SECTION 905 -- PROPOSAL (CONTINUED)

I (We) hereby certify by digital signature and electronic submission via Bid Express of the Section 905 proposal below, that all certifications, disclosures and affidavits incorporated herein are deemed to be duly executed in the aggregate, fully enforceable and binding upon delivery of the bid proposal. I (We) further acknowledge that this certification shall not extend to the bid bond or alternate security which must be separately executed for the benefit of the Commission. This signature does not cure deficiencies in any required certifications, disclosures and/or affidavits. I (We) also acknowledge the right of the Commission to require full and final execution on any certification, disclosure or affidavit contained in the proposal at the Commission's election upon award. Failure to so execute at the Commission's request within the time allowed in the Standard Specifications for execution of all contract documents will result in forfeiture of the bid bond or alternate security.

Bidder acknowledges receipt of and has added to and made a part of the proposal and contract documents the following addendum (addenda):

ADDENDUM NO.	1	DATED	1/3/2019	ADDENDUM NO.		DATED	
ADDENDUM NO		DATED		ADDENDUM NO.		DATED	
ADDENDUM NO		DATED		ADDENDUM NO.		DATED	

Number	Description
1	Revised Table of Contents; Revised NTB No. 1102; Add SP Nos. 907-659-1, 907-661-3, & 907-663-3; Revised Bid Items; Amendment EBS Download Required.

TOTAL ADDENDA: 1
(Must agree with total addenda issued prior to opening of bids)

Respectfully Submitted,

DATE _____

_____
Contractor

BY _____
Signature

TITLE _____

ADDRESS _____

CITY, STATE, ZIP _____

PHONE _____

FAX _____

E-MAIL _____

(To be filled in if a corporation)

Our corporation is chartered under the Laws of the State of _____ and the names, titles and business addresses of the executives are as follows:

_____
President Address

_____
Secretary Address

_____
Treasurer Address

The following is my (our) itemized proposal.

NH-0059-01(075)/ 102334301000

Forrest County(ies)

Revised 01/26/2016

MISSISSIPPI DEPARTMENT OF TRANSPORTATION
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01/02/2019 04:06 PM

MISSISSIPPI DEPARTMENT OF TRANSPORTATION

SECTION 904 - NOTICE TO BIDDERS NO. 1102

DATE: 01/02/2019

SUBJECT: Specialty Items

PROJECT: NH-0059-01(075)/102334301 - FORREST

Pursuant to the provisions of Section 108, the following work items are hereby designated as "Specialty Items" for this contract. Bidders are reminded that these items must be subcontracted in order to be considered as specialty items.

CATEGORY: CURBING, SIDEWALKS, GUTTERS

Line No	Pay Item	Description
0880	609-D004	Combination Concrete Curb and Gutter Type 2 Modified

CATEGORY: DISPOSAL OF BUILDINGS, RIGHT OF WAY CLEARING & GRUBBING

Line No	Pay Item	Description
0090	202-B240	Removal of Traffic Stripe

CATEGORY: EROSION CONTROL

Line No	Pay Item	Description
0180	213-C001	Superphosphate
0190	216-A001	Solid Sodding
0200	217-A001	Ditch Liner
0210	219-A001	Watering
0220	220-A001	Insect Pest Control
0230	221-A001	Concrete Paved Ditch
0240	223-A001	Mowing
0250	225-A001	Grassing
0260	225-B001	Agricultural Limestone
0270	225-C001	Mulch, Vegetative Mulch
0280	226-A001	Temporary Grassing
0290	227-A001	Hydroseeding
0300	234-A001	Temporary Silt Fence
0310	234-D001	Inlet Siltation Guard
0320	236-A008	Silt Basin, Type D
0330	237-A002	Wattles, 20"
0340	246-B002	Rockbags
0350	249-A001	Riprap for Erosion Control
1490	907-240-A001	Interlocking Flexible Block Erosion Control System
1500	907-253-A001	Coir Fiber Baffle

CATEGORY: FENCE, GATES

Line No	Pay Item	Description

CATEGORY: FENCE, GATES

Line No	Pay Item	Description
0850	607-B020	60" Type II Chain Link Fence, Class II
0860	607-P1008	Line Post, 7' x 1 1/2" Galvanized Steel
0870	607-P2004	Brace Post, 7 1/2' x 2" Galvanized Steel

CATEGORY: GUARDRAIL, GUIDERAIL

Line No	Pay Item	Description
0800	606-B001	Guard Rail, Class A, Type 1
0810	606-C003	Guard Rail, Cable Anchor, Type 1
0820	606-D001	Guard Rail, Bridge End Section
0830	606-E005	Guard Rail, Terminal End Section, Flared
0840	606-E007	Guard Rail, Terminal End Section, Non-Flared

CATEGORY: INTELLIGENT TRANSPORTATION SYSTEMS

Line No	Pay Item	Description
1712	907-659-A001	Traffic Management Center Modifications

CATEGORY: LIGHTING, ALUMINUM TRUSSED ARM

Line No	Pay Item	Description
1464	682-A005	Underground Branch Circuit, AWG 1/0, 3 Conductor
1465	682-A018	Underground Branch Circuit, AWG 2, 3 Conductor
1466	682-A025	Underground Branch Circuit, AWG 3/0, 3 Conductor
1467	682-A039	Underground Branch Circuit, AWG 8, 3 Conductor
1468	682-B005	Underground Branch Circuit, Jacked or Bored, AWG 1/0, 3 Conductor
1469	682-B016	Underground Branch Circuit, Jacked or Bored, AWG 2, 3 Conductor
1471	682-B022	Underground Branch Circuit, Jacked or Bored, AWG 3/0, 3 Conductor
1472	682-B037	Underground Branch Circuit, Jacked or Bored, AWG 8, 3 Conductor
1473	682-D003	Underground Pull Box
1474	682-E003	Underground Junction Box With Concrete Pad
1475	682-F002	Secondary Power Controllers
1476	683-A126	Lighting Assembly, High Mast, LED, Type 110-8-S
1477	683-A127	Lighting Assembly, High Mast, LED, Type 110-6-S
1478	683-A128	Lighting Assembly, High Mast, LED, Type 110-6-A
1479	683-A129	Lighting Assembly, High Mast, LED, Type 130-8-S
1481	683-B197	Lighting Assembly, Low Mast, LED, Type 40-1-15-268
1482	683-D001	Portable Electric Power Units
1483	684-A004	Pole Foundation, 30" Diameter
1484	684-A007	Pole Foundation, 48" Diameter
1485	684-B004	Slip Casing, 30" Diameter
1486	684-B007	Slip Casing, 48" Diameter

CATEGORY: MISCELLANEOUS/ SPECIALTY WORK ITEMS

Line No	Pay Item	Description
0480	423-A001	Rumble Strips, Ground In

CATEGORY: PAVEMENT STRIPING AND MARKING

Line No	Pay Item	Description
1100	626-A001	6" Thermoplastic Double Drop Traffic Stripe, Skip White
1110	626-B001	6" Thermoplastic Double Drop Traffic Stripe, Continuous White
1120	626-C002	6" Thermoplastic Double Drop Edge Stripe, Continuous White
1130	626-E001	6" Thermoplastic Double Drop Traffic Stripe, Continuous Yellow
1140	626-F001	6" Thermoplastic Double Drop Edge Stripe, Continuous Yellow
1150	626-G004	Thermoplastic Double Drop Detail Stripe, White
1160	626-G005	Thermoplastic Double Drop Detail Stripe, Yellow
1170	626-H001	Thermoplastic Double Drop Legend, White
1180	626-H002	Thermoplastic Double Drop Legend, White
1190	627-B001	Two-Way Clear Reflective Raised Markers
1200	627-K001	Red-Clear Reflective High Performance Raised Markers
1210	627-L001	Two-Way Yellow Reflective High Performance Raised Markers

CATEGORY: SURVEY AND STAKING

Line No	Pay Item	Description
1487	699-A001	Roadway Construction Stakes

CATEGORY: TRAFFIC CONTROL - PERMANENT

Line No	Pay Item	Description
1220	630-A001	Standard Roadside Signs, Sheet Aluminum, 0.080" Thickness
1230	630-A003	Standard Roadside Signs, Sheet Aluminum, 0.125" Thickness
1240	630-B002	Interstate Directional Signs, Bolted Extruded Aluminum Panels, Ground Mounted
1250	630-B003	Interstate Directional Signs, Bolted Extruded Aluminum Panels, Overhead Mounted
1260	630-C002	Steel U-Section Posts, 2.0 lb/ft
1270	630-C003	Steel U-Section Posts, 3.0 lb/ft
1280	630-D003	Structural Steel Beams, W10 x 22
1290	630-D006	Structural Steel Beams, W6 x 12
1300	630-D007	Structural Steel Beams, W6 x 15
1310	630-D008	Structural Steel Beams, W6 x 9
1320	630-D010	Structural Steel Beams, W8 x 21
1330	630-E001	Structural Steel Angles & Bars, 3 1/2" x 3 1/2" x 1/4" Angles
1340	630-E002	Structural Steel Angles & Bars, 3" x 3" x 1/4" Angles
1350	630-E003	Structural Steel Angles & Bars, 4" x 4" x 5/16" Angles
1360	630-E004	Structural Steel Angles & Bars, 7/16" x 2 1/2" Flat Bar
1370	630-F006	Delineators, Guard Rail, White
1380	630-F010	Delineators, Post Mounted, Double White

CATEGORY: TRAFFIC CONTROL - PERMANENT

Line No	Pay Item	Description
1390	630-F011	Delineators, Post Mounted, Double Yellow
1400	630-F012	Delineators, Post Mounted, Single White
1410	630-F013	Delineators, Post Mounted, Single Yellow
1420	630-G004	Type 3 Object Markers, OM-3R or OM-3L
1430	630-I003	Metal Overhead Sign Supports, Assembly No. 1, Contractor Designed
1440	630-K001	Welded & Seamless Steel Pipe Posts, 3 1/2"
1450	630-K002	Welded & Seamless Steel Pipe Posts, 3"
1459	656-A002	Dynamic Message Sign, Type 2
1460	630-K003	Welded & Seamless Steel Pipe Posts, 4"
1461	656-A003	Dynamic Message Sign, Type 3
1462	660-A003	Equipment Cabinet, Type B
1463	660-A004	Equipment Cabinet, Type C
1470	630-K004	Welded & Seamless Steel Pipe Posts, 5"
1480	647-A001	Removal of Existing Traffic Signal Equipment
1520	907-630-L001	Pedestal Sign Support, Assembly No 1, Contractor Designed
1530	907-630-L002	Pedestal Sign Support, Assembly No 2, Contractor Designed
1540	907-630-M001	Post Sign Support, Assembly No 1, Contractor Designed
1550	907-630-M002	Post Sign Support, Assembly No 2, Contractor Designed
1560	907-632-J001	Power Service Pedestal
1570	907-634-E001	Camera Pole with Foundation, 50' Pole
1580	907-636-B043	Electric Cable, Underground in Conduit, THHN, AWG #2, 4 Conductor
1590	907-636-B051	Electric Cable, Underground in Conduit, THHN, AWG #4, 4 Conductor
1600	907-636-B053	Electric Cable, Underground in Conduit, THHN, AWG #6, 3 Conductor
1610	907-637-A002	Pullbox Enclosure, Type 2
1620	907-637-A004	Pullbox Enclosure, Type 4
1630	907-637-A005	Pullbox Enclosure, Type 5
1640	907-637-C028	Traffic Signal Conduit, Underground, Type 4, 2"
1650	907-637-H001	Traffic Signal Conduit Bank, Underground, Rolled Pipe, 2 @ 2"
1660	907-637-H002	Traffic Signal Conduit Bank, Underground, Rolled Pipe, 2"
1670	907-637-I001	Traffic Signal Conduit Bank, Underground, Drilled or Jacked, Rolled Pipe, 2 @ 2"
1680	907-637-I002	Traffic Signal Conduit Bank, Underground, Drilled or Jacked, Rolled Pipe, 2"
1700	907-641-C001	ITS Radar Detection Sensor
1710	907-650-A002	On Street Video Equipment, Fixed Type
1714	907-661-A004	Fiber Optic Cable, 72 SM
1716	907-661-B002	Fiber Optic Drop Cable, 12 SM
1718	907-663-A001	Network Switch, Type A
1719	907-663-A002	Network Switch, Type B
1720	907-650-A003	On Street Video Equipment, PTZ Type

CATEGORY: TRAFFIC CONTROL - TEMPORARY

Line No	Pay Item	Description
0950	619-A1001	Temporary Traffic Stripe, Continuous White

CATEGORY: TRAFFIC CONTROL - TEMPORARY

Line No	Pay Item	Description
0960	619-A2001	Temporary Traffic Stripe, Continuous Yellow
0970	619-A3001	Temporary Traffic Stripe, Skip White
0980	619-A5001	Temporary Traffic Stripe, Detail
0990	619-A6001	Temporary Traffic Stripe, Legend
1000	619-A6002	Temporary Traffic Stripe, Legend
1010	619-D1001	Standard Roadside Construction Signs, Less than 10 Square Feet
1020	619-D2001	Standard Roadside Construction Signs, 10 Square Feet or More
1030	619-E1001	Flashing Arrow Panel, Type C
1040	619-G4001	Barricades, Type III, Double Faced
1050	619-G4005	Barricades, Type III, Single Faced
1060	619-G5001	Free Standing Plastic Drums
1070	619-G7001	Warning Lights, Type "B"
1080	619-G8001	Warning Lights, Type "C"
1510	907-619-E3001	Changeable Message Sign

MISSISSIPPI DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION NO. 907-659-1 **CODE: (SP)**

DATE: 01/17/2017

SUBJECT: Traffic Management Center (TMC) Modifications

Section 907-659, Traffic Management Center (TMC) Modifications, is hereby added to and made part of the 2017 Edition of the Mississippi Standard Specifications for Road and Bridge Construction as follows.

SECTION 907-659 - TRAFFIC MANAGEMENT CENTER (TMC) MODIFICATIONS

907-659.01--Description. The MDOT Statewide Traffic Management Center (TMC) is located in the Traffic Engineering Division in the MDOT Shop Complex at 2567 North West Street, Jackson, Mississippi. Regional and City Traffic Management Centers may be located statewide. The following is a list of existing/planned centers and their addresses:

City of Jackson TMC – 300 North State Street, Jackson, Mississippi (basement)
Northwest Regional Combined TMC – 8791 Northwest Drive, Southaven, Mississippi (Police Department)
City of Ridgeland TOC – 304 Hwy 51, Ridgeland, Mississippi (City Hall)
Oxford Combined TMC – 715 Mollybarr Road, Oxford, Mississippi (Oxford Police Department)
Hattiesburg Regional TMC/EOC – 6356 Hwy 49N, Hattiesburg, Mississippi (MDOT District 6 Headquarters)
Batesville Regional TMC/EOC – 150 Hwy 51N, Batesville, Mississippi (MDOT District 2 Headquarters)
Natchez Combined TMC – 233 Devereaux Drive, Natchez, Mississippi (Police Department)
Gulf Regional TMC – 16499 Hwy 49, Saucier, Mississippi (MDOT Lyman Project Office)

Additional Traffic Management Centers may be added as needed.

907-659.02--Blank.

907-659.03--Construction and Operation Requirements.

907-659-03.1--TMC Modifications. The MDOT TMC modifications required to integrate and operate the traffic systems and devices shall be provided. These include, but are not limited to, expanding the central video management system, interconnecting the appropriate number of video interfaces to the TMC video management systems, expanding the MSTraffic backbone network through radio communications, wireless communications, T1 lines or fiber communications, expanding the TACTICS signal system, or upgrading existing signal systems, expanding or modifying existing adaptive control signal software systems (i.e. SCOOT, ACS Lite, etc.), expanding the Automated Traffic Management System (ATMS), and integrating all the existing

computing facilities. All TMC modifications must meet U.S. Department of Transportation Intelligent Transportation System (ITS) Standards, Policies, and Architectures as well as MDOTs applicable Statewide or Regional Architecture.

907-659.03.2--TMC Modifications - Monitor Systems. Roadway traffic monitor locations shall provide local control functions related to traffic slowdowns and other congestion monitors as defined by MDOT Traffic Engineering. Additionally, the traffic monitor systems shall provide on-line data for use by the existing MDOT ATMS for engineering, operations, planning, incident, and mstraffic.com purposes. This data shall include, but is not limited to, per vehicle data raw data which shall be transmitted to and stored and managed by the ATMS. The traffic monitor systems shall be capable of utilizing both or either loop, microloop, radar, and/or video detection information. The system shall provide a consistent communication and management system regardless of detection methods used. All Traffic Monitoring Systems must meet U.S. Department of Transportation Intelligent Transportation System (ITS) Standards, Policies, and Architectures as well as MDOT's applicable Statewide or Regional Architecture.

907-659.03.3--TMC Modifications – Installation Requirements. All equipment shall be installed according to the manufacturer's recommendations, the Plans and as follows:

1) Any new, additional or updated drivers required for the existing ATMS software to communicate and control new devices installed by Contractor shall be the responsibility of the Contractor.
2) Installation of all equipment and software shall be included. The Contractor must provide the MDOT ITS Manager with an Installation Schedule. The Installation Schedule must be approved by the State Traffic Engineer.
3) All equipment and software must be fully functional and pass a Final Inspection by the ITS Manager and Project Engineer before being accepted by MDOT.

907-659.03.4--MDOT Employee Training. Training shall be provided covering the system architecture, operations, and maintenance of the TMC systems. If training requirements include travel on the part of training participants then the cost of the travel shall be included.

907-659.04--Method of Measurement. Traffic Management Center Modifications and Traffic Management Center Modifications – Monitor Systems, complete in place, tested and accepted, will be measured per each intersection or on a lump sum basis. Traffic Management Center Modifications – Training will be measured on a lump sum basis.

907-659.05--Basis of Payment. Traffic Management Center Modifications, Traffic Management Center Modifications – Monitor Systems, and Traffic Management Center Modifications - Training, measured as prescribed above, will be paid for at the contract unit price per each or contract lump sum price, which price shall be full compensation for furnishing all materials for all installing, connecting, cutting, pulling and testing and for all equipment, tools, labor and incidentals necessary to complete the work.

Payment will be made under:

907-659-A: Traffic Management Center Modifications	- per each or lump sum
907-659-B: Traffic Management Center Modifications – Monitor Systems	- per each or lump sum
907-659-C: Traffic Management Center Modifications – Training	- lump sum

MISSISSIPPI DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION NO. 907-661-3 **CODE: (SP)**

DATE: 08/09/2017

SUBJECT: Fiber Optic Cable

Section 907-661, Fiber Optic Cable, is hereby added to and made a part of the 2017 Edition of the Mississippi Standard Specifications for Road and Bridge Construction as follows.

SECTION 907-661 – FIBER OPTIC CABLE (OSP)

907-661.01--Description. The work shall consist of the construction of the infrastructure required to install, replace, or upgrade fiber optic cable. The infrastructure shall include all necessary conduits, pull boxes, pole line hardware, building entries, risers and fiber cable to make a complete system.

907-661.02--Materials.

907-661.02.1--Single Mode Fiber Optic Cable (FO Cable). The Contractor shall provide 72-count fiber optic cable that meets the following requirements:

- All-dielectric, outside plant, loose tube cable with central strength/anti-buckling member
- Dry water blocking materials and construction
- Reverse oscillating “SZ” stranded buffer tube construction
- High tensile strength yarn
- Medium density polyethylene outer jacket
- 72-fiber cable with six (6) active buffer tubes and 12 individual stranded fibers per buffer tube
- Cable construction design that allows no more than six (6) buffer tube positions
- Maximum diameter 0.48 inches
- Maximum weight 0.07 pounds per foot.

The Contractor shall provide a cable in accordance with the Plans and contract documents. This cable shall be designated as a trunk cable.

The Contractor shall ensure that the cable can withstand a maximum pulling tension of 600 pounds (lbf) during installation and 180 pounds (lbf) installed long term (at rest).

The cable shall have a shipping, storage and operating temperature range of -22°F to +158°F and installation temperature range of -22°F to +140°F.

The Contractor shall provide cable with outer jacket marking using the following template.

Manufacturer's Name - “Optical Cable” - Month/Year of Manufacture - Telephone Handset

Symbol - "MDOT" - "72F SM"

The Contractor shall include in the outer jacket marking the cable sequential length in accordance with the following:

- In English units every two (2) feet
- Within -0/+1% of the actual length of the cable
- In contrasting color to the cable jacket
- Marking font height no less than 0.10 inch
- On any single length of cable on a reel, the sequential length markings do not run through "00000"

907-661.02.2--Single Mode Fiber Optic Cable Indoor/Outdoor Riser Rated. The Contractor shall provide fiber optic plenum rated cable that meets the following requirements when called for on the Plans:

- All-dielectric, inside plant, loose tube central core cable
- High tensile strength yarn surrounding the central tube core
- Dry water blocking materials and construction
- 72-fiber cable with six (6) active buffer tubes and 12 individual stranded fibers per buffer tube
- The Contractor shall provide a cable in accordance with the Plans and contract documents. This cable shall be designated as the building entry cable.

The Contractor shall ensure that the cable can withstand a maximum pulling tension of 300 pounds (lbf) during installation.

The cable shall have a shipping, storage and operating temperature range of -22°F to +158°F and an installation temperature range of 14°F to 140°C shall be provided.

The Contractor shall provide cable with outer jacket marking using the following template.

Manufacturer's Name - "Optical Cable" - Month/Year of Manufacture - Telephone Handset
Symbol - "MDOT" - "72F SM"

The Contractor shall include in the outer jacket marking the cable sequential length in accordance with the following:

- English units every two (2) feet.
- Within -0/+1% of the actual length of the cable
- Contrasting color to the cable jacket
- Marking font height no less than 0.10 inch
- The sequential length markings do not run through "00000" on any single length of cable on a reel

907-661.02.3--Single Mode Fiber Optic Drop Cable (FO Drop Cable). The Contractor shall

provide 12-count Single Mode Fiber, Pre-Terminated Drop Cable Assemblies. These assemblies shall be employed when connecting a camera, traffic controller, DMS or other device to the main cable.

Assemblies shall be factory assembled and terminated on one end with ceramic ferrule, LC compatible, heat cured epoxy connectors with an operational temperature of -40°F to +158°F. Each connector shall have a minimum of a 1-inch strain relief boot.

Insertion loss for each connector shall not exceed 0.30 dB.

Return loss for single mode connectors shall be greater than 45 dB.

Each assembly shall be fully tested and those test results placed on a test tag for each assembly.

Each assembly shall be individually packaged within a box or reel, with the submitted manufacturer's part number marked on the outside of the package.

Individual 250-µm coated fibers shall be up-jacketed to 1/8-inch using fan-out tubing. This tubing shall contain a 900-µm Teflon inner tube, aramid yarn strength members and an outer jacket.

The fan-out tubing shall be secured to the cable in a hard epoxy plug transition. Length of the individual legs shall be a minimum of three feet with the length difference between the shortest and longest legs of the assembly being no more than two inches.

The 12-Fiber, Pre-terminated Drop Cable Assemblies provided shall meet the following minimum requirements:

- All-dielectric, outside plant, loose tube central core cable shall be used
- High tensile strength yarn surrounding the central tube core
- Dry water blocking materials and construction
- Twelve (12) individual stranded fibers contained within the central tube core
- The Contractor shall provide a cable in accordance with the Plans and contract documents. This cable shall be designated as the drop cable.

The Contractor shall ensure that the cable can withstand a maximum pulling tension of 300 pounds (lbf) during installation.

The cable shall have a shipping, storage and operating temperature range of -22°F to +158°F and an installation temperature range of 14°F to 140°F.

The Contractor shall provide cable with outer jacket marking using the following template.

Manufacturer's Name - "Optical Cable" - Month/Year of Manufacture - Telephone Handset Symbol - "MDOT" - "12F SM"

The Contractor shall include in the outer jacket marking the cable sequential length in accordance

with the following:

- English units every two (2) feet
- Within -0/+1% of the actual length of the cable
- Contrasting color to the cable jacket
- Marking font height no less than 0.10 inch
- The sequential length markings do not run through "00000" on any single length of cable on a reel

907-661.02.4--Multimode Fiber Optic Drop Cable (MM FO Drop Cable). The Contractor shall provide 12-count Multimode Fiber, Pre-Terminated Drop Cable Assemblies. These assemblies shall be employed when connecting a camera, traffic controller, DMS or other device to the main cable.

Cable Assembly shall be rated for outdoor environment and have operational temperature of -40°F to +158°F. Each connector shall have a minimum of a 1-inch strain relief boot. The Cable Assembly shall also be pre-terminated on one end.

Insertion loss for each connector shall not exceed 0.30 dB.

Fiber loss shall not exceed 3dB/km for 850 nm and 1 dB/km for 1300 nm.

Each assembly shall be fully tested and those test results placed on a test tag for each assembly.

Each assembly shall be individually packaged within a box or reel, with the submitted manufacturer's part number marked on the outside of the package.

The fan-out tubing shall be secured to the cable in a hard epoxy plug transition. Length of the individual legs shall be a minimum of three feet with the length difference between the shortest and longest legs of the assembly being no more than two inches.

The 12-Fiber, Pre-terminated Drop Cable Assemblies provided shall meet the following minimum requirements:

- All-dielectric, outside plant, loose tube central core cable
- High tensile strength yarn surrounding the central tube core
- Dry water blocking materials and construction
- Twelve (12) individual stranded fibers contained within the central tube core
- The Contractor shall provide a cable in accordance with the Plans and contract documents. This cable shall be designated as the drop cable.

The Contractor shall ensure that the cable can withstand a maximum pulling tension of 300 pounds (lbf) during installation.

The cable shall have a shipping, storage and operating temperature range of -22°F to +158°F and an installation temperature range of 14°F to 140°F.

The Contractor shall provide cable with outer jacket marking using the following template.

Manufacturer's Name - "Optical Cable" - Month/Year of Manufacture - Telephone Handset Symbol - "MDOT" - "12F MM"

The Contractor shall include in the outer jacket marking the cable sequential length in accordance with the following:

- English units every two (2) feet
- Within -0/+1% of the actual length of the cable
- Contrasting color to the cable jacket
- Marking font height no less than 0.10 inch
- The sequential length markings do not run through "00000" on any single length of cable on a reel

907-661.02.5--Plenum Rated Nonmetallic Corrugated Raceway. The Contractor shall provide plenum rated nonmetallic corrugated raceway inside buildings when cable is not in rigid conduit when called for on the plans.

The installation shall conform to NEC articles 770 and 800.

Raceway shall meet UL Standards 910 and 2024.

The Contractor shall provide 2-inch diameter raceway unless larger is called for in the plans.

The Contractor shall provide Fiber Optic Fusion Splice (FO Splice Fusion) for splicing of all fibers with a fully automatic portable fusion splicer that provides consistent low loss (max 0.10 dB) splices.

Splicer shall provide three-axis fiber core alignment using light injection and loss measurement techniques.

The fusing process shall be automatically controlled.

The splicer shall provide splice loss measurements on an integral display, as well as a magnified image of the fiber alignment.

The Contractor shall retain ownership of the fusion splicer.

907-661.02.6--Fiber Optic Connectors. The Contractor shall provide fiber optic connectors for all fiber optic infrastructures including but not limited to fiber optic termination cabinets, fiber optic drop panels, and fiber optic patch cords.

The Contractor shall provide only factory-installed keyed LC compatible connectors for all fiber optic infrastructures.

Field-installed connectors shall not be used.

Adapter couplers shall not be used to change connector types.

Ceramic ferule connectors, factory-installed, with a thermal-set heat-cured epoxy and machine polished mating face shall be used.

Connectors shall be installed as per manufacturer application and recommendations, including proper termination to the outer-tubing (900-micron tubing, 3-mm fan out tubing, etc.) required for the application.

Connectors rated for an operating temperature of -40°F to +167°F shall be used.

Simplex connectors for all male LC connectors shall be used and a latching cover for two male connectors being used in a duplex configuration shall be provided. Female couplers may be duplex but must allow simplex mating connectors.

Dust caps shall be provided for all exposed male connectors and female couplers at all times until permanent connector installation.

907-661.02.7--Fiber Optic Termination Cabinet (FO Termination Cabinet). Fiber optic termination cabinets shall be provided in communications hubs, field junctions, and the MDOT Traffic Management Center (TMC) as shown in the Plans for termination of 72-fiber outside plant (OSP) cable.

The Contractor shall provide wall/shelf mount 12-fiber distribution cabinet equipped with fiber optic connector modules in a 12-fiber configuration. These will be used in field equipment and communication cabinet locations.

Termination cabinets with cable management features included shall be provided.

The Contractor shall use termination cabinets that are fully compatible with all components of the fiber optic infrastructure as specified, including, but not limited to, fiber optic cable, fiber optic fusion splices and fiber optic connectors.

The Contractor shall provide rack-mount termination cabinets designed to fit standard 19-inch EIA equipment racks.

The Contractor shall provide all mounting hardware and supports to mount the termination cabinets in the locations shown in the Plans.

The Contractor shall provide fiber optic termination cabinets providing 72-fiber connectors and capable of storing 72 fusion splices in splice trays.

The Contractor shall provide termination cabinets that integrate the splice trays and connector

modules into one compartment within one cabinet, or houses the splice trays and connector modules in separate compartments integrated into one cabinet.

The maximum dimensions of a complete termination cabinet shall be 7-rack units, 12.25 inches high by 16 inches deep.

Fiber optic termination cabinets shall be fully enclosed metallic construction with a protective hinged front cover for the connector ports.

The cabinet shall have cable access on all sides of the enclosed area behind the connector port panel.

The Contractor shall provide sufficient splice trays for storing 72 fusion splices in 12 or 24-splice increments.

The Contractor shall provide termination cabinets with fiber optic connector modules in a 12 fiber configuration of six (6) rows of one (1) duplex connector couplers. Connector modules shall mount vertically in the termination cabinet front panel.

Connector modules shall include clearly legible and permanent labeling of each of the 12 fiber connector couplers, and shall be labeled and identified as shown in the Plans.

The Contractor shall provide factory-assembled 12-fiber termination interconnect cables (pigtail cables) to be fusion spliced to the outside plant or indoor cable and connected to the rear of the connector modules.

Termination interconnect cables shall be all-dielectric, single jacketed cable with high tensile strength yarn surrounding 12 individual 900-micron fibers following EIA/TIA-598B color identification with factory-installed connectors.

The Contractor shall provide all incidental and ancillary materials including but not limited to grommets, cable strain relief and routing hardware, blank connector panels and labeling materials.

The cable shall be new (unused) and of current design and manufacture.

907-661.02.8--OSP Closures for Aerial, Pole Mount, Pedestal and Hand Hold Environments.
OSP closures for aerial, pole mount, pedestal and hand hole shall be capable of accepting up to eight cables. The closures shall be capable of storing up to eight 90-inch lengths of expressed buffer tubes and up to 96 splices.

Assembly shall be accomplished without power supplies, torches, drill kits or any special tools. Re-entry shall require no additional materials.

Sealing shall be accomplished by enclosing the splices in a polypropylene case that is clamped together with a stainless steel latch and sealed with an O-ring.

Closure shall be capable of strand mounting with the addition of a strand mounting bracket.

Splice case shall be non-filled, non-encapsulate to prevent water intrusion, and shall allow re-entry without any special tools.

The closure shall be capable of preventing a 10-foot water head from intruding into the splice compartment for a period of seven (7) days.

It is the responsibility of the Contractor to ensure that the water immersion test has been performed by the manufacturer or an independent testing laboratory, and the appropriate documentation has been submitted to the Engineer.

907-661.02.9--OSP Closures for Drop Cable Splice Points. OSP closures for aerial, pole mount, pedestal and hand hold shall be capable of accepting the trunk cable and two drop cables. The closures shall be capable of storing up to eight 90-inch lengths of expressed buffer tubes and up to 48 splices.

Assembly shall be accomplished without power supplies, torches, drill kits or any special tools. Re-entry shall require no additional materials.

Sealing shall be accomplished by enclosing the splices in a polypropylene case that is clamped together with a stainless steel latch and sealed with an O-ring.

Closure shall be capable of strand mounting with the addition of a strand mounting bracket.

Splice case shall be non-filled, non-encapsulate to prevent water intrusion, and shall allow re-entry without any special tools.

The closure shall be capable of preventing a 10-foot water head from intruding into the splice compartment for a period of seven days.

It is the responsibility of the Contractor to ensure that the water immersion test has been performed by the manufacturer or an independent testing laboratory, and the appropriate documentation has been submitted to the Engineer.

907-661.02.10--Patch Cords and Jumper Cables. Any patch cords or jumper cables required to connect the new fiber and equipment at existing locations shall be considered incidental and shall be included in the cost of pay items Fiber Optic Cable and Fiber Optic Drop Cable.

Any patch cords used for system configuration shall be compatible with fiber types and connectors specified herein.

Single-mode patch cords shall be yellow in color.

Jacketing material shall conform to the appropriate NEC requirement for the environment in which installed.

All cordage shall incorporate a 900-µm buffered fiber, aramid yarn strength members and an outer jacket.

Patch cords may be simplex or duplex, depending on the application.

Attenuation shall be less than 1.0 dB/km @ 1310 nm, 0.75 dB/km @ 1550 and have a total attenuation of less than 0.5 dB.

The Contractor shall be responsible to determine and provide attenuators with the proper attenuation to not exceed the optical budgets of the equipment connected by patch cables.

907-661.02.11 Cable Labels. The Contractor shall provide cable labels that meet the following requirements:

- Self-coiling wrap-around type
- PVC or equivalent plastic material with UV and fungus inhibitors
- Base materials and graphics/printing inks/materials designed for underground outside plant use including solvent resistance, abrasion resistance and water absorption
- Minimum size of 2.5 inches wide by 2.5 inches long
- Minimum thickness of 0.010 inches
- Orange label body with pre-printed text in bold black block-style font with minimum text height of 0.375 inches
- The Contractor shall pre-print the following text legibly on labels used for all fiber optic trunk cables:

  Caution Fiber Optic Cable Mississippi Department of Transportation (601) 359-1454

- The Contractor shall pre-print the following text legibly on labels used or all fiber optic drop cables (FO Drop Cable):

  Caution Fiber Optic Drop Cable Mississippi Department of Transportation (601) 359-1454

- On all cable labels, the Contractor shall print the text specified above twice on the label with the text of the second image inverted. The end result shall be text which "reads correctly" when the label is coiled onto a cable.

907-661.02.12--Cable Markers. The Contractor shall provide low profile soil cable markers which meet the following requirements:

- 3.5 inches in diameter
- UV stabilized for Maximum fade resistance
- Durable and abrasion resistant
- Lawn mower resistant
- Orange in color

- Printed Legend:

  Fiber Optic Cable
  Mississippi Department of Transportation
  Traffic Engineering Division (601)359-1454

The Contractor shall install cable markers with a 13-inch nylon stake every 500 feet along the fiber run.

907-661.02.13--Conduit Detection Wire. Conduit detection wire shall be #10 AWG stranded copper, orange-insulated, THHN -THWN conductor.

The Contractor shall furnish and install a detection wire surge protection system. The Contractor shall ensure that detection wires are attached to a surge protection system designed to dissipate high transient voltages or other electrical surges.

The Contractor shall ensure that the detection wire surge protection system is grounded to a driven rod within 10 feet of the system using AWG #6 single conductor wire. Grounding must be done through a stand alone system not connected to power or ITS device grounding.

The Contractor shall ensure that the surge protection system normally allows signals generated by locate system to pass through the protection system without going to ground.

907-661.02.14--Project Submittal Program Requirements. The Contractor shall provide project submittals for all fiber optic infrastructures. The project submittals for fiber optic infrastructure shall include all items in this provision and any additional requirements included in any Notice to Bidders.

The Contractor shall provide project submittals including manufacturer recommended operations, maintenance and calibration procedures for the following equipment:

- Fiber optic installation and testing tools
- Fusion splicers
- Cable pulling strain dynamometers and breakaway links
- Cable air jetting/blowing systems
- OTDRs
- Optical attenuation testers (light sources and power meters)

The Contractor shall submit documentation and proof of manufacturer recommended operator training and certification for the following equipment:

- Fusion splicers
- Cable air jetting/blowing systems
- OTDRs
- Optical attenuation testers (light sources and power meters)

907-661.03--Construction Requirements. All equipment shall be installed according to the manufacturer's recommendations, the Plans and as follows.

907-661.03.1--General Requirements. The Contractor shall install all fiber optic infrastructures according to the manufacturer's recommended procedures and specifications.

The Contractor shall provide all necessary interconnections, services and adjustments required for a complete and operable data transmission system.

The Contractor shall install all fiber truck, drop, and patch cables such that attenuation shall be less than 1.0 dB/km @ 1310 nm, 0.75 dB/km @ 1550.

All pole attachments, service loops and conduit risers shall be placed to minimize the possibility of damage as well as to facilitate future expansion or modernization.

The cable shall be installed in continuous runs as indicated on the plans. Splices shall be allowed only at drop points or reel end points specified in the plans.

At drop locations only, those fibers necessary to complete the communication path shall be spliced. Other fibers in the cable(s) shall be left undisturbed, with a minimum of five feet of buffer tube coiled inside the closure.

Sufficient slack shall be left at each drop point to enable access of the cable components and splicing to occur on the ground. This is typical two times the pole height plus 15 feet.

For aerial installations, the following minimum slack requirements shall apply:

- For aerial slack storage at splice points, a radius controlling device, commonly referred to as a snowshoe, shall be used for securing resulting cable slack at aerial splice points and shall be mounted directly to the strand.
- For aerial cable runs exceeding 6-pole spans between splice points as indicated on the plans, two opposing snowshoe shall be placed on the span 50 feet apart to provide for a 100-foot service loop for future drops and for slack for repair and pole relocations.

Snowshoe devices shall be manufactured by Multilink, Preformed Line Products, Opti-Loop, or an approved equal.

For aerial supported installations, the slack requirements shall be the same as in the underground conduit runs. The slack will be coiled in the structure-mounted pull boxes.

Drop cable shall be routed to the controller cabinets via conduit risers as illustrated in the plans. The cable entrance shall be sealed with a duct plug designed for fiber optic cable to prevent water ingress.

The minimum requirement for fiber protection outside a fiber optic enclosure in ALL cases shall be 1/8-inch fan-out tubing, containing a hollow 900-µm tube, aramid strength members and an

outer jacket, and shall be secured to the cable sheath.

The minimum requirement for fiber protection inside wall mount or rack mount fiber enclosure shall be 900-µm buffering, intrinsic to the cable in the case of tight buffered fibers, or in the case of 250-µm coated fibers, a fan-out body and 900-µm tubing secured to the buffer tube(s).

During installation, even if the tension specifications for the cable are not exceeded, the first ten feet shall be discarded.

Warning tape shall be placed 12 inches above the cable not to deviate ±18 inches from the centerline of the optical cable. Warning tape shall be at least two inches wide and colored orange.

907-661.03.2--Cable Shipping and Delivery. The cable shall be packaged on reels for shipment. Each package shall contain only one continuous length of cable. The packaging shall be constructed as to prevent damage to the cable during shipping and handling.

Both ends of the cable shall be sealed to prevent the ingress of moisture.

A weatherproof reel tag shall be attached to each reel identifying the reel and cable so that it can be used by the manufacturer to trace the manufacturing history of the cable and the fiber. A cable data sheet shall be included with each reel containing the following information:

- Manufacturer name
- Cable part number
- Factory order number
- Cable length.
- Factory measured attenuation of each fiber

The Contractor shall cover the cable with a protective and thermal wrap.

The outer end of the cable shall be securely fastened to the reel head so as to prevent the cable from becoming loose in transit. The inner end of the cable shall be projected a minimum of 6.5 feet into a slot in the side of the reel, or into housing on the inner slot of the drum, in such a manner as to make it available for testing.

Each reel shall be plainly marked to indicate the direction in which it is to be rolled to prevent loosening of the cable on the reel.

907-661.03.3--Cable Handling and Installation. The Contractor shall not exceed the maximum recommended pulling tension during installation as specified by the cable manufacturer.

The Contractor shall continuously monitor pulling tensions with calibrated measuring devices, such as a strain dynamometer.

The Contractor shall ensure that the depth of the cable is a minimum of 36 inches unless shown otherwise in plans.

All pulled installations shall be protected with calibrated breakaway links.

The Contractor shall ensure that the minimum recommended bend radius is not exceeded during installation as specified by the cable manufacturer. Unless the manufacturer's recommendations are more stringent, the following guidelines shall be used for minimum bend radius:

- 20 X Cable Diameter Short Term - During Installation
- 10 X Cable Diameter Long Term - Installed

Before cable installation, the cable reels and reel stands shall be carefully inspected for imperfections or faults such as nails that might cause damage to the cable as it is unreeled.

All necessary precautions shall be taken to protect reeled cable from vandals or other sources of possible damage while unattended. Any damage to reeled cable or the reel itself shall necessitate replacement of the entire cable section at no additional cost to the State.

Whenever unreeled cable is placed on the pavement or surface above a pull box, the Contractor shall provide means of preventing vehicular or pedestrian traffic through the area in accordance with the safe maintenance of traffic provisions.

The cable shall be kept continuous throughout the pull. Cable breaks and reel end splices are permitted only in Type 5 pull boxes and occur at a minimum of 10,000 feet.

Where a cable ends in an underground fiber optic closure, all unused fibers and buffer tubes shall be secured and stored in splice trays in preparation for future reel end splicing and continuation.

907-661.03.4--Cable Storage. The Contractor shall properly store all cable to minimize susceptibility to damage. The proper bend radius shall be maintained, both short and long term, during cable storage.

Storage coils shall be neat in even length coils, with no cross over or tangling.

Storage coils of different cables shall be kept completely separate except when the cables terminate in the same splice closure.

Storage coils shall be secured to cable racking hardware with tie wraps, Velcro straps, or non-metallic cable straps with locking/buckling mechanism. No adhesive or self-adhering tapes, metal wires and straps, or rope/cord shall be used to secure coils.

Unless otherwise noted on the plans, the following are the requirements for cable storage for underground applications:

Trunk cable in Type 4 pull box ..... 25 feet
Trunk cable in Type 5 pull box ..... 200 feet
Drop cable in Type 4 pull box ..... 10 feet

Drop cable in Type 5 pull box, not terminated in a splice closure 10 feet
Drop cable in Type 5 pull box, terminated in a splice closure with the trunk cable ..... 100 feet
Trunk cable end in Type 5 pull box ..... 200 feet
Drop cable terminated in same splice closure as trunk cable end 200 feet

The Contractor shall label each pull box with a numbered disk obtained from the Traffic Engineering Division. The disk shall be installed in accordance with the manufactures specification on the lid of each pull box. Numbers shall be noted on the As-Built plans for each pull box.

No slack cable shall be stored inside the communications hub building or Control Center.

907-661.03.5--Cable Labels. Cable labels shall be installed on all trunk and drop fiber optic cables. The installed cable shall be cleaned of all dirt and grease before applying any label.

The Contractor shall label all cables in or at every location where the cable is exposed outside of a conduit, innerduct or pole using the cable IDs for trunk cables or the device number for drop cables.

As a minimum, cable labels shall be installed in the following locations:

- Within 12 inches of every cable entry to a pull box, equipment cabinet, communications hub, or the TMC
- Within 12 inches of the exterior entry point of every fiber optic splice closure, termination cabinet and drop panel
- Every 30 feet for the entire length of cable in any storage coil in pull boxes
- Within one (1) foot of every pole attachment
- On every riser
- On every splice enclosure

907-661.03.6--Conduit Detection Wire. The Contractor shall install one conduit detection wire in all conduit banks. Conduit detection wire is required in all conduit banks installed by any installation method, including trenching, directional boring or plowing.

Only one conduit detection wire is required per installed conduit bank regardless of the number of conduits installed in that segment. Conduit detection wire shall be installed inside the conduit.

Conduit detection wire is not required for structure mounted conduit, except where underground segments of structure mounted conduit are greater than 20 feet in length.

The conduit detection wire shall be continuous and unspliced between pull boxes and shall enter the pull boxes at the same location as the conduit with which it is installed, entering under the lower edge of the pull box.

Four (4) feet of conduit detection wire shall be coiled and secured in each pull box or vault.

When two or more detection wires are in any pull box, the Contractor shall mechanically splice all detection wire together.

Conduit detection wire is required in drop cable conduits.

A detection wire surge protection system shall be furnished and installed. Detection wires shall be attached to surge protection systems designed to dissipate high transient voltages or other electrical surges. The detection wire surge protection system shall be grounded to a driven rod within 10 feet of the system using AWG #6 single conductor wire. Grounding shall be done through a stand alone system not connected to power or ITS device grounding. The surge protection system shall normally allow signals generated by locate system to pass through the protection system without going to ground.

907-661.03.7--Splicing into Existing Fiber Optic Cable. At some locations, the Contractor may be required to splice new drop cable into existing fiber optic cable at existing pull boxes. The Contractor is responsible to protect all existing fiber during this work. No separate payment shall be made for splicing into the existing fiber. The cost for all fiber optic work and equipment shall be included in the bid price for pay items Fiber Optic Cable and Fiber Optic Drop Cable.

The Contractor must notify the Project Engineer in writing no less than 10 days in advance of doing any work to existing fiber optic cable. Before any work can begin the Contractor must have obtain approval from the Project Engineer.

907-661.03.8--Replace Fiber Optic Cable. In locations specified in the Plans, the Contractor shall be required to remove and replace existing fiber optic cable with new fiber optic cable. The new fiber optic cable shall be an equivalent cable having the same cable type, assembly, connectors, size, construction, buffer tube construction, temperature characteristics, tensile strength, and optical characteristics. The cable type and mode shall be the same unless specified as otherwise in the Plans or contract documents. The new cable shall be a compatible replacement having equivalent or improved link characteristics. The Contractor shall install the cable as per manufacturer application and recommendations and adhere to the Installation Requirements and Testing specifications as stated herein. No separate payment will be made for this work. The cost for pulling new fiber optic cable for cable replacement, and splicing/terminating all fibers shall be included in the cost of the pay item Replace Fiber Optic Cable.

907-661.03.9--Replace Fiber Optic Drop Cable. In locations specified in the Plans, the Contractor shall be required to remove and replace existing fiber optic drop cable with new fiber optic drop cable. The new fiber optic drop cable shall be an equivalent cable having the same cable type, assembly, connectors, size, construction, buffer tube construction, temperature characteristics, tensile strength, and optical characteristics. The cable type and mode shall be the same unless specified as otherwise in the Plans or Notice to Bidders. The new cable shall be a compatible replacement having equivalent or improved link characteristics. The Contractor is required to install the cable as per manufacturer application and recommendations and adhere to the Installation Requirements and Testing specifications as stated herein. No separate payment will be made for this work. The cost for pulling new fiber optic drop cable for cable replacement,

and splicing/terminating all fibers shall be included in the cost of pay item Replace Fiber Optic Drop Cable.

907-661.03.10--Upgrade Fiber Optic Cable. In locations specified in the Plans, the Contractor shall be required to upgrade existing fiber optic cable to new cable that adheres to the respective cable specification and requirements. The cable type and mode shall be the same unless specified as otherwise in the Plans or contract documents. The cable upgrade shall be treated as a new cable installation and adhere to all corresponding specifications and requirements stated herein. No separate payment will be made for this work. The cost for pulling new fiber optic to upgrade existing cable, and splicing/terminating all fibers shall be included in the cost of pay item Replace Fiber Optic Cable, Aerial.

907-661.03.11--Fiber Optic Connections at Existing Communication Nodes. In some locations, the Contractor shall be required to pull new fiber optic cable into an existing communications huts. No separate payment will be made for this work. The cost for pulling the fiber into the hut, providing and installing the termination equipment, and terminating all the fibers shall be included in the cost of pay items Fiber Optic Cable and Fiber Optic Drop Cable.

907-661.03.12--Drop and Insert Applications. The signal from the TMC to local controllers, cameras, and/or dynamic message signs will be conveyed via the backbone and branch cables.

The appropriate closure, as set out in Subsection 907-661.02.8, shall be used.

A 12-port fiber distribution cabinet and appropriate jumper shall be installed within the cabinet at locations approved by the Engineer.

At each device, the applicable fibers will be routed in and out of the equipment cabinet using a pre-terminated drop cable.

Only fibers required for the drop and insert shall be cut, no other fibers in the cable shall be cut without the approval of the Engineer.

The fibers shall be connected to the transmission equipment via LC/LC fiber optic patch cables.

The drop cable shall be routed in a position that will allow access to all installed components without movement of the cable.

In traffic signal control boxes the drop cable shall be routed up the left rear corner to a shelf mounted fiber optic termination cabinet.

In ITS equipment or communication cabinets the cable shall be routed neatly allowing for service of all installed components.

907-661.03.13--Testing.

907-661.03.13.1--General Requirements. The project testing program for fiber optic

infrastructure shall include but is not limited to the specific requirements in this subsection.

All test results shall confirm physical and performance compliance with this TSP including but not limited to optical fibers and fusion splices. No event in any given fiber may exceed 0.10 dB. Any event measured above 0.10 dB shall be replaced or repaired at the event point.

The Contractor shall provide the tentative date, time and location of fiber optic infrastructure testing no less than seven (7) days in advance of the test. The Contractor shall provide confirmed date, time and location of fiber optic infrastructure testing no less than 48 hours before conducting the test.

The Contractor shall provide test results documentation in electronic format (3 copies) and printed format (3 copies). Electronic formats shall be readable in Microsoft Excel or other approved application. Printed copies shall be bound and organized by cable segment.

- Two sets are for the Traffic Engineering ITS Department
- One set are for the Engineer

All test results shall be provided in English units of measure of length.

All test results documentation shall be submitted to the Engineer within 14 days of completion of the tests.

The ITS Engineer, Project Engineer and/or their designee(s) are only responsible for attending and observing each test, and reviewing and approving the Contractor's test results documentation. The ITS Engineer, Project Engineer and/or their designee(s) reserve the right to attend and observe all tests. The Contractor shall perform the Pre-Installation test and the Standalone Acceptance test with the the Department ITS Engineer or their designee present.

907-661.03.13.2--Pre-Installation Test (PIT). The Contractor shall perform a PIT on all FO Cable prior to any cable removal from the shipping reels.

The Contractor shall perform a PIT on each cable reel delivered to the job site.

The PIT for FO Cable shall include but is not limited to:

- A visual inspection of each cable and reel
- An OTDR Test and documentation as required in the Standalone Acceptance Test (SAT) for three randomly selected fibers from each buffer tube

An Optical Attenuation Test is not required. However, if the Contractor decides to perform one of these tests for their own protection, it shall be documented and provided to the Engineer.

907-661.03.13.3--Standalone Acceptance Test (SAT). The Contractor shall perform an SAT on all fiber optic infrastructures on this project after field installation is complete, including but not limited to all splicing and terminations. All fiber in pull boxes shall be in its final position mounted

to the racks prior to the start of testing.

An SAT for each fiber in each cable shall include OTDR Tests and Optical Attenuation Tests.

For the Attenuation Tests, all fibers in all FO Cables and FO Drop Cables shall be tested from termination point to termination point, including:

- Fibers from FO Termination Cabinet to FO Termination Cabinet
- Fibers from FO Termination Cabinet to FO Drop Panel
- Fibers from FO Drop Panel to FO Drop Panel
- Fibers from FO Termination Cabinet to the end of the cable run in the last FO closure

All test results shall confirm compliance with this TSP including but not limited to optical fibers and fusion splices. No event in any given fiber may exceed 0.10 dB. Any event measured above 0.10 dB shall be replaced or repaired at the event point.

Test documentation shall include but is not limited to:

- Cable & fiber identification
- Cable & fiber ID and location - Physical location (device ID and station number of FO Termination Cabinet, FO Drop Panel, or cable end FO closure), fiber number, and truck or drop cable ID for both the beginning and end point
- Operator name
- Engineer's representative
- Date & time
- Setup and test conditions parameters
- Wavelength
- Pulse width Optical Time Domain Reflectometer (OTDR)
- Refractory index (OTDR)
- Range (OTDR)
- Scale (OTDR)
- Ambient temperature
- Test results for OTDR test (each direction and averaged)
- Total fiber trace (miles)
- Splice loss/gain (dB)
- Events > 0.05 dB
- Measured length (cable marking)
- Total length (OTDR measurement)
- Test results for attenuation test (each direction and averaged)
- Measured cable length (cable marking)
- Total length (OTDR measurement from OTDR test)
- Number of splices (determined from as-builts)
- Total link attenuation

The OTDR Test shall be conducted using the standard operating procedure and recommended

materials as defined by the manufacturer of the test equipment.

The Contractor shall use a factory patch cord ("launch cable") of a length equal to the "dead zone" of the OTDR to connect the OTDR and the fiber under test.

Bi-directional OTDR tests shall be conducted and bi-directional averages calculated for each fiber.

All tests shall be conducted at 1310 and 1550 nm for single mode cable.

The Contractor shall conduct the Optical Attenuation Test using the standard operating procedure and recommended materials as defined by the manufacturer of the test equipment.

Bi-directional Optical Attenuation tests shall be conducted and bi-directional averages calculated for each fiber.

A continuity or tone test shall be performed after installation to confirm that a continuous run of conduit detection wire was installed between pull boxes or vaults.

The Contractor shall prepare a test plan, supply equipment, conduct the test and document the results.

The test plan shall be submitted at least 15 working days prior to the desired testing date.

Testing shall not begin until the Engineer has approved the test plan, and all tests shall be conducted in the presence of the Engineer. The Traffic Engineering ITS Department representative shall be notified of the testing dates and invited to observe all testing.

The Traffic Engineering ITS Department may perform additional testing of any and all infrastructure using their own equipment. The Contractor may observe this testing.

The burn in period cannot start until the Traffic Engineering ITS Department is satisfied with the installation.

907-661.03.14--Documentation - As-Built Plans. The Contractor shall provide GPS locations of all pull boxes, splices, termination equipment cabinets, DMS, CCTV, Detectors and all pole locations.

The Contractor shall record the sequential footage markers from the fiber optic trunk and drop cables for each GPS location.

The Contractor shall provide scanned PDF files of all plan sheets with pen and ink markups.

The Contractor shall also provide the Department with an electronic file containing all of the data and test reports required above in a format that is compatible with Microsoft Excel.

A copy of all documentation shall be provided to the the Department Traffic Engineering ITS

Department and Project Office

The Contractor shall provide a site location inventory of ITS devices to include manufacturer model, serial numbers, and quantity. It shall also include the following:

- OTN Nodes and OTN Cards
- Fiber modems
- Video Encoders and Decoders
- Cameras
- Dome Camera housings
- DMS Signs
- Any other serial numbered devices installed

All documentation timing will be due to the Department by the close of business on the Friday of the week following the installation.

907-661.03.15--MDOT Employee Training. Minimum training requirements are as follows:

After the installation is complete, the Contractor shall provide formal classroom training and "hands-on" operations training for proper operation and maintenance of the fiber optic plant. The training shall be provided for up to six personnel designated by the Engineer and shall be a minimum of one day in duration. The training shall cover as a minimum preventive maintenance, troubleshooting techniques, fault isolation and OTDR trace analysis. All training materials shall be provided by the Contractor.

A Training Plan shall be submitted within 90 days of the Notice-to-Proceed. Approval of the Plan shall be obtained from the Engineer and the Traffic Engineering ITS Department. A detailed explanation of the contents of the course and the time schedule of when the training shall be given shall be included in the Training Plan.

Prior to training, the Contractor shall submit resume and references of the training instructor(s) along with an outline of the training course in a Training Plan. Training instructor(s) shall be manufacturer-certified, experienced in the skill of training others. The training shall be conducted by a trainer with a minimum of four years of experience in training personnel on the operation and maintenance of fiber optic systems.

The Contractor shall furnish all handouts, manuals and product information for the training. The same models of equipment furnished for the project shall be used in the training. The Contractor shall furnish all media and test equipment needed to present the training. Training shall be conducted in the Jackson area.

907-661.04--Method of Measurement. Fiber optic cable of the type specified will be measured by the linear foot. The measurement will be made horizontally along the conduit, aerially along the messenger cable, or from the trunk line to the controller cabinet.

The cost for all fiber optic work, equipment and testing shall be included in the bid price for fiber

optic cable.

All required cabinet facilities shall not be measured for separate payment. All standard or special fiber optic modems, fan out boxes, connectors, termini nation cabinets, patch cords, raceways, splicing devices, splicing, detection wire, warning tape, above ground markers, backplane facilities, twisted pair communications cable interface devices, etc., and any other cabinet modifications required for the fiber optic system shall be included in the price bid for other items of work.

907-661.05--Basis of Payment. Fiber optic cable, measured as prescribed above, will be paid for at the contract unit price bid per linear foot, which price shall be full compensation for furnishing all materials, for all installing, connecting, cutting, pulling and testing and for all equipment, tools, labor and incidentals necessary to complete the work.

Payment will be made under:

907-661-A:	Fiber Optic Cable, *	- per linear foot
907-661-B:	Fiber Optic Drop Cable, *	- per linear foot
907-661-C:	Fiber Optic Cable, Aerial, *	- per linear foot
907-661-D:	Replace Fiber Optic Cable	- per linear foot
907-661-E:	Replace Fiber Optic Drop Cable	- per linear foot
907-661-F:	Replace Fiber Optic Cable, Aerial	- per linear foot
907-661-G:	Upgrade Fiber Optic Cable	- per linear foot

* Indicate the type of cable

MISSISSIPPI DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION NO. 907-663-3 **CODE: (SP)**

DATE: 08/02/2017

SUBJECT: Networking Equipment

Section 907-663, Network Switch, is hereby added to and becomes part of the 2017 Edition of the Mississippi Standard Specifications for Road and Bridge Construction as follows.

SECTION 907-663 -- NETWORKING EQUIPMENT

907-663.01--Description. This section specifies the minimum requirements for providing networking communication equipment, including network switches, terminal servers, fiber optic modems, cell modems, and associated cabling, furnished and installed.

Type A, Type B, Type D, Type E, and Type F switches shall be environmentally hardened and rated for an operating temperature of 70 degrees celcius. These switches support Intelligent Transportation Elements deployed on arterial streets and the highway system. Elements include but are not limited to traffic signals, dynamic message signs, surveillance cameras, and vehicle detection systems. Type C switches will support the Intelligent Transportation System and be installed in the Traffic Management Center and Communications Huts which are environmentally controlled. Type C switches are not required to be hardened.

This Section also specifies the minimum requirements for stand alone and network switch module Terminal Servers, stand alone and network switch module cellular modems, and Category 6 cable. The Terminal Servers shall be hardened. The Terminal Server device, also commonly referred to as a Port Server device, will be used to communicate bi-directionally between IP-based Ethernet network systems and existing field devices that communicate or are controlled via a full-duplex serial interface. Cellular modems shall be used to communicate via cell to remote sites such as portable traffic signal sites, portable CMS, smart work zones or ITS site locations, or sites or devices, that need serial or Ethernet communication that can be provided over cellular service.

The Category 6 cable will be installed in conduit and cabinets between elements that are within 300 feet of each other to eliminate the need for two hardened switches. The work shall consist of providing all labor, materials, equipment, and incidentals necessary to furnish, install, and test the networking equipment.

907-663.02--Materials. Network Switches Type A, Type B, Type C, Type D, Type E, Terminal Servers, Cell Modems, and associated cabling will be placed in the field device cabinets and shall meet the following requirements:

907-663.02.1--Network Switch Requirements. The Type A, Type B, Type C, Type D, Type E and Type F Network switches shall adhere to the following minimum requirements.

1) Field switch optical ports shall meet the following:

a. The minimum optical budget between transmit and received ports shall be 18dB.
b. Shall include LC connector types.
c. Optical receiver maximum input power level shall not be exceeded.
d. Optical attenuators shall be added as needed; fiber optic attenuator patch cords shall be in accordance with Section 657 of the Standard Specifications. It is the Contractor's responsibility to determine where attenuators are needed and shall be included in the cost of the switch.
e. The Contractor shall be required to measure the optical power on each optical port to ensure that power entering the receiver is within the acceptable power budget of the optical port.
f. Optical interface equipment shall operate at 1310 nm.

2) Operate from 100 VAC to 200 VAC.
3) The field switches [this excludes Type C] shall operate between -34° to +74° Celsius, including power supply.
4) The field switches [this excludes Type C] shall operate from 10% to 90% non-condensing humidity.
5) Meet the IEEE 802.3 (10Mbps Ethernet) standard.
6) Meet the IEEE 802.3u (Fast Ethernet 100 Mbps) standard.
7) Meet the IEEE 802.3x (Full Duplex with Flow Control) standard.
8) Meet the IEEE 802.1p (Priority Queuing) standard.
9) Meet the IEEE 802.1Q (VLAN) standard per port for up to four VLAN's.
10) Meet the IEEE 802.1w (Rapid Spanning Tree Protocol) standard.
11) Meet the IEEE 802.3ad (Port Trunking) standard for a minimum of two groups of four ports.
12) The field switches shall meet IEEE 802.3D (Spanning Tree Protocol) standard.
13) Capable of mirroring any port to any other port within the switch.
14) Password manageable through:
    a. SNMP
    b. Telnet/CLI
    c. HTTP (Embedded Web Server) with Secure Sockets Layer (SSL)
15) Full implementation of SNMPv1 and SNMPv2c.
16) Full implementation of GVRP (Generic VLAN Registration Protocol).
17) Full implementation of IGMP and IGMP snooping.
18) Minimum MTBF of 100,000 hrs using Bellcore TS-332 standard.
19) Full implementation of RFC 783 (TFTP) to allow remote firmware upgrades.
20) UL approved.
21) The field switch shall provide status indicators as follows: 1) power on an off, 2) network status per port (transmit, receive, link, speed), and 3) status indicators shall be LED.
22) Unused ports (copper and optical) shall be covered with rubber or plastic dust caps/cover.

907-663.02.1.1--Type A Network Switch. Type A network switches shall adhere to the following minimum requirements.

1) Minimum of six 10/100/1000 Base-TX ports. Each port shall connect via RJ-45 connector.
2) Minimum of two 1000 Base Long Reach optical ports.
3) Full implementation of RMON I and RMON II.
4) Rack, shelf or DIN Rail mountable. If shelf mounted, the Contractor must furnish and install a shelf if shelf space is not available in the facility. Any shelf used shall be ventilated as per the Network Switch manufacturer recommendation.

5) All power transformers provided shall be "fastening mechanism" type. No plug-in types shall be permitted. All corded transformers shall be mountable with the ability to neatly secure power cords.

907-663.02.1.2--Type B Network Switch. Type B network switches shall adhere to the following minimum requirements.

1) Minimum of twelve 10/100/1000 Base-TX ports. Each port shall connect via RJ-45 connector.
2) Minimum of one 10/100/1000 Base-TX ports. Each port shall connect via RJ-45 connector.
3) Full implementation of RMON I and RMON II.
4) Minimum of two 1000 Base Long Reach optical ports.
5) Rack, shelf or DIN Rail mountable. If shelf mounted, the Contractor must furnish and install a shelf if shelf space is not available in the facility. Any shelf used shall be ventilated as per the Network Switch manufacturer recommendation.
6) All power transformers provided shall be "fastening mechanism" type. No plug-in types shall be permitted. All corded transformers shall be mountable with the ability to neatly secure power cords.

907-663.02.1.3--Type C Network Switch. Type C network switches shall be installed in the communication hubs and shall meet the following requirements:

1) Each switch shall be populated with modules including the following features and capabilities:
    i. Layer 2/3 switching and routing services
    ii. Minimum of 64Gbps/48Mpps module Bandwidth
    iii. Min of 8-GE uplink ports available per network switch assembly. The Contractor shall provide an uplink SFP optical module compatible with the interface for the uplink as indicated in the Location & Configuration of Communication Nodes notice to bidders for each uplink
    b. In one (or more)Fiber SFP-based module(s): a minimum of 48 1000Base-X (SFP-based) compatible access ports and a minimum of 8 1000Base-X (SFP-based) uplink ports. The Contractor shall provide whichever is greater between a min number of SFP optic modules to interface to the fiber as indicated in the plans and NTBs, or a min of 14 and shall meet the following minimum requirements:
        i. Optical budget of 18dB
        ii. Hot-swappable network modules
        iii. Same optical wavelength as Type A & B switches
        iv. Same optical transmitter power as Type A & B switches
    c. In one (or more) modules: 24 Ethernet 10/100/1000 RJ-45 ports
2) Optical receiver maximum input power level shall not be exceeded.
3) Optical attenuators shall be added as needed; fiber optic attenuator patch cords shall be in accordance with Section 657 of the Mississippi Standard Specifications for Road and Bridge Construction. It is the Contractor's responsibility to determine where attenuators are needed and shall be included in the cost of the switch.
4) 19" rack mountable.
5) Operate from 5° to 40° Celsius.

6) NEBS Level 3 compliant.
7) Operate from 10 to 80 non-condensing humidity
8) Designed as a chassis with easy to remove modules.
9) Chassis backplane shall be passive.
10) All modules shall be hot-swappable.
11) Meet the IEEE 802.1d (Virtual Bridge) standard.
12) Meet the IEEE 802.1x (authentication) standard.
13) Meet the requirements of :
    a. IEEE 802.3z
    b. IEEE 802.3ab
    c. GR-20-CORE: Generic requirements for Optical Fiber and Optical Fiber Cable
    d. GR-326-CORE: Generic Requirements for Singlemode
14) Full implementation of RIP protocol as outlined by RFCs: 1058, 1723, 1812
15) Full implementation of OSPF protocol as outlined by RFCs: 2178, 1583, 1587, 1745, 1765, 1850, 2154, 2328, 1850, 1997, 2385, 2439, 2842, 2918, 2370.
16) Capable of mirroring any port to any other port within the switch.
17) Password manageable through SSH (Secure Shell).
18) Full implementation of MLD (Multicast Listener Discovery).
19) Full implementation of IGMPv2.
20) Full implementation of PIM-SM and PIM-DM.
21) Comply with FCC 47 CRF Part 15 Class A emissions.
22) Bandwidth flow rate limiting policing support per port.
23) Full security implementation of
    a. Support SSH, 802.1x (rel 2)
    b. Access Control Lists (ACL's)
    c. RADIUS authentication
    d. TACACS+ authentication
24) Have redundant power supplies installed.
25) The power supply units shall be hot swappable.
26) Switch assembly shall have a minimum of 4 module slots.
27) Blank covers for all remaining slots.

907-663.02.1.4--Type D Network Switch. Type D network switches shall be of chassis design. The switch shall be able to accept a minimum of four (4) different type modular cards and have Layer 2 switch and Layer 3 routing cababilities. The Type D network switch shall meet the minimum requirements specified below:

1) The switch shall be chassis designed with a minimum of four (4) module slots.
2) Each switch shall be able to accept the following type modules:
    a. Ethernet module:
        i. A minimum number of six (6) 10/100Base-TX compatible RJ45 ports.
        ii. The Contractor shall provide the minimum number of modules necessary to meet or exceed the required number of ports as indicated in the plans and NTBs.
        iii. Total required bandwidth shall per chassis shall not exceed 10 Gbps
    b. Fiber based modules:
        i. The module shall accept SFP type fiber modules

ii. The Contractor shall supply any necessary fiber modules that meet the requirements of speed, type of fiber, and link budget connection.
iii. The Contractor shall provide the minimum number of modules necessary to meet or exceed the required number of ports as indicated in the plans and NTB

c. WAN module:
i. T1, DS3 or Metro Ethernet Interface (as per NTB or project plans)
1) The Interface shall be T1, DS3 or Metro Ethernet
2) The ports shall connect via RJ45 connector.
ii. Cellular Iterface
1) Contractor shall provide information to the Project Engineer to enable activation of the modem.
2) Contractor shall get prior approval from the Projcet Engineer on selection of cellular radio type (HSPA/EVDO)

d. Terminal Server module:
i. Module that meets Terminal Server requirements Subsection 663.02.6.

e. Power Supply module:
i. The power module provided shall be "screw terminal block" type. No pluggable terminal block.
ii. Input power: Same as Type A and Type B switches.
iii. Power module shall be hot-swappable.
iv. The Contractor shall supply the necessary amount of power supplies to meet power requirements for all cards installed and the chassis itself

3) Software license shall provided to match functionality of installed modules.
4) Shall be DIN or Panel mountable.
5) The swich shall provide layer 2 and 3 switching and routing services
6) Meet the IEEE 802.1d (Virtual Bridge) standard.
7) Meet the IEEE 802.1x (authentication) standard.
8) Password manageable through SSHv2 (Secure Shell).
9) Full implementation of VRRP.
10) Comply with FCC 47 CRF Part 15 Class A emissions.
11) Bandwidth flow rate limiting policing support per port.
12) Full security implementation of
a. Support SSH2, 802.1x (rel 2)
b. Access Control Lists (ACL's)
c. RADIUS
13) Blank covers for all remaining slots.
14) Electronic surfaces shall be covered with conformal coating for additional environmental protection.

907-663.02.1.5--Type E Network Switch. Type E network switches will be installed in locations where multiple backbone fibers converge or high concentration of ports are needed for a field location but need a hardened switch and shall meet the following requirements:

1) Each switch shall be populated with redundant switch fabric modules that meet the following minimum requirements:
a. Layer 2/3 switching and routing services
b. 64Gbps/48Mpps module Bandwidth

c. Min of 2-GE uplinks available per card with a minimum capability to expand to 8. The Contractor shall provide an uplink SFP optical module compatible with the interface for the uplink as indicated in the Location & Configuration of Communication Nodes notice to bidders for each uplink.

2) Optical interfaces shall include 1000 Base-X (SFP-based module(s)) with a minimum of 8 ports. The Contractor shall provide whichever is greater between a min number of SFP optic modules to interface to the fiber as indicated in the plans and NTBs, or a min of six (6) and shall have a minimum Optical budget of 18dB and be the same optical wavelength as Type A & B switches.
   a. Optical receiver maximum input power level shall not be exceeded.
   b. Optical attenuators shall be added as needed; fiber optic attenuator patch cords shall be in accordance with Section 657 of the Standard Specifications. It is the Contractor's responsibility to determine where attenuators are needed and shall be included in the cost of the switch.
3) Include a minimum 8 Ethernet 10/100/1000 ports
4) 19" rack mountable.
5) Operate from -30° to +70° Celsius.
6) Operate from 10 to 90 non-condensing humidity
7) Chassis backplane shall be passive.
8) All modules shall be hot-swappable.
9) Meet the IEEE 802.1d (Virtual Bridge) standard.
10) Meet the IEEE 802.1x (authentication) standard.
11) Meet the requirements of :
   a. IEEE 802.3z
   b. IEEE 802.3ah
   c. GR-20-CORE: Generic requirements for Optical Fiber and Optical Fiber Cable
   d. GR-326-CORE: Generic Requirements for Singlemode
12) Full implementation of RIP protocol as outlined by RFCs: 1058, 1723, 1812
13) Full implementation of OSPF protocol as outlined by RFCs: 2178, 1583, 1587, 1745, 1765, 1850, 2154, 2328, 1850, 1997, 2385, 2439, 2842, 2918, 2370.
14) Capable of mirroring any port to any other port within the switch.
15) Password manageable through SSHv2 (Secure Shell).
16) Full implementation of GMRP (Generic Multicast Registration Protocol).
17) Full implementation of IGMPv2.
18) Full implementation of PIM-SM and PIM-DM.
19) Full implementation of DVMRPv3.
20) Full implementation of VRRP.
21) Comply with FCC 47 CRF Part 15 Class A emissions.
22) Bandwidth flow rate limiting policing support per port.
23) Full security implementation of
   a. Support SSH2, 802.1x (rel 2)
   b. Access Control Lists (ACL's)
   c. RADIUS
   d. TACACS
24) Have redundant power supplies installed.
25) Blank covers for all remaining slots.
26) Have options or modules to add a terminal server as specified in Subsection 663.02.2

27) Have options or modules to add a cellular interface as specified in Subsection 663.02.3

907-663.02.1.6--Type F Network Switch. Type F network switches will be layer 3 switches installed in field locations with wireless communications or access points and shall meet the following requirements:

1) Each switch shall be populated with switch modules that meet the following minimum requirements:
   a. Layer 2/3 switching and routing services
   b. 20Gbps Aggregate Bandwidth
   c. Min of 4-GE uplinks available per switch with a minimum of 2 being fiber ports. The Contractor shall provide an uplink SFP optical module compatible with the interface for the uplink as indicated in the Location & Configuration of Communication Nodes notice to bidders for each uplink.
   d. SD flash port for swappable Management Card configuration
   e. Supports High Density Power over Ethernet (PoE) for up to 8 devices
   f. Supports Cisco Common Industrial Protocol (CIP)
   g. Support of SCADA (Supervisory Control And Data Acquisition) connectivity.
   h. Can be supported with IP services.
   i. 5 year PID warranty
2) In addition to the uplink ports, interfaces ports shall include:
   a. 8 PoE 10/100/1000
   b. 4 SFP ports
      i. Optical receiver maximum input power level shall not be exceeded.
      ii. Optical attenuators shall be added as needed; fiber optic attenuator patch cords shall be in accordance with Section 657 of the Mississippi Standard Specifications for Road and Bridge Construction. It is the Contractor's responsibility to determine where attenuators are needed and shall be included in the cost of the switch.
3) Din Rail Mountable.
4) Operate from -40° to +70° Celsius.
5) Operate from 5 to 95 non-condensing humidity
6) Supports IEEE 802.1AE MACsec, Security Group Access Control Lists (SGACL)
7) Meet the IEEE 802.1d (Virtual Bridge) standard.
8) Meet the IEEE 802.1x (authentication) standard.
9) RIPng, OSPFv6, and EIGRPv6 support
10) Full implementation of GMRP (Generic Multicast Registration Protocol).
11) Full implementation of IGMPv2.
12) Full implementation of PIM-SM and PIM-DM.
13) Full implementation of DVMRPv3.
14) Full implementation of VRRP.
15) Supports Redundant DC input voltage
16) Power supplies with PoE support and 6-foot minimum power cord(s).

907-663.02.2--Terminal Server. Terminal server shall adhere to the following minimum requirements.

1) 10/100 Base-T Ethernet port connection

2) RJ-45/DB9 Serial port connection
3) RS-232/422/485 selectable serial connections
4) Baud rates up to 230 Kbps
5) Full Modem and hardware flow control
6) TCP/UDP Socket Services
7) UDP Multicast
8) Telnet and Reverse Telnet
9) Modem emulation
10) SNMP (Read/Write)
11) PPP
12) Port buffering
13) HTTP
14) Remote management
15) DHCP/RARP/ARP-Ping for IP address assignment
16) LED status for link and power
17) The Terminal Server shall support a minimum of Four (4) bi-directional serial communications over Ethernet 10/100 Base-TX.
18) Each Terminal Server shall have a minimum of four (4) EIA-232/422/485 serial interface ports. These ports shall be individually and independently configurable, directly or over the network, to EIA-232/422/485 mode of operation as defined by the EIA for data format, data rate and data structure (e.g., the number of bits, parity, stop bits, etc.). Each serial port shall support up to 230 Kbps.
19) Each serial port shall support IP addressing and socket number selection.
20) The equipment shall provide the capability to establish an IP connection directly from a workstation to any encoder IP address and socket number transport serial data.
21) Each Terminal Server shall have an Ethernet Interface (10/100Base-TX protocol, Full/Half-Duplex, Auto Sense (802.3), RJ-45).

907-663.02.3--Cell Modem. Cellular Modem, and associated equipment shall be new and constructed using the highest quality, commercially available components and techniques to assure high reliability and minimum maintenance and meet the following requirements.

907-663.02.3.1--Functional Requirements. Cellular Modem, antenna, wiring assemble, configuration software, and installation necessary shall be provided and furnished for a working cellular wireless communication connection in accordance with plans and specifications and compatible with the requirements of the MDOT system, and the wireless service carrier used by MDOT. Unless otherwise indicated on the plans, all items that are required to complete the installation and ensure an operational system shall be supplied by the Contractor whether listed above or not. Items required but not listed above shall be at no direct pay. All components supplied by the Contractor are the responsibility of the Contractor. It shall be the responsibility of the Contractor to properly configure and deliver a working cellular communications system. It shall be the responsibility of the Contractor to determine the final configuration of all electrical connections. Cellular account setup shall be coordinated with MDOT Traffic Engineering Division. Warranty and cellular carrier account shall be transferred into MDOT's name upon acceptance of the project.

907-663.02.3.2--Cellular Modem System. The cellular modem shall adhere to the following

minimum requirements.

1) Model and Type provided shall be pre-approved on a MDOT cellular service carrier.
2) Highest available on a MDOT cellular service carrier of 4G, EVO, or higher service.
3) Minimum of one 10/100 Base-T RJ45 Ethernet port
4) Minimum of one RS-232 serial port
5) Minimum of one external antenna connector
6) GPS Data available
    a. Acquisition Time under 2 seconds
    b. Accuracy: under 5m 90% of time
    c. Tracking Sensitivity: -161 dBm
7) Device Configuration and Management Software via web interface.
8) Communications and Protocols supported:
    a. Network: TCP/IP, UDP/IP, DNS
    b. NAT and DHCP routing with VLAN, VRRP, and Static Routes configurable
    c. Includes TELNET, SMTP, SNMP, SMS sessions and services
    d. Serial: TCP/UDP PAD Mode, Modbus (ASCII,
    e. GPS: NMEA V3.0, TAIP, RAP
    f. Provides VPN security with up to five (5) tunnels
9) Provides event reporting for GPS/AVL, Network Parameters, Data Usage, Time, Power, and Device Temperature over SMS, SNMP, or Email, SNMP.
10) Input Voltage: 10 to 36 VDC
11) Operating Temperature of -30° to +70° Celsius

907-663.02.4--Category 6 Cable. Category 6 cable shall adhere to the following minimum requirements.

1) 4 Pair #24 AWG UTP Category 6 Cable
2) This item is paid for Category 6 cables installed between cabinets and does not apply to other patch cords installed inside cabinets or huts.
3) Supplied Category 6 cable shall be suitable for use outdoors in duct and as a minimum meet the following requirements:
4) Fully water blocked
5) Conforms to the National Electrical Code Article 800
6) UL 1581 certified
7) Voltage Rating 300 Volts or greater
8) Operating and installation temperature (-4°F to 140°F)
9) Bend Radius 10 x Cable OD or smaller
10) Recommended for 1000Base-T applications for a distance of 100 meters.

907-663.02.4.1--Category 6 Patch Cords. The Cat 6 Patch Cords shall be furnished and installed as needed to connect the Network Switches with other equipment. Cat 6 Patch Cords shall be considered an incidental component for this project and furnished and installed as needed to provide a functional system. Cat 6 Patch Cords shall meet the following minimum requirements:

1) All patch cords shall be from the same manufacturer.
2) Shall incorporate four (4) pair 24 AWG stranded PVC Category 6.

3) Shall be factory made; Contractor or vendor assembled patch cords are not permitted.
4) Shall be TIA/EIA 568-B.2-1 compliant. Patch Cords shall be compliant to T568B pin configuration (which ever is used).
5) Certified by the manufacturer for Category 6 performance criteria.
6) Length as needed. Excessive slack is not permitted.

907-663.02.5--Project Submittal Program Requirements. The Contractor shall provide project submittals for network switches including scheduling requirements. The project submittals for network switches, terminal servers, cellular modems, and fiber optic modems shall include but are not limited to the specific requirements in this subsection.

1) The Contractor shall submit detailed cut sheets which document compliance with all parameters required in this section. If a parameter is not covered in the cut sheet a signed statement from the manufacturer on letterhead shall be submitted as an attachment. Failure to address all requirements will result in rejection of the submittal.
2) The Contractor shall submit documentation and proof of manufacturer-recommended training and certification for the installation and configuration of network switches.
3) The Contractor shall submit technical specifications for the minimum transmitter port to receiver port optical attenuation required for the switches to function in accordance with this specification for the optical links shown on the plans.

907-663.03--Construction Requirements. All networking equipment shall be installed according to the manufacturer's recommendations, the Plans and as follows:

1) Network switches shall only be configured and installed by the switch manufacturer trained personnel.
2) Network switches shall be installed in accordance with manufacturer's guidelines and requirements.
3) The Contractor shall request from the Department, switch configuration information (such as IP address, VLAN Tag values, etc.) not more than 30 days after the switch submittals have been approved.
4) The Contractor shall provide as needed the necessary Cat 6 patch cords and fiber optic patch cords for a complete and functional installation.
5) Category 6 cable installed in conduit shall be installed and terminated per the manufacturers recommended procedures. Slack CAT-6 cable shall be provided in pullboxes as indicated in the plans.
6) The Contractor shall provide training for proper management of the equipment installed. This training should cover daily operation as well as maintenance and configuration of the switching equipment installed as part of this project and meet the requirements of Subsection 663.03.4 of this document.
7) The Contractor shall provide the MDOT with a written inventory of items received and the condition in which they were received. Inventory shall be inclusive of make, model, and serial numbers, MAC address, and installation GPS coordinates. All equipment shall be installed according to the manufacturer's recommendations or as directed by the MDOT.
8) Any new, additional or updated drivers required for the existing ATMS software to communicate and control new Networking Equipment installed by the Contractor shall be the responsibility of the Contractor.

907-663.03.1--Switch Configuration Requirements. The Contractor shall configure network switches as follows:

1) All 100 Base-TX ports shall be configured as follows:
   a. RSTP/STP – Off.
   b. Unused TX ports shall be disabled.
   c. Operating TX ports shall be programmed to filter only for the MAC address of the connected device.
2) All 1000 Base-FX ports shall be configured as follows:
   a. RSTP/STP – On.
   b. IGMP Snooping – On.
3) The Type D switch configuration shall be as outline in the Project plans and details.
4) All network switches shall be installed and configured with the same firmware configuration. The optimum settings shall be used consistently system-wide. Any locations that require different settings for optimum performance shall be approved by the Engineer.
5) The Switches shall be configured to enable multicasting and turn on multicast protocols.
6) The Contractor may submit an alternate switch configuration to the ITS Engineer for review and approval; The ITS Engineer will review alternate switch configuration documentation. The goal of the switch configuration is to reduce the network delay, as well as provide network redundancy.
7) The Contractor shall submit an electronic copy of all final and approved configurations of all switches to the Project engineer and to the ITS Engineer.

907-663.03.2--Testing. The Contractor shall conduct a Project Testing Program as required below. All costs associated with the Project Testing Program shall be included in the overall contract price; no separate payment will be made for any testing.

1) All test results shall confirm physical and performance compliance with these Special Provisions.
2) Each test shall fully demonstrate that the equipment being tested is clearly and definitely in full compliance with all project requirements.
3) Contractor shall submit all test results documentation to the Engineer for review within 14 calendar days of completion of the tests.
4) All tests deemed by the Project Engineer to be unsatisfactorily completed shall be repeated by the Contractor. In the written request for each test occurrence that is a repeat of a previous test, the Contractor shall summarize the diagnosis and correction of each aspect of the previous test. The Contractor shall summarize the diagnosis and correction of each aspect of the previous test that was deemed unsatisfactory. The test procedures for a repeated test occurrence shall meet all the requirements of the original test procedures, including review and approval by the Project Engineer and ITS Manager or designee.
5) The satisfactory completion of any test shall not relieve the Contractor of responsibility to provide a completely acceptable and operating system that meets all requirements of this project.

907-663.03.3--Documentation. As-built Plans showing switch configuration and connections shall be provided to the Project Engineer and ITS Engineer in electronic format.

The Contractor shall submit documentation and proof of measured optical power budgets to all optical links of all type switches. All equipment and software must be fully functional and pass a Final Inspection by the ITS Manager and Project Engineer before being accepted by the MDOT

907-663.03.4--Warranty. Minimum warranty requirements shall be as follows.

1) All warranties and guarantees shall be assigned to the Mississippi Department of Transportation.
2) The warranty shall be a minimum of one (1) year warranty unless otherwise stated.

907-663.03.5--MDOT Employee Training. After the installation is complete, the Contractor shall provide formal classroom training and "hands-on" operations training for proper operation and maintenance of the network switch. The training shall be provided for up to six personnel designated by the ITS Engineer and shall be a minimum of four hours in duration. The training shall cover as a minimum preventive maintenance, troubleshooting techniques, fault isolation and circuit analysis. All training materials shall be provided by the Contractor.

1) Prior to training, submit resume and references of instructor(s). Also submit an outline of the training course in a Training Plan. Submit the Training Plan within 90 days of Contract Notice to Proceed. Obtain approval of the Plan from the Engineer and the Traffic Engineering ITS Department. Explain in detail the contents of the course and the time schedule of when the training will be given.
2) Furnish all handouts, manuals and product information.
3) For the training, use the same models of equipment furnished for the project. Furnish all media and test equipment needed to present the training.
4) Training shall be conducted in the Jackson area.
5) Training instructor(s) shall be manufacturer-certified, experienced in the skill of training others.
6) The training shall be conducted by a trainer with a minimum of four years of experience in training personnel on the operation and maintenance of fiber optic systems.

907-663.04--Method of Measurement. Network Switches of the type specified, Terminal Server, and Cellular modem will be measured per each installation as specified in the Plans.

Category 6 Cable, Installed in Conduit, will be measured by the linear foot, obtained by accurate measurement of the runs including horizontally, vertically, aerially along the messenger cable, from the device to the device cabinet, and with liberal allowances made for slack in boxes, as indicated in the plans.

907-663.05--Basis of Payment. Network Switches, measured as prescribed above, will be paid for at the contract price per each installation, which price shall be inclusive of furnishing, installing, system integration and testing of a Network Switch including all chassis, modules, power cables, power supplies, software, license, fiber optic patch cords, fiber optic attenuator patch cords, Cat 6 patch cords, and all incidental components, attachment hardware, mounting shelf and hardware, testing and training requirements, and all work, equipment and appurtenances as required to provide a fully functional switch ready for use. Type C, Type D, and Type E Network Switch

module cards shall be specified per Project plans or NTBs for each site location. It shall also include all system documentation including: shop drawings, operations and maintenance manuals, wiring diagrams, block diagrams, and other material necessary to document the operation of the switch and network.

Terminal Server, measured as prescribed above, will be paid for at the contract price per each, which price shall be inclusive of furnishing, installing, system integration and testing of a Terminal Server including all incidental components, attachment hardware, mounting shelf and hardware, testing and training requirements, and all work, equipment and appurtenances as required to provide a fully functional Terminal Server ready for use.

Cellular modem, measured as prescribed above, will be paid for at the contract unit price per each, which price shall include the modem, antenna, reset timers, cabling, factory and manufacturing inspection, testing, storage, packaging, shipping, warranty, and all work, equipment, and appurtenances as required to effect the full operation and control of the cellular modem complete in place and ready for use.

Category 6 Cable, Installed in Conduit, measured as prescribed above shall be paid for at the contract price per the linear foot, which price shall include all incidentals necessary to complete the work.

Payment will be made under:

907-663-A:	Network Switch, Type __	- per each
907-663-B:	Terminal Server	- per each
907-663-C	Cellular Modem	- per each
907-663-D:	Category 6 Cable, Installed in Conduit	- per linear foot

Interchange construction on I-59 at SR 42, known as Federal Aid Project No. NH-0059-01(075) / 102334301 in Forrest County.

Line No.	Item Code	Adj Code	Quantity	Units	Description [Fixed Unit Price]
			Roadway Items		
0010	201-A001		1	Lump Sum	Clearing and Grubbing
0020	202-A001		1	Lump Sum	Removal of Obstructions
0030	202-B007		34,044	Square Yard	Removal of Asphalt Pavement, All Depths
0040	202-B052		410	Square Yard	Removal of Concrete Driveways, All Depths
0050	202-B088		120	Linear Feet	Removal of Curb & Gutter, All Types
0060	202-B136		827	Linear Feet	Removal of Guard Rail
0070	202-B191		287	Linear Feet	Removal of Pipe, 8" And Above
0080	202-B215		173	Each	Removal of Sign Including Post & Footing
0090	202-B240		3,700	Linear Feet	Removal of Traffic Stripe
0100	203-A001	(E)	65,950	Cubic Yard	Unclassified Excavation, FM, AH
0110	203-EX017	(E)	446,250	Cubic Yard	Borrow Excavation, AH, FME, Class B7
0120	203-EX018	(E)	1,000	Cubic Yard	Borrow Excavation, AH, FME, Class B7-6
0130	203-G001	(E)	16,250	Cubic Yard	Excess Excavation, FM, AH
0140	206-A001	(S)	923	Cubic Yard	Structure Excavation
0150	206-B001	(E)	565	Cubic Yard	Select Material for Undercuts, Contractor Furnished, FM
0160	209-A005		170,295	Square Yard	Geotextile Stabilization, Type V, Non-Woven
0170	211-B001	(E)	500	Cubic Yard	Topsoil for Slope Treatment, Contractor Furnished
0180	213-C001		24	Ton	Superphosphate
0190	216-A001		3,343	Square Yard	Solid Sodding
0200	217-A001		450	Square Yard	Ditch Liner
0210	219-A001		26	Thousand Gallon	Watering [$20.00]
0220	220-A001		24	Acre	Insect Pest Control [$30.00]
0230	221-A001	(S)	81	Cubic Yard	Concrete Paved Ditch
0240	223-A001		94	Acre	Mowing [$50.00]
0250	225-A001		47	Acre	Grassing
0260	225-B001		24	Ton	Agricultural Limestone
0270	225-C001		94	Ton	Mulch, Vegetative Mulch
0280	226-A001		47	Acre	Temporary Grassing
0290	227-A001		47	Acre	Hydroseeding
0300	234-A001		72,500	Linear Feet	Temporary Silt Fence
0310	234-D001		2	Each	Inlet Siltation Guard
0320	236-A008		29	Each	Silt Basin, Type D
0330	237-A002		3,000	Linear Feet	Wattles, 20"

Line No.	Item Code	Adj Code	Quantity	Units	Description [Fixed Unit Price]
0340	246-B002		50	Linear Feet	Rockbags
0350	249-A001		500	Ton	Riprap for Erosion Control
0360	403-A001	(BA1)	9,629	Ton	12.5-mm, HT, Asphalt Pavement
0370	403-A002	(BA1)	4,858	Ton	12.5-mm, MT, Asphalt Pavement
0380	403-A003	(BA1)	1,114	Ton	12.5-mm, ST, Asphalt Pavement
0390	403-A004	(BA1)	10,592	Ton	19-mm, HT, Asphalt Pavement
0400	403-A005	(BA1)	7,894	Ton	19-mm, MT, Asphalt Pavement
0410	403-A006	(BA1)	12,220	Ton	19-mm, ST, Asphalt Pavement
0420	403-A013	(BA1)	5,718	Ton	9.5-mm, HT, Asphalt Pavement
0430	403-A014	(BA1)	3,643	Ton	9.5-mm, MT, Asphalt Pavement
0440	403-A015	(BA1)	821	Ton	9.5-mm, ST, Asphalt Pavement
0450	406-A002		2,000	Square Yard	Cold Milling of Bituminous Pavement, All Depths
0460	407-A001	(A2)	15,809	Gallon	Asphalt for Tack Coat
0470	413-E001		118	Linear Feet	Sawing and Sealing Transverse Joints in Asphalt Pavement
0480	423-A001		13	Mile	Rumble Strips, Ground In
0490	502-A001	(C)	258	Square Yard	Reinforced Cement Concrete Bridge End Pavement
0500	601-A001	(S)	478	Cubic Yard	Class "B" Structural Concrete
0510	601-B001	(S)	55	Cubic Yard	Class "B" Structural Concrete, Minor Structures
0520	602-A001	(S)	74,216	Pounds	Reinforcing Steel
0530	603-ALT003	(S)	316	Linear Feet	18" Type A Alternate Pipe
0540	603-CA012	(S)	408	Linear Feet	18" Reinforced Concrete Pipe, Class III, Rubber Type Gaskets
0550	603-CA027	(S)	272	Linear Feet	24" Reinforced Concrete Pipe, Class III, Rubber Type Gaskets
0560	603-CA041	(S)	568	Linear Feet	30" Reinforced Concrete Pipe, Class III, Rubber Type Gaskets
0570	603-CA056	(S)	320	Linear Feet	36" Reinforced Concrete Pipe, Class III, Rubber Type Gaskets
0580	603-CA067	(S)	80	Linear Feet	42" Reinforced Concrete Pipe, Class III, Rubber Type Gaskets
0590	603-CA077	(S)	96	Linear Feet	48" Reinforced Concrete Pipe, Class III, Rubber Type Gaskets
0600	603-CB003	(S)	10	Each	18" Reinforced Concrete End Section
0610	603-CB004	(S)	6	Each	24" Reinforced Concrete End Section
0620	603-CB005	(S)	13	Each	30" Reinforced Concrete End Section
0630	603-CB006	(S)	5	Each	36" Reinforced Concrete End Section
0640	603-CB007	(S)	2	Each	42" Reinforced Concrete End Section
0650	603-CB008	(S)	2	Each	48" Reinforced Concrete End Section
0660	603-CE002	(S)	744	Linear Feet	22" x 13" Concrete Arch Pipe, Class A III

Line No.	Item Code	Adj Code	Quantity	Units	Description [Fixed Unit Price]
0670	603-CE008	(S)	128	Linear Feet	29" x 18" Concrete Arch Pipe, Class A III
0680	603-CE013	(S)	128	Linear Feet	36" x 23" Concrete Arch Pipe, Class A III
0690	603-CE018	(S)	168	Linear Feet	44" x 27" Concrete Arch Pipe, Class A III
0700	603-CF002	(S)	16	Each	22" x 13" Concrete Arch Pipe End Section
0710	603-CF003	(S)	4	Each	29" x 18" Concrete Arch Pipe End Section
0720	603-CF004	(S)	4	Each	36" x 23" Concrete Arch Pipe End Section
0730	603-CF005	(S)	4	Each	44" x 27" Concrete Arch Pipe End Section
0740	603-SB012	(S)	1	Each	18" Branch Connections, Stub into Box Culvert
0750	604-B001		500	Pounds	Gratings
0760	605-AA001	(S)	67	Square Yard	Geotextile for Subsurface Drainage, Type III
0770	605-T001	(S)	120	Linear Feet	4" Perforated Pipe for Underdrains
0780	605-U001	(S)	5	Linear Feet	4" Non-perforated Pipe for Underdrains
0790	605-W001	(GY)	5	Cubic Yard	Filter Material for Combination Storm Drain and/or Underdrains,Type A, FM
0800	606-B001		650	Linear Feet	Guard Rail, Class A, Type 1
0810	606-C003		3	Each	Guard Rail, Cable Anchor, Type 1
0820	606-D001		2	Each	Guard Rail, Bridge End Section
0830	606-E005		5	Each	Guard Rail, Terminal End Section, Flared
0840	606-E007		2	Each	Guard Rail, Terminal End Section, Non-Flared
0850	607-B020		18,550	Linear Feet	60" Type II Chain Link Fence, Class II
0860	607-P1008		900	Each	Line Post, 7' x 1 1/2" Galvanized Steel
0870	607-P2004		900	Each	Brace Post, 7 1/2' x 2" Galvanized Steel
0880	609-D004	(S)	4,501	Linear Feet	Combination Concrete Curb and Gutter Type 2 Modified
0890	614-B001	(S)	175	Square Yard	Concrete Driveway, With Reinforcement
0900	615-A002	(S)	40	Linear Feet	Concrete Bridge End Barrier, 33.5"
0910	616-A001	(S)	158	Square Yard	Concrete Median and/or Island Pavement, 10-inch
0920	616-A004	(S)	2,673	Square Yard	Concrete Median and/or Island Pavement, 4-inch
0930	617-A001		90	Each	Right-of-Way Marker
0940	618-A001		1	Lump Sum	Maintenance of Traffic
0950	619-A1001		11	Mile	Temporary Traffic Stripe, Continuous White
0960	619-A2001		10	Mile	Temporary Traffic Stripe, Continuous Yellow
0970	619-A3001		2	Mile	Temporary Traffic Stripe, Skip White
0980	619-A5001		21,261	Linear Feet	Temporary Traffic Stripe, Detail
0990	619-A6001		87	Square Feet	Temporary Traffic Stripe, Legend

Line No.	Item Code	Adj Code	Quantity	Units	Description [Fixed Unit Price]
1000	619-A6002		1,115	Linear Feet	Temporary Traffic Stripe, Legend
1010	619-D1001		472	Square Feet	Standard Roadside Construction Signs, Less than 10 Square Feet
1020	619-D2001		1,279	Square Feet	Standard Roadside Construction Signs, 10 Square Feet or More
1030	619-E1001		2	Each	Flashing Arrow Panel, Type C
1040	619-G4001		288	Linear Feet	Barricades, Type III, Double Faced
1050	619-G4005		72	Linear Feet	Barricades, Type III, Single Faced
1060	619-G5001		207	Each	Free Standing Plastic Drums
1070	619-G7001		15	Each	Warning Lights, Type "B"
1080	619-G8001		51	Each	Warning Lights, Type "C"
1090	620-A001		1	Lump Sum	Mobilization
1100	626-A001		2	Mile	6" Thermoplastic Double Drop Traffic Stripe, Skip White
1110	626-B001		374	Linear Feet	6" Thermoplastic Double Drop Traffic Stripe, Continuous White
1120	626-C002		10	Mile	6" Thermoplastic Double Drop Edge Stripe, Continuous White
1130	626-E001		7	Mile	6" Thermoplastic Double Drop Traffic Stripe, Continuous Yellow
1140	626-F001		4	Mile	6" Thermoplastic Double Drop Edge Stripe, Continuous Yellow
1150	626-G004		18,174	Linear Feet	Thermoplastic Double Drop Detail Stripe, White
1160	626-G005		11,263	Linear Feet	Thermoplastic Double Drop Detail Stripe, Yellow
1170	626-H001		883	Square Feet	Thermoplastic Double Drop Legend, White
1180	626-H002		1,021	Linear Feet	Thermoplastic Double Drop Legend, White
1190	627-B001		162	Each	Two-Way Clear Reflective Raised Markers
1200	627-K001		250	Each	Red-Clear Reflective High Performance Raised Markers
1210	627-L001		775	Each	Two-Way Yellow Reflective High Performance Raised Markers
1220	630-A001		362	Square Feet	Standard Roadside Signs, Sheet Aluminum, 0.080" Thickness
1230	630-A003		1,622	Square Feet	Standard Roadside Signs, Sheet Aluminum, 0.125" Thickness
1240	630-B002		3,128	Square Feet	Interstate Directional Signs, Bolted Extruded Aluminum Panels, Ground Mounted
1250	630-B003		190	Square Feet	Interstate Directional Signs, Bolted Extruded Aluminum Panels, Overhead Mounted
1260	630-C002		186	Linear Feet	Steel U-Section Posts, 2.0 lb/ft
1270	630-C003		2,234	Linear Feet	Steel U-Section Posts, 3.0 lb/ft
1280	630-D003		347	Linear Feet	Structural Steel Beams, W10 x 22
1290	630-D006		38	Linear Feet	Structural Steel Beams, W6 x 12
1300	630-D007		398	Linear Feet	Structural Steel Beams, W6 x 15
1310	630-D008		381	Linear Feet	Structural Steel Beams, W6 x 9
1320	630-D010		62	Linear Feet	Structural Steel Beams, W8 x 21

Line No.	Item Code	Adj Code	Quantity	Units	Description [Fixed Unit Price]
1330	630-E001		456	Pounds	Structural Steel Angles & Bars, 3 1/2" x 3 1/2" x 1/4" Angles
1340	630-E002		477	Pounds	Structural Steel Angles & Bars, 3" x 3" x 1/4" Angles
1350	630-E003		591	Pounds	Structural Steel Angles & Bars, 4" x 4" x 5/16" Angles
1360	630-E004		1,281	Pounds	Structural Steel Angles & Bars, 7/16" x 2 1/2" Flat Bar
1370	630-F006		32	Each	Delineators, Guard Rail, White
1380	630-F010		126	Each	Delineators, Post Mounted, Double White
1390	630-F011		77	Each	Delineators, Post Mounted, Double Yellow
1400	630-F012		66	Each	Delineators, Post Mounted, Single White
1410	630-F013		40	Each	Delineators, Post Mounted, Single Yellow
1420	630-G004		14	Each	Type 3 Object Markers, OM-3R or OM-3L
1430	630-I003		1	Lump Sum	Metal Overhead Sign Supports, Assembly No. 1, Contractor Designed
1440	630-K001		120	Linear Feet	Welded & Seamless Steel Pipe Posts, 3 1/2"
1450	630-K002		289	Linear Feet	Welded & Seamless Steel Pipe Posts, 3"
1459	656-A002		2	Each	Dynamic Message Sign, Type 2
1460	630-K003		411	Linear Feet	Welded & Seamless Steel Pipe Posts, 4"
1461	656-A003		2	Each	Dynamic Message Sign, Type 3
1462	660-A003		4	Each	Equipment Cabinet, Type B
1463	660-A004		2	Each	Equipment Cabinet, Type C
1464	682-A005		2,550	Linear Feet	Underground Branch Circuit, AWG 1/0, 3 Conductor
1465	682-A018		8,940	Linear Feet	Underground Branch Circuit, AWG 2, 3 Conductor
1466	682-A025		210	Linear Feet	Underground Branch Circuit, AWG 3/0, 3 Conductor
1467	682-A039		7,355	Linear Feet	Underground Branch Circuit, AWG 8, 3 Conductor
1468	682-B005		65	Linear Feet	Underground Branch Circuit, Jacked or Bored, AWG 1/0, 3 Conductor
1469	682-B016		683	Linear Feet	Underground Branch Circuit, Jacked or Bored, AWG 2, 3 Conductor
1470	630-K004		38	Linear Feet	Welded & Seamless Steel Pipe Posts, 5"
1471	682-B022		76	Linear Feet	Underground Branch Circuit, Jacked or Bored, AWG 3/0, 3 Conductor
1472	682-B037		397	Linear Feet	Underground Branch Circuit, Jacked or Bored, AWG 8, 3 Conductor
1473	682-D003		27	Each	Underground Pull Box
1474	682-E003		34	Each	Underground Junction Box With Concrete Pad
1475	682-F002		1	Each	Secondary Power Controllers
1476	683-A126		1	Each	Lighting Assembly, High Mast, LED, Type 110-8-S
1477	683-A127		5	Each	Lighting Assembly, High Mast, LED, Type 110-6-S
1478	683-A128		2	Each	Lighting Assembly, High Mast, LED, Type 110-6-A
1479	683-A129		4	Each	Lighting Assembly, High Mast, LED, Type 130-8-S

Line No.	Item Code	Adj Code	Quantity	Units	Description [Fixed Unit Price]
1480	647-A001		1	Lump Sum	Removal of Existing Traffic Signal Equipment
1481	683-B197		34	Each	Lighting Assembly, Low Mast, LED, Type 40-1-15-268
1482	683-D001		1	Each	Portable Electric Power Units
1483	684-A004		56	Cubic Yard	Pole Foundation, 30" Diameter
1484	684-A007		110	Cubic Yard	Pole Foundation, 48" Diameter
1485	684-B004		9	Linear Feet	Slip Casing, 30" Diameter
1486	684-B007		21	Linear Feet	Slip Casing, 48" Diameter
1487	699-A001		1	Lump Sum	Roadway Construction Stakes
1488	815-A007	(S)	5,500	Ton	Loose Riprap, Size 300
1489	815-F002	(S)	971	Ton	Sediment Control Stone
1490	907-240-A001		1,484	Square Yard	Interlocking Flexible Block Erosion Control System
1500	907-253-A001		4,350	Linear Feet	Coir Fiber Baffle
1510	907-619-E3001		6	Each	Changeable Message Sign
1520	907-630-L001		1	Lump Sum	Pedestal Sign Support, Assembly No 1, Contractor Designed
1530	907-630-L002		1	Lump Sum	Pedestal Sign Support, Assembly No 2, Contractor Designed
1540	907-630-M001		1	Lump Sum	Post Sign Support, Assembly No 1, Contractor Designed
1550	907-630-M002		1	Lump Sum	Post Sign Support, Assembly No 2, Contractor Designed
1560	907-632-J001		1	Each	Power Service Pedestal
1570	907-634-E001		5	Each	Camera Pole with Foundation, 50' Pole
1580	907-636-B043		85	Linear Feet	Electric Cable, Underground in Conduit, THHN, AWG #2, 4 Conductor
1590	907-636-B051		925	Linear Feet	Electric Cable, Underground in Conduit, THHN, AWG #4, 4 Conductor
1600	907-636-B053		2,915	Linear Feet	Electric Cable, Underground in Conduit, THHN, AWG #6, 3 Conductor
1610	907-637-A002		20	Each	Pullbox Enclosure, Type 2
1620	907-637-A004		28	Each	Pullbox Enclosure, Type 4
1630	907-637-A005		26	Each	Pullbox Enclosure, Type 5
1640	907-637-C028		160	Linear Feet	Traffic Signal Conduit, Underground, Type 4, 2"
1650	907-637-H001		365	Linear Feet	Traffic Signal Conduit Bank, Underground, Rolled Pipe, 2 @ 2"
1660	907-637-H002		2,495	Linear Feet	Traffic Signal Conduit Bank, Underground, Rolled Pipe, 2"
1670	907-637-I001		36,915	Linear Feet	Traffic Signal Conduit Bank, Underground, Drilled or Jacked, Rolled Pipe, 2 @ 2"
1680	907-637-I002		2,330	Linear Feet	Traffic Signal Conduit Bank, Underground, Drilled or Jacked, Rolled Pipe, 2"
1690	907-637-K001		1,985	Linear Feet	Traffic Signal Conduit Bank, Aerial Supported, Type 1, 2 @ 2"
1700	907-641-C001		2	Each	ITS Radar Detection Sensor
1710	907-650-A002		14	Each	On Street Video Equipment, Fixed Type

Line No.	Item Code	Adj Code	Quantity	Units	Description [Fixed Unit Price]
1712	907-659-A001		1	Lump Sum	Traffic Management Center Modifications
1714	907-661-A004		39,975	Linear Feet	Fiber Optic Cable, 72 SM
1716	907-661-B002		1,375	Linear Feet	Fiber Optic Drop Cable, 12 SM
1718	907-663-A001		7	Each	Network Switch, Type A
1719	907-663-A002		4	Each	Network Switch, Type B
1720	907-650-A003		8	Each	On Street Video Equipment, PTZ Type
1730	907-906001		1,040	Hours	Trainees [$5.00]
			ALTERNATE GROUP AA NUMBER 1		
1740	304-F001	(GT)	62,600	Ton	3/4" and Down Crushed Stone Base
			ALTERNATE GROUP AA NUMBER 2		
1750	304-F002	(GT)	62,600	Ton	Size 610 Crushed Stone Base
			ALTERNATE GROUP AA NUMBER 3		
1760	304-F003	(GT)	62,600	Ton	Size 825B Crushed Stone Base
			ALTERNATE GROUP BB NUMBER 1		
1770	605-W002	(GY)	88	Cubic Yard	Filter Material for Combination Storm Drain and/or Underdrains,Type B, FM
			ALTERNATE GROUP BB NUMBER 2		
1780	605-W003	(GY)	88	Cubic Yard	Filter Material for Combination Storm Drain and/or Underdrains,Type C, FM
			Bridge Items		
1790	221-A001	(S)	28	Cubic Yard	Concrete Paved Ditch
1800	501-K001		1,716	Square Yard	Transverse Grooving
1810	803-I004	(S)	3	Each	PDA Test Pile, Steel Pipe Pile
1820	803-J001	(S)	2	Each	Pile Restrike
1830	803-P001	(S)	3,775	Linear Feet	24" Steel Pipe Piling, Wall Thickness 0.500"
1840	804-C167	(S)	2,360	Linear Feet	99' Prestressed Concrete Beam, Type BT-54
1850	805-A001	(S)	162,682	Pounds	Reinforcement
1860	809-A001	(S)	8,525	Square Feet	Retaining Wall System
1870	813-A002	(S)	598	Linear Feet	Concrete Railing, 32"
1880	907-804-A002	(S)	266	Cubic Yard	Bridge Concrete, Class AA
1890	907-804-A004	(S)	485	Cubic Yard	Bridge Concrete, Class BD