabinets as part of any Preventative Maintenance tasks.

2.0 Requirements. While performing any Preventative Maintenance task, the contractor shall use Commission furnished as-built plans to verify and/or correct the plans for each ITS device cabinet (other than node cabinets).

Items to check and correct on the plans shall include, but not be limited to, fiber optics (type, splice, termination, pigtails, etc.), communication devices (make, model and serial number), power outlets, and end devices (make, model and serial number) visible inside the cabinet, and

all connections and cable types between cabinet devices. Any variances to these plans are to be clearly marked and returned to the engineer, in color, for both Visio and PDF formats. The scan must clearly show the ITS device name, location and each needed correction. Locations with accurate plans requiring no adjustments shall be noted in the MoDOT Online Maintenance System work order comments.

The contractor shall exercise reasonable care in the inspection of the existing ITS facilities during this task. Should any of the equipment be damaged by the contractor's negligence, it shall be replaced at the contractor's expense immediately.

3.0 Basis of Payment. No direct payment. Payment is to be included as part of yearly ITS Preventative Maintenance (PM) task.

V. Split Duct Conduit Repair

1.0 Description. At locations noted on MoDOT Online Maintenance System Work order, the contractor shall repair a damaged conduit using "Split Duct Conduit" method per conduit manufacturer and MoDOT specifications.

2.0 Requirements. The contractor shall use MoDOT approved conduit materials to repair the damaged conduit. Using the conduit manufacturer requirements, when snapping the two piece conduits together, the interlocking design of Split Duct Conduit shall provide watertight connection and smooth tight seal protecting the cable or fiber optics from weathering. No tape, plastic, or any strap materials shall be used to seal or provide extra strength to the Split Duct Conduit repair.

The Split Duct Conduit Repair method and materials shall be inspected and approved by the engineer prior to filling the area.

3.0. Construction Requirements. Construction requirements shall conform to Sec 902.16.

4.0 Basis of Payment. No direct payment will be made to provide conformance to this section. Payment is to be included as part of Conduit, 2", 3", or 4" (depending on the repaired conduit size), in trench, for any conduit repair task.

W. Site Restoration

1.0 Description. Restore to its original condition any disturbed areas at sites including, but not limited to, pull box, conduit and pole base installations. Restoration shall be accomplished by placing material equivalent to that of the adjacent undisturbed area. Disturbed unpaved areas shall be fertilized and either seeded and mulched or sodded as directed by the engineer. The engineer will have the final authority in determining the acceptability of the restoration work.

2.0 Basis of Payment. The cost of restoration of disturbed areas will be incidental to the unit price of pole base, conduit, and/or pull box. No direct payment will be made for any materials or labor, which is performed under this provision.

X. Out of Scope Work and Repairs

1.0 Description. The contractor shall be aware that there may be additional work or repairs required outside of the scope of routine maintenance or common repairs as identified within the job special provisions above (Preventative Maintenance & Remedial Maintenance). This work may include emergency relocations of ITS devices or fiber to avoid construction conflicts, catastrophic damage to major devices such as Dynamic Message Signs, or essential upgrades to ITS and/or network devices.

2.0 Basis of Payment. When such work is necessary, the engineer shall notify and request a bid for the additional work from the contractor. If appropriate, the contractor and engineer shall meet in the field to discuss and clarify the scope of work. The contractor shall submit a bid price(s) for the work item(s) to the engineer for approval. If a mutually agreed upon bid price cannot be determined, the work item(s) shall be compensated as outlined in Missouri Standard Specifications for Highway Construction under Sec 109.

Y. Spare Parts (Contractor-Furnished, Contractor-Salvaged, or Commission-Furnished)

1.0 Description. The contractor shall maintain and store an inventory of spare parts in order to fulfill the requirements of this contract. The spare parts may be Commission-furnished, Contractor-furnished, or Contractor-salvage. The contractor shall also manage and verify repair work on existing ITS devices and equipment removed from the field.

2.0 Storage Facility. The spare parts storage area for this contract must be in a secure location and either be in a building dedicated to the spare parts of this contractor, or be physically separated and secured from areas of the building used for other purposes. Equipment larger than 20-feet long and weatherproof may be stored in a secure location adjacent to the building used to store the smaller equipment. The physical warehouse space must be sized adequately to store all parts and equipment necessary to complete the requirements of this contract.

3.0 Size of Inventory.

3.1 Commission-furnished Equipment. The engineer will provide a sufficient inventory of Commission-furnished spare parts to the contractor in order to prevent delays to the preventative or remedial repairs. The contractor shall advise the engineer if spare parts are getting low or provide recommendations on size of Commission-furnished inventory.

3.1.1 The Commission will procure the following equipment for use with this project:

- CCTV cameras and assemblies
- Non-intrusive vehicle detectors and assemblies (RTMS Side Radar Detection)
- Intrusive vehicle detectors and assemblies (In-pavement vehicle sensors, wireless repeaters and access points)
- Ethernet switches
- Video Encoders/Decoders
- Fiber Optic Data Modems
- Device Servers
- DMS pixel board, driver board, power supply, fan, controller, and LCA

3.2 Contractor-furnished Equipment. The contractor shall provide and maintain a sufficient inventory of spare parts and equipment in order to complete the requirements of this contract. No extension in maximum time of completion per MoDOT Online Maintenance System work order shall be given for insufficient inventory, unless approved by the engineer. It shall be the sole responsibility of the contractor to determine the size of the inventory of Contractor-furnished equipment.

3.2.1 Contractor furnished equipment shall include, but not be limited to the following:

- DMS enclosure filters
- Jumper wires and connectors
- Field cabinet air filters
- Any and all wiring within a single field cabinet or between two cabinets on the same base/pole.
- Cleaning solutions and chemicals
- Lubricating solutions, lubricants, oils or greases
- Light bulbs (incandescent, fluorescent, and LED)
- CCTV camera cable
- CCTV Camera Poles
- Vehicle Detector Poles
- Pull boxes
- All necessary mounting hardware
- Solar Panel Battery replacements

4.0 Record of Inventory. In addition to storing the spare and salvaged parts, the contractor shall be responsible for tracking and reporting on this inventory, including quantities, model numbers and serial numbers of all equipment. The contractor shall also be required to track warrantee information for all equipment within the inventory.

The contractor shall provide the engineer a *monthly report* of all the equipment by storage location. The report shall summarize, at a minimum, the quantity of units ready for deployment, units under repair, units failed and waiting for parts, units failed with no action yet taken, and dates of unit status changes.

4.1 Commission-Furnished Equipment. The equipment furnished by the Commission shall remain Commission-owned and shall only be used to complete the requirements of this contract. These parts shall be neatly stored, separate from the other parts, and clearly labeled as owned by the Commission. The cost of any of these parts missing or otherwise unaccounted for shall be reimbursed to the Commission at the end of this contract.

4.2 Salvaged Equipment. The equipment removed from the field by the contractor shall remain Commission owned equipment and shall be stored, repaired or disposed of as directed by the engineer. The cost of any of these parts missing or otherwise unaccounted for shall be reimbursed to the Commission at the end of this contract.

4.3 Audits. The contractor shall provide the engineer, or engineer's representative access to the spare part storage facility within twenty four (24) hours of being notified.

5.0 Repairing Salvaged Equipment. The contractor shall be responsibility for facilitating and verifying repairs made to existing equipment. This work shall include, but limited to:

- Package defective or damaged component(s) for shipping to the manufacturer for repair
- Ship packaged component(s) to approved repair facility for repair or replacement
- Track and report on parts in their repair cycle
- Receive repaired or replacement parts and add to inventory
- Test repaired parts to verify acceptable completion of repairs
- Negotiate repair rates or maintenance agreements with vendors or other qualified companies
- Meet with engineer, or engineer's representative, in order to determine policies on the diagnosis repair, or disposal of damaged equipment.

6.0 Basis of Payment. No direct payment shall be made for the compliance with this provision.

Z. Documentation and Reporting

1.0 Description. The contractor shall prepare a series of documents and reports for the engineer throughout the project. These reports shall, in general, track the frequency and type of work performed and the costs necessary for maintaining the ITS system. All reports shall be provided to the engineer in electronic format (MS Word or as approved by the engineer) through email.

2.0 Annual, Monthly, and Daily Progress Reports.

2.1 Annual Maintenance Report. The contractor shall provide a report at the end of the year (or end of this contract), which includes a simple summary of all maintenance activities for every field element, including the communication system, in the contract. This report may be in table format and shall include, at a minimum, the following information:

- Number of preventative maintenance visits to each site
- Scheduled date and actual date of preventative maintenance visits to each site
- Number of problem call visits to each site
- Average duration of each problem call visit for each site (actual time on site)
- Average time to resolve problems for each site (time from notification to resolution)
- Cost of spare parts used at each site (contractor & commission furnished)
- Total spare parts cost for the system for the year (contractor & commission furnished)
- Total compensation from the Commission to the contractor for this contract with **out-of-scope** work and component repairs broken out separately.

2.2 Progress Reports. The contractor shall provide the engineer with a progress report, via email, every two weeks. This report shall be clear and concise with only relevant information. This report shall include, at a minimum:

- Completed items for payment (separate standard pay items from out-of-scope work)
- Project work status
- Total cost per date
- Estimated cost for completion.

The report should also include any outstanding action and/or risk items, updated schedule, and a recovery plan if necessary.

2.3 Daily Work Report. Each staff member of the contractor, assigned to the project, shall maintain a bound daily log with name clearly indicated. The daily logs of all staff working on the project shall be delivered to the engineer by 10:00 a.m. the following work day. At a minimum, the information in the daily log reports, shall include:

- Date
- Weather and Road Conditions
- Problem(s) reported
- Cause of problem(s) discovered
- Work performed using traffic control and description of traffic control
- Motorized equipment utilized and duration
- Any traffic crashes within or adjacent to work zone or work area
- Any work-related accidents or injuries.

2.4 Preventative Maintenance Checklist/Inventory. The contractor shall submit to the engineer all preventative maintenance checklists, inspection sheets, and testing results per device within 48 hours of performing the work.

3.0 Schedule. The contractor shall develop and maintain a schedule for all maintenance activities. The engineer shall provide the contractor with the previous year's preventative maintenance visit/dates per site a minimum of four (4) weeks prior to preconstruction meeting. The contractor shall incorporate this information into the schedule to ensure that each ITS device is maintained at the frequency required in this provision and per manufacturer's guidelines. The first schedule shall be submitted by the pre-construction meeting.

The schedule shall include preventative maintenance and on-going repairs. The contractor shall update the schedule daily. After the initial schedule submittal and engineer's approval, an updated schedule shall be submitted to the engineer every two weeks or upon request by the engineer.

4.0 Maintenance Plan. The contractor shall create a document to describe in detail how all requirements in this project will be achieved and how repairs will be handled from notification to resolution.

It shall contain a process for efficiently expediting maintenance activities described within this proposal. The maintenance plan shall include, as a minimum:

- Date
- Preventative maintenance schedule for all field elements in the contract
- Description of the process that will be put into place to incorporate and expedite the resolution of unplanned field element service outages while maintaining the prescribed preventative maintenance schedule
- Process for ensuring consistent compliance with the required response times described in this contract.

An initial Maintenance Plan shall be submitted to the engineer prior to the preconstruction meeting. A revised Maintenance Plan based on comments from the engineer shall be submitted prior to the start of work.

5.0 Basis of Payment. No direct payment shall be made for the compliance with this provision.

AA. MoDOT Buried Cable Driveable Delineator Post

1.0 Description. The contractor shall install a MoDOT 'Buried Cable' delineator post next to existing fiber optic cables and fiber optic pull boxes as instructed. The post shall withstand multiple directional impacts and providing a long lasting and extremely durable product requiring little field maintenance. The contractor shall not be required to install posts at pull boxes near existing field cabinets. The posts shall be placed at a minimum spacing of 250 feet or as directed by the engineer. If line of sight to the adjacent post would be obstructed at the minimum spacing, the engineer may direct the contractor to install posts at points to allow for ground-level line of sight from adjacent posts or field cabinets.

2.0 Construction Requirements. Construction requirements shall conform to the delineator post manufacture recommendations and engineer's approval. The contractor shall be responsible for all utility locates prior to installation.

3.0 Materials. The contractor shall provide all equipment and materials necessary to furnish and install delineator posts. The post shall be supplied in orange color and incorporate a premium UV inhibitor package to resist harmful effects to the sun. The post shall have a minimum 0.20" wall thickness and shall stand up straight in all weather conditions and self-right to straight upon impact. Top of post shall be permanently sealed and partially flattened and transition to round to afford 360 degree visibility. The post materials shall include an anchor, a non-mechanical flexible joint, and a round delineator post. The post assembly should allow for easy change-out of any one part if necessary.

4.0 Method of Measurement. Measurement of the drivable delineator posts shall be made per each.

5.0 Basis of Payment. Payment for furnishing the labor, materials, and equipment necessary to install Drivable Delineator Posts shall be paid for by the contract unit price for:

Item Number	**Item Description**	**Unit**
910-99.02	MoDOT Buried Cable Drivable Delineator Post	EA

BB. Coordination with MoDOT Signal Shop for Cabinet Entry

1.0 **Description.** Commission-furnished color-coded pad locks have been placed on all of MoDOT's signal cabinets in addition to the key used to unlock the door handle. To gain access to the appropriate cabinets during the project all contractors shall coordinate with MoDOT's signal shop to obtain the proper keys and locks.

1.0.1 Keys & Locks. Red locks and keys are provided when a contractor has modified the signal cabinet and MoDOT staff shall not have access to the cabinet until it is accepted for maintenance. The blue keys are provided for entry into the cabinet where MoDOT's Signal Shop group deems the access to be minor in nature (entry to the cabinet to make a simple network switch connection, for example).

1.0.2 Completion of Project. At the completion of the project all keys and pad locks distributed to contractor during the project shall be returned to the Signal Shop supervisor or their representative and keys shall not be reproduced.

2.0 Contact. Initial contact must be made at least seven calendar days before work begins, preferably when the project has the notice to proceed or during the pre-construction meeting, if applicable. MoDOT's Signal Shop supervisors shall be notified prior to work beginning. Contact the signal shop via email at **sltrs@modot.mo.gov** to coordinate which padlocks are to be used.

3.0 Basis of Payment. No direct payment shall be made for compliance with this provision.

CC. Wrong Way Alert Systems Preventative Maintenance, Software and Recertification

1.0 Description. Annual preventative maintenance, software and recertification of the existing Wrong Way Alert Systems at the below noted locations shall be completed by the manufacturer as a subcontractor to the prime contractor on this project.

Wrong Way Alert System Locations:	**Manufacturer:**
EB 44 Off-Ramp to Hampton Ave, Exit 286	Traffic & Parking Control Co, Inc. (TAPCO)
EB 44 Off-Ramp to Lafayette Ave, Exit 290B	Traffic & Parking Control Co, Inc. (TAPCO)
EB 44 Off-Ramp to S Jefferson Ave., Exit 289	Traffic & Parking Control Co, Inc. (TAPCO)
I-70 EB at N. Florissant	Traffic & Parking Control Co, Inc. (TAPCO)
MO 100 East to Gray Summit	Traffic & Parking Control Co, Inc. (TAPCO)
St. Clair Rest Area – EB 44 Ramp	Traffic & Parking Control Co, Inc. (TAPCO)
St. Clair Rest Area – WB 44 Ramp	Traffic & Parking Control Co, Inc. (TAPCO)
WB 370 to Off-Ramp to Earth City Expy, Exit 9	Traffic & Parking Control Co, Inc. (TAPCO)
WB 44 Off-Ramp to Arsenal St., Exist 284B	Traffic & Parking Control Co, Inc. (TAPCO)
WB 44 Off-Ramp to Grand/Louisiana, Exit 288	Traffic & Parking Control Co, Inc. (TAPCO)
WB 44 Off-Ramp to Hampton Ave, Exit 286	Traffic & Parking Control Co, Inc. (TAPCO)
WB 44 Off-Ramp to S. Jefferson Ave., Exit 289	Traffic & Parking Control Co, Inc. (TAPCO)
WB 44 Off-Ramp to Vandeventer Ave., Exit 287B	Traffic & Parking Control Co, Inc. (TAPCO)

2.0 Scope of Work. This section includes scope of work requirements for Wrong Way Alert Systems preventative maintenance, software and recertification.

Power Source Testing (Solar Package or AC Source and DC Power Supplies)
-Perform tests on the power source to verify the equipment and power source are operating within an acceptable range
Calibration of Existing Detection Equipment
-Verify each detection sensor for the system is calibrated properly -Clean each detection sensor assembly -Verify detection by temporarily changing the detection direction to detect right-way traffic -Verify each sensor's output triggers as the detection of right-way traffic occurs -Perform general housekeeping to include cabinet vacuuming -Perform cable management
Calibration of Existing Video Equipment

-Align each camera to optimal video capture position
-Verify each camera is receiving transmitted trigger from logic controller or individual sensor
-Verify each camera is capturing snapshots upon receipt of trigger
-Verify each camera is sending a daily image
-Verify each camera is sending status updates
-Verify each camera has the correct date and time
-Perform general housekeeping to include wiping the camera lens
-Perform cable management

Alignment and Testing of Warning Equipment

-Verify all static signs are properly orientated
-Verify the LED-enhanced signs or beacons are properly orientated
-Verify warning equipment operates for determined time interval
-Verify all lights are operational
-Perform general housekeeping to include wiping the face of the equipment
-Perform cable management

Verification of Activation and System Updates

-Verify all warning equipment activates upon initial detection
-Verify wrong way alert activation upon wrong way verification
-Perform Firmware and other system updates as they become available

Certification of Complete System by Drive Testing

-Drive a small vehicle twice in each lane to confirm low speed detection of system
-Drive a small vehicle twice in each lane to confirm high speed detection of system
-Drive a large vehicle twice in each lane to confirm low speed detection of system
-Drive a large vehicle twice in each lane to confirm high speed detection of system

Documentation To Be Provided

-Preventative maintenance documentation will be provided.
-System testing documentation will be provided.

Software To Be Provided

The below-described Blinklink® 2.18.0 features and functionality shall be included for the term of this contract and provided by manufacturer, Traffic & Parking Control Co, Inc. (TAPCO). TAPCO will verify system performance in concert with BlinkLink software by testing and verifying the speed of alert delivery and transmission confirmation on a biannual basis. Updates, meaning any updates, bug fixes, patches, or other error corrections to the BlinkLink software that TAPCO generally makes available free of charge to all licensees of BlinkLink is included with this agreement. BlinkLink new versions or new features, meaning any new feature or version of BlinkLink that TAPCO may from time to time introduce and market generally as a distinct licensed feature or product (as may be indicated by Licensor's designation of a new version number or feature name), and which TAPCO may make available to you at an additional cost under a separate written agreement, shall not be included in contract price but can be quoted separately as needed.

Quickly Monitor Wrong Way Alert and other Intellignet Warning Systems
Blinklink® powered by TAPCO will monitor the status of every TAPCO Intelligent Warning System from its interactive map view, gather historical device data and quickly access individual systems through the search and filter function.

- **Controller Based Mapping**
  View every device on an interactive map.

- **Historical Data**
  View system status and activation history.

Remotely Manage Intelligent Warning Systems
Eliminate time-consuming site visits with BlinkLink® powered by TAPCO.

- **Remote On Demand Manual Flash Activation**
  Override any set schedule to immediately turn on any device.
- **Configurable Flash Duration**
  Extend or reduce flash times when needed
  User-selected event resolutions
    - **Select appropriate event resolutions in conjunction with the details provided in the alert package**
- **Camera and thermal sensor streaming**
    - **"Offline" stream from any BlinkLink connected camera or thermal sensor**
    - Health and diagnostics
    - Remotely monitor vital system elements to ensure system uptime and proactively identify issues

Receive Email and SMS Alerts
Receive immediate Email/SMS alert notifications when a system activation occurs or system maintenance is identified. Determine what traffic events and pre-set systems thresholds transmit an email or SMS alert. Keep predetermined recipients informed by programming alerts according to their access or responsibilities across city, county and state agencies.

- **Configure Email Alerts**
  Receive email alerts straight to your inbox.
- **Configure SMS Alerts**
  Receive text message alerts on your phone or mobile device.
- **Image Alerts**
  Alerts include up to 15 high resolution color images that include the directional overlay
- **Streaming Alerts**
  Alerts include up to 15 high resolution color images that include the directional overlay
- **Video Alerts**
  Alerts include downloadable high-resolution color video

Custom Reporting
Generate custom reporting for each device's historical data. Analyze traffic trends through system activations and event details to better manage current and future system deployments.

- **System Activation Reporting**
  Better understand event occurrences and document system effectiveness
- **Export Data Logs**
  View and download alert, activation and system status history.

3.0 Traffic Control. The prime contractor shall completely close each ramp listed above in Section 1.0 in order to allow for the Wrong Way Alert System manufacturer subcontractor to perform an annual recertification of the Wrong Way Alert System. Traffic control items are included within the Plans and shall be paid as specified in the JSP F – Temporary Traffic Control.

4.0 Basis of Payment. Measurement and payment for preventative maintenance, software and recertification of Wrong Way Alert Systems shall be paid for at the contract unit price for all labor and items included within the scope of work above as follows:

Item No.	Type	Description
910-99.02	Each	Wrong Way Alert Systems Preventative Maintenance, Software and Recertification

DD. Pad-Mounted Power Supply

1.0 Description. This work shall consist of furnishing and installing 120/240 Volt power supply assembly. The power supply shall be multi-circuit pad mounted. Available power supplies are listed in the lighting section of the MoDOT approved products list under Pad Mounted Lighting Controllers. Control stations shall be installed in accordance with the plans and by direction of the engineer.

1.1 The contractor shall remove the power supply after installing the new pad-mounted power supply

2.0 Basis of Payment. Payment for furnishing and installing pad mounted power supplies shall include all excavation, materials, equipment, tools, labor, and work incidental thereto. Payment will be made as follows:

Item No.	Type	Description
910-99.02	Each	Pad Mounted Power Supply, 120V ITS

EE. ITS Pull Box

1.0 Description. Furnish and install ITS Pull Boxes with concrete pads as shown on the plans.

2.0 Materials.

2.1 Pull Box. ITS pull boxes shall meet the requirements in Section 1062 of the Missouri Standard Specifications for Highway Construction.

2.2 Ground Rod. Ground rods shall be listed according to UL requirements as detailed in the standard UL 467, Grounding and Bonding Equipment, and meet the requirements of NEC 250. Use electrodes that are solid copper or copper-bonded steel.

2.3 Concrete Pad. The contractor shall install a non-reinforced concrete pad around the ITS pull box as shown in the plans. The concrete used shall be a Class 'B' concrete as described within Sec 501 of the Standard Specifications.

3.0 Construction. Install ITS pull boxes as shown in the plans. Provide a concrete pad around the pull boxes as shown in the plans. Install a ground rod in the Class 5 pull boxes nearest ITS or signal cabinets.

4.0 Basis of Payment. Measurement and payment for ITS Pull Boxes with a concrete pad includes excavation, materials, construction, backfill and all miscellaneous hardware required for a fully operational system. Payment will be made as follows:

Item No.	Type	Description
910-99.02	Each	ITS Pull Box with Concrete Pad, Preformed Class 2
910-99.02	Each	ITS Pull Box with Concrete Pad, Preformed Class 5

FF. Fiber Optic Cable Installation

1.0 Description. This work shall consist of installing, splicing, and terminating fiber optic cables.

2.0 Materials. Some of the below noted materials may not be applicable on this project. Please see the plans and below quantities for details.

2.1 Cable. Fiber optic cable shall be of loose tube construction. Provide certification by an independent testing laboratory that the cable meets all requirements of Rural Utilities Service Bulletin 1753F-601a *Minimum Performance Specification for Fiber Optic Cables* (http://rurdev.sc.egov.usda.gov/SupportDocuments/UTP_Bulletins_1753F-601a.pdf). The cable shall be gel free, all dielectric, and have 12 fibers per tube. The cable sheath shall have length markings in feet, and shall indicate that the unit of measure is feet. The cable shall have single mode fibers whose attenuation does not exceed 0.35 dB/km and 0.25 dB/km for 1310 nm and 1550 nm signals, respectively.

2.2 Splice Tray. Splice trays shall be 11.7” long, 3.9” wide, and 0.2” tall. They shall be aluminum with clear plastic covers, designed for outdoor use. Each shall accommodate 24 fusion splices. The trays shall have a black powder coat finish. The trays shall have both perforations for cable ties and crimpable metal tabs for buffer tube strain relief.

2.3 Connector. Connectors shall be the LC type with ceramic ferrules, unless a different connector is required to mate with the equipment or an existing panel. They shall be suitable for use in traffic cabinets and shall be designed for single mode fibers.

2.4 Pigtail. Pigtails shall be factory-made, buffered, and strengthened with aramid yarn to reduce the possibility that accidental mishandling will damage the fiber or connection. Pigtails shall be yellow. Each must contain one fiber. Length shall suffice to provide two feet of slack after installation.

2.5 Jumper. Jumpers shall meet the requirements for pigtails, but shall have a connector on each end. Length shall suffice to provide approximately five feet of slack after installation.

2.6 Interconnect Center. An interconnect center is a splice enclosure that has a patch panel built into one of its walls. Within the interconnect center, fibers in cables are spliced to pigtails and the pigtails are plugged into the patch panel from the inside. This allows jumper cables (not part of the interconnect center) to plug into the patch panel from the outside, connecting the fibers to equipment in the cabinet or to other fibers on the patch panel. Within an interconnect center, some fibers may be spliced to the corresponding fiber in a mating cable, rather than to a pigtail. Still other fibers may be coiled, un-terminated.

The enclosure shall be made of powder-coated metal. It shall have provisions for cable strain relief and for connector labeling. The enclosure's patch panel shall have at least 24 positions. Provide enough splice trays for all splices made in the interconnect center.

2.6.1 Wall-Mounted Interconnect Center. The enclosure shall be designed for wall or panel mounting and occupy no more than 350 square inches of wall space. It shall have a gasketted, hinged door. It shall hold at least six splice trays.

2.7 Underground Splice Closure. Closures for underground fiber splices include all materials necessary to make, organize, and protect the splices.

2.7.1 The closure shall supply environmental protection of cable and splices from water and dirt and that is designed to be submersed in water and installed underground outside plant use for splicing fiber-optic cables in pull boxes.

2.7.2 Provide certification by an independent testing laboratory that the closure meets all requirements of Telcordia GR-771 for environmentally sealed closures.

2.7.2 The closure shall be re-enterable without any special tools.

2.7.3 The closure shall be able to accommodate at least four fiber optic cables.

2.7.4 The closure shall accommodate 144 single mode fiber splices.

2.7.5 It shall be possible to remove any splice tray without disturbing the others.

2.7.6 Splice trays in the closure need not be of the type specified in 2.2, above.

2.7.7 Designed for butt splicing.

2.7.8 No encapsulated materials shall be allowed.

2.8 Tracer Wire. A jacketed #14 AWG XHHW-2 standard blue tracer wire (also known as the locator wire) shall be provided in the conduit within the project limits unless it exists. See the details in the construction requirements.

3.0 Construction Requirements.

3.1 Cable Installation. Prior to installation, confirm that the cable is in good condition and complies with the specifications. Any defects found after installation will be deemed the fault of the contractor.

3.1.1 Install the cable such that the optical and mechanical characteristics of the fiber are not degraded. Do not violate the minimum bend radius or the maximum tension, both during and after installation.

3.1.2 Before any cable installation is performed, provide the engineer with four copies of the cable manufacturer's recommended maximum pulling tensions for each cable size. These pulling tensions shall be specified for pulling from the cable's outer jacket. Also, provide a list of the minimum allowable cable bending radius and the cable manufacturer's approved pulling lubricants. Only those lubricants approved by the cable manufacturer will be permitted.

3.1.3 If the cable is pulled by mechanical means, use a clutch device to ensure the allowable pulling tension is not exceeded. Also, attach a strain gauge to the pulling line at the cable exit location, and at a sufficient distance from the take-up device, such that the strain gauge can be read throughout the entire cable pulling operation.

3.1.4 Do not leave the let-off reel unattended during a pull, in order to minimize the chance of applying excess force, center pull, or back feeding.

3.1.5 Use an approved lubricant, in the amount recommended by the cable manufacturer, to facilitate pulling the cable. After the cable has been installed, wipe the exposed cable in a pull box, junction box, or cabinet clean of cable lubricant with a cloth before leaving the pull box, junction box, or cabinet.

3.1.6 In every intermediate pull box, store 10 feet of slack fiber optic cable for every cable that passes through the pull box, unless otherwise noted on plans. Additional slack storage, as indicated on the plans, is required in designated pull boxes. At cabinet locations, where cable runs from the pull box directly to an equipment cabinet, store 60 feet of slack fiber optic cable in the pull box, unless otherwise noted on plans. Additionally, treat the cable returning from the cabinet to the pull box as a separate cable, and store 60 feet of slack for these links, unless otherwise noted on plans. Store slack cable neatly on the walls of the pull box using racking hardware acceptable to the engineer.

3.2 Splicing. Splice all optical fibers, including spares, to provide continuous runs. Splices shall be allowed only in equipment cabinets except where shown on the plans.

3.2.1 Make all splices using a fusion splicer that automatically positions the fibers using the Light Injection and Detection (LID) system. Provide all equipment and consumable supplies.

3.2.2 Secure each spliced fiber in a protective groove. Completely re-coat bare fibers with a protective room temperature vulcanizing (RTV) coating, gel or similar substance, prior to insertion in the groove, so as to protect the fiber from scoring, dirt, or microbending.

3.2.3 Prior to splicing to a fiber installed by others, measure and record the optical loss over that fiber. See Sec 4.0 of this provision.

3.2.4 Use a different splice tray for each buffer tube color. If an enclosure contains multiple buffer tubes of the same color, but none of the fibers in one of the tubes are spliced to fibers in other tubes of the same color, use a separate splice tray for that tube.

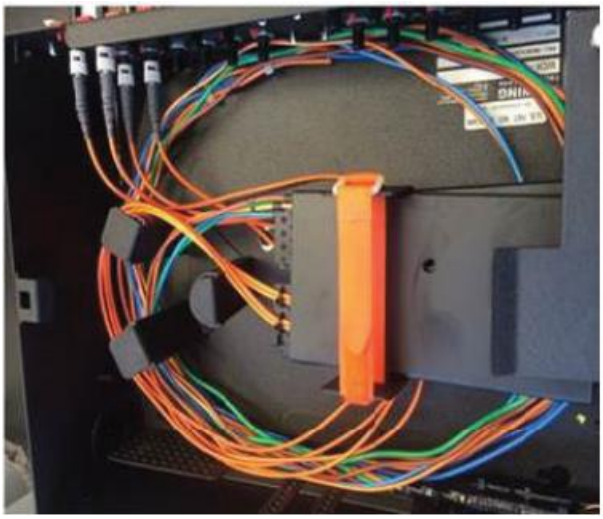
3.3 Termination. Terminate fibers by splicing them to factory-made pigtails. Cap all connectors that are not connected to a mating connector.

3.4 Tracer Wire. The contractor shall install a jacketed #14 AWG XHHW-2 standard blue tracer wire (also known as the locator wire) in conduit with new or replaced fiber optic cable(s). In every pull box connect the tracer wire to a ground rod with a ground rod clamp and provide five feet of slack. Secure the tracer wire slack in individual coils to the inside wall of each pull box. If the tracer wire already exists, the contractor shall ensure it is connected to the ground rod properly in each pull box and demonstrate a locate signal will transmit between pull boxes.

3.5 Fiber Management. Fiber in splice trays along with pigtails and buffer tubes in the interconnect center shall be neatly looped and restrained following telecom industry standard fiber and cable management practice and enclosure manufacturer's recommendations. Shown below are examples of acceptable and unacceptable fiber and cable management. Work will not be accepted unless good fiber management practices are followed.

3.6 Required Fiber Splicing, Installation and Testing Experience. Submit resumes, certificates and references detailing fiber installation, splicing and testing for on-site personnel to the Engineer for approval. Subcontractors used on the project are considered part of the contractor's team and are also required to submit resumes, certificates and references. Submit to the Engineer references including client project manager, phone number and project experience. Demonstrate successful completion of fiber optic cable installation and splice training courses by providing certificates of completion. Failure to comply may result in a declaration of noncompliance.

In addition, ensure a number of the contractor's team approved by the Engineer that has at least two years of experience in the installation, splicing and testing of the fiber optic cable is on site at all times during the fiber optic cable installation and fiber optic splicing work until successful completion of the work. Receive approval from the Engineer for any substitution of this individual. The Engineer may stop the work activity on this project as a result of the absence of these on-site personnel from the project and may continue to charge time to the contractor and will not grant a time extension.



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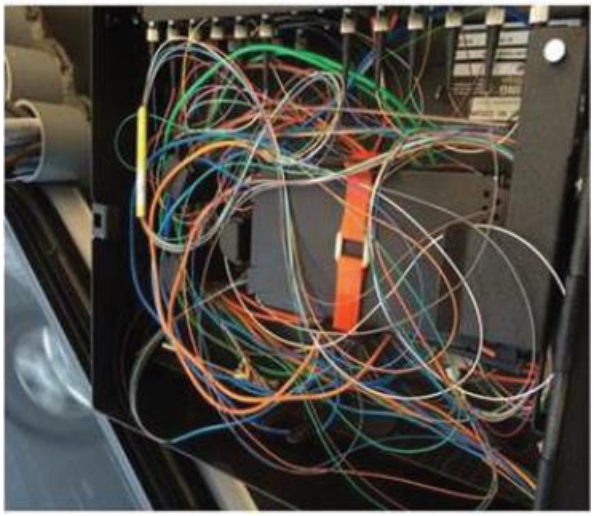

Unacceptable

4.0 Acceptance Testing.

4.1 General. Test the fiber after installation, including all splicing and termination, is complete. Note, however, that this test procedure involves measuring the loss of fiber installed by others before splicing to it. For each fiber optic link, including spare fibers, determine whether the optical loss is within the limits permitted by these specifications. A link is a continuous segment of fiber between one connector (or unterminated end) and another connector (or unterminated end). When testing links that do not have connectors on both ends, use a mechanical splice to attach a pigtail to the unterminated fiber for the duration of the test.

4.2 Test Procedure. For each fiber link, follow this procedure:

(a) If the link includes fiber installed by others, use an optical loss test set to measure and record the optical loss over that portion of the link before it is spliced to new fiber.

(b) Calculate the maximum allowable loss for the completed link, both at 1310 nm and at 1550 nm. Use the following formula:

Maximum link loss = Measured loss over portion installed by others
+ (Fiber length in km) x (0.35 for 1310 nm and 0.25 for 1550 nm)
+ (Number of fusion splices) x (0.05)
+ (Number of mechanical splices [for temp. connection]) x (0.3)
+ (Number of connections) x (0.5)

Provide this calculation to the engineer along with the test results.

(c) Calibrate an optical loss test set and provide evidence satisfactory to the engineer that the set produces accurate results at both wavelengths. This can be a demonstration that the set correctly measures the loss of a test fiber whose loss is known.

(d) Use the test set to measure the loss of the link under test. Record the result at both 1310 nm and 1550 nm. Arrange for the engineer or his representative to witness these tests.

(e) If the measured loss exceeds the calculated maximum, use an optical time domain reflectometer and other test equipment to troubleshoot the link. Take whatever corrective action is required, including cable replacement, to achieve a loss less than the calculated maximum.

4.3 Test Result Documentation. Prepare a diagram showing all of the links tested in this project. For the portions installed in this project, show the equipment cabinets, splices, and pigtails. On each line representing a link, show the maximum allowable loss and the actual loss. The actual loss shall be the one measured after all corrective actions have been taken. Submit 5 copies of this diagram to the engineer, along with the calculations for the maximum allowable loss. Submit the diagrams and calculations in an electronic format acceptable to the engineer.

5.0 Basis of Payment. Measurement and payment for items covered by this specification include the acceptance testing and guarantee, in addition to all materials and equipment necessary for a fully operational system. Payment will be made as follows:

Item No.	Type	Description
910-99.03	Linear Foot	Fiber Optic Cable, 72 Strand, Single Mode
910-99.03	Linear Foot	Fiber Optic Cable, 24 Strand, Single Mode

GG. NTCIP Compliant Changeable Message Sign Requirements

1.0 Description. All solar powered changeable message signs, hereinafter referred to as a CMS, shall be in accordance with these specifications.

2.0 Material. Each CMS shall consist of an all LED (light emitting diode) matrix message board, solar/battery power supply and a user-operated interface, as specified, all mounted on a heavy duty, towable trailer.

2.1 Each CMS shall be either Full Matrix or Character Matrix, and have the following minimum characteristics:

(a) Full Matrix - Each CMS shall be the Full Matrix type with the capability of providing one, two, and three lines of individual changeable characters with minimum heights of 52 (1300), 28 (700), and 18 (450) inches (mm), respectively. Full Matrix signs shall be capable of both static and dynamic graphics, and full display sized messages.

(b) Character Matrix (Three Line) – Each CMS shall consist of a minimum of three lines containing eight individual changeable characters per line. Each character shall be a minimum of 12 inches wide and 18 inches (450 mm) high.

(c) Sign firmware shall comply with the current FHWA and DOT (Department of Transportation) NTCIP standards and support all NTCIP mandatory objects.

(d) The sign controller shall be remotely accessible by the MoDOT St Louis District Transportation Management Center (TMC) through the Commission's ATMS (Advanced Traffic Management System) software, currently TransSuite provided by TransCore. The contractor will be responsible for ensuring the CMS is added to the ATMS software.

(e) The CMS shall have a cellular data modem compatible with the district's current cellular IP (packet data) service provider and be capable of allowing the MoDOT St Louis District TMC ATMS software to have full control of the NTCIP compliant CMS controller remotely. Modem shall be capable of being programmed with a static IP.

(f) The sign shall have a GPS unit that can assist in locating the sign's position when polled by the TMC. The GPS unit must be remotely accessible by the TMC and be part of or work with the provided communication modem.

(g) Physical access to the onboard computer shall be protected by a padlock or other locking handle mechanism. Electronic access to the onboard computer shall be protected by a username and password.

2.2 Full matrix CMS and character matrix CMS shall meet the following:

(a) The overall sign dimensions shall not be less than 72 inches (1800 mm) high x 126 inches (3150 mm) wide.

(b) The CMS shall be legible up to a distance of 650 feet (200 m) for both day and night operations and shall be visible for ½-mile (800 m) with 18 inch (450 mm) characters.

(c) When fully raised in the display position, the bottom of the CMS board shall be at least a height of 7 feet (2100 mm) from the ground and shall be able to rotate a complete 360 degrees atop the lift mechanism. A sight tube, used to aim the CMS board to oncoming traffic, shall be installed on the CMS board or mast. The CMS shall have an electrical-hydraulic lifting mechanism that includes a manual lifting and lowering relief mechanism

as a backup. It also must be able to be locked into various viewing angles as determined best for the motorists by the CMS operator.

(d) All LED displays and control circuitry shall be operational from -20 F (-29 C) to 120 F (50 C). The LED's shall have a rated life of 100,000 hours. The LED's shall be ITE amber in color on a flat black background.

(e) The CMS face shall be constructed that if an individual panel or pixel fails the rest of the face shall continue to display the message.

(f) All costs and coordination needed for testing to verify modem communication, sign NTCIP compliance, remote GPS status polling, ability to control the sign via the St Louis District's ATMS software provided by TransCore shall be the sole responsibility of the Contractor. Full integration into TransCore's ATMS shall be completed at least 5 business days prior to use of the CMS in the project. TransCore contact information will be provided to the contractor by contacting MoDOT's Gateway Guide staff at 314-275-1526 or via email at ggtech@modot.mo.gov with details of the request. No other support shall be provided by MoDOT other than TransCore contact information. Information provided shall include, at a minimum, CMS make and model, IP address, and proposed locations and messages.

(g) The Contractor shall be responsible for all monthly cellular service fees for the duration of the project.

(h) The unit shall be able to withstand a 65-mph (105-kmph) maximum road wind speed. The trailer shall be able to support the fully extended CMS board in an 80-mph (130-kmph) wind load.

(i) Solar charging system shall allow for total autonomy of 24/7/365 continuous operation.

(j) All exterior surfaces except the sign face shall be cleaned, primed, and finished with two coats of Highway Safety Orange and the sign interior itself shall be cleaned and finished with one coat of corrosion inhibiting primer and two coats of flat black. The sign face shall be covered with a rigid translucent material to prevent damage to the sign face caused by the environment.

3.0 Construction Requirements. Prior to placing a CMS on a project, the engineer shall verify proposed CMS location is void of conflict with another DMS or CMS locations presently established. If a conflict is present, the engineer shall contact the Traffic Management Center (TMC) at 314-275-1526 to mitigate. If no conflict is present, engineer shall provide Traffic Management Center (TMC) with the Job Number, Route, County, specific CMS location, and a CMS identification number that is permanently affixed to the CMS. The engineer and contractor shall verify the message displayed on board is compliant with CMS messaging policies. The contractor shall place the CMS 6 feet [2 meters] off of the right edge of shoulder at the location shown on the plans or as directed by the engineer. The CMS shall be placed so that the right side of the unit is advanced approximately 3 degrees ahead with the direction of traffic. CMS shall not be located in medians. CMS shall be delineated with a minimum of five non-metallic channelizing devices. Installation, including location and placement, shall be approved by the engineer. If needed, the contractor shall relocate the CMS as directed by the engineer.

3.1 When not in use, the CMS shall be stored no closer than 30 feet [10 meters] to the edge of pavement carrying traffic, unless it is in a properly protected area or an off-site storage area or as otherwise directed by the engineer.

4.0 Basis of Payment. All expenses incurred by the contractor in integrating, maintaining, relocating, operating and protecting the changeable message signs as outlined above shall be paid for at the contract unit price for Item 616-99.02 Changeable Message Sign, Contractor Furnished and Retained, per Each.

4.1 Cost for channelizers shall be included in the contract unit price for CMS.

4.2 Cost for cellular phone hookup and monthly usage fee for the duration of the project shall be included in the contract unit price for CMS.

Item No.	Type	Description
616-99.02	Each	NTCIP COMPLIANT CHANGEABLE MESSAGE SIGN (CONTRACTOR FURNISHED AND RETAINED

HH. Supplemental Revisions JSP-18-01R

Compliance with 2 CFR 200.216 – Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment.

The Missouri Highways and Transportation Commission shall not enter into a contract (or extend or renew a contract) using federal funds to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as substantial or as critical technology as part of any system where the video surveillance and telecommunications equipment was produced by Huawei Technologies Company, ZTE Corporation, Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).

Stormwater Compliance Requirements

1.0 Description. This provision requires the contractor to provide a Water Pollution Control Manager (WPCM) for any project that includes land disturbance on the project site and the total area of land disturbance, both on the project site, and all Off-site support areas, is one (1) acre or more. Regardless of the area of Off-site disturbance, if no land disturbance occurs on the project site, these provisions do not apply. When a WPCM is required, all sections within this provision shall be applicable, including assessment of specified Liquidated Damages for failure to correct Stormwater Deficiencies, as specified herein. This provision is in addition to any other stormwater, environmental, and land disturbance requirements specified elsewhere in the contract.

1.1 Definitions. The project site is defined as all areas designated on the plans, including temporary and permanent easements. The project site is equivalent to the “permitted site”, as defined in MoDOT’s State Operating Permit. An Off-site area is defined as any location off the project site the contractor utilizes for a dedicated project support function, such as, but not limited to, staging area, plant site, borrow area, or waste area.

1.2 Reporting of Off-Site Land Disturbance. If the project includes any planned land disturbance on the project site, prior to the start of work, the contractor shall submit a written report to the engineer that discloses all Off-site support areas where land disturbance is planned, the total acreage of anticipated land disturbance on those sites, and the land disturbance permit number(s). Upon request by the engineer, the contractor shall submit a copy of its land disturbance permit(s) for Off-site locations. Based on the total acreage of land disturbance, both on and Off-site, the engineer shall determine if these Stormwater Compliance Requirements shall apply. The Contractor shall immediately report any changes to the planned area of Off-site land disturbance. The Contractor is responsible for obtaining its own separate land disturbance permit for Off-site areas.

2.0 Water Pollution Control Manager (WPCM). The Contractor shall designate a competent person to serve as the Water Pollution Control Manager (WPCM) for projects meeting the description in Section 1.0. The Contractor shall ensure the WPCM completes all duties listed in Section 2.1.

2.1 Duties of the WPCM:

(a) Be familiar with the stormwater requirements including the current MoDOT State Operating Permit for construction stormwater discharges/land disturbance activities; MoDOT's statewide Stormwater Pollution Prevention Plan (SWPPP); the Corps of Engineers Section 404 Permit, when applicable; the project specific SWPPP, the Project's Erosion & Sediment Control Plan; all applicable special provisions, specifications, and standard drawings; and this provision;

(b) Successfully complete the MoDOT Stormwater Training Course within the last 4 years. The MoDOT Stormwater Training is a free online course available at MoDOT.org;

(c) Attend the Pre-Activity Meeting for Grading and Land Disturbance and all subsequent Weekly Meetings in which grading activities are discussed;

(d) Oversee and ensure all work is performed in accordance with the Project-specific SWPPP and all updates thereto, or as designated by the Engineer;

(e) Review the project site for compliance with the Project SWPPP, as needed, from the start of any grading operations until final stabilization is achieved, and take necessary actions to correct any known deficiencies to prevent pollution of the waters of the state or adjacent property owners prior to the engineer's weekly inspections;

(f) Review and acknowledge receipt of each MoDOT Inspection Report (Land Disturbance Inspection Record) for the Project within forty eight (48) hours of receiving the report and ensure that all Stormwater Deficiencies noted on the report are corrected as soon as possible, but no later than stated in Section 5.0.

3.0 Pre-Activity Meeting for Grading/Land Disturbance and Required Hold Point. A Pre-Activity meeting for grading/land disturbance shall be held prior to the start of any land disturbance operations. No land disturbance operations shall commence prior to the Pre-Activity meeting except work necessary to install perimeter controls and entrances. Discussion items at the pre-activity meeting shall include a review of the Project SWPPP, the planned order of grading operations, proposed areas of initial disturbance, identification of all necessary BMPs that shall be installed prior to commencement of grading operations, and any issues relating to

compliance with the Stormwater requirements that could arise in the course of construction activity at the project.

3.1 Hold Point. Following the pre-activity meeting for grading/land disturbance and subsequent installation of the initial BMPs identified at the pre-activity meeting, a Hold Point shall occur prior to the start of any land disturbance operations to allow the engineer and WPCM the time needed to perform an on-site review of the installation of the BMPs to ensure compliance with the SWPPP is met. Land disturbance operations shall not begin until authorization is given by the engineer.

4.0 Inspection Reports. Weekly and post run-off inspections will be performed by the engineer and each Inspection Report (Land Disturbance Inspection Record) will be entered into a web-based Stormwater Compliance database. The WPCM will be granted access to this database and shall promptly review all reports, including any noted deficiencies, and shall acknowledge receipt of the report as required in Section 2.1 (f.).

5.0 Stormwater Deficiency Corrections. All stormwater deficiencies identified in the Inspection Report shall be corrected by the contractor within 7 days of the inspection date or any extended period granted by the engineer when weather or field conditions prohibit the corrective work. If the contractor does not initiate corrective measures within 5 calendar days of the inspection date or any extended period granted by the engineer, all work shall cease on the project except for work to correct these deficiencies, unless otherwise allowed by the engineer. All impact costs related to this halting of work, including, but not limited to stand-by time for equipment, shall be borne by the Contractor. Work shall not resume until the engineer approves the corrective work.

5.1 Liquidated Damages. If the Contractor fails to complete the correction of all Stormwater Deficiencies listed on the MoDOT Inspection Report within the specified time limit, the Commission will be damaged in various ways, including but not limited to, potential liability, required mitigation, environmental clean-up, fines and penalties. These damages are not reasonably capable of being computed or quantified. Therefore, the contractor will be charged with liquidated damages specified in the amount of $2,000 per day for failure to correct one or more of the Stormwater Deficiencies listed on the Inspection Report within the specified time limit. In addition to the stipulated damages, the stoppage of work shall remain in effect until all corrections are complete.

6.0 Basis of Payment. No direct payment will be made for compliance with this provision.

COVID-19 Safety

1.0 Description. The coronavirus disease 2019 or COVID-19 has reached a pandemic stage across the United States, including the State of Missouri. To reduce the impact of COVID-19 outbreak conditions on businesses, workers, customers and the public, the contractor shall be aware of all COVID-19 guidance from the Center for Disease Control (CDC) and other government health mandates. The contractor shall conduct all operations in conformance with these safety directives. The guidance may change during the project construction and the contractor shall change and adapt their operation and safety protocols accordingly.

2.0 Safety Plan. The contractor shall include these procedures in the project safety plan as called for in the contract documents and revise the safety plan as needed.

3.0 Essential Work. In accordance with any state or local Stay at Home Order, care for the infrastructure has been deemed essential and MoDOT is moving forward with construction projects, this project is considered essential and the contractor and their employees, subcontractors and suppliers are considered essential business and performing essential functions.

4.0 Basis of Payment. Compliance with regulations and laws pertaining to COVID-19 is covered under Sec 107 of the Missouri Standard Specifications for Highway Construction. No direct payment will be made for compliance with this provision.

Anti-Discrimination Against Israel Certification

By signing this contract the Company certifies it is not currently engaged in and shall not, for the duration of the contract, engage in a boycott of goods or services from the State of Israel, companies doing business in or with Israel or authorized by, licensed by, or organized under the laws of the State of Israel, or persons or entities doing business in the State of Israel as defined by Section 34.600 RSMo. This certification shall not apply to contracts with a total potential value of less than One Hundred Thousand Dollars ($100,000) or to contractors with fewer than ten (10) employees.